(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 284 476 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
16.02.2011 Bulletin 2011/07

(51) Int Cl.:
F42D 1/04 *(2006.01)*

(21) Application number: **09466028.9**

(22) Date of filing: **28.12.2009**

(84) Designated Contracting States:
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 SE SI SK SM TR
Designated Extension States:
AL BA RS

(30) Priority: **12.08.2009 CZ 20090543**
12.08.2009 CZ 20090544

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(54) **Connector for detonators**

(57) A connector of non-electrical detonators made of elastically flexible plastic material, consisting of a head (1) for the fastening of detonating tubes, a hollow body (2) for the insertion of an initial detonator and a base (3) for the initial detonator fixation, where the head (1) is made of a flat axial part (11) and at least one lateral flap (12) connected to the axial part (11) in the upper part of the head (1) by a connecting bridge (16), where the lateral flap (12) is in its lower part fitted with an elastic flat plate (15) which has a locking catch (41) on the inside that together with an anchor (42) in the lower part of the head (1) make a snap-on lock (4).

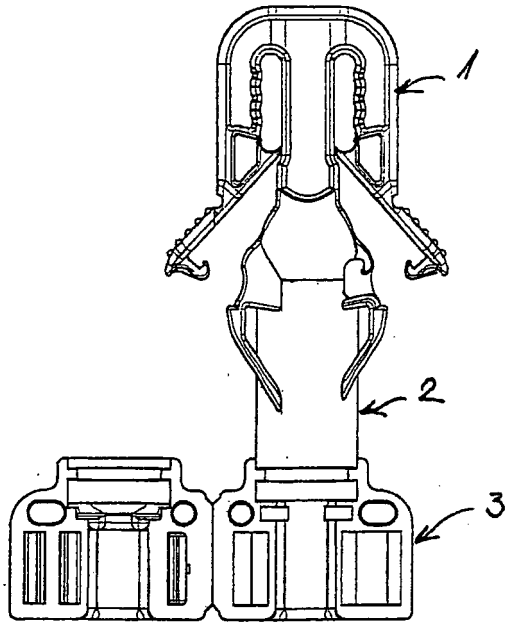

fig. 1

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Description

Field of the Invention

[0001] The present invention relates to a plastic connector of non-electrical detonators used for the insertion and fastening of an initial detonator as well as the fastening of the eye of a detonating cord, also known as a bundler, to which detonating tubes are fixed, and which is also used for the fastening of detonating tubes of non-electrical detonators.

State of the Art

[0002] When driving tunnels, shafts, underground reservoirs and performing underground rehabilitation work, delay firing circuits are installed for blasting operations. They make use of initial detonators connected to the detonating tube, which is a plastic tube filled with an explosive mixture intended for the firing of individual detonators. The network of detonating tubes must be created firmly and precisely and individual detonating tubes must not be loose or move in the plane or space, etc. The precise distribution of the initial detonators and the creation of the network of detonation tubes is enabled by connectors with a hollow where the initial detonator is inserted and fitted by means of several well-known methods. Usually, the connector also has a head used for the attachment of the detonating tubes in a required position. The head is also used for the attachment of the detonating cord, also known as a bundler, which initiates the inserted detonating tube. In one of the known designs of the connector base for the attachment of the detonating tube the base is fitted with a plastic lid with an axial opening for the detonating tube. The tube is fitted at its end below the initial detonator with an elastic ring usually made of rubber material. When the lid is snapped in the connector base, the ring is arrested by flexible clamps of the base and the initial detonator with the diameter bigger than that of the detonating tube is arrested inside by means of the lid and the base. Various fastening pins are also used for this purpose inserted into the connector base opening(s), following the insertion of the initial detonator, so that the initial detonator cannot slip out. Such bases arresting the initial detonator have several disadvantages. Firstly, they do not provide sufficient installation stability, secondly, they comprise a number of parts which is disadvantageous both as regards manufacture and handling. The detonating tubes are fastened using the connector head. Known simple solutions usually make use of the elasticity of a plastic material. There is a clamp bearing between the central part of the head and the lateral flap, into which the detonating tubes are inserted perpendicular to the connector axis. The lateral flap is used either on one side only or symmetrically on both sides of the central part. Usually, the flap has a fitting stud in its bottom interior section. When inserting the detonating tube(s), the spring resistance of the material and the stud must be overcome. The detonating tubes are then arrested in the bearing by the compressive force of the flaps and the stud prevents them from slipping out. A disadvantage of the known solutions is that the arresting of the detonating tubes in the clamp bearing is usually difficult, but what is more problematic is the insufficient clamp force of the bearing. The detonating tubes are not clamped sufficiently, they are loose, and their undesirable displacement or tension can occur during the preparatory operations. In another form, the detonating cords make the bundler in the form of a loop, which is created by crossing over the detonating cord and running the free end through the loop created in this way. The free end is locked in the connector head slot and when the detonation tubes are inserted in the bundler, the free end of the bundler is firmly tightened around the detonating tubes pulling at the free end of the detonating cord. The detonating cord in the slot is prevented against displacement by means of the material elasticity. As the firmness of the grip is very important, there are several types of the head design. They differ in shape and design of the clamps creating the clamping slot. A disadvantage of these known solutions is usually difficult arresting of the detonating cord in the clamping slot, but what is more problematic is the insufficient clamping of the detonating cord end. The bundlers often get loose, the detonating tubes move and their undesirable displacement or tension can occur during the preparatory operations. The state of the art is described in several US patents. US D443,331S descloses a head with two lateral flaps and a locking bill situated inwards. There is a clamp base equipped with a closing lid with a stud inside the detonator body. US D424,155S features a base of a similar design, however, the head comprises clamp flaps with a guide face. US 6,425,332B1 describes a base with a snap-on lid and a head with a pair of parallel retaining flaps. The published US application US 2002/073870A1 (US 6,425,332B1) describes a base and a head designed in a similar way, making use of the material elasticity, mainly as the head is concerned.

