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(54) **PLUG CONNECTOR**

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(58) **Field of Classification Search**
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(Continued)

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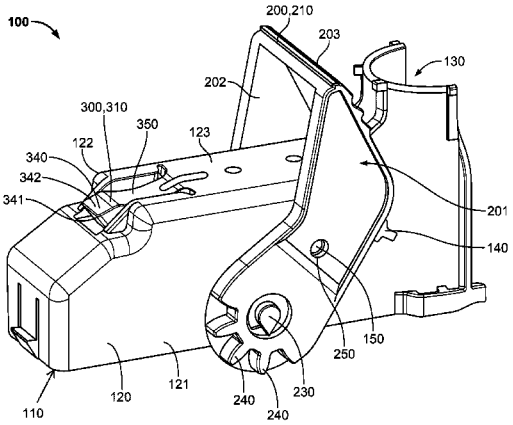
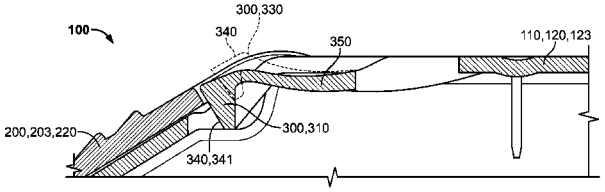
(57) **ABSTRACT**

A plug connector has a housing with a cap, the cap having a lever which can adopt a first position and a second position. In this case, the housing is opened in the first position of the lever and closed in the second position of the lever. Furthermore, the plug connector has a locking device which can adopt a blocking position which is intended to lock the lever in the second position. The locking device is elastically movable out of its blocking position into a release position in order to unlock the lever in the second position. Furthermore, the locking device is elastically movable out of its blocking position into an overload position in order to unlock the lever in the second position if a force exerted on the lever exceeds a set value. In this case, the overload position differs from the release position.

22 Claims, 5 Drawing Sheets





(58) **Field of Classification Search**
USPC 439/157, 372, 131, 587
See application file for complete search history.

