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

(11) EP 0 967 686 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.12.1999 Bulletin 1999/52

(51) Int. Cl.[6]: **H01R 13/436**

(21) Application number: **99111409.1**

(22) Date of filing: **11.06.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **23.06.1998 IT TO980543**

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(54) Electrical connector with terminal position assurance device

(57) An electric connector (1) having an insulating casing (3) fittable in a longitudinal assembly direction (A) to a complementary connector and defining a number of longitudinal cavities (4) for housing respective electric terminals (5); primary retaining lances (20, 21) for retaining the terminals (5) inside the respective cavities (4) and preventing withdrawal of the terminals; and a secondary retaining device (30) having a front movable member (31) movable, in the assembly direction (A), between a preassembly position and a closed position cooperating with the primary retaining lances (20, 21) to determine correct engagement and prevent release of the terminals (5) by the primary retaining lances; the secondary retaining device (30) also has a pair of U-shaped elastic members (40) projecting from the movable member (31) and deformable, by interaction with the casing (3), between a disabling configuration in which the elastic members (40) project partially outwards of the casing (3) and prevent insertion of the connector (1) inside a receptacle of the complementary connector, and an enabling configuration reached when the movable member (31) is in the closed position, and in which the elastic members (40) are housed entirely within the outer contour of the casing (3) and permit insertion and connection of the connector (1) inside the receptacle of the complementary connector.

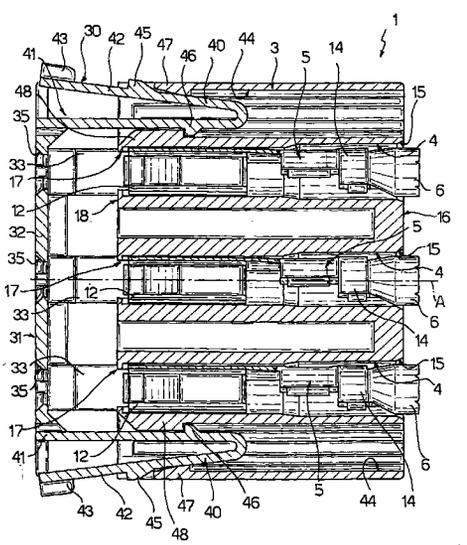

Fig.2

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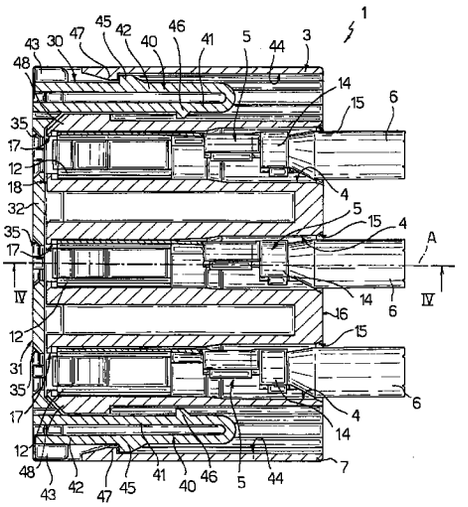
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Fig.3

Description

[0001] The present invention relates to an electric connector and in particular to an electric connector fittable in an assembly direction inside a receptacle of a complementary connector.

[0002] Connectors of the above type are known which comprise an insulating casing defining a number of cavities having respective axes parallel to the assembly direction and for housing respective electric terminals, which are connected to respective electric cables and retained inside the cavities by primary retaining means.

[0003] Connectors of this sort also comprise a secondary retaining device normally defined by a movable member, which is fitted frontally to the casing in a preassembly position partially engaging a hollow front portion of the casing and therefore projecting frontwards from the casing, and is movable, in the assembly direction, between the preassembly position and a closed position closing the hollow front portion of the casing and cooperating with the primary retaining means to determine correct engagement, and prevent release, of the terminals by the primary retaining means.

[0004] The movable member can only be moved into the closed position on the casing when all the terminals are correctly inserted and retained inside the respective cavities by the primary retaining means, which normally comprise an elastically deformable lance forming part of the casing.

[0005] If any one of the terminals is not fully or correctly inserted, the primary retaining means remain deformed, thus preventing the movable member from being fitted fully and into the closed position inside the hollow front portion of the casing, and so preventing complete connection of the connector inside the receptacle of the complementary connector.

