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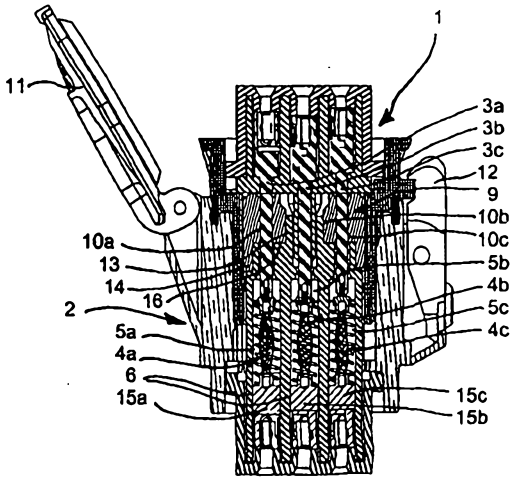
(54) Titre: SOCLE DE CONNEXION ELECTRIQUE, NOTAMMENT POUR ATMOSPHERE EXPLOSIBLE, ET SON PROCEDE DE FABRICATION

(57) **Abstract**

The invention concerns an electric connection base plate (2), in particular for an explosible environment, provided with electrical contacts (4a, 4c) mounted in peripheral contact housings (5a, 5c) of an insulating unit (6) and designed to co-operate with the corresponding contact pins (3a, 3c) of a plug (1) while a safety disc (9) provided with at least as many peripheral orifices (10a, 10c) as the insulating unit is equipped with contact peripheral housings (5a, 5c), is mounted rotating on said insulating unit (6) through a central orifice (10b) with which it is equipped and whereof the inner surface co-operates with the lateral surface of a central protuberance (13) of the insulating unit (6) forming a rotating hub. The inventive base plate is characterised in that at least some of the surfaces in contact with the safety disc (9) and with the insulating unit (6) as well as the respective inner surfaces of at least the peripheral orifices (10a, 10c) of the safety disc (9) and outer surfaces of the plug corresponding pins (3a, 3c) form explosion-proof joint surfaces such that at least the insulating unit peripheral contact housings (5a, 5c) constitute at least an explosion-proof casing.



(57) **Abrégé**

L'invention concerne un socle (2) de connexion électrique, notamment pour atmosphère explosible, pourvu de contacts électriques (4a, 4c) qui sont montés dans des logements périphériques (5a, 5c) de contact d'un bloc isolant (6) et qui sont prévus pour coopérer avec des broches de contact (3a, 3c) correspondantes d'une fiche (1), tandis qu'un disque de sécurité (9) pourvu d'au moins autant d'ajours périphériques (10a, 10c) que le bloc isolant (6) est muni de logements périphériques (5a, 5c) de contact, est monté rotatif sur ledit bloc isolant (6) par un ajour central (10b) dont il est muni et dont la surface intérieure coopère avec la surface latérale d'une protubérance centrale (13) du bloc isolant (6) formant un moyeu de rotation. Le socle selon l'invention est notamment remarquable en ce qu'au moins certaines des surfaces en contact du disque de sécurité (9) et du bloc isolant (6) ainsi que les surfaces respectivement intérieures d'au moins les ajours périphériques (10a, 10c) du disque de sécurité (9) et extérieures des broches (3a, 3c) correspondantes de la fiche forment des surfaces de joint antidéflagrant de telle sorte qu'au moins les logements périphériques (5a, 5c) de contact du bloc isolant constituent au moins une enveloppe antidéflagrante.

ELECTRICAL CONNECTION SOCKET, PARTICULARLY FOR AN EXPLOSIVE ATMOSPHERE, AND ITS MANUFACTURING PROCESS

This invention relates to an electrical connection socket, particularly for an explosive or explodable atmosphere, for example in the form of a power connector socket or a mobile extension cable socket, and its manufacturing process.

It is already known how to manufacture an electrical connection socket provided with electrical contacts installed in contact housings of an insulating block, and which are designed to cooperate with the corresponding contact pins of a plug.

An "explosion proof" enclosure needs to be provided for each connection area in order to make a socket particularly suitable for an explosive atmosphere.

In the past, this type of explosion proof confinement was obtained using intermediate mobile contacts, for example in the form of pistons moving in translation as described in European patent 0 112 258.

However one of the difficulties with this type of device is the reliability of the disconnection time between the contact pistons and the electrical contacts between the plug and socket to prevent breaking outside the explosion proof area, particularly when the plug is extracted suddenly.

Known practice also includes a connection socket like that described in document GB-2125234 A that is provided with a safety disk with a peripheral opening for each peripheral contact housing in the insulating block of the socket, and that it is installed free to rotate on the said insulating block through a central

opening in the block, and in which the inside surface cooperates with a lateral surface of a central protuberance from the insulating block forming a rotation hub, such that the peripheral openings in the disk may be moved at will by rotating this disk with respect to the corresponding housings on the insulating block.

Furthermore, if this type of device is to be used in an explosive atmosphere, an explosion proof joint surface is created between the inside surface of the casing of the plug that is inserted in the socket, and the outside surface of an element fixed to the insulating block of the said socket.

It can then be understood that the body of the plug must fit precisely while being plugged in, to form the above-mentioned explosion proof joint surface. It is usually difficult to make a large diameter explosion proof joint and requires the use of metal parts as described here for precision reasons.

Furthermore, this part is vulnerable and the slightest damage can reduce the efficiency of the said explosion proof joint surface.

