

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
19 October 2006 (19.10.2006)

PCT

(10) International Publication Number
WO 2006/108445 A1

(51) International Patent Classification:

H01R 4/36 (2006.01) H01R 11/05 (2006.01)
H01R 4/18 (2006.01) H01R 11/07 (2006.01)

AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(21) International Application Number:

PCT/EP2005/005209

(22) International Filing Date: 14 April 2005 (14.04.2005)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant (for all designated States except US): FCI ELECTRIQUE FRANCE [FR/FR]; 8/12, rue Jacquard, Zone Industrielle La Madeleine, F-27000 Evreux (FR).

(72) Inventor; and

(75) Inventor/Applicant (for US only): COUVERT, Jean-Luc [FR/FR]; 87, chemin de l'Eglise, F-38690 Bevenais (FR).

(74) Agents: DOMENEGO, Bertrand et al.; Cabinet Lavoix, 2, place D'Estienne D'Orves, 75441 Paris Cedex 09 (FR).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:

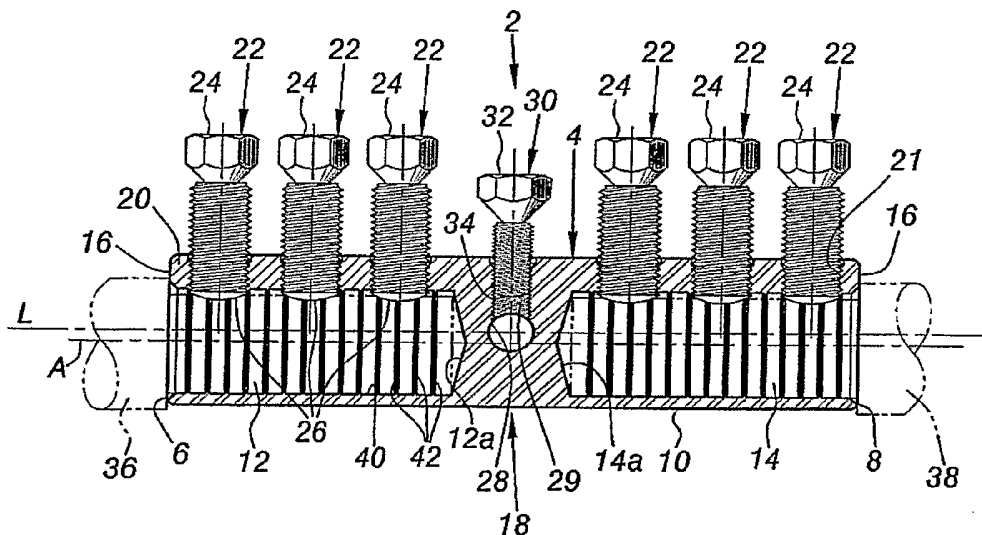
— of inventorship (Rule 4.17(iv))

Published:

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: CONNECTING DEVICE FOR ELECTRICALLY CONNECTING AT LEAST THREE ELECTRICAL CONDUCTORS, AND KIT COMPRISING SUCH DEVICES



(57) Abstract: The device comprises an electrically conductive elongated body (4) extending along longitudinal axis (L), said body (4) comprising: at least one first longitudinal hole (12) for accommodating an end portion of a first conductor (36), at least one second longitudinal hole (14) for accommodating an end portion of a second conductor, at least one third hole (28) for accommodating an end portion of a third conductor, the third hole (28) extending within the body (4) under a positive angle relative to the longitudinal axis (L), and means (22, 30) for holding the end portions of said conductors in position within the associated holes (28). Application to kits for repairing deficient sections in electricity delivery networks.

WO 2006/108445 A1

Connecting device for electrically connecting at least three electrical
conductors, and kit comprising such devices

The present invention relates to a connecting device for electrically
5 connecting at least three electrical conductors.

Such connecting devices are used for example to repair deficient
sections of conductors of an electricity delivery network. To this end, a
deficient section of a conductor is cut off and replaced by a new conductor the
ends of which are connected to the cut ends of the conductors of the network.

10 An object of the present invention is to provide a connecting and/or
repairing device that is compact and convenient in use.

This aim is at least partly achieved by a connecting device comprising
an electrically conductive elongated body extending along a longitudinal axis,
said body comprising:

15 - at least one first hole for accommodating an end portion of a first
conductor, said first hole extending longitudinally within the body from a first
longitudinal end of the body, and first means for holding an end portion of said
first conductor in position within the first hole;

20 - at least one second hole for accommodating an end portion of a
second conductor, said second hole extending longitudinally within the body
from a second longitudinal end of the body, opposite the first longitudinal end,
and second means for holding an end portion of said second conductor in
position within the second hole; and

25 - at least one third hole for accommodating an end portion of a third
conductor, the third hole extending within the body under a positive angle
relative to the longitudinal axis and opening on the outer surface of the body
between the longitudinal ends thereof, and third means for holding an portion
end of said third conductor in position within the third hole.

