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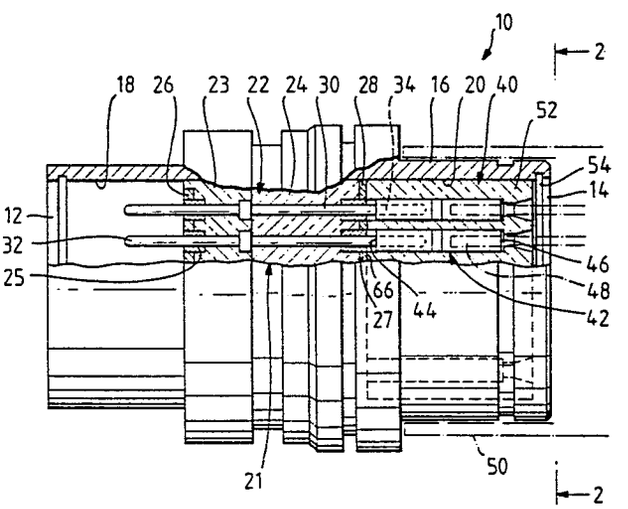
(71) Applicant: **International Standard Electric Corporation, 320 Park Avenue, New York New York 10022 (US)**

(72) Inventor: **Powell, Lloyd James, 300 Maple Street, Newmarket (CA)**

(74) Representative: **Vaufrouard, John Charles, ITT Patent Department UK Maidstone Road Foots Cray, Sidcup KentDA14 5HT (GB)**

(54) Connector with removable socket elements.

(57) A connector (10) which has socket contacts (40) at one end which can be removed for cleaning or replacement. The connector includes a shell (16) with a hollow end portion (20), an insulator or web (21) lying within the shell and having a face (28) facing the shell end portion, and a plurality of pin contacts (30) extending through the insulator or web and having ends projected into the shell end portion. A plurality of socket modules (42) each have inner and outer ends that can each receive a pin contact (30, 48). The inner ends of the modules are mounted on the projecting pin contacts (30), and the outer ends are free to receive pin contacts (48) of another connector (50).



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CONNECTOR WITH REMOVABLE SOCKET ELEMENTS

This invention relates to connectors in particular connectors with removable socket elements.

Some connectors are used in a hostile environment such as to make electrical connection deep within an oil well where there is considerable heat and dirt. In some cases, the contacts must be hermetically heat sealed to a ceramic glass, or glass ceramic insulator within the connector. The heat used during sealing may be so high that it destroys the spring temper of most spring materials that could be used in a socket contact that must receive and resiliently press against a pin contact. U.S. Patent 4,221,447, describes a socket contact assembly in which the spring can be installed after the rest of the socket contact has been hermetically sealed in the insulator. While this permits a spring to be used without damaging it by the heat used during heat sealing of the socket contact, it still results in the presence of a permanently installed socket contact portion. Such a socket contact portion with a deep hole for receiving a pin contact, is much more likely to be damaged during use than a simple pin contact which has no recesses. Also, the deep recess of a socket contact portion can be difficult to clean in the field. A connector with socket contacts, for use in a hostile environment, which facilitated replacement and cleaning of the entire socket element would be

of considerable value.

According to one aspect of the present invention there is provided a connector comprising a shell with a hollow end portion and an end; an insulator lying within said shell and having a first face lying closest to said shell hollow end portion; a plurality of elongated pin contacts fixed in place in said insulator, each pin contact having an end that projects from said insulator face and into said shell hollow end portion; a plurality of socket modules, each having first and second opposite ends each end forming a pin-receivable socket contact, the first end of each socket module receiving and contacting the end of a corresponding one of said plurality of pin contact, and the second end of each socket module facing away from the first end to receive in use of said connector a pin contact of another connector, both ends of each socket module lying substantially within said shell hollow end portion to form part of the connector; and retaining means fastened in said shell for retaining said socket modules securely in said shell hollow end portion so they are not pulled out therefrom in use of said connector.