In particular, this is why the invention proposes a connection socket provided with a safety disk as mentioned above, but which is particularly remarkable in that at least some of the surfaces in contact with the safety disk and the insulating block and the inside surfaces of at least some of the peripheral openings in the safety disk and the outside surfaces of the corresponding pins in the plug form the surfaces of the explosion proof joint such that at least the peripheral housings in the contact of the insulating block form at least one explosion proof enclosure.

However, it is obvious that this type of structure does have advantages for use even when there is no explosive atmosphere.

In one embodiment, the central protuberance or the hub of the insulating block may be drilled to allow passage of the central pin of the plug designed to cooperate with a contact formed in a central housing of the insulating block.

For example, the safety disk and the insulating block have plane front surfaces that come into contact with each other, and in which at least part forms an explosion proof joint surface and/or furthermore the explosion proof joint surfaces between the safety disk and the insulating block are composed at least partly of at least part of the lateral rotation surface of the insulating block hub and the inside surface of the central opening of the disk.

According to one embodiment, the safety disk is provided with a peripheral annular extension that covers part of the insulating block, at least part of the overlapping areas of the said insulating block and the said extension forming the rotating lateral surfaces of the said explosion proof joint.

In this case and according to one embodiment, the rotating lateral surfaces of the insulating block and the safety disk formed firstly by the hub and the central opening in the disk, and secondly by the overlapping areas of the insulating block and the disk extension, are cylindrical surfaces of revolution. This type of embodiment is not compulsory since the said rotating surfaces, although they must be surfaces of revolution, do not need to be cylindrical.

At least the peripheral contact housings may for example be closed at the bottom of the corresponding contacts by elements forming explosion proof joint surfaces in the said housings.

Preferably, the hub of the insulating block has a flared and recessed end that holds the disk and the insulating block fixed together in translation.

According to one advantageous but not exclusive embodiment, the contacts of the socket are pressure contacts in end to end contact, each provided with a contact head, a braid and a helical spring located in the corresponding contact housing.

It is known that high precision is necessary for the interstices and the lengths of the explosion proof joints.

The invention also proposes a particular non-compulsory molding process which is remarkable in that the insulating block is insert molded in or on the safety disk, itself made in advance and acting as an insert, the necessary and adjusted interstice or clearance between surfaces of parts in contact to allow rotation of the disk on the said block and to form the said explosion proof joints being created by removal of material from the block after molding.

The invention will be understood, and other specific features will be clear to the reader, from the following description with reference to the attached drawings in which:

- Figure 1 is a top view of a power connector equipped with a power connector socket according to the invention and a plug in the inserted position,
- Figure 2 is a section along II-II in Figure 1,

- Figures 3 and 4 are applicable to Figures 1 and 2 respectively showing the plug in the position ready for connection after having been rotated (the section in Figure 4 being along IV-IV in Figure 3),
- Figures 5 and 6 correspond to Figures 1 and 2 or 3 and 4 respectively, showing the plug in the connected position (the section in Figure 6 being along VI-VI in Figure 5),
- Figure 7 diagrammatically shows a manufacturing process by insert molding the insulating block of the socket in the safety disk,
- Figure 8 is a sectional view along VIII-VIII in Figure 7,
- Figure 9 is a perspective bottom view of a safety disk according to the invention,
- Figure 10 is a perspective top view of the insulating block and its safety disk.

Therefore the electrical connector shown comprises a plug 1 and a socket 2.

Plug 1 is provided with contact pins such as pins 3a, 3b, 3c that are shown on the sectional views, and socket 2 comprises corresponding contacts 4a, 4b, 4c.

Contacts 4a, 4b, 4c on the socket are located in housings 5a, 5b, 5c formed in an insulating block 6 and in this case as a non-limitative example they are in the form of end to end pressure contacts, usually each classically composed as shown by a contact head 7, a conducting braid 7' and a helical pressure spring 8 (in Figure 2, references 7, 7' and 8 are only shown for the central contact 4b).

As shown in Figures 1, 3 and 5, in this case the plug 1 comprises five pins and obviously the same

number of corresponding contacts in socket 2, but only three of these can be seen in Figures 4 and 6 and only one in Figure 2.

As can be seen clearly in the Figures, the socket 2 is provided with a central housing 5b for a central contact 4b forming the earthing contact designed to cooperate with a central contact pin 3b of the plug, the other contacts 4a, 4c, 3a, 3c of the socket and the plug being called peripheral contacts and forming the phase or neutral contacts.

Furthermore, as clearly shown in the drawings, the socket is provided with a safety disk 9 mounted free to rotate on the insulating block 6, the disk 9 being provided with the same number of openings 10a, 10b, 10c as the number of contacts in the plug and the socket, since the said openings are provided to allow the plug contact pins to pass through, as will be described later.

Also as shown in the drawings, the socket is provided with a protection cover 11 designed to be folded down when the plug is not connected, and a hook 12 (Figures 4 and 6) to lock either the cover or the plug in the socket in the connection position (Figures 5 and 6).

The insulating block 6 is provided with a central protuberance 13 drilled in its center forming a rotation hub for the safety disk 9 that cooperates with the said hub through the inside surface of its central opening 10b.

The said central opening 10b of the disk 9 and the central protuberance or hub 13 of the insulating block 6 form lateral rotation surfaces that are also at least

partly cylindrical surfaces of revolution, as shown in this example.

As is clearly shown in Figures 2, 4 and 6, the safety disk 9 is also provided with a peripheral annular extension 14 that covers part of the insulating block 6, the areas covering the extension 14 and the insulating block 6 forming rotating cylindrical surfaces of revolution coaxial with the surfaces mentioned above.

Conventionally, in the initial position, the safety disk 9 conceals the peripheral contacts 4a, 4c of socket 2, whereas pins 3a, 3b, 3c in the plug may be inserted through openings 10a, 10b, 10c in the safety disk (Figures 1 and 2).

