(19) Europäisches Patentamt
European Patent Office
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(11) **EP 2 741 377 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
11.06.2014 Bulletin 2014/24

(51) Int Cl.:
H01R 13/627 *(2006.01)* ***H01R 13/633*** *(2006.01)*
H01R 13/629 *(2006.01)*

(21) Application number: **12195873.0**

(22) Date of filing: **06.12.2012**

(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 RS SE SI SK SM TR
Designated Extension States:
BA ME

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(54) **Cable connector and connector assembly**

(57) A cable connector is designed for being connected to a mating second connector in a connection direction. The cable connector comprises a latch with a latch-eye. The latch is deflectable. Deflecting the latch moves the latch-eye in the connection direction and in a direction perpendicular to the connection direction.

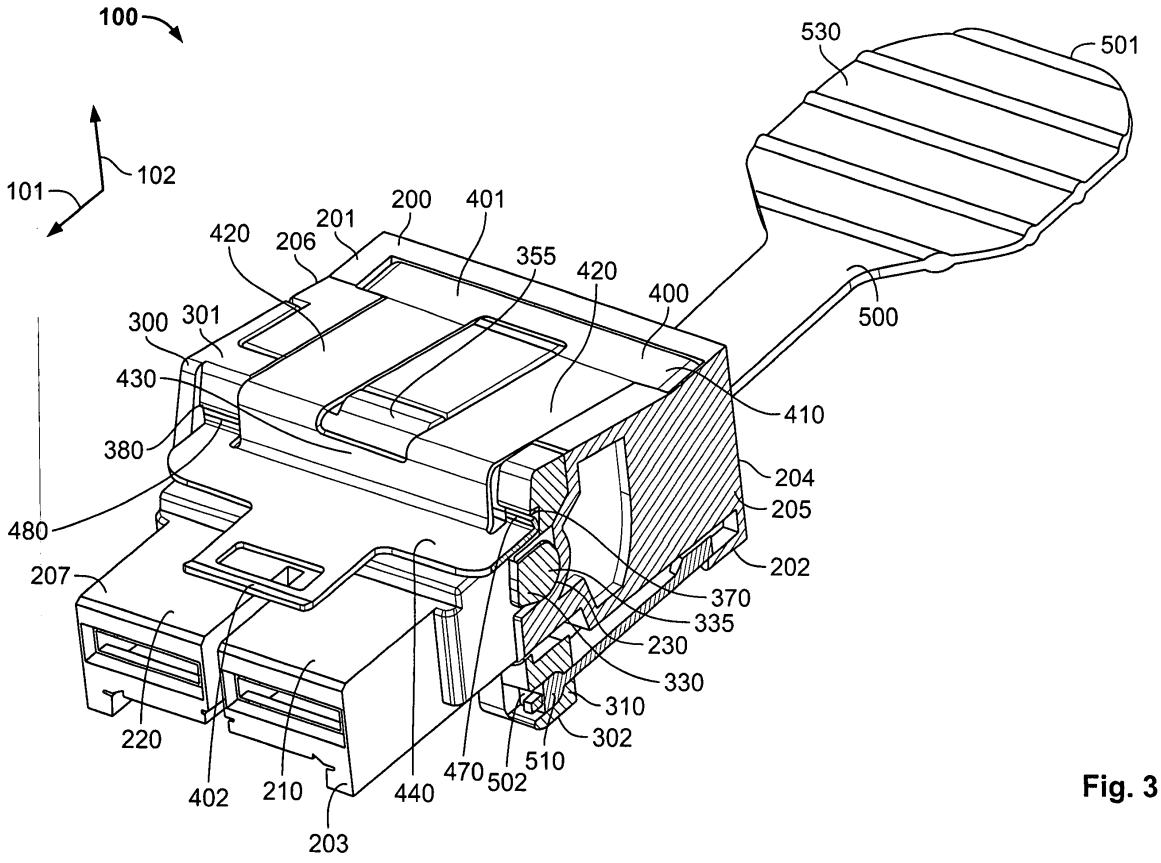

Fig. 3

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Description

[0001] The present invention relates to a cable connector according to claim 1 and to a connector assembly according to claim 9.

[0002] Connector assemblies for connecting electrical or optical cables are known in the state of the art. Such connector assemblies comprise a cable connector and a mating second connector. The cable connector and the mating second connector can be connected in order to provide an electrical or optical connection.

[0003] It is known in the state of the art to provide such connector assemblies with latching mechanisms to secure the cable connector on the mating second connector and to prevent an accidental separation of the cable connector from the mating second connector. It is known to design such latching mechanisms with a latch-eye arranged on the cable connector and a corresponding latch-notch on the mating second connector. The latch-eye is provided to latch on the latch-notch to fixate the cable connector onto the mating second connector.

[0004] Exerting a pull force on a cable connector according to the state of the art increases a normal force between the latch-eye and the latch-notch. This increased normal force results in an increased friction between these two latching surfaces. The increased friction results in increased lifting forces necessary to lift the latch-eye from the latch-notch. After multiple mating and separation cycles of conventional latch-eyes and latch-notches a rim is sometimes created in the latching surface of the latch-notch. This can cause the latch-eye to get stuck, making it impossible to lift the latch-eye from the latch-notch.

[0005] It is an object of the present invention to provide an improved cable connector. This objective is achieved by a cable connector according to claim 1. It is a further object of the present invention to provide an improved connector assembly. This objective is achieved by a connector assembly according to claim 9. Preferred embodiments are disclosed in the dependent claims.