30 The connecting device of the invention may comprise one or several of
the features corresponding to claims 2-8.

The invention also relates to a kit comprising at least one set made of one conductor and two connecting devices as defined above, each connecting device having his first hole adapted to accommodate a respective end portion of the associated conductor. Beside, the end portions of the conductor of the set might be permanently held in position in the first holes of the connecting devices of the set. Advantageously, the end portions of the conductor of the set are crimped in the first holes of the connecting devices of the set.

The invention will be better understood from the following description, with a reference to the accompanying drawings representing, by way of non-limiting examples, embodiments of connecting devices according to the invention as well as a set including such connecting devices.

Figure 1 is a perspective view of a connecting device according to a first embodiment of the invention;

Figures 2 and 3 are cross sectional views of the connecting device of Figure 1 taken along plane II-II and plane III-III respectively ;

Figure 4 is plan view of a bundle of cables having one section repaired using a number of connecting devices as shown in Figure 1;

Figure 5 is a perspective view of a connecting device according to a second embodiment of the invention;

Figures 6 and 7 are cross-sectional views of the connecting device of Figure 4 taken along plane VI-VI and plane VII-VII respectively;

Figure 8 is a view similar to Figure 5, one end of a conductor being crimped in a hole of the connecting device; and

Figure 9 is a plan view of a permanently assembled set comprising one conductor having its ends crimped in the connecting device of Figure 5.

As shown in Figures 1-3, a connecting device 2 according to the invention comprises an electrically conductive elongated body 4 extending along a longitudinal axis L, said body 4 having opposed longitudinal ends 6, 8 and an outer cylindrical surface 10 extending between the first 6 and the second 8 longitudinal ends. The outer surface 10 of the body 4 is developable about the longitudinal axis L.

The body 4 comprises a first blind hole 12 extending longitudinally within the body 4 from the end 6, and a second blind hole 14 extending longitudinally within the body 4 from the other end 8.

The holes 12, 14 open on to respective end faces 16 of the body, said
5 end faces 16 being perpendicular to axis L.

The holes 12, 14 have approximately the same longitudinal length. The sum of the axial lengths of holes 12, 14 is less than the length of the body 4 between its ends 6, 8. Therefore, the holes 12, 14 do not pass through an intermediate central section 18 of the body 4.

10 The holes 12, 14 have a circular transverse cross-section. Furthermore, as best seen on Figure 3, the holes 12, 14 extend along the same axis A which is different but parallel to the longitudinal axis L. Hence, the thickness of the walls of the body 4 surrounding the holes 12, 14 is greater in the region 20
opposite to the axis A relative to the axis L.

15 In the region 20, the body 4 is provided, for each hole 12, 14, with a number of threaded bores 21, for example three, each bore opening on the outer surface 10 and in the hole 12, 14. Each bore extends radially relative to axis L. The device 2 comprises pressure screws 22, each screw 22 being received in a bore 21, and having a head 24 accessible from outside the body
20 4, and an opposite end 26 adapted to protrude in the hole 12, 14 when screwing the screw 22. In the embodiment as shown, all the bores 21 have parallel axes contained in a common plane containing the axes L and A.

As best seen on figure 2, in the intermediate region 18, the body 4 comprises a third hole 28 extending within the body 4 along an axis B. The
25 third hole 28 extends between the closed ends 12a, 14a of the first and second holes 12, 14.

Axis B makes a positive angle with axis L. The angle θ between axis B and axis L is preferably comprised between 20° and 90° , more preferably between 40° and 70° . θ is for example 60° . If θ is 90° , axis B is perpendicular
30 to axis L.

The third hole 28 opens at both ends on the outer surface 10 of the body 4 between the ends 6, 8 thereof.

The body 4 comprises a threaded bore 29 opening at one end on the outer surface 10 of the body 4, and at the other end into the third hole 28. The
5 axis of the bore 29 is perpendicular to the axis B.

The device 2 comprises a pressure screw 30 received in the bore 29, said screw 30 having an head 32 protruding outside the body 4, and an opposed end 34 adapted to protrude into the third hole 28 when the screw 30 is screwed in the bore 29.

10 The holes 12, 14 have the same diameter, which is greater than the diameter of the third hole 28.

In use, as illustrated in dash-dot lines on Figures 2 and 3, the device 2 is used to electrically connect two insulated electrical conductors 36, 38 forming part of an electricity delivery network (not shown).

15 A bared end portion of conductor 36 is introduced in the first hole 12 and held in position therein by clamping the corresponding screws 22, whereby the bared end is clamped between the end 26 of the screws 22 and the inner surface 40 of the first hole 12.

Similarly, a bared end portion of conductor 38 is introduced in the
20 second hole 14 and held in position therein by clamping by the corresponding screws 22.

Thus, the first and second conductors are electrically connected through the electrically conductive body 4.

To improve wedging of the conductors 36, 38 and electrical contact
25 between the body 4 and the conductors 36, 38, the inner surfaces 40 of the holes 12, 14 are provided with annular ribs 42.

The section and conductivity of the body 4 is selected to enable transmission of the nominal electrical current between conductors 36 and 38. The body 4 is for example made of aluminum or aluminum alloy so as exhibit
30 high electrical conductivity, whereby the transverse cross-section of body 4 can be kept small, yet enabling the passage of high electrical currents. The

body may be constituted of different metallic alloys. For instance, the metallic alloy of the first longitudinal end section is softer than the metallic alloy of the second longitudinal end section.

