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(54) Electrical shielding.

(57) An arrangement for electrically shielding an aperture in an electrical connector housing through which a plurality of screened wires are intended to pass comprises:

i) a number of electrically conductive ferrules which can receive the wires, and which can be electrically connected to the screen of the wire or wires extending therethrough;

ii) an electrically conductive shielding plate that can be positioned in the aperture to close it, the member having a number of apertures and/or slots into which the ferrules can be releasably positioned so that the wires can extend through the plate; and

iii) a retaining plate which co-operates with the shielding plate and/or the ferrules to secure the ferrules in position on the shielding plate. The retaining plate can be released to allow one or more ferrules to be detached from the shielding plate.

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Description

ELECTRICAL SHIELDING

This invention relates to electrical shielding.

It is common to provide wires with an electrical shield, for example in the form of a metal braid screen, in order to screen the wires from electrical, magnetic or electromagentic interference, or to prevent interference in neighbouring equipment. A separate screen may be provided for each individual wire, or a single screen may be provided around a bundle of wires.

Where it is desired to terminate a plurality of such wires or bundles of wires, it is necessary not only to connect each of the individual wires but also to earth each of the shields. In order to terminate such a plurality of shielded wires which pass through an aperture, a number of techniques have hitherto been proposed.

Thus it has been proposed to separate the screens from the central wires, and then firmly clamp each of the screens into the aperture. The screens are generally also earthed by the clamping. One such method is described in U.K. Patent No. 1512626. The method comprises the steps of separating the central wires from their respective shields by passing each insulated wire through an aperture in the braid, by a technique known as "pigtailing", inserting the plurality of screens between the tines of a longitudinally slotted tubular grounding member, and then fastening a heat-shrinkable band of memory-metal (as defined hereinafter) around the tines so that when the band or ring shrinks it causes the slotted portion of the tubular grounding member to contract so that the screens are firmly gripped between the tines.

This method has a number of disadvantages. For example it is often not possible to dismantle the arrangement in order to introduce new wires, it is difficult and time-consuming to assemble, especially where so-called optimised cable screens are used, and the cable screens may be considerably weakened at the point of pigtailing and/or where they are connected to the grounding member.

Another method of terminating shielded wires involves connecting the shield of each wire to a grounding lead either by solder device or by a crimp, and joining the individual grounding leads together before connecting them to conductive housing. Alternatively a single grounding lead may be connected to the screens of all the wires and then grounded. These methods also suffer from the disadvantage that they do not permit disassembly once installed and that they are difficult to install, in this case caused largely by the necessity of "centre stripping" of the wire insulation to obtain access to the shield at some distance from its end. In addition there is the possibility that the grounding leads will act as antennae and pick up electro-magnetic interference. These proposed termination methods also suffer from the disadvantage that they are, at least to some extent, random in that the value of the screening effectiveness may not be reproducible for different terminations.

Yet another method of terminating shielded wires uses the connector device as described in U.S. patent No. 4,382,653 to Blanchard. This connector employs a number of ferrules that are connected to the shields and are dip-brazed to a plate that is secured in the housing. This arrangement also cannot be disassembled once it has been formed.

The present invention provides another arrangement for terminating shielded wires.

The present invention provides an arrangement for electrically shielding an aperture in an electrical connector housing through which a plurality of wires are intended to pass, the wires being screened at least outside the connector housing, which comprises:

i) a plurality of electrically conductive hollow elements which are capable of receiving one or more wires so that the wires extend through and beyond the element and which can be electrically connected to the screen of the wire or wires extending therethrough;

ii) an electrically conductive shielding member that can be positioned in the aperture to close the aperture, the member having a plurality of apertures and/or slots into which the elements can be releasably positioned so that the wires can extend through the member; and

iii) a retaining member which co-operates with the shielding member and/or the elements to secure the elements in position, on the shielding member but which can be released to allow one or more elements to be detached from the shielding member.

The arrangement according to the invention enables shielded wires to be terminated easily with 360° shielding if desired and with a low surface transfer impedance (Zt) to ground, but can easily be dismantled if required for example in order to repair or replace any of the components.

The arrangement allows each of the screens to be terminated without the need to "pig-tail" out the central wire or wires or provide grounding leads. This is advantageous since 'pigtailing' is an undesirable extra step that is time consuming and also involves "centre stripping" of the shielding wires to bare the screens. To "centre strip" a wire, a length of the insulation that is not an end of the wire must be removed from the braid. This requires two circumferential cuts to be made in the insulation and also a longitudinal cut connecting the circumferential cuts. Centre-stripping is less convenient that end-stripping of the shielded wires which may be used in the present invention. Furthermore if a mistake is made during centre-stripping, for example if the braid is cut and a fresh strip is required, a longer length of wire is wasted than with end stripping. 'Pigtailing' is also generally undesirable since it may result in electromagnetic interference.

Since each screen is terminated individually to a separate shielding element the arrangement also advantageously provides a convenient means whereby any one of the screen terminations can be replaced or

repaired without affecting the other terminations.

