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(54) **Self-locking electrical plug connector particularly for automotive applications**

(57) Described is a self-locking electrical plug connector with a cylindrical plug (1), a counterplug (21) which is complementary to (1), a bayonet ring (23) which is rotatable about the housing (22) of the counterplug (21) for locking the plug (1) into the counterplug (21). The bayonet ring (23) is gripped by at least one tension spring (66). Around the bayonet ring (23) is arranged a rotatable collar (24) which on being closed, releases the bayonet ring (23) which is interlocked with the counterplug housing (22), so that the bayonet ring is closed by the power of the tension spring (66).

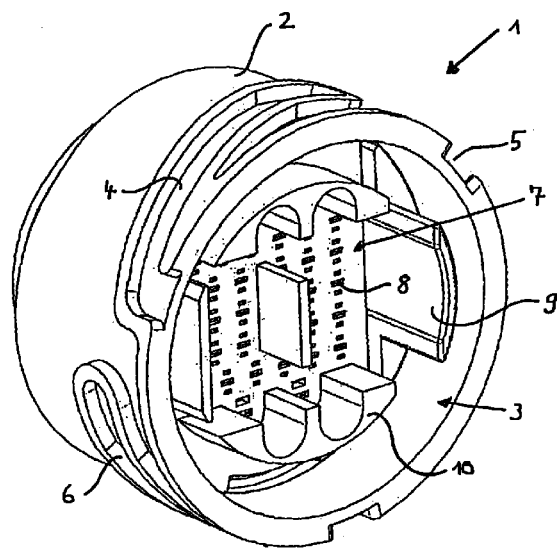


Fig 1

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Description

[0001] The invention concerns a self-locking electrical plug connector, in particular for automotive applications with a cylindrical plug, a counterplug which is complementary thereto and a bayonet ring which is rotatable about the housing of the counterplug for the locking of the plug into the counterplug.

[0002] Such plug connectors are preferably located in the wall of a housing in order to link the electrical connectors of a device located within the housing with outside current conductors. For example, such plug connectors are used as gear pre-cabling. Especially in the area of motor vehicles there occur, apart from relatively high operating temperature, strong vibrations which may lead to the loosening of the plug connector.

[0003] In order to make the plug connector safe from becoming loosened, existing plug connectors have locking devices which are intended to lock the plug into the counterplug. During fitting, care must be exercised to ensure that the locking device really *is* locked into place. It can happen in practice that the fitter will only bring the locking device (for example a bayonet ring) into an intermediate position in which, whilst the plug admittedly is inside its counterplug, the locking device is not in its correct locked-in position. In this case, the plug connector may become loosened spontaneously through strong vibrations during use of the vehicle.

[0004] Patent Specification DE 199 16 075 refers to a plug connector which has a rotatable sliding ring and a spring component so that when the bayonet ring of the plug connector is closed, an increasing restoring force builds up on the said bayonet ring. Then the combined action of the bayonet ring, the spring component and the rotatable sliding ring cause the electrical plug connector to loosen spontaneously, if the bayonet ring is incompletely closed.

[0005] According to this application, plug connectors have a certain number of electrical contacts. The number of these contacts can be of the order of 40. Frictional forces arise between the contact pin and the contact socket which must be overcome during the process of insertion of the plug. This is particularly disadvantageous for the aforementioned plug connector, because during the process of insertion of the plug into the counterplug, the fitter must overcome not only the ongoing frictional forces, but also the increasing restoring force caused by the closing of the bayonet ring.

[0006] The invention has the basic purpose of creating a self-locking electrical plug connector which can be fitted rapidly and without the expenditure of increased effort.

[0007] This purpose is accomplished through the characteristics of patent Claim 1.

[0008] The self-locking plug connector according to the invention comprises a cylindrical plug, a counterplug which is complementary thereto and a bayonet ring which can be rotated about the counterplug housing for

the purpose of locking the plug into the counterplug. At least one tension spring can grip the bayonet ring. A rotatable collar can be arranged around the bayonet ring which will, on being closed, release the bayonet cap locked into the counterplug so that the latter is able to be closed by the power of the tension spring.

[0009] The combined action, according to the invention, of the bayonet ring, the tension spring and the collar brings it about that after the actuation of the collar which must have passed a certain point, the electrical plug connector automatically arrives its closed position. "Closed position" means that the two plug "halves" are pushed into one another, their electrical contacts are electrically joined, that the plug connectors are locked together by means of the bayonet ring and that the spring is not under tension. If the collar is not actuated at all or if the collar does not reach this point, the plug connector will remain in its open position. This means that the tension spring is under tension, the plug connector is not locked and there is no electrical connection between the plug and the counterplug. However, the plug parts (the housing of the plug and counterplug) may be engaged.

[0010] The invention offers the advantage that the plug connector is in a well defined condition, either in the closed position or in the open position. The fitter can therefore very quickly recognize which plug connector is, or is not, locked. A further particularity resides in the fact that only a very small amount of force is needed to lock the plug connector. The fitter only needs to let the plug and the counterplug engage and actuate the collar. The brief turning of this collar requires very little force. Only the passing of a certain point temporarily calls for an increased turning torque on the collar. This releases the bayonet ring and the spring under tension allows it to turn about its own axis and in the process to lock the plug connector.

[0011] An advantageous feature of the invention is that the tension spring is fixed to the bayonet ring and to the counterplug, which makes possible a compact construction of the plug connector.