[0003] The present invention aims at designing a connector for non-electrical detonators which would meet two fundamental requirements. The first requirement is simple but at the same time firm and permanent fastening of the initial detonator in the connector body, while maintaining simple production conditions and simple handling. The second requirement is the fastening of the detonating tubes enabling fast and simple handling, which, on the other hand, would ensure high fastening strength so that the tubes cannot move or get loose from the head.

Nature of the Invention

[0004] This goal was achieved by the connector with the application of three independent solutions realizing a single inventive idea. Two of the solutions relate to the design of the connector head and the third one concerns the design of the connector base. Although these inven-

tions are mutually independent and can be applied separately, the intended effect and the solution of the given task are only achieved by their mutual connection. Therefore, the application should be considered as a whole, even though it comprises three individual solutions.

[0005] The nature of the invention applied on the connector of non-electrical detonators made of elastically flexible plastic material, consisting of a head for the fastening of detonating tubes, a hollow body for the insertion of an initial detonator and a base for the initial detonator fixation, where the head is made of a flat axial part and at least one lateral flap connected to the axial part in the upper part of the head by a connecting bridge, is that the lateral flap is in its lower part fitted with an elastic flat plate which has a locking catch on the inside that together with an anchor in the lower head part make a snap-on lock.

[0006] It is also essential that a spring back rib can be made in the bottom part of the clamp bearing created between the lateral flap and the flat axial part of the head. It can be made on the inside of the lateral flap or on the axial part of the head.

[0007] The nature of the second invention realizing the same inventive idea is a connector of non-electrical detonators made of elastically flexible plastic material comprising a head for the fastening of detonating tubes by means of a bundler, a hollow body for the insertion of an initial detonator and a base for the initial detonator fixation, the nature of which, according to the invention, rests in that the head is made of a fixed lower clamp in the upper part of the connector body and a swivel upper clamp firmly connected to the lower clamp by a flexible bridge on one side, while on the other side it is connected to it detachably by means of a two-stage lock. Its fixed part made on the lateral side of the lower clamp comprises a pair of horizontal anchors situated one above the other having the form of oblong blocks with the axes parallel with the axis of the bridge and with an irregular cover which makes a sloping guide face on the outer top side and a support anchor face on the outer bottom side. The movable part of the two-stage lock made on the lateral side of the upper clamp comprises a pair of horizontal catches situated one above the other having the form of oblong blocks with the axes parallel with the axis of the bridge and with irregular section, which makes a sloping leading face on the inner bottom side and a locking face on the outer top side.

[0008] It is essential for the present invention that the lower clamp on the top side and the upper clamp on the bottom side have two grooves practically parallel with the bridge axis, where the detonating cord - free bundler end is placed. The grooves in the locked condition make a clamp casing for the detonating cord.