According to another aspect of the present invention there is provided a connector comprising a largely cylindrical shell having hollow first and second opposite end portions; a plurality of parallel pin contacts extending between said end portions, said pin contacts arranged in a predetermined pattern as seen from an end of said shell; pin holding means fixing said pins in position in said shell and electrically isolating them from each other, each pin contact having an end extending into said hollow first end portion of said

shell; a plurality of socket modules, each having opposite ends forming pin-receiving holes, each module having means for connecting a pair of pins received in its opposite holes; and a retainer constructed of insulative material and formed to fit into said first end portion of said shell, said retainer having a plurality of through holes with inner and outer ends arranged in the same pattern as said pin contacts, each hole having a greater inside width than the outside of said socket modules to receive them therein from the inner end of the hole and along most of the hole length, but each retainer hole having a constriction near its outer end which prevents the passage of a socket module whilst allowing passing a pin contact of another connector; each socket module lying in a retainer hole, said retainer lying in said first end portion of said shell, and each socket module receiving an end of one of said pin contacts.

According to a further aspect of the present invention there is provided a socket module apparatus comprising a body extending along a predetermined axis, said body having a middle, and said body having a pair of opposite end portions of arcuate shape and extending by less than a circle around said axis, said body middle having a pair of intermediate surface portions each having a largely cylindrical outside surface; a pair of largely cylindrical hollow hoods, each having an inner end surrounding one of said intermediate surface portions of said body, and each hood having an outer end of reduced inside diameter and lying beyond the end of a body end portion; and a pair of springs, each spring having a first side trapped between a respective one of said arcuate end portions and the

respective hood, and each spring having a second side spaced from and lying largely opposite said arcuate end portion and serving in use to press a pin contact against the arcuate end portion, said reduced inside diameter end of each hood being small enough to prevent passage of a corresponding spring but large enough to pass the pin contact in use of the socket module .

In accordance with one embodiment of the present invention, a connector with socket contacts is provided, for use in a hostile environment, which facilitates removal of the socket contacts for replacement or cleaning. The connector includes a housing forming a shell, an insulator or web lying within the shell, and a group of pin contacts fixed in the insulator and having ends projecting from a face of the insulator. A group of socket modules is provided which each have inner and outer ends that can each receive a pin contact. In the use of the connector to provide socket contacts thereat, the socket modules are installed with their inner ends receiving the pin contacts, a retainer being used to hold the socket modules in place. Another connector with pin contacts can be mated by projecting the pin contacts of the other connector into the outer ends of the socket modules.

Each socket module can include a body with a largely circular middle portion and with arcuate end portions. A hood covers each end portion. A spring lying between the hood and the arcuate end portion of the body presses a pin contact that projects through an end of the hood, against the inside surface of the arcuate end portion of the body.

An embodiment of the invention will now be

described with reference to the accompanying drawings, in which:

Figure 1 is a partially sectional side elevation view of a connector constructed in accordance with an embodiment of the present invention;

Figure 2 is a view taken on the line 2-2 of Figure 1;

Figure 3 is a partial sectional view of a portion of the connector of Figure 1, showing a socket module installed in a retainer;

Figure 4 is a sectional view of the socket module of Figure 3;

Figure 5 is a view taken on the line 5-5 of Figure 4, and

Figure 6 is an exploded perspective view of a portion of the socket module of Figure 4.

Figure 1 illustrates a connector 10 which is designed for use in hostile environments where the connector might be subjected to dirt and corrosive materials. The connector includes a first or male end 12 which is designed to mate with a female connector or "push-on" socket contact or the like, and a second female end 14 designed to mate with a male connector. The connector includes a housing which forms a shell 16 with hollow end portions 18, 20. A pin holding assembly 21 includes an insulator or web 22, which is here shown composed of two insulator plates 23, 24, and is fixed in position within the shell. The holding assembly also includes metal end plates 25, 27 and has opposite faces 26, 28 that respectively face the first and second ends 12, 14 of the connector. The insulator 22 may be replaced by a solid web integral with shell 16 and which contains or fixes in

position pin contacts 30, by individual insulated glass or glass ceramic sealing beads. A group of elongated pin contacts 30 are fixed in place in the insulator or web 22, and each pin contact has a pair of opposite ends 32, 34 that project from opposite faces of the insulator or web into the hollow end portions 18, 20 of the shell.

The portion of the connector which includes just the shell, insulator, and pin contacts, is very rugged and easy to keep clean. Unlike socket contacts which require a deep hole for receiving a pin contact and means for resiliently pressing against the pin contact, a pin contact is a simple projecting rod that does not have to have a spring temper. The pin contacts can be heat sealed in the insulator, at temperatures high enough to melt a glass or other similar sealant, where the temperature would destroy the spring temper of suitable socket contacts. Experience with contacts in hostile environments show that socket contacts are damaged several times more often than pin contacts.

