(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 390 968 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
30.11.2011 Bulletin 2011/48

(21) Application number: **10425175.6**

(22) Date of filing: **25.05.2010**

(51) Int Cl.:
H01R 13/703 *(2006.01)* ***H01R 13/453*** *(2006.01)*
H01R 13/52 *(2006.01)* ***H01R 13/53*** *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
BA ME RS

(71) Applicant: **Faster S.P.A.**
20124 Milano (IT)

(72) Inventors:
- **Danelli, Alessandro**
  24053 Brignano Gera D'Adda (IT)
- **Rusconi, Paolo**
  26027 Rivolta D'Adda (IT)

(74) Representative: **Borsano, Corrado et al**
Notarbartolo & Gervasi S.p.A.
Corso di Porta Vittoria, 9
20122 Milano (IT)

(54) Connector to simultaneously connect a plurality of electrical lines adapted to make the connection in two separate phases

(57) The present invention relates to a connector to simultaneously connect a plurality of electrical lines (9a, 9b, 9c, 20a, 20b, 20c) of the type comprising a female part (1) and a male part (2).

The connector according to the present invention is characterized in that it is possible to separate the connection operation of the two parts into two phases, due to a specific moveable element (40) on which supplementary electrical contacts (30) are inserted, the first phase making the connection of the male with the female without the electrical contacts being energized, and a second phase in which the two parts already connected are in turn connected to the energized lines.

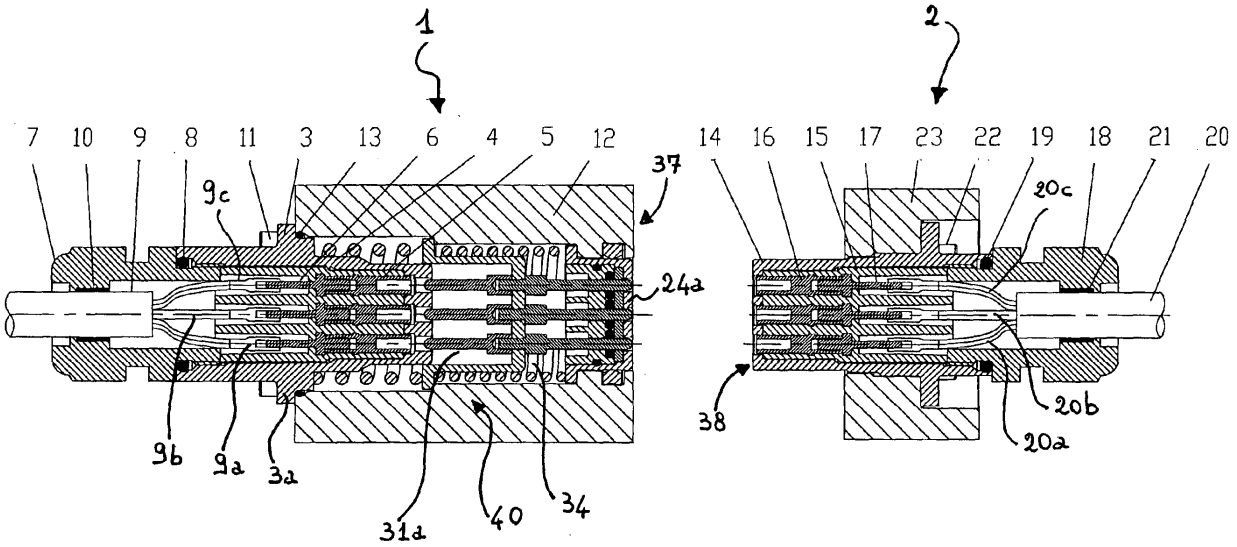

Fig. 1

EP 2 390 968 A1

Description

[0001] The present invention relates to an electrical connector adapted to simultaneously and guidedly connect a plurality of electrical lines. It is also an object of the present patent a method to safely and simultaneously connect a plurality of energized electrical lines.

[0002] The electrical connector according to the present invention is typically used in the industrial field, but this type of connector is increasingly also used in other sectors.

[0003] As known, there are in fact several sectors in which a plurality of electrical lines may require quick and safe simultaneous connection, and therefore several technical solutions are known in the market which achieve this object.

[0004] A sector in which multiple electrical connections are used is e.g. that of ground moving machines and in this as in other sectors, in addition to quickly connecting a plurality of electrical lines, the need is also strongly felt to be able to arrange connection systems able to resist dirt such as dust or grease and moisture, caused e.g. by the presence of mud or water in the area of use or due to atmospheric events.

[0005] In order to protect the electrical connection from ambient conditions, from the water or moisture and from dirt in general, connectors are known in the market which provide for the use of a cap closing the connection, e.g. the female connection which is generally the one connected to the machine, while the male connection is the one generally connected to the utility.

[0006] However this known solution has the drawback that the operator should intervene manually to remove this covering to make the connection, and thus it is not optimal as it does not make the connection itself completely automatic.

[0007] Moreover, the solutions of known type do not guarantee the desired safety levels as the elements - in particular the female element in general which is connected to the machine - are energized. The fact that the female element is energized constitutes a potential danger in the case in which the seal provided by the cap is not entirely effective. In fact, in this case water or moisture may penetrate from the closure and come into contact with the contacts on the female connector and close the contacts themselves by short circuiting, with consequent damage to the system.

[0008] Again, the multiple connection devices known from the state of the art are not easy to clean as they get dirty due to the effect of the poor ambient conditions in which they are used.