[0006] A cable connector is designed for being connected to a mating second connector in a connection direction. The cable connector comprises a latch with a latch-eye. The latch is deflectable. Deflecting the latch moves the latch-eye in the connection direction and in a direction perpendicular to the connection direction. Advantageously, the cable connector allows for creating and interrupting a connection between the cable connector and the mating second connector. Advantageously, the movement of the latch-eye in the connection direction creates a distance between a surface of the latch-eye and a surface of a mating latch-notch. This eliminates any mechanical friction between the latch-eye and the latch-notch and eliminates the risk that the latch-eye gets stuck on the latch-notch. At the same time, the latch-eye is lifted above the latch-notch by moving the latch-eye in the direction perpendicular to the connection direction to unlatch the latch-eye. Advantageously, lifting the latch-eye over the latch-notch is supported and simplified by the gap created between the surfaces of the latch-eye and the latch-notch.

[0007] According to an embodiment of the cable connector, the latch-eye is provided for latching onto a latch-notch of a mating second connector. Advantageously, the latch of the cable connector allows to lock the cable connector onto the mating second connector, preventing an accidental separation of the cable connector from the mating second connector.

[0008] According to an embodiment of the cable connector, the cable connector comprises a housing and a lever being pivotally connected to the housing. The latch is connected to the housing. A pull-tab is provided for pivoting the lever. The lever is provided for deflecting the latch. Advantageously, the latch of this cable connector can be moved and disengaged comfortably using the pull-tab.

[0009] According to an embodiment of the cable connector, the latch comprises a fixed end and a free end. The fixed end is connected to the housing. The latch-eye is arranged on the free end. The lever is provided for deflecting the free end of the latch. Advantageously, this allows to transmit a small movement of the lever into a larger movement of the free end of the latch.

[0010] According to an embodiment of the cable connector, the latch is deflected upon moving the pull-tab in a direction opposed to the connection direction. Advantageously, this allows for a natural and intuitive operation of the cable connector. Moving the pull-tab in a direction opposed to the connection direction deflects the latch and unlocks the locking mechanism of the cable connector, allowing to separate the cable connector from the mating second connector. The moving direction of the pull-tab coincides with the natural and intuitive direction of movement of the cable connector to separate the cable connector from the mating second connector.

[0011] According to an embodiment of the cable connector, pivoting the lever deforms the latch elastically. Advantageously, the elastic deformation of the latch can create a restoring force that drives the latch, the lever and the pull-tab back to their original positions after releasing the pull-tab.

[0012] According to an embodiment of the cable connector, the latch-eye is oriented perpendicularly to the connection direction. Advantageously, this allows for a simple latching and unlatching of the latch-eye onto a latch-notch of a mating second connector.

[0013] According to an embodiment of the cable connector, the cable connector is an electrical connector. Advantageously, the cable connector may serve to create electrical connections.

[0014] A connector assembly according to the invention comprises a cable connector as previously described and a mating second connector. Advantageously, the cable connector and the mating second connector of the connector assembly can easily be locked to each other to prevent an accidental separation of the cable connec-

tor from the mating second connector. The locking mechanism can easily and intuitively be unlatched to allow for a separation of the cable connector from the mating second connector.

[0015] According to an embodiment of the connector assembly, the second connector comprises a latch-notch. The latch-eye is provided for latching onto the latch-notch of the second connector. Advantageously, latching the latch-eye onto the latch-notch locks the cable connector onto the second connector and prevents an accidental separation of the cable connector from the mating second connector.

[0016] The invention will now be explained in more detail with reference to the figures in which

Figure 1 shows a perspective view of a cable connector;

Figure 2 shows a side-view of the cable connector;

Figure 3 depicts a cut-open view of the cable connector;

Figure 4 shows a perspective view of components of the cable connector; and

Figure 5 depicts a schematic view of a latch of the cable connector.

[0017] Figure 1 shows a perspective view of a cable connector 100. Figure 2 shows a side view of the cable connector 100. The cable connector 100 may for example be an electrical cable connector or an optical cable connector. The cable connector 100 is part of a connector assembly comprising the cable connector 100 and a mating second connector. The mating second connector is not depicted in the figures. The cable connector 100 is designed to be connected to the mating second connector by moving the cable connector 100 in a connection direction 101 towards the mating second connector. An upward direction 102 is oriented perpendicular to the connection direction 101.

[0018] The cable connector 100 comprises a housing 200. The housing 200 may for example comprise a plastic material. The housing 200 comprises an upper side 201 and a lower side 202 that is opposed to the upper side 201. The upper side 201 of the housing 200 points in the upward direction 102. The housing 200 further comprises a front side 203 and a rear side 204 that is opposed to the front side 203. The front side 203 is oriented in the connection direction 101. The housing 200 further comprises a left side 205 and a right side 206 that is opposed to the left side 205.

[0019] A first sleeve 210 and a second sleeve 220 are arranged on the front side 203 of the housing 200 of the cable connector 100 in the example of Figure 1. The first sleeve 210 and the second sleeve 220 serve to house electrical or optical connection elements which provide an electrical or optical connection between the cable connector 100 and the mating second connector when the cable connector 100 is connected to the mating second connector. It is, however, possible to omit the first sleeve 210 and/or the second sleeve 220 or to design the front side 203 of the housing 200 of the cable connector 100 differently.

[0020] The first sleeve 210 and the second sleeve 220 comprise a stepped upper side 207 which points in the same upward direction 102 as the upper side 201 of the remaining parts of the housing 200. The stepped upper side 207, however, stands back from the upper side 201 in such a way that the upper side 201 of the housing 200 is higher in the upward direction 102 than the stepped upper side 207.

[0021] The cable connector 100 further comprises a lever 300. The lever 300 may for example comprise a plastic material. The lever 300 may comprise the same material as the housing 200.

[0022] The lever 300 is connected to the housing 200 of the cable connector 100. The lever 300 comprises an upper side 301 and a lower side 302. The upper side 301 of the lever 300 is approximately flush with the upper side 201 of the housing 200. The lower side 302 of the lever 300 is approximately flush with the lower side 202 of the housing.

