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(54) **Vessel**

(57) Vessel (1) that is provided with a spud carriage (5) for fastening a spud (2) therein, whereby this spud carriage (5) can move with respect to the rest of the vessel (1) in the longitudinal direction (L) of the vessel (1), characterised in that on both sides (7) the spud carriage (5) is provided with a compressible damper (15,19) to enable a rotation of the spud carriage (5) with respect to the rest of the vessel (1) around a geometric axis that extends in the longitudinal direction (L) of the vessel (1).

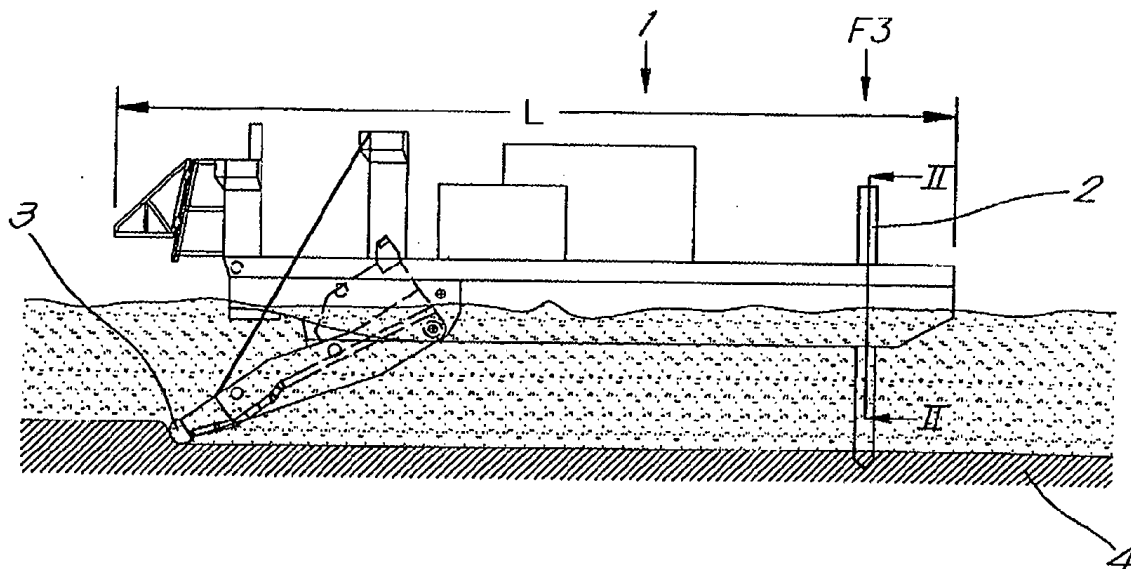


Fig. 1