[0006] Nevertheless, even when the movable member is not in the closed position, so that at least one of the terminals is not properly engaged by the primary retaining means, the connector described above can still be inserted inside the receptacle of the complementary connector and may therefore be forced into the complementary connector despite the movable member interfering with the primary retaining means, thus resulting, for example, in breakage or deformation of the contacting parts. In which case, the misinserted terminal may go undetected when tested, by being so positioned, for example, as to determine, in use, some measure of electric contact, albeit precarious, but which, in applications in which the connector is subjected to vibration, as on a vehicle, is bound to fail eventually, with the obvious consequences this entails.

[0007] Also known from US Patent US 4,629,271 is a connector for a printed-circuit board, and which comprises a casing having a number of parallel receiving chambers; an elastic member housed inside each chamber to retain the printed-circuit terminals; and a press-on insertion member which clicks onto the front of the casing into a closed position to keep the terminals in a fixed position. The insertion member comprises a number of wedges, each for engaging a respective receiving chamber; and a pair of flexible U-shaped members located on opposite sides of the wedges, having parallel arms, and which click inside respective seats on the casing by means of respective teeth.

[0008] It is an object of the present invention to provide an electric connector designed to eliminate, in a straightforward, reliable, low-cost manner, the aforementioned drawback typically associated with known connectors.

[0009] According to the present invention, there is provided an electric connector comprising:

- an insulating casing fittable in an assembly direction inside a receptacle of a complementary connector, and defining a number of cavities having respective axes parallel to said assembly direction and for housing respective electric terminals;
- primary retaining means for retaining said terminals inside respective said cavities and preventing withdrawal of the terminals; and
- secondary retaining means in turn comprising at least one movable member fitted frontally to said casing in a preassembly position and movable, in said assembly direction, between said preassembly position and a closed position cooperating with said primary retaining means to determine correct engagement and prevent release of said terminals by the primary retaining means;

characterized in that said secondary retaining means comprise elastic means, which are carried by said movable member, cooperate in sliding manner with said casing as said movable member is moved between said preassembly and closed positions, and are deformed, by interaction with the casing, between a disabling configuration, in which said elastic means project at least partly outwards of said casing and prevent insertion of said connector inside said receptacle of said complementary connector, and an enabling configuration reached when said movable member is in said closed position, and in which said elastic means are housed entirely within the outer contour of said casing and permit insertion and connection of said connector inside said receptacle of said complementary connector.

[0010] A preferred, non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a view in perspective of an electric connector in accordance with the present invention and in a preassembly position;

Figure 2 shows a larger-scale longitudinal section of the Figure 1 connector;

Figure 3 shows a larger-scale longitudinal section of the Figure 1 connector in a fully assembled position;

Figure 4 shows a section along line IV-IV in Figure 3.

[0011] Number 1 in Figures 1 to 4 indicates as a whole an electric connector in accordance with the present invention.

[0012] In the example shown, connector 1 is a "female-holder" connector fittable in an assembly direction A (Figures 2 and 3) inside a receptacle of a complementary "male-holder" connector (not shown).

[0013] Connector 1 comprises a box-shaped insulating casing 3, which defines a number of longitudinal cavities 4 having respective axes parallel to direction A and for receiving respective female electric terminals 5 connected to respective electric cables 6 and retained inside cavities 4 by known primary retaining means described later on.

[0014] In particular, casing 3 comprises a parallelepiped main portion 7; and a parallelepiped secondary portion 8 projecting from a lateral wall 9 of portion 7 and extending along an intermediate longitudinal strip of wall 9. More specifically, casing 3 defines four cavities 4, three of which are formed in portion 7 and aligned in a transverse row, while the fourth cavity is formed in portion 8 and located alongside an intermediate cavity in said transverse row.

[0015] With reference to Figures 2 to 4, each terminal 5 comprises a box-shaped front contact portion 12, which has a retaining seat 13 for the primary retaining means and is connected to a corresponding male terminal (not shown) of the complementary connector; and a rear portion 14 for connection to respective electric cable 6.

[0016] Each terminal 5 is inserted inside respective cavity 4 through a rear opening 15 of cavity 4, formed in a substantially T-shaped rear wall 16 of casing 3, and is positioned with contact portion 12 facing a front opening 17 of cavity 4, formed in a substantially T-shaped front wall 18 opposite wall 16. In use, cables 6 extend out of casing 3 through respective openings 15.

