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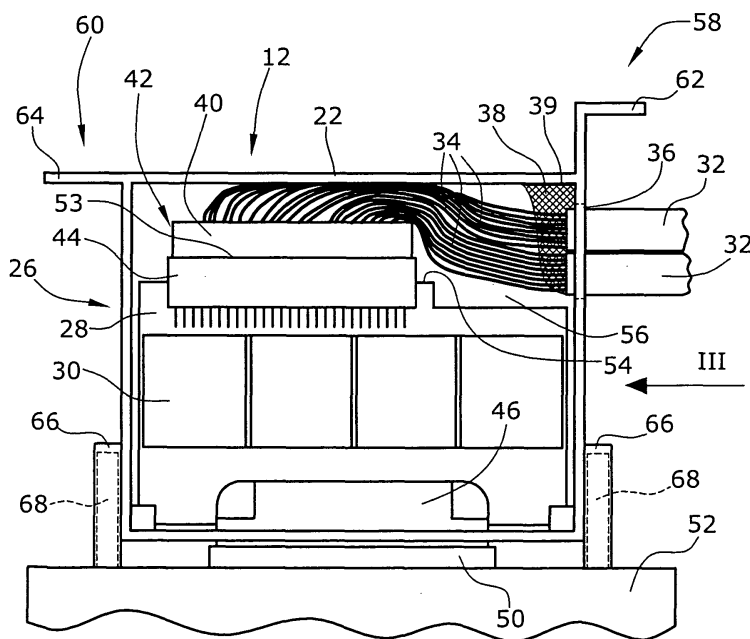
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(54) **Cable connector shell**

(57) The cable connector shell for a multiple wire cable comprises a housing (12) having an opening (36) for passing therethrough at least one multiple wire cable (32), an electronic circuitry (26) within said housing (12), a first connector (42) arranged within said housing (12) said first connector (42) comprising at least one first connector element (40) to be electrically connected to the individual wires (34) of the multiple wire cable (32), and

an engageable and disengageable mating second connector element (44) electrically connected to said electronic circuitry (26), and a third connector element (46) electrically connected to said electronic circuitry (26) said third connector element (46) engageable with a mating connector element (50) of an electrical device (52) for electrically connecting thereto the multiple wire cable (32).



**Fig.2**

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## Description

### Background of the invention

#### 1. Field of the invention

[0001] The present invention relates to a cable connector shell for a multiple wire cable and, in particular, for a multiple wire twisted pair cable.

#### 2. Description of the prior art

[0002] Connectors for connecting multiple wire cable (e.g. multiple coaxial cables or multiple twisted pair cables) are known in the art. Such connectors are used, for example, in telecommunication applications to connect a multiple wire cable to an electronic card at the face plate of a 19" rack card. Such a connector, as well as a connector shell, are described, for example, in EP-A-0 952 637.

[0003] In DE-C-37 10 616, a cable connector shell is described that comprises a housing including a printed circuit board and a connector element, attached to the printed circuit board, for engaging with a mating connector element of an electronic device that is to be electrically connected to the cable. The cable is a twisted pair wire cable and extends through an opening of the housing. The printed circuit board includes a circuitry for converting parallel signals at the contact pins of the connector element into serial signals to be transmitted via the twisted pair wire cable and vice versa.

[0004] US-A-2002/0097105 discloses a multi-circuit signal transformer comprising a chassis-mountable housing with connector elements on the front for attaching the connector elements of twisted pair cables to connector elements on the rear that are attached to coaxial cables. Within the housing, there is located a printed circuit board, including baluns, for transforming the impedance of the signals and attenuation of the amplitude of the signal voltages. The circuitry may include provisions for the baluns to be removably inserted, so that baluns of different impedance levels may be utilized.

[0005] US-A-5 190 479 discloses a female connector receptacle including replaceable modules for effecting electromagnetic interference (EMI), radio frequency interference (RFI), and electromagnetic transient pulses (EMP) protection for the electronics with which the connector is used.

[0006] In EP-A-0 324 629 there is described a multi-contact connector having a shell including an insulating body with two sets of first and second sets of conductors, respectively. Attached to the body is at least one electronic module for electrical contact with the contact pins. The module may comprise components for protecting sensitive electrical equipment connected directly or indirectly to the multicontact connector.

[0007] There is still a need in the telecommunication field to increase the signal density and the signal trans-

mission rate. This need can be achieved by increasing the number of wires or cables to a connector and by increasing the frequency by which the signals are transmitted. However, accommodation for increasing numbers of wires in a connector typically leads to a bulky overall design of the connector. Bulkiness and size are also a problem if one chooses to include electronic circuitry within the connector because the connector must be large enough to accommodate the circuitry. Accordingly, there is a need for a smart design of a multiple wire cable connector shell which is easily to manufacture and to repair as well as relatively small in overall size.