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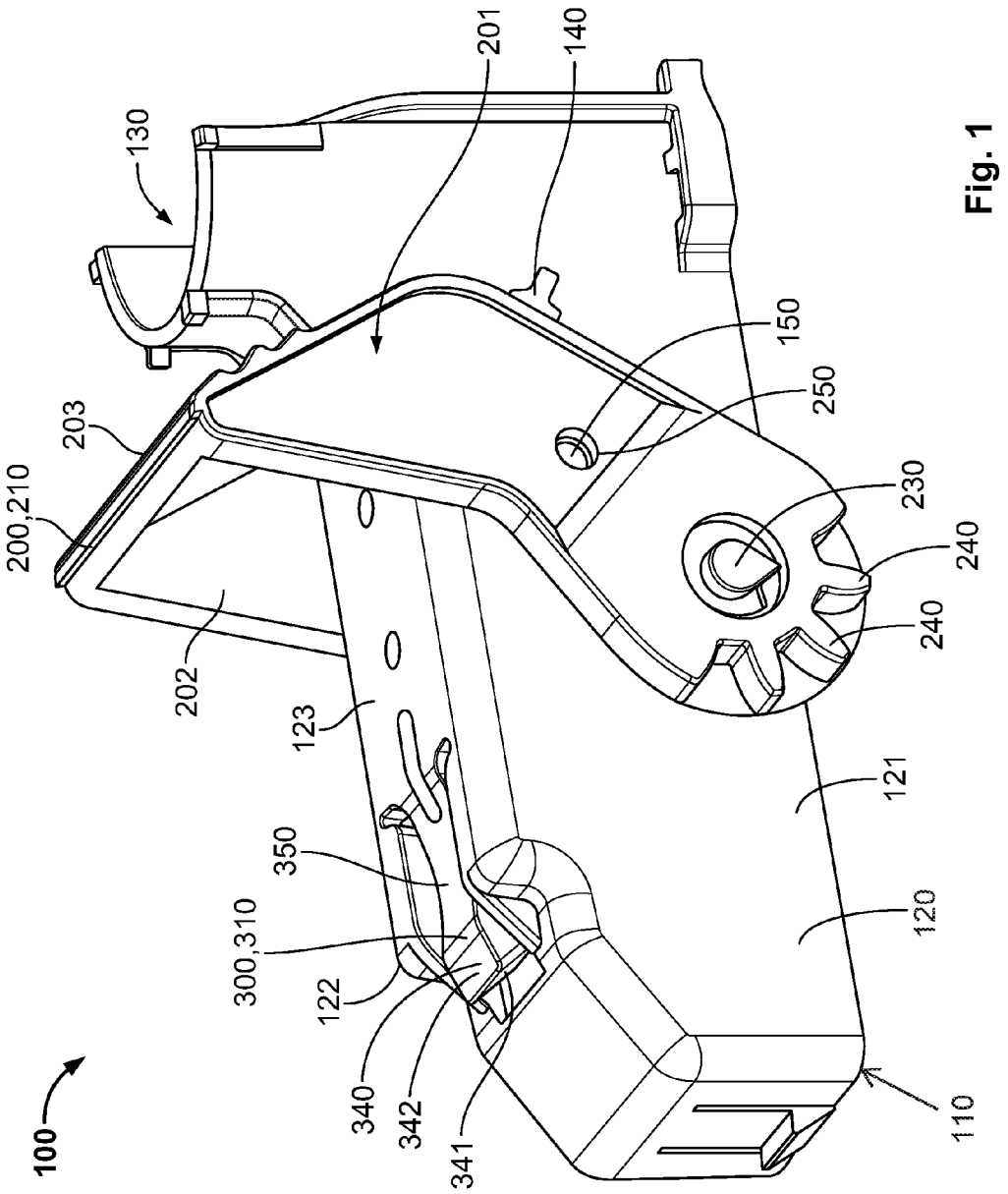
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110
120
121
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123
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202
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240
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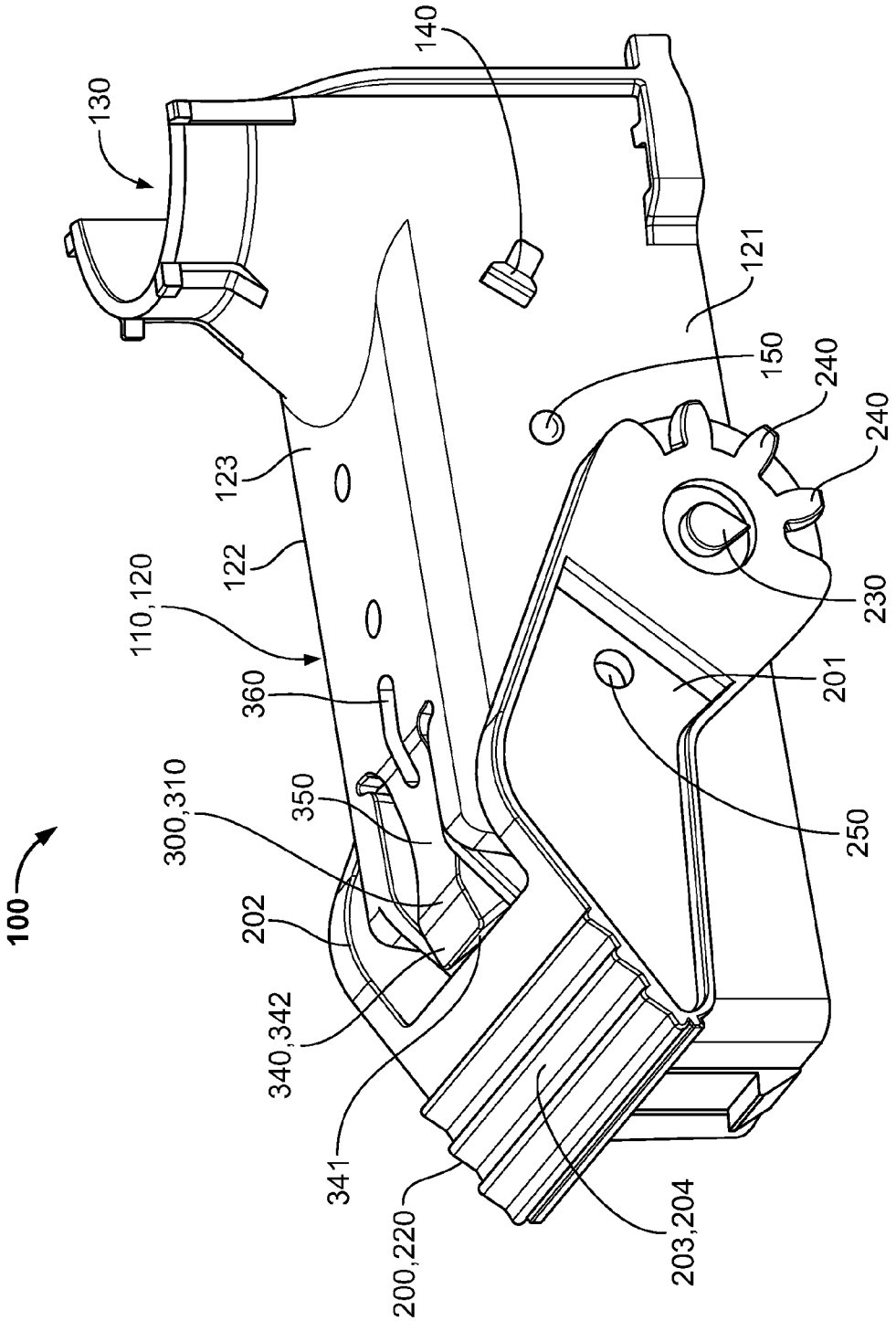
300,310
340
341
342
350

Fig. 1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150
240
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201
300,310
350
250
202
340,342
341
200,220
203,204

Fig. 2

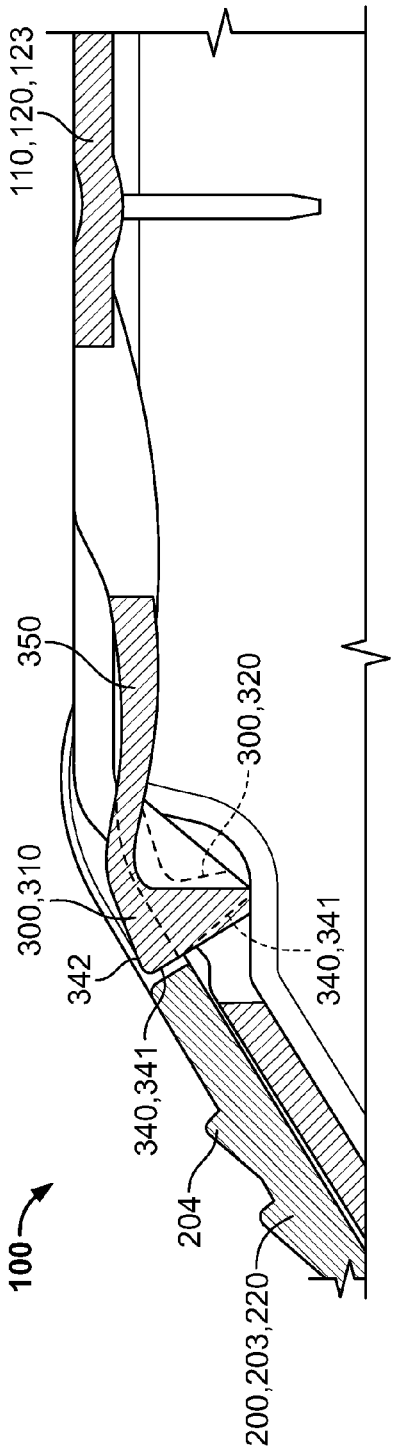
110,120,123
350
300,320
300,310
342
340,341
340,341
204
100
200,203,220

