

ELECTRICAL PLUG-AND-SOCKET DEVICE

5 The invention relates to an electrical plug-and-socket device for use in hazardous areas, comprising a plug part and a socket part having at least one outer housing and an inner part rotatable relatively thereto, wherein a locking pin is longitudinally movably mounted in the inner part.

10 Such plug-and-socket devices are, for example, known from EP 1344 286 B1 or EP 1208 619 B1. The previously known inner part is mounted rotatably between the off position and the on position in the socket part. The locking pin is movably mounted between a blocking position (pushed in) and a release position (projecting from the inner part). When the locking pin is in the release position, the inner part can be turned between the off position and the on position. This turning takes place via the inserted plug part.

15 In the aforementioned publications, the plug-and-socket device is accordingly de-energized prior to removal of the plug part since the plug part should only be removed when a turn into the off position was previously carried out.

20 The locking pin moreover comprises an adapter end, which is received by a corresponding adapter recess in the plug part if the plug part and the socket part match. If the adapter recess in the plug part does not match the adapter end of the locking pin, the locking pin will be pressed into the inner part.

25 Disadvantageous in the aforementioned prior art is that although a current can be interrupted by turning the inner part, it is not possible to directly switch on or off the load assigned to the plug-and-socket device. This means that the property of plugging and the property of switching the current on or off are combined in the electrical plug-and-socket device.

30 The invention is based on the aim of improving an electrical plug-and-socket device of the aforementioned type such that it easily allows direct switching off of the assigned load and that various loads with other possibilities for switching on and off can also possibly be switched by the same plug-and-socket device.

35 This aim is achieved by the features of claim 1. The invention is in particular characterized in that the locking pin, at an engagement end opposite its adapter end, is engaged with a switching pin for switching on or off. This means that when the plug part fits the socket part, the locking pin is not influenced in its position and in particular in the axial direction by the plug part so that a turning of the inner part relative to the outer housing of the socket part is possible. By simultaneously engaging the locking pin and the switching pin, switching the load on or off also takes place.

40 If other loads with other switching pins are used, this can be easily effected by also using, for example, a different locking pin which again engages its engagement end with the switching pin.

According to the invention, the load is directly switched on and off in this way, wherein this can take place in addition to de-energizing the electrical plug-and-socket device in accordance with the aforementioned European patent specifications. This can, where applicable, also take place at different times so that the load is switched on and off first, after which the electrical plug-and-socket device is de-energized.

In order to arrange the load directly in the socket part, the load can be arranged in a rear switch part and the switching pin can project from the rear switch part toward the locking pin. The rear switch part and the remaining socket part can be releasably connected to each other so that the rear switch part together with the respective load can be exchanged.

In order to be able to cover the rear switch part on the sides of the inner part, the rear switch part can, at its front end which faces the inner part, be covered by a cover.

The socket part is generally supplied with electricity from the rear side so that an electrical connection can be routed through the rear switch part and cover toward the inner part, for example. In this regard, it can be considered advantageous if contact element openings and a switching pin opening are formed in the cover. The contact element openings serve the insertion or through-routing of corresponding contact elements.

Since, according to the invention, the electrical plug-and-socket device is suitable for hazardous areas, it is advantageous in this respect if the contact element openings and the switching pin opening are designed to be breakdown-safe when both the contact elements and the switching pin are inserted.

The further electrical connection can then, for example, be made such that the contact elements are electrically connected to female connectors for wrap pins arranged in the inner part.

In order to design the rear switch part with cover to be usable by itself in hazardous areas, it may be advantageous if the cover can be screwed to the rear switch part, forming spark-breakdown-safe gaps. However, there is also the possibility of gluing or welding the cover to the rear switch part. Welding can be effected by friction welding. In this case, this would also result in a corresponding protection class for hazardous areas, e.g., protection class Ex-d.

In order to ensure in a simple manner that no relative turn between the socket part and the plug part is possible when the two do not match, a locking insert which comprises a rotation guide for the inner part and a locking device for the locking pin can be arranged between the inner part and the cover.

The locking device in particular prevents turning of the locking pin and thus of the plug inner part (see the aforementioned publications) so that de-energizing the electrical plug-and-socket device or switching the load on or off is not possible. Only when the corresponding adapter recess of the plug part matches the adapter end of the locking pin will no locking of the locking pin occur and the plug inner part be able to be turned relatively to the outer housing.

In a simple exemplary embodiment, it is conceivable that the rotation guide be designed as a guide wall, as guide wall sections, or even as guide walls projecting toward the inner part. The guide wall, guide wall sections or guide walls are engaged with guide grooves and/or guide recesses on the inner part so that a relative turn between the inner part and the locking insert is possible.