#### 15 Summary of the Invention

[0008] The invention provides a cable connector shell for a multiple wire cable, comprising

- 20 - a housing having at least one opening for passing therethrough at least one multiple wire cable,
- an electronic circuitry within the housing,
- a first connector arranged within the housing, the first connector comprising at least one first connector element to be electrically connected to the individual wires of the multiple wire cable, and an engagable and disengagable second connector element electrically connected to the electronic circuitry, and
- 25 - a third connector element electrically connected to the electronic circuitry, the third connector element interacting with an engageable and disengageable mating connector element of an electrical device to electrically connect the device to the multiple wire cable.
- 30
- 35

[0009] According to a first aspect of the invention, the cable connector shell is provided with an electronic circuitry that can be removed or replaced even if all the wires of the multiple wire cable are connected thereto. This is achieved by providing a first connector arranged within the shell that comprises: (i) at least one first connector element, to which the wires are electrically connected, and (ii) a second connector element, which can be electrically connected to the electronic circuitry, such connector elements being engageable together and disengageable.

[0010] If all the wires of the multi-wire cable to be connected are attached to one first connector element, then a first connector with only one first connector element is needed to wire the cable. However, if individual wires or pairs or sets of wires are to be attached to different first connector elements, then several first connector elements should be provided in the shell.

[0011] The shell further includes a third connector element that is engagable, and preferably also disengageable, with a connector element on the electronic device to be connected to the multiple wire cable. In one em-

bodiment of the invention according to the first aspect, the third connector element can be positioned within the shell such that it is exposed through an opening in the housing of the shell. In such a configuration, the third connector element may project partly, or not at all, through the opening.

**[0012]** After disengaging the first and second connector elements of the first connector from each other, the electronic circuitry, together with the third connector element, can be removed from the shell, thereby permitting removal, replacement, repair, testing, etc. of the electronic circuitry.

**[0013]** In another embodiment of the first aspect of the invention, the third connector element can be attached to the housing of the shell. Such connector will remain within the shell when the electronic circuitry is removed from the shell. In this case, the third connector element is engageable and disengageable with an additional connector element that is attached to the electronic circuitry. Accordingly, the electronic circuitry can be disengaged from the first connector element of the first connector and from the third connector element. This embodiment can also provide the feature of replaceability of the electronic circuitry without exchanging the cable connector shell and the multiple wire cable attached thereto. The replaceability of the electronic circuitry within the shell is an advantageous feature because replacing the multiple wire cable arranged in cable channels of and routed in a building comprising the electronic devices can be cumbersome and time consuming. Moreover, by removing the electronic circuitry from the housing it is possible to have access to the electronic device to which the shell is connected. This is useful, e.g., for testing the electronic device from outside.

**[0014]** In one embodiment of the invention, the electronic circuitry comprises rigid or flexible printed circuit board. Moreover, the second and third connector elements can be edge-mountable connector elements (socket connectors or headers) or can be attached in a different way to the printed circuit board.

**[0015]** In order to reduce the overall size of the shell, the housing should be similar in size to the printed circuit board. Close tolerances between the interior surface of the shell and the printed circuit board may make it difficult to thread the cable through the opening in the housing. In order to provide the necessary space for positioning the cable within the shell while keeping to a minimum the height of the housing, the printed circuit board, in accordance with another embodiment of the invention, can be provided with a cutout portion adjacent to the opening in the housing. The cable connector shell for a multiple wire cable according to a second aspect of the invention comprises

- a housing having a at least one opening for passing therethrough at least one multiple wire cable,
- a printed circuit board within the housing, the printed circuit board being provided, along an edge, with

contact pads for electrical connection to the wires of the cable, and

- wherein the at least one opening of the housing is located near the edge of the printed circuit board.

**[0016]** The second aspect of the invention may be used together with the features of the first aspect of the invention providing removal of the electronic circuitry or without those features.

**[0017]** When the second connector element is attached along an edge of the printed circuit board, the cutout portion in the circuit board should be adjacent the second connector element.

**[0018]** Moreover, in order to reduce the overall length of the cable connector shell, it is useful to employ connector elements having multiple rows of contact pins, for example, four rows of contact pins.

**[0019]** In a further embodiment of the present invention, the at least one opening in the housing is positioned in a plane that is perpendicular to the length direction of the connector element(s) arranged in the housing. Accordingly, the multiple wire cable can exit the housing substantially at a 90° angle with respect to the side wall of the housing.

**[0020]** The design of the cable connector shell of the present invention permits a lot of contact pins per connector element, for example, up to 128 or more per connector element. This is particularly true for the third connector element.

**[0021]** The contact elements of the third connector element of the shell, and the contact elements of the mating connector element of the electronic device, should be carefully aligned when engaging or disengaging the connector elements. Relatively small movements between the male and female contact elements can cause damage resulting in malfunctions. Therefore, the housing of the cable connector shell can be provided with guiding elements that help align the contact elements of the electronic device with those of the third connector element prior to the engagement.

**[0022]** Moreover, due to the limited space available in the racks for mounting cable connector shells, cable connector shells are generally arranged side-by-side. In order to easily grip a cable connector shell after it is mounted in the rack, the housing of the shell may be further provided with at least one handle element. One embodiment of such a handle element is configured as a flange laterally projecting from the surface of the housing pointing outwardly from the rack.