Fig. 3

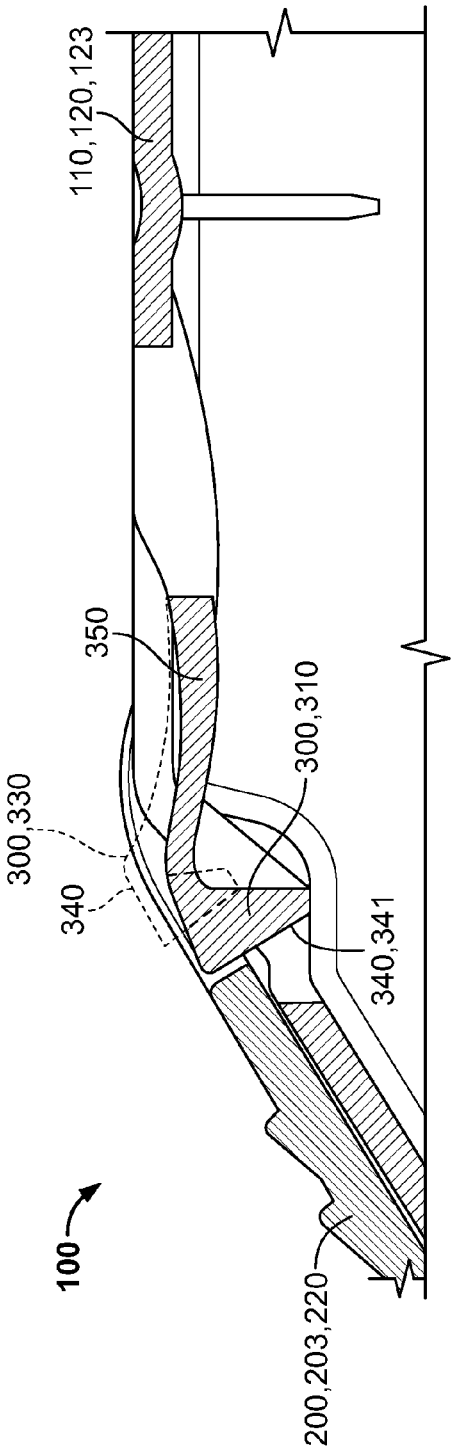
110,120,123
350
300,310
300,330
340
340,341
100
200,203,220