[0009] The upper clamp may be fitted on the upper side with an additional reinforcing layer to achieve sufficient head stiffness.

[0010] The nature of the third independent invention intended to be applied simultaneously with one of the aforementioned inventions rests in that the connector for non-electrical detonators made from elastically flexible plastic material with a head for the fastening of detonating tubes, hollow body for the insertion of an initial detonator and a base for the initial detonator fixation has the base made in the form of a practically cylindrical casing separated vertically along the axis plane into two parts, of which the fixed one is attached firmly to the bottom part of the connector body and the swivel part is rotationally connected to the fixed part along the outside vertical surface line on one side of the casing by means of a part of the flexible plastic material that the connector is made of. On the other side of the casing there is a double lock comprising a pair of flexible vertical catches with anchoring tongues in one part of the casing and a recess with vertical anchors in the other part of the casing. The swivel part has guide stop pieces in its inside upper part while the fixed part has a guide stop face corresponding to the guide stop pieces.

[0011] The upper part of the swivel part and the bottom part of the connector body can feature an anchoring ring and an anchoring flange.

[0012] To increase the lock reliability, the base casing swivel part and fixed part can be equipped with a simple lock on the side along the connection surface line consisting of a flexible hook on one part of the casing and a recess with a fixation face on the other part of the casing.

[0013] The increased effect of the invention is the possibility of locking the initial detonator inside the connector, so that the initial detonator cannot be removed from the connector intentionally or incidentally. In this way, total reliability of the initial detonator installation is insured, even if further work in the firing circuit is performed. Due to the head design, the detonating tube can be inserted easily into the opened head and secured against its dislocation. As this position is very stable, incidental displacement cannot occur, however, the head can be released or opened using the appropriate tool, if necessary, in order to adjust the position or add or take away other detonating tubes, etc.

Figures in Drawings

[0014] The inventions are described using the drawings attached, where Fig. 1 is a general view of the connector with unlocked head plates and with the base opened. Fig. 2 is an auxiliary view of the head in opened-unlocked position, while Fig. 3 is an auxiliary view of the head locked.

[0015] Fig. 4 to Fig. 8 depict the second head design. Fig. 4 is a general view of the connector with the head clamps and the base opened, Fig. 5 representing an axonometric view. Fig. 6 shows the head in opened position, Fig. 7 shows the first locking stage of the head, i.e. the installation position, and Fig. 8 shows the second locking stage of the head, i.e. the fixation position.

[0016] Fig. 9 is an auxiliary view of the base in opened position and Fig. 10 is a broken-out section of the base

in opened position where the locks can be seen in detail.

Example of the Inventions

[0017] The connector of non-electrical detonators is made of an elastically flexible plastic material, whose physical properties are made use of in the design to achieve clamping effect and movement of some parts in mutual interactivity. The connector has three elementary parts.

[0018] A head 1 for the fastening of the detonating tubes, a hollow body 2 where the initial detonators are inserted, and the third part, a base 3, locking the initial detonator in the body 2 of the connector.

[0019] The head 1 comprises a flat axial part 11 and a pair of lateral flaps 12 , that are in the upper part of the head 1 connected to the axial part 11 by the connecting bridge 16, creating in the central part of the head 1 below the connecting bridge 16 an aperture of the clamp bearing 13 for the detonating tubes by their inside faces and the axial part 11 of the head 1. In the lower part of the clamp bearing 13, a spring back rib 14 is created on the lateral flaps 12. Each of the lateral flaps 12 has on its lower end part a flexible flat plate 15, which is fitted on the inside by a lockable catch 41 making together with an anchor 42 a snap-on lock 4 on the bottom part of the head 1.

[0020] Alternatively, the back rib 14 on the lower part of the clamp bearing 13 can be made on the axial part 11 of the head 1.

[0021] The second independent solution of the connector of non-electrical detonators also makes use of the elastically flexible plastic material, whose properties are utilized in the design to achieve clamping effect and movement of some parts in mutual interactivity. The connector has again three elementary parts.