[0012] A further advantageous feature of the invention is that when closing the collar, it is possible to loosen the locked connection between an inward-projecting locking hook of the bayonet ring and an outward-pointing locking lug of the counterplug through an inward-projecting tongue running in a rotating direction. This locked connection defines the aforementioned point.

[0013] This special feature offers the advantage that there are no parts which project from the collar which surrounds the plug connector. Accordingly, the collar defines the outer dimensions of the plug connector.

[0014] A further advantageous feature of the invention is that the collar exhibits at least one inward-projecting projection which, on the collar being slackened, engages at least one corresponding outward-projecting

shoulder of the bayonet ring, so that the spring comes under tension. This has the advantage that when the connection between the plug and counterplug is loosened, the plug connector with the aforementioned advantages can again be closed. Since on slackening the collar, the counterplug is pushed into the plug, only the bayonet ring is engaged and the tension spring which is suspended between the latter and the counterplug is again placed under tension.

[0015] A further advantageous feature of the invention consists in the fact of the collar possessing at least one front locking arm which runs in the direction of plugging for interlocking with the bayonet ring. This further development offers the advantage that the collar can be arranged on the bayonet ring in a manner which makes it loss proof and by means of the projections it is at the same time possible to achieve a rotation guidance.

[0016] A further favorable feature of the invention is that, on the circumference of the bayonet ring, are molded two outward-directed rails running in the direction of plugging whose distance apart is so chosen that the front part of the tongue can be positioned between the rails without any clearance. The plug connector is as a rule supplied in this condition. To actuate the collar, it is necessary to overcome a bump defined by the position of the tongue between the rails. This will effectively prevent any unintentional loosening of the spring loading, since the collar has no freedom to move when in its delivery condition.

[0017] A further advantageous feature of the invention is that a coding is molded into one of the plug fronts which project beyond the electrical contacts and can be introduced into its complementary coding located on the other plug front, before the respective electrical contacts of the plug and those of the counterplug are electrically connected. This opens up the advantageous possibility that no contact of the plug and the counterplug ensues for as long as they are engaged, because this would lead to the erroneous conclusion that the plug connector is correctly connected, current being able to pass through it without difficulty. However, due to strong vibration, this plug connector would become loosened in time.

[0018] Only when the bayonet ring is released should an electrical link come into being between the plug and counterplug with the sliding channel guide and the lug bringing the two plug "halves" together. In this way the plug connector is locked and is in its closed position. This gives the fitter the possibility of checking, by means of a simple current test, on the correct locking of the plug connector.

[0019] An embodiment example of the invention is represented in the drawings and will be described in greater detail below, where further particularities and advantages of the invention will become clear.

[0020] The following is shown by the figures:

Fig 1 a perspective view of a plug according to

the invention;

Fig 2 an assembled counterplug according to the invention;

Fig 3 an exploded view of the counterplug from Fig 2;

Fig 4 a perspective view of the rearside of the assembled counterplug from Fig 2 with the plug from Fig 1 inserted;

Fig 5a-5d are perspective views of plane E section of the counterplug according to the invention from Fig 4

Fig 6a,6b show the plug connector according to the invention respectively in the open and the closed position

[0021] Fig 1 shows a perspective view of a plug according to the invention. This plug 1 has a cylindrical housing with an opening 3 and sliding channels 4, 5 and 6 running obliquely. In opening 3 there is an insert 7 with chambers 8 running in the direction of plugging, for electrical contacts (not shown), which are locked by a cross-slide 9 with coding. On the front side of the insert 7 is a molded coding 10 stretching in the direction of plugging. On the rear side of plug 1 (see Fig 6) there are cable lead apertures 11, which lead to the chambers 8. On the circumference 12 which is somewhat offset inwards is machined the channel 13 to receive cable bushings. Between the circumference 12 and the rear side 14 is an intermediate space 15 for receiving a fixing, of for example, a gearbox wall.

[0022] Fig 2 shows in perspective view the front of an assembled counterplug 21 according to the invention. Fig 3 shows an exploded view of the said counterplug. The counterplug 21 has a counterplug housing 22, a bayonet ring 23 and a collar 24. The counterplug housing 22 also has on its front 20 an opening 25 into which a further insert 26 with chambers 27 running in the direction of plugging for electrical contacts (not shown) and a further cross-slide 28 is inserted, with coding for locking the electrical contacts in chambers 27. Furthermore, insert 26 of the counterplug has a coding 33 which is complementary to the coding 16 of the insert 7. Outside a profiled gasket 29 has been drawn onto the counterplug housing 22. On the circumference of the counterplug housing 22 are various molded elements which are listed individually below, from the front 20 to the rear 30. Somewhat offset from the gasket 29, two guide channels 31 and 32 are molded which frame a spring chamber 36 and are connected to the fastening of one end of a spring (not shown) via the cross-rail 37. Surrounding the counterplug housing 22 is arranged a cylindrical rotatable bayonet ring 23 with three inward-pointing pegs 40, 41 and 42. From the cylinder wall 43 of the bayonet ring 23 which is offset inwards runs, over only a part of the circumference, a sliding rail 44 with two channels 45 and 46 pointing in the direction of plugging. Surrounding this bayonet ring 23 is a rotatable collar 24. This collar 24

has on the front and running in the direction of plugging locking arms 47, 48, 49 and 50 for guiding the rotation of collar 24 about the bayonet ring 23. The locking arms 47 to 50 have an inward-pointing lug 51 framed by a slanting ramp 52 and a vertical plane 53. The collar 24 is of about the same length as the bayonet ring 23. Into the cylindrical wall 57 of the collar 24 has been cut a first recess 58a. At the same distance from the front side, although offset by a certain angle, a second recess 58b has been cut which also runs in the direction of the circumference.