[0023] The lever 300 comprises a left blade 350 and a right blade 360. The left blade 350 and the right blade 360 are mirror-symmetric with respect to each other. The left blade 350 of the lever 300 is arranged on the left side 205 of the housing 200. The right blade 360 of the lever 300 is arranged on the right side 206 of the housing 200. The left blade 350 and the right blade 360 of the lever 300 are connected by a connection bar 355. The connection bar 355 is arranged on the upper side 201 of the housing 200.

[0024] Figure 3 shows a perspective view of the cable connector 100 with parts of the lever 300 removed and the housing 200 partially cut open. The left blade 350 of the lever 300 is not depicted in Figure 3. The housing 200 is cut open on a plane parallel to the left side 205 of the housing 200. Figure 4 shows a perspective view of the lever 300 of the cable connector 100 with the housing 200 removed.

[0025] As can be seen in the depiction of Figure 4, the side of the left blade 350 of the lever 300 that faces the right blade 360 of the lever 300 comprises a left pivot 330. In a symmetric manner, the right blade 360 of the lever 300 that faces the left blade 350 of the lever 300 comprises a right pivot 340. The left pivot 330 and the right pivot 340 are designed as short cylindrical sections that extend from the respective side faces of the left blade 350 and the right blade 360. The left pivot 330 and the right pivot 340 together define a pivoting axis 335 which extends between the left pivot 330 and the right pivot 340.

[0026] Figure 3 shows that the housing 200 comprises a left bush 230 on the left side 205 of the housing 200. In a symmetric manner, the housing 200 also comprises

a right bush 240 on the right side 206 of the housing 200. The left pivot 330 of the lever 300 is arranged in the left bush 230. The right pivot 340 of the lever 300 is accordingly arranged in the right bush 240 of the housing 200. The left pivot 330 and the right pivot 340 of the lever 300 are pivot-mounted in the left bush 230 and the right bush 240 of the housing 200 in such a way that the lever 300 can be rotated or pivoted around the pivoting axis 335 with respect to the housing 200.

[0027] As can be seen in the depictions of Figure 3 and 4, the left blade 350 of the lever 300 comprises a left holder 310 near the lower side 302 of the left blade 350 of the lever 300. In a symmetric manner, the right blade 360 of the lever 300 comprises a right holder 320 near the lower side 302 of the right blade 360. The left holder 310 and the right holder 320 are arranged on the same surfaces of the left blade 350 and the right blade 360 as the left pivot 330 and the right pivot 340. The left holder 310 and the right holder 320 are both designed as mouths that open towards the front side 203 of the housing 200.

[0028] The cable connector 100 further comprises a pull-tab 500. The pull-tab 500 may for example comprise a plastic material. The pull-tab 500 is designed as an elongate strip with an outer end 501 and an opposed inner end 502. The outer end 501 of the pull-tab 500 is arranged outside the housing 200 of the cable connector 100. The inner end 502 of the pull-tab 500 is arranged inside the housing 200 of the cable connector 100. On the outer end 501, the pull-tab 500 comprises a holder 530 that is provided for being gripped by a user of the cable connector 100.

[0029] As can be seen in the depictions of Figure 3 and 4, the pull-tab 500 comprises a left lug 510 and a right lug 520 at the inner end 502 of the pull-tab 500. The left lug 510 and the right lug 520 are designed as thickenings at the inner end 502 of the pull-tab 500. The left lug 510 of the pull-tab 500 is arranged and retained in the left holder 310 of the lever 300. The right lug 520 of the pull-tab 500 is accordingly arranged and retained in the right holder 320 of the lever 300.

[0030] A movement of the pull-tab 500 along the longitudinal direction of the pull-tab 500 rotates the lever 300 around the pivoting axis 335 with respect to the housing 200 of the cable connector 100. Pulling the pull-tab 500 in a direction opposed to the connection direction 101 out of the housing 200 exerts a pull-force on the lower side 302 of the lever 300 via the connection between the lugs 510, 520 of the pull-tab 500 and the holders 310, 320 of the lever 300. The pull-force exerted on the lever 300 moves the lower side 302 of the lever 300 in the direction of the rear side 204 of the housing 200. This rotates the lever 300 around the pivoting axis 335 with respect to the housing 200 of the cable connector 100. The rotation of the lever 300 moves the upper side 301 of the lever 300 in the connection direction 101 with respect to the housing 200.

[0031] Pushing the pull-tab 500 in the connection direction 101 rotates the lever 300 in the opposite direction around the pivoting axis 335 in such a way that the lower side 302 of the lever 300 moves in the connection direction 101 and the upper side 301 of the lever 300 moves in the direction opposed to the connection direction 101 with respect to the housing 200.

[0032] The left blade 350 of the lever 300 of the cable connector 100 comprises a left push face 370 near the upper side 301 of the lever 300. In a symmetric manner, the right blade 360 of the lever 300 comprises a right push face 380 near the upper side 301 of the lever 300. The left push face 370 and the right push face 380 are arranged on the same surfaces of the left blade 350 and the right blade 360 as the left pivot 330 and the right pivot 340, respectively. The left push face 370 and the right push face 380 point in the connection direction 101.

[0033] The cable connector 100 further comprises a latch 400. The latch 400 comprises a mechanically elastic material. The latch 400 may for example comprise a metal.

[0034] The latch 400 is designed as a thin sheet that is partially bent. The latch 400 is arranged on the upper side 201 of the housing 200 of the cable connector 100. The latch 400 comprises a fixed end 401 and an opposed free end 402. The fixed end 401 of the latch 400 is located near the rear side 204 of the housing 200. The free end 402 of the latch 400 is located near the front side 203 of the housing 200.

[0035] At the fixed end 401, the latch 400 comprises a fixation mechanism 410 which fixates the latch 400 on the housing 200. The fixation mechanism 410 comprises two tilted wings that are press-fit into the housing 200.