In accordance with the present invention, a socket assembly 40 is installed in one hollow end portion 20 of the shell to form a group of socket contacts therein. The socket assembly includes a plurality of socket modules 42 that each have an inner end 44 that receives the projecting end 34 of a pin contact, and an opposite outer end 46 that can receive the projecting end 48 of a pin contact of a mating connector 50. Both ends 44, 46 of each socket module lie within the hollow end portion 20 of the connector shell so that all portions of the socket modules are encircled and protected by the shell to form a rugged connector with a socket end.

The socket assembly 40 includes a retainer 52 (retainer insulator) that fits at least partially into the hollow shell end 20 to hold the socket modules 42 in place. The retainer 52 is itself releaseably held to the shell by a snap ring 54. The socket assembly with its socket modules, is installed after the pin contacts 30 have been heat sealed in place, and the socket assembly and its modules can be easily removed and replaced.

As shown in Figure 3, the retainer 52 includes a first or inner face or end 56 which faces the face 28 of the insulator and an opposite second or outer face or end 58. The retainer has a plurality of through holes 60 that extends between its ends. Each hole includes a major portion 62 having a diameter H which is larger than the diameter S of a socket module 42 to receive the socket module therein. The hole diameter H is at least 3% greater than the module diameter S, to permit the socket modules to shift position and/or tilt to accommodate the pin contacts without requiring high precision in hole spacing and diameter. However, the hole diameter H should not be more than about 20% greater than S, or else they will not position the socket modules to receive the pin contacts when the retainer is pushed into the shell.

Each hole 60 includes a constricted portion 64 near the outer end 58 of the retainer that is of smaller diameter than the socket module to prevent its passage therethrough. However, the constricted portion 64 is of a grat enough diameter to pass the end of a pin contact that is to be mated to the outer end 46 of the socket module. The major portion 62 of the through hole is made longer than

the lengths of the socket modules, to fully receive them. This allows the inner end 56 of the retainer to be pressed directly against an abutting surface 66 (Figure 1) at the second end of the connector and from which the ends of the pin contacts project. By making the length of the major portion 62 of the retainer hole somewhat greater than the length of the socket module, the socket module can slide outwardly, in the direction of arrow R, every time a mating connector contact is withdrawn from the outer end 46 of the socket module. This results in the socket module sliding and therefore wiping, against the pin contact end 34 of the connector 10. Also, this facilitates removal of the retainer 52 after the snap ring is removed. The major portion 62 of the through hole is also made long enough to allow the inner end 44 of each socket module to lie a distance from a surface 66 of the connector.

Figure 4 illustrates details of a socket module 42. The socket module includes a body 70 extending along an axis 72 of the module. The body has a middle 74 and a pair of opposite end portions 76, 78. Each end portion is of arcuate shape but extends (in cross-section) by less than a full circle about the body axis 72. Each end portion has an inside surface 80 (Figure 5) that is substantially cylindrical, to closely match the outside curvature of a pin contact 82 and 30. The arcuate end portions 76, 78 form socket contacts that can receive and engage a pin contact in wiping contact. A napkin spring 84 is installed at the body end portion, with one side 86 lying under the arcuate end portion, and with the other side forming a pair of free arms 88, 90 (Figure 5) that press the pin contact 82 against the inside surface 80 of the

body end portion.

A hood 92 has an inner end 94 surrounding and attached to the middle 74 of the body, and an outer end 96 lying beyond the end portion 78 of the body. The outer end portion 96 of the hood is constricted, so it can pass a pin contact 82, but prevents the loss of the spring 84. In this socket module, the middle 74 of the body includes a greatest diameter part 100 and two slightly reduced diameter intermediate portions 102, 104 that form ledges 106 against which the inner ends of the hoods abut to limit the insertion distance of the hoods. Each hood is in interference fit with an intermediate portion 102 or 104. However, in this embodiment of the invention, the hoods can be removed, when necessary, in order to replace a napkin spring 84, because they are free of welding to the intermediate body portion. Each end portion such as 78 is of a smaller outside radius (as measured from the axis 72) than each intermediate portion 102, 104, to provide a gap 110 in which the lower side 86 of the spring can lie. The greatest diameter middle part 100 has a length dependent on how far apart are the ends of the two pin contacts that are to be interconnected, and can have a length ranging from zero up to any produceable length.