**[0023]** The cable connector shell according to the invention can accommodate connection of multiple twisted pair wire cables. Such cables are typically provided with a common shield which is placed in electrical connection to a portion of the housing to provide grounding.

**[0024]** For shielding purposes, the housing preferably comprises an electrically conductive material for providing a Faraday-cage effect.

**[0025]** In the field of telecommunications different

countries have different standards for how systems are cabled, and for the characteristics of the signals (e.g. unbalanced or balanced) transmitted via the cables. For example, unbalanced signals are generally transmitted via coaxial cables while balanced signals are generally transmitted via twisted pair cables. Signals coming from the various electronic devices in the systems may vary depending upon the application. Accordingly, it is sometimes necessary to transform a signal from an electronic device, like the aforementioned electronic card, before the signal is transmitted to a cable.

**[0026]** One way to transform a balanced signals to an unbalanced signal and vice versa is to use an electronic module called a balun (balanced/unbalanced). It converts the impedance of a signals and attenuates the signal voltage.

**[0027]** When signal transformation between a cable and an electronic device is necessary in a system, the telecommunications equipment manufacturer must add baluns to their system. The baluns is usually added to the electronic device (e.g., by adding a printed circuit board with baluns). However, that means the telecommunication equipment manufacturers have to provide different electronic equipment (with and without baluns) in their systems which can be disadvantageous.

**[0028]** Accordingly, instead of having different electronic cards, it would be better to provide for different multi-wire cable connector shells, wherein the one type of shell includes baluns while the other does not. However, the overall height and size of the connector shell is a major concern, because rack space is limited. Inclusion of baluns in the connector shell can be accomplished by the invention in that the electronic circuitry within the housing of the cable connector shell can comprise a balun.

#### Brief Description of the Drawing

**[0029]** In the following a preferred embodiment of the invention will be described referring to the drawing in which

- Fig. 1 is an isometric view of the cable connector shell,
- Fig. 2 is a view into the interior of the shell when open,
- Fig. 3 is a side view of the cable connector shell in the direction of arrow III of Fig. 2,
- Fig. 4 is an exploded representation showing the individual elements of the cable connector shell according to Figs. 1 and 2 when disassembled,
- Fig. 5 is representing the situation in which the cable connector shell is already aligned with the electronic device but without the connector el-

ements engaged,

Fig. 6 is a different view into the interior of an other embodiment of a cable shell connector comprising alternative features for the first connector and the third connector element, and

Fig. 7 is an exploded presentation similar to that of Fig. 3 showing the individual elements of the cable connector shell according to Fig. 6 when disassembled.

#### Detailed Description of a Preferred Embodiment

**[0030]** According to Fig. 1 a multiple cable connector shell 10 comprises a box-like housing 12 having major side walls 14 and 16 (see also Fig. 3) and lateral side walls 18, 20, 22, and 24. These side walls can be made of metal to provide a shielding effect (e.g., Faraday-cage). Other materials known in the art can be used for the housing 12 and provide shielding too, for example, synthetic materials with a metal layer or coating. The shape of the housing need not necessarily be box-like. Other shapes of the housing are possible, for example, a shape similar to the connector shown in EP 0 952 637 B1.

**[0031]** Access to the inside of the housing 12 of the cable connector shell 10 can be provided by removing, for example, the major side wall 14 (referred to hereinbelow also as cover 14), but other configurations permitting opening are acceptable. For example, one or more lateral side walls can be removed to provide access to the inside of the housing. Alternatively, the housing 12 can be comprised of two substantially identical housing halves which are attached together so they can be opened and reclosed, for example by a hinge and a latch, by pins, screws, etc.

**[0032]** Within the housing 12 is arranged an electronic circuitry 26 comprising a printed circuit board 28 and electronic modules 30. The electronic modules 30 can be arranged on one side of the printed circuit board or on both thereof. In this particular embodiment, the electronic modules 30 function as baluns for transforming signal impedance and voltage attenuation. In particular, baluns are used for converting signals transmitted via twisted pair cables into signals transmitted via coaxial cables and vice versa. Any baluns known in the art is suitable for use in this invention.

**[0033]** As can be seen from Fig. 2, two multiple wire cables 32 comprising twisted pair cables 34 extend from outside into the housing 12 through an opening 36 of the housing 12 located in its lateral side 24. Instead of a single opening 36 for one or more multiple wire cables, it is also possible to provide separate openings each for one or several cables 32. The multiple wire cables 32 are provided with common shield layers 38 which are in electrical contact, e.g. at 39, with the housing 12 for shielding purposes. For the electrical contact between

the shield layer 38 and the housing 12 a clamp (not shown) or the like can be used.