[0009] It is therefore the primary task of the present invention to provide an electrical connector adapted to simultaneously connect a plurality of electrical lines which allows overcoming the drawbacks afflicting the solutions of known type.

[0010] Within the scope of this task, the particular object of the present invention is to provide an electrical connector adapted to connect a plurality of electrical lines which is also able to effectively resist when used in conditions of moisture or of water and dirt when the female part and the male part are connected to each other in the operating phase, and also the ability for the female part alone disconnected from the male part, to resist in adverse ambient conditions.

[0011] Again, it is the object of the present invention to provide an electrical connector having several lines in which the female part is exempt from the risk of short circuiting even when it is energized and is exposed to the action of adverse ambient conditions.

[0012] This task and these and other objects which shall become more apparent hereinafter are achieved by an electrical connector according to the claims in the accompanying claim 1.

[0013] The connector to simultaneously connect a plurality of electrical lines according to the present invention is of the type comprising a female part and a male part, a plurality of first electrical contacts being provided on each of said parts, one for each line, adapted to be connected electrically to make the male-female connection, and is characterized in that at least one of said parts comprises at least one element, moveable according to the longitudinal direction of said connector, supporting said plurality of first electrical contacts of said part and also supporting a plurality of second electrical contacts connected electrically to said first electrical contacts, said moveable element being moveable between a first resting position in which the male and female parts are disconnected, at least a second intermediate position in which said first electrical contacts of the male part and of the female part are connected to each other while said second electrical contacts of said moveable element do not make the electrical connection with the electrical lines, and a third final connected position in which said first electrical contacts of the male part and of the female part are connected to each other and said second electrical contacts of said moveable element make the electrical connection with the electrical lines on the part comprising the moveable element.

[0014] The electrical connector according to the present invention is also characterized in that said moveable element is comprised in the female part.

[0015] Again, the electrical connector according to the present invention is characterized in that it comprises a plurality of seals adapted to effectively insulate the inside of the connector against liquids, moisture, dust and dirt in general.

[0016] Further features and advantages of the present invention will become more apparent from the following detailed description, provided by way of non-limiting example and illustrated in the accompanying drawings, in which:

figure 1 shows, in a sectional view according to a longitudinal plane, the female part and the male part of the connector according to the present invention,

in uncoupled phase;
figure 2 shows the same view in figure 1 in which the male part begins being inserted in the female part;
figure 3 shows the same view in figure 1 in which the insertion of the male part in the female part is in an intermediate phase;
figure 4 shows the same view in figure 1 in which the male part is connected to the female part;
figures 5 and 6 show a disconnection phase, and in figure 6, the two male and female elements separated again at the end of the disconnection phase, respectively.

[0017] According to a preferred embodiment of the present invention illustrated in the cited figures by way of non-limiting example, the electrical connector according **to** the present invention consists of a female part **1** and of a male part **2**. The female part **1** comprises a main body **3** in which a group of joint components is contained comprising an insulating body **4** inside of which a plurality of third female contacts **5** and third male contacts **6** are placed, connected to each other and made of conductor material.

[0018] The main body **3** is in turn connected to a cable gland **7**, a seal **8** being advantageously inter-placed between the two elements which allows hermetically sealing the body **3** against liquids and/or dirt in general. The cable gland **7**, while firmly holding it, receives an electrical cable (indicated with **9**) which brings the electrical lines **9a**, **9b** and **9c** and which is connected to said third male contacts **6**. When the cable **9** is subjected to electric voltage, it is propagated to the third male **6** and female **5** contacts.

[0019] A sealing ring **10** to prevent the entry of fluids and dirt in general is also conveniently provided between the cable **9** and the cable gland **7**.

[0020] The female part **1** also comprises a containment element **12**, preferably plate conformed, to which said main body **3** with all the elements and the contacts therein contained is fastened by means of connection means such as e.g. the screws **11**. For this purpose, the main body **3** will have a collar **3a** adapted to converge against a surface of said plate and adapted to allow the insertion of said fastening means. The plate **12** is provided with a housing of convenient dimensions in which the main body **3** is inserted until the collar **3a** converges against the external surface of the plate itself. Therefore, in the assembled configuration shown in the accompanying figures, the main body **3** is partially inserted in said plate **12**. In this case too, at least one seal **13**, whose purpose is to hermetically seal the inside of the female part of the connector against liquids and/or dirt in general, is inserted between the main body **3** and the plate **12.**

[0021] The female part **1** also comprises a first slider **31**, inserted in said plate and slidingly associated with the portion of said main body **3** inserted in said plate. Said first slider **31** is associated externally with said main body **3** and supports a plurality of pins or first male contacts **29** protruding from said slider **31** towards the front portion of the female part 1, and a plurality of second male contacts **30**, connected to said pins **29**, and turned towards the inside of said connector, towards the main body **3**, and positioned so that said second male contacts **30** may co-penetrate the third female contacts **5** of said female part **1** when the first slider **31** moves longitudinally with respect to the main body **3** in the direction away from the front portion of the female part.

[0022] Advantageously said first slider **31** has a mainly longitudinal development and is hollow, the inner cavity being indicated with the reference number **31a,** and is coaxial to said main body **3** so that said external slider is guided in its longitudinal run and in its positioning by the inner surface of said plate and by the external surface of the portion of main body **3** inserted in said plate, so that said slider **31** slides externally with respect to said main body **3.** An elastic element, preferably a first helicoid spring **33** adapted to resist the co-penetration of said main body **3** in the inner cavity **31a** and therefore the nearing of the two elements, main body and slider, is conveniently provided between said first slider **31** and said main body **3**.