In addition, assembly of the connector is facilitated because it is possible to connect each element individually to its associated wire and only then to collect all the elements and wires together for final assembly. This method may be contrasted with the method described in U.S. patent No. 4,382,653 in which all the electrical connections to the wire screens must be made together or at least in the close proximity of the other wires, which rapidly becomes extremely difficult as the number of wires increases.

If desired, the items of the arrangement may be shaped to fit into existing, standard housings or backshells in connector assemblies, and thereby shield the aperture through the housing or backshell.

The shielding member is required, in cooperation with the shielding elements and, if necessary, the retaining member, to extend transversely to cover and thereby shield the aperture. It is not, however, required to extend axially thereof. This is advantageous since the weight of the shielding member can therefore be minimised. This is particularly advantageous for applications where low weight is important, for example in aircraft. Where the term axially is used herein it is intended to denote the direction axially of the aperture throught the connector housing.

Preferably the shielding member comprises a plate, especially a circular plate. The slots in the member may extend from an edge, preferably the outer edge, of the plate so that the shielding elements may be inserted into the slots from the edge of the plate.

In another embodiment the plate contains a hole and at least some of slots extend from the hole towards the outer edge of the plate. The plate may have, for example, eight slots extending from the outer edge of the plate and four slots extending outwardly from the hole in the plate. The hole is preferably located substantially in the centre of the plate. This preferred embodiment comprising a plate containing a hole increases the number of shielding elements that can be accommodated.

Where the plate contains a hole it is necessary to cover the, preferably central, hole such that there is substantially no significant straight interstitial path through the hole. This may be achieved for example by means of the retaining member which is preferably also in the form of a plate and which covers the first plate hole. In one embodiment the retaining member has slots adapted to be positioned in register with the slots in the first plate to allow the wires to pass therethrough.

The arrangement of the invention preferably comprises means for axially locating the hollow elements relative to each other and/or to the shielding member. In the preferred embodiment, the elements preferably have one or more protuberances and/or ridges which engage the shielding member substantially to pre vent relative axial movement of the member and the element. For example, there may be two protuberances on the element such that the element can be inserted into the slot of the plate from an edge thereof, preferably the outer edge thereof, such that one protuberance lies on one side and the other protuberance on the other side of the plate. Preferably the protuberances are in the form of circumferentially extending flanges on the elements.

Where the retaining member is in the form of a plate it is particularly preferred for it to be able to be secured against the shielding member so that the protuberances of the elements are held between the shielding member and the retaining member for example they may be gripped between the two members, or one or both of the members may be profiled to prevent the elements moving.

In the preferred arrangement comprising a shielding member having openings, the portion of the hollow element that cooperates with the shielding member is preferably circular in external cross-section. Where, for example, the openings in the shielding member comprise slots, the circular cross-section enables the shielding elements to rotate relative to the member, which may be advantageous for some applications. With this arrangement the braid and element may be assembled on a bench and the element and shielding member may be assembled without suffering any torsion couple from the bundle.

In addition to the hollow elements, one or more other shielding elements, referred to herein as "blanks" may be included in the arrangement. The blanks may be used to block any apertures in the shielding member when an insufficient number of wires is to be used with the connector. As examples, blanks may be solid or they may be hollow with one or both ends closed.

One advantage of including blanks in the arrangement according to the invention is that if at a later date it is decided to introduce a further screened wire through the aperture it is a simple operation to replace one of the blank shielding elements with a hollow shielding element, of the same external configuration, having two open ends, that is capable of allowing the wire to extend therethrough.

The retaining element is preferably arranged so that it can be positioned against the shielding member so as to hold the protuberances of the hollow elements, and so that the periphery of the shielding and retaining members can be forced together, or at least toward each other, by some appropriate means such as a screw-threaded tightening ring on the connector backshell, thereby tightening the grip of the screening and retaining member on the hollow elements.

The hollow elements are preferably provided with a device for forming an electrical connection to the shield of the wire. The device for electrically connecting the screen of each wire to the shielding element may comprise, for example, a crimp connector. Preferably the crimp connector comprises an outer crimp barrel and a substantially rigid inner support barrel that is positioned in use between the screen and the central wire or wires to protect the wires from mechanical damage as a result of crimping. In the preferred arrangement comprising a barrier having openings the inner crimp support barrel is preferably integral with a portion of the shielding element that cooperates with the screening member.

In another embodiment the device for electrically connecting the screen of each wire to its respective element may comprise an electrically conductive material. The electrically conductive material is preferably solder, but electrically conductive materials not conventionally regarded as solders may be used. As an example, an adhesive for example a hot-melt adhesive, loaded with electrically conductive particles for example silver flake or carbon particles may be used.

In a further embodiment the device for electrically connecting the screen of each wire to its respective shielding element may comprise a heat-recoverable preferably heat-shrinkable sleeve containing en electrically conductive material as described above. Preferably the heat-recoverable sleeve contains solder for example as described in British patent application No. 1,470,049 the disclosure of which is incorporated herein by reference.

