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(72) Inventors:
• **Zen, Gianluca**
10137 Torino (IT)
• **Rampone, Renzo**
10024 Moncalieri (IT)

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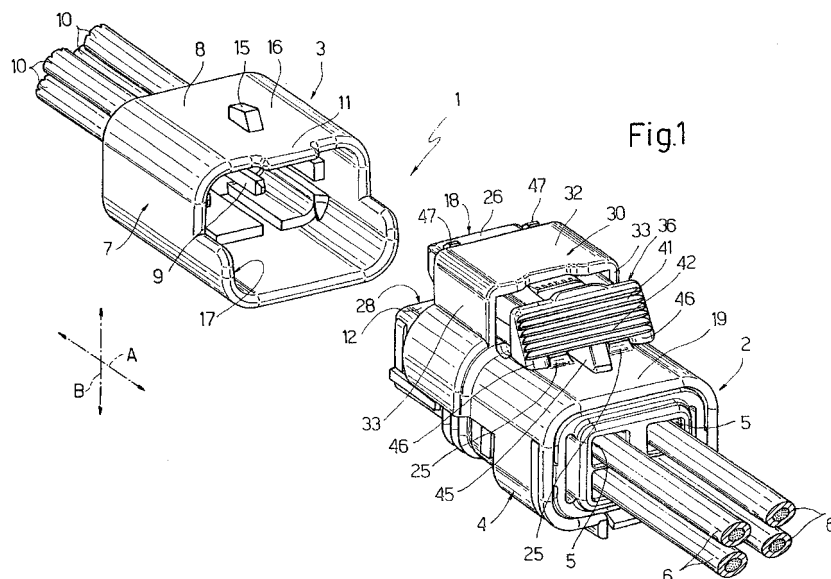
(74) Representative: **Franzolin, Luigi et al**
STUDIO TORTA S.r.l.,
Via Viotti, 9
10121 Torino (IT)

(71) Applicant: **F.C.I. - Framatome Connectors
International**
92400 Courbevoie (FR)

(54) Electrical connecting unit

(57) There is described a connecting unit (1) having a first and a second connector (2, 3) mutually connectable in a first direction (A); first and second coupling means (18, 15) carried respectively by the first and second connector (2, 3) and which click together, in the first direction (A), into a coupled position; and coupling detecting means (36) mounted to slide, along the first connector (2) and in the first direction (A), between a pre-assembly position and a fully assembled position, and having a disabling arm (50) flexible elastically in a second direction (B) crosswise to the first direction (A), and

normally set in an undeformed configuration in which it presses against the first coupling means (18) to prevent the fully assembled position from being reached; the second coupling means (15) having an opposing surface (22), which, in the coupled position, defines a temporary stop for an interacting portion (55) of the disabling arm (50) as the coupling detecting means (36) move into the fully assembled position, and which is cam-shaped to flex the disabling arm (50) and to be passed over by the interacting portion (55) only when additional thrust is exerted on the coupling detecting means (36) in the first direction (A).



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Description

[0001] The present invention relates to a connecting unit, and in particular to an automotive electric connecting unit of the type comprising a first and a second electric connector, which click together in a first longitudinal direction into a locked position, and have respective insulating casings complementary in shape and each having a number of longitudinal cavities for housing respective electric terminals.

[0002] Known connecting units have retaining means substantially comprising a tooth projecting from a casing wall of the first connector, and an elastic member projecting longitudinally from a casing wall of the second connector, flexible in a second direction crosswise to the first direction, and having a retaining projection which clicks on to the tooth into a coupled position defining the locked position of the connectors.

[0003] Connecting units of the type described also have a coupling detecting device for determining correct coupling of the connectors.

[0004] In one known embodiment described, for example, in US Patent 5,604,472, the coupling detecting device substantially comprises a platelike member fitted to the elastic member to slide in the first direction between a withdrawn preassembly position and a forward fully assembled position which is only achievable when the connectors are coupled correctly.

[0005] More specifically, the platelike member has an integral disabling arm flexible elastically in the second direction and having a free-end portion resting, in the preassembly position, against the retaining projection of the elastic member.

[0006] The tooth and the retaining projection click together along the side of the retaining projection resting on the free-end portion of the disabling arm, so that, when coupling the connectors, the tooth moves into the position previously occupied by the free-end portion of the disabling arm, which it pushes in the second direction and deforms elastically until it is released from the retaining projection.

[0007] Once the connectors are coupled, the disabling arm is in an elastically deformed configuration, in which it can slide in the first direction along the bottom surfaces of the tooth and retaining projection and click on to the retaining projection on the opposite side of the tooth into the fully assembled position, in which the disabling arm prevents release of the tooth and retaining projection.

[0008] In the event the connectors are not coupled correctly, the disabling arm obviously remains resting on the retaining projection, so that the coupling detecting device cannot be moved into the fully assembled position, thus detecting the fault.

[0009] Known units of the above type have the drawback of failing to provide for foolproof coupling of the connectors. That is, in the event the platelike member is not pushed right down in the first direction into the fully

assembled position, the free-end portion of the disabling arm may stop in a position other than the final position engaging the retaining projection. In which case, in the absence of retention by the disabling arm, the tooth and retaining projection may be released accidentally in use, with the obvious consequences this entails.