The body 70 forms an abutting surface 112, which can be engaged by the tip 30T of a pin contact of the connector whose hollow end portion receives the socket assembly. The distance D between the abutting surface 112 and the inner end 44 of the socket module, is less than the length P of the projecting portion of the pin contact 30. This assures that the module ends 44 do not contact the abutting surface 66 of the metal plate 27.

Thus, the invention provides a connector for use in hostile environments, wherein only pin contacts are permanently fixed in place, and yet the connector has a socket end portion. This is accomplished by the use of socket modules that lie at least partially within an end of the connector shell and which have one end for receiving a pin contact of the connector and an opposite end for receiving a pin contact of another mating connector. A retainer holds a group of socket modules in place in the connector. Each socket module can include a body with arcuate opposite end portions, a spring having one side anchored behind the arcuate end portion and an opposite side which can press against a pin contact, and a hood which surrounds each end portion of the body. The socket modules can be easily removed for cleaning or replacement, and are not present during the heat sealing of the pin contacts in an insulator of the connector. It is possible for the socket module to be made so that it can be taken apart, as to replace a spring that has been damaged.

CLAIMS:

1. A connector (10), characterised by a shell (16) with a hollow end portion (20) and an end (18); an insulator (22) lying within said shell (16) and having a first face (28) lying closest to said shell hollow end portion (20); a plurality of elongated pin contacts (30) fixed in place in said insulator (22), each pin contact (30) having an end (34) that projects from said insulator face (28) and into said shell hollow end portion (20); a plurality of socket modules (42), each having first and second opposite ends (44, 46) each end forming a pin-receivable socket contact, the first end (44) of each socket module (42) receiving and contacting the end (34) of a corresponding one of said plurality of pin contacts (30), and the second end (46) of each socket module (42) facing away from the first end (44) to receive in use of said connector a pin contact (82) of another connector, both ends (44, 46) of each socket module (42) lying substantially within said shell hollow end portion (20) to form part of the connector (10); and retaining means (52) fastened in said shell (16) for retaining said socket modules (42) securely in said shell hollow end portion (20) so they are not pulled out therefrom in use of said connector (10).

2. A connector as claimed in claim 1, characterised in that said retaining means (52) is removably fastened in said hollow shell end portion (20) so it can be removed from the shell (16) to enable removal of said socket modules (42).

3. A connector as claimed in claim 1 or claim 2, characterised in that said retaining means (52) includes a retainer insulator (52) having an inner end (56) facing said first face (28) of said

insulator (22) and a second outer end (58), said retainer insulator (52) having a plurality of through holes (60) extending between its ends (56, 58), said through holes (60) being of greater diameter than said socket modules (42) at locations extending from said inner ends (56) of said through holes (60) and along most of their length to receive said socket modules (42), but said through holes being narrower than said socket modules near said outer ends (58) of said retainer insulator (52), whereby the socket modules (42) can be loaded in the retainer insulator holes and pressed all together onto the ends (34) of the pin contacts.

4. A connector as claimed in claim 1, characterised in that said retaining means (52) holds the second ends (46) of said socket modules (42) so they can move in lateral directions that are perpendicular to the lengths of the pin contacts (34) by at least about 3% of their outside width.

5. A connector as claimed in any one of the preceding claims, characterised in that each socket module (42) includes an elongated body (70) extending along a predetermined axis (72), said body (70) having a largely cylindrical middle (74) of a first outside radius, opposite intermediate largely cylindrical portions (102, 104) extending in opposite directions from the middle (74) and having a second outside radius that is less than said first radius, and opposite end portions (76, 78) extending from said intermediate portions (102, 104), each end portion (76, 78) having a smaller outside radius than said second radius and each end portion being of arcuate shape but extending by less than a full circle about said axis (72); a pair of springs (84), each extending outside a respective one of said end

portions (76, 78) and having at least one pin-engaging region (88, 90) lying on a side of said axis (72) that is generally opposite a body end portion (76, 78) to press a pin contact (72, 82) towards the inside surface (80) of the end portion (76, 78); and a pair of largely cylindrical hoods (92) surrounding said end portions (76, 78) of said body (70) and said springs (84), each hood (92) having an inner end (94) surrounding and in interference fit with the respective intermediate portion (102, 104) of the body (70) and an outer end (96) that is of reduced inside diameter to prevent the loss of the respective spring (84) therethrough.