It is preferred to use an electrically conductive material to connect the screens to the shielding elements rather than a crimp because a wider range of screen sizes may be accommodated using an electrically conductive material, either alone or in combination with a heat-recoverable sleeve, than with a crimp. Heat-recoverable sleeves generally have a recovery ratio (pre-recovered diameter to post-recovered diameter-on free recovery) of 2:1 or as much as 3:1 so the sleeves can accommodate a wide range of screen sizes. The use of a heat-recoverable sleeve containing solder is especially preferred since the recovered sleeves provide strain relief of the connection. Furthermore the sleeves may be provided with a pre-packed quantity of solder thereby ensuring that the correct amount of solder is applied. Preferably the sleeves are substantially transparent so that the finished connection may be inspected. As a preferred example the sleeve may comprise polyvinylidene fluoride.

In addition, it is preferred for the device and element to be arranged so that the end of the shield of the wire can be positioned over the end of the associated element so that, at very high frequencies, the skin currents will be carried along the outside of all the conductive elements and the external surface of the connector housing.

In a further embodiment a gasket formed e.g. from a silicone gel may be provided around each element and/or a sealing insert may be provided at the back of each heat-shrinkable sleeve in order to seal the connector against pressure changes which will be caused by changes in altitude.

Embodiments of the present invention will now be described with reference to the accompanying drawings, wherein:

Figure 1 is a schematic side view showing various parts of an arrangement according to the present invention before assembly;

Figure 2 is a view of the parts of figure 1 after partial assembly;

Figure 3 is a perspective view of part of the assembly of figure 2;

Figure 4 is an exploded perspective view of part of an arrangement according to the invention employing the assembly of figure 3;

Figure 5 is a side elevation of an alternative hollow element and connecting device;

Figure 6 shows an alternative configuration of the shielding and retaining members used in the arrangement of the invention;

Figure 7 is a schematic side section showing part of an assembled connector according to the present invention;

Figure 8 is a side section through part of a further form of device according to the invention;

Figure 9 shows the shielding and retaining plates of the device shown in figure 8; and

Figure 10 shows part of the shielding and retaining plates of figure 9 in greater detail.

Referring initially to figures 1 to 4 of the drawings, an arrangement for electrically shielding a connector comprises an electromagnetic shielding member 4, in the form of a plate, four identical hollow elements 6 in the form of ferrules (for clarity only one is shown) and a retaining member 5 also in the form of a plate. Each ferrule 6 has a device 7 for electrically connecting the screen of the or each wire or wires extending therethrough to the ferrule 6.

The shielding plate 4 has four identical slots 8 extending from the outer edge towards its centre. The boundary of each slot defines a U-shape, and each slot 8 extends approximately two-thirds of the distance towards the centre of the plate 4. The plate 4 is made of free cutting brass.

Each hollow element or ferrule 6 comprises a metallic tubular portion 10 for engagement with the slots 8 in the plate 4. The metallic tubular portion 10 is of uniform, circular, cross-section along its length. It has two protuberances 14 projecting radially outwards at one end. The protuberances 14 are spaced apart a distance corresponding to the thickness of the plate 4. The external cross-section of the tubular portion 10 between the protuberances 14 is slightly smaller than the width of the slots 8 in the plate 4. This enables each tubular portion 10 to be inserted into a slot 8 of the plate 4 from the outer edge of the plate 4 such that one protuberance 14 lies on one side and the other protuberance 14 on the other side of the plate 4. The metallic tubular portion 10 is made from free cutting brass.

The device 7 for electrically connecting the screened wire to the element 6 comprises a sleeve 12 of heat-shrinkable polyvinylidene fluoride containing a prefluxed tinned copper braid 16 and optionally, adjacent to the braid 16, a pre-fluxed, tin based solder ring (not shown). The heat-shrinkable sleeve 12 may be partially pre-shrunk onto the braid 16 and solder ring 18 such that it retains them in the desired position, and such that one end 20 thereof has an internal cross-section that is the same size as the external cross-section of the tubular portion 10 to enable it to be push fitted on it.

Approximate typical dimensions for the shielding member 4, element 6 and its associated connecting device 7 are as follows:

Shielding plate	Dimension	mm
a) Plate 4	diameter to plate edge	17.0
	thickness	0.8
b) Slot 8	length	5.5
	width	4.0
Hollow Ferrule 6		
a) Tubular portion 10	length	14.0
	diameter	4.0
	thickness	0.3
b) Projections 14 on tubular portion 10	outer diameter	6.0
	thickness	0.3
c) Spacing between protuberances 14		1.0
Connecting Device 7		
a) Polyvinylidene sleeve 12	length	22.0
	pre-recovered outer diameter	5.2
	pre-recovered thickness	0.5
b) Braid 16	length	12.0
	outer diameter	4.5
c) Solder ring	width	5.0
	outer diameter	4.5
	thickness	0.5