A relatively simply structured and safely functioning locking device can result when it comprises a pin receptacle with at least one locking recess which is open toward the locking pin and in which a locking projection projecting substantially radially on the locking pin engages in a torque-proof manner when the locking pin is moved axially toward the locking insert. This means that when the locking pin is moved axially toward the locking insert, the locking projection engages with the locking recess so that the locking pin is disposed in a torque-proof manner even if it can, where appropriate, be moved further axially in the locking insert.

As a result of the torque-proof arrangement of the locking pin in the locking insert, a relative rotation of the inner part relative to the socket part or outer housing of the socket part is also no longer possible.

In order to allow a corresponding contact between the locking pin and the switching pin in this respect also, it proves to be advantageous if the locking pin and the switching pin are axially movably engaged with each other. This means that when the locking pin is not changed in its position by the plug part, i.e., is not moved axially, an engagement between the locking pin and the switching pin exists in order to turn the switching pin for switching the load on or off when the inner part and the locking pin are turned relatively to the outer housing. If the locking pin is axially moved by a plug part not matching the socket part, the engagement with the switching pin will persist. However, the load cannot then be switched on or off since the locking pin is held in a torque-proof manner in the locking insert and a relative rotation of the inner part relative to the outer housing is not possible.

In order to make a corresponding engagement between the locking pin and the switching pin possible in a simple manner, it is conceivable for the switching pin to comprise at its connecting end an insertion slot in which the engagement end of the locking pin engages axially movably, wherein, in addition to the insertion slot, at least one slot opening is formed, in which an insertion projection engages axially movably at the engagement end. This results in a relatively stable connection between the switching pin and the

locking pin, which safely allows a turning of both together to switch the load on or off. It is also conceivable that, in addition to the insertion slot, several slot openings be formed, in which a corresponding number of insertion projections on the engagement end of the locking pin engage.

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In order to be able to guide the electrical connection rearwardly toward the socket part in a simple manner, it may be advantageous, where appropriate, for the contact elements to be connected via an electrical connection to the plug contacts that can be inserted at the rear end of the rear switch part into
10 plug contact openings, forming a spark-ignition-safe gap. The gap can also be glued together. The gap in this case satisfies spark protection class Ex-d. The electrical connections can take the form of electrical cables or the like. The plug contact openings are guided through the rear end in order to connect up electrical lines at the socket part or rear switch part from outside.

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In order to satisfy the requirements for explosion protection in this region as well, spark-breakdown-safe gaps can correspondingly be formed between the plug contact openings and the inserted plug contacts.

20 Such a load is, for example, an industrial switch, which can be used via additional plug contacts or plug lugs in the plug-and-socket device in a corresponding protection class, such as Ex-d. The plug contacts/lugs are used for electrical connection.

25 An advantageous exemplary embodiment is explained in more detail below using the figures enclosed in the drawing. They show:

Figure 1: A perspective plan view of a plug-and-socket device according to the invention, comprising a plug part and a socket part;

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Figure 2: An exploded view of a socket part according to the invention in a lateral view;

Figure 3: The socket part according to Figure 2 in a longitudinal section and assembled; and
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Figure 4: An enlarged view of a contact element.

40 Figure 1 is a perspective view of an exemplary embodiment of an electrical plug-and-socket device 1 viewed obliquely from the front. This device comprises a plug part 2 and a socket part 3. They are shown in Figure 1 in an arrangement connected to each other. The plug part 2 has in its front end an opening for a cable not shown. This cable is inserted into the plug part 2 and connected there to corresponding, in particular pin-shaped, plug contacts. The plug part 2 and
45 socket part 3 are locked via a corresponding fastening device, which in the exemplary embodiment shown takes the form of a bayonet coupling.

A relative rotation of the plug part and the socket part about an appropriate angle of rotation takes place in order to both fasten the plug part 2 in the socket part 3 and correspondingly switch a load in a rear switch part 11 visible at the rear end of the socket part 3. This angle of rotation is, for example, between 20° and 120°, preferably between 40° and 100°, and particularly preferably between 60° and 90°. In order to define an angle of rotation, a rotational adjustment mark can be provided on a front end of the socket part or even on the plug part. This rotational adjustment mark may also comprise an end stop, which, for example, defines the locking position or the on position of the plug part relative to the socket part.

The socket part 3 according to Figure 1 is open at its front end, wherein a corresponding cover plate 37 is arranged laterally next to the socket part 3.

Figure 2 shows the socket part 3 of Figure 1 in a lateral exploded view.