6. A connector as claimed in any one of the preceding claims, characterised in that said shell end (18) comprises a respective shell hollow end portion, the connector (10) including a pin holding assembly (21) which includes said insulator (22) and a pair of metal end plates (25, 27) which each have a face (26, 28) that lies at a respective hollow end portion (18, 20) of the shell (16); and each socket module (42) has an internal abutting surface (112) that abuts a tip of the respective projecting pin contact end (30T), each pin contact end (30T) projects a distance P from a corresponding face (28) of the respective metal end plate, where P is greater than the distance D between the abutting surface (112) of the socket module (42) and the first end (44) of the socket module (42), whereby to maintain the first end (44) of the socket module away from the face (28) of the metal end plate (27).

7. A connector (10) characterised by a largely cylindrical shell (16) having hollow first and second opposite end portions (20, 18); a plurality of parallel pin contacts (30) extending

between said end portions (18, 20), said pin contacts (30) arranged in a predetermined pattern as seen from an end of said shell (16); pin holding means (22) fixing said pins (30) in position in said shell (16) and electrically isolating them from each other, each pin contact (30) having an end (32) extending into said hollow first end portion (20) of said shell (16); a plurality of socket modules (42), each having opposite ends (44, 46) forming pin-receiving holes, each module (42) having means for connecting a pair of pins (30, 82) received in its opposite holes; and a retainer (52) constructed of insulative material and formed to fit into said first end portion (20) of said shell, said retainer (52) having a plurality of through holes (60) with inner and outer ends (56, 58) arranged in the same pattern as said pin contacts (30), each hole (60) having a greater inside width than the outside of said socket modules (42) to receive them therein from the inner end (56) of the hole (60) and along most of the hole length, but each retainer hole having a constriction (64) near its outer end (58) which prevents the passage of a socket module (42) whilst allowing passing a pin contact (82) of another connector; each socket module (42) lying in a retainer hole (60), said retainer (52) lying in said first end portion (20) of said shell, and each socket module (42) receiving an end (34) of one of said pin contacts (30).

8. A connector as claimed in claim 7, characterised in that said retainer (52) lies substantially completely within said first shell end portion (20) and has substantially no protrusion therefrom.

9. A socket module apparatus (42), characterised by a body (70) extending along a predetermined axis (72), said body having a middle (74), and said body having a pair of opposite end portions (76, 78) of arcuate shape and extending by less than a circle around said axis (72), said body middle (74) having a pair of intermediate surface portions (102, 104) each having a largely cylindrical outside surface; a pair of largely cylindrical hollow hoods (92), each having an inner end surrounding one of said intermediate surface portions (102, 104) of said body (70), and each hood (92) having an outer end (96) of reduced inside diameter and lying beyond the end of a body end portion (76, 78); and a pair of springs (84), each spring (84) having a first side (86) trapped between a respective one of said arcuate end portions (76, 78) and the respective hood (92), and each spring (84) having a second side (88, 90) spaced from and lying largely opposite said arcuate end portion and serving in use to press a pin contact (30, 82) against the arcuate end portion (76, 78), said reduced inside diameter end (96) of each hood (92) being small enough to prevent passage of a corresponding spring (84) but large enough to pass the pin contact (30, 82) in use of the socket module.

10. A socket module apparatus as claimed in claim 9 in combination with a connector characterised by a shell (16) with a middle (22) and a hollow end portion (20), and a plurality of pin contacts (30) projecting from said middle (22) into said end portion (20); a retainer (52) which can fit into said hollow end portion (20), said retainer (20) having inner and outer opposite faces (56, 58) and having a plurality of elongated holes (60)

extending between said inner and outer faces (56, 58); a plurality of additional socket modules (42) which are substantially the same as the first mentioned socket module, each of said socket modules (42) being formed to receive a respective one of said pin contacts (30) at a first end of the body thereof; said holes in said retainer (60) being wide enough along most of their length, from said inner face (56) to a location spaced from said outer face (58), to receive said socket modules (42), but said holes being of reduced width (64) near said outer face (58) to prevent the passage of said socket modules (42); said socket modules (42) lying in said retainer holes (60), said retainer (52) lying in said hollow end portion (20) of said shell (16), and said pin contacts (30) lying in one end of each socket module (42).