In order to terminate the screen of a wire to a ferrule 6 the heat-shrinkable tubular sleeve 12 is first fitted over

the sleeve 10 of the ferrule 6. The wire, prestripped to bare the screen, is then inserted into the sleeve 12 until the screen abuts the free end of the tubular portion 10 of the ferrule 6 as shown in figure 2. The length of the bared wire screen is selected such that the screen lies beneath the solder impregnated braid 16 and any solder ring but does not extend beyond the free end of the heat-shrinkable sleeve 12. Heat is then applied to shrink the heat-shrinkable sleeve. This causes the solder ring and the solder in the solder impregnated braid 16 to melt and flow, and also causes the sleeve 12 to shrink. As the solder melts and flows from the braid 16 the braid becomes deformable and is urged together with the solder (from the braid 16) into conformity with the underlying metal tubular portion 10 and the bared shield of the wire. The result is a strong electrical connection via the copper braid 16 and flowed solder. Shrinkage also causes one end of the sleeve 12 to shrink into contact with the metal tubular portion 10 of the shielding element adjacent the protuberance 14, and the other end of the sleeve to shrink into gripping contact with the insulation covering the shielded wire adjacent the bared portion. The shrunk sleeve advantageously provides strain relief of the formed joint. A typical shrinkage ratio (pre-shrunk diameter: shrunk diameter) is 2:1. Sealing material may be provided at one or both ends of the sleeve to provide additional sealing. If present the sealing material is preferably provided as sealing rings that fuse below the melting point of the solder such that they flow and provide dams to prevent egress of the solder from the sleeve. The sleeve is preferably partially pre-shrunk to retain the sealing rings.

Each wire can be terminated to a ferrule 6 separately from the others and, after the wires have been terminated to the ferrules 6, they can be provided with contacts 9 for the connector. The ferrules 6 of the terminated wires can then be inserted into the plate 4. When all the elements 6 have been inserted into the plate and the wires pushed through their respective holes 5′ in the retaining plate 5, the retaining plate is pressed against the side of the plate 4 facing toward the connector. After inserting the wire contacts in the connector, both plates are then located in the appropriate position in the connector backshell and the plates are forced together at their periphery by means of a screw-threaded locking ring, thereby clamping the elements 6 in place.

Figure 5 shows an alternative device for electrically connecting the screen of the wire to the hollow element (which in Figures 1 to 4 comprises the solder impregnated copper braid 16 and sleeve 14). In this case the device comprises crimp barrel 24 and an inner support barrel 26. The crimp barrel 24 comprises soft copper and the inner support barrel 26 extends from and is formed integrally with the free cutting brass tubular metal portion 10. In use the screen of the screened wire is telescoped over the inner support barrel 26. The crimp barrel 24 is then crimped over the screen of the wire and the inner support barrel 26. The inner support barrel 26 is selected to be as small as possible to allow the maximum range of braid sizes to be fitted over it, and as thick walled as possible to provide the maximum support while allowing passage of the inner insulated conductor or conductors of the shielded wires.

Figure 6 is a plan view showing a shielding plate 4 and a retaining plate 5 that are capable of receiving eighteen wires. The shielding plate has twelve iden tical slots 8 in its outer edge and six slots 8 leading from a central aperture 61. The retaining plate 5 has eighteen apertures 62 each having a diameter approximately equal to the bore of the hollow elements. In addition, each aperture may be surrounded by a stepped area 63 for receiving the end flange or protuberance of the elements.

Figure 7 shows an assembled connector with a single shielded cable 40 extending from it. The connector assembly comprises a connector backshell 41, a screw-threaded adaptor 42, a screw-threaded sleeve 43, a pair of half-shells 44 and the shielding assembly 45 comprising a shielding plate 46, hollow elements 47 and retaining plate 48.

In order to assemble the connector the jackets and shields of the wires are cut back by the appropriate amount, or a cut is made in the jacket to expose the shield the appropriate distance from the end of the cable, and the hollow elements 47 are connected to the screen of the wires by means of a heat-shrinkable solder connector 49. The adaptor 42 is screwed onto the connector backshell. The purpose of the adaptor is to increase the diameter of the end of the connector backshell so that it is greater than that of the shielding plate 46 and will therefore enable the plate 46 to be inserted into the sleeve 43.

The sleeve 43 is passed over the bundle of wires 40 and the elements 47 are positioned in the shielding plate 46. After placing the retaining plate 48 on the screening plate, the contacts formed at the ends of the wire are inserted into the connector and the screening and retaining plates are inserted into the sleeve 43. The two half-shells 44 are then positioned together and pushed into the sleeve 43, and the sleeve 43 is screwed onto the adaptor.

In order to gain access to the connector at a later date, for example to replace one of the wires 40, one simply unscrews the sleeve 43, removes the half-shells 44 and the shielding assembly 45, and the shielding assembly is then ready to be dismantled.

