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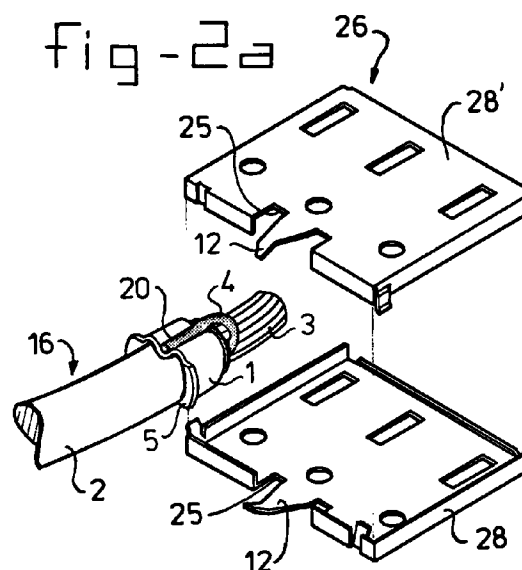
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### (54) Ground wire attachment to shield for cable assembly and method to produce same

(57) Arrangement comprising a cable (16) and a connector (26), said cable (16) comprising at least one inner signal conductor (3) and a ground wire (4) and being provided with a crimp element (1) on an insulating sheath (2) for improving strain relief of the cable (16) against pull and flexure, said connector (26) comprising at least one shield element (28'), and said ground wire (4) being electrically connected to said at least one shield element (28') wherein said ground wire (4) is mechanically and electrically connected to said crimp element (1) and said shield element (28') is provided with a resilient means (12) which, in the assembled state, is electrically connected to said crimp element (1).



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## Description

The problem to be solved by the present invention is best illustrated by reference to figures 1a, 1b, 3a, 3b, and 4, which show intermediate steps in the assembly of a shielded connector 6 to a terminal of a (shielded) multi-wire cable 16.

Figure 1a shows the end of the (shielded) multi-wire cable 16 having an insulating sheath 2. The internal signal conductors 3 extend from the end of insulating sheath 2, which is stripped by proper stripping means known by a person skilled in the art. An exposed ground wire 4 also extends from the insulating sheath 2. Ground wire 4 may be one of the wires of the multi-wire cable 16 but may, alternatively, be a 'pig-tail' end part of a braided metal sheath surrounding the other conductors within the cable 16.

Ground wire 4 needs to be electrically connected to metal shield 8 of the connector 6 in order to obtain sound electrical connection. As an initial step to achieve this, a crimp ring 1 is crimped at the end of insulating sheath 2. Figure 1a shows crimp ring 1 after crimping to the insulating sheath 2. Crimp ring 1, then, immobilizes the internal conductors 3 and ground wire 4. Preferably, crimp ring 1 comprises at least one flange 5, the purpose of which will be explained below.

After crimp ring 1 has been crimped on the sheath 2 the individual wires 3 are loaded on a spread block 17, which is shown in figure 4, in order to establish a proper spacing between adjacent wires 3. Then, all wires 3 are cut to the same length and stripped as required. The stripped wires are, e.g. by soldering, connected to suitable terminals 18 (see also figure 4), which may be either female, male or hermaphrodite connected terminals.

Then, the ground wire 4 is soldered to shield 8 in order to provide electrical connection, as shown in figure 1a. The crimp ring 1 is located in an opening 15 between two extending lips 7 of shield 8 and cover shield 8', which may be identical to shield 8, is arranged on shield 8 in order to provide an electrically closed shielding. Lips 7 provide for a central location of crimp ring 1 within opening 15 and, by touching crimp ring 1, additional electrical connection security. This is shown in figure 1b.

Two plastic covers 9, one of which is shown in figures 3a, 3b, are used to cover metal shields 8, 8'. Figure 3a shows a top view of plastic cover 9 (as will be seen from the connector enclosure portion) and shows the inner surface of cover 9 which has to be put on shield 8. Figure 3b shows a side view of cover 9. As shown cover 9 has two upstanding pegs 10 with respective ends 11, an opening for receiving crimp ring 1 and slots 13 for accommodating flanges 5 of crimp ring 1.