[0023] Fig 4 shows an perspective view of the rear side 30 of the assembled counterplug 21 with the plug 1 inserted. In this view, the diametrically opposed inward-pointing projections 59 and 60 of the collar 24 which rest on the rear side 30 of the counterplug housing 22 can easily be recognised. From the said rear side 30 project shoulders 61 and 62. When the collar 24 is advanced, the projections 59 and 60 push against the shoulders 61 and 62 as shown in the figure. The advance of the collar 24 proceeds in the direction A of the arrow.

[0024] Fig 6b shows the plug connector in the open position, where the pegs 40 to 42 are in front of their corresponding sliding channels 4 to 6. The fronts of both the plug "halves" 1 and 21 are engaged inside one another. A fitter only needs to slide the counterplug 21 from Fig 2 onto the plug 1 from Fig 1 so that the pegs 40 to 42 slide into the channels 4 to 6. As the next step, the collar 24 is turned in the direction Z so that the bayonet ring 23 which is located between the counterplug housing 22 and the collar 24 is released in order that it can turn about its own axis and pegs 40 to 42 slide into the end 16 of the sliding channels as seen in Fig 5b which shows the closed position of the plug connector. The plug 1 and the counterplug 21 are brought together and the plug connector is locked by the bayonet ring 23.

[0025] Figs 5a to 5d show in perspective a plane E section of the counterplug 21 from Fig 4. The section runs parallel to the guide rail 32 so that the spring chamber 36 becomes visible. From inside to outside it is possible to see the counterplug housing 22 with the chambers 27. Between the inner circumference 62 of the bayonet ring 23 and the shell surface 65 of the counterplug 22 is located the spring chamber 36. On the shell surface 65 is molded in the 12 o'clock position a locking lug 69, framed by a ramp 67 and a vertical plane 68. In the 9 o'clock position can be seen the cross-rail 37 which belongs to the counterplug housing 22 and which secures one end of a tension spring 66 located in the spring chamber 36.

[0026] Projecting further outwards can be seen the bayonet ring 23 with a sliding rail 44, offset inwards (in a position intermediate between 9 and 12 o'clock). On this are molded both the cross-rails 45 and 46. An inward-pointing locking hook is molded on one side of the outer shell surface 43 of the bayonet ring 23 and is aligned with the said surface. The locking hook has a substantially triangular inward-pointing locking lug 71 on which

is molded an inward-pointing cubical block 72 which slides on the shell surface 65 of the counterplug housing 22. At the free end of the locking hook 70 is an aperture 74 into which the locking hook 73 projects. The second fastening cross-rail 78 of the tension spring 66 is molded on, starting clockwise from the locking hook 70 and offset by a certain angle.

[0027] Entirely outside can be recognized the collar 24. As already stated earlier, the collar 24 has two recesses 58a and 58b where the first recess 58a is located over the sliding rail 44 (this is not true of 58b). Projecting into the said recess 58a, a slightly inward-pointing tongue 79 is molded on the collar 24, so that its front part can rest on sliding rail 44, as shown in Fig 5a.

[0028] With the help of Figs 5a to 5c, the manner of functioning of the locking mechanism of the plug connector is explained below.

[0029] In Fig 5a can be seen the condition on delivery of the counterplug. In this condition, the block 72 rests against the locking lug 68. The tension spring 66 is extended as far as it can be. The tongue 79 between rails 45 and 46 is in the 10 o'clock position. Normally, plug 1 is fastened to a housing wall, that is to say, when the counterplug is pushed onto the said plug 1 as shown in Fig 6b, the counterplug housing 22 cannot rotate because of the codings 10 and 33, since these are cross-engaged. Therefore the housing 22 of the counterplug 21 shown in Figs 5a to 5d will not change its position, that is to say, the locking lug 69 will remain in the 12 o'clock position and the cross-rail 37 in the 9 o'clock position.

[0030] When the fitter now pulls the collar 24 in direction Z, only the collar 24 will move where the tongue 79 will pass the rail 45 and is led onto sliding rail 44, arrive at the opening 74 and slide under hook 73, as can be seen in Fig 6b. There it is easy to see that neither the counterplug housing 22, nor the bayonet ring 23 have changed their respective positions. If the fitter now turns the collar 24 further in direction Z, the locking hook 70 is lifted by the tongue 79 and arrives at the first recess 58a so that block 72 is lifted over the locking lug 69. At that moment the stored spring energy will be released. The spring under tension 66 therefore contracts, so that the fastening rail 78 of the bayonet ring 23 which has hitherto been in the 1 o'clock position will now be drawn clockwise into the 4 o'clock position (see Fig 6c). As already stated earlier, the pegs 40 to 42 of the bayonet ring 23 will simultaneously slide on end 16 of the sliding rails 4 to 6 and lock the plug connector. It should be noted that in this closed position the spring 66 can be under slight tension so that the pegs 40 to 42 will be held against the end 16 of the sliding rail.