If yet higher densities of wires are required for the connector, it is possible for two or more wires to be provided with a common screen, so that all the wires enclosed by that screen extend through a single hollow element.

Figures 8 to 10 show another form of connector according to the present invention. A conventional metal connector housing 100 is provided with a back-shell 101 that has a rear opening through which the shielded cables can extend. The back-shell 101 can receive a shielding arrangement 102 in the rear opening and is provided with a spin coupling arrangement 103, 104 in order to be able to secure the shielding arrangement in the rear opening and release it as desired.

The shielding arrangement comprises a number of brass ferrules 105, one such ferrule for each cable, a

shielding plate 106, a locking plate 107 and a pair of clamping half rings 108. Each ferrule 105 has an annular flange 109 extending around its periphery for enabling the ferrule to be secured, and a bevelled nose that is divided into a number of tines 110 by a number of slots 111, the nose terminating in a rearwardly facing annular shoulder 112. Each ferrule is hollow to allow the shielded cable (not shown) to extend through it and may be provided with suitable means (not shown) for forming an electrical connection to the cable shield, e.g. a solder-braid device 7 as shown in figure 1.

The shielding plate 106 has eighteen circular apertures 113 and 114 extending through it, the apertures being arranged in an inner ring of six apertures 113 and an outer ring of twelve apertures 114. Each aperture has a diameter that will allow the nose of a ferrule 105 to be positioned in it to form a tight fit, i.e. with a slight radially inward force exerted by the aperture walls on the tines 110 of the ferrule. The locking plate 107 is generally circular in shape having an internal diameter that corresponds to the centre of the apertures 113 in the inner ring in the shielding plate 106, and an outer diameter that corresponds to the centres of the apertures 114 in the outer ring. The radially inward facing edge 116 and radially outwardly facing edge 118 of the locking plate is provided with a number of substantially semi-circular recesses 118 that correspond to the apertures 113 and 114. Each semi-circular recess 118 has a radius that is slightly smaller than that of the aperture 113 or 114 and that corresponds to the radius of the portion 119 of the ferrule located axially between the shoulder 112 and the flange 109. The radially intermediate portion of the shielding plate 106 has a reduced thickness to receive the locking plate 107 in such a way that the surface of the locking plate 107 is flush with the central and peripheral surfaces of the shielding plate.

In order to assemble the connector, the shield of each cable is first electrically terminated to the rear end of its associated ferrule 105, e.g. by means of the solder connector 7 shown in figure 1. Each ferrule 105 is then positioned in one of the recesses 118 in the locking plate 107 so that the edge of each recess is located between the shoulder 112 and flange 109 of the ferrule. The locking plate is then oriented so that the recesses 118 and ferrules 105 are in alignment with the apertures 113 and 114 of the shielding plate, and the locking plate and shielding plate are pushed together so that the nose portion of each ferrule is received by its corresponding aperture in the shielding plate. A pair of half-rings 108 are then positioned over the periphery of the shielding arrangement to lock the arrangement in place. Each locking half-ring has an inwardly oriented flange 120 that engages the forwardly facing surface of the shielding plate 106, and another inwardly oriented flange 121 that engages the rearwardly facing surface of the flange 109 of each ferrule 105 located in the outer row of apertures 114. Thus, the half-rings 108 retain the ferrules 105 in the outer row of apertures 114. These ferrules secure the locking plate 107 which itself retains the ferrules 105 in the inner row of apertures 113 in place.

The shielding assembly 102 is then inserted into the rear opening of the connector backshell 101 until the half-rings abut a rearwardly facing internal shoulder 122 of the half shell. The spin coupling arrangement 103,104 is then used to secure the shielding assembly in place.

This form of arrangement has the advantage that because the nose portion of the ferrules 105 can be formed so that they form a tight fit in the apertures 113 and 114, the electrical resistance between the cable shield and the connector back-shell is reduced and hence the electrical shielding is improved.

Claims

1. An arrangement for electrically shielding an aperture in an electrical connector housing through which a plurality of wires are intended to pass, the wires being screened at least outside the connector housing, which comprises:

i) a plurality of electrically conductive hollow elements which are capable of receiving one or more wires so that the wires extend through and beyond the element and which can be electrically connected to the screen of the wire or wires extending therethrough;

ii) an electrically conductive shielding member that can be positioned in the aperture to close the aperture, the member having a plurality of apertures and/or slots into which the elements can be releasably positioned so that the wires can extend through the member; and

iii) a retaining member which co-operates with the shielding member and/or the elements to secure the elements in position on the shielding member but which can be released to allow one or more elements to be detached from the shielding member.

2. An arrangement according to claim 1, wherein the shielding member comprises a plate.

3. An arrangement according to claim 2, wherein the plate has slots extending from its outer edge for receiving the elements.

4. An arrangement according to claim 2 or 3, wherein the plate contains a hole, and wherein at least some of the slots extend from the hole toward the outer edge of the plate.

5. An arrangement as claimed in any one of claims 1 to 4, wherein each element has a protuberance that extends laterally to limit the axial extent to which the element can be inserted in the shielding member.