To assemble the connector 6, pegs 10 are inserted into corresponding holes in metal shields 8, 8'. Another (similar) plastic cover (not shown), which may be identical to plastic cover 9 (of figure 3a and 3b), is arranged on both sides of metal shields 8, 8', however, from the

opposite side as cover 9. Cover 9 is provided with suitable holes 19 for receiving pegs from the other plastic cover. Plastic cover 9 and the other plastic cover are pressed together and in this condition the ends 11 of pegs 10 of both plastic covers are heat-staked on protruding ends 11 formed to maintain the entire assembly tightly together.

Figure 4 shows a partly sectional view through the final product. In this figure crimp ring 1 is shown partly cut away and partly in side view. As is clearly shown in figures 3 and 4, flanges 5 of crimp ring 1 are firmly accommodated in suitable slots 13 in plastic cover 9. Such a construction provides for the required strain relief to the cable against pull and flexure, which is required to prevent deterioration, and subsequent rupture, of individual connections of the conductors 3 to connector 6. This applies both to conductors 3 and ground wire 4.

The following disadvantages, which affect the manufacturing costs, the application simplicity and the performance, are related to the known manufacturing process described above.

First of all, an additional step is required to solder ground wire 4 to metal shield 8. Metal shield 8 is usually a steel type of material resulting in a difficult soldering process to assure an electrical connection of good quality. Moreover, it results in the necessity to remove solder flux residues from the surface of shield 8.

Secondly, a relatively long ground wire 4 is required which, when exposed in open air, is prone in promoting "noise" in an associated electronic device due to an "antenna-effect". Moreover, openings 15 in shield 8, 8' for receiving crimp ring 1 are relatively large resulting in a poor shielding effectiveness in the area of openings 15.

The object of the present invention is provide a ground wire attachment to a shield in a connector which avoids the problems mentioned above.

Therefore, the present invention provides an arrangement comprising a cable and a connector, the cable comprising at least one inner signal conductor and a ground wire and being provided with a crimp element on an insulating sheath for improving strain relief of the cable against pull and flexure, the connector comprising at least one shield element, and the ground wire being electrically connected to the at least one shield element characterized in that the ground wire is mechanically and electrically connected to the crimp element and the shield element is provided with a resilient means which, in the assembled state, is electrically connected to the crimp element.

In such arrangement the length of the ground wire extending from the insulating sheath is shorter than in the prior art arrangement resulting in less electromagnetic interference problems since the antenna-effect is smaller. Moreover, the crimp ring may be selected from any material suitable for solder connections thereby avoiding the difficulty of soldering the ground wire to a steel type shield element of the connector.

Another object of the present invention is to provide a method for producing a ground wire attachment as defined above which avoids the problems related to the prior art. According to the invention there is provided a method of manufacturing an arrangement defined above comprising the following steps:

- a. crimping the crimp element on the insulating sheath;
- b. connecting the at least one signal conductor to at least one terminal within the connector;
- c. pressing a first and a second metal shield to one another wherein at least either the first or the second metal shield comprises a resilient means which clamps the ground wire to the crimp element;
- d. soldering the ground wire, the crimp element and the resilient means to one another.

Advantages of this method are that it is easier to put the ground wire in its intended location and that it is easier to access the location where the ground wire, the crimp element and the resilient means are to be soldered to one another.

An alternative method of manufacturing an arrangement according to the invention comprises the following steps:

- a. crimping the crimp element on the insulating sheath wherein the ground wire is clamped between the crimp element and the insulating sheath;
- b. connecting the at least one signal conductor to at least one terminal within the connector;
- c. pressing a first and a second metal shield to one another wherein at least either the first or the second metal shield comprises the resilient means which is pressed against the crimp element.

In such a method the soldering step may be omitted resulting in a shortened manufacturing period.

The invention will be explained in greater detail by reference to figures 2a, 2b, 5a, and 5b. Figures 2a, 2b and 5a, 5b, respectively, show intermediate steps during the assembly of a first and second embodiment, respectively, of a ground wire attachment according to the invention. In these figures, the same reference numbers refer to the same elements as in figures 1a, 1b, 3a, 3b, and 4.

At least one, but preferably both of metal shields 28, 28' of connector 26 according to the invention are provided with a sharp lip 12, which is preferably located at the centre of opening 25. Ground wire 4, which may be of substantially less length than in the arrangement according to the prior art, is bent over the crimp ring 1 such that when crimp ring 1 is inserted into openings 25 and both shields 28, 28' are pressed to one another, one of the sharp lips 12 will directly make a pressure connection with ground wire 4. Preferably, ground wire 4 is arranged within a dimple 20 of crimp ring 1, resulting

from crimping crimp ring 1 on cable 16, in order that ground wire 4 cannot easily slip away.