[0023] A second elastic element, also consisting in this case in the example shown in the figures of a second helicoid spring **34** then acts between said first slider **31** and a second external slider **24**, having action opposite to the preceding, i.e. resisting the separation of the slider **31** from the main body **3**. The two elastic means **33** and **34** are conveniently sized so as to bring and keep said first slider **31** in the position in figure 1, i.e. in the position in which said second male contacts **30** are not inserted in said third female contacts **5**, when the female part **1** is not connected to a male part **2** and the moveable element consisting of said first slider **31** and of said second male contacts **30** and said pins or first male contacts **29** is in neutral position.

[0024] The moveable element (generically indicated with the reference number **40**) of the female part **1** of the connector also comprises said second external slider **24** to close the coupling zone of the male part **2** located in the front part of said plate **12** opposite to the part from which the main body **3** protrudes, also similarly conformed to said first slider **31** and having a collar adapted to contact said second spring **34** when the connector is in the configuration in figure 1, and said first slider **31** when the connector is in the configuration in figure 3.

[0025] Said second external slider **24** is associated with an internal spacer **25** and with an anti-extrusion disc **26,** a seal **27** being conveniently provided between said internal spacer and said anti-extrusion disc, while a further seal **28** is advantageously provided at each of said third male contacts **29** in order to prevent liquids, dust and/or dirt in general from penetrating from the front surface **37** of the female part **1**. The seals **28** seal the pins or third male contacts **29** belonging to said moveable element **40**. The seal **32** seals the external slider **24** in uncoupled conditions, said seal, together with the seal

of the O-rings **28** on the pins, make the front part of the uncoupled female pin impermeable.

[0026] With particular reference to figure 1, when the female part **1** of the connection is uncoupled, the moveable element **40** is in the position in which the front surface **24a** giving outwards onto said second external slider **24** is aligned with said front surface **37** of the female part, so as to form a continuous and flat surface therewith closed to the entry of dirt, moisture or water.

[0027] Moving now on to the description of the male part **2** of the connector according to the present invention, it comprises a main body **14** which contains a plurality of joint components. The main body **14** internally comprises an insulating body **15** in which a variable number of first female contacts **16** and first male contacts **17** are provided, connected to each other and made of conductor material. The first female contacts **16** give outwards onto the front surface **38** of said male part **2**, while the first male contacts **17** give inwards onto said insulating body **15** and are in turn connected to the electrical lines **20a**, **20b** and **20c** brought by the cable **20**. The portion of said main body **14** which terminates with said front surface **38** protrudes from a plate **23**, provided with a convenient housing inside of which said main body **14** is inserted and to which it is connected by means of convenient connection means, e.g. consisting of screws **22**.

[0028] A cable gland **18** in which said electrical cable **20** is firmly inserted, which as said is connected to the male contacts **17**, is inserted in the main body **14**. A suitable number of male electrical contacts **17**, each for every electrical line, will be provided depending on the electrical lines brought by the cable **20**.

[0029] As said, the male part **2** of the connection is generally connected to a utility, thus the cable **20** and the first contacts **16** and **17** are not subject to electric voltage but they receive voltage from the contacts on the female part **1**, when the two parts are connected.

[0030] A plurality of seals is also provided on the male part **2**, in particular a seal **21** is provided between the cable gland **18** and the cable **20**, to insulate the electrical contacts of the male part of the connector against liquids, dust and dirt in general. Similarly, a seal **19** is conveniently provided at the joint of said cable gland **18** and said main body **14**, as shown in the accompanying figures.

[0031] The operation of the connector object of the present invention will now hereinafter be disclosed with reference to the coupling and uncoupling phases shown in the accompanying figures, from 1 to 6.

[0032] Figure 2 shows the beginning of the coupling phase between the female part **1** and the male part **2** of the connector under examination. When the male **part 2** is neared to the female part, the two flat front surfaces, **37** for the female part and **38** for the male part, respectively, are juxtaposed one facing the other. The front surface **38** of the male part comes into contact with the front surface **37** of the female part **1**, in particular the external front part **24a** of said external slider **24** which is part of the moveable element **40**. Thus the moveable element **40** moves back pushed by the main body **14** of the male part **2**. In particular the external slider **24** moves back pushed by the front surface **38** of the male part, at this point the first male contacts **29** of the female part are inserted in the first female contacts **16** of the male part thus forming an electrical connection as shown in figure 3.

[0033] However, up to this point, said second male contacts **30** have not yet established an electrical contact with said third female contacts **5** of said female connection **1**, therefore (we are in the configuration of figure 3) the electrical connection established by means of the first male contacts **29** of the female part **1** with the first female contacts **16** of the male part **2** is not subject to voltage even when the lines **9a**, **9b**, **9c** connected to the female part **1**, by means of the cable **9**, are energized.

[0034] Therefore, the moveable element **40** in the female part, with the double electrical contacts **29** and **30** which allow separating the coupling procedure of the male part with the female part into two phases, allows making the electrical connection in a first phase between the male part and the female part without the contacts of the female part being energized even when the lines of the female part are energized.