**[0034]** The individual wires of the twisted pairs are connected to a first connector element 40 that is located within the housing. This first connector element, which may be a male or female connector element, is part of a first connector 42 that also comprises an engagable and disengageable mating second connector element 44. The mating second connector element 44 is attached to the printed circuit board 28 and, in this embodiment, it is an edge-mountable connector element. However, also other designs of the connector elements 40 and 44 are acceptable.

**[0035]** Attached to the printed circuit board 28 is a third connector element 46, which in this specific embodiment, is an edge-mountable connector element. Other designs are acceptable. This third connector element 46 has its contact interface is exposed through an opening 48 (see Fig. 4) in the lower side wall 18 of the housing 12. The third connector element 46 is engageable and disengageable with a mating connector element 50 of the electronic device or equipment 52 to which the multiple wire cable 32 is to be connected. In this embodiment, the electronic equipment 52 is an electronic card such as that used in the telecommunication field for central signal switching and signal distribution units.

**[0036]** An advantage of the design of the cable connector shell 10 according to Figs. 1 and 2 is that the printed circuit board 28, i.e. the electronic circuitry 26, can be removed or exchanged by opening the housing 12 and thereafter disconnecting the first connector 42 at 53 between its two connector elements the twisted pair cables 34 and the electronic circuitry 26. The printed circuit board 28 together with the attached second and third connector elements 44 and 46 are then replaced.

**[0037]** Fig. 4 shows an exploded view of the individual elements of the cable connector shell 10.

**[0038]** Another aspect of the present invention will be apparent from Figs. 2 to 4. Namely, in order to reduce the overall height of the cable connector shell 10, the housing 12 should be just big enough to encompass the printed circuit board 28 and electronic circuitry 26 together with the connectors and connector elements 42 to 46. It is useful in such situations to use four row (or more) connector elements, i.e., wherein the individual male and female contact elements are arranged in four rows. This helps reduces the length of the connector elements and, in particular, the length of the first connector 42 and its respective second connector element 44. That way the second connector element will not occupy the complete length of the upper edge of the printed circuit board 28 (see Fig. 2 and 4). Accordingly, it is possible to provide the printed circuit board 28 with a cutout section 56 located adjacent and close to the opening 36. From Fig. 3, one can see that the level of the upper edge 54 of the printed circuit board 28 is below or within the lower area of the opening 36 of the housing 12. That means that within the housing 12, and close to the open-

ing 36, there is additional available space for the wires 34 although the cables 32 are located rather close to the printed circuit board 28.

**[0039]** To manually grip the housing 12 to engage and disengage the connector shell from the electronic equipment 52, the upper side wall 22 and the vertical side wall 24 with the opening 36 are each provided with handle elements 58,60 configured as flange portions 62,64. The handle elements 58,60 laterally project from their respective side walls 12. Other handle elements known in the prior art of cable connector shells are also acceptable.

**[0040]** Finally, another aspect of the present invention will be described referring to Fig. 5. As already mentioned above, the connector elements of the cable connector shell 10 and the electronic equipment 52 can include a significant number of contact elements (up to 128 and more). Accordingly, the connector elements should be aligned with each other when engaging and disengaging them. Guidance is provided in the instant embodiment by means of cooperating guiding elements 66 and 68 attached to the cable connector shell 10 and the electronic equipment 52. The respective guiding elements 66,68 cooperate with each other. In this embodiment, each pair of guiding elements 66,68 comprises one guiding element 68 built as a pin and projecting from the electronic device 52 while the other guiding element 66 comprises a body having a bore 70 therein for slidably receiving the guiding element 68. When engaging the cable connector shell 10 with the electronic equipment 52, the housing 12 of the shell 10 is guided towards the electronic equipment 52 in that the guiding elements 68 are received by the guiding elements 66. Prior to the engagement of the connector elements of the cable connector shell 10 and the electronic equipment 52 the guiding elements 68 are already received by the bores 70 of the guiding element 66 to such an extent that any tilting or lateral relative movements of the shell 10 and the electronic equipment 52 can be substantially prevented. The housing 12 can be mechanically fixed to the electronic equipment 52 by any known suitable engageable and disengageable fastening means like thumb screws or other kinds of screws, bail mount, or the like.

**[0041]** Figs. 6 and 7 show another embodiment of a multiple wire cable connector shell 10' which except for two features is more or less identical to the shell 10 of Figs. 1 to 5. Both alternative features can be used separately from or in combination with each other.

**[0042]** The first alternative feature relates to the provision of the first connector 42' as a card-edge connector element 40' connected to the wires 34' and interacting with a mating connector element 44' comprising individual contact pads 45' on one or both sides of the printed circuit board 28' along its edge 54' (see Fig. 7). With the printed circuit board 28' by sliding the card-edge connector element 40' onto the edge 54' of the printed circuit board 28' contact elements 47' of the card-edge connector element 40' are in contact with the contact pads

45' of the printed circuit board 28'.