[0022] A head 1 for the fastening of the detonating tubes by the bundler eye, a hollow body 2 where the initial detonators are inserted, and the third part, a base 3, locking the initial detonator in the body 2 of the connector. The head 1 comprises the lower clamp 11 created on the top part of the connector body 2 and the swivel upper clamp 12. It is connected with the lower clamp 11 on one side of the head 1 firmly by means of the elastic bridge 13 made of a thin piece of the connector material, while on the other side, it is connected to it detachably by means of the two-stage lock 4 . The fixed part, i.e. immobile during handling, of the two-stage lock 4 is made on the lateral side of the lower clamp 11 and comprises a pair of horizontal anchors 41 situated one above the other and having the form of oblong blocks with the axes parallel with the axis of the bridge 13 and with an irregular cover which makes an inclined guide face 42 on the outer top side and a support anchor face 43 on the outer bottom side. The movable part of the two-stage lock 4 made on the lateral side of the upper clamp (12) comprises a pair of horizontal catches 44 situated one above the other and having the form of oblong blocks with the axes parallel with the axis of the bridge 13 and with irregular section, which makes a sloping leading face 45 on the inner bottom side and a locking face 46 on the outer top side. In the top face of the lower clamp 11 and on the bottom face of the upper clamp 12, there are two grooves 14 situated parallel with the axis of the bridge 13 which are used for the installation of the detonating cord, i.e. of the free end of the bundler. The grooves 14 in the locked condition make a clamp casing for the detonating cord. The upper clamp 12 is fitted on the upper side with an additional reinforcing layer 15 to achieve optimum stiffness.

[0023] The base 3 comprises a practically cylindrical casing separated vertically along the axis plane into two parts 31,32, of which the fixed one 31 is attached firmly to the bottom part of the connector body 2 and the swivel part 32 is rotationally connected to the fixed part 31 along the outside vertical surface line 33 on one side of the casing by means of a part of the flexible plastic material that the connector is made of. The surface line 33 thus makes the turning axis of the swivel part 32 . On the other side of the casing there is a double lock 5 comprising a pair of flexible vertical catches 51 with anchoring tongues 52 on one of the parts 31, 32 of the casing, on the swivel part 32 in the depicted form, and a recess 53 with vertical anchors 54 on the other of the parts 31, 32 of the casing, on the fixed part 31 in the depicted form. The swivel part 32 also has guide stop pieces 34 in its inside upper part while the fixed part 31 has a guide stop face 35 corresponding to the guide stop pieces 34. The upper part of the swivel part 32 and the bottom part of the connector body 2 feature an anchoring ring 35 and an anchoring flange 36 for correct mutual connection. To increase the connection safety and the lock strength, the base 3 casing swivel part 32 and fixed part 31 are also equipped with a simple lock 6 on the side along the connection surface line 33 consisting of a flexible hook 61 on one of the casing parts 31, 32, on the swivel part 32 in the depicted form, and a recess 62 with a fixation face 63 on the other of the casing parts, 31, 32, on the fixed part 31 in the depicted form.

[0024] Alternatively, the detonating cord with the bundler eye is inserted in the opened head 3. The two-stage lock 4 gets snapped into the first, installation position by pressure exerted on the reinforcing layer 15. A respective number of detonating tubes are inserted through the bundler eye and the bundler eye is then tightened pulling by the detonating cord. Exerting pressure on the reinforcing layer 15 the two-stage lock 4 gets snapped into the second, fixation position. The twin detonating cord is clamped in the pair of grooves 14 and it cannot be released without unlocking the head 3 using a simple tool. The initial detonator is inserted from below into the hollow of the connector body 2, the swivel part 32 of the base 3 is turned around the surface line 33 and pressed against the fixed part 31 . The guide stop pieces 34 will guide and push the initial detonator into the hollow of the body 2 and both locks 5,6 will snap in firmly.

[0025] The detonating tube, or a number of tubes, are

inserted under the lateral flap 12 and by pulling towards the connecting bridge 16 the resistance of the back rib 14 is overcome. Thus the tube is positioned in the clamp bearing 13. Following the insertion of the respective number of tubes, the locking catch 41 is snapped in under the anchor 42 in the bottom part of the head 1 by pressure exercised on the outer side of the lateral flap 12. This will result in the locking of the lock 4, which can now only be opened by applying much higher strength or a simple tool. Also, the clamp bearing 13 is clamped more tightly, so that the movement of the detonating tube is prevented.

[0026] The initial detonator is inserted from below into the hollow of the connector body 2, the swivel part 32 of the base 3 is turned around the surface line 33 and pressed against the fixed part 31. The guide stop pieces 34 will guide and push the initial detonator into the hollow of the body 2 and both locks 5,6 will snap in firmly.