[0035] Only in a second phase, seen in the successive figure 4, is the first slider **31** of the moveable element supporting the electrical contacts **29** and **30,** pushed by the male part **2** until it comes into contact with the main body **3** thus making the electrical connection of said second male contacts **30** with said first female contacts **5.** Only at this point the connection is subjected to electrical voltage of the lines, as the first female contacts **5,** through the first male contacts **6,** are directly connected to the electrical lines brought by the cable **9.**

[0036] Therefore the pins or third male contacts **29** are not energized in the intermediate connection phase due to the moveable element **40.** (We are in the configuration of figures 1 to 3.) The connection is therefore safe for the operator even when there is voltage in the electrical lines of the female part **1** brought by the cable **9.** The operator may safely come into contact with the pins **29** in complete safety, and the lack of voltage also makes the connection completely safe should it occur under adverse ambient conditions or in the presence of water or moisture. In order to ensure that liquids, moisture, dust and dirt in general still do not penetrate inside the connector, a further seal **32** is provided between the containment plate **12** and the second external slider **24,** so that it then exerts a seal on the main body **14** of the male part **2** when this is inserted in the female part by pushing the second external slider **24** and forcing it to move axially.

[0037] Figures 5 and 6 show an intermediate uncoupling phase of the connection according to the present invention and the result of a final uncoupling phase, respectively, showing how the moveable element **40** of the female part **1** returns to the neutral position in figure 1.

[0038] Hence, due to the elastic means **33** and **34,** the moveable element **40** is moveable between a first resting position shown in figures 1 and 6 which corresponds to

the disconnected configuration of male part **2** and female part **1**, and in which the second male contacts **30** and therefore the pins **29** are not connected to the first female contacts **5** of the main body **3** of the female part, and therefore are not energized, a second intermediate position in which said female contacts **16** of the male part **2** are connected to said third male contacts or pins **29** of said female part **1** but the second male contacts **30** of the moveable element **40** are not connected to the said first female contacts **5** joint with said main body **3**, and finally a third final connected position (seen in figure 4) in which said moveable element **40** converges against said main body **3** and in which, therefore, said second male contacts **30** of said moveable element are connected, thus making the electrical connection, with said first female contacts **5** of said main body **3**, so that the voltage of the lines of the cable **9** connected to the female part **1** is transmitted to the lines of the cable **20** connected to the male part **2**.

[0039] It has thus been shown how the electrical connector to simultaneously connect one or more electrical lines according to the present invention achieves the object and the purposes proposed.

[0040] In particular, it has been shown how the electrical connector according to the present invention is extremely safe, as the contacts exposed externally and therefore subject to the ambient conditions and exposed to the accidental contact by the operator are not energized unless the connection has completely occurred and therefore in conditions of total safety.

[0041] Moreover, it has been shown how the electrical connector according to the present invention is completely insulated with respect to the external ambient, as liquids, moisture, dust and/or dirt in general are totally prevented from penetrating the connector and jeopardizing the correct operation of the electrical contacts. This result is obtained without the need to use caps or closing covers of the contacts which would require the manual intervention by the operator to be removed, thus jeopardizing the simplicity and speed of the connection phase.

[0042] Several modifications may be made by the person skilled in the art without departing from the scope of protection of the present invention.

[0043] Hence, the scope of protection of the claims should not be limited by the disclosures or preferred embodiments shown in the description by way of example, but rather the claims should comprise all features of patentable novelty inferable from the present invention, including all features which would be treated as equivalent by the field technician.

Claims

1. A connector to simultaneously connect a plurality of electrical lines (9a, 9b, 9c, 20a, 20b, 20c) of the type comprising a female part (1) and a male part (2), a plurality of first electrical contacts (16, 29) being provided on each of said parts, one for each line, adapted to be connected electrically to make the male-female connection, **characterized in that** at least one of said parts (1, 2) comprises at least one element (40), moveable according to the longitudinal direction of said connector, supporting said plurality of first electrical contacts (29) of said part and also supporting a plurality of second electrical contacts (30) connected electrically to said first electrical contacts (29), said moveable element (40) being moveable between a first resting position in which the male (2) and female (1) parts are disconnected, at least a second intermediate position in which said first electrical contacts of the male part (16) and of the female part (29) are connected to each other while said second electrical contacts (30) of said moveable element (40) do not make the electrical connection with the electrical lines (9a, 9b, 9c), and a third final connected position in which said first electrical contacts of the male part (16) and of the female part (29) are connected to each other and said second electrical contacts (30) of said moveable element (40) make the electrical connection with the electrical lines (9a, 9b, 9c) of the part comprising the moveable element.

2. A connector according to the preceding claim, **characterized in that** said moveable element (40) is comprised in the female part (1).

3. A connector according to the preceding claim, **characterized in that** said female part comprises a main body (3) at least partially inserted in a containment element (12).

4. A connector according to the preceding claim, **characterized in that** said moveable element (40) comprises at least a first slider (31), associated externally with said main body (1) and restrained from longitudinally moving along said portion of main body (3) inserted in said containment element (12).

5. A connector according to the preceding claim, **characterized in that** said first slider (31) supports said first electrical contacts (29) and said second electrical contacts (30) connected electrically to each other.

6. A connector according to the preceding claim, **characterized in that** said first electrical contacts (29) protrude externally from said slider (31) in the direction opposite to said main body (3) towards the front surface (37) of said containment element (12) of the female part (1), and said plurality of second male contacts (30), in turn connected electrically to said first electrical contacts (29), are turned inwards towards said main body (3).

7. A connector according to the preceding claim, **char-**

acterized in that said moveable element (40) also comprises a second external slider (24), also moveable in longitudinal direction with respect to said main body (3) and with respect to said first slider (31), a helicoid spring (34) acting between said first slider (31) and said second slider (24) by resisting the reciprocal nearing of the two elements, said second slider (24) also being sliding with respect to said first electrical contacts (29).