The connecting device 2 is adapted to electrically connect a third
5 insulated electrical conductor 44 to conductors 36 and 38. Conductor 44 is for example a service conductor for retrieving electricity from the network to a facility or a building. Conductor 44 is of smaller diameter than the conductors 36 and 38.

To this end, a bared end portion of service conductor 44 is introduced
10 in the third hole 28, and held in position therein by clamping the corresponding screw 30.

Thus, the service conductor 44 is electrically connected to the conductors 36 and 38.

As illustrated in Figure 2, the connecting device 2 optionally comprises
15 a small auxiliary blind threaded bore 55 extending within the body 4, and adapted to receive a screw for fixing a grounding conductor to the outer surface of the body 4, for example a metallic braid.

The threaded bore 55 extends, for example, within the body 4 adjacent
the third hole 28.

As illustrated in Figure 4, a number of devices 2 are used to repair a
20 deficient section of a bundle 46 of conductors of an electricity delivery network. The bundle 46 comprises for example three phase conductors 48 (only two of them being shown) and one neutral conductor 50 of smaller traverse cross-section.

25 The deficient section has been cut off and removed on a length D.

The deficient section is situated at the place of connecting of two
different service bundles 52 of conductors extending along the bundle 46 of the network. As a matter of fact, the deficiencies occur most of the time at such connection or branching places.

30 The removed section of each conductor 48, 50 of the bundle 46 is replaced by a set comprising an electrical replacement conductor 54 having a

length approximately equal to removed length D, and two connecting devices 2 as described above.

Each replacement conductor 54 has its end portions received and wedged in the first holes of the associated connecting devices 2.

5 The free end portions of the corresponding conductors 48, 50 of the bundle 46 left by the cut off of the deficient section are received and wedged in the second holes of said connecting devices 2.

Each connecting device 2 is wrapped into an insulating cover (not shown) so as to insulate the various connecting devices 2 from one another.

10 Then, the whole repaired section is embedded in a resin bloc (not shown), the resin bloc being wrapped into a conductive cover (not shown) forming an electrical grounding screen. The repaired section can be buried.

One of the connecting devices 2 connected to the neutral conductor 50 is electrically connected to the grounding screen by a metallic braid fixed to
15 the body 4 of said connecting device 2 via a screw passed through a lumen of the metallic braid and engaged in an auxiliary threaded hole 55 (figure 2) provided in said body 4.

Each connecting device is elongated in the longitudinal direction of the conductors received in the first and second holes. Therefore, the repaired
20 section is compact in transverse cross-section.

The end portions of the conductors of each service bundle 52 are received and wedged in the third holes of the associated connecting devices 2. Therefore, it is not necessary to provide separate derivation connecting devices. Thus, the repaired section at a branching place can be maintained
25 compact.

Furthermore, the inclined third hole 28 of each connecting device 2 enables to easily connect the service conductor into the connecting device 2 without bending the service conductor with too small a curvature radius. This reduces the chance of deficiency at the branching of the service conductor on
30 the network conductors.

A repair kit advantageously comprises a number of sets, each set comprising a length of replacement electrical conductor 54 and two associated connecting devices 2 adapted for receiving and wedging the end portions of the conductor 54 in their first holes.

5 Preferably, the replacement conductor 54 is less stiff in flexion than the conductor it is intended to replace. Thus, installation of the replacement conductor 54 is made easier, since the replacement conductor can easily be bent by the operator to adjust the position thereof.

 The embodiment of Figures 5-7 mainly differs from the embodiment of
10 Figures 1-4 in that the body 4 is deprived of bores and screws for clamping an electrical conductor in the first hole 12.

 As best seen on Figures 6 and 7, the body 4 is made of a first metallic elongated part 56 and a second metallic elongated part 58, said parts 56, 58 extending along the axis L. The parts 56, 58 are joined end to end, for
15 example by welding. The first part 56 has a smaller outer diameter than the second part 58, such that the body 4 comprises a revolution outer surface 10 having a shoulder 60.

 The first hole 12 extends in the first part 56, and the second hole 14 and third hole 28 extend in the second part 58.

20 Screws 22 and 30 are provided for wedging conductors in the second 14 and third 28 holes.

 The parts 56, 58 are made of different materials, for example of different aluminum alloys, the aluminum of the first part 56 being softer.

 The second part 58 is designed to withstand the clamping forces when
25 screwing the screws 22.

 The first part 56 is adapted to be plastically deformed to crimp a bared end portion of a conductor 36 introduced in the first hole, as illustrated on Figure 8, whereby the conductor is permanently wedged in the connecting device 2.

30 As illustrated in Figure 6, the body 4 optionally comprises an auxiliary blind threaded bore 61 for fixing a grounding conductor to the outer surface of

the body 4, said threaded bore 61 extending adjacent the third holes, preferably within the second part 58.

As illustrated in Figure 9, a repair kit advantageously comprises at least one set made of an electrical conductor 62, preferably insulated, having its bared end portions received and permanently wedged in the first holes of two
5 connecting devices 2 according to Figures 5-7.