Subsequently, the plug is rotated causing rotation of the safety disk until it uncovers the peripheral contacts 4a and 4c in the socket (Figures 3 and 4).

All that is necessary then is to translate the plug once more so that the pins 3a, 3b and 3c of the plug come into contact with the corresponding contacts 4a, 4b and 4c of the socket when sufficient pressure is exerted to resist the force of the springs 8 fitted in them (Figure 2), causing a slight swelling of the conducting braids 7', the plug and socket then coming into the connection position shown in Figures 5 and 6, the plug being locked in the socket by hook 12 (obviously, the same movements carried out in the reverse order disconnect the connection).

The protuberance 13 of the insulating block 6 is also provided with a recessed flared part 13' (Figure 1) that moves the safety disk 9 and the said insulating block 6 in translation together, and the said part 13' may also be fitted with slits (clearly visible in

Figure 10) creating sectors that in particular provide some flexibility. However, according to another embodiment not shown, the protuberance 13 does not have a flared part 13', and the disk 9 is fixed by an add on clip.

Furthermore, as can be seen in Figures 2, 4 and 6, the peripheral openings 10a, 10c in disk 9 are a perfect fit for the contact pins 3a, 3c on plug 1.

It can be understood that the inside surface of the opening 10b in the disk and the outside surface of the hub 13 form lateral rotation surfaces over a certain length, like the areas overlapping the extension 14 of the disk on block 6, whereas the peripheral pins 3a, 3c of the plug pass through the calibrated openings 10a, 10c of disk 9 over a certain length.

Consequently, by choosing suitable lengths (or heights) of the above mentioned surfaces and the interstice between the said surfaces, explosion proof joint surfaces can be created such that the peripheral housings 5a, 5c of the socket that are the volumes within which the electrical contacts are made, form an explosion proof enclosure (see definitions below).

For this purpose, the contact housings 5a, 5c (and even 5b in this case) are closed at their opposite ends at contact heads by any means and particularly by elements forming clamping stands for socket contacts as shown in 15a, 15b and 15c. In this example, these elements form the said housings 15a, 15b and 15c of the explosion proof joint surfaces.

Note that French and European standards define an explosion proof enclosure as being a protection method in which parts that can ignite an explosive atmosphere

are enclosed in an enclosure that resists the pressure developed during an internal explosion of an explosive mix, and that prevents the explosion from being transmitted to the explodable atmosphere surrounding the enclosure.

An explosion proof joint is the location at which the corresponding surfaces of two elements of an enclosure or the common part of enclosures join together to prevent the transmission of an internal explosion to the explodable atmosphere surrounding the enclosure, its length being the shortest path between the inside and outside of the enclosure.

Obviously, the interstice of an explosion proof joint is the spacing between the corresponding surfaces of the said joint. For cylindrical surfaces forming cylindrical joints, the interstice is thus the difference between the diameters of the bore and the cylindrical body.

Therefore, the socket according to the invention can be explosion proof due to the creation of a common explosion proof enclosure for all peripheral contacts simply by creating explosion proof joints.

Although the example shown is applicable to a connection plug and socket for a three-phase power connection, it may be required (for example) to use the same socket (therefore with four peripheral pin passages) for a single phase current and in this case the plug is fitted with only two peripheral pins. Consequently, the invention also includes a flat explosion proof joint if necessary between the insulating block 6 and the disk 9.

As can be seen clearly on the cross-sectional drawings, the insulating block 6 and the disk 9 have

plane front surfaces that are applied in contact with each other.

The interstice between the said surfaces combined with the distance between two peripheral housings, or similarly between two peripheral openings 10a, 10c in the safety disk such as the distance shown diagrammatically as d in Figure 9, is used to create a flat explosion proof joint reference 16 if required as shown in section in the Figures, that can thus create an explosion proof enclosure for each peripheral contact housing 5b, 5c such that the absence of some pins and therefore unclosed disk openings is not a problem.

Very many combinations are possible, due to the use of this type of flat explosion proof joint.

The embodiment described above includes two cylindrical explosion proof joints (hub 13 and extension 14), apart from the joints formed by the pins themselves, and possibly a flat explosion proof joint 16 that is used to make an explosion proof enclosure for each peripheral electrical contact.

However, it can be understood that if the radial distance between peripheral openings 10a, 10c in the safety disk 9 and the protuberance 13 forming the hub is sufficiently large, the flat explosion proof joint 16 produced means that it is not essential to have a cylindrical explosion proof joint formed by the said protuberance.

Similarly, if the radial distance between the said peripheral openings and the outside is sufficiently large, the other explosion proof cylindrical joint can also be deleted and therefore the extension 14 of the disk can also be eliminated.

Therefore, there are several possibilities for making a connection socket for an explosive atmosphere; two explosion proof cylindrical joints with or without a flat explosion proof joint, or a single flat explosion proof joint, or a flat explosion proof joint and a single cylindrical explosion proof joint, either on the protuberance side or on the disk extension side.

However, if the required interstices (for example 0.1 mm) are relatively easy to obtain between the pins 3a, 3c of the plug and the corresponding openings of the disk, the adjustment between the disk rotation surface and the surface of the insulating block is undoubtedly more difficult.

Furthermore, the invention includes an innovative insert molding process, although this is not compulsory.

In the process according to the invention, the first step is to make the safety disk shown in Figures 2, 4 and 6, and particularly in Figures 9 and 10, for example by molding and particularly using a thermosetting material.