8. A connector according to the preceding claim, **characterized in that** said main body (3) also comprises an insulating body (4) inside of which is a plurality of third female contacts (5) and third male contacts (6) connected electrically to each other.

9. A connector according to the preceding claim, **characterized in that** said third male contacts (6) are in turn connected to said electrical lines (9a, 9b, 9c), each contact being connected to a line.

10. A connector according to any one of the preceding claims, **characterized in that** when said moveable element (40) is in the resting position, the external front surface (24a) of said moveable element (40) achieves a flat and continuous surface with the front surface (37) of the female part.

11. A method to connect a plurality of electrical lines (9a, 9b, 9c, 20a, 20b, 20c) by means of a connector comprising a female part (1) and a male part (2), **characterized in that** it comprises a first phase in which the electrical connection is made of the contacts (29) of the female part with the contacts (16) of the male part without said electrical contacts being connected to the energized lines, and a second phase in which the two parts (1, 2) already connected to each other are in turn connected electrically to the energized lines.

12. A method according to the preceding claim **characterized in that** said energized lines are lines (9a, 9b, 9c) connected to said female part (1) of said connector.

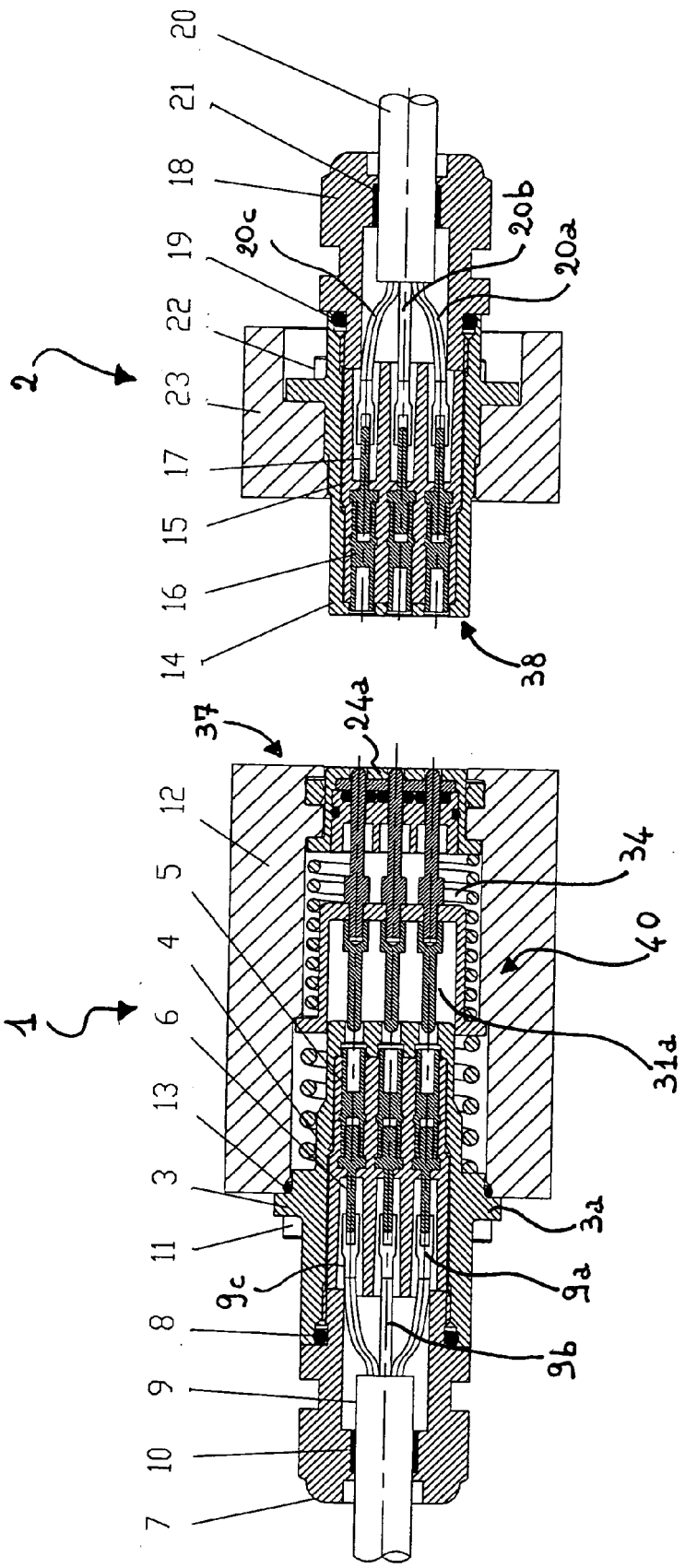
20
21
18
19
22
23
17
15
16
14
2
20c
20b
20a
38
37
24a
12
5
4
6
13
3
11
8
9
10
7
1
34
40
31a
3a
9c
9a
9b