Fig. 4

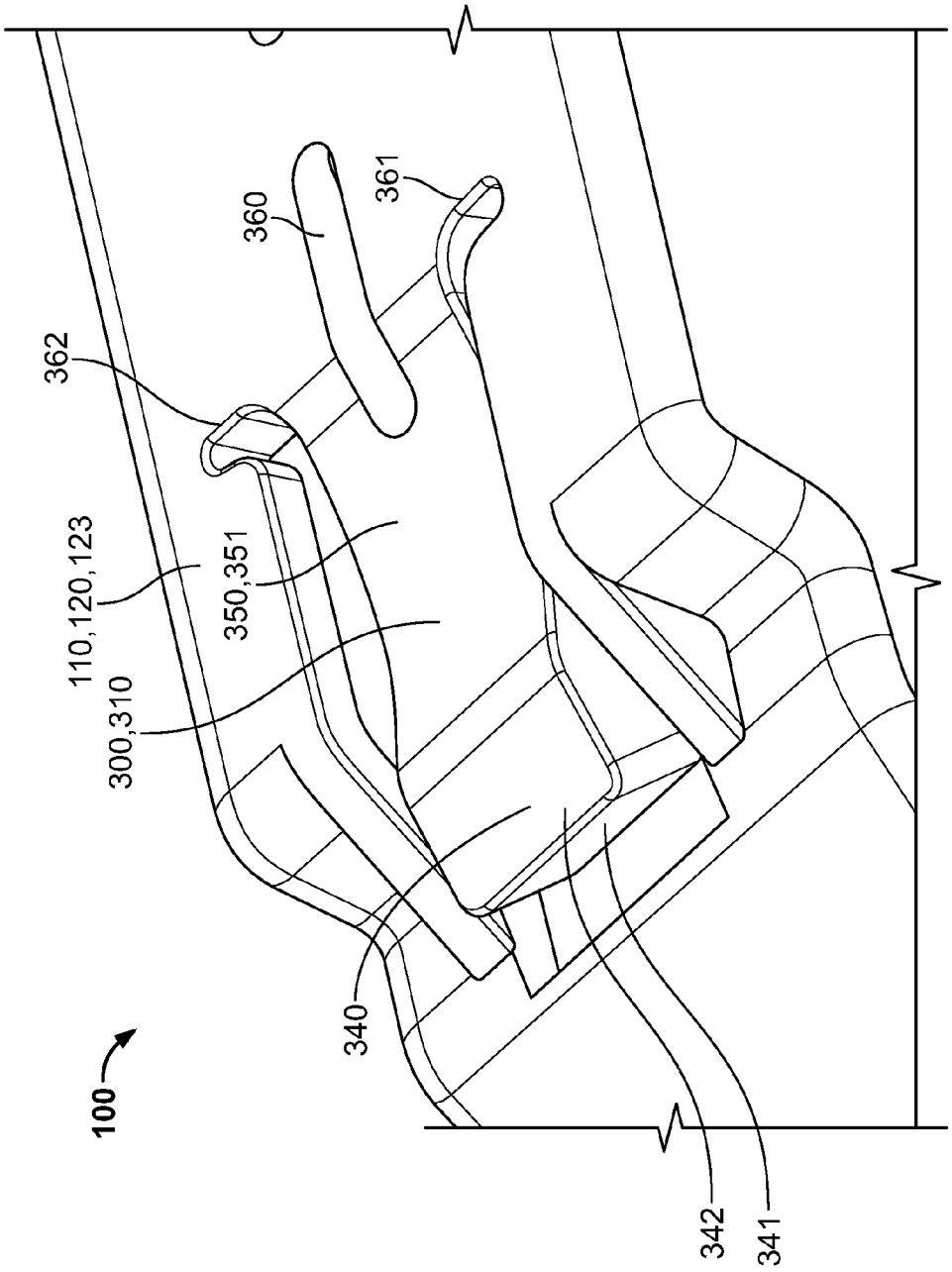

Fig. 5

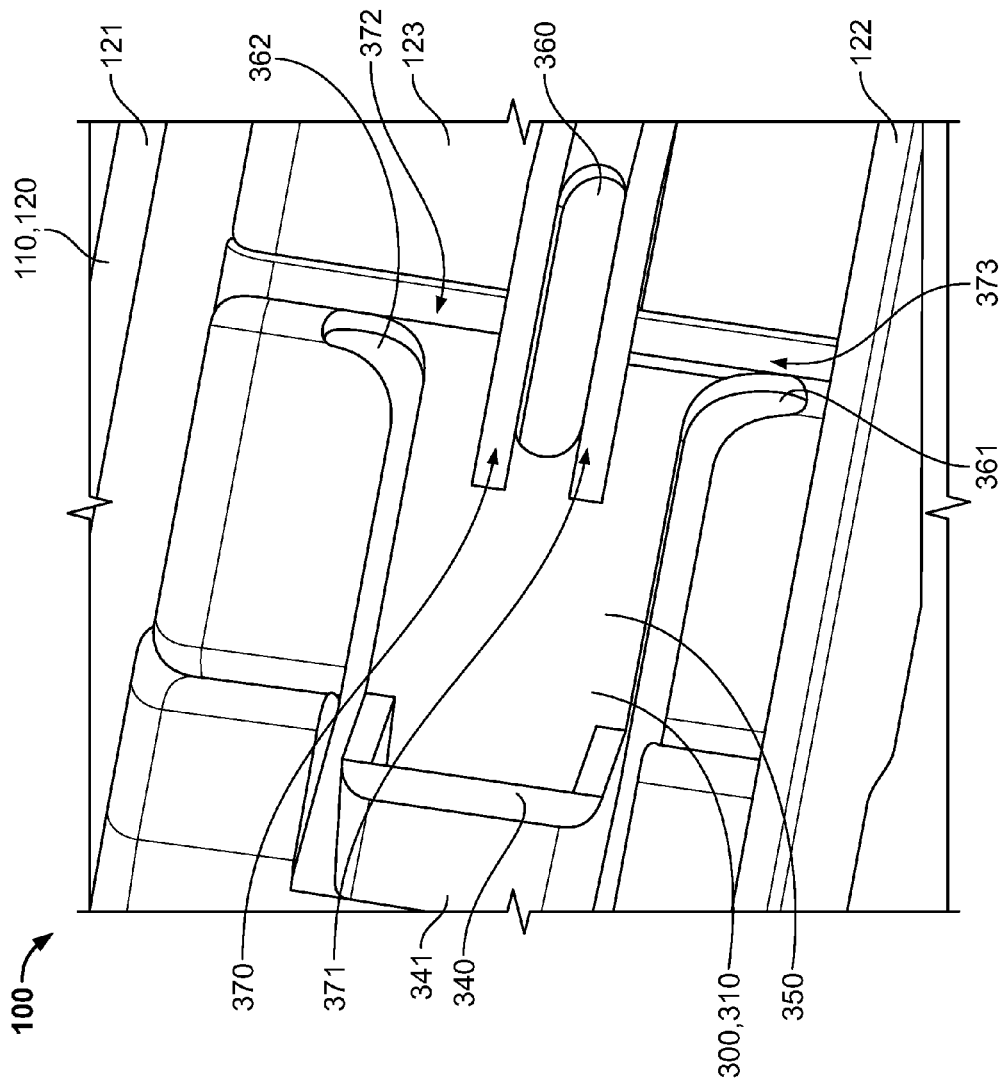
121
362
372
123
360
122
110,120
373
361
100
370
371
341
340
300,310
350

Fig. 6

PLUG CONNECTOR

The invention relates to a plug connector with a closable housing with a locking device in accordance with the preamble of claim **1**.

BACKGROUND OF THE DISCLOSURE

Electrical plug connectors and plug-connector systems are known in diverse embodiments from the prior art. There are plug connectors in which a lever has to be thrown in order to close a housing of the plug connector and/or to produce an electrical connection. It is also known to lock such a lever in its closed position by means of a locking mechanism. In order to move the lever which is locked in the closed position back into its open position, first of all the locking mechanism has to be released. It has been shown that incorrect operation of such plug connectors, for example an attempt to move the locked lever into the open position without releasing the locking mechanism beforehand, can result in damage to the locking mechanism and hence to the entire plug connector.

The object of the present invention is to provide an improved plug connector. This object is achieved by a plug connector having the features of claim **1**. Preferred developments are set forth in the dependent claims.

