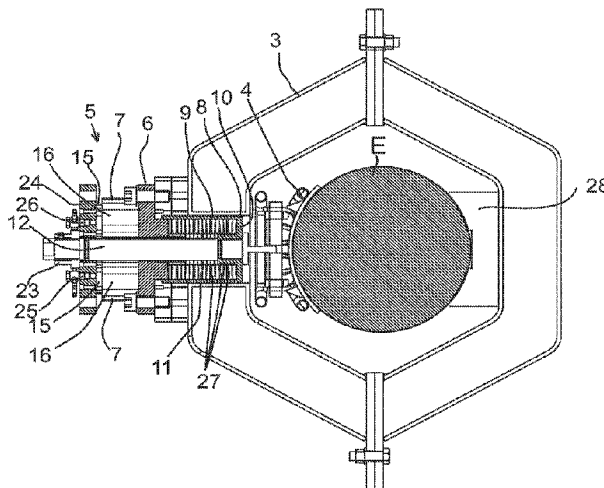




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(54) Titre : DISPOSITIF DE GLISSEMENT D'ELECTRODE
 (54) Title: ELECTRODE SLIPPING DEVICE



(57) **Abrégé/Abstract:**

An electrode slipping device (1) comprises an upper holder ring (2) and a lower holder ring (3) having one or more clamping assemblies including a clamping shoe (4) and a clamping device (5). The clamping shoe (4) is operable between a clamping position and a release position. The clamping device (5) comprises a frame element (6) fixedly attachable to a holder ring (2, 3) to be stationary in relation to the holder ring, a cylinder portion (7), a plunger (8) and a pressing spring (11) arranged inside the cylindrical housing (9) of the plunger (8) for urging the plunger (8) towards the clamping shoe (4) and for pressing the clamping shoe (4) against the electrode (E). A tension bar (12) is releasably attached to the end plate (10) of the plunger (8). A piston element (15) is arranged movable inside the cylinder portion (7) to form a hydraulic power means (16). The clamping device (5) comprises one and single tension bar (12) arranged centrally in relation to the frame element (6), the plunger (8), the pressing spring (11) and the piston element (15).

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(54) Title: ELECTRODE SLIPPING DEVICE

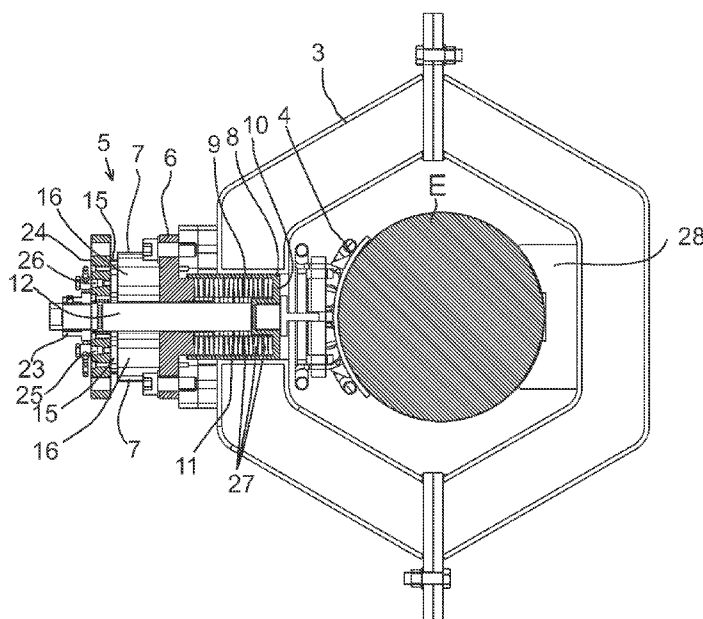


Fig. 5

(57) **Abstract:** An electrode slipping device (1) comprises an upper holder ring (2) and a lower holder ring (3) having one or more clamping assemblies including a clamping shoe (4) and a clamping device (5). The clamping shoe (4) is operable between a clamping position and a release position. The clamping device (5) comprises a frame element (6) fixedly attachable to a holder ring (2, 3) to be stationary in relation to the holder ring, a cylinder portion (7), a plunger (8) and a pressing spring (11) arranged inside the cylindrical housing (9) of the plunger (8) for urging the plunger (8) towards the clamping shoe (4) and for pressing the clamping shoe (4) against the electrode (E). A tension bar (12) is releasably attached to the end plate (10) of the plunger (8). A piston element (15) is arranged movable inside the cylinder portion (7) to form a hydraulic power means (16). The clamping device (5) comprises one and single tension bar (12) arranged centrally in relation to the frame element (6), the plunger (8), the pressing spring (11) and the piston element (15).



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ELECTRODE SLIPPING DEVICE**FIELD OF THE INVENTION**

The present invention relates to an electrode slipping
5 device.

BACKGROUND OF THE INVENTION

In prior art, e.g. documents WO 2015/001180 A1 and WO
2015/001179 A1 disclose an electrode slipping device.
10 Also Figure 1 shows this kind of an electrode slipping
device having, on the left side encircled with a dot-
and-dash line denoted with A, two prior art clamping
devices 5' mounted on the upper holder ring 2 and on
the lower holder ring 3. Figure 2 shows such a prior
15 art clamping device 5'. The clamping device 5' com-
prises a frame element 6' which is attachable to a
holder ring 2 and/or 3 to be stationary in relation to
the holder ring. A cylinder portion 7' is stationary
in relation to the frame element 6'. A plunger 8 is
20 arranged to be engaged with a clamping shoe (not
shown). The plunger 8 comprises a cylindrical housing
9' and an end plate 10' (not shown). A pressing spring
(not shown) is arranged inside the cylindrical housing
9' to act between the frame element 6' and the plunger
25 8' for urging the plunger 8' towards the clamping shoe
and for pressing the clamping shoe against the elec-
trode E. Four tension bars 12' are arranged outside
the cylindrical housing 9' inside which the pressing
spring is located. Each tension bar 12' has a first
30 end which is releasably attached to the end plate 10'
of the plunger 8'. A piston element (not shown) is ar-
ranged movable inside the cylinder portion 7' to form
a hydraulic power means 16' wherein the piston element
can be moved by hydraulic pressure of hydraulic fluid
35 which is arranged to be guided to a space between the
piston element and the cylinder portion. Movement of

the piston element by hydraulic pressure of the hydraulic fluid causes the tension bars 12' to pull the plunger 8 against the spring force of the pressing spring to move the clamping shoe from a clamping position to a release position.