[0036] Adjacent to the fixation mechanism 410, the latch 400 comprises a spring section 420. In the spring section 420 the latch 400 is elastically deformable. The spring section 420 is designed as two parallel elongate strips that are both connected to the fixation mechanism 410 of the latch 400 and to a benched section 430 of the latch 400. The spring section 420 reaches from the fixation mechanism 410 of the latch 400 near the rear side 204 of the housing 200 to the connection bar 355 of the lever 300.

[0037] Adjacent to the spring section 420 of the latch 400 is the benched section 430 of the latch 400. The benched section 430 extends over the connection bar 355 of the lever 300 of the cable connector 100 towards the first sleeve 210 and the second sleeve 220 of the housing 200. In the benched section 430, the latch 400 is bent twice to follow the step from the upper side 201 of the housing 200 to the stepped upper side 207 of the first sleeve 210 and the second sleeve 220 of the housing 200.

[0038] Adjacent to the benched section 430 of the latch 400 is a deflectable section 440 of the latch 400 that is arranged on the stepped upper side 207 of the housing 200. The deflectable section 440 extends from the benched section 430 of the latch 400 to the free end 402 of the latch 400. In the deflectable section 440, the latch 400 comprises a latch-eye 450. The latch-eye 450 is de-

signed as an opening in the deflectable section 440 of the latch 400. The latch-eye 450 is oriented in parallel to the stepped upper side 207 of the housing 200 and perpendicularly to the upward direction 102.

[0039] In the deflectable section 440, the benched section 430 and the spring section 420, the latch 400 is not connected to the housing 200. Consequently, the free end 402 of the latch 400 can be moved with respect to the housing 200 by elastically deforming the latch 400.

[0040] As shown in Figure 3, the latch 400 comprises a left engagement part 470 and a right engagement part 480. The left engagement part 470 and the right engagement part 480 are both connected to the deflectable section 440 of the latch 400 and oriented in the direction opposed to the connection direction 101. The left engagement part 470 abuts on the left push face 370 of the lever 300. The right engagement part 480 abuts on the right push face 380 of the lever 300.

[0041] When the lever 300 is rotated or pivoted around the pivoting axis 335 in such a way that the upper part 301 of the lever 300 moves towards the connection direction 101, the push faces 370, 380 of the lever 300 exert a force on the engagement parts 470, 480 of the latch 400 that is oriented in the connection direction 101. This force exerted on the engagement parts 470, 480 of the latch 400 deflects the free end 402 of the latch 400 by elastically deforming the latch 400.

[0042] Figure 5 shows a schematic side view of the latch 400. The latch 400 is depicted in a relaxed state 490 and a deformed state 495.

[0043] In the relaxed state 490 of the latch 400, the latch 400 is elastically relaxed. The spring section 420 of the latch 400 is not elastically deformed. The latch 400 takes the relaxed state 490 when the lever 400 is pivoted around the pivoting axis 335 in such a way that the upper side 301 of the lever 300 is located as far in the direction opposed to the connection direction 101 as possible. In this state, the pull-tab 500 is positioned maximally inside the housing 200 of the cable connector 100.

[0044] In the deformed state 495 of the latch 400, the latch 400 is elastically deformed in the spring section 420 of the latch 400. In the deformed state 495 of the latch 400, the deflectable section 440 of the latch 400 is deflected with respect to the position of the deflectable section 440 of the latch 400 in the relaxed state 490. The deformation of the spring section 420 is such that the free end 402 of the latch 400 is moved in the connection direction 101 and the upward direction 102 with respect to the position of the free end 402 in the relaxed state 490.

[0045] The latch 400 takes the deformed state 495 when the lever 300 of the cable connector 100 is pivoted around the pivoting axis 335 in such a way that the upper side 301 of the lever 300 is moved in the connection direction 101 as far as possible. In this position of the lever 300, the left push face 370 and the right push face 380 of the lever 300 exert a force on the left engagement part 470 and the right engagement part 480 of the latch 400 that elastically deforms the latch 400 to take the deformed state 495. In this situation, the pull-tab 500 of the cable connector 100 is maximally pulled out of the housing 200 of the cable connector 100 in the direction opposed to the connection direction 101.

[0046] In the deformed state 495 of the latch 400, the elastic deformation of the latch 400 exerts a restoring force that aims at driving the latch 400 back to the relaxed state 490. This restoring force exerts a force on the left push face 370 and the right push face 380 of the lever 300 via the left engagement part 470 and the right engagement part 480 of the latch 400. The force exerted on the push faces 370, 380 of the lever 300 aims at rotating the lever 300 around the pivoting axis 335 in such a way that the upper side 301 of the lever 300 is moved in the direction opposed to the connection direction 101 and the lower side 302 of the lever 300 is moved in the connection direction 101. The force exerted on the lever 300 is transmitted to the pull-tab 500 via the holders 310, 320 of the lever 300 and the lugs 510, 520 of the pull-tab 500. The transmitted force aims at pulling the pull-tab 500 into the housing 200 in the connection direction 101. Consequently, if the pull-tab 500 is released in a situation when the latch 400 takes the deformed state 495, the latch 400 returns to its relaxed state 490 whereby the lever 300 is rotated around the pivoting axis 335 and the pull-tab 500 is pulled in the connection direction 101 into the housing 200.

[0047] The mating second connector of the connector assembly that is provided for being connected to the cable connector 100 comprises a latch-notch. When the cable connector 100 is connected to the mating second connector, the latch-eye 450 of the latch 400 of the cable connector 100 latches on the latch-notch of the mating second connector. This prevents an accidental removal of the cable connector 100 from the mating second connector. If the cable connector 100 is attempted to be removed from the mating second connector by pulling the cable connector 100 in the direction opposed to the connection direction 101, the latch-eye 450 of the latch 400 of the cable connector 100 is blocked on the latch-notch of the mating second connector and prevents a removal of the cable connector 100 from the mating second connector.