A plug connector according to the invention has a housing with a cap, the cap in turn having a lever which can adopt a first position and a second position. In this case, the housing is opened in the first position of the lever and closed in the second position of the lever. The plug connector further has a locking device which can adopt a blocking position which is intended to lock the lever in the second position. Furthermore, the locking device is elastically movable out of its blocking position into a release position in order to unlock the lever in the second position. Furthermore, the locking device is elastically movable out of its blocking position into an overload position in order to unlock the lever in the second position if a force exerted on the lever exceeds a set value. In this case, the overload position differs from the release position. Advantageously, with this plug connector the lever is also released from the second position when the locking device has not previously been moved into the release position, but a force exerted on the lever exceeds a set minimum value. This advantageously avoids damage to the locking device, the lever or other components of the plug connector which would otherwise be a risk. Advantageously, the plug connector is then still functional even after incorrect operation or inadvertent opening of the lever.

SUMMARY OF THE DISCLOSURE

In a preferred embodiment of the plug connector, the locking device has a latch projection. Advantageously, a latch projection is highly suitable for locking the lever in its second position.

It is expedient for the lever in its second position to lie against the latch projection. Advantageously, the latch projection then brings about reliable locking of the lever in its second position.

In a particularly preferred embodiment of the plug connector, the locking device is movable out of the blocking position into the release position by pressing-in the latch projection. Advantageously this embodiment permits simple and intuitive unlocking of the locking device in the second position of the lever.

It is expedient for the locking device to have a bar-shaped section and for the latch projection to be arranged on a longitudinal end of the bar-shaped section. Advantageously, the bar-shaped section of the locking device then permits elastic deformation of the locking device in order to move the locking device out of its blocking position both into the release position and into the overload position. Owing to the elastic deformability of the locking device, advantageously damage to the locking device is avoided.

Particularly preferably, the locking device has a recess. Advantageously, the recess can increase the elastic deformability of the locking device, which prevents inelastic, non-reversible deformation of the locking device.

It is likewise preferable for the locking device to have a reinforcing rib. Advantageously, a reinforcing rib also improves the elastic properties of the locking device. Furthermore, the reinforcing rib can advantageously partially dissipate forces acting on the locking device into the area around the locking device, which advantageously effectively prevents damage to the locking device.

In one embodiment of the plug connector, the lever is pivotable about a rotation spindle. Advantageously, the lever can then be moved between the first position and the second position by pivoting about the rotation spindle.

In a particularly preferred embodiment of the plug connector, the lever has teeth which are arranged along an arc of a circle about the rotation spindle. Advantageously, turning the lever about the rotation spindle then brings about turning of the teeth about the rotation spindle, by which the movement of the lever can be transmitted to further components of the plug connector which are engaged with the teeth of the lever. Advantageously, the movement of the lever can then serve for closing and opening the plug connector, and also for producing and releasing an electrical connection brought about by the plug connector.

In an expedient embodiment of the plug connector, the locking device is arranged on the cap. Advantageously, this embodiment permits particularly simple manipulation of the plug connector, since placing of the cap on a further part of the housing of the plug connector and closing of the housing can then take place in a joint operation.

Particularly preferably, the locking device and the cap are formed in one piece. Advantageously, this simplifies the manipulation of the plug connector, since merely a common component has to be manipulated for closing the plug connector.

Advantageously, the one-piece configuration of the locking device and cap furthermore prevents one of the components from being lost during wiring or maintenance work. The one-piece configuration of the locking device and cap advantageously furthermore reduces the production costs, and also the transportation and storage costs.

It is expedient for the cap and/or the locking device to consist of plastics material. Advantageously, plastics material represents an inexpensive material, and offers suitable elastic properties.

In one embodiment of the plug connector, the cap and/or the locking device are produced by injection moulding. Advantageously, injection moulding represents an inexpensive production method which is suitable for mass production.

The invention will be explained in greater detail below with reference to figures. Therein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of part of a cap of a housing of a plug connector with a lever in a first position;

FIG. **2** is a perspective view of the cap of the housing of the plug connector with the lever in a second position;

FIG. **3** is a section through the cap of the housing with a locking device in a blocking position and a release position;

FIG. **4** is a section through the cap with the locking device in a blocking position and an overload position;

FIG. **5** is a detail view of the locking device; and

FIG. **6** is a further detail view of the locking device.

DETAILED DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a perspective view of part of a cap **120** of a housing **110** of a plug connector **100**. The plug connector **100** may for example serve for producing an electrical connection in a motor vehicle. The plug connector **100** may for example serve for producing an electrical connection with an electrical energy storage means of an electric or hybrid vehicle.

The plug connector **100** has a multipart housing **110**, of which merely a cap **120** is illustrated in FIG. **1**. In order to produce an electrical connection by means of the plug connector **100**, the cap **120** is connected to the other sections of the housing **110** and the housing **110** is closed. The housing **110** is closed by means of a lever **200**. By closing the housing **110**, an electrical connection can be produced in various ways which are known from the prior art.

The cap **120** of the housing **110** of the plug connector **100** has a first side wall **121**, a second side wall **122** located opposite the first side wall **121** and a top wall **123** extending between the first side wall **121** and the second side wall **122**. Furthermore, the cap **120** of the housing **110** has a strain relief device **130** in which for example an electric cable can be guided and held.

The lever **200** is approximately U-shaped and has a first arm **201** and a second arm **202** parallel to the first arm **201**. The first arm **201** and the second arm **202** are connected together via an operating region **203**. The first arm **201** of the lever **200** is oriented parallel to the first side wall **121** of the cap **120** and is adjacent to the first side wall **121**, and is connected rotatably to the first side wall **121** in the region of a rotation spindle **230**. The second arm **202** of the lever **200** is oriented parallel to the second side wall **122** of the cap **120**, is adjacent to the second side wall **122**, and is connected rotatably to the second side wall **122** in the region of the rotation spindle **230**. The operating region **203** extends across the top wall **123** of the cap **120**.