**[0043]** The other alternative feature of the embodiment of Figs. 6 and 7 relates to provision of an additional connector element 49' arranged between the third connector 46' and the printed circuit board 28'. The additional connector element 49' is an edge-mountable connector element electrically connected to the printed circuit board 28'. However, also other designs for the additional connector element 49' are acceptable. The third connector element 46' is fixed to the housing 12'. The third and additional connector elements 46', 49' are engageable and disengageable. Accordingly, when removing the electronic circuitry 26' from the housing 12', the additional connector element 49' is disengaged from the third connector element 46' which remains in the housing 12.

**[0044]** Alternatively, the third connector element 46' of the embodiment of the multiple wire cable connector shell 10 according to Figs. 1 to 5 or the additional connector element 49' of the embodiment according to Figs. 6 and 7 can be provided as a card-edge connector element similar to the card-edge connector element 40' of the multiple wire cable connector shell 10' of Figs. 6 and 7.

## Claims

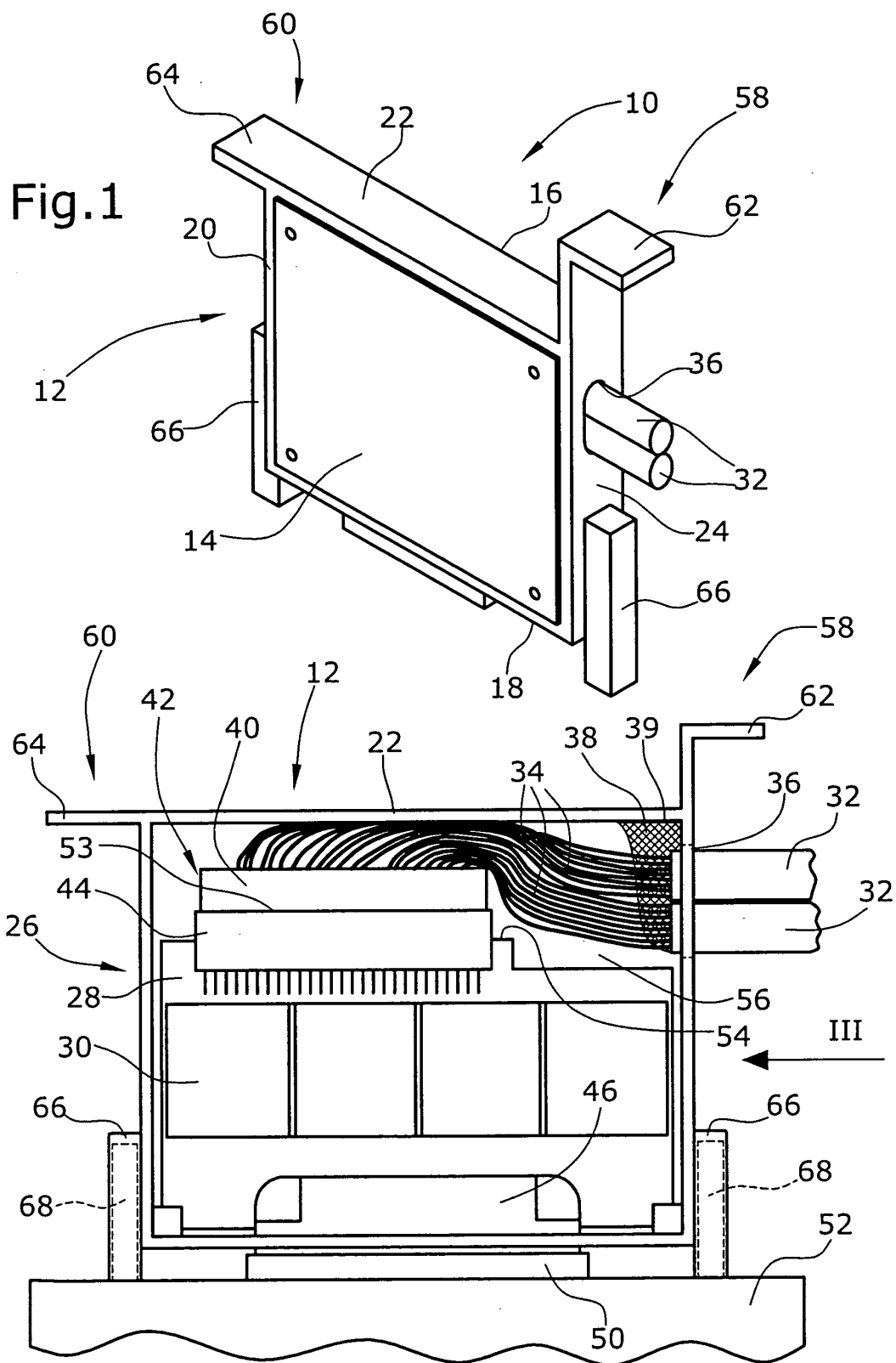
1. Cable connector shell for a multiple wire cable comprising
  - a housing (12) having at least one opening (36) for passing therethrough at least one multiple wire cable (32),
  - an electronic circuitry (26) within said housing (12),
  - a first connector (42) arranged within said housing (12) said first connector (42) comprising at least one first connector element (40) to be electrically connected to the individual wires (34) of the multiple wire cable (32), and an engageable and disengageable mating second connector element (44) electrically connected to said electronic circuitry (26), and
  - a third connector element (46) electrically connected to said electronic circuitry (26) said third connector element (46) being engageable with a mating connector element (50) of an electrical device (52) to be electrically connected to the multiple wire cable (32).
2. Cable connector shell according to claim 1, wherein the electronic circuitry (26) comprises a printed circuit board (28).
3. Cable connector shell according to claim 2, wherein said third connector element (46) is attached to said printed circuit board (28) and is exposed through an opening (48) of said housing (12).
4. Cable connector shell according to claim 2 or 3, wherein said second connector element (44) of said first connector (40) is attached along an edge (54) of said printed circuit board (28) said opening (36) of said housing (12) being arranged substantially in the direction of said edge (54) of said printed circuit board (28).
5. Cable connector shield according to claim 4, wherein said edge (54) of said printed circuit board (28) is provided with a cutout portion (56) adjacent to said opening (36) of said housing (12).
6. Cable connector shell according to any one of claims 1 to 5, wherein said second and third connector elements (44, 46) each comprises contact elements (47') both for electrical contact with a respective mating connector element (50) and said circuitry (26), said contact elements being arranged in at least two rows, in particular, in four rows, respectively.
7. Cable connector shell according to any one of claims 1 to 6, wherein said opening (36) of said housing (12) is in a plane perpendicular to the lengthwise direction of said connector elements (44, 46).
8. Cable connector shell according to any one of claims 1 to 7, wherein said housing (12) is provided with guiding elements (66) arranged adjacent to opposite ends of said third connector element (46), said guiding elements (66) for engaging with mating guiding elements (68) of the electronic device (52), and for aligning said third connector element (46) with the mating connector element (50) of the electronic device (52) prior to their engagement.
9. Cable connector shell according to any one of claims 1 to 8, wherein said housing (12) comprises at least one handle element (58, 60) for manually gripping said housing (12) for connecting and disconnecting said third connector element (46) with the mating connector element (50) of the electronic device (52).
10. Cable connector shell according to any one of claims 1 to 9, wherein the at least one handle element (58, 60) is formed as at least one flange portion (62, 64) of said housing (12) and laterally projects therefrom.
11. Cable connector shell according to any one of claims 1 to 10, wherein said housing (12) substantially has a box-like shape.