[0010] It is an object of the present invention to provide an electric connecting unit designed to eliminate the aforementioned drawback typically associated with known units.

[0011] According to the present invention, there is provided a connecting unit comprising:

- a first and a second connector mutually connectable, in a first direction, in a locked position and having, respectively, a first and a second casing for housing respective terminals;
- first and second coupling means carried respectively by said first and said second connector and which click together, in said first direction, into a coupled position defining said locked position of the connectors; and
- coupling detecting means mounted to slide, along said first casing and in said first direction, between a preassembly position and a fully assembled position achievable when said first and said second connector are coupled correctly; said coupling detecting means comprising a disabling member flexible elastically in a second direction crosswise to said first direction, and movable between an undeformed configuration, in which it pushes against said first coupling means to prevent said coupling detecting means from moving into said fully assembled position, and an elastically deformed configuration, in which it is allowed to slide, in said first direction, along said first and second coupling means in said coupled position to allow said coupling detecting means to move into said fully assembled position;

characterized in that said second coupling means comprise an opposing surface, which, in said coupled position, defines a temporary stop for an interacting portion of said disabling member as said coupling detecting means move into said fully assembled position, and which is cam-shaped to flex said disabling member into said elastically deformed configuration and to be passed over by the interacting portion only when additional thrust is exerted on said coupling detecting means in said first direction.

[0012] 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 an exploded view in perspective of an electric connecting unit in accordance with the present invention;

Figure 2 shows a larger-scale view in perspective

of a coupling detecting member of the Figure 1 unit; Figures 3 to 5 show larger-scale longitudinal sections of assembly of the Figure 2 coupling detecting member to the Figure 1 unit;

Figure 6 shows a partly sectioned view in perspective of the Figure 2 coupling detecting member in the fully assembled position on the connecting unit; Figure 7 shows a longitudinal section of the Figure 2 coupling detecting member in the configuration obtained in the event of incorrect coupling of the Figure 1 unit.

[0013] Number 1 in Figure 1 indicates as a whole an electric connecting unit in accordance with the present invention and comprising two electric connectors 2, 3 which click together into a locked position in a longitudinal direction A.

[0014] It should be stressed that terms such as "top", "bottom", "front" and "rear" used in the following description are in no way functionally limiting, and are used solely for the sake of clarity with reference to the position of unit 1 shown in Figure 1.

[0015] Connector 2 comprises a substantially parallelepiped-shaped insulating casing 4 defining a number of longitudinal through cavities 5; and a number of female electric terminals (not shown) housed in respective cavities 5 and connected to relative electric cables 6.

[0016] Connector 3 comprises a substantially parallelepiped-shaped insulating casing 7 having a rear portion 8 defining a number of longitudinal cavities (not shown) for housing respective male electric terminals 9 connectable to the female terminals of connector 2 and in turn connected to relative electric cables 10. Casing 7 also has a hollow front portion 11 defining a compartment for housing a complementary front portion 12 of casing 4 of connector 2.

[0017] Unit 1 also comprises a device 13 for click-on coupling connectors 2 and 3. Device 13 comprises a tooth 15 projecting integrally outwards from a top wall 16 of casing 7 and located close to a front opening 17 of front portion 11; and an elastic member 18 projecting longitudinally outwards from a top wall 19 of casing 4, defining a seat 20 for retaining tooth 15, and flexible elastically in a direction B perpendicular to direction A and to wall 19 to engage and release tooth 15.

[0018] More specifically, tooth 15 is defined by a flat rear side 21 perpendicular to direction A, and by an opposite flat front surface 22 in the form of an oblique ramp and diverging with respect to rear side 21 towards wall 16 of casing 7. On the opposite side to wall 16, tooth 15 is also defined by an oblique, flat top surface 23 extending between front surface 22 and rear side 21, and sloping downwards towards rear side 21.

[0019] Elastic member 18 comprises two parallel lances 25 projecting longitudinally from wall 19 and having respective free ends 25a connected integrally by a cross member 26, which is raised manually in direction B to release connectors 2 and 3. More specifically, at

the opposite end to cross member 26, lances 25 have respective ends 25b integral with an intermediate portion of wall 19.

[0020] Cross member 26 is located adjacent to a front wall 28 of casing 4, which, when connectors 2 and 3 are in the locked position, contacts an end wall (not shown) of the compartment defined by front portion 11 of casing 7.

[0021] More specifically, casing 4 is provided at the front with a projecting portion 30 substantially in the form of an upside down U, extending integrally from wall 19, and defining a longitudinal through compartment 31 through which lances 25 of elastic member 18 extend, and from which opposite ends 25a, 25b of lances 25 and cross member 26 project outwards. Projecting portion 30 is defined by a wall 32 parallel to wall 19, and by two lateral tabs 33 extending perpendicularly from opposite lateral edges of wall 32 and connected to casing 4.

[0022] As shown in Figures 3 to 7, adjacent to cross member 26, lances 25 are also connected to each other by a further cross member 34, which mainly provides for retaining tooth 15. More specifically, cross member 34 and the portions of lances 25 between cross member 34 and ends 25b define seat 20 for housing tooth 15.

[0023] Tooth 15 and elastic member 18 click together in direction A into a coupled position (Figures 3 to 6) defining the locked position of connectors 2 and 3. More specifically, in the coupled position, tooth 15 is housed inside seat 20 of elastic member 18, and a rear end surface 35 of cross member 34 defines a retaining surface for rear side 21 of tooth 15 to prevent withdrawal of tooth 15 from seat 20. End surface 35 is flat and perpendicular to direction A.