[0048] In order to remove the cable connector 100 from the mating second connector, the latch-eye 450 of the latch 400 of the cable connector 100 has to be unlatched by pulling the pull-tab 500 in the direction opposed to the connection direction 101. As previously explained, pulling the pull-tab 500 in the direction opposed to the connection direction 101 deflects the deflectable section 440 of the latch 400 whereby the latch-eye 450 of the latch 400 is moved in the connection direction 101 and in the upward direction 102. Movement of the latch-eye 450 in the connection direction 101 separates the edge of the latch-eye 450 from a surface of the latch-notch of the mating second connector. This prevents the latch-eye 450 from getting stuck on the latch-notch. Movement of the latch-eye 450 in the upward direction 102 lifts the

latch-eye 450 above the latch-notch whereby the latch-eye 450 of the latch 400 is unlatched. After unlatching the latch 400, the cable connector 100 can be separated from the mating second connector of the connector assembly.

[0049] Pulling the pull-tab 500 in the direction opposed to the connection direction 101 does not instantly separate the cable connector 100 from the mating second connector due to a static friction between the electrical or optical connection elements arranged in the first sleeve 210 and the second sleeve 220 of the cable connector 100 and corresponding connection elements of the mating second connector. A force required to overcome this static friction is higher than a force necessary to elastically deform the latch 400 and unlatch the latch-eye 450. Consequently, upon pulling the pull-tab 500 in the direction opposed to the connection direction 101, the latch-eye 450 of the latch 400 is unlatched first before the cable connector 100 is separated from the mating second connector of the connector assembly.

Reference symbols

[0050]

100	cable connector
101	connection direction
102	upward direction
200	housing
201	upper side
202	lower side
203	front side
204	rear side
205	left side
206	right side
207	stepped upper side
210	first sleeve
220	second sleeve
230	left bush
240	right bush
300	lever
301	upper side
302	lower side
310	left holder
320	right holder
330	left pivot
335	pivoting axis
340	right pivot
350	left blade
355	connection bar
360	right blade
370	left push face
380	right push face
400	latch
401	fixed end
402	free end
410	fixation mechanism
420	spring section
430	benched section
440	deflectable section
450	latch-eye
470	left engagement part
480	right engagement part
490	relaxed state
495	deformed state
500	pull-tab
501	outer end
502	inner end
510	left lug
520	right lug
530	holder

Claims

1. A cable connector (100),
wherein the cable connector (100) is designed for being connected to a mating second connector in a connection direction (101),
wherein the cable connector (100) comprises a latch (400) with a latch-eye (450),
wherein the latch (400) is deflectable,
wherein deflecting the latch (400) moves the latch-eye (450) in the connection direction (101) and in a direction (102) perpendicular to the connection direction (101).

2. The cable connector (100) according to claim 1,
wherein the latch-eye (450) is provided for latching onto a latch-notch of a mating second connector.

3. The cable connector (100) according to any one of the previous claims,
wherein the cable connector (100) comprises a housing (200)
and a lever (300) being pivotally connected to the housing (200),
wherein the latch (400) is connected to the housing (200),
wherein a pull-tab (500) is provided for pivoting the lever (300),
wherein the lever (300) is provided for deflecting the latch (400).

4. The cable connector (100) according to claim 3,
wherein the latch (400) comprises a fixed end (401) and a free end (402),
wherein the fixed end (401) is connected to the housing (200),
wherein the latch-eye (450) is arranged on the free end (402),
where the lever (300) is provided for deflecting the free end (402) of the latch (400).

5. The cable connector (100) according to any one of claims 3 and 4,
wherein the latch (400) is deflected upon moving the pull-tab (500) in a direction opposed to the connection direction (101).

6. The cable connector (100) according to any one of claims 3 to 5,
wherein pivoting the lever (300) deforms the latch (400) elastically.

7. The cable connector (100) according to any one of the previous claims,
wherein the latch-eye (450) is oriented perpendicular to the connection direction (101).

8. The cable connector (100) according to any one of the previous claims,
wherein the cable connector (100) is an electrical connector.

9. An connector assembly
comprising a cable connector (100) as claimed in any one of the previous claims,
and a mating second connector.

10. The connector assembly according to claim 9, wherein the second connector comprises a latch-notch, wherein the latch-eye (450) is provided for latching onto the latch-notch of the second connector.