The lever **200** is rotatable about the rotation spindle **230**, and can be moved back and forth between a first position **210** and a second position **220**. FIG. **1** shows the lever **200** in its first position **210**. FIG. **2** shows a further perspective view of the cap **120** of the housing **110** of the plug connector **100**, in which the lever **200** is in its second position **220**. In the first position **210** of the lever **200**, the housing **110** is opened and an electrical connection which can be produced by the plug connector **100** is broken. The first position **210** can thus be referred to as an open position. In the second position **220** of the lever **200**, the housing **110** is closed and the electrical connection which can be produced by the plug connector **100** is likewise closed. The second position **220** can thus be referred to as a closed position.

The movement of the lever **200** is limited in the first position **210** of the lever **200** by a stop **140** arranged on the first side wall **121** of the cap **120**. The stop **140** is arranged such that the first arm **201** of the lever **200** lies against the stop **140** if the lever **200** is in the first position **210**. The stop **140** causes the lever **200** to be able to be moved out of its second position **220** into the first position **210**, but not beyond the first position **210**. A corresponding stop **140**, not visible in FIGS. **1** and **2**, can also be arranged on the second side wall **122** of the cap **120**.

Furthermore, the first side wall **121** of the cap **120** has a knob **150** which is formed as a rounded-off hemispherical projection of the first side wall **121**. The first arm **201** of the lever **200** has a hole **250**, the dimensions of which correspond to those of the knob **150**. In the first position **210** of the lever **200** illustrated in FIG. **1**, the knob **150** of the first side wall **121** latches in the hole **250** in the first arm **201** of the lever **200** in order to fix the lever **200** in the first position **210**. This advantageously prevents the lever **200** from swinging back and forth disruptively between its first position **210** and its second position **220** during the assembly of the plug connector **100**. The fixing of the lever **200** in the first position **210** by the knob **150** and the hole **250** can however be released by a user without great expenditure of force by pushing the lever **200** out of the first position **210** in the direction of the second position **220**. The second side wall **122** of the cap **120** may have a corresponding knob **150**, not visible in FIGS. **1** and **2**. In this case, the second arm **202** of the lever **200** also has a corresponding hole **250**.

Both the stop **140** and the knob **150** and the hole **250** can be omitted in simplified embodiments.

The first arm **201** of the lever **200** furthermore has a plurality of teeth **240** which are arranged on a longitudinal end of the first arm **201** which is located opposite the operating region **203**, close to the rotation spindle **230** and approximately along the arc of a circle about the rotation spindle **230**. The second arm **202** of the lever **200** also has corresponding teeth, but these are not visible in FIGS. **1** and **2**.

The teeth **240** are formed like the teeth of a gear wheel, and may engage with further teeth or other components of the plug connector **100**. A movement of the lever **200** between its first position **210** and its second position **220** can be transmitted to other parts of the plug connector **100** via the teeth **240** in order to effect closing or opening of the plug connector **100** and making or breaking of an electrical connection brought about by the plug connector **100**. Appropriate mechanisms are known from the prior art.

The operating region **203** of the lever **200** has a plurality of ribs **204** by which the operating region **203** is made easier to grip, and which thereby simplify manipulation of the lever **200** for a user of the plug connector **100**. The ribs **204** could however also be omitted or be replaced by other configurations of the operating region **203**.

The cap **120** of the housing **110** of the plug connector furthermore has a locking device **300**. The locking device **300** serves to lock the lever **200** when the lever **200** is in its second position **220**; the housing **110** of the plug connector **100** is therefore closed by the lever **200**. The locking of the lever **200** in its second position **220** means that the lever **200** cannot be readily moved back again into its first position **210**; the housing **110** of the plug connector **100** cannot therefore be unintentionally opened and an electrical connection brought about by the plug connector **100** cannot be unintentionally broken.

The locking device **300** is arranged on the cap **120** of the housing **110** of the plug connector **100** and is formed in one piece with the cap **120** of the housing **110** of the plug connector **100**. The locking device **300** could however also be provided at a different point on the plug connector **100**.

The locking device **300** has a bar-shaped section **350**, the first longitudinal end of which merges into the top wall **123** of the cap **120** and the second longitudinal end of which has a latch projection **340**. The latch projection **340** in turn has

an actuating region **342** and a contact surface **341**. It can be seen in FIG. **2** that the latch projection **340** of the locking device **300** is arranged such that the operating region **203** of the lever **200** lies right next to the contact surface **341** of the latch projection **340** of the locking device **300** if the lever **200** is in its second position **220**; the housing **110** of the plug connector **100** is therefore closed by the lever **200**. Owing to the location of the operating region **203** of the lever **200** right next to the contact surface **341** of the latch projection **340**, pivoting of the lever **200** out of the second position **220** back into the first position **210** is prevented. If an attempt is made to move the lever **200** in the direction of the first position **210**, the operating region **203** of the lever **200** strikes the contact surface **341** of the latch projection **340**. The lever **200** is thus locked in the second position **220**.

FIG. **3** shows a first section through the cap **120** of the housing **110** of the plug connector **100** with the locking device **300**. The locking device **300** is in a blocking position **310** which the locking device **300** adopts if no external forces are acting on the locking device **300**. It can be recognised that the operating region **203** of the lever **200** which is in the second position **220** lies against the contact surface **341** of the latch projection **340** of the locking device **300** or at least is located right next to the contact surface **341** of the latch projection **340**. If an attempt is made to move the lever **200** in this situation into the first position **210**, the operating region **203** of the lever **200** butts against the contact surface **341** of the latch projection **340**, which prevents further movement of the lever **200**.