[0024] With reference to Figures 2 to 7, connector 2 also comprises a coupling detecting member indicated as a whole by 36 and which provides for determining correct coupling of connector 2 to connector 3.

[0025] Coupling detecting member 36 is housed through compartment 31 of projecting portion 30 of casing 4, and is connected to elastic member 18 to slide, in direction A, between a preassembly position (Figures 1 and 3) and a fully assembled position (Figures 5 and 6) achievable when connectors 2 and 3 are coupled correctly.

[0026] More specifically, coupling detecting member 36 comprises a relatively rigid main portion 40 substantially in the form of a rectangular plate, housed through projecting portion 30, and which slides on lances 25 of elastic member 18.

[0027] Main portion 40 has a wider rear end portion 41 which projects outwards of compartment 31, rests against a rear edge of projecting portion 30 in the fully assembled position, and is defined at the rear by a grooved oblique push surface 42 by which to push coupling detecting member 36 manually.

[0028] From end portion 41, there project downwards a central projection 45 elongated in direction A and which slides, in use, between lances 25 of elastic mem-

ber 18, and two shorter lateral projections 46 extending parallel to and on opposite sides of central projection 45, and which slide along the outer sides of respective lances 25.

[0029] As it moves between the preassembly and fully assembled position, coupling detecting member 36 is therefore guided by lances 25 of elastic member 18, and slides between lances 25 and wall 32 of projecting portion 30.

[0030] Coupling detecting member 36 has two front lateral projections 47 projecting from a front end of main portion 40, on the opposite side to elastic member 18, and which click releasably on to a front edge of wall 32 of projecting portion 30 to prevent withdrawal of coupling detecting member 36 from compartment 31; and main portion 40 has a projecting front edge 48 interposed between projections 47, projecting towards elastic member 18, and which releasably engages cross member 26 in the fully assembled position of coupling detecting member 36. More specifically, as coupling detecting member 36 moves into the fully assembled position, cross member 26 is passed over by projecting front edge 48 of main portion 40 and, once passed over, defines a releasable stop for edge 48.

[0031] Coupling detecting member 36 also comprises a disabling arm 50 projecting longitudinally from end portion 41 of main portion 40, engaging a through opening 51 in main portion 40, and which prevents coupling detecting member 36 from moving into the fully assembled position in the event connectors 2 and 3 are not coupled correctly.

[0032] More specifically, disabling arm 50 is flexible elastically in direction B, projects through opening 51 towards elastic member 18, and is normally in an undeformed configuration (Figure 7) in which it pushes against end surface 35 of cross member 34 of elastic member 18 to prevent coupling detecting member 36 from moving into the fully assembled position. As explained in detail later on, by interacting with tooth 15, disabling arm 50 is movable into an elastically deformed configuration in which a free-end portion 52 of disabling arm 50 is allowed to slide in direction A on tooth 15 and cross member 34, both in the coupled position, to enable coupling detecting member 36 to move into the fully assembled position.

[0033] Disabling arm 50 has a section tapering towards end portion 52, and is separated from main portion 40 along three sides. More specifically, the peripheral edge of opening 51 is shaped according to the lateral profile of disabling arm 50.

[0034] In the undeformed configuration, disabling arm 50 extends obliquely with respect to direction A, and slopes downwards from end portion 41 of main portion 40 towards cross member 34 of elastic member 18.

[0035] At end portion 52, disabling arm 50 defines a substantially L-shaped recess 53 which rests against an L-shaped top rear edge 54 of cross member 34 to prevent coupling detecting member 36 from moving into the

fully assembled position in the event connector 2 is not coupled, or is coupled incorrectly, to connector 3.

[0036] Disabling arm 50 also has an intermediate lateral projection 55 projecting towards elastic member 18 and which intercepts front surface 22 of tooth 15, in the coupled position, as coupling detecting member 36 moves into the fully assembled position. Given its oblique ramp shape, front surface 22 of tooth 15 can only be passed over by projection 55 when additional thrust is exerted by the user on coupling detecting member 36. This ensures against the thrust exerted on coupling detecting member 36 not being sufficient to move it into the fully assembled position, with all the consequences this entails in terms of reliable in-service connection of connectors 2 and 3.

[0037] The interaction between projection 55 and front surface 22 of tooth 15 flexes disabling arm 50 from the undeformed to the elastically deformed configuration.

[0038] More specifically, projection 55 has an end edge 56 which contacts and has the same oblique ramp shape as front surface 22 of tooth 15. End edge 56 connects a front surface 57 and a bottom surface 58 of projection 55, which are respectively the same shape as rear end surface 35 of cross member 34 and top surface 23 of tooth 15; and projection 55 is defined at the rear by an oblique end surface 59 sloping oppositely with respect to front surface 22 of tooth 15.

[0039] In the preassembly position (Figure 3), coupling detecting member 36 is positioned with lateral projections 47 engaging the front edge of wall 32 of projecting portion 30, and with wider end portion 41 detached from the rear edge of projecting portion 30; and disabling arm 50 is in the undeformed configuration, in which end recess 53 is aligned in direction A with edge 54 of cross member 34.