Then, sharp lip 12, crimp ring 1 and ground wire 4 are soldered to one another to provide the required, reliable electrical connection. This step of soldering ground wire 4 to shield 28' may be done in a later manufacturing stage than in the method according to the prior art where it was done before pressing both shields 8, 8' together. Putting ground wire 4 in its proper location is simpler than in the prior art arrangement. Moreover, the location where ground wire 4 has to be soldered to shield 28' is much easier to access than in the arrangement according to the prior art, which reduces manufacturing costs and shortens manufacturing time.

Figures 5a, 5b show an alternative arrangement in accordance with the present invention. As figure 5a shows, ground wire 4 can be interposed between crimp ring 1 and insulating sheath 2 before crimping. Subsequent crimping, than, results in a pressure joint between the crimp ring 1 and ground wire 4 which avoids the need for a soldering operation to establish a reliable electrical connection between ground wire 4 and shield 28'. In this alternative arrangement, as shown in figure 5b, shields 28, 28' need only be pressed against one another without the need to care for ground wire 4 not to slip away. Such pressing together is advantageously done by two plastic covers 9 (not shown in figures 5a, 5b) which are connected to one another like in the arrangement according to the prior art. Sharp lips 12 will, than, automatically be pressure connected to the outer periphery of crimp ring 1 and, thereby, establish the desired electrical connection. No additional soldering step for soldering lips 12 to crimp ring 1 is needed in the arrangement according to figures 5a, 5b. However, it is to be understood that, if required, both ground wire 4 and lips 12 in the arrangement according to figure 5a, 5b may be connected to crimp ring 1 by soldering to improve the electrical connection.

The arrangement according to figures 5a, 5b results in a further cost reduction relative to the figures 2a, 2b arrangement, provided no additional soldering steps are carried out to connect ground wire 4 and lips 12 to crimp ring 1.

The embodiments described above are not intended to limit the scope of the present invention, which is only defined by the features of the accompanying claims. For instance, lips 12 may be replaced by any other suitable resilient means, e.g., resilient spring like elements.

## Claims

1. Arrangement comprising a cable (16) and a connector (26), said cable (16) comprising at least one inner signal conductor (3) and a ground wire (4) and being provided with a crimp element (1) on an insulating sheath (2) for improving strain relief of the cable (16) against pull and flexure, said connector (26) comprising at least one shield element (28'),

and said ground wire (4) being electrically connected to said at least one shield element (28') characterized in that said ground wire (4) is mechanically and electrically connected to said crimp element (1) and said shield element (28') is provided with a resilient means (12) which, in the assembled state, is electrically connected to said crimp element (1).

2. Arrangement according to claim 1 wherein said crimp element is a crimp ring (1).
3. Arrangement according to any of the preceding claims wherein the cable is a shielded, multi-wire cable (16) and said ground wire (4) is a 'pig-tail' end part of a braided sheath within the cable (16).
4. Arrangement according to any of the preceding claims wherein the resilient means (12) is pressed against said crimp element (1) by at least one plastic cover (9).
5. Method of manufacturing an arrangement according to any of the claims 1 through 4 comprising the following steps:
  - a. crimping crimp element (1) on said insulating sheath (2);
  - b. connecting the at least one signal conductor (3) to at least one terminal (18) within the connector (26);
  - c. pressing a first (28) and a second (28') metal shield to one another wherein at least either said first (28) or said second (28') metal shield comprises a resilient means (12) which clamps said ground wire (4) to said crimp element (1);
  - d. soldering said ground wire (4), said crimp element (1) and said resilient means (12) to one another.
6. Method of manufacturing an arrangement according to any of the claims 1 through 4 comprising the following steps:
  - a. crimping crimp element (1) on said insulating sheath (2) wherein said ground wire (4) is clamped between said crimp element (1) and said insulating sheath (2);
  - b. connecting the at least one signal conductor (3) to at least one terminal (18) within the connector (26);
  - c. pressing a first (28) and a second (28') metal shield to one another wherein at least either said first (28) or said second (28') metal shield comprises said resilient means (12) which is pressed against said crimp element (1).