[0027] The inventions applied in the connector are mutually connected which results in the desired effect, i.e. accomplishment of a single inventive idea. Thus, the application unity is preserved.

Industrial Application

[0028] The connector according to the inventions disclosed above can be produced industrially and used for delay firing circuits with non-electrical detonators.

Claims

1. A connector of non-electrical detonators made of elastically flexible plastic material, consisting of a head (1) for the fastening of detonating tubes, a hollow body (2) for the insertion of an initial detonator and a base (3) for the initial detonator fixation, where the head (1) is made of a flat axial part (11) and at least one lateral flap (12) connected to the axial part (11) in the upper part of the head (1) by a connecting bridge (16), ***characterised in that*** the lateral flap (12) is in its lower part fitted with an elastic flat plate (15) which has a locking catch (41) on the inside that together with an anchor (42) in the lower part of the head (1) make a snap-on lock (4).

2. A connector of non-electrical detonators according to claim 1, ***characterised in that*** there is a spring back rib (14) in the lower part of the clamp bearing (13) created between the lateral flap (12) and the flat axial part (11) of the head (1).

3. A connector of non-electrical detonators according to claim 2, ***characterised in that*** the spring back rib (14) is created on the inner side of the lateral flap (12) or on the axial part (11) of the head (1).

4. A connector of non-electrical detonators made from elastically flexible plastic material comprising a head (1) for the fastening of detonating tubes by means of a bundler, a hollow body (2) for the insertion of an initial detonator and a base (3) for the initial detonator fixation, ***characterised in that*** the head (1) is made of a fixed lower clamp (11) in the upper part of the connector body (3) and a swivel upper clamp (12) firmly connected to the lower clamp (11) by a flexible bridge (13) on one side, while on the other side it is connected to it detachably by means of a two-stage lock (4) whose fixed part made on the lateral side of the lower clamp (11) comprises a pair of horizontal anchors (41) situated one above the other having the form of oblong blocks with the axes parallel with the axis of the bridge (13) and with an irregular cover which makes a sloping guide face (42) on the outer top side and a support anchor face (43) on the outer bottom side, where the movable part of the two-stage lock (4) made on the lateral side of the upper clamp (12) comprises a pair of horizontal catches (44) situated one above the other having the form of oblong blocks with the axes parallel with the axis of the bridge (13) and with irregular section, which makes a sloping leading face (45) on the inner bottom side and a locking face (46) on the top side.

5. A connector of non-electrical detonators according to claim 1, ***characterised in that*** in the top face of the lower clamp (11) and on the bottom face of the upper clamp (12), there are two grooves (14) situated parallel with the axis of the bridge (13) which are used for the installation of the detonating cord, i.e. of the free end of the bundler, thus making in the locked position the clamp casing for the detonating cord.

6. A connector of non-electrical detonators according to claim 1, ***characterised in that*** the upper clamp (12) is fitted on the top side with an additional reinforcement layer (15).

7. A connector of non-electrical detonators made from elastically flexible plastic material comprising a head (1) for the fastening of detonating tubes, a hollow body (2) for the insertion of an initial detonator and a base (3) for the fixation of the initial detonator, ***characterised in that*** the head (3) comprises a practically cylindrical casing separated vertically along the axis plane into two parts (31,32), of which the fixed one (31) is attached firmly to the bottom part of the connector body (2) and the swivel part (32) is rotationally connected to the fixed part (31) along the outer vertical surface line (33) on one side of the casing by means of a part of the flexible plastic material that the connector is made of made of, where on the other side of the casing there is a double lock (5) comprising a pair of flexible vertical catches (51) with anchoring tongues (52) on one of the parts (31,32) of the casing and a recess (53) with vertical

anchors (54) on the other of the parts (31,32) of the casing, where swivel part (32) has guide stop pieces (34) in its inside upper part while the fixed part (31) has a guide stop face (35) corresponding to the guide stop pieces (34).

8. A connector for non-electrical detonators according to claim 4, ***characterised in that*** the upper part of the swivel part (32) and the bottom part of the connector body (2) are fitted with and anchoring ring (35) and an anchoring flange (36).

9. A connector of non-electrical detonators according to claim 4, ***characterised in that*** the swivel part (32) and the fixed part (31) of the base (3) casing are on the side along the connecting surface line (33) fitted with a simple lock (6) comprising a flexible hook (61) on one of the two parts (31,32) of the casing and a recess (62) with a fixation face (63) on the other of the two parts (31,32) of the casing.