Thus, repair operations can be simplified, since the operator no longer has to fix the connecting devices 2 on the replacement conductor 62.

Alternatively, the body 4 comprises several parallel first holes 12
10 extending longitudinally within the body 4 from end 6, and/or several parallel second holes extending longitudinally within the body 4 from end 8. Hence, the connecting device is usable at a network node having several bundles of network conductors extending therefrom.

Alternatively or optionally, the body 4 comprises several third holes 28
15 extending within the body 4 under a positive angle relative to the longitudinal axis L. The third holes 28 preferably extend between closed ends 12a, 14a of blind first 12 and second 14 holes. The third holes 28 extend under the same angle or different angles relative to the longitudinal axis L.

These alternatives can be combined together and with the embodiment
20 of figures 1 – 3 or the embodiment of figures 5 – 7.

CLAIMS

- 1.- A connecting device for electrically connecting at least three electrical conductors (36, 38), comprising an electrically conductive elongated
5 body (4) extending along a longitudinal axis (L), said body comprising:
- at least one first hole (12) for accommodating an end portion of a first conductor (36), said first hole (12) extending longitudinally within the body (4) from a first longitudinal end (6) of the body (4), and first means (22) for holding an end portion of said first conductor (36) in position within the first hole (12);
 - 10 - at least one second hole (14) for accommodating an end portion of a second conductor, said second hole (14) extending longitudinally within the body (4) from a second longitudinal end (8) of the body (4), opposite the first longitudinal end, and second means (22) for holding an end portion of said second conductor in position within the second hole (14); and
 - 15 - at least one third hole (28) for accommodating an end portion of a third conductor, the third hole (28) extending within the body (4) under a positive angle relative to the longitudinal axis (L) and opening on the outer surface (10) of the body (4) between the longitudinal end (6, 8) thereof, and third means (30) for holding an end portion of said third conductor in position
20 within the third hole (28).
- 2.- A connecting device according to claim 1, wherein the outer surface (10) of the body (4) is developable about the longitudinal axis (L).
- 25 3.- A connecting device according to claim 1 or 2, wherein said first, second, and/or third means comprise threaded bores opening in the or each said first, second and/or third hole (12, 14, 28), and corresponding screws (22, 30) adapted to protrude in the or each first, second and/or third holes (12, 14, 28) to hold in position an end portion of an electrical conductor introduced
30 therein.

4.- A connecting device according to any preceding claim, wherein the first and second holes (12, 14) are blind, and the third hole (28) extends within the body (4) between the closed ends (12_a, 14_a) of the first and second holes (12, 14).

5

5.- A connecting device according to any preceding claim, wherein said first and/or second means comprises a longitudinal end section (56) of the body having one (12) of the first and second holes (12, 14) extending therein, said longitudinal section being adapted to be deformed plastically to hold an end portion of an electrical conductor in position in said first or second hole (12, 14).

10

6.- A connecting device according to any preceding claim, wherein the body (4) has a first longitudinal end section (56) made of a metallic alloy, and a second longitudinal end section (58) made of another metallic alloy, the metallic alloy of the first longitudinal end section (56) being softer than the metallic alloy of the second longitudinal end section (58).

15

7.- A connecting device according to claim 6, wherein the first and second longitudinal end section (56) are joined end to end by welding.

20

8.- A connecting device according to any preceding claim, wherein the angle (θ) between an axis (B) of the third hole (28) and the longitudinal axis (L) is between 20° and 90°, preferably between 40° and 70°, more preferably about 60°.

25

9.- Kit comprising at least one set made of one conductor and two connecting devices (2) according to any preceding claim, each connecting device (2) having his first hole adapted to accommodate a respective end portion of the conductor.

30

10.- Kit according to claim 9, comprising at least one set having the end portions of the conductor permanently held in position in the first holes of the associated connecting devices (2) of the set.

- 5 11.- Kit according to claim 10, wherein the end portions of the conductor of the set are crimped in the first holes of the connecting devices (2) of the set.