6. An arrangement as claimed in claim 5, wherein the protuberance is in the form of a circumferentially extending flange.

7. An arrangement as claimed in claim 6, wherein each element has a pair of circumferentially extending flanges that are arranged to lie against opposite sides of the shielding member when the element is received by the shielding member.

8. An arrangement as claimed in claim 3, wherein the retaining member is in the form of a plate.

9. An arrangement as claimed in any one of claims 5 to 8, wherein the retaining member is in the form of a plate that can be secured against the shielding member so that the protuberances of the elements are gripped between the shielding member and the retaining member.

10. An arrangement as claimed in any one of claims 1 to 9, wherein at least some of the elements are provided with a device for forming an electrical connection to the shield of the wire.

11. An arrangement as claimed in claim 10, wherein the device is a crimp connector or a heat-shrinkable solder device.

12. An arrangement as claimed in claim 10 or claim 11, wherein the device for forming the electrical connection enables the end of the wire shield to be positioned over the end of its associated element.

13. A connector assembly for terminating a plurality of shielded wires which comprises a connecting element to which a plurality of wires can be connected, a connector housing having an aperture through which the plurality of wires are intended to pass, at least part of the inner surface of the housing being electrically conductive, and an arrangement according to any one of claims 1 to 12 which can be assembled and positioned in the aperture to ground the wire shields to the housing.

Fig.1.

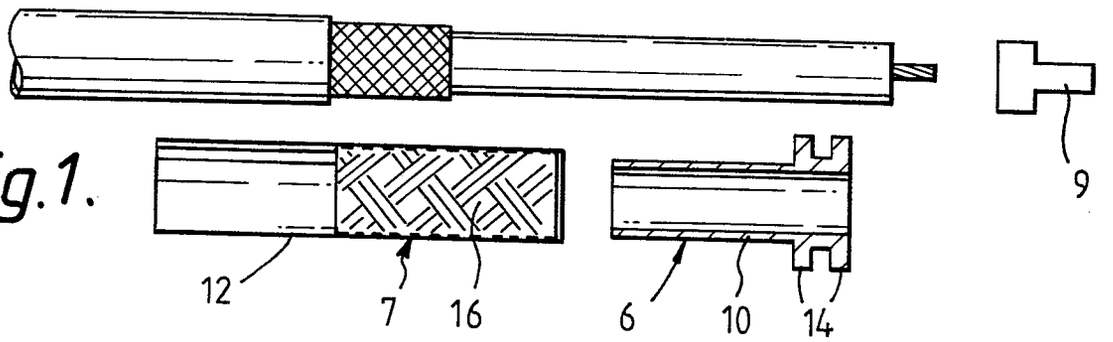


Fig.2.

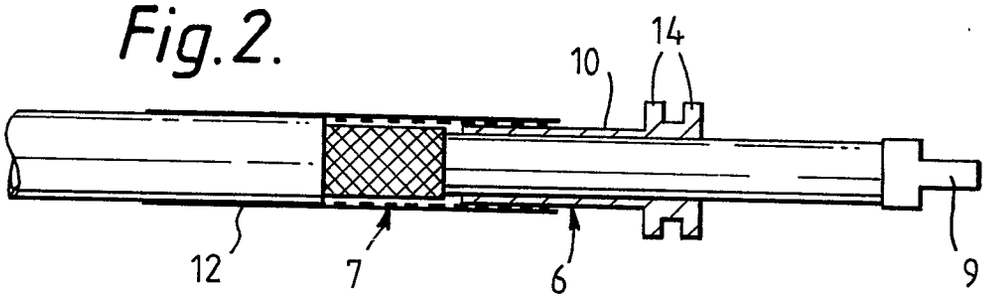


Fig.3.

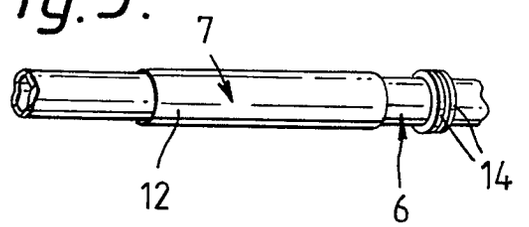
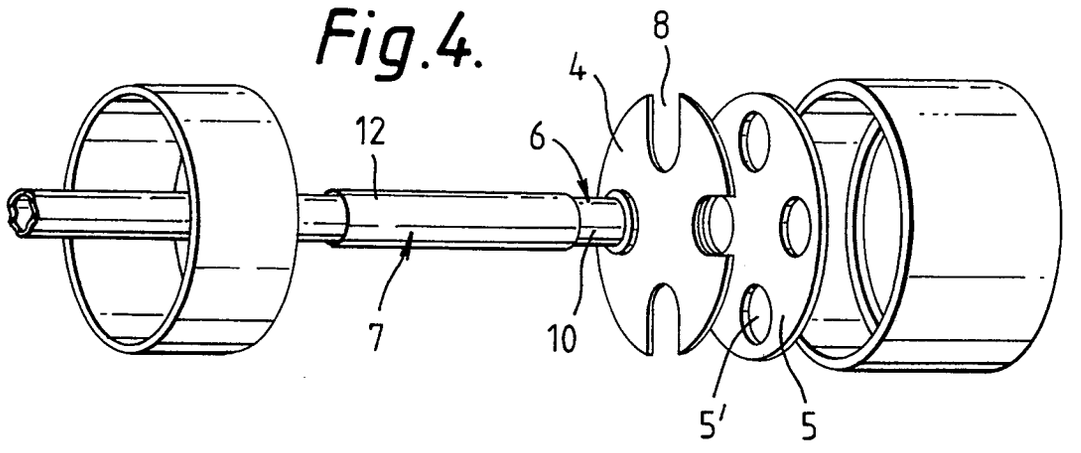