As mentioned, the four tension bars are located outside the cylindrical housing which accommodates the pressing spring. This kind of arrangement of tension bars makes the clamping device bulky and heavy. The end plates, to which the tension bars are attached, must be both wide and thick to be sturdy enough to withstand the bending force caused by the pressing spring acting on the central region of the end plate and at a distance from the support points to tension bars, in order to avoid bending of the end plates. The clamping device also has many parts making it complicated and expensive to manufacture and difficult to service.

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OBJECTIVE OF THE INVENTION

The objective of the invention is to alleviate the disadvantages mentioned above.

In particular, it is an objective of the present invention to provide an electrode slipping device having a clamping device which has a simple, compact and light-weight structure with few parts, easy to maintenance and cheap to manufacture.

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SUMMARY OF THE INVENTION

According to an aspect of the invention, the present invention provides an electrode slipping device comprising an upper holder ring and a lower holder ring, the upper holder ring and the lower holder ring containing one or more clamping assemblies including a clamping shoe and a clamping device arranged in co-

operation with each other, so that the clamping shoe is operable between a clamping position, where an electrode is clamped, and a release position, where the electrode is unclamped. The clamping device comprises a frame element fixedly attachable to a holder ring to be stationary in relation to the holder ring. The clamping device comprises a cylinder portion, the cylinder portion being arranged stationary in relation to the frame element. The clamping device comprises a plunger, the plunger comprising a cylindrical housing and an end plate arranged to be engaged with the clamping shoe. The clamping device comprises a pressing spring arranged inside the cylindrical housing to act between the frame element and the plunger, for urging the plunger towards the clamping shoe and for pressing the clamping shoe against the electrode. The clamping device comprises a tension bar having a first end releasably attached to the end plate of the plunger, and a second end. The clamping device comprises a piston element arranged movable inside the cylinder portion to form a hydraulic power means wherein the piston element can be moved by hydraulic pressure of hydraulic fluid which is arranged to be guided to a space between the piston element and the cylinder portion. Movement of the piston element by hydraulic pressure of the hydraulic fluid causes the tension bar to pull the plunger against the spring force of the pressing spring to move the clamping shoe from the clamping position to the release position.

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According to the invention the clamping device comprises one and single tension bar arranged centrally in relation to the frame element, the plunger, the pressing spring and the piston element.

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The advantage of the invention is that due to one and single central tension bar the clamping device can be

a simple, compact and light-weight structure with few parts, being easy to maintenance and cheap to manufacture. The single centrally arranged tension bar enables that a thick end plate is not needed since the
5 tension bar does not exert bending forces to the end plate, as happens in the prior art device. For example, a prior art clamping device having a pressing force 60 tn may have a weight 450 kg. The weight of the clamping device according to the invention with
10 the same pressing force may be less than 300 kg. Reduction of weight is considerable.

In an embodiment of the electrode slipping device, the frame element, the plunger and the pressing spring
15 each have a central hole to receive the tension bar therein.

In an embodiment of the electrode slipping device, the end plate has a central hole having an inner thread,
20 and that the first end of the tension bar has a first outer thread threaded to the inner thread of the end plate.

In an embodiment of the electrode slipping device, the
25 second end of the tension bar has a second outer thread on which a lock nut is threaded.

In an embodiment of the electrode slipping device, the clamping device comprises two or more cylinder portions and piston elements disposed radially around the
30 tension bar to form two or more hydraulic power means around the tension bar.

In an embodiment of the electrode slipping device, the
35 clamping device comprises three or four cylinder portions and piston elements disposed radially around the

tension bar to form three or four hydraulic power means around the tension bar.

5 In an embodiment of the electrode slipping device, the clamping device comprises a second end plate to which the piston elements are attached, the second end plate comprising inlets and outlets for guiding the hydraulic fluid to and from the two or more hydraulic power means.

10

In an embodiment of the electrode slipping device, the cylinder portion and the piston element are both annular thereby forming an annular hydraulic power means which is concentric in relation to the tension bar.

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In an embodiment of the electrode slipping device, the frame element comprises an inlet and an outlet for guiding the hydraulic fluid to and from the annular hydraulic power means

20

In an embodiment of the electrode slipping device, the pressing spring consists of a plurality of conical disc spring washers.

In an embodiment of the electrode slipping device, the lower holder ring comprises a single clamping device configured to releasably press one clamping shoe against the surface of the electrode. Further the lower holder ring comprises a contact shoe made of electrically conductive material for supplying current to the electrode, the contact shoe being arranged at an opposite side of the lower holder ring in relation to the position of the clamping shoe.

25 In an embodiment of the electrode slipping device, the upper holder ring is attached to a stationary structure, and that the lower holder ring is suspended from

the stationary structure by vertical hydraulic cylinders.

5 It is to be understood that the aspects and embodiments of the invention described above may be used in any combination with each other. Several of the aspects and embodiments may be combined together to form a further embodiment of the invention.