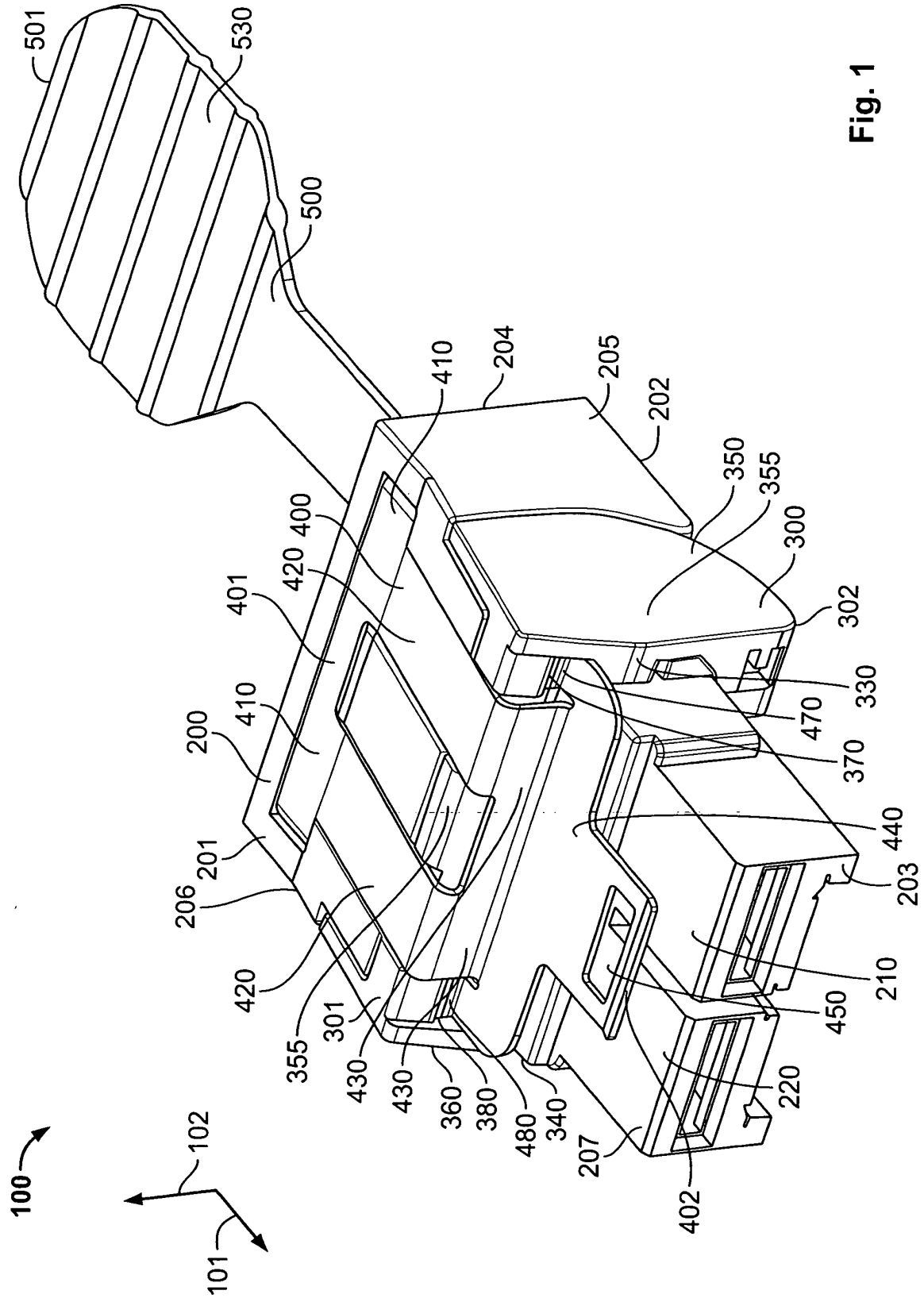
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Fig. 1

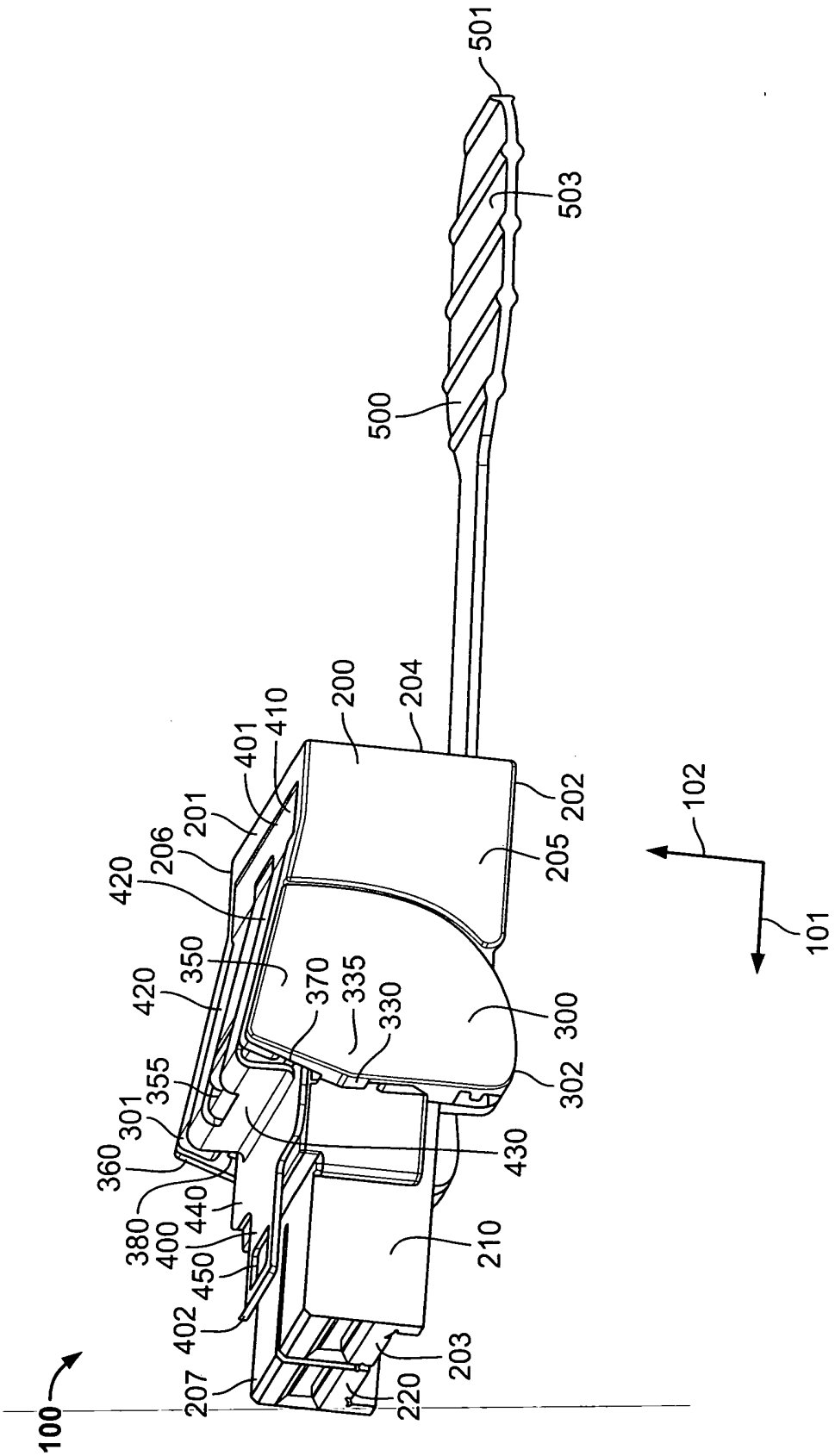
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Fig. 2