An inner part 5, which is rotatably mounted relative to the outer housing 4, is arranged in the outer housing 4. Female connectors (not shown; see Figure 3), into which the corresponding plug pins are inserted when the plug part 2 is inserted into the socket part 3, are arranged in this inner part 5.

In a central opening in the inner part 5, a locking pin 6 is mounted, which in Figure 2 is shown separately between the outer housing 4 and a locking insert 19. The locking pin 6 comprises an adapter end 7, which projects from the inner part 5 toward the plug part 2. A fitting adapter recess in the plug part 2 is generally placed onto this adapter end 7. At its engagement end 8 opposite the adapter end 7, the locking pin comprises laterally projecting insertion projections 31, which project from a substantially centrally arranged insertion projection 38 extending in the axial direction. Adjacent to its engagement end 8, the locking pin 6 furthermore comprises a series of locking projections 27 projecting radially outward. These locking projections are explained in more detail in connection with Figure 3 and the locking insert 19.

The locking insert 19 has a central opening, through which at least the engagement end 8 of the locking pin 6 is guided toward the switching pin 9. The switching pin 9 comprises a connecting end 29. In this connecting end, an insertion slot 28 for receiving the insertion projection 38 is formed approximately centrally. In addition, at least two slot openings 30 in which the insertion projections 31 engage are arranged laterally next to the insertion slot. The engagement end 8 and the connecting end 29 are axially movably connected to each other.

At its end opposite the connecting end 29, the switching pin 9 has an insertion projection 38.

At its end opposite the connecting end 29, the switching pin 9 has a projection 39, which has an angular cross-section and can be inserted into a corresponding receptacle 40 on the load 10.

Between the switching pin 9 and the load 10, a cover 13 is arranged, which can be placed onto a corresponding front end 12 of a rear switch part 11 or be inserted thereinto. When the socket part 3 is assembled, the load 10 is arranged in the rear switch part 11 (see also Figure 3) and the corresponding front end 12 is closed by the cover 13. Contact elements 16 projecting from the load 10 are received by corresponding contact element openings 14 in the cover 13, wherein a switching pin opening 15 for inserting or guiding through the switching pin 9 is furthermore formed in the cover.

On its rear side facing away from the cover 13, the load 10 has a number of plug contacts 33, which can be inserted into corresponding plug contact openings 35 (see Figure 3) at the rear end 34 of the rear switch part 11. These plug contacts 33 serve to connect electrical connecting lines in the region of the rear end 34.

The contact elements 16 of the load 10 are connected to the plug contacts 33 via cable-shaped electrical connections 32.

The load is an industrial plug, which can be arranged in the form of lugs in the manner of spark protection class Ex-d in the plug-and-socket device via the contact elements 16 and connections 32.

Figure 3 shows in a longitudinal section the corresponding individual parts according to Figure 2 when assembled.

Visible in Figure 3 is the inner part 5 which is rotatably mounted in the outer housing 4 and in which a number of female connectors 17 are arranged. The number of female connectors may vary depending on the plug-and-socket device used, wherein three-pin, five-pin, or even differently pinned plug-and-socket devices are possible. These plug-and-socket devices generally serve to supply a load or the like with 20 to 100 A.

At its end facing the locking insert 19, the inner part 5 comprises a series of guide grooves 23 or guide recesses 24. These grooves or recesses engage in or abut against the corresponding guide walls 22, wherein these guide walls 22 are part of a rotation guide 20. By means of this rotation guide 20, the inner part 5 is rotatably mounted relative to the locking insert 19.

With its engagement end 8, the locking pin 6 projects from the inner part 5 and engages there with a locking device 21 of the locking insert 19 and is accordingly disposed in a pin receptacle 25 and also guided through toward the switching pin 9. There, the corresponding engagement takes place (see also Figure 2) of the engagement end 8 with the insertion projection 31 and insertion projection 38 as well as connecting end 29 of the switching pin 9 (see insertion slot 28 and slot openings 30).

The corresponding contact elements 16 are guided through contact element openings 14 in the cover 13 and, together with them, form spark-breakdown-safe gaps 18. This also analogously applies to the switching pin 9, which is disposed in the corresponding switching pin opening 15 of the cover 13, forming spark-breakdown-safe gaps 18.

The load 10 is arranged in the rear switch part 11 and, by means of its receptacle 40, connected to the insertion projection 38 of the switching pin 9 (see also Figure 2). The corresponding contact elements 16 are connected by means of the cable-shaped electrical connection 32 to the plug contacts 33, which are in turn inserted into the corresponding plug contact openings 35 in Figure 3, forming corresponding spark-breakdown-safe gaps 36. On the outside at the rear end 34 of the rear switch part 11, an electrical contact can take place via electrical connections and is then routed inside the socket part 3 to the female connectors 17.