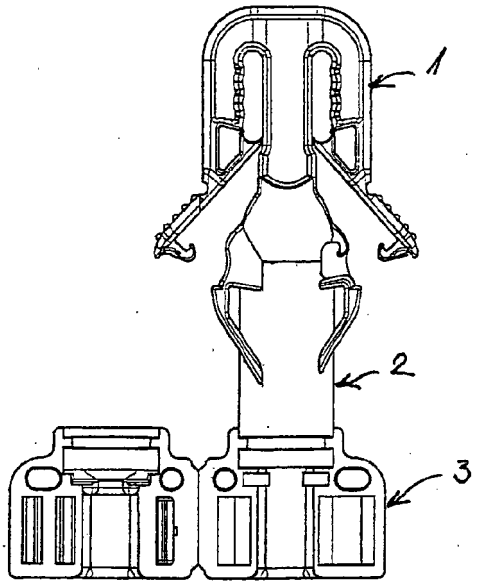

fig. 1

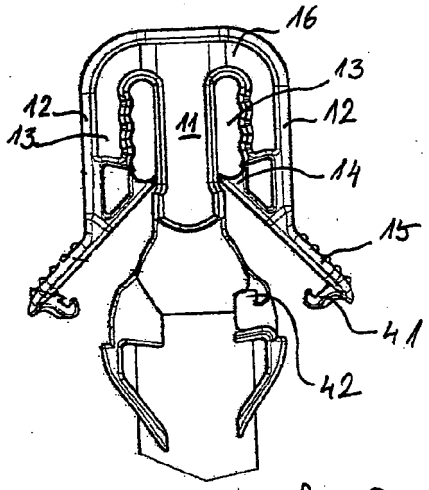

fig. 2

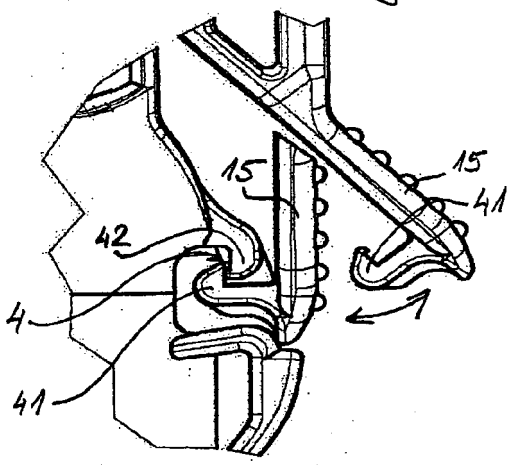

fig. 3

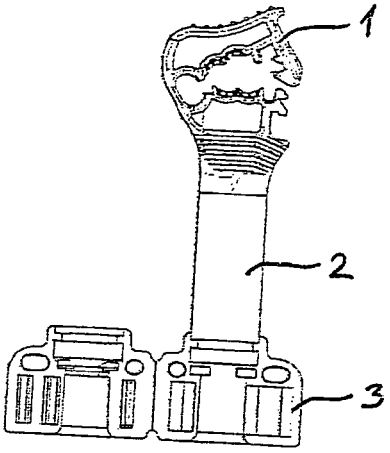

fig. 4

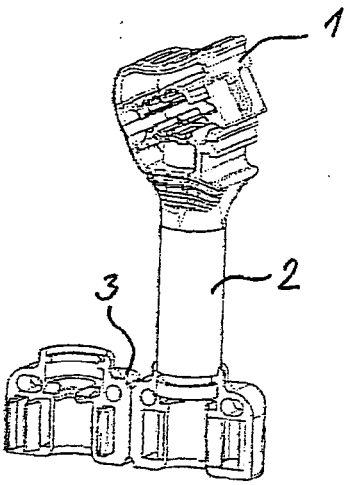

fig. 5

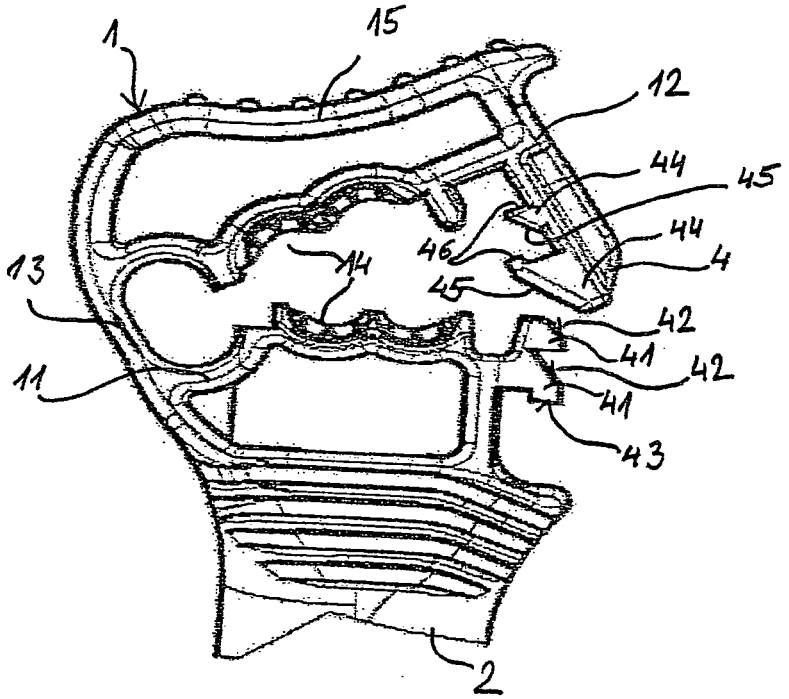