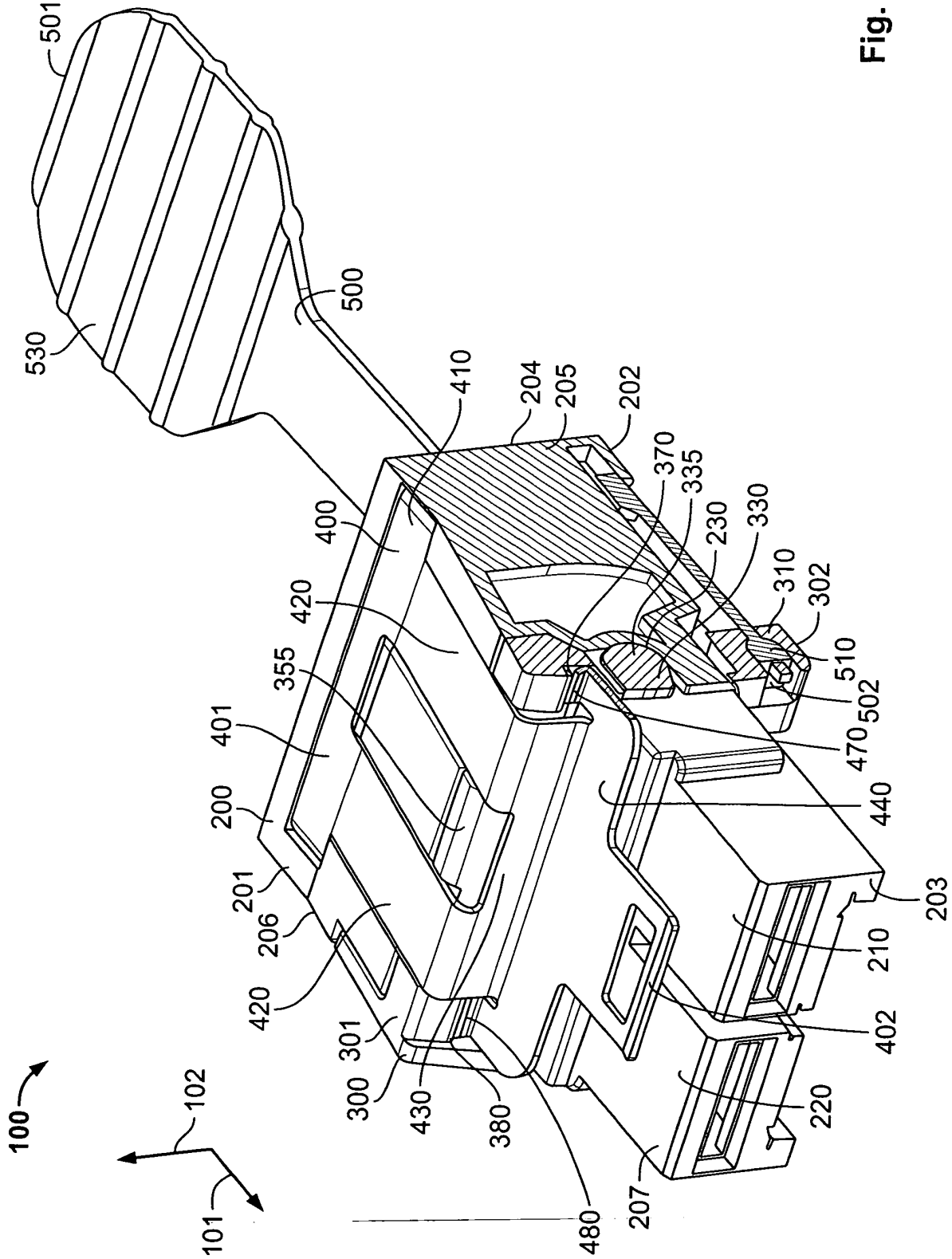
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Fig. 3