Figure 4 shows an enlarged view of the insertion of the plug contact 33 into the plug contact openings 35, wherein in this regard the corresponding gap 36 is formed.

According to the invention, the result is a plug-and-socket device 1, and in particular a socket part 3, which is structured to be explosion-safe and comprises appropriate spark-breakdown-safe gaps 18 or 36 at several points. The locking pin 6 is axially movably mounted in the inner part 5 so that in case of a matching plug part 2 (in this respect see in particular adapter end 7), the locking pin 6 remains unmoved axially in the inner part 5 and, when the inner part 5 is subsequently turned relatively to the outer housing 4 by means of the plug part 2, the locking pin 6 turns the switching pin 9, which, via its connection to the load 10, switches said load on or off.

If the plug part 2 does not fit the socket part 3 (once again see adapter end 7), the locking pin 6 will be moved longitudinally toward the rear switch part 11. As a result of this longitudinal movement, the locking projections 27 engage with the corresponding locking recesses 26 of the locking insert 19 so that the locking pin 6 is held in a torque-proof manner by the locking insert 19. This makes switching the load 10 on or off impossible on the one hand and on the other hand also prevents energizing or de-energizing according to the aforementioned prior art.

The corresponding gaps can be glued, friction welded, or formed in another manner in order to comply with spark protection class Ex-d.

Claims

1. Electrical plug-and-socket device (1) for use in hazardous areas, comprising a plug part (2) and a socket part (3) having at least one outer housing (4) and an inner part (5) rotatable relatively thereto, wherein a locking pin (6) is longitudinally movably mounted in the inner part (5), characterized in that at an engagement end (8) opposite its adapter end (7), the locking pin (6) engages with a switching pin (9) for switching a load (10) on or off.
2. Plug-and-socket device according to claim 1, characterized in that the load (10) is arranged in a rear switch part (11) and the switching pin (9) projects from the rear switch part (11) toward the locking pin (6).
3. Plug-and-socket device according to claim 1 or 2, characterized in that at its front end (12) facing the inner part (5), the rear switch part (11) is covered by a cover (13).
4. Plug-and-socket device according to one of the preceding claims, characterized in that contact element openings (14) and a switching pin opening (15) are formed in the cover (13).
5. Plug-and-socket device according to one of the preceding claims, characterized in that contact element openings (14) and switching pin opening (15) are designed to be breakdown-safe when both the contact elements (16) and switching pin (9) are inserted.
6. Plug-and-socket device according to one of the preceding claims, characterized in that the contact elements (16) are electrically connected in the inner part (5) to female connectors (17) for plug contact pins of the plug part (2).
7. Plug-and-socket device according to one of the preceding claims, characterized in that the cover (13) can be screwed to the rear switch part (11), forming spark-breakdown-safe gaps (18).
8. Plug-and-socket device according to one of the preceding claims, characterized in that a locking insert (19) is arranged between the inner part (5) and the cover (13) and comprises a rotation guide (20) for the inner part (5) and a locking device (21) for the locking pin (6).
9. Plug-and-socket device according to one of the preceding claims, characterized in that the rotation guide (20) is designed at least as a guide wall (22) which projects toward the inner part (5) and with which guide grooves (23) and/or guide recess (24) on the inner part (5) engage.
10. Plug-and-socket device according to one of the preceding claims, characterized in that locking device (21) comprises a pin receptacle (25)

with at least one locking recess (24) which is open toward the locking pin (6) and in which a locking projection (27) projecting substantially radially from the locking pin (6) engages in a torque-proof manner when the locking pin (6) is axially moved toward the locking insert (19).

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11. Plug-and-socket device according to one of the preceding claims, characterized in that the locking pin (6) and the switching pin (9) axially movably engage with each other.

- 10 12. Plug-and-socket device according to one of the preceding claims, characterized in that at its connecting end (29), the switching pin (9) comprises one insertion slot (28), in which the engagement end (8) of the locking pin (6) engages axially movably, wherein, in addition to the insertion slot (28), at least one slot opening (30) is formed, in which an insertion projection (31)
- 15 on the engagement end (8) of the locking pin (6) axially movably engages.

13. Plug-and-socket device according to one of the preceding claims, characterized in that the contact elements (16) are connected via an electrical connection (32) to plug contacts (33), which can be inserted into plug contact openings (35) at the rear end (34) of the rear switch part (11), forming a spark-breakdown-safe gap.
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14. Plug-and-socket device according to one of the preceding claims, characterized in that a spark-breakdown-safe gap is formed between plug contact openings (35) and inserted plug contacts (33).
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