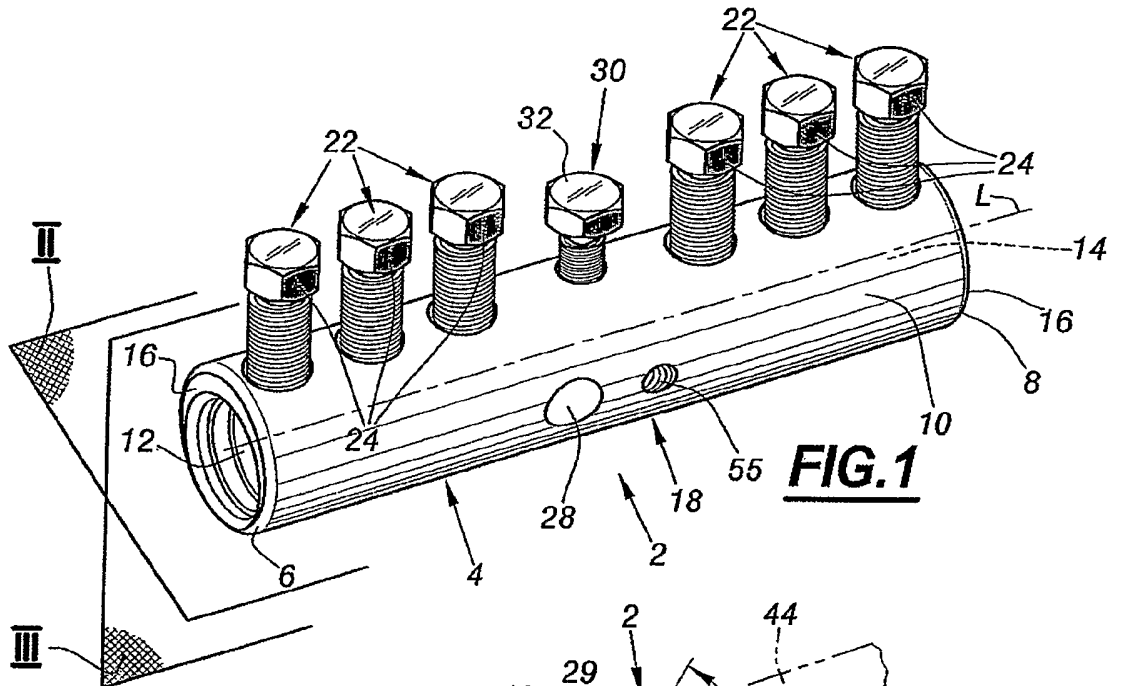


FIG. 1

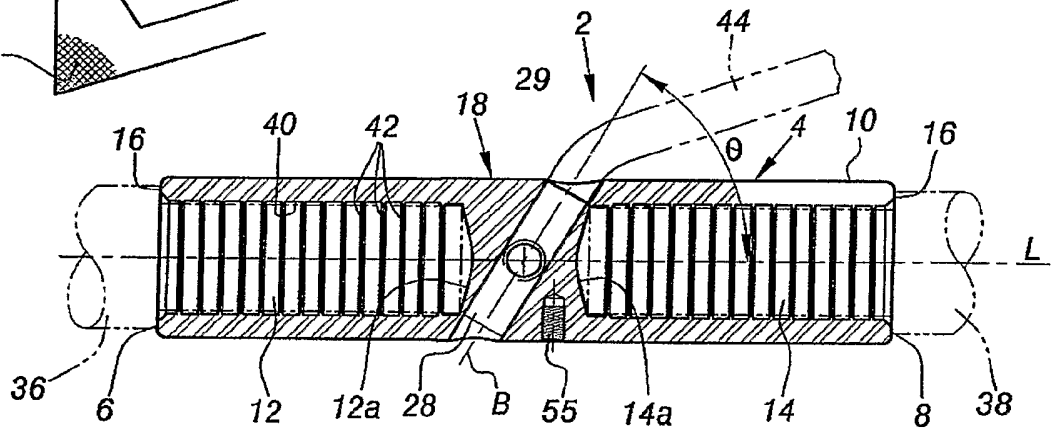


FIG. 2