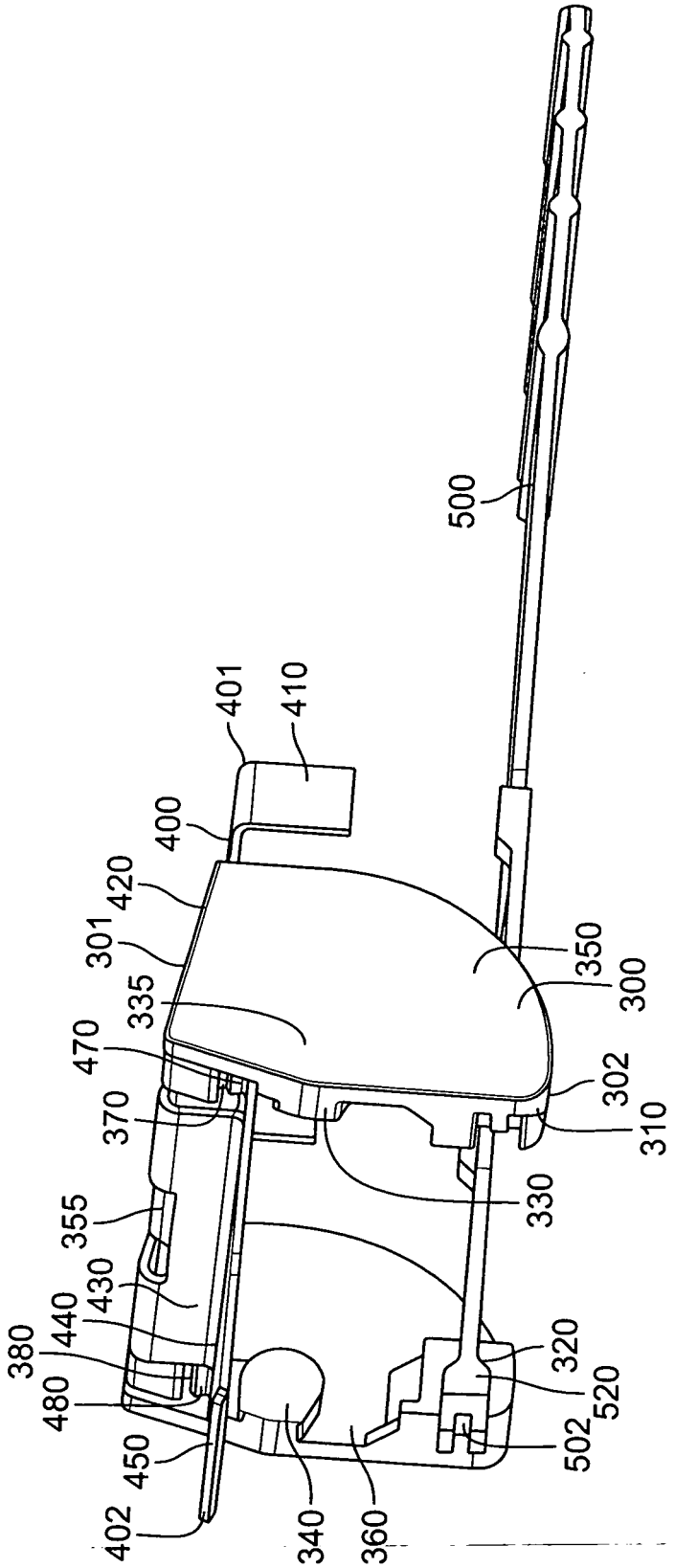
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Fig. 4

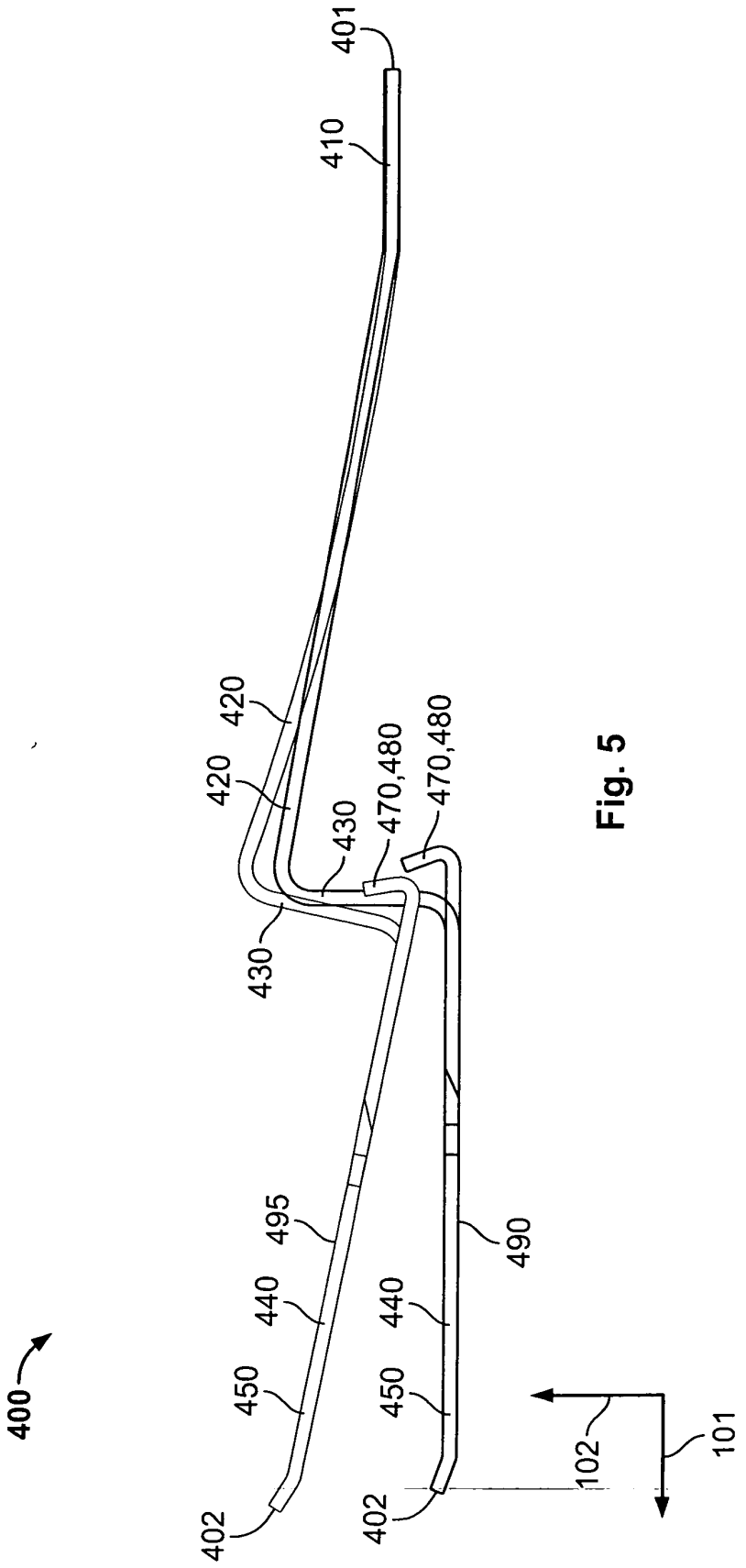
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Fig. 5

Europäisches Patentamt
European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 12 19 5873

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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