[0040] In the fully assembled position (Figures 5 and 6) of coupling detecting member 36, end portion 41 rests against the rear edge of projecting portion 30, projections 47 are detached from the front edge of wall 32, projecting front edge 48 engages cross member 26, and disabling arm 50 is positioned with projection 55 over tooth 15 and resting against cross member 34, and with end portion 52 interposed between cross members 26 and 34. In the above position, main portion 40 and disabling arm 50 of coupling detecting member 36 therefore cooperate, on opposite sides in direction B, with cross member 26 of elastic member 18 to prevent elastic member 18 from flexing and so possibly being released from tooth 15.

[0041] Unit 1 is assembled by sliding front portion 12 of connector 2 longitudinally in direction A into portion 11 of connector 3. At this stage, tooth 15 moves between lances 25 of elastic member 18 into contact with cross member 34, and, by virtue of the slope of front surface 22, is inserted inside the gap between cross member 34 and front portion 12 of casing 4, thus flexing elastic member 18 upwards in direction B.

[0042] The coupling of connectors 2 and 3 is completed as tooth 15 clicks inside seat 20 of elastic member 18, on the other side of cross member 34, so that elastic member 18 springs back into the undeformed configuration.

[0043] Tooth 15 is thus set to the coupled position connected to elastic member 18 (Figure 3), in which end surface 35 of cross member 34 defines a stop for rear side 21 of tooth 15 to prevent release of connectors 2 and 3.

[0044] At this point, to ensure connectors 2 and 3 are coupled correctly, coupling detecting member 36 is pushed in direction A from the preassembly to the fully assembled position, so that end portion 52 of disabling arm 50 slides along top surface 23 of tooth 15 until projection 55 contacts front surface 22 of tooth 15. Given the resistance of front surface 22, additional thrust must be exerted on coupling detecting member 36 to get projection 55 over surface 22 and so deform disabling arm 50 elastically upwards in direction B (Figure 4).

[0045] The additional thrust enables projection 55 to get over top surface 23 of tooth 15, and end portion 52 to slide across cross member 34 and between cross members 34 and 26. At the same time, projecting front edge 48 of main portion 40 of coupling detecting member 36 slides over and clicks on to cross member 26 (Figures 5 and 6).

[0046] In the fully assembled position, elastic member 18 is therefore retained in the coupled position, connected to tooth 15, by the simultaneous action of end portion 52 of disabling arm 50 located between cross members 26 and 34, and by projecting front edge 48 of main portion 40 of coupling detecting member 36 engaging top cross member 26.

[0047] Connectors 2 and 3 can only be released by first acting on coupling detecting member 36 to restore it to the preassembly position.

[0048] In the event connectors 2 and 3 are not fully or correctly coupled (Figure 7), i.e. tooth 15 is located outside seat 20 of elastic member 18, with front surface 22 facing the opposite surface of cross member 34 to end surface 35, disabling arm 50 presses against cross member 34 when coupling detecting member 36 is moved in direction A from the preassembly position. More specifically, end recess 53 of disabling arm 50 engages edge 54 of cross member 34, thus preventing coupling detecting member 36 from moving into the fully assembled position, and so indicating connectors 2 and 3 are not coupled correctly.

[0049] The same also applies in the event connector 2 is not yet coupled to connector 3, thus preventing coupling detecting member 36 from being moved accidentally into the fully assembled position before unit 1 is assembled.

[0050] The advantages of unit 1 according to the present invention will be clear from the foregoing description.

[0051] In particular, when connectors 2 and 3 are in

the locked position, front surface 22 of tooth 15 defines an obstacle preventing coupling detecting member 36 from moving in direction A into the fully assembled position, unless sufficient additional thrust is exerted on coupling detecting member 36 to get projection 55 of disabling arm 50 past surface 22. Once the obstacle posed by surface 22 is overcome, the additional thrust applied definitely ensures coupling detecting member 36 reaches the fully assembled position, by it being physically impossible, for reasons of inertia, for coupling detecting member 36 to be arrested along the portion of its travel following contact with surface 22.

[0052] Clearly, changes may be made to unit 1 without, however, departing from the scope of the present invention.

[0053] Though described with reference to an electric connecting unit, the invention may also be applied to other types of, and in particular optical or hybrid, connecting units.

Claims

1. A connecting unit (1) comprising:

- a first and a second connector (2, 3) mutually connectable, in a first direction (A), in a locked position and having, respectively, a first and a second casing (4, 7) for housing respective terminals;
- first and second coupling means (18, 15) carried respectively by said first and said second connector (2, 3) and which click together, in said first direction (A), into a coupled position defining said locked position of the connectors (2, 3); and
- coupling detecting means (36) mounted to slide, along said first casing (4) and in said first direction (A), between a preassembly position and a fully assembled position achievable when said first and said second connector (2, 3) are coupled correctly; said coupling detecting means (36) comprising a disabling member (50) flexible elastically in a second direction (B) crosswise to said first direction (A), and movable between an undeformed configuration, in which it pushes against said first coupling means (18) to prevent said coupling detecting means (36) from moving into said fully assembled position, and an elastically deformed configuration, in which it is allowed to slide, in said first direction (A), along said first and second coupling means (18, 15) in said coupled position to allow said coupling detecting means (36) to move into said fully assembled position;