10 **BRIEF DESCRIPTION OF THE DRAWINGS**

The accompanying drawings, which are included to provide a further understanding of the invention and constitute a part of this specification, illustrate 15 embodiments of the invention and together with the description help to explain the principles of the invention. In the drawings:

20 Figure 1 shows an axonometric view of an electrode slipping device provided with clamping devices according to prior art A and according to a first embodiment of the invention B,

25 Figure 2 shows an axonometric view of a prior art clamping device,

Figure 3 shows an axonometric view of a clamping device of a first embodiment of the electrode slipping device of the invention,

30 Figure 4 shows an axonometric view of an electrode slipping device according to a second embodiment of the invention,

35 Figure 5 shows a cross-section V-V from Figure 4,

Figure 6 shows a side view of a clamping device of Figure 5,

Figure 7 shows an end view VII-VII of the clamping device of Figure 6,

5 Figure 8 shows a cross-section VIII-VIII from Figure 6,

Figure 9 shows a longitudinal cross-section of a further embodiment of a clamping device in a clamping position I wherein the hydraulic power means is unpressurized, and

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Figure 10 shows the clamping device of Figure 9 in in a release position wherein the hydraulic power means is pressurized.

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DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows an electrode slipping device 1 which is for holding and slipping of a self-baking Söderberg electrode E. The slipping device 1 comprises an upper holder ring 2 and a lower holder ring 3. The upper holder ring 2 and the lower holder ring 3 both comprise several clamping assemblies including a clamping shoe (not shown in Figure 1) and a clamping device 5 arranged in co-operation with each other. The clamping shoe is operable between a clamping position where an electrode E is clamped and held in its position and a release position where the electrode E is unclamped and can be moved. The operation principle of the clamping device 5 is explained in more detail with reference to Figure 9 and 10.

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The operation principle of the slipping device 1 is known from the prior art. The slipping device allows controlled displacement of the electrode. The upper and lower holder rings 2, 3, are sequentially operated and moved to extend the electrode as the tip of the

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electrode is consumed in use in the furnace. The two holder rings 2, 3 are connected with vertical hydraulic cylinders 100 that enable relative movement between the upper and lower holder rings. This action
5 enables slipping through of the electrode whilst always maintaining a positive grip on the outer surface of the electrode.

In Figure 1 the clamping devices 5 according to the invention are installed in the upper and lower holder rings 2, 3 and are shown on the right side and encircled by a dot-and-dash line denoted by B. The clamping device 5 is also shown in Figure 3. When compared to the prior art clamping device 5' shown in Figure 2,
10 Figure 3 shows that the new clamping device 5 is a more simple, compact and light-weight structure with fewer parts.
15

The structure of the clamping device 5 is disclosed in more detail with reference to Figures 5 to 10 in the following.
20

As shown in Figures 5, 9 and 10 the clamping device 5 comprises a frame element 6 which is fixedly attached to a lower holder ring 3 to be stationary in relation to the holder ring. A cylinder portion 7 is arranged stationary in relation to the frame element 6. The cylinder portion 7 may be a separate part in relation to the frame element 6 whereby the cylinder portion 7
25 is attached to the frame element 6. The clamping element 5 comprises a plunger 8. The plunger 8 comprises a cylindrical housing 9 and an end plate 10. The end plate 10 can be engaged with the clamping shoe 4 to press it. A pressing spring 11 is arranged inside the
30 cylindrical housing 9. The pressing spring 11 acts between the frame element 6 and the end plate 10 of the plunger 8 urging the plunger 8 towards the clamping
35

shoe 4 and for pressing the clamping shoe 4 against the electrode E.

One and single centrally disposed tension bar 12 is
5 releasably attached to the end plate 10 of the plunger
8. The end plate 10 has a central hole 19 having an
inner thread 20. The first end 13 of the tension bar
12 has a first outer thread 21 which is threaded to
10 the inner thread 20 of the end plate 10 to provide a
releasable attachment.

A piston element 15 is arranged movable inside the
cylinder portion 7 of the frame element 6 to form a
hydraulic power means 16. The piston element 15 can be
15 moved by hydraulic pressure of hydraulic fluid which
is guided into a space S between the piston element 15
and the cylinder portion 7. Movement of the piston el-
ement 15 by hydraulic pressure of the hydraulic fluid
causes the tension bar 12 to pull the plunger 8
20 against the spring force of the pressing spring 11 to
move the clamping shoe 4 from the clamping position I
(Figure 9) to the release position II (Figure 10).

As shown in Figure 9, in the clamping position I the
25 hydraulic power means 16 is unpressurized and the
pressing spring 11 urges the plunger 8 to press the
clamping shoe (not shown) against the electrode (not
shown). In this position an end E of the cylinder
portion 9 of the plunger 8 is at a distance from a
30 stopper F formed by a surface of the frame element 6.

As shown in Figure 10, in the release position II the
hydraulic power means 16 is pressurized and the press-
ing spring 11 is pulled by the tension bar 12 to a
35 shortened state wherein the end E of the cylinder por-
tion 9 of the plunger 8 abuts against stopper F. In
this position the clamping shoe (not shown) is pulled

away from contact to the electrode (not shown) and the electrode is free to be moved.

The one and single tension bar 12 is arranged centrally in relation to the frame element 6, the plunger 8, the pressing spring 11 and the piston element 15. The frame element 6, the plunger 8 and the pressing spring 11 each have a central hole 17, 18, 19 to receive the tension bar 12 therein. The second end 14 of the tension bar 12 has a second outer thread 22 on which a lock nut 23 is threaded.