[0017] With reference to Figure 4, the primary retaining means comprise, for each terminal 5, a first and second elastic lance 20, 21 projecting on opposite sides inside respective cavity 4 and in direction A towards front opening 17. More specifically, lances 20 project from wall 9; lances 21 housed in cavities 4 of portion 7 of casing 3 project from a wall 22 of portion 7 opposite and parallel to wall 9; and the lance 21 housed in cavity 4 of portion 8 of casing 3 projects from a wall 23 of portion 8 also opposite and parallel to wall 9. Walls 22, 23 of respective portions 7 and 8 of casing 3 define, at lances 21, respective rectangular end openings 24 communicating with corresponding cavities 4.

[0018] The surface of each lance 20, 21 facing inwards of respective cavity 4 has a tooth 28 with a substantially right-trapezium-shaped profile and which clicks inside retaining seat 13 of relative terminal 5.

[0019] More specifically, teeth 28 of each pair of lances 20, 21 permit insertion of relative terminal 5, which, sliding along respective oblique sides of teeth 28 facing opening 15, elastically deforms lance 20 towards wall 9 and lance 21 inwards of respective opening 24; and, once terminal 5 is inserted fully inside respective cavity 4 (Figures 3 and 4), lances 20, 21 are restored to the undeformed position by teeth 28 clicking inside retaining seat 13 of terminal 5 so that respective sides of the teeth, perpendicular to direction A and opposite the respective oblique sides, define a stop preventing withdrawal of terminal 5.

[0020] With reference to Figures 1 and 4, connector 1 also comprises a secondary retaining device, indicated as a whole by 30, for retaining terminals 5.

[0021] Device 30 comprises a movable member 31 formed separately from casing 3 and which is fitted, in direction A, to the front of casing in a closed position (Figures 3 and 4) to determine correct insertion of terminals 5 inside respective cavities 4 and prevent withdrawal of the terminals.

[0022] More specifically, movable member 31 comprises a substantially T-shaped plate 32 which is positioned contacting wall 18 of casing 3 in the closed position of movable member 31; and a number of first wedges 33, one for each cavity 4, projecting integrally from plate 32 and parallel to direction A, and each of which is inserted, inside respective cavity 4, between lance 20 and wall 9 from which lance 20 originates, so as to prevent deformation of lance 20 (Figure 4).

[0023] Movable member 31 also comprises a number of second wedges 34 projecting integrally from plate 32 and parallel to wedges 33, and engaging respective openings 24 in walls 22, 23 of casing 3.

[0024] Plate 32 also comprises a number of through seats 35 coaxial with front openings 17 of respective cavities 4 and which are engaged, in use, by respective contact portions of the male terminals of the complementary connector.

[0025] Movable member 31 is fitted to the front of casing 3 in a preassembly position (Figures 1 and 2) - in which plate 32 is positioned facing and parallel to wall 18, and wedges 33 and 34 engage the inlets of respective cavities 4 and are separated, in direction A, from respective lances 20, 21 to permit deformation of the lances when assembling terminals 5 - and is movable, in direction A, between the preassembly position and said closed position (Figures 3 and 4) in which plate 32 is positioned contacting wall 18, wedges 33 are inserted inside respective cavities 4, between lances 20 and wall 9 from which lances 20 originate, so as to prevent deformation of lances 20, and wedges 34 are positioned closing respective openings 24.

[0026] According to the present invention, device 30 also comprises a pair of elastic members 40 which project from respective lateral end portions of plate 32

of movable member 31, on the same side as wedges 33, 34, are located on opposite sides of wedges 33, 34, cooperate in sliding manner with casing 3 as movable member 31 is moved between said preassembly and closed positions, and are deformable, by interaction with casing 3, between a disabling configuration (Figures 1 and 2) in which elastic members 40 project partly outwards of casing 3 and prevent insertion of connector 1 inside the receptacle of the complementary connector, and an enabling configuration (Figures 3 and 4) reached when movable member 31 is in the closed position, and in which elastic members 40 are housed entirely within the outer contour of casing 3 and permit insertion and connection of connector 1 inside the receptacle of the complementary connector.