12. Cable connector shell according to any one of claims 1 to 11, wherein said electronic circuitry (26) comprises at least one balun (30) for converting unbalanced signals transmitted via the electronic device (52) into balanced signals to be transmitted through the multiple wire cable (32). 5
13. Cable connector shell according to any one of claims 1 to 12, wherein said housing (12) comprises an electrically conductive material for providing a Faraday-cage effect. 10
14. Cable connector shell according to any one of claims 1 to 13, wherein said housing (12) is provided with a contact portion (39) for contacting thereto a common shielding layer (38) of the multiple wire cable (32). 15
15. Cable connector shell according to any one of claims 1 to 14, wherein at least one multiple wire cable (32) is connected to said first connector element (40) of said first connector (42) and extends through said at least one opening (36) of said housing (12). 20
16. Cable connector shell according to any one of claims 1 to 15, further comprising an additional connector element (49') engageable and disengageable with said third connector element (46') said additional connector element (49') being electrically connected to said electronic circuitry (26'). 25 30
17. Cable connector shell according to any one of claims 1 to 16, wherein said first connector element comprises a card-edge connector element (40') and wherein said second connector element is integral with the electronic circuitry (26) and comprises contact pads (44') contactable by contact elements (47') of said card-edge connector element (40'). 35 40

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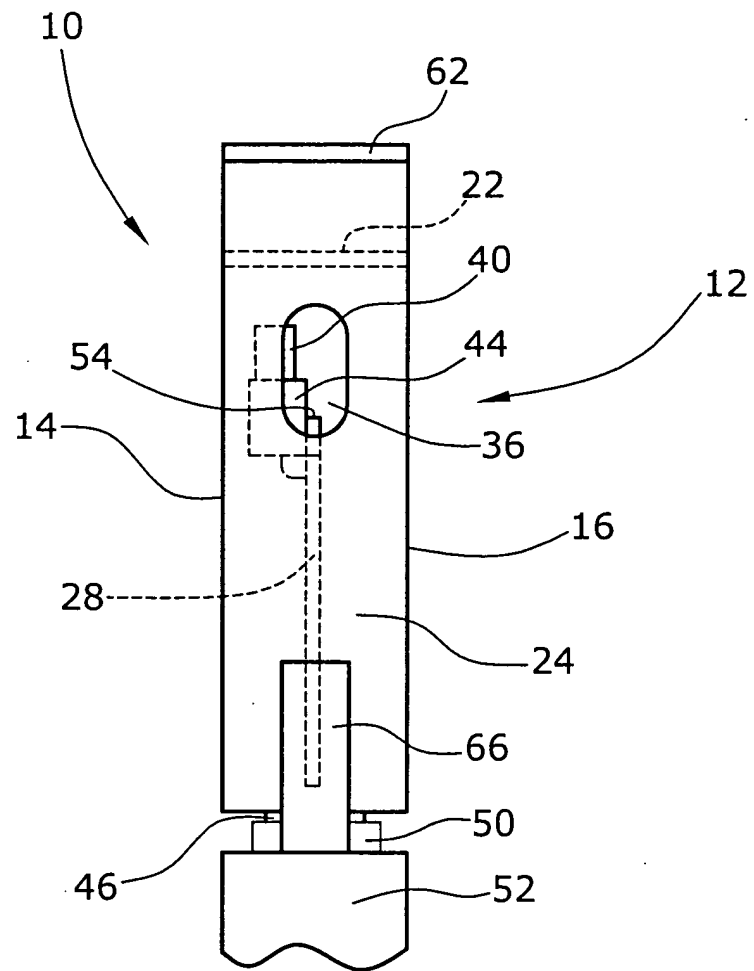
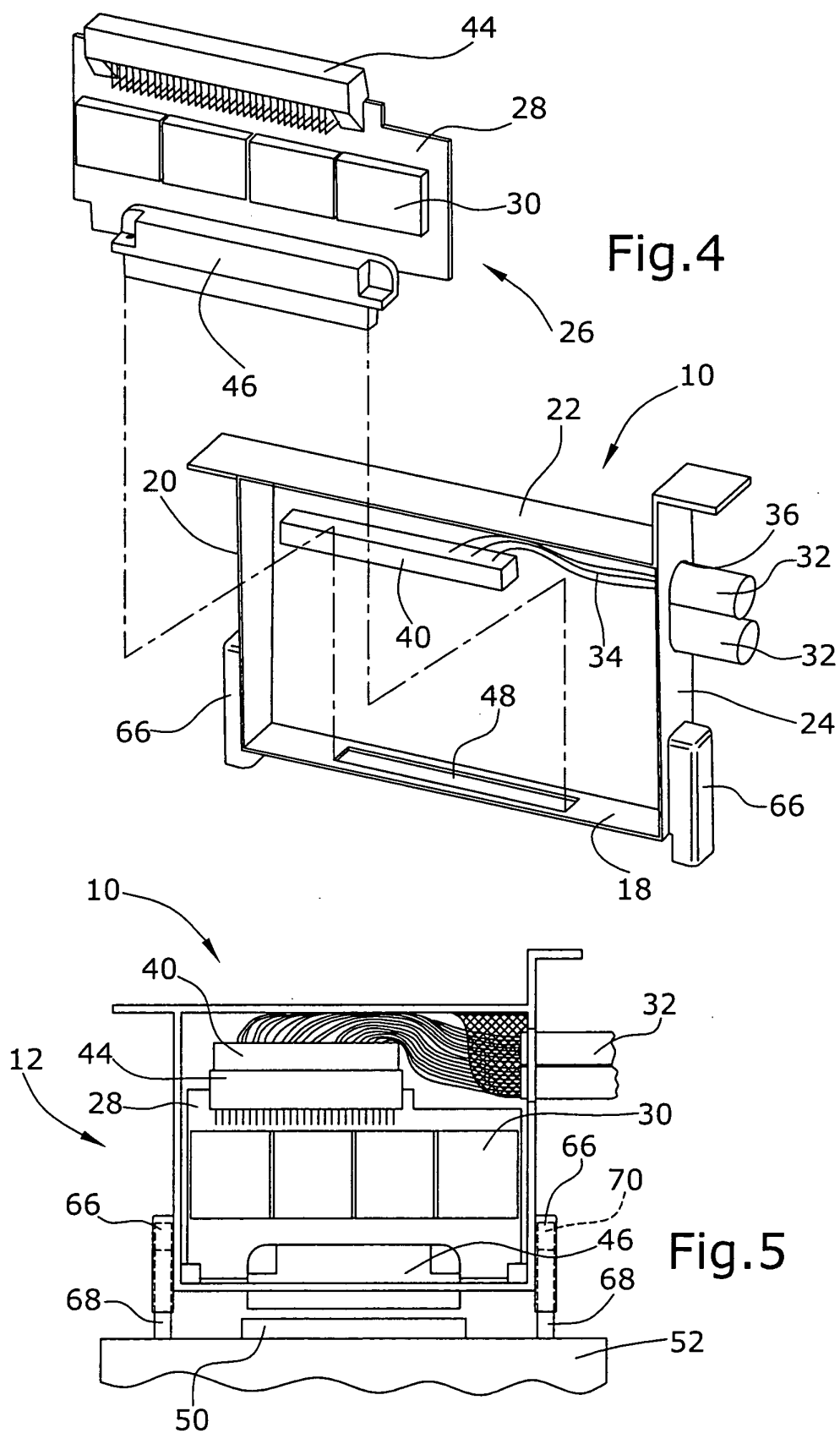
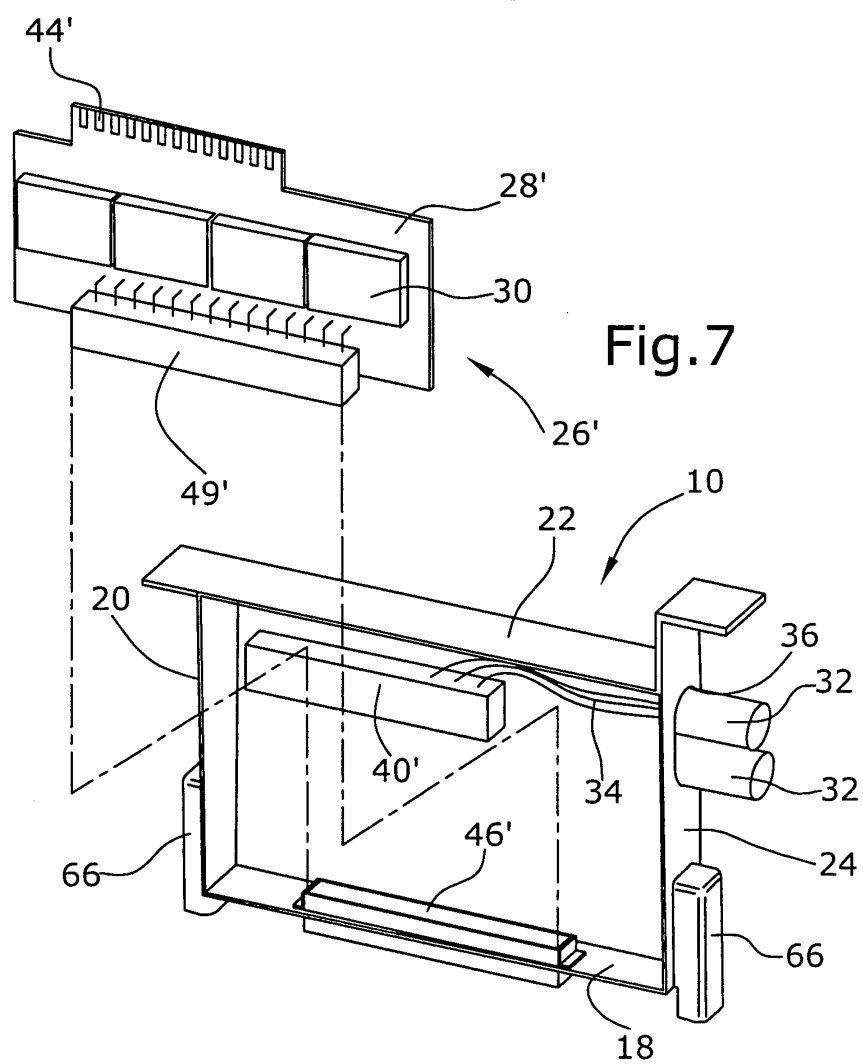
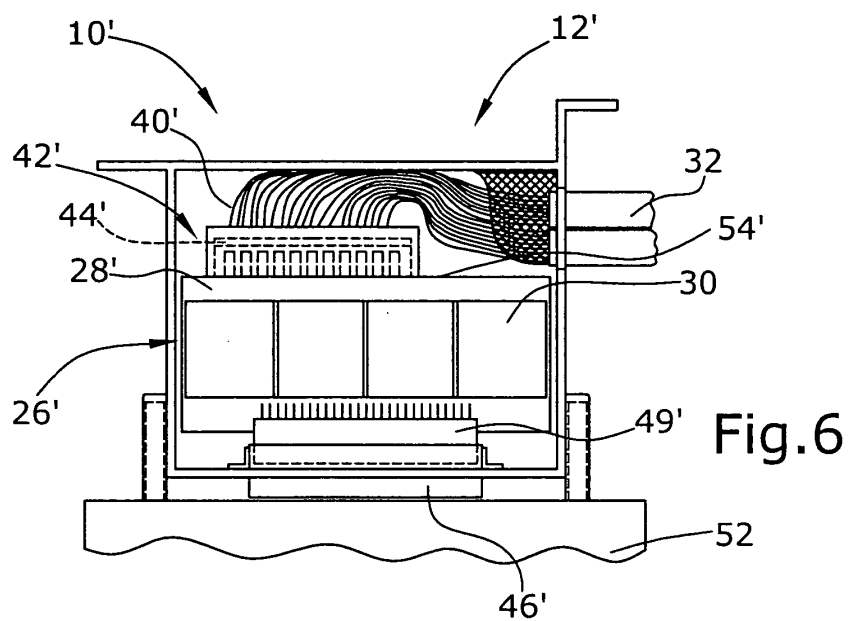


Fig.3







European Patent  
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# EUROPEAN SEARCH REPORT

Application Number  
EP 02 02 8340

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The present search report has been drawn up for all claims			
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>17 February 2003</b>	Examiner <b>Durand, F</b>
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			

EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
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