Figures 5 to 8 show an embodiment of the clamping device 5 which comprises four cylinder portions 7 and four piston elements 15 disposed radially around the tension bar 12 to form four hydraulic power means 16 around the tension bar 12. The clamping device 5 comprises a second end plate 24 to which the piston elements 15 are attached. The second end plate 24 comprising inlets 25 and outlets 26 for guiding the hydraulic fluid to and from the two or more hydraulic power means 16. Preferably the inlet 25 is at a lower level than the outlet 26 in order to prevent formation of air bubbles in the hydraulic fluid. In Figure 7 can be seen that the four hydraulic cylinder means are connected in series so that the hydraulic fluid flows through all four hydraulic power means 16.

Figures 9 and 10 show another embodiment wherein the cylinder portion 7 and the piston element 15 are both annular thereby forming one annular hydraulic power means 16 which is concentric in relation to the tension bar 12. An annular hydraulic power means 16 is compact and can provide a great force. In this embodiment the cylinder portion 7 comprises an inlet 25 and an outlet 26 for guiding the hydraulic fluid to and from the annular hydraulic power means 16. Preferably

the outlet 26 is above the level of the inlet 25 in order to prevent formation of air bubbles in the hydraulic fluid.

In the embodiments shown in Figures 5, 9 and 10 the pressing spring 11 consists of a plurality of conical disc spring washers 27, so-called Belleville washers, arranged as a stack.

The hydraulic power means 16 of the clamping devices 5 of both embodiments of Figure 5 and Figure 9 can be easily detached for service simply by removing the lock nut 23 and by unthreading the tension bar 12 from the end plate 10 whereby the frame element 6, plunger 8 and the pressing spring can remain in its place to press the clamping shoe 4 while the cylinder portion 7 and the piston element 15 are detached.

Reference is now made to Figures 4 and 5. Figure 4 shows an electrode slipping device 1 designed for graphite electrode. The lower holder ring 3 comprises a single clamping device 5 arranged to releasably press one clamping shoe 4 against the surface of the electrode E (shown in Figure 5). The lower holder ring also comprises a single contact shoe 28 made of electrically conductive material for supplying current to the electrode. The contact shoe 28 is arranged at an opposite side of the lower holder ring 3 in relation to the position of the clamping shoe 4. As can be seen in Figure 4, the upper holder ring 2 is attached to a stationary structure 29. The lower holder ring 3 is suspended from the stationary structure 29 by vertical hydraulic cylinders 30.

Although the invention has been described in conjunction with a certain type of the slipping device, it should be understood that the invention is not limited to any certain type of the slipping device. While

the present inventions have been described in connection with a number of exemplary embodiments, and implementations, the present inventions are not so limited, but rather cover various modifications, and
5 equivalent arrangements, which fall within the purview of prospective claims.

CLAIMS

1. An electrode slipping device (1) comprising an upper holder ring (2) and a lower holder ring (3), the upper holder ring and the lower holder ring containing one or more clamping assemblies including a clamping shoe (4) and a clamping device (5) arranged in cooperation with each other so that the clamping shoe (4) is operable between a clamping position (I), where an electrode (E) is clamped, and a release position (II), where the electrode (E) is unclamped, and wherein the clamping device (5) comprises
- a frame element (6) fixedly attachable to a holder ring (2, 3) to be stationary in relation to the holder ring,
 - a cylinder portion (7), the cylinder portion (7) being arranged stationary in relation to the frame element (6),
 - a plunger (8), the plunger (8) comprising a cylindrical housing (9) and an end plate (10) arranged to be engaged with the clamping shoe (4),
 - a pressing spring (11) arranged inside the cylindrical housing (9) to act between the frame element (6) and the plunger (8), for urging the plunger (8) towards the clamping shoe (4) and for pressing the clamping shoe (4) against the electrode (E),
 - a tension bar (12) having a first end (13) releasably attached to the end plate (10) of the plunger (8), and a second end (14),
 - a piston element (15) arranged movable inside the cylinder portion (7) to form a hydraulic power means (16) wherein the piston element can be moved by hydraulic pressure of hydraulic fluid which is arranged to be guided to a space between the piston element (15) and the cylinder portion (7),
- whereby movement of the piston element by hydraulic pressure of the hydraulic fluid causes the

tension bar to pull the plunger (8) against the spring force of the pressing spring (11) to move the clamping shoe (4) from the clamping position (I) to the release position (II), characterized in that the clamping device (5) comprises one and single tension bar (12) arranged centrally in relation to the frame element (6), the plunger (8), the pressing spring (11) and the piston element (15).

2. An electrode slipping device according to claim 1, characterized in that the frame element (6), the plunger (8) and the pressing spring (11) each have a central hole (17, 18, 19) to receive the tension bar (12) therein.

15

3. An electrode slipping device according to claim 1 or 2, characterized in that the end plate (10) has a central hole (19) having an inner thread (20), and that the first end (13) of the tension bar (12) has a first outer thread (21) threaded to the inner thread (20) of the end plate (10).

4. An electrode slipping device according to any one of the claims 1 to 3, characterized in that the second end (14) of the tension bar (12) has a second outer thread (22) on which a lock nut (23) is threaded.

5. An electrode slipping device according to any one of the claims 1 to 4, characterized in that the clamping device (5) comprises two or more cylinder portions (7) and piston elements (15) disposed radially around the tension bar (12) to form two or more hydraulic power means (16) around the tension bar.

35

6. An electrode slipping device according to claim 5, characterized in that the clamping device (5)

comprises three or four cylinder portions (7) and piston elements (15) disposed radially around the tension bar (12) to form three or four hydraulic power means (16) around the tension bar.

5

7. An electrode slipping device according to claim 5 or 6, characterized in that the clamping device comprises a second end plate (24) to which the piston elements (15) are attached, the second end plate (24) comprising inlets (25) and outlets (26) for guiding the hydraulic fluid to and from the two or more hydraulic power means (16).