The next step is to make the insulating block 6 in the disk 9 used as an insert, by insert molding as shown in Figures 7 and 8. The injected material 6' used to obtain the said block 6, for example a thermoplastic, passes through appropriate injection ducts as shown in the drawings.

Consequently, shrinkage of the material 6' after the insulating block has been molded provides the necessary interstice for the disk to rotate on the said block and to form the explosion proof joint(s).

It can thus be understood that the two parts 6 and 9 are necessarily well adjusted to the need even when tolerances for the safety disk 9 itself are large.

Figure 9 shows the safety disk 9 actually in the form of a cap due to its annular peripheral extension 14, Figure 10 shows the result obtained for block 6 and disk 9 after insert molding, or after assembly of the parts molded separately.

CLAIMS

1. Electrical connection socket (2), particularly for explodable atmospheres, provided with electrical contacts (4a, 4c) that are mounted in peripheral contact housings (5a, 5c) in an insulating block (6) and that are designed to cooperate with the corresponding contact pins (3a, 3c) of a plug (1), whereas a safety disk (9) provided with at least the same number of peripheral openings (10a, 10c) as the number of peripheral contact housings (5a, 5c) in the insulating block (6), is mounted free to rotate on the said insulating block (6) through a central opening (10b) with which it is provided and the inside surface of which cooperates with the lateral surface of a central protuberance (13) of the insulating block (6) forming a rotation hub, such that the peripheral openings (10a, 10c) of the disk may be moved by rotating the disk until it is facing the corresponding housings (5a, 5c) in the insulating block (6), characterized in that at least some of the surfaces in contact between the safety disk (9) and the insulating block (6) and at least the inside surfaces of the peripheral openings (10a, 10c) in the safety disk (9) and the outside surfaces of the corresponding pins (3a, 3c) of the plug form the explosion proof joint surfaces such that at least the peripheral housings (5a, 5c) of the insulating block contacts form at least one explosion proof enclosure.

2. Connection socket according to claim 1, characterized in that the central protuberance or the hub (13) of the insulating block is drilled to allow passage of a central pin (3b) of the plug designed to

cooperate with a contact (4b) formed in a central housing (5b) of the insulating block (6).

3. Connection socket according to claims 1 and 2, characterized in that the safety disk (9) and the insulating block (6) have plane front surfaces that come into contact with each other and at least part of these surfaces form an explosion proof joint surface (16).

4. Connection socket according to one of claims 1 to 3 characterized in that the surfaces of the explosion proof joint between the safety disk (9) and the insulating block (6) are formed at least partly by at least part of the lateral rotation surface of the hub (13) of the insulating block (6) and the inner surface of the central opening (10b) of the disk.

5. Connection socket according to any one of claims 1 to 4, characterized in that the safety disk (9) is provided with a peripheral annular extension (14) that covers part of the insulating block (6), at least part of the overlapping areas of the said insulating block (6) and the said extension (14) forming lateral rotation surfaces forming an explosion proof joint.

6. Connection socket according to claim 5, characterized in that the lateral rotation surfaces of the insulating block (6) and the safety disk (9) formed firstly by the hub (13) and the central opening (10b) of the disk, and secondly by the overlapping areas of the insulating block (6) and the extension (14) of the disk, are cylindrical surfaces of revolution.

7. Connection socket according to one of claims 1 to 6, characterized in that at least the peripheral contact housings (5a, 5c) are closed at the bottom of

the corresponding contacts (4a, 4c) by elements (15a, 15c) forming the said housings of the explosion proof joint surfaces.

8. Connection socket according to one of claims 1 to 7, characterized in that the hub (13) of the insulating block (6) has a flared and recessed end (13') that holds the disk (9) and the insulating block (6) fixed together in translation.

9. Connection socket according to one of claims 1 to 8, characterized in that the contacts (4a, 4b, 4c) of the socket are end to end pressure contacts, each provided with a contact head (7), a braid (7') and a helical spring (8) located in the corresponding contact housing (5a, 5b, 5c).

10. Connection socket according to one of claims 1 to 9, characterized in that the insulating block (6) is insert molded in or on the safety disk (9), itself made in advance and acting as an insert, the necessary and adjusted interstice or clearance between surfaces of parts in contact to allow rotation of the disk (9) on the said block (6) and to form the said explosion proof joints being created by shrinkage of material from the block (6) after molding.