[0027] Each elastic member 40 is defined by a substantially U-shaped blade positioned with the concavity facing plate 32 and which comprises a first arm 41 having one end integral with plate 32, and a second arm 42 facing and free to flex with respect to arm 41. More specifically, arms 42 of elastic members 40 are located on opposite sides with respect to arms 41, and diverge from arms 41 towards plate 32 when undeformed and in the disabling configuration of elastic members 40. Each arm 42 has, at a respective free end adjacent to plate 32, a pair of projections 43 projecting outwards with respect to casing 3 in the disabling configuration of elastic member 40.

[0028] Elastic members 40 are engaged inside respective longitudinal through seats 44 formed in portion 7 of casing 3, on opposite sides of the relative row of cavities 4.

[0029] With reference to Figures 2 and 3, each elastic member 40 also comprises a pair of teeth 45, 46 which click onto respective teeth 47, 48 associated with respective seat 44 to respectively define said closed and preassembly positions.

[0030] More specifically, teeth 45 and 47 defining the closed position of movable member 31 project respectively from an intermediate portion of arm 42 of each elastic member 40 and from an inlet portion of the lateral edge of relative seat 44, and have a substantially isosceles-trapezium-shaped profile with the respective oblique sides facing opening 15 and opening 17 respectively.

[0031] Similarly, teeth 46 and 48 defining the preassembly position of movable member 31 project respectively from an end portion of arm 41 of each elastic member 40 and from the inlet portion of the lateral edge of relative seat 44, and both have a substantially isosceles-trapezium-shaped profile with the respective oblique sides facing opening 15 and opening 17 respectively.

[0032] Teeth 45 and 46 of each elastic member 40 are located in succession in direction A from plate 32 towards the inside of relative seat 44; and teeth 47 and 48 of each seat 44 are positioned facing each other.

[0033] In the undeformed and disabling configuration of each elastic member 40, arm 41 extends perpendicularly from plate 32 and cooperates in sliding manner with a side of tooth 48 parallel to direction A, while arm 42 diverges from arm 41 towards plate 32, so that projections 43 project outwards of casing 3, and cooperates with the oblique side of tooth 47.

[0034] In the enabling configuration of each elastic member 40, arms 41 and 42 are positioned parallel to each other, and projections 43 are aligned with the lateral edge of portion 7 of casing 3.

[0035] Connector 1 is assembled as described below, and commencing from an initial condition in which movable member 31 is fitted to casing 3 in the preassembly position with elastic members 40 in the disabling configuration, and terminals 5 are located inside respective cavities 4 (Figure 2). The preassembly position is defined by teeth 46 of elastic members 40 engaging teeth 48 associated with respective seats 44.

[0036] If one of terminals 5 is not inserted properly inside respective cavity 4, relative lances 20, 21 remain deformed towards wall 9 and inwards of respective opening 24 respectively. The deformation of lance 20 prevents the corresponding wedge 33 of movable member 31 from being inserted fully inside cavity 4, between lance 20 and wall 9, and so prevents movable member 31 from being moved into the closed position, so that projections 43 of elastic members 40 project outwards of casing 3 and prevent insertion of connector 1 inside the receptacle of the complementary connector.

[0037] Conversely, if terminals 5 are all engaged properly by respective lances 20, 21, wedges 33 may be inserted fully between lances 20 and wall 9, wedges 34 may be positioned closing respective openings 24, and movable member 31 may therefore be moved into the closed position defined by teeth 45 of elastic members 40 engaging teeth 47 associated with respective seats 44; in which case, elastic members 40 assume the enabling configuration in which projections 43 are aligned with the lateral edge of casing 3 (Figure 3), thus permitting insertion and complete connection of connector 1 inside the receptacle of the complementary connector.

[0038] The advantages of connector 1 according to the present invention will be clear from the foregoing description.

[0039] In particular, when movable member 31 is not set to the closed position on the casing, arms 42 of elastic members 40 diverge with respect to respective arms 41 so that respective projections 43 project outwards with respect to casing 3 to increase the normal overall transverse dimension of casing 3 and so prevent insertion of connector 1 inside the receptacle of the complementary connector. Connector 1 is thus faultproof. In fact, if movable member 31 is set to other than the closed position, there is absolutely no way of connecting connector 1 to the complementary connector, not even by forcing the contacting parts.