fig-1a

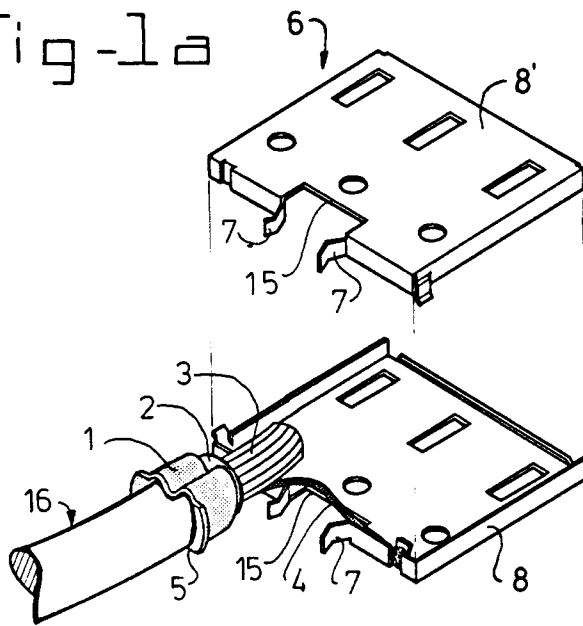


fig-1b

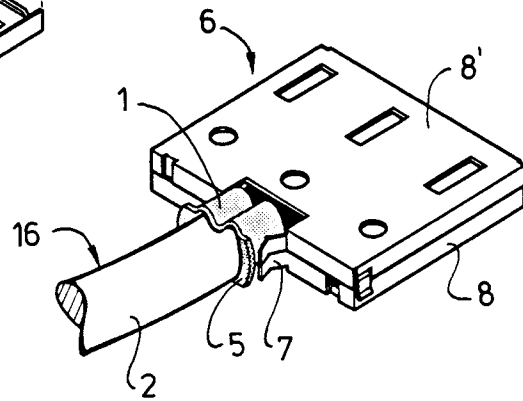


fig-2a

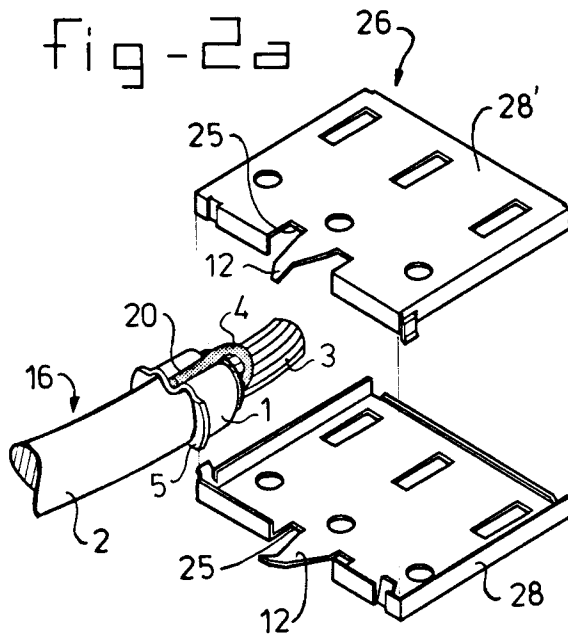


fig-2b

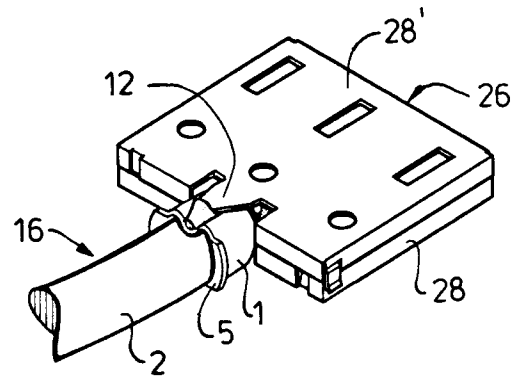


fig - 3a

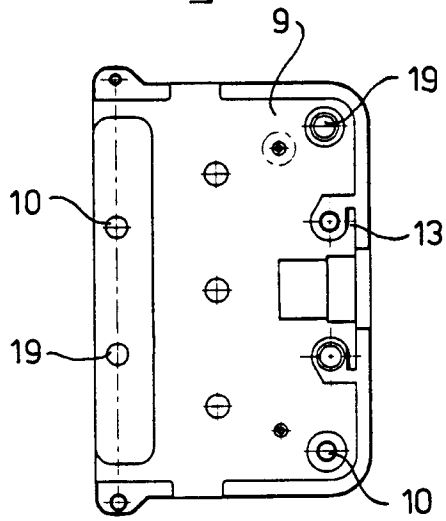


fig - 3b

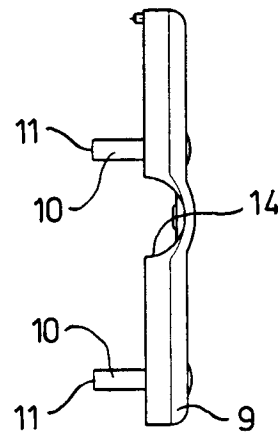


fig - 4

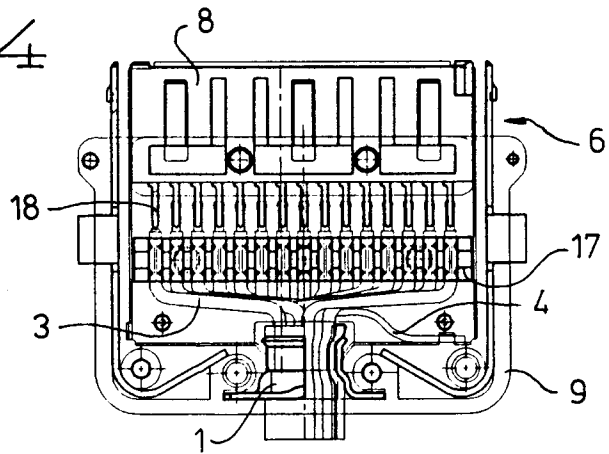


fig - 5a

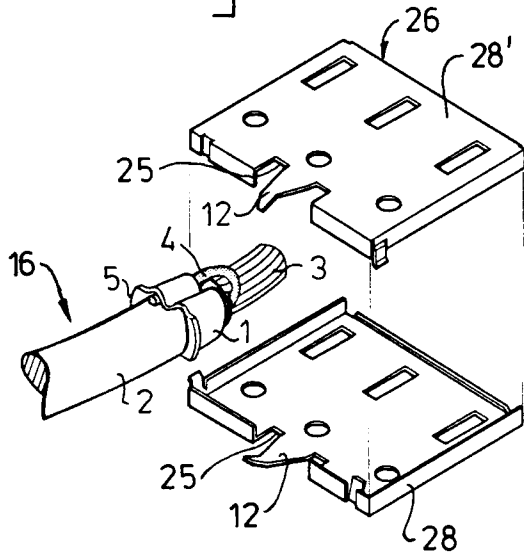
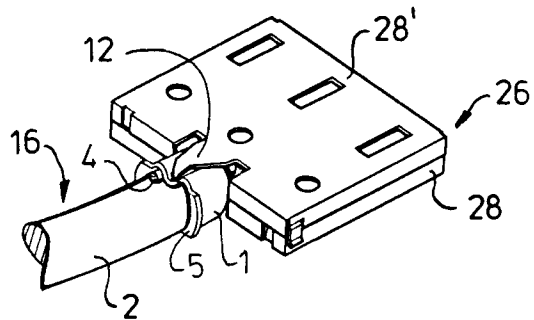


fig - 5b





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# EUROPEAN SEARCH REPORT

Application Number  
EP 95 20 2655

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.6)
X	EP-A-0 224 200 (STEWART STAMPING CORP) 3 June 1987	1-4,6	H01R9/05 H01R13/658
Y	* page 6, column 9, line 7 - line 33 * * page 7, column 12, line 29 - line 55 * * page 8, column 14, line 15 - page 9, column 15, line 44; figures 1,6 * ---	5	
Y	EP-A-0 168 649 (JAPAN AVIATION ELECTRON ;NIPPON ELECTRIC CO (JP)) 22 January 1986	5	
A	* page 8, line 4 - line 26; figures 10,11 * -----	1-4,6	
The present search report has been drawn up for all claims			<b>TECHNICAL FIELDS SEARCHED (Int.Cl.6)</b>  H01R
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>29 January 1996</b>	Examiner <b>Criqui, J-J</b>
<b>CATEGORY OF CITED DOCUMENTS</b> 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			

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