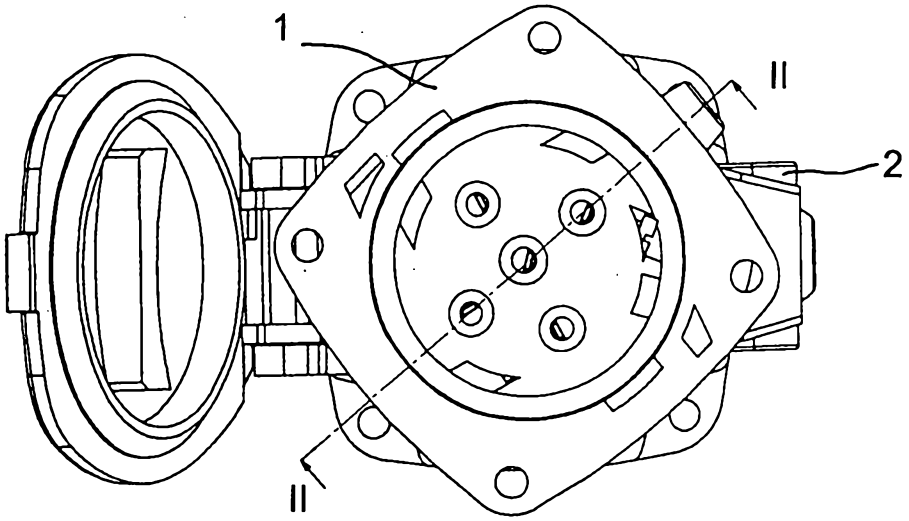


FIG.1

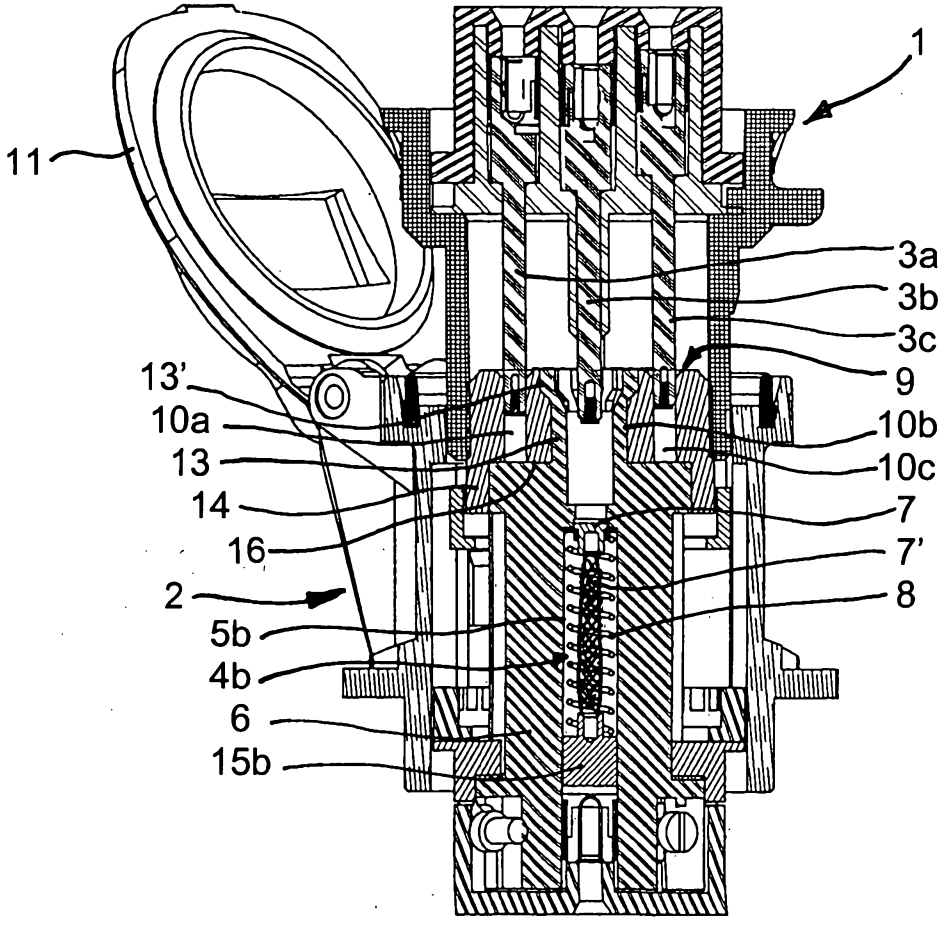


FIG.2

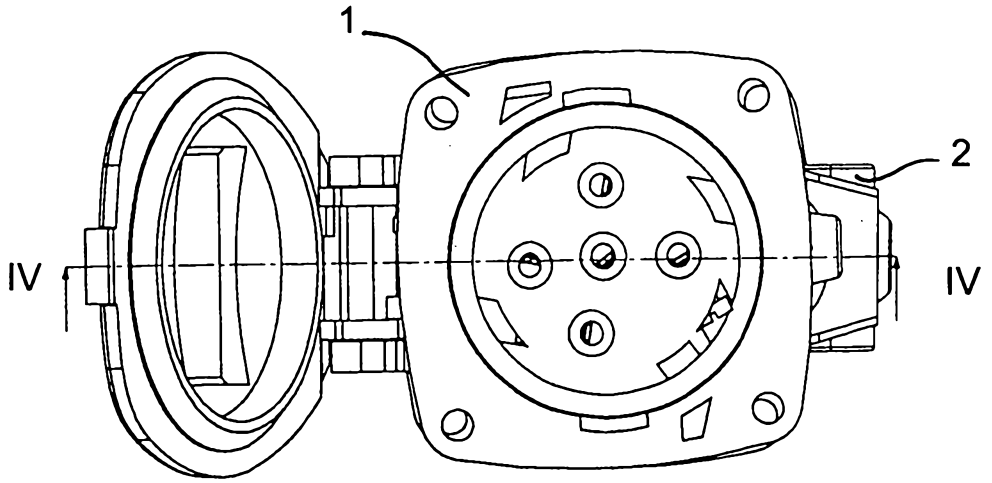

1
2
IV
IV

FIG.3