Further, the locking device **300** is illustrated in a release position **320** in broken lines in FIG. **3**. In its release position **320**, the locking device **300** is elastically deformed relative to its blocking position **310**. The elastic deformation of the locking device **300** in this case is achieved substantially by the bar-shaped section **350** of the locking device **300**. The locking device **300** can be bent out of its blocking position **310** into its release position **320** by exerting a force directed in the direction of the interior of the housing **110** of the plug connector **100** onto the actuating region **342** of the latch projection **340**. The force can for example be exerted by a user of the plug connector **100** pressing with a finger on the actuating region **342** of the latch projection **340**.

In the release position **320**, the locking device **300** is deformed such that the latch projection **340** is located further within the housing **110** of the plug connector **100** than in the blocking position **310**. This means that the contact surface **341** of the latch projection **340** in the release position **320** is no longer right next to the operating region **203** of the lever **200**. Consequently, the lever **200** can be moved out of the second position **220** into the first position **210** without the operating region **203** of the lever **200** butting against the contact surface **341** of the latch projection **340** of the locking device **300**.

Thus the lever **200** can be unlocked by exerting a force on the actuating region **342** of the latch projection **340** of the locking device **300** in its second position **220**. If the exertion of a force on the actuating region **342** of the latch projection **340** is discontinued, the user of the plug connector **100** therefore stops pressing on the actuating region **342** of the latch projection **340**, then the locking device **300** moves back out of its release position **320** again elastically into its blocking position **310**.

Upon closing the lever **200** out of its first position **210** into its second position **220**, the operating region **203** of the lever **200** slides over the latch projection **340** of the locking device **300**, which causes the locking device **300** to be moved briefly out of its blocking position **310** into its release position **320** by the lever **200**. This means that the operating region **203** of the lever **200**, upon moving the lever **200** into the second position **220**, can slide past the latch projection **340**. If the lever **200** has completely arrived in its second position **220**, the locking device **300** automatically moves elastically back into its blocking position **310**, which locks the lever **200** in the second position **220**.

FIG. **4** shows a further section through the cap **120** of the plug connector **100** and the locking device **300**. Again, the locking device **300** is shown in its blocking position **310**. Furthermore, the locking device **300** is shown in an overload position **330** in broken lines.

If the lever **200** is in the second position **220** and an attempt is made to turn the lever **200** out of the second position **220** into the first position **210** without moving the locking device **300** out of the blocking position **310** into the release position **320** beforehand, the operating region **203** of the lever **200** butts against the contact surface **341** of the latch projection **340**. If the lever **200** is nevertheless pressed further in the direction of the first position **210** with great force, the locking device **300** could break off and the plug connector **100** could thus be permanently damaged. For this reason, the locking device **300** is configured such that it can elastically deform out of its blocking position **310** into the overload position **300** shown in FIG. **4**. The deformation of the locking device **300** out of the blocking position **310** into the overload position **330** preferably requires a greater force than the deformation of the locking device **300** out of the blocking position **310** into the release position **320**. The elastic deformation of the locking device **300** in the overload position **330** is achieved substantially by the bar-shaped section **350** of the locking device **300**.

In the overload position **330** of the locking device **300**, the contact surface **341** of the latch projection **340** of the locking device **300** is no longer arranged right next to the operating region **203** of the lever **200** which is in the second position **220**. Consequently, the operating region **203** of the lever **200** can be guided past the latch projection **340** of the locking device **300** if the locking device **300** is in the overload position **330**. If the lever **200** is initially in the second position **220** and is blocked by the locking device **300** which is in the blocking position **310**, and if the lever **200** is then moved in the direction of the first position **210** with a force which exceeds a set minimum value, the operating region **203** exerts a force on the contact surface **341** of the latch projection **340** of the locking device **300** by which the locking device **300** is deformed out of its blocking position **310** into its overload position **330**, until the operating region **203** of the lever **200** can finally slide past the latch projection **340** and the lever **200** can be moved into the first position **210**. Then the locking device **300** moves independently elastically out of the overload position **330** back into the blocking position **310**, without the locking device **300** having been damaged.

The force to be applied for moving the locking device **300** out of the blocking position **310** into the overload position **330** is preferably selected to be so large that inadvertent opening of the lever **200** which is locked in the second position **220** is ruled out. Merely in the case of incorrect operation of the plug connector **100**, or in the case of a force exerted on the lever **200** for other reasons which is so great that there is a risk of damage to the locking device **300**, should the locking device **300** move elastically into the overload position **330** in order to avoid damage to the locking device **300**.

FIG. **5** shows a detail view of the locking device **300**. The locking device **300** is formed in one piece with the cap **120**

of the housing **110** of the plug connector **100**. The bar-shaped section **350** and the latch projection **340** arranged at one longitudinal end of the bar-shaped section **350** are separated by a first lateral recess **361** and by a second lateral recess **362** from the other sections of the top wall **123** of the cap **120**.

The bar-shaped section **350** has a concave section **351** which is curved in the direction of the interior of the housing **110**. The concave section **351** increases the elastic deformability of the bar-shaped section **350**.

In the transitional region between the bar-shaped section **350** and the top wall **123** of the cap **120** there is provided a middle recess **360** which extends parallel to the bar-shaped section **350** and is arranged centred between the first lateral recess **361** and the second lateral recess **362**. The middle recess **360** also improves the elastic deformability of the bar-shaped section **350** of the locking device **300**.