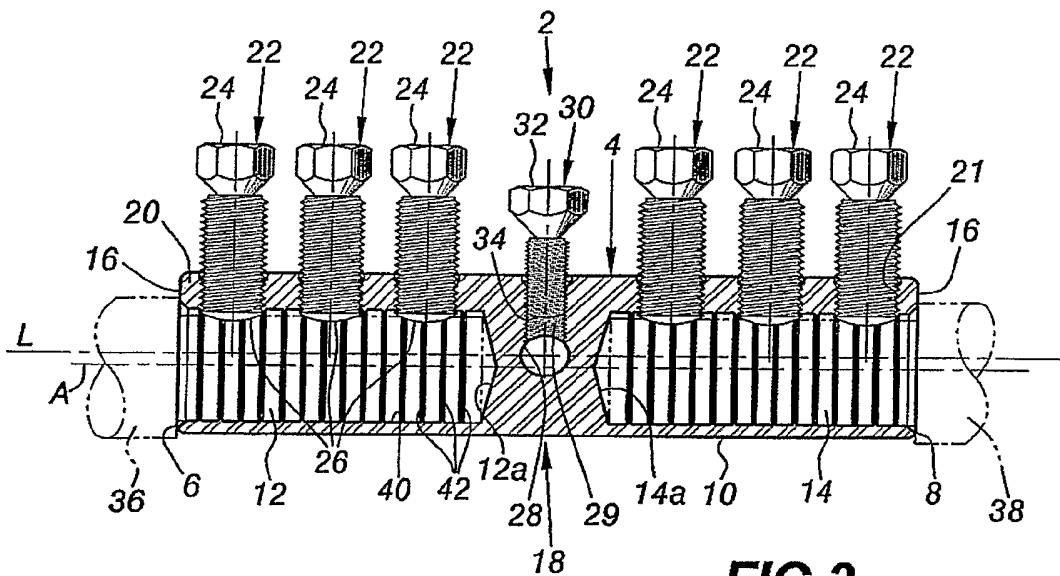


FIG. 3

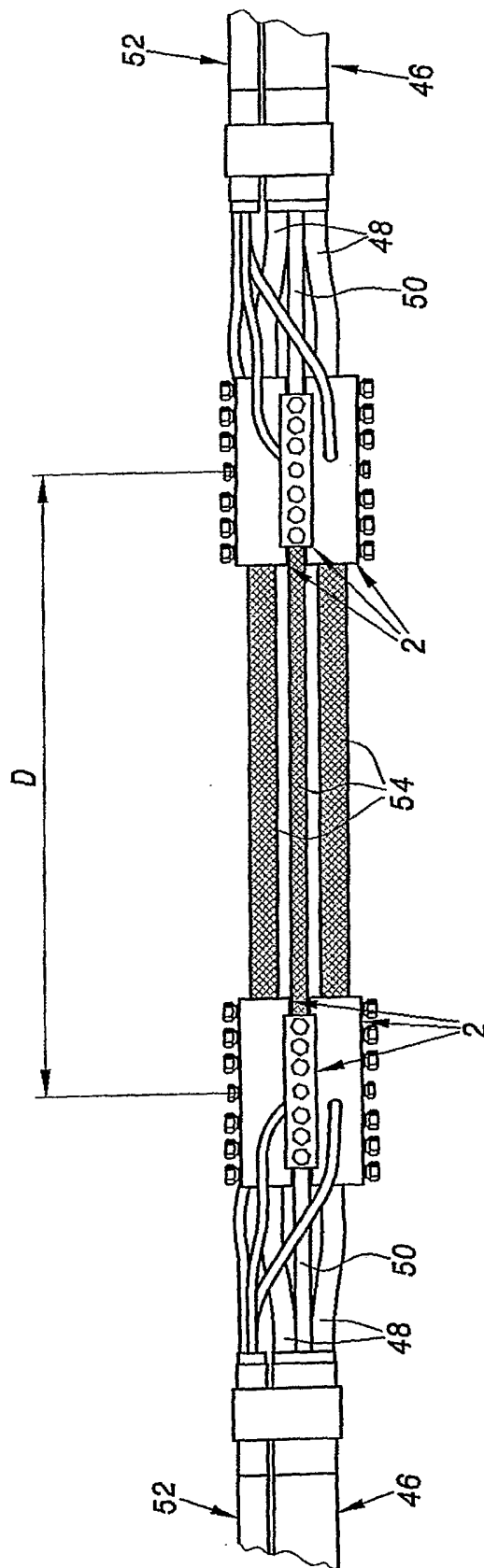