10

8. An electrode slipping device according to any one of the claims 1 to 4, characterized in that the cylinder portion (7) and the piston element (15) are both annular thereby forming an annular hydraulic power means (16) which is concentric in relation to the tension bar (12).

15

20

9. An electrode slipping device according to claim 8, characterized in that the frame element (6) comprises an inlet (25) and an outlet (26) for guiding the hydraulic fluid to and from the annular hydraulic power means (16)

25

10. An electrode slipping device according to any one of the claims 1 to 9, characterized in that the pressing spring (11) consists of a plurality of conical disc spring washers (27).

30

11. An electrode slipping device according to any one of the claims 1 to 10, characterized in that the lower holder ring (3) comprises
- a single clamping device (5) arranged to releasably press one clamping shoe (4) against the surface of the electrode (E), and

35

- a contact shoe (28) made of electrically conductive material for supplying current to the electrode, the contact shoe (28) being arranged at an opposite side of the lower holder ring (3) in relation to the position of the clamping shoe (4).

12. An electrode slipping device according to claim 11, characterized in that the upper holder ring (2) is attached to a stationary structure (29), and that the lower holder ring (3) is suspended from the stationary structure (29) by vertical hydraulic cylinders (30).

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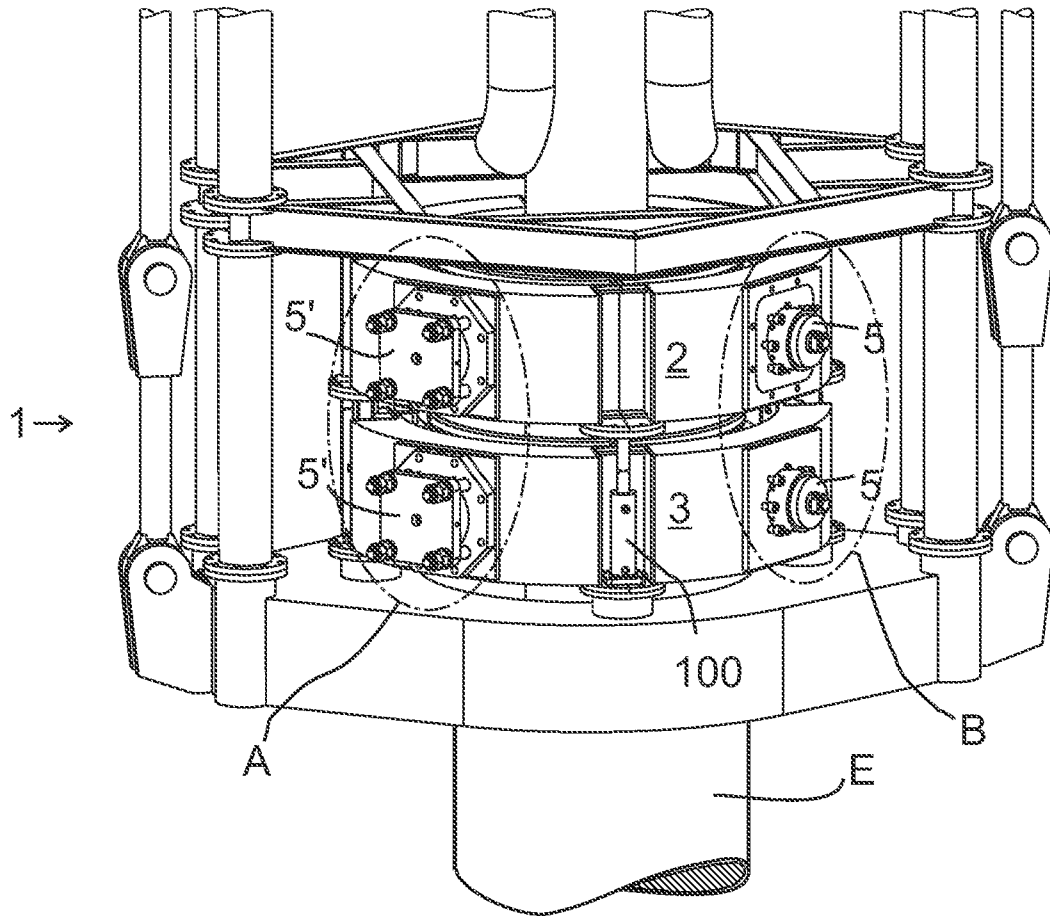
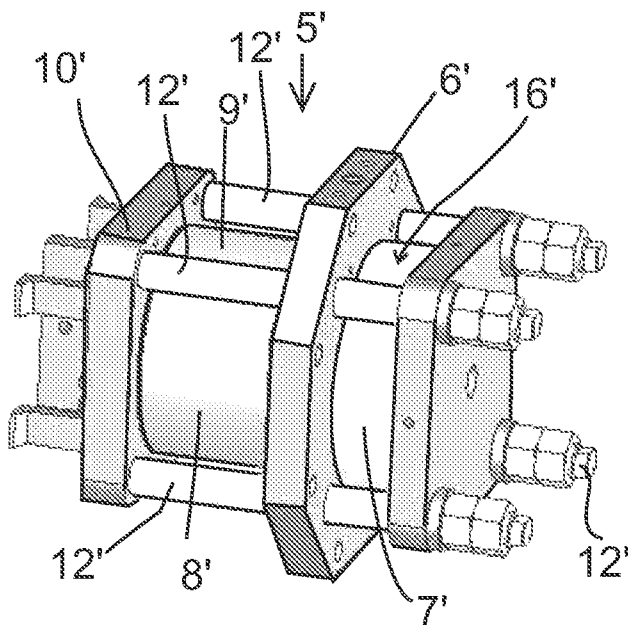