11. A socket module apparatus as claimed in claim 9, characterised in that the inner end (94) of each hood (92) is in interference fit with the outside of a corresponding intermediate surface portion (102, 104), but is free of welding thereto, so the hood (92) can be removed to remove the corresponding spring.

12. A socket module apparatus as claimed in claim 9, characterised in that said body (70) has a greatest diameter portion (74) of greater diameter than said intermediate portion (102, 104) and lying between them, and the inner end (94) of each hood (92) substantially abuts (106) said greatest diameter portion (74), whereby to limit the insertion distance of the hood (92).

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Fig.1.

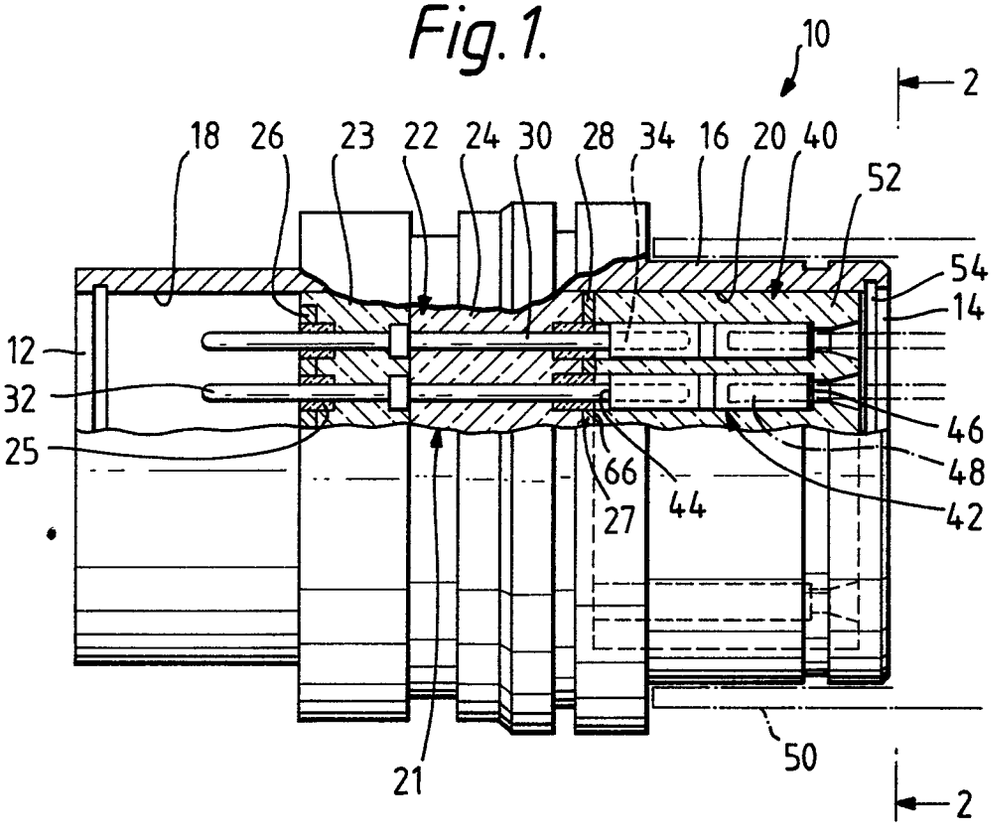


Fig.2.

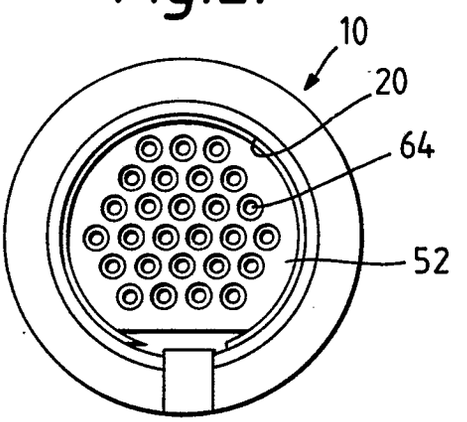


Fig.3.