Fig. 1

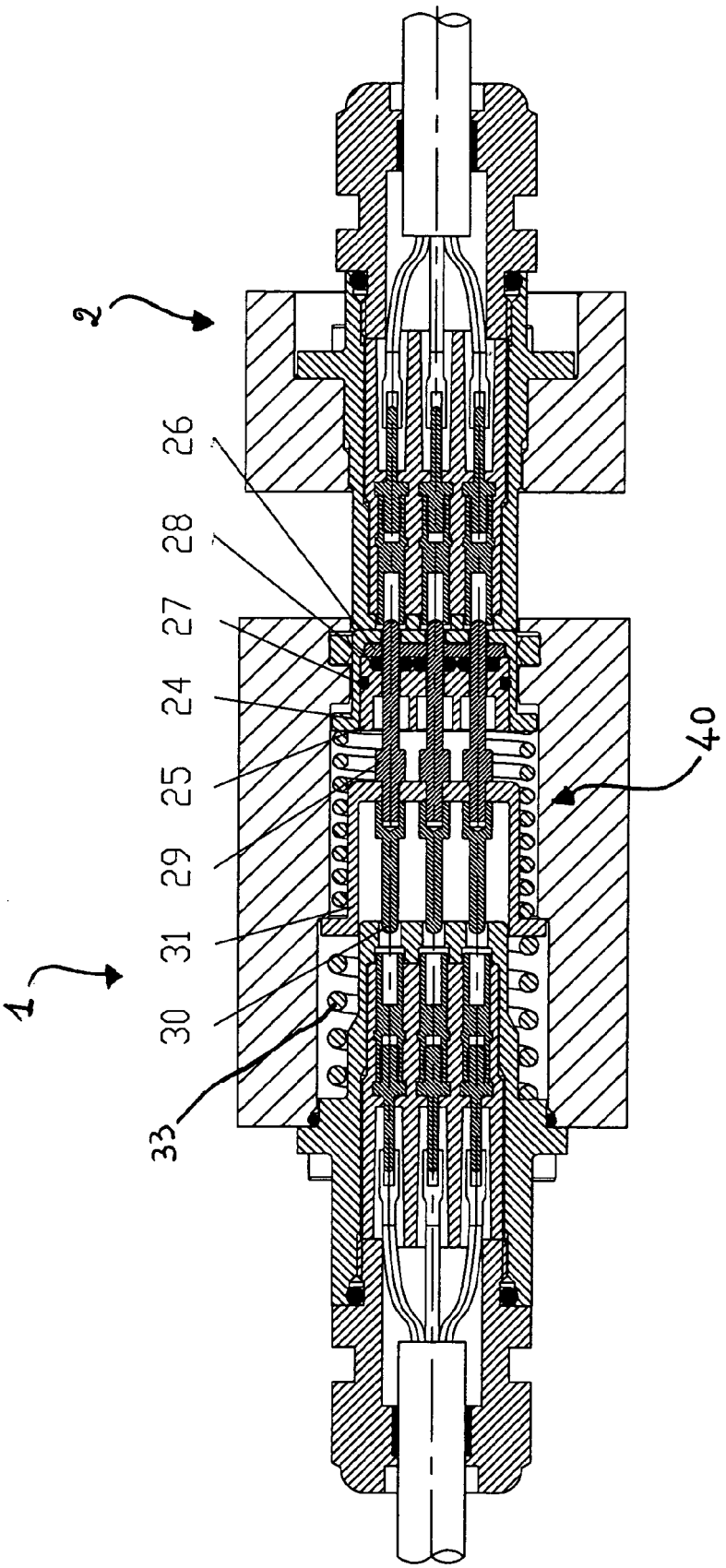

Fig. 2

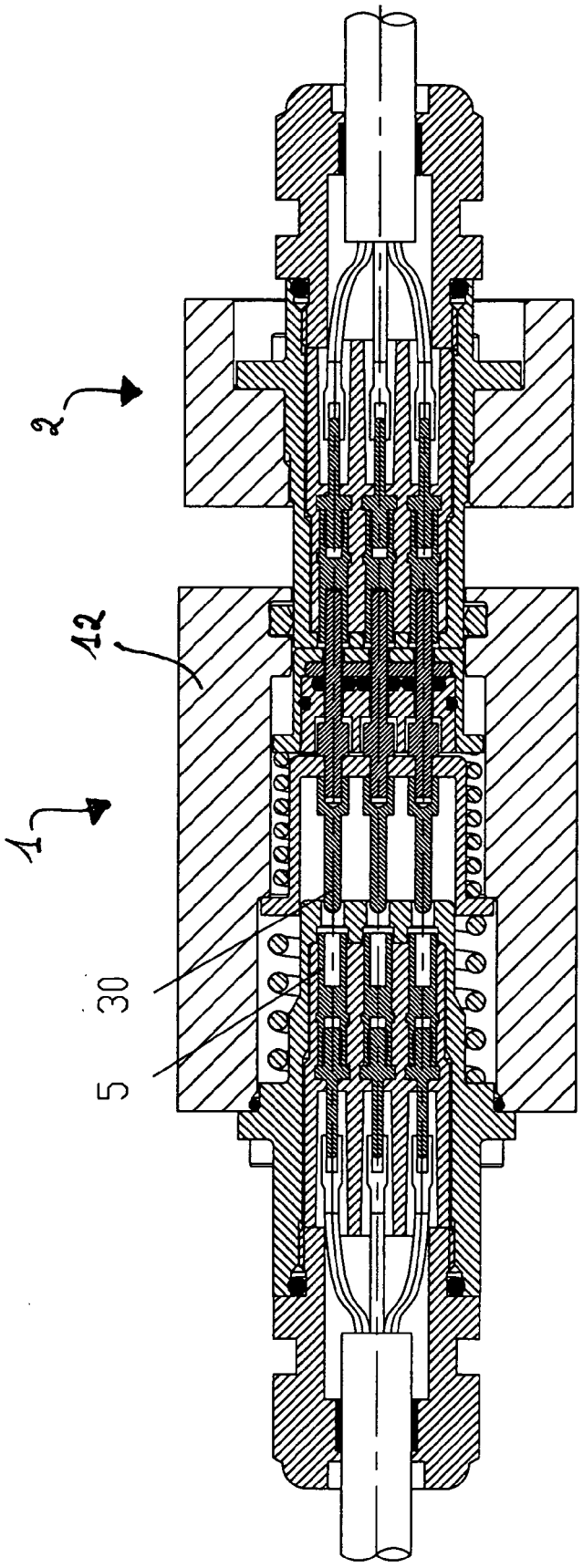

Fig. 3

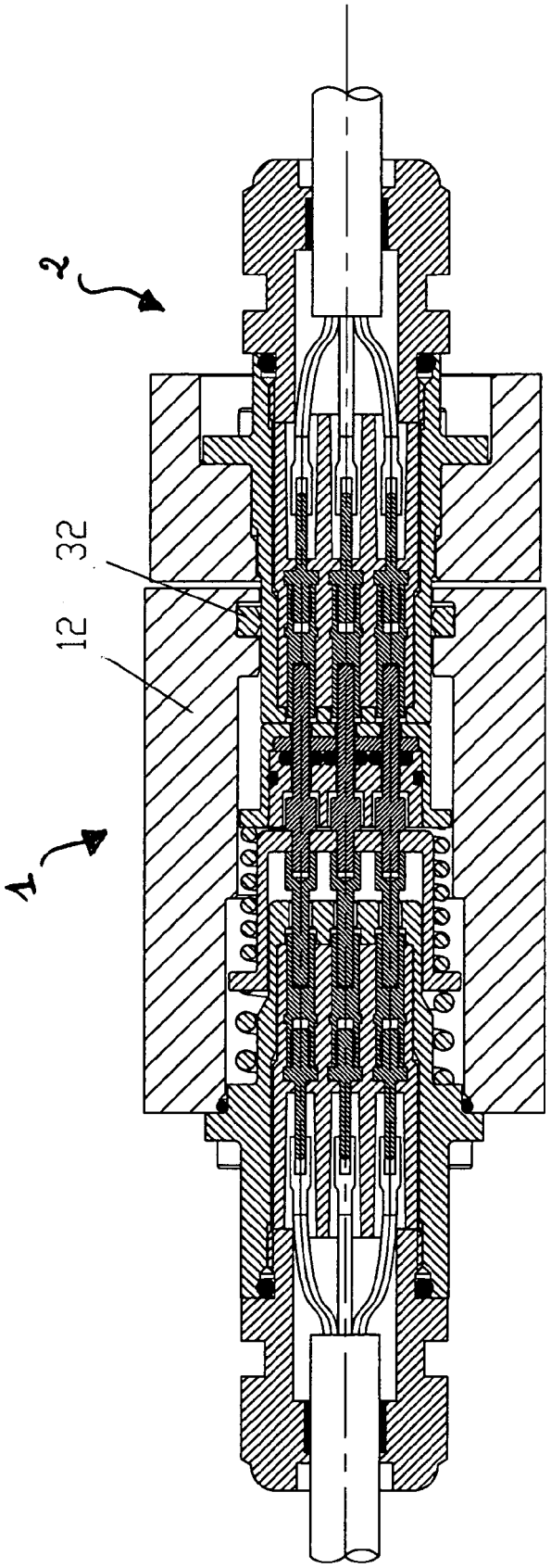

Fig. 4

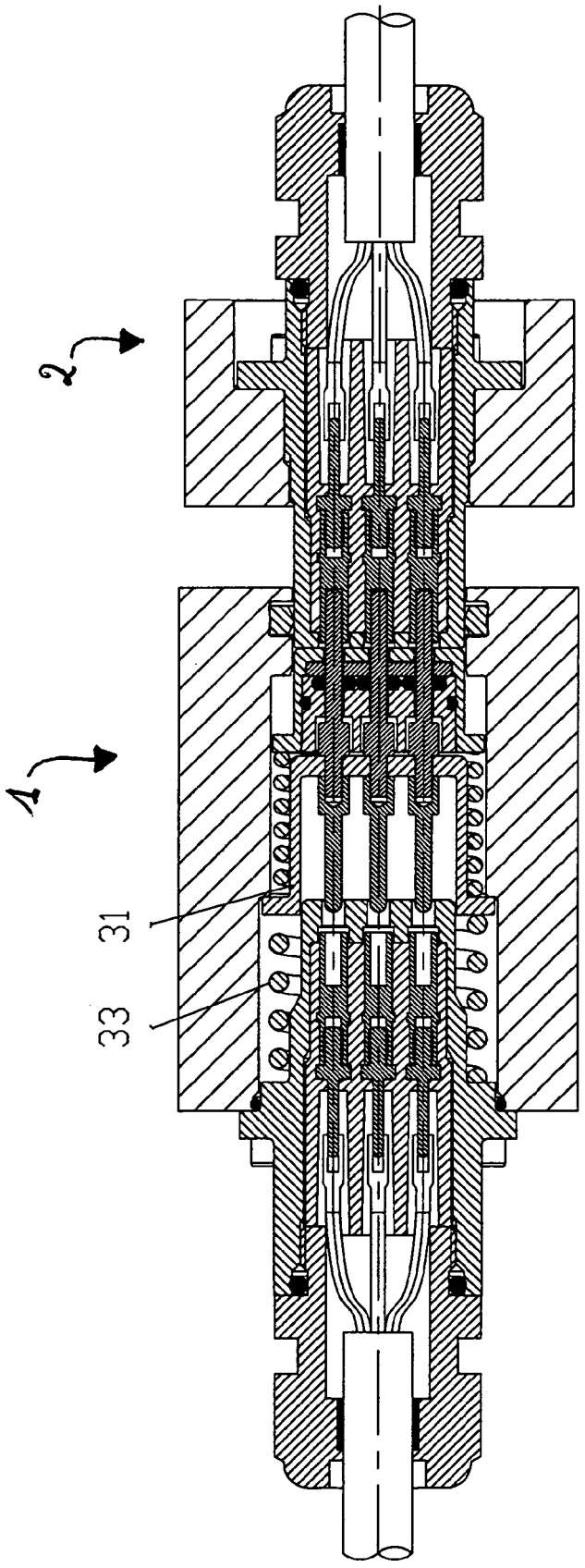

Fig. 5

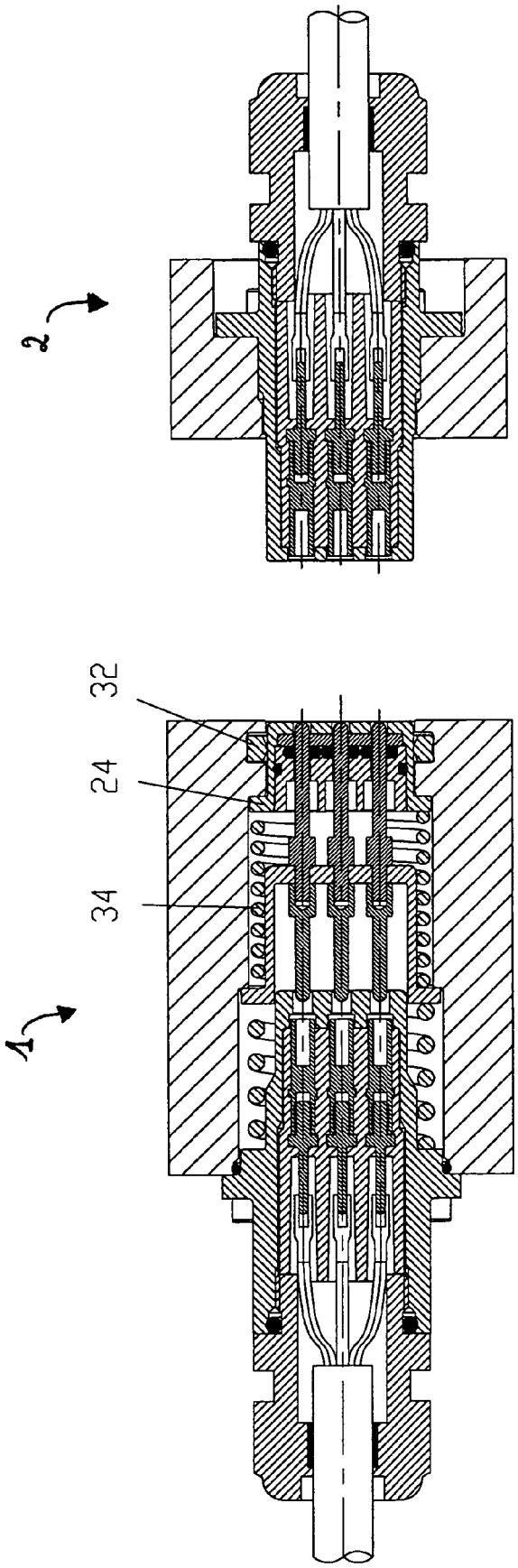

Fig. 6

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 10 42 5175

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	WO 00/46884 A1 (ROTA ENG LTD [GB]; FAWCETT MICHAEL J [GB]; RYDE PETER ERIC [GB]) 10 August 2000 (2000-08-10) * the whole document * -----	1-6,11, 12 7-9	INV. H01R13/703 H01R13/453 H01R13/52 H01R13/53
X	FR 2 873 237 A1 (SOURIAU SOC PAR ACTIONS SIMPLI [FR]) 20 January 2006 (2006-01-20) * the whole document * -----	1-5, 10-12	