[0040] Moreover, device 30 is particularly straightforward and inexpensive by requiring no relatively complex additional parts on casing 3 other than a pair of through

seats 44 formed in a conventional casing.

[0041] Clearly, changes may be made to connector 1 as described herein without, however, departing from the scope of the present invention.

Claims

1. An electric connector (1) comprising:

   - an insulating casing (3) fittable in an assembly direction (A) inside a receptacle of a complementary connector, and defining a number of cavities (4) having respective axes parallel to said assembly direction (A) and for housing respective electric terminals (5);
   - primary retaining means (20, 21) for retaining said terminals (5) inside respective said cavities (4) and preventing withdrawal of the terminals; and
   - secondary retaining means (30) in turn comprising at least one movable member (31) fitted frontally to said casing (3) in a preassembly position and movable, in said assembly direction (A), between said preassembly position and a closed position cooperating with said primary retaining means (20, 21) to determine correct engagement and prevent release of said terminals (5) by the primary retaining means;

   characterized in that said secondary retaining means (30) comprise elastic means (40), which are carried by said movable member (31), cooperate in sliding manner with said casing (3) as said movable member (31) is moved between said preassembly and closed positions, and are deformed, by interaction with the casing (3), between a disabling configuration, in which said elastic means (40) project at least partly outwards of said casing (3) and prevent insertion of said connector (1) inside said receptacle of said complementary connector, and an enabling configuration reached when said movable member (31) is in said closed position, and in which said elastic means (40) are housed entirely within the outer contour of said casing (3) and permit insertion and connection of said connector (1) inside said receptacle of said complementary connector.

2. A connector as claimed in Claim 1, characterized in that said movable member (31) comprises a plate (32) facing a front wall (18) of said casing (3) in said preassembly position; and a number of interacting elements (33, 34) interacting with said primary retaining means (20, 21) and projecting from said plate (32); said elastic means comprising a pair of substantially U-shaped elastic members (40), which project from respective lateral end portions of said plate (32), on the same side as said interacting elements (33, 34) have respective concavities facing said plate (32), and are engaged inside respective seats (44) formed in said casing (3) and having respective axes parallel to said assembly direction (A).

3. A connector as claimed in Claim 2, characterized in that each said elastic member (40) comprises a first arm (41) having one end integral with said plate (32); and a second arm (42), which faces said first arm (41), is free to flex with respect to the first arm (41), and has, at a free end adjacent to said plate (32), projecting means (43) projecting outwards with respect to said casing (3) in said disabling configuration.

4. A connector as claimed in Claim 3, characterized in that said second arms (42) of said elastic members (40) are located on opposite sides with respect to said first arms (41), and, when undeformed and in said disabling configuration of said movable member (31), diverge with respect to the first arms (41) towards said plate (32).

5. A connector as claimed in Claim 3 or 4, characterized in that each said elastic member (40) comprises a first and a second tooth (45, 46), which click respectively onto a third and a fourth tooth (47, 48) of the respective said seat (44) to respectively define said closed and preassembly positions; said first tooth (45) being carried by one (42) of said first and second arms (41, 42), and said second tooth (46) being carried by the other (41) of said first and second arms (41, 42).

6. A connector as claimed in Claim 5, characterized in that said first and second tooth (45, 46) of each said elastic member (40) are located in succession in said assembly direction (A) and from said plate (32) towards the inside of the respective said seat (44); and in that said third and fourth tooth (47, 48) of each said seat (44) are positioned facing each other and are carried by a lateral edge of said seat (44).