Fig. 1



Prior art
Fig. 2

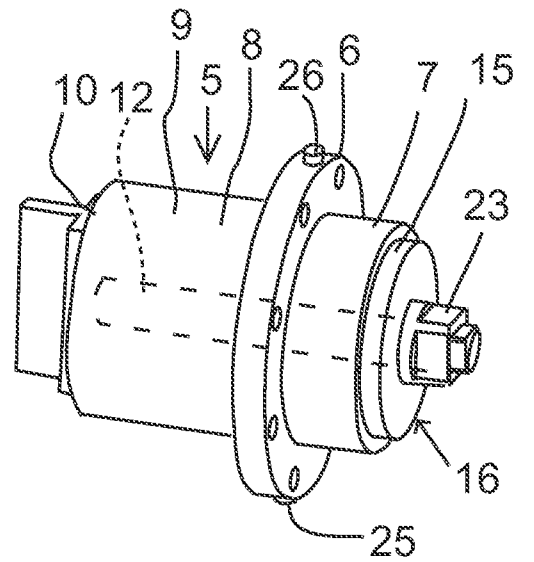


Fig. 3

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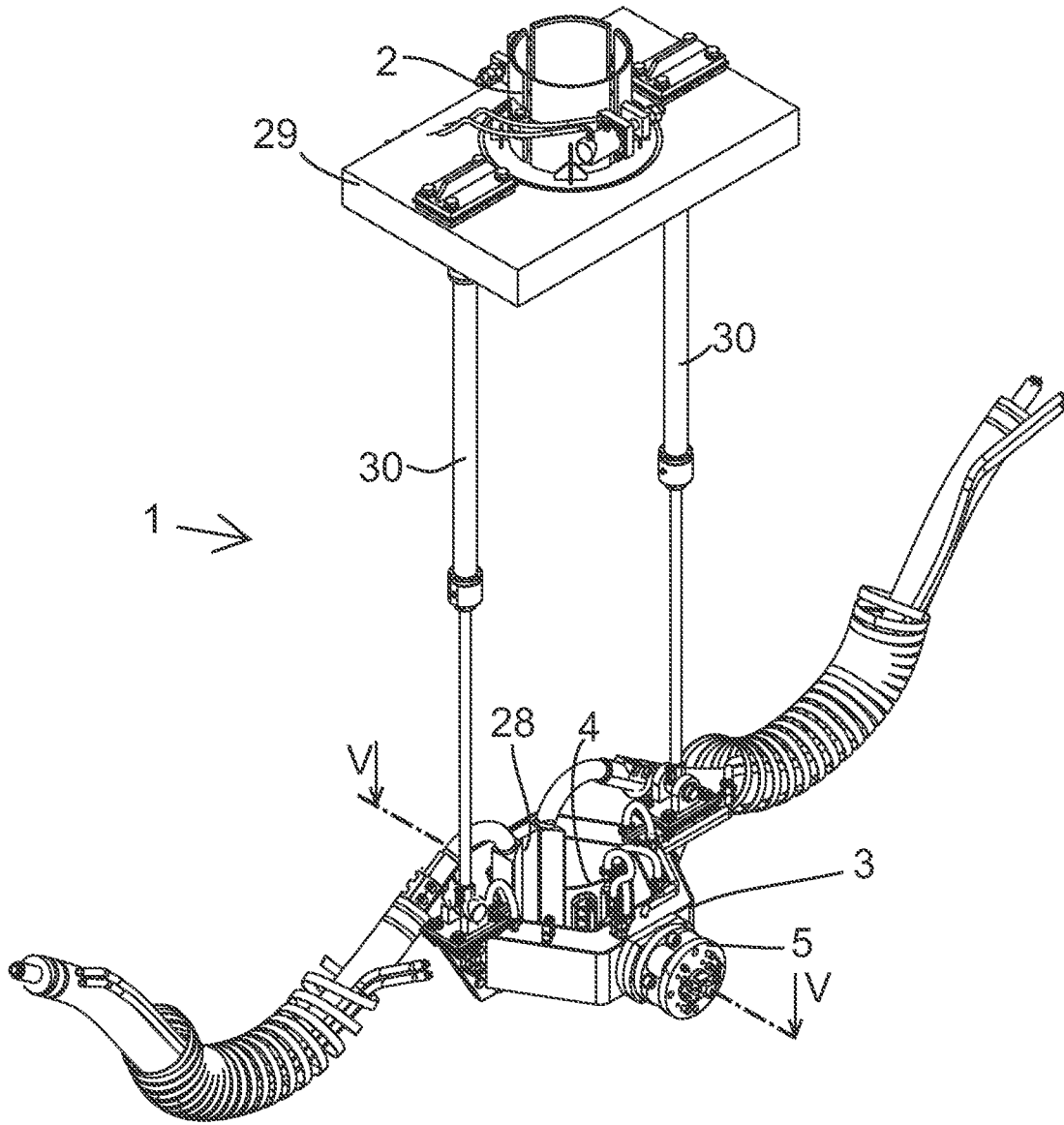