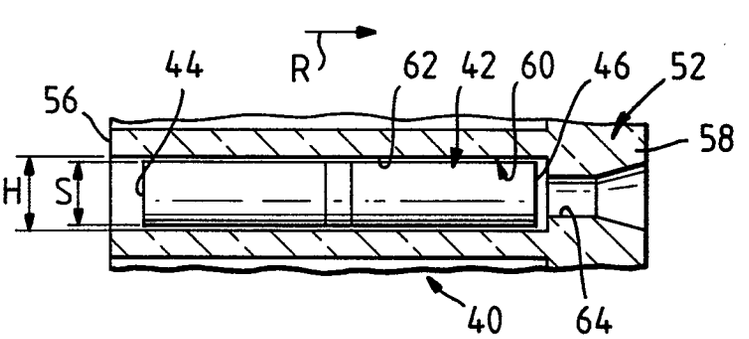


Fig.4.

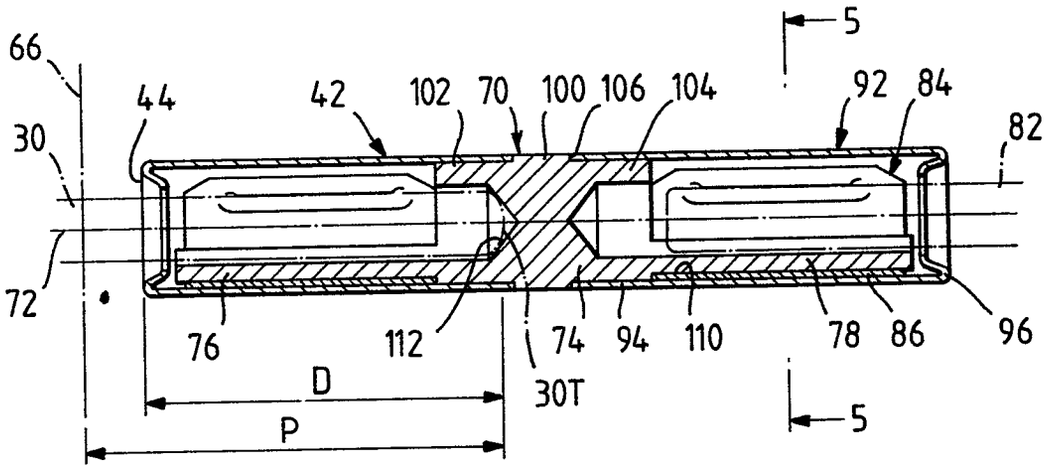


Fig.5.

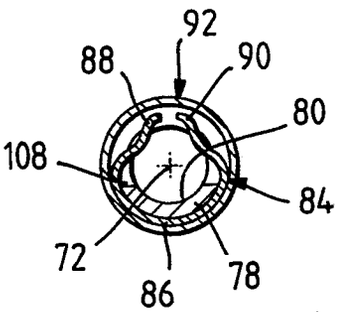
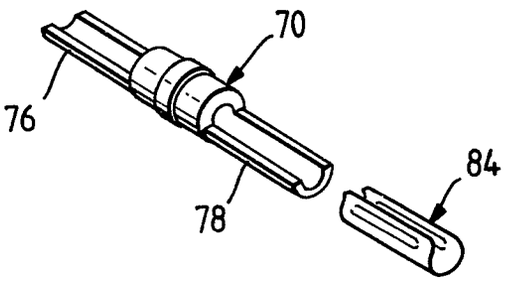


Fig.6.



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European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 86 30 4632

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	GB-A-2 023 357 (ITT) * page 3, lines 104-128; figure 7 *	9,11, 12	H 01 R 13/533 H 01 R 13/523
A	* page 3, lines 104-128; figure 7 * & US - A - 4 221 447 (Cat. D)	5	
A	GB-A-1 594 183 (STANDARD TELEPHONES AND CABLES) * page 1, lines 25-28; claim 1; figure 1 *	1,7	
A	FR-A-2 304 195 (SOURIAU) * claim 1; the figure *	1-3	
A	DE-A-2 637 727 (ITT) * page 9, lines 18-31; figure 1 *	1,7	TECHNICAL FIELDS SEARCHED (Int. Cl.4) H 01 R 13/00
A	DE-B-1 026 393 (VAUXHALL MOTORS) * column 3, lines 42-70; fgures 5-7 *	3,7	
A	DE-A-1 640 554 (INTERNATIONAL STANDARD ELECTRIC) * figure 3 *	5	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	18-09-1986	LEOUFFRE M.

CATEGORY OF CITED DOCUMENTS

X particularly relevant if taken alone
Y particularly relevant if combined with another document of the same category
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