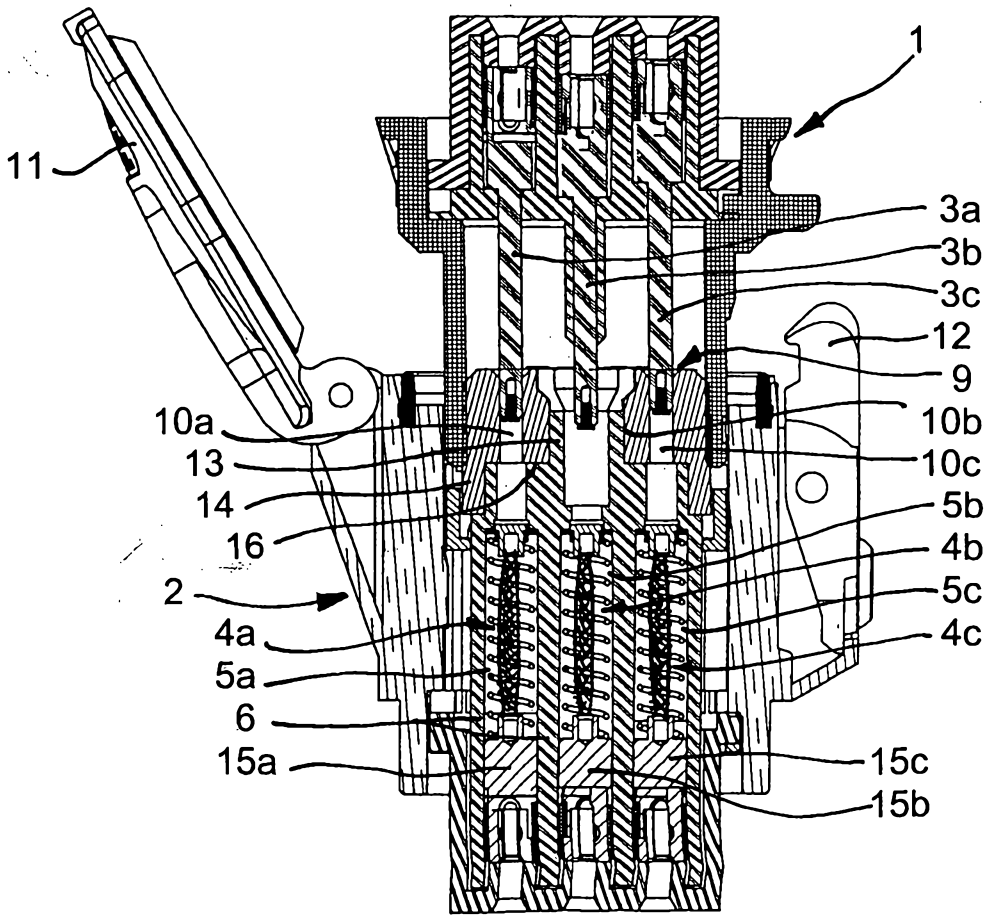

1
11
3a
3b
3c
12
9
10a
10b
13
10c
14
5b
16
4b
2
5c
4a
4c
5a
6
15a
15c
15b

FIG.4

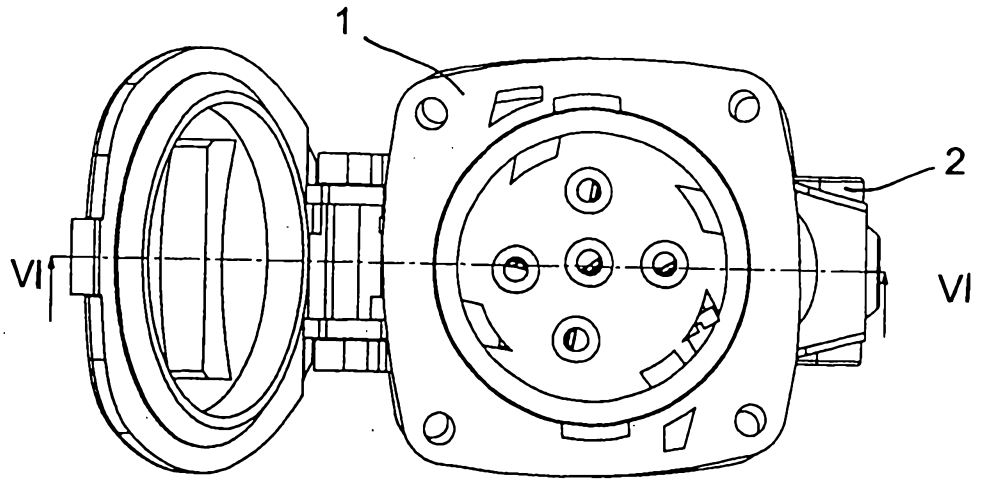

1
2
VI