Fig. 4

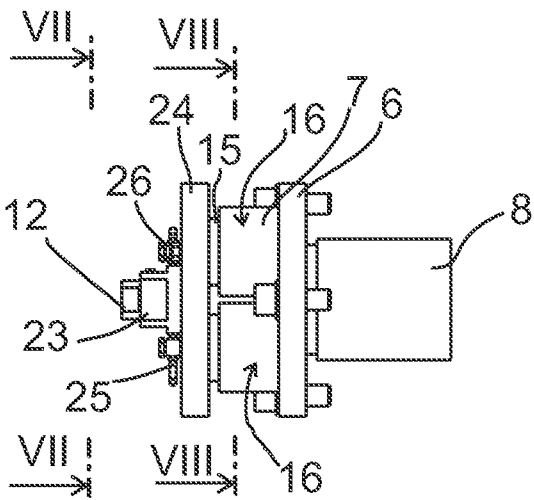
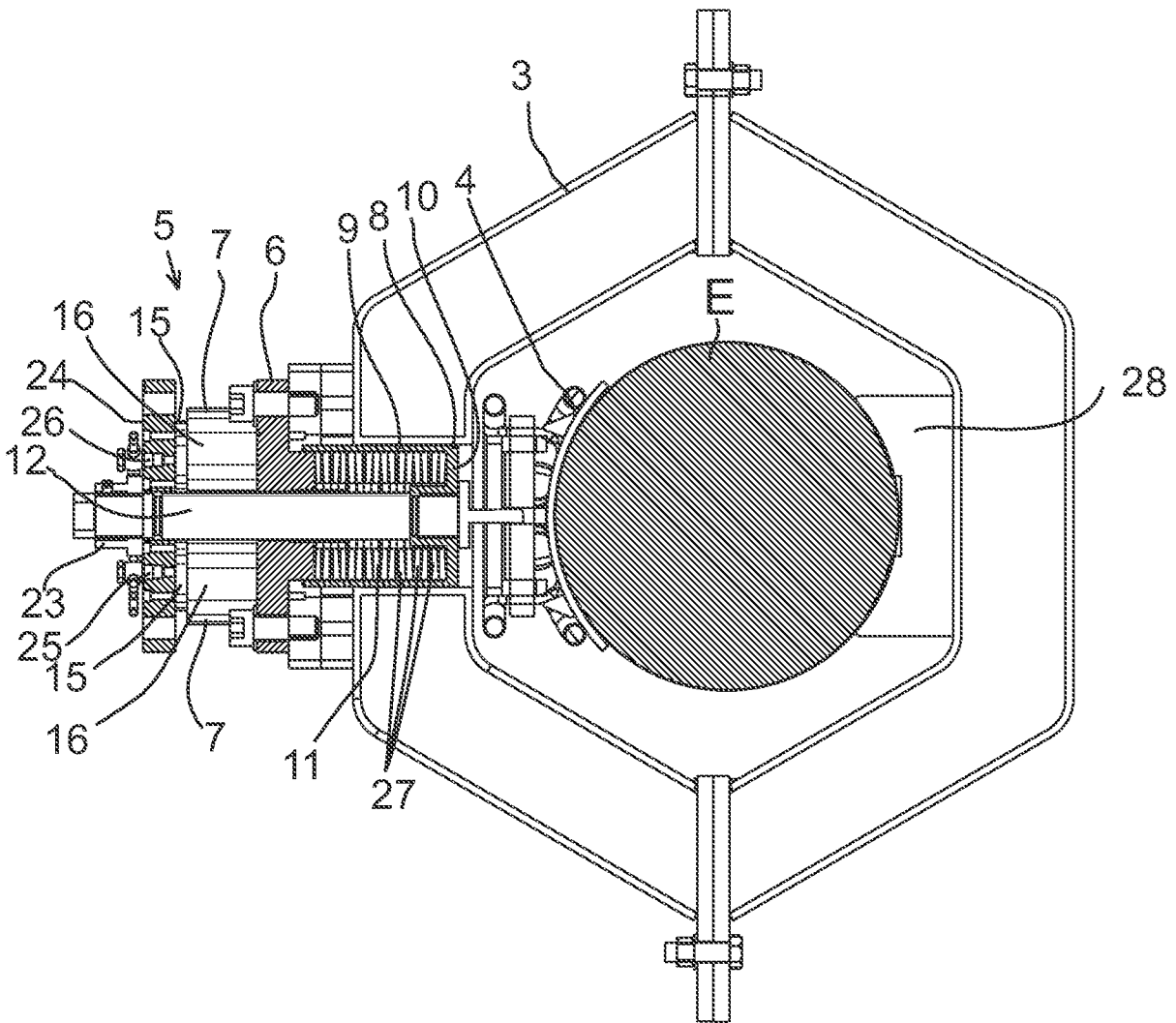