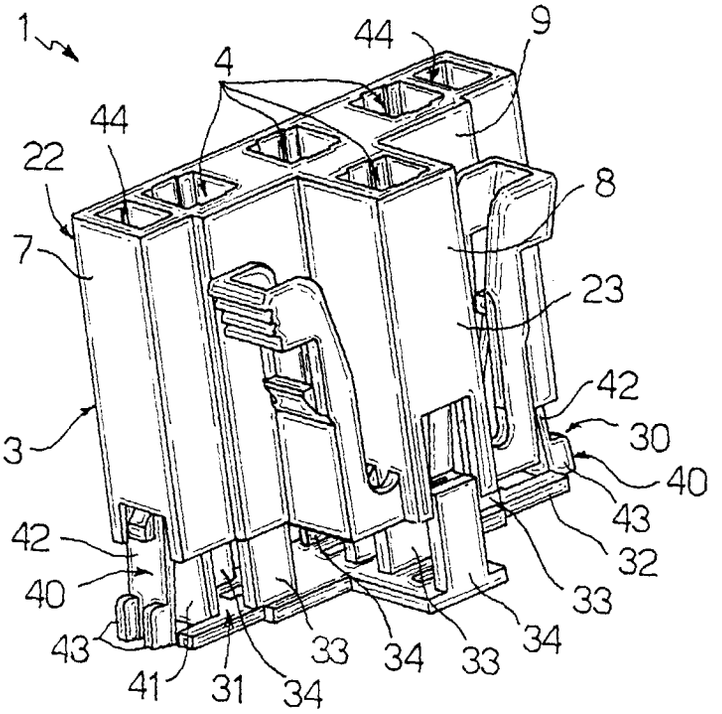
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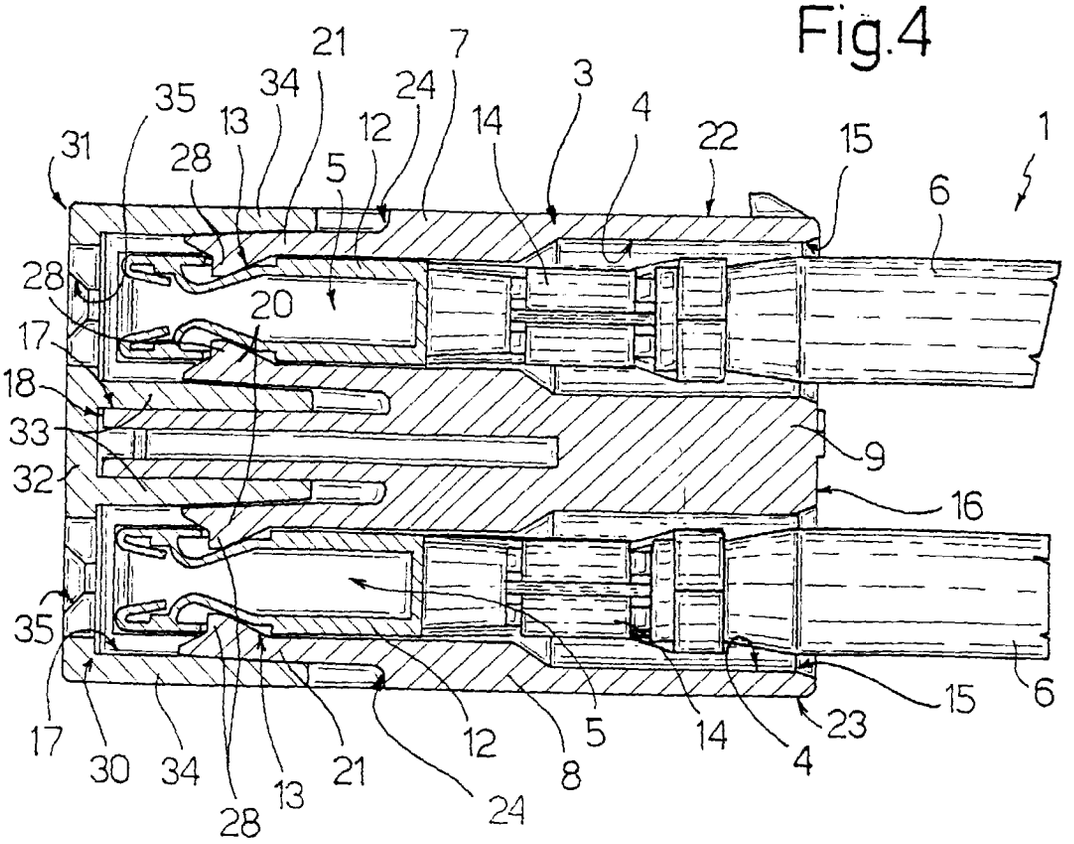
Fig.1