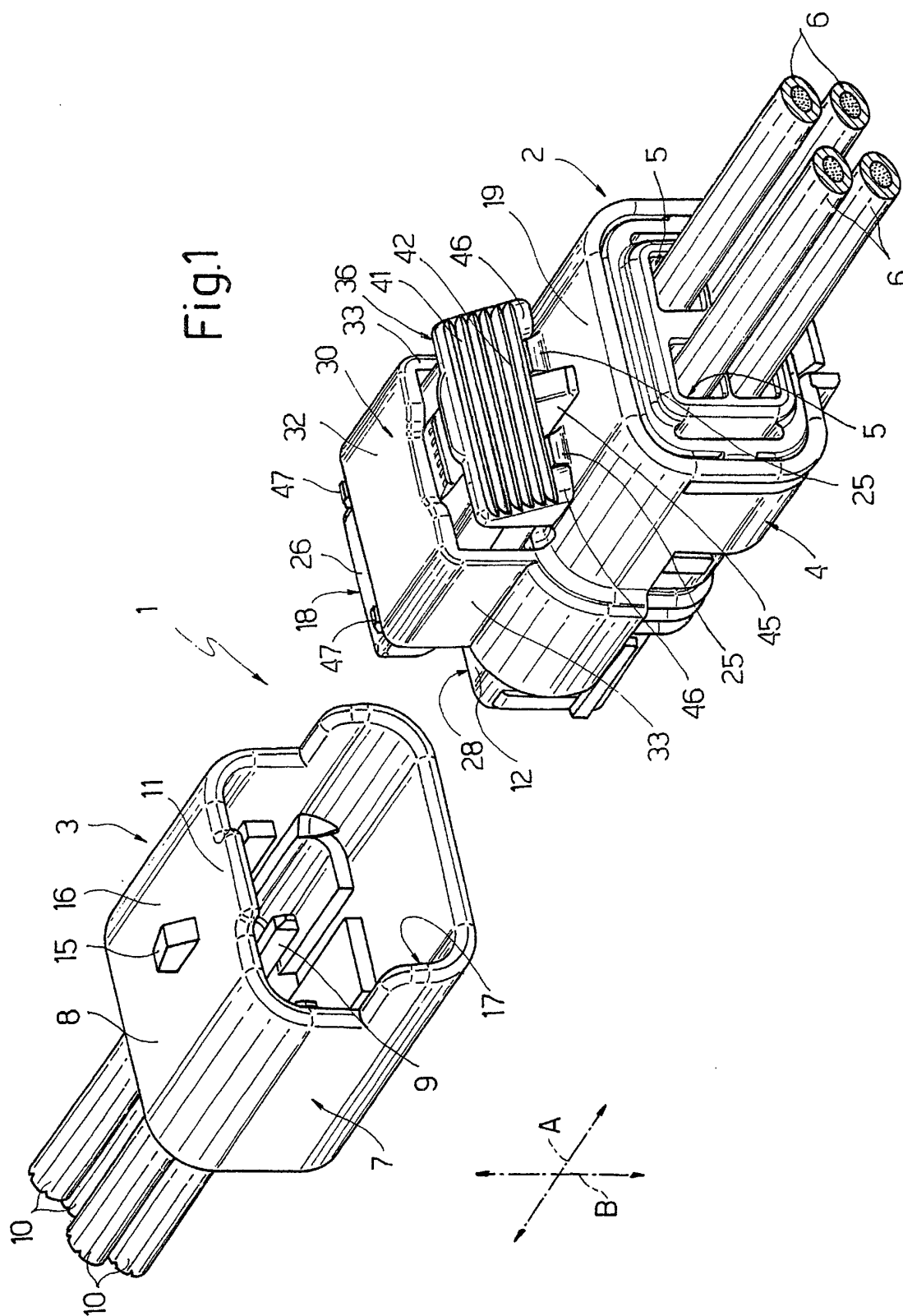
characterized in that said second coupling means (15) comprise an opposing surface (22),

which, in said coupled position, defines a temporary stop for an interacting portion (55) of said disabling member (50) as said coupling detecting means (36) move into said fully assembled position, and which is cam-shaped to flex said disabling member (50) into said elastically deformed configuration and to be passed over by the interacting portion (55) only when additional thrust is exerted on said coupling detecting means (36) in said first direction (A).

2. A unit as claimed in Claim 1, **characterized in that** said opposing surface (22) of said second coupling means (15) is in the form of an oblique ramp.
3. A unit as claimed in Claim 2, **characterized in that** said interacting portion is defined by an intermediate lateral projection (55) of said disabling member (50) having an end edge (56), which contacts said opposing surface (22) of said second coupling means (15) and has the same oblique ramp shape as the opposing surface (22).
4. A unit as claimed in any one of the foregoing Claims, **characterized in that** said second coupling means comprise a tooth (15) projecting from a defining wall (16) of said second casing (7) and defined at one end by said opposing surface (22); and **in that** said first coupling means comprise an elastic member (18), which projects, in said first direction (A), from a defining wall (19) of said first casing (4), is elastically flexible in said second direction (B), and receives in sliding manner said coupling detecting means (36).
5. A unit as claimed in Claim 4, **characterized in that** said elastic member (18) comprises a first retaining portion (34) extending crosswise to said first and said second direction (A, B) and having an end surface (35) defining, in said coupled position, a retaining surface for said tooth (15), and, in the event said first and said second connector (2, 3) are coupled incorrectly, a stop for arresting said disabling member (50) in said first direction (A).
6. A unit as claimed in Claim 4 or 5, **characterized in that** said elastic member (18) is housed through a through compartment (31) defined by said first casing (4); and **in that** said coupling detecting means (36) are mounted to slide through said compartment (31) between said elastic member (18) and a cover wall (32) of the compartment (31) perpendicular to said second direction (B).
7. A unit as claimed in any one of Claims 4 to 6, **characterized in that** said coupling detecting means (36) comprise a relatively rigid structural member (40) connected to said elastic member (18) to slide in said first direction (A); and **in that** said disabling

member (50) comprises a flexible arm projecting from said structural member (40) in said first direction (A).