fig. 6

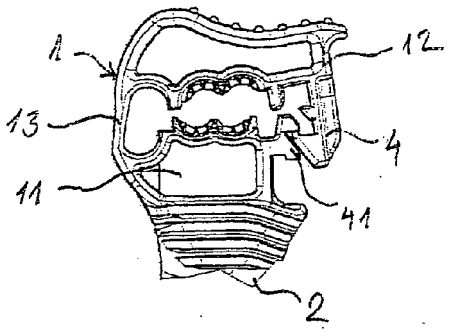

fig. 7

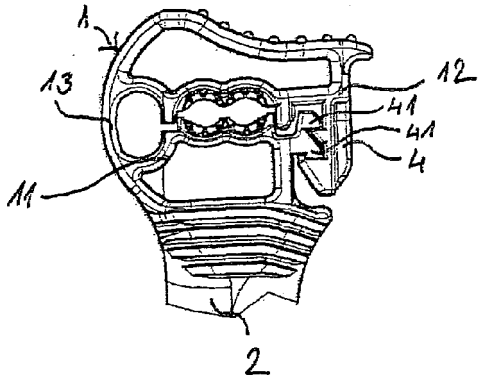

fig. 8

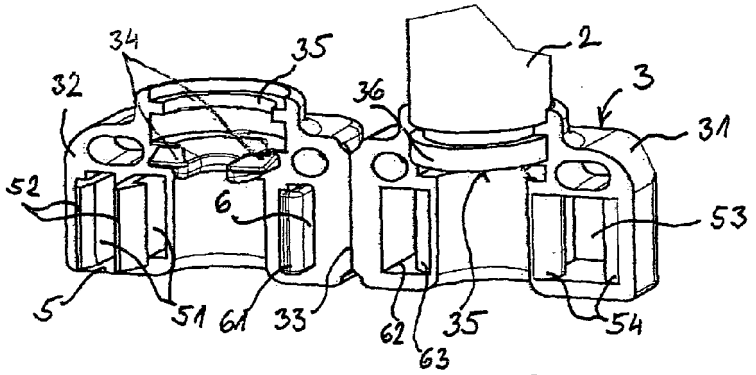

fig. 9

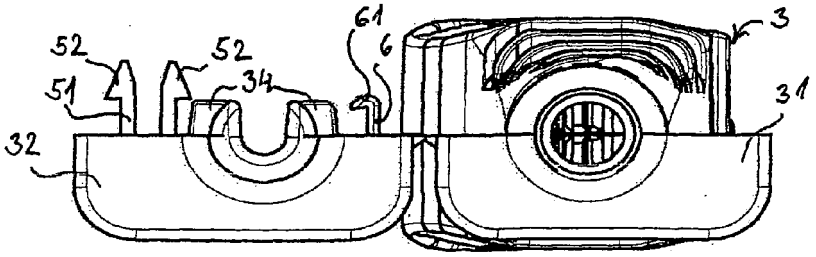

fig. 10

REFERENCES CITED IN THE DESCRIPTION

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