Fig.4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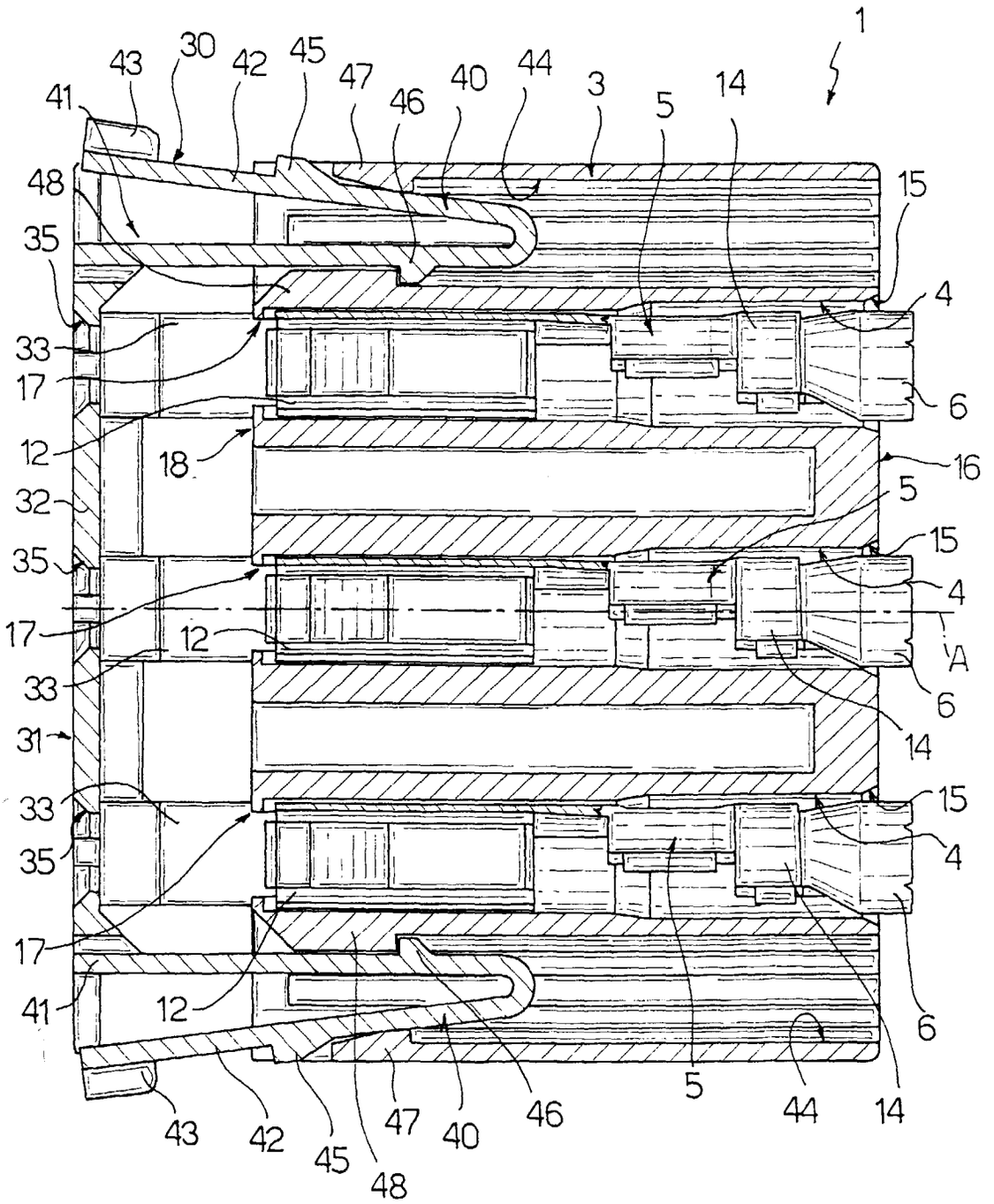
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Fig.2