8. A unit as claimed in Claim 7, **characterized in that** said structural member (40) comprises releasable first retaining means (47) which click on to an edge of said cover wall (32) facing said second connector (3) to define said preassembly position of said coupling detecting means (36).
9. A unit as claimed in Claim 7 or 8, **characterized in that**, in said fully assembled position, said structural member (40) and said disabling member (50) cooperate, on opposite sides in said second direction (B), with a second retaining portion (26) of said elastic member (18) to prevent the elastic member (18) from flexing.
10. A unit as claimed in Claim 9, **characterized in that** said elastic member (18) comprises two parallel flexible lances (25) connected integrally to each other, at their respective free ends (25a), by said second retaining portion (26), and at an intermediate point by said first retaining portion (34); said structural member (40) comprising releasable second retaining means (48) which click on to said second retaining portion (26) of said elastic member (18) in said fully assembled position; said disabling member (50) having a free-end portion (52) movable, in use, between said lances (25) of said elastic member (18), and which is interposed between said first and said second retaining portion (34, 26) of the elastic member (18) in said fully assembled position.



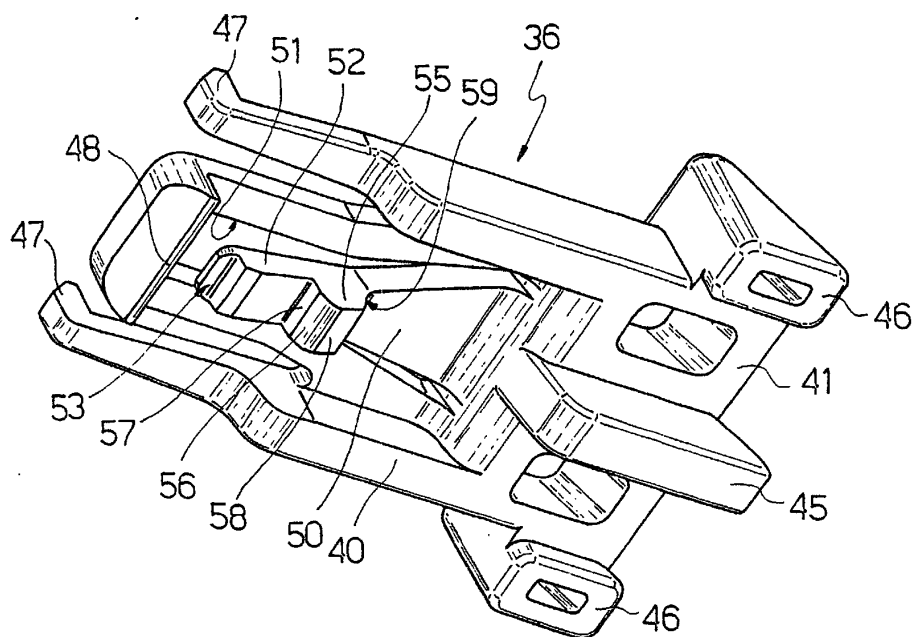


Fig.2

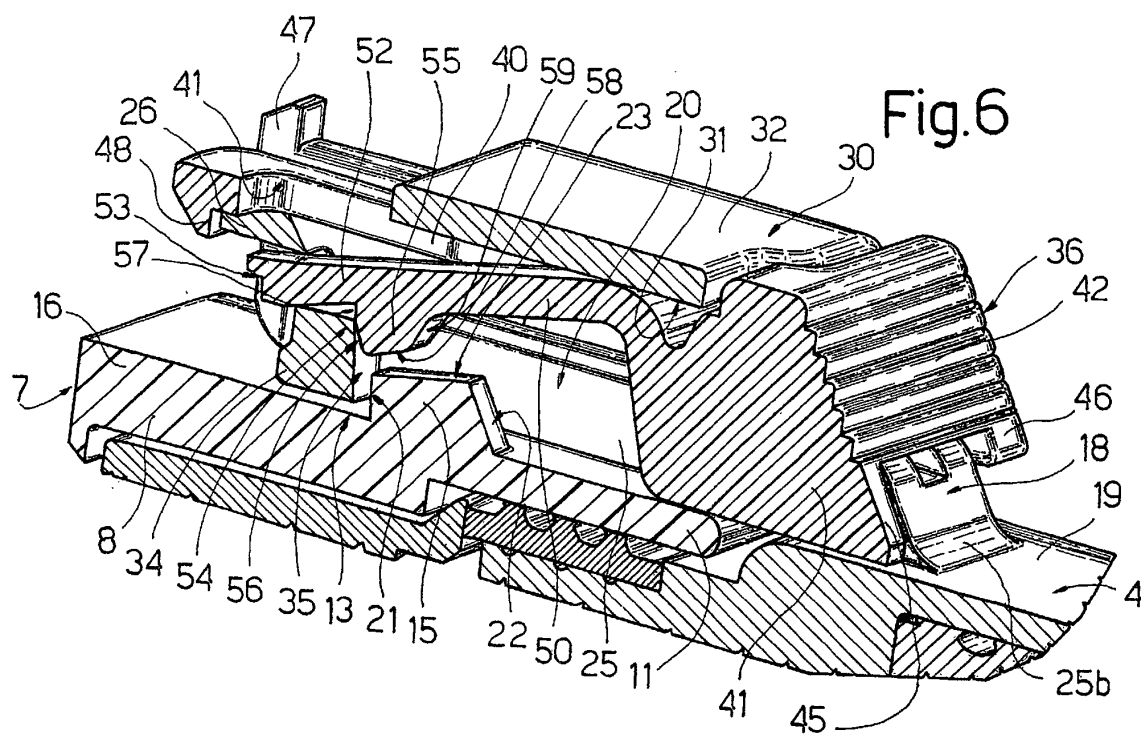
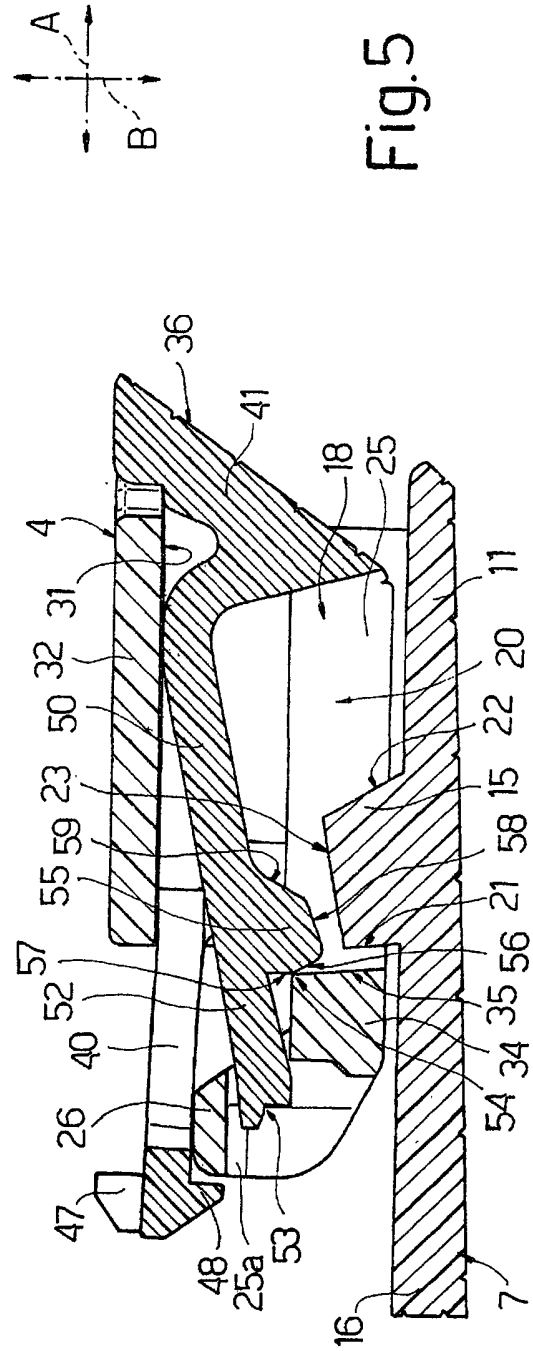
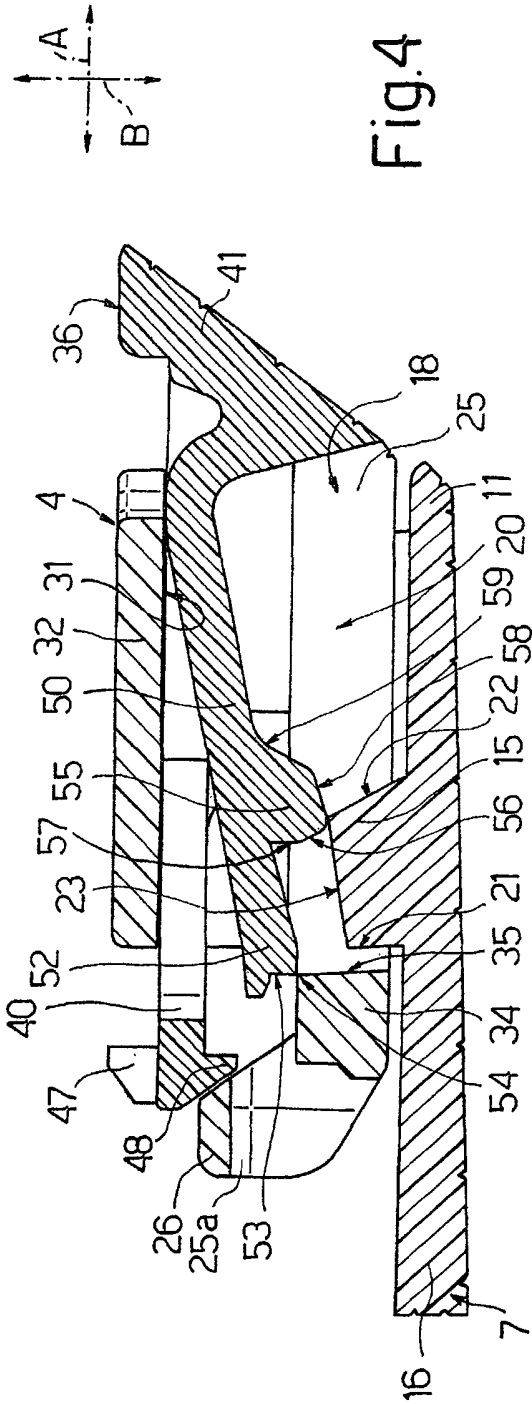