Fig. 6

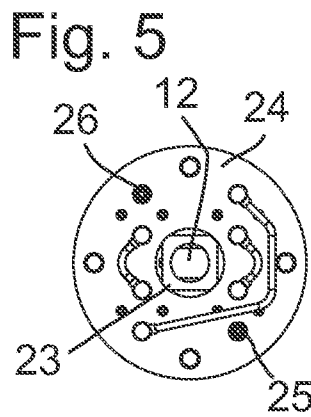


Fig. 7

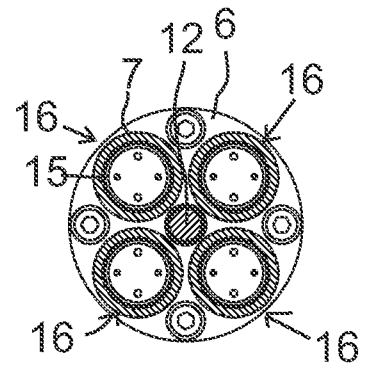


Fig. 8

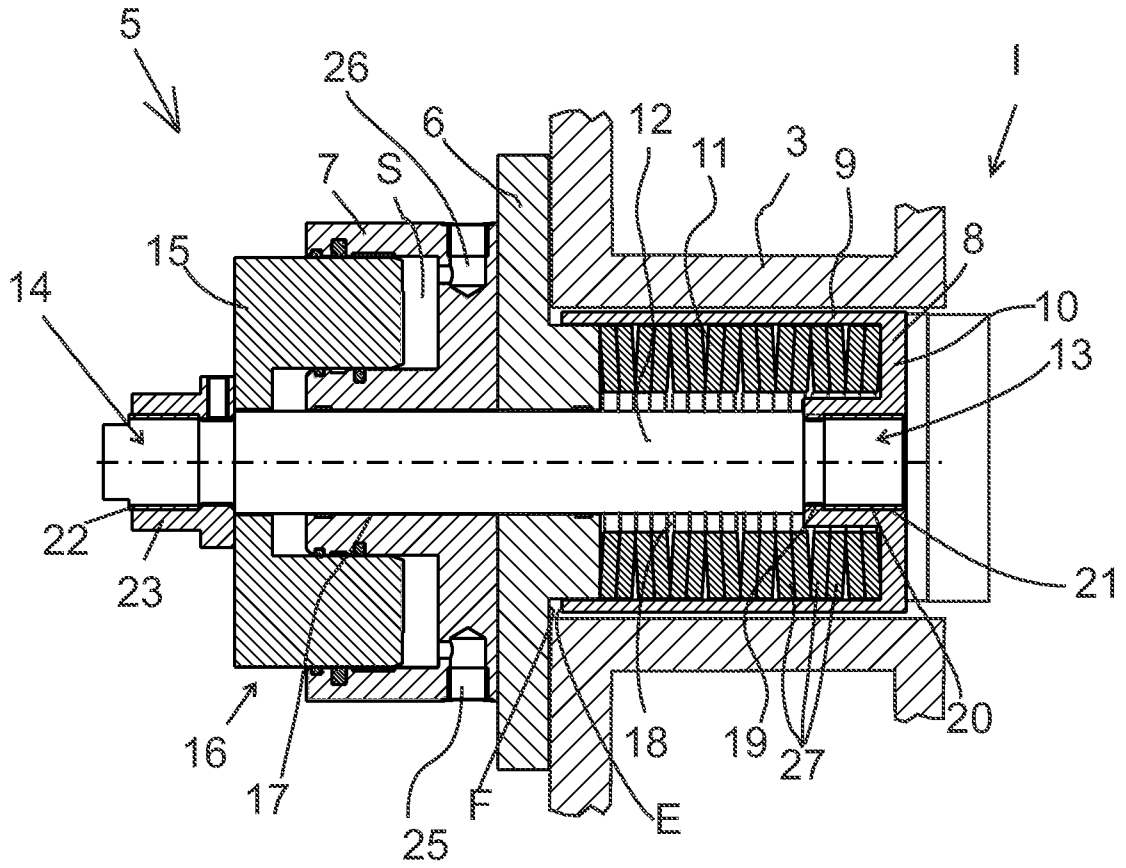


Fig. 9

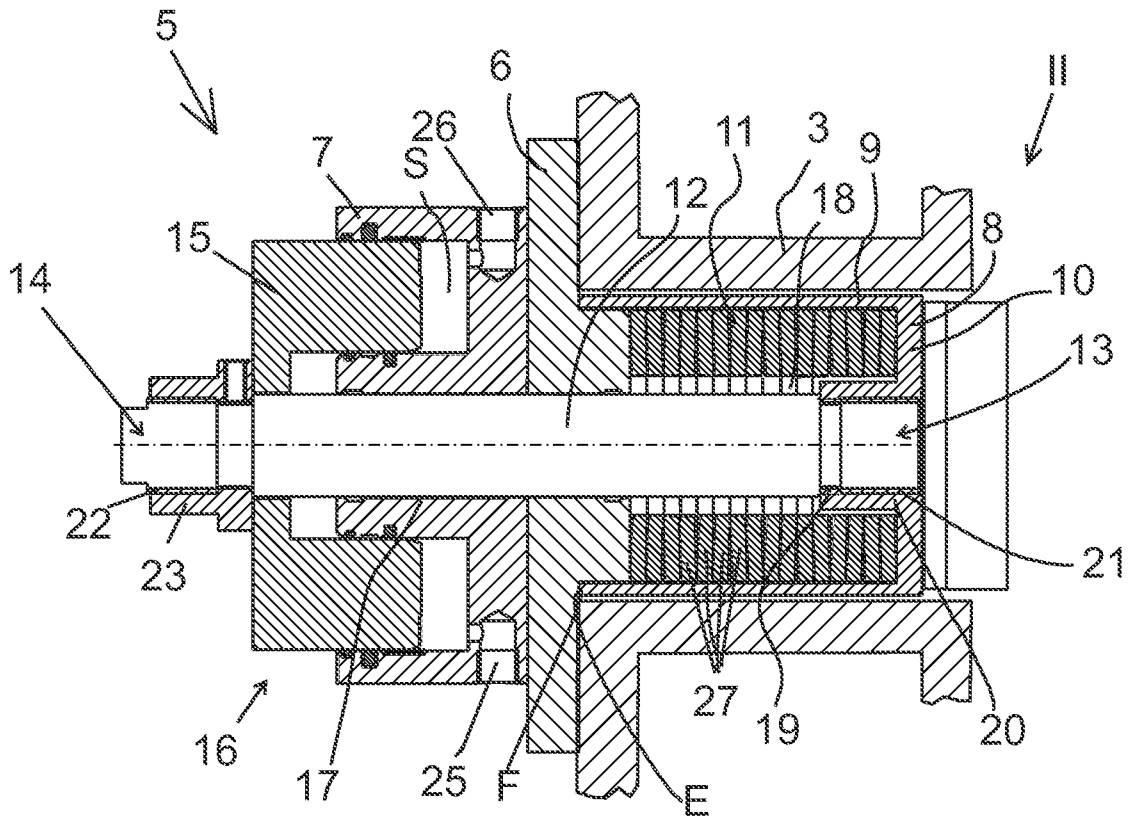


Fig. 10