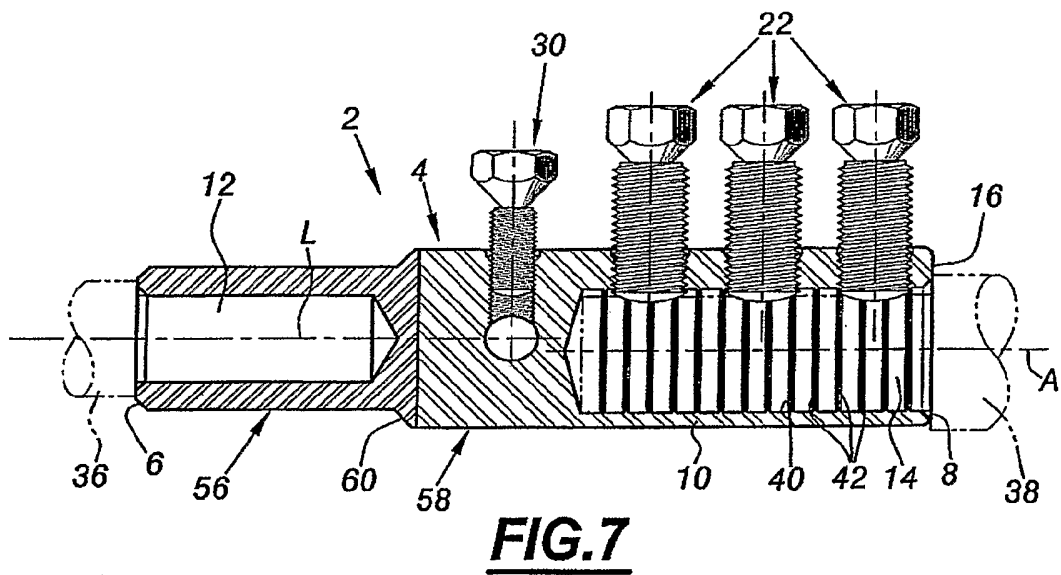
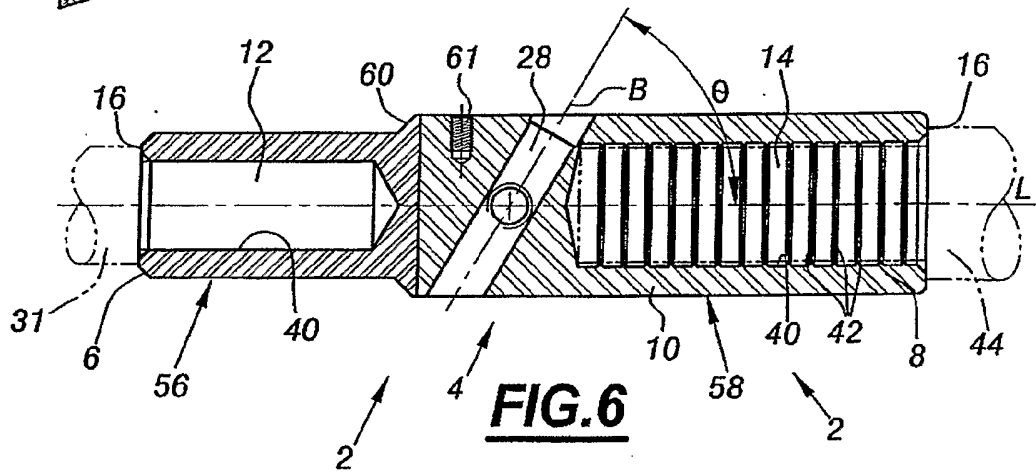
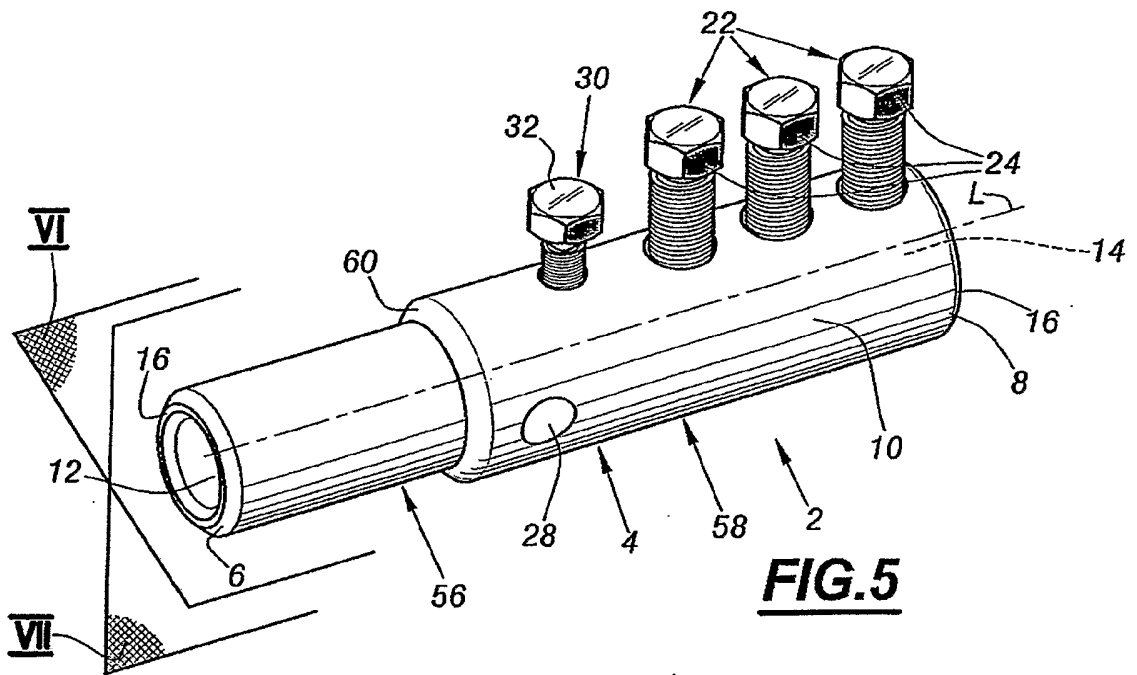