VI

FIG.5

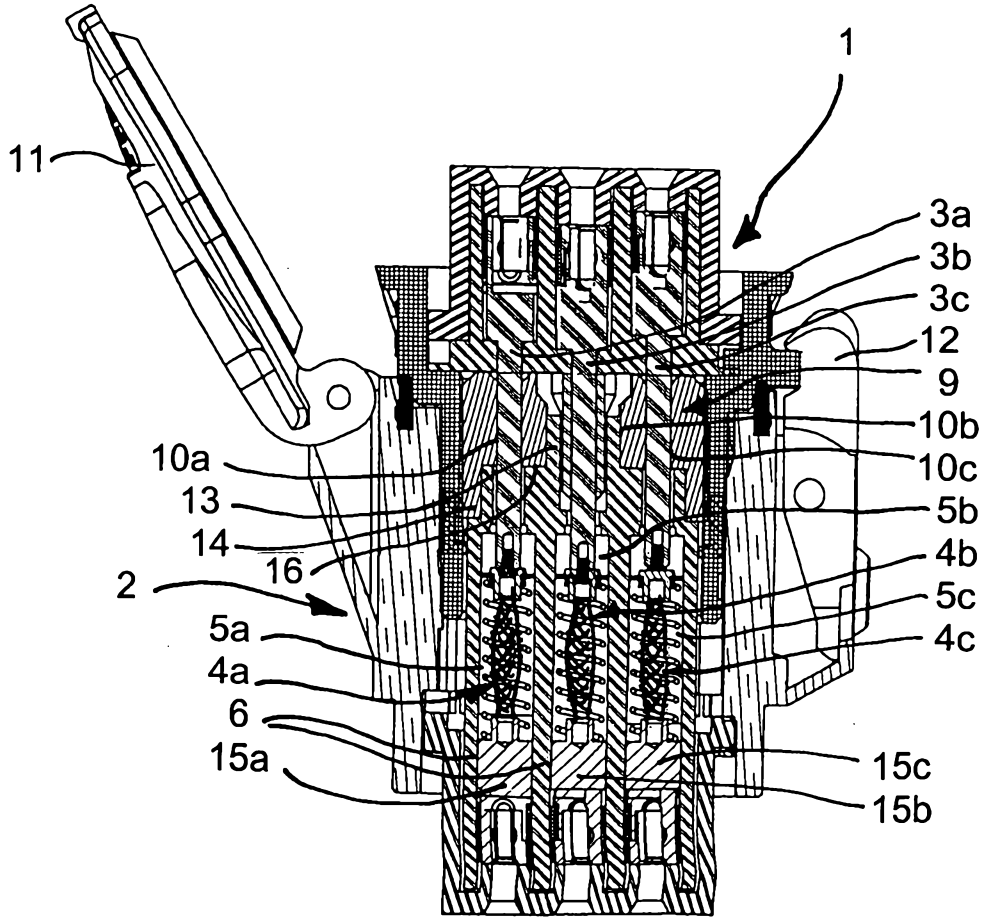

1
11
3a
3b
3c
12
9
10b
10c
5b
4b
5c
4c
10a
13
14
16
2
5a
4a
6
15a
15c
15b

FIG.6

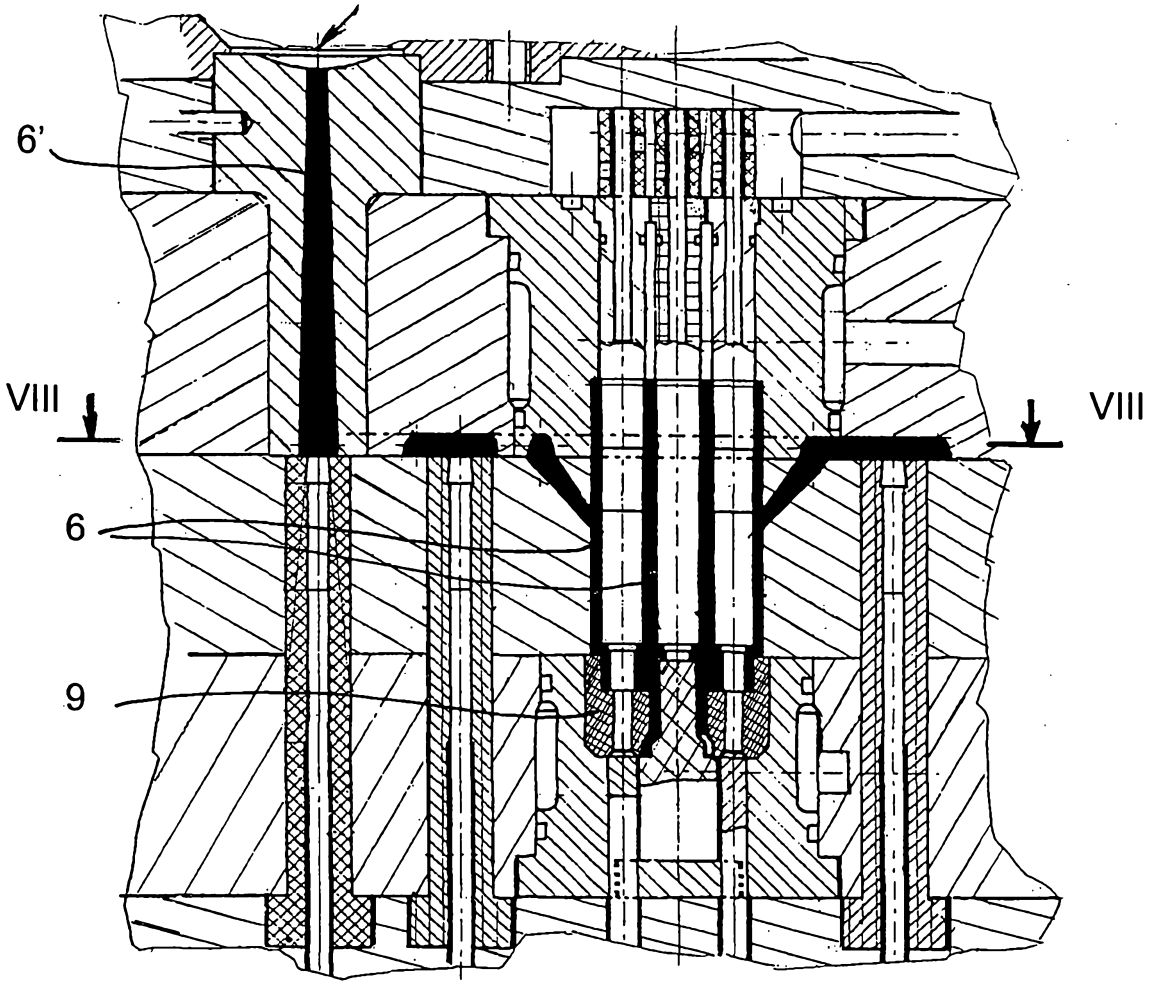