FIG. **6** shows a further detail representation of the locking device **300** of the plug connector **100**. FIG. **6** shows the locking device **300** viewed from the interior of the housing **110**. It can be seen that a first reinforcing rib **370** and a second reinforcing rib **371** are provided in the transitional region between the bar-shaped section **350** of the locking device **300** and the top wall **123** of the cap **120**. The first reinforcing rib **370** and the second reinforcing rib **371** are oriented parallel to the middle recess **360** and are arranged on both sides adjacent to the middle recess **360**. The first reinforcing rib **370** and the second reinforcing rib **371** are formed in one piece with the locking device **300** and the top wall **123** of the cap **120**.

Furthermore, a third reinforcing rib **372** and a fourth reinforcing rib **373** are provided in the transitional region between the bar-shaped section **350** of the locking device **300** and the top wall **123** of the cap **120**. The third reinforcing rib **372** and the fourth reinforcing rib **373** are arranged at right-angles to the first reinforcing rib **370** and to the second reinforcing rib **371**. The third reinforcing rib **372** extends between the first reinforcing rib **370** and the first side wall **121** of the cap **120**. The fourth reinforcing rib **373** extends between the second reinforcing rib **371** and the second side wall **122** of the cap **120**.

The reinforcing ribs **370**, **371**, **372**, **373** serve to deflect a force exerted on the locking device **300** partially into the cap **120** of the housing **110** of the plug connector **100**, in order to avoid damage to the locking device **300**. The reinforcing ribs **370**, **371**, **372**, **373** could however be omitted or be formed differently, as could also the middle recess **360** and the lateral recesses **361**, **362**.

The cap **120** of the housing **110** of the plug connector **100** preferably consists of plastics material and can be produced by injection moulding. The lever **200** also preferably consists of a plastics-material part produced by injection moulding. The configuration of the locking device **300** with the stabilising reinforcing ribs **370**, **371**, **372**, **373** and the recesses **360**, **361**, **362** which increase the elasticity also permits the use of an inexpensive plastics material with non-optimum mechanical properties.

The invention claimed is:

1. A plug connector with a housing and with a cap,

the cap having a lever which can adopt a first position and a second position,

the housing being opened in the first position of the lever and being closed in the second position of the lever,

the plug connector having a locking device which can adopt a blocking position which is intended to lock the lever in the second position, the locking device being elastically movable out of its blocking position into a release position in order to unlock the lever in the second position, the locking device having a latch projection and a bar-shaped section, the latch projection being arranged on a longitudinal end of the bar-shaped section and the bar-shaped section having a concave section which is curved in the direction of the interior of the housing to increase the elastic deformability of the bar-shaped section, wherein the locking device is elastically movable out of its blocking position into an overload position in order to unlock the lever in the second position if the locking device is not moved to the release position and a force is exerted on the lever that exceeds a set value, the overload position differing from the release position.

2. The plug connector of claim **1**, wherein the lever in its second position is locked by the latch projection.

3. The plug connector of claim **1**, wherein the locking device being movable out of the blocking position into the release position by pressing-in the latch projection.

4. The plug connector of claim **1**, wherein the locking device has a recess.

5. The plug connector of claim **1**, wherein the locking device has a reinforcing rib.

6. The plug connector of claim **1**, wherein the lever is pivotable about a rotation spindle.

7. The plug connector of claim **6**, wherein the lever has teeth which are arranged along an arc of a circle about the rotation spindle.

8. The plug connector of claim **1**, wherein the locking device is arranged on the cap.

9. The plug connector of claim **8**, wherein the locking device and the cap are formed in one piece.

10. The plug connector of claim **1**, wherein the cap and/or the locking device consist of plastics material.

11. The plug connector of claim **10**, wherein the cap and/or the locking device are produced by injection moulding.

12. The plug connector of claim **1**, wherein the lever is rotatable into the latch projection of the locking device and the locking device is elastically movable out of its blocking position into the overload position.

13. The plug connector of claim **1**, wherein the bar-shaped section of the locking device buckles in the longitudinal direction at the concave section in the overload position.

14. A plug connector with a housing and with a cap,

the cap having a lever which can adopt a first position and a second position,

the housing being opened in the first position of the lever and being closed in the second position of the lever,

the plug connector having a locking device which can adopt a blocking position which is intended to lock the lever in the second position, the locking device depending from a top surface of the cap and being elastically movable out of its blocking position into a release position in order to unlock the lever in the second position, the locking device having a latch projection and a bar-shaped section, the latch projection being arranged on a longitudinal end of the bar shaped section and the bar-shaped section having a concave section which is curved in the direction of the interior of the housing with a top surface of the bar-shaped section being inward of the top surface of the cap when in the blocking position, wherein the locking device is elastically movable out of its blocking position into an overload position in order to unlock the lever in the second position if the locking device is not moved to

the release position and a force exerted on the lever exceeds a set value, the overload position differing from the release position.

15. The plug connector of claim **14**, wherein the lever in its second position lies against the latch projection.

16. The plug connector of claim **14**, wherein the locking device being movable out of the blocking position into the release position by pressing-in the latch projection.

17. The plug connector of claim **14**, wherein the locking device has a recess.

18. The plug connector of claim **14**, wherein the locking device has a reinforcing rib.

19. The plug connector of claim **14**, wherein the lever is pivotable about a rotation spindle.

20. The plug connector of claim **19**, wherein the lever has teeth which are arranged along an arc of a circle about the rotation spindle.

21. The plug connector of claim **14**, wherein the lever is rotatable into the latch projection of the locking device and the locking device is elastically movable out of its blocking position into the overload position.

22. The plug connector of claim **14**, wherein the bar-shaped section of the locking device buckles in the longitudinal direction at the concave section in the overload position.

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