[0031] The opening of the plug connector will be explained with the help of Figs 4 and 5c and 5d.

[0032] Figs 5c and 6a show the counterplug in the closed position. To open the plug connector, the collar 24 is turned in the direction A of the arrow (anti-clockwise). The projections 59 and 60 push against the

shoulders 61 and 62 or may already be lying against shoulders 61 and 62 and thereby engage the bayonet ring 23 (see Fig 4). As before, the counterplug housing 22 is fast and therefore not able to move. The collar 24 and the bayonet ring 23 turn in synchronisation (anti-clockwise) where the tongue 79 as shown in Fig 5c (12 o'clock position) is now rotated into the 9 o'clock position. During this process, block 72 slides on the shell surface 65, arrives at the ramp 67 which lifts the locking hook 70 into the recess 58b and arrives, after passing over locking lug 69, once again on the shell surface 65 and there presses against the vertical plane 68. Since the distance between the crossrail 37 and the fixing rail 78 increases all the time, the spring 66 passes under tension. Simultaneously with the advance of the bayonet ring 23, the pegs 40 to 42 slide out of sliding channels 4 to 6. The lock is loosened, the plug "halves" are guided apart and may break the connection (see Fig 6b). If the locking hook 70 has passed the locking lug 69, the counterplug 21 will then be in the open position. The fitter needs only to rotate the collar 24 slightly in direction Z so that the tongue 79 will arrive between the rails 45 and 46, that is to say, the tongue is in the 10 o'clock position as shown in Fig 5a. The counterplug according to the invention is now ready for renewed introduction.

Claims

1. Self-locking electrical plug connectors with

- a cylindrical plug (1),
- a counterplug (21) complementary to plug (1),
- a bayonet ring (23) which is rotatable about the housing (22) of the counterplug (21) for locking the plug (1) into the counterplug (21),

characterised by the fact that at least one tension spring (66) grips the bayonet ring (23) and that a rotatable collar (24) is arranged around the bayonet ring (23) which on closing interlocks with counterplug housing (22) and releases the bayonet ring (23) so that this is closed by the power of tension spring (66).

2. Plug connector according to Claim 1, characterised by the fact that the tension spring (66) is suspended from the bayonet ring (23) at one end and from the counterplug housing (22) on the other end.

3. Plug connector according to at least one of the preceding claims, characterized by the fact that on closing the collar (24), the locking connection between an inward-projecting locking hook (70) of the bayonet ring (23) and an outward-pointing locking lug (69) of the counterplug housing (22) is able to be loosened by means of an inward-projecting tongue (79) of the collar (24) which runs in a rotat-

ing direction.

4. Plug connector according to at least one of the preceding claims, characterised by the fact that the collar (24) has at least one projection (53 and 60) which projects towards the bayonet ring (23) and which, on the collar (24) being advanced, engages at least one corresponding shoulder (61, 62) of the bayonet ring (23) so that the spring (66) is under tension.

5. Plug connectors according to at least one of the preceding Claims characterised by the fact that the collar (24) has at least one locking arm (47, 48, 49, 50) running along the front and in the direction of plugging for interlocking with the bayonet ring (23).

6. Plug connector according to at least one of the preceding Claims, characterised by the fact that the cylinder wall of the collar (24) has at least one recess (58a, 58b) running in the direction of the diameter for receiving the locking hook (70).

7. Plug connector according to Claim 6, characterised by the fact that the tongue (79) projects into the first recess (58a) so that on closing the collar (24), the locking hook (70) is lifted by the tongue (79) into the said first recess (58a) and that the second recess (58b) is so arranged that on advancing of the collar (24), the locking hook (70) is lifted by the locking lug (69) into the said second recess (58b).

8. Plug connector according to at least one of the preceding Claims, characterised by the fact that two outward-pointing rails (45, 46) running in the direction of plugging are molded on the circumference (44) of the bayonet ring (23), where the distance between them is so chosen that the front portion of the tongue (79) is positioned between the rails (45,46) without any clearance.

9. Plug connectors according to at least one of the preceding Claims, characterised by the fact that onto the fronts of both the plug "halves" (1, 21) is molded a coding (10) projecting above the electrical contacts which can be introduced into its complementary coding (33) located on the other plug front, before the electrical contacts of the plug (1) and the electrical contacts of the counterplug (21) are electrically joined.

10. Plug connectors according to at least one of the preceding Claims, characterised by the fact that the plug (1) has on its circumference at least one sliding rail (4, 5, 6) running at an angle to the direction of plugging for receiving a peg (40, 41, 42) molded on the bayonet ring (23).