FIG.4



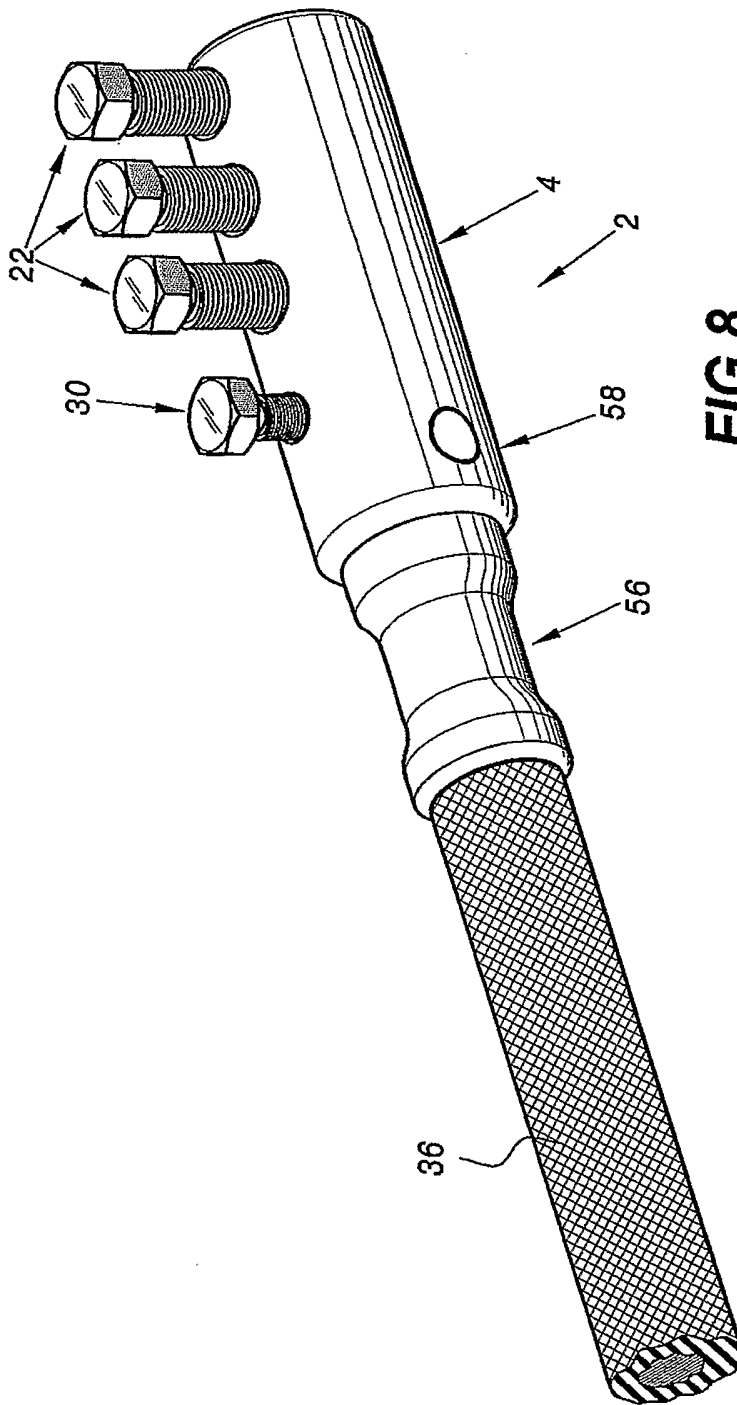


FIG. 8

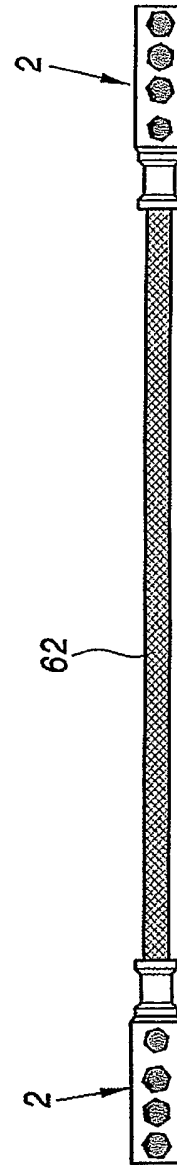


FIG. 9

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2005/005209

A. CLASSIFICATION OF SUBJECT MATTER
 H01R4/36 H01R4/18 H01R11/05 H01R11/07

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
 Minimum documentation searched (classification system followed by classification symbols)
 H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
 EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 368 162 B1 (REETZ KERRY L ET AL) 9 April 2002 (2002-04-09)	1-4, 8
Y	figures 1-7	9, 10
A	US 3 585 566 A (JAMES A. SIEVERT) 15 June 1971 (1971-06-15) column 1, line 35 - line 67	5-7, 11
Y	US 4 324 949 A (GRANDJEAN ET AL) 13 April 1982 (1982-04-13)	9, 10
A	figure 1	5-7, 11
A	US 6 203 384 B1 (DEFRANCE ROBERT) 20 March 2001 (2001-03-20) figure 1	8
	-/--	

Further documents are listed in the continuation of box C. Patent family members are listed in annex.

° Special categories of cited documents :

<p>*A* document defining the general state of the art which is not considered to be of particular relevance</p> <p>*E* earlier document but published on or after the international filing date</p> <p>*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>*O* document referring to an oral disclosure, use, exhibition or other means</p> <p>*P* document published prior to the international filing date but later than the priority date claimed</p>	<p>*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>*8* document member of the same patent family</p>
--	--

Date of the actual completion of the international search 8 December 2005	Date of mailing of the international search report 19/12/2005
--	--

Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Langbroek, A
--	--

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2005/005209

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 736 550 A (WALLACE J,US ET AL) 29 May 1973 (1973-05-29) figures 3,4 -----	8
A	GB 2 328 802 A (* BICC PUBLIC LIMITED COMPANY; * BALFOUR BEATTY PLC) 3 March 1999 (1999-03-03) figure 4 page 5, line 1 -----	9,10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No PCT/EP2005/005209

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6368162	B1	09-04-2002	NONE
US 3585566	A	15-06-1971	CH 526863 A 15-08-1972 DE 2047823 A1 22-04-1971 FR 2062463 A5 25-06-1971 GB 1259919 A 12-01-1972 NO 128840 B 14-01-1974 SE 362169 B 26-11-1973 ZA 7006460 A 27-05-1971
US 4324949	A	13-04-1982	FI 801312 A 27-10-1980 FR 2455371 A1 21-11-1980 NO 801187 A 27-10-1980
US 6203384	B1	20-03-2001	CA 2331427 A1 28-09-2000 MX PA00011431 A 21-06-2002 WO 0057517 A1 28-09-2000
US 3736550	A	29-05-1973	CA 961947 A1 28-01-1975
GB 2328802	A	03-03-1999	NONE