Fig.4.



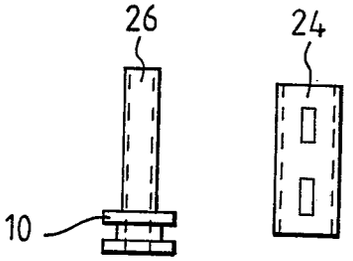


Fig.5.

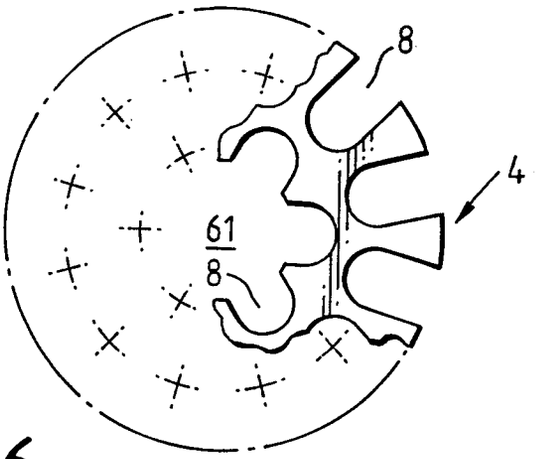


Fig.6.

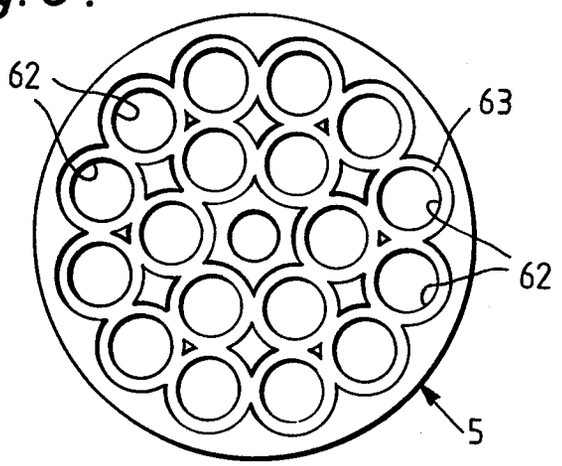
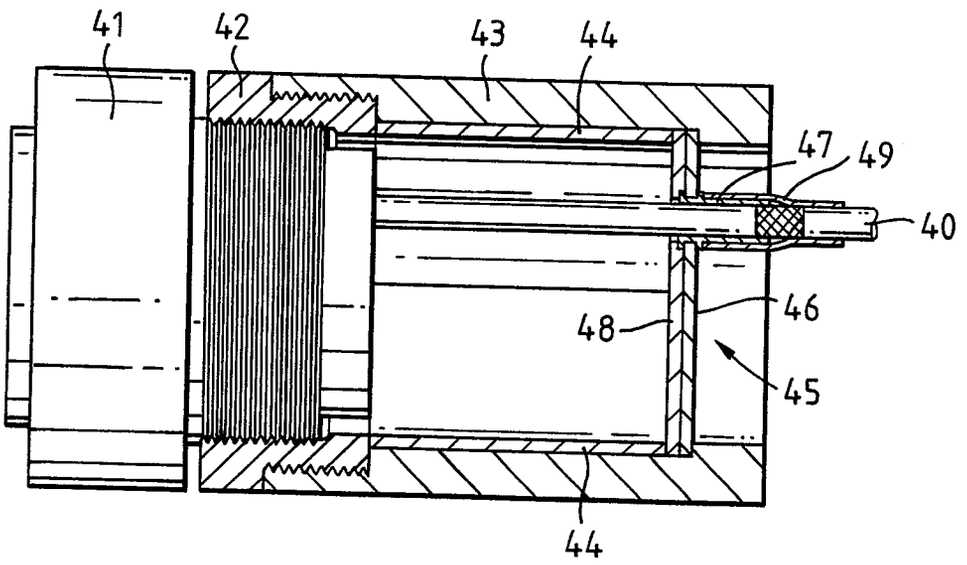


Fig.7.