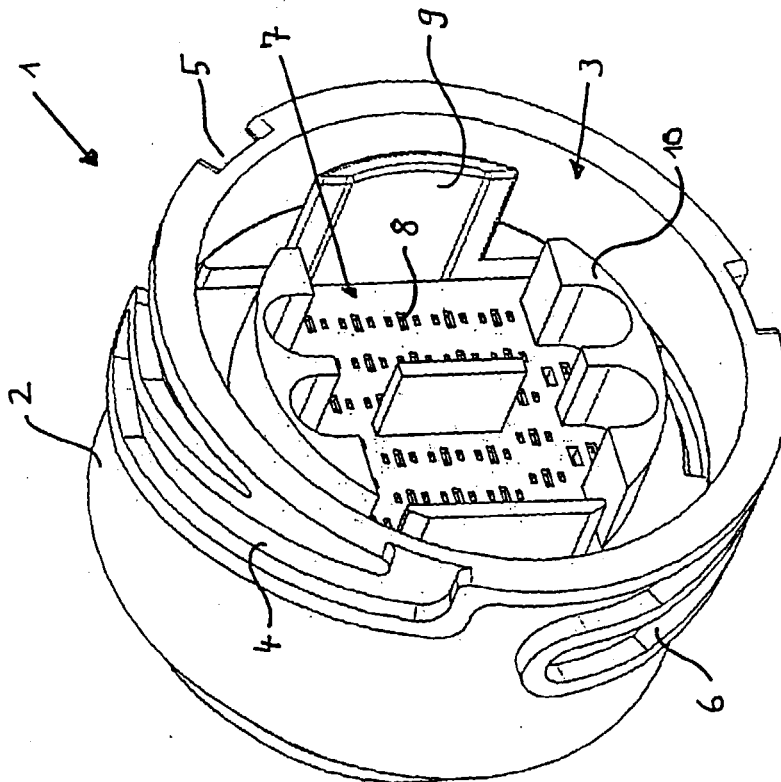


Fig 1

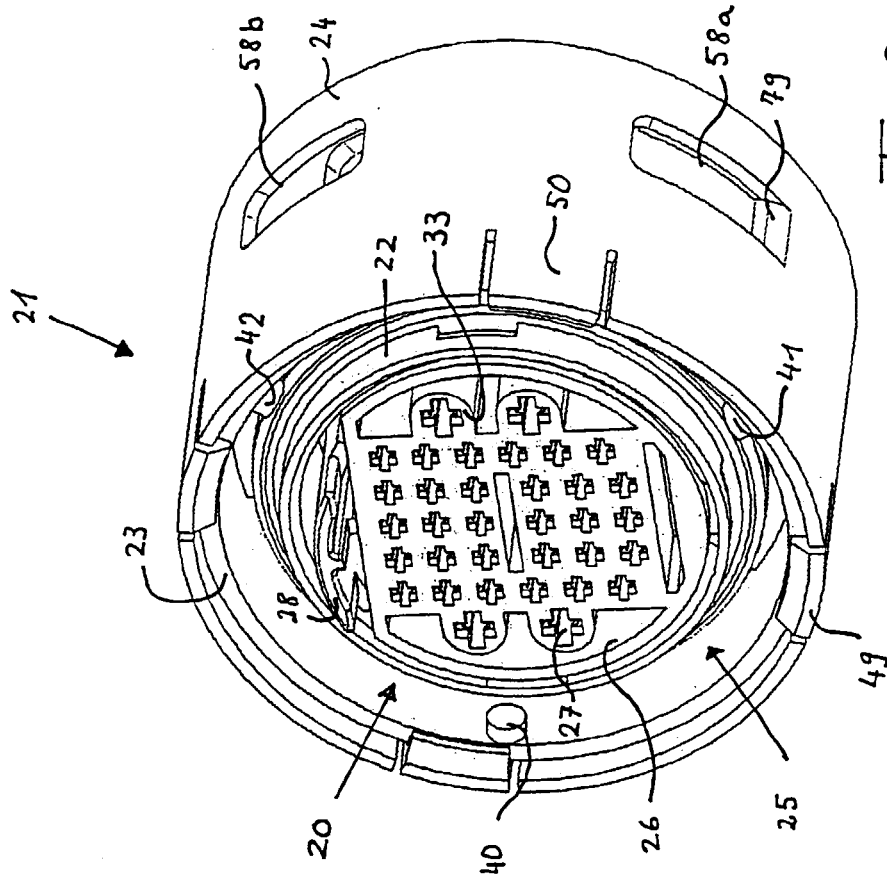
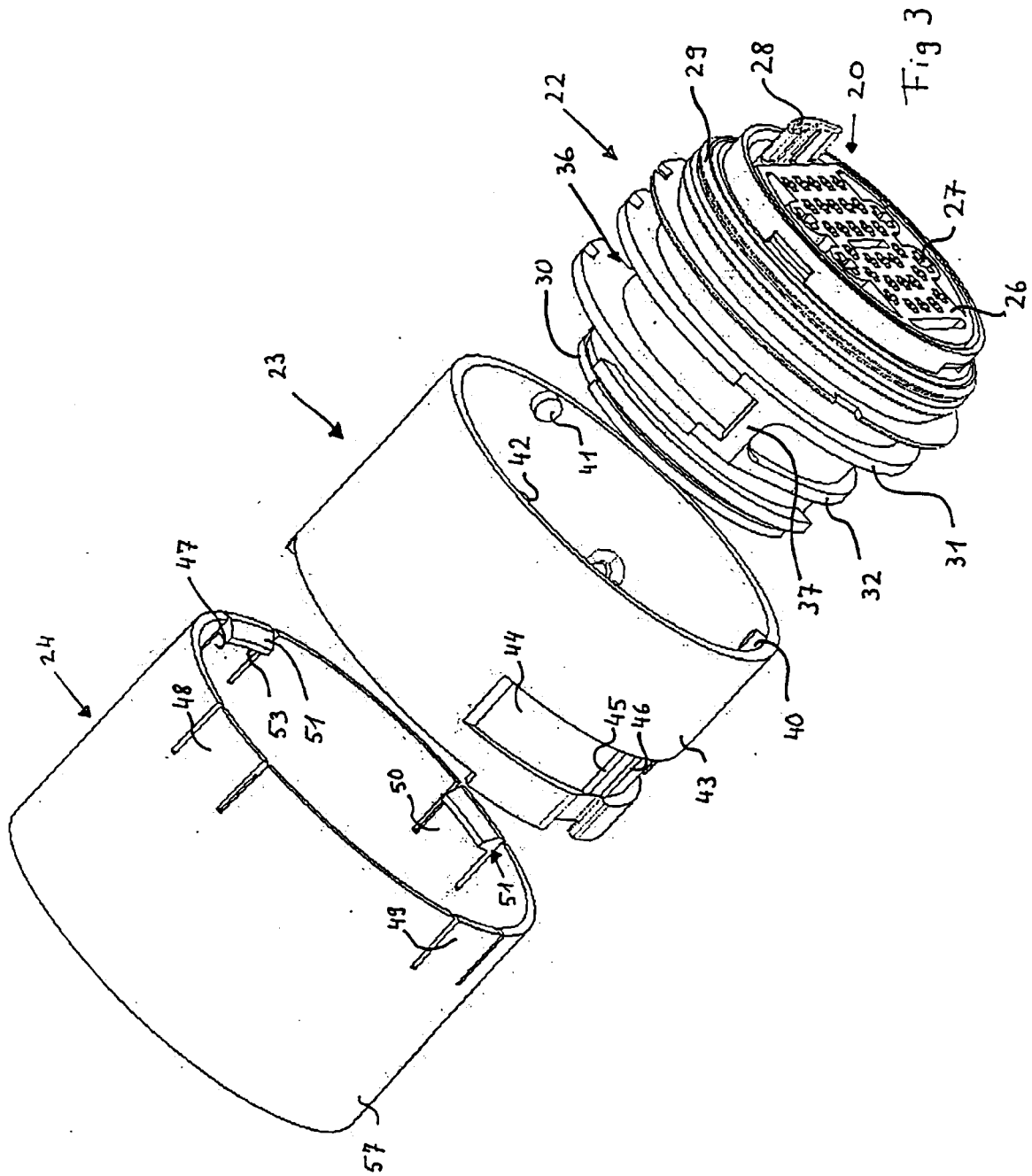
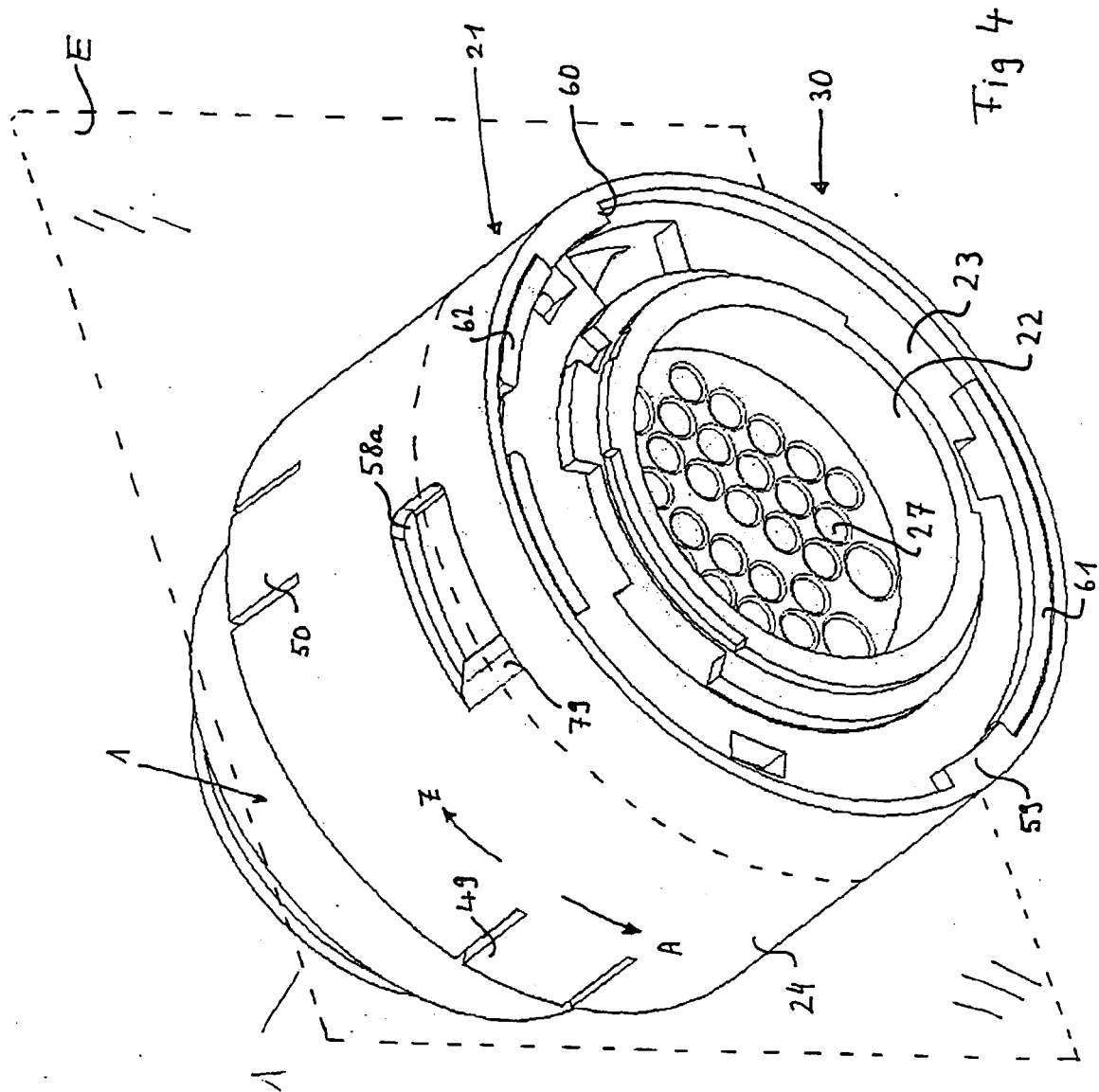
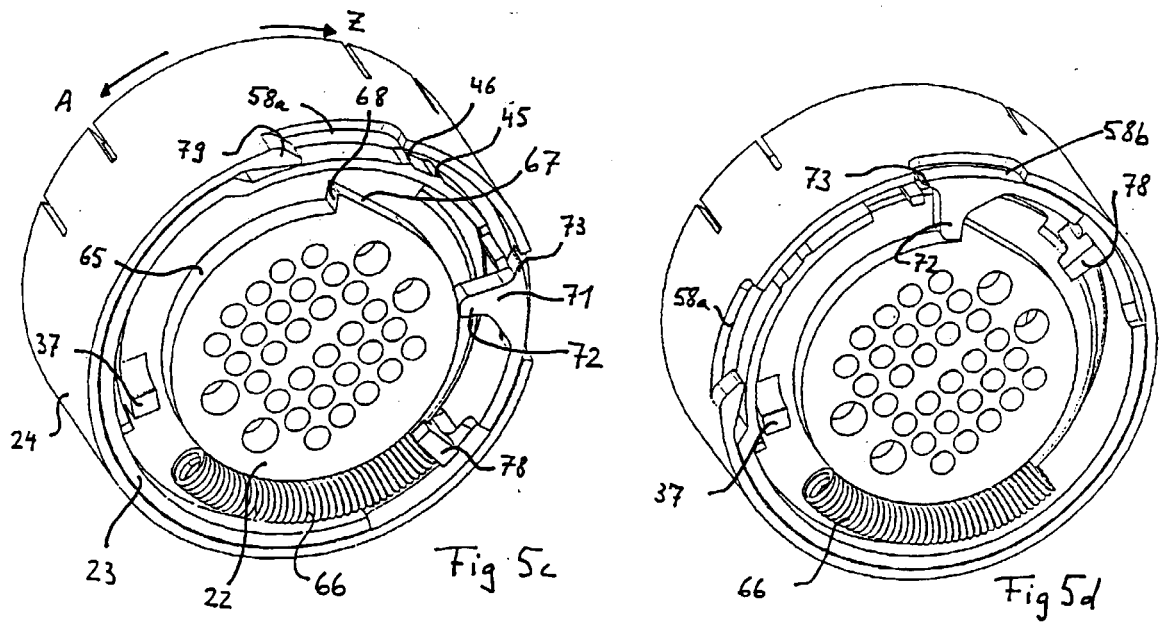