Fig.6



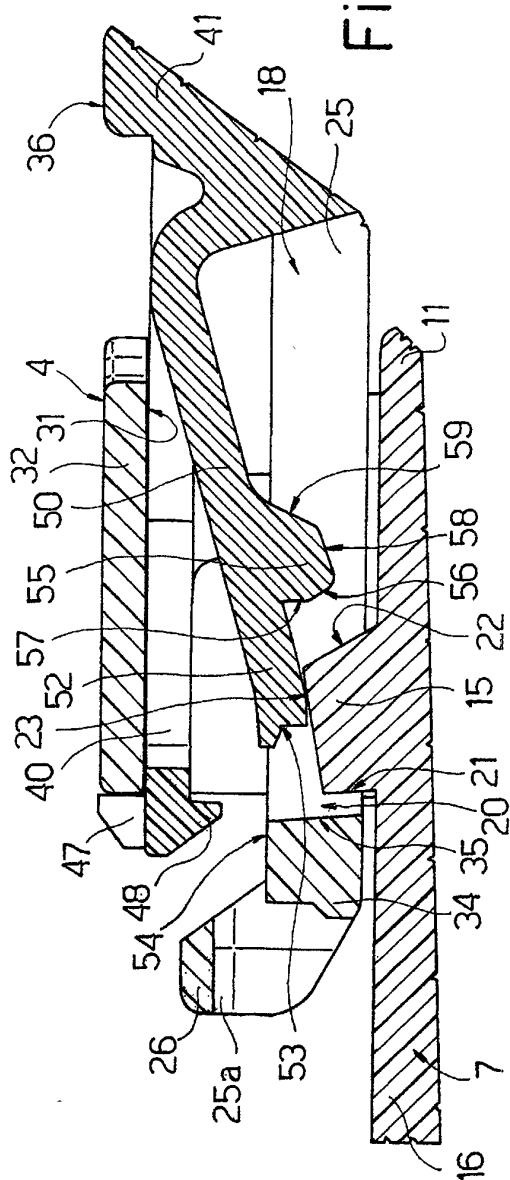
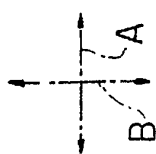


Fig. 3

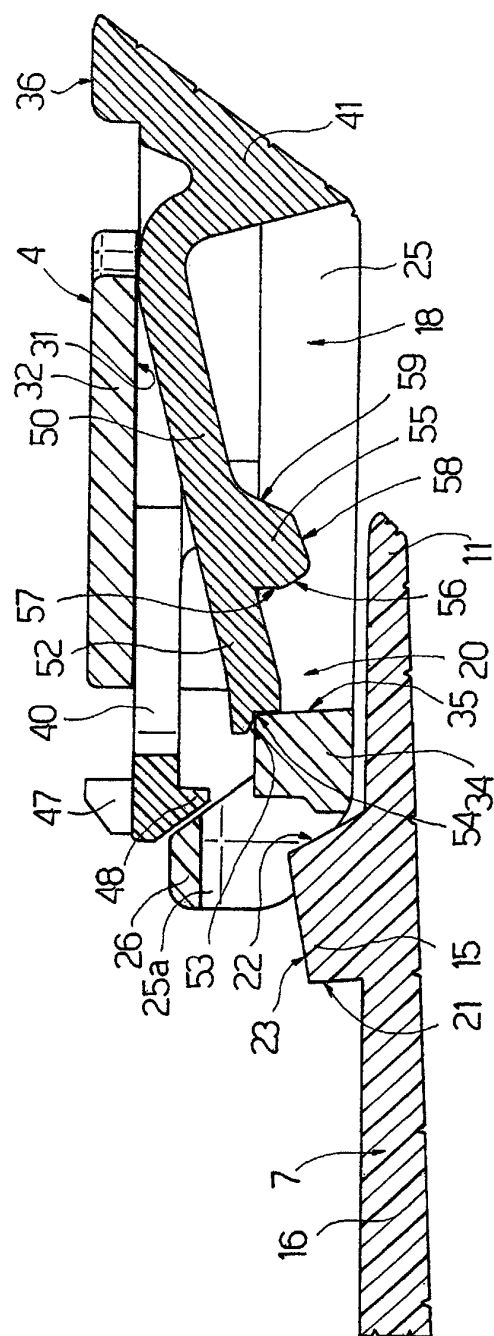
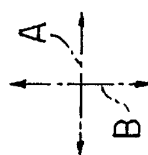


Fig. 7