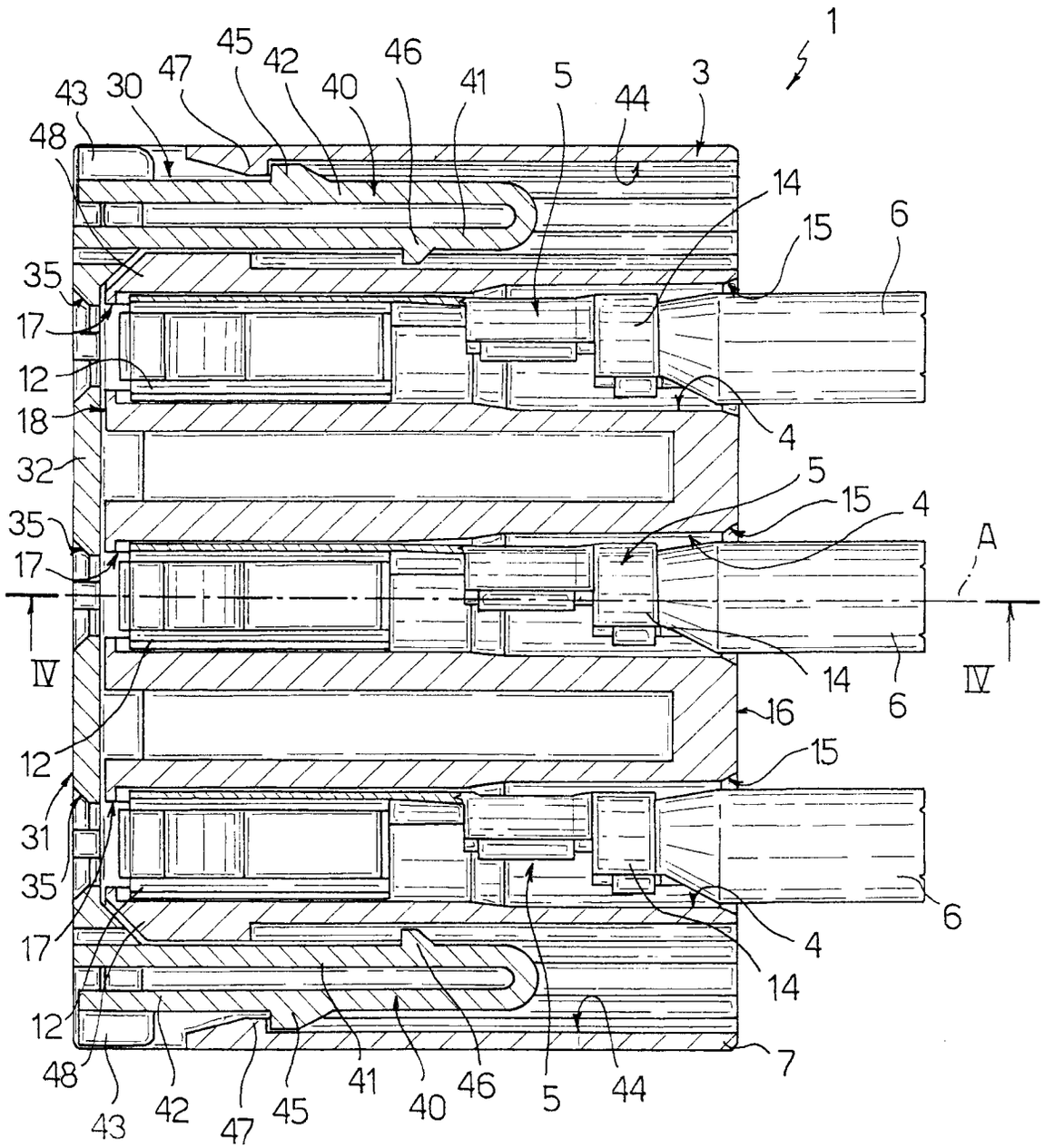
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Fig.3

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EUROPEAN SEARCH REPORT

Application Number
EP 99 11 1409

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.6)
X	DE 195 38 613 A (CINCH CONNECTEURS SA) 2 May 1996 (1996-05-02)	1	H01R13/436
A	* column 2, line 20 - column 3, line 66 *	3-6	
A	GB 2 262 664 A (WHITAKER CORP) 23 June 1993 (1993-06-23) * page 4, paragraph 2 - page 7, paragraph 3 *	1-6	
A	US 5 645 453 A (YAMAGUCHI NOBORU) 8 July 1997 (1997-07-08) * column 3, line 30 - column 6, line 36 *	1	
D,A	US 4 629 271 A (AWANO YOSHIYUKI) 16 December 1986 (1986-12-16) * abstract *	1-6	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	1 October 1999	Demol, S

CATEGORY OF CITED DOCUMENTS

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