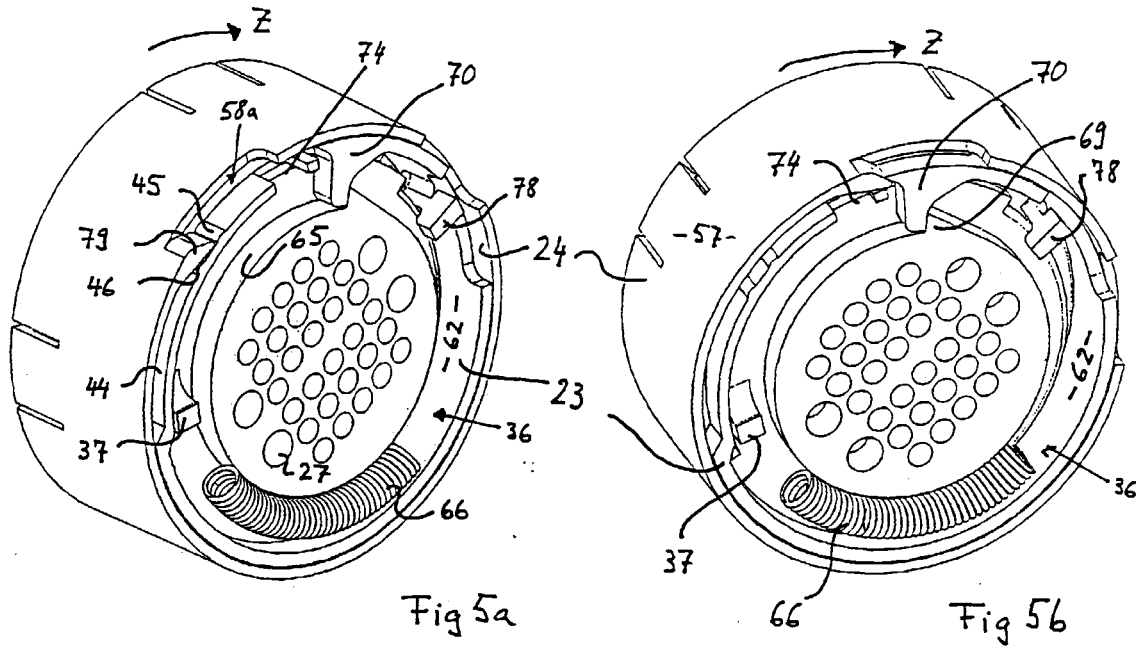
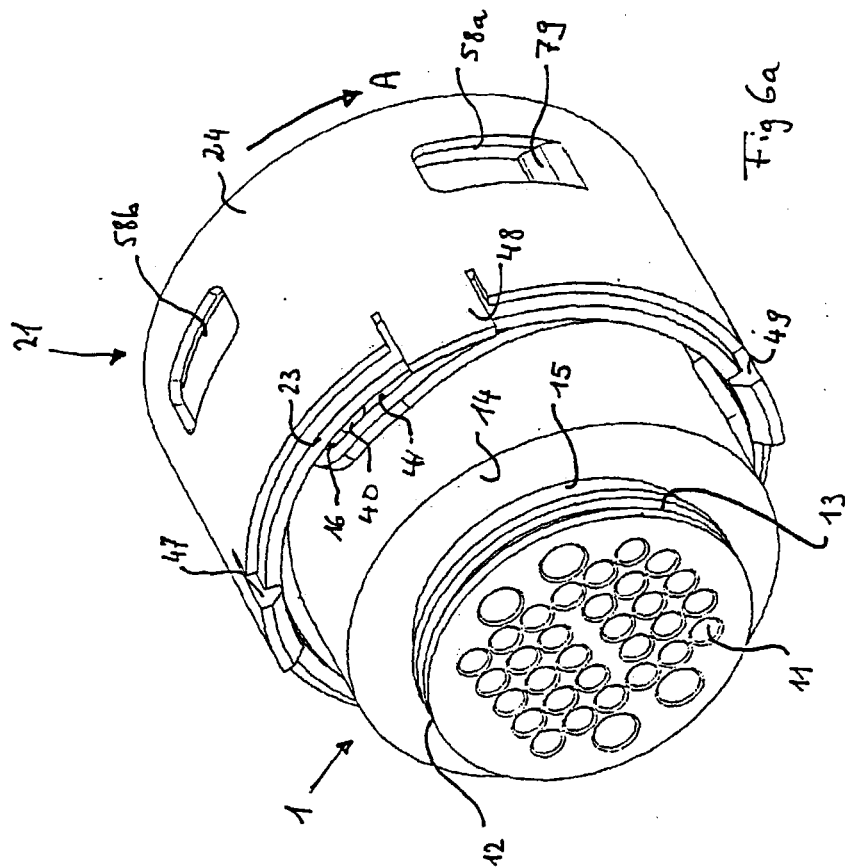
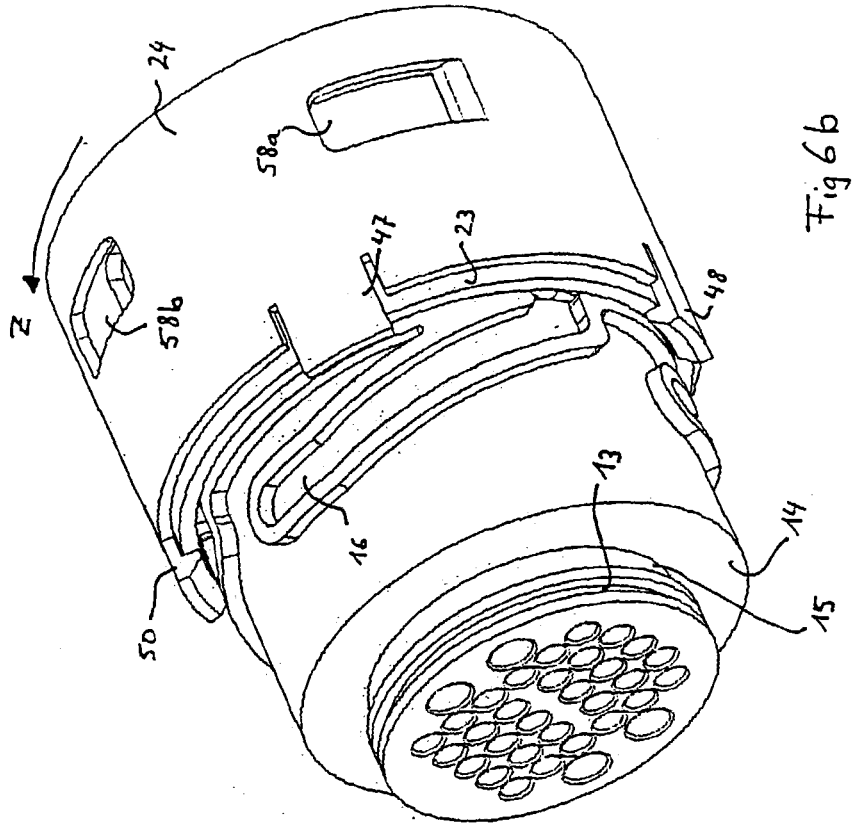


Fig 2











European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 00 10 9073

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 3 848 950 A (MCCORMICK L ET AL) 19 November 1974 (1974-11-19) * column 7, line 3 - column 10, line 30; figure 6 *	1,9	H01R13/625
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The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 14 August 2000	Examiner Stirn, J-P
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 00 10 9073

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