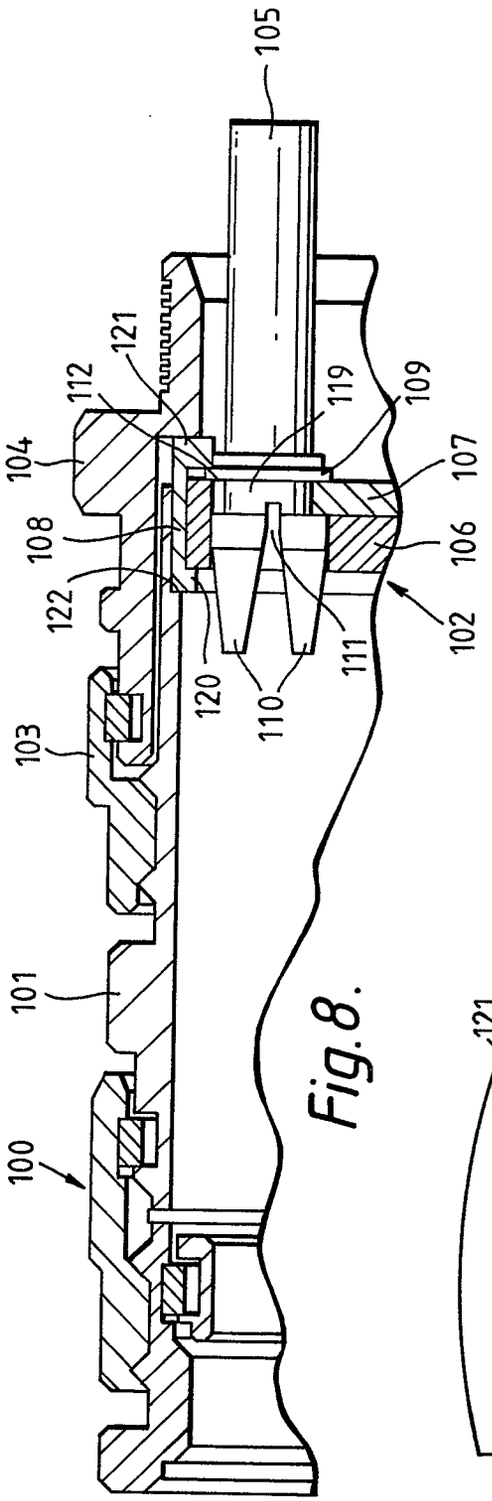


Fig.8.

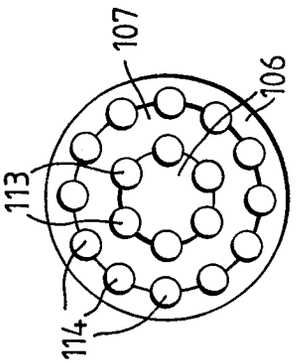


Fig.9.

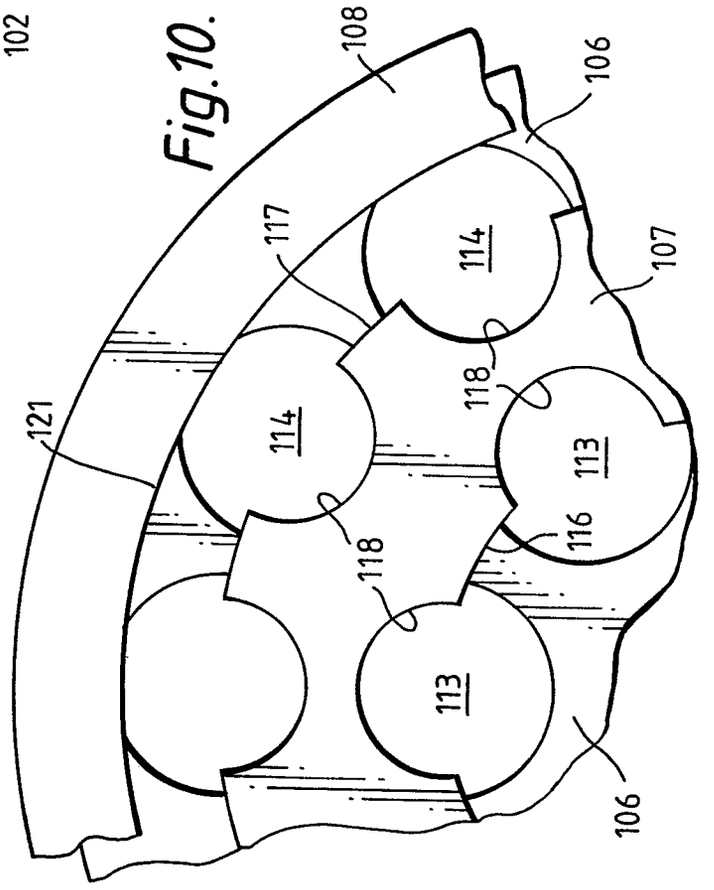


Fig.10.