FIG.7

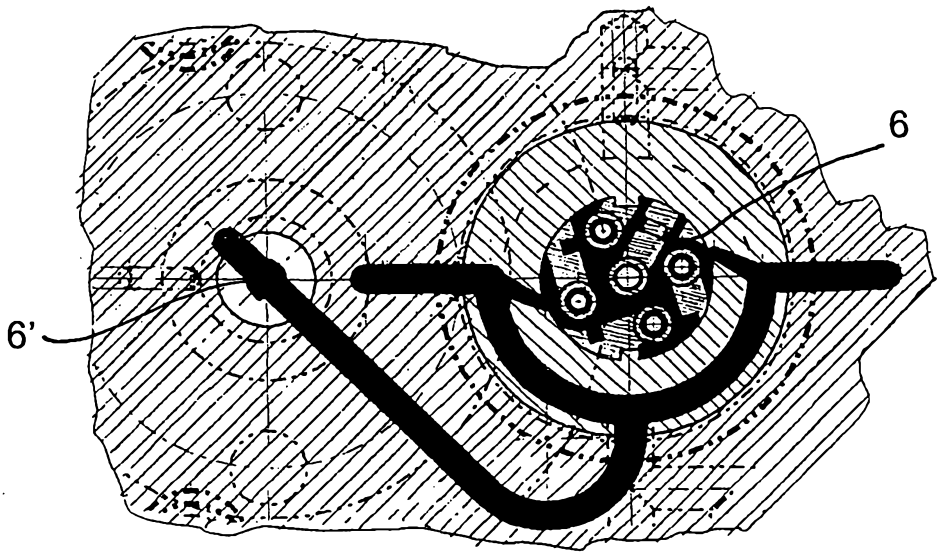


FIG.8

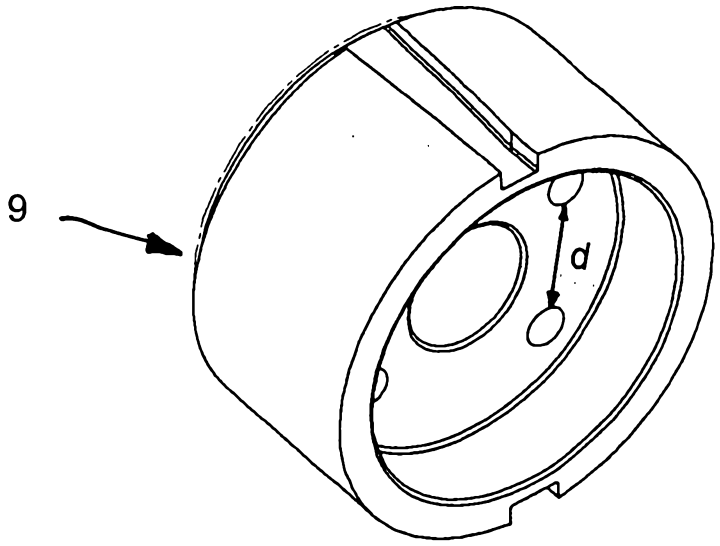


FIG.9

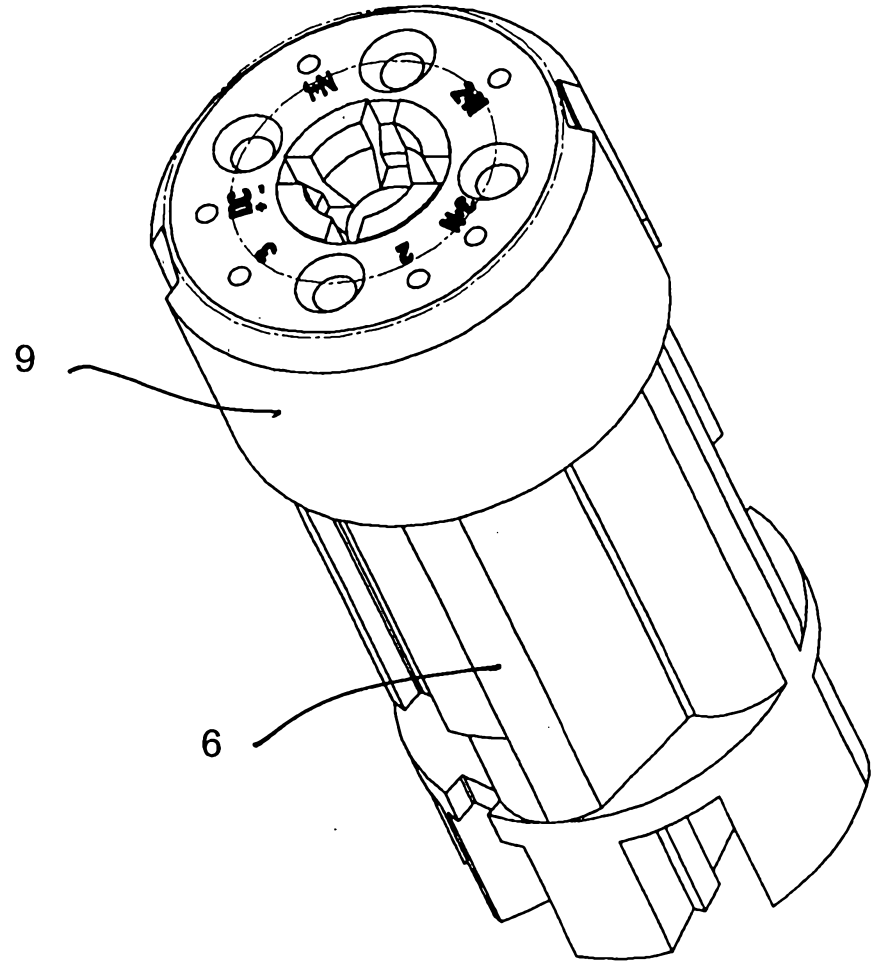


FIG.10