X	DE 801 998 C (CALOR EMAG ELEK ZITAETS AKT GE) 1 February 1951 (1951-02-01) * the whole document * -----	1-5, 10-12	
Y	US 4 109 989 A (SNYDER JR CLAIR WILSON ET AL) 29 August 1978 (1978-08-29) * column 1, line 13 - column 1, line 62 * * the whole document * -----	7-9	

TECHNICAL FIELDS SEARCHED (IPC)

H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	2 November 2010	Camerer, Stephan

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

1

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 42 5175

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

02-11-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0046884 A1	10-08-2000	AT 255777 T	15-12-2003
		AU 2306900 A	25-08-2000
		DE 60006934 D1	15-01-2004
		DE 60006934 T2	04-11-2004
		EP 1149437 A1	31-10-2001
		US 6893284 B1	17-05-2005
FR 2873237 A1	20-01-2006	NONE	
DE 801998 C	01-02-1951	NONE	
US 4109989 A	29-08-1978	AR 210497 A1	15-08-1977
		AU 504615 B2	18-10-1979
		AU 1411876 A	24-11-1977
		BR 7603511 A	11-01-1977
		CA 1066789 A1	20-11-1979
		DE 2625648 A1	30-12-1976
		ES 448516 A1	16-11-1977
		FR 2314595 A1	07-01-1977
		GB 1503275 A	08-03-1978
		IT 1060692 B	20-08-1982
		JP 51150686 A	24-12-1976
		NL 7605602 A	14-12-1976
		SE 411820 B	04-02-1980
		SE 7606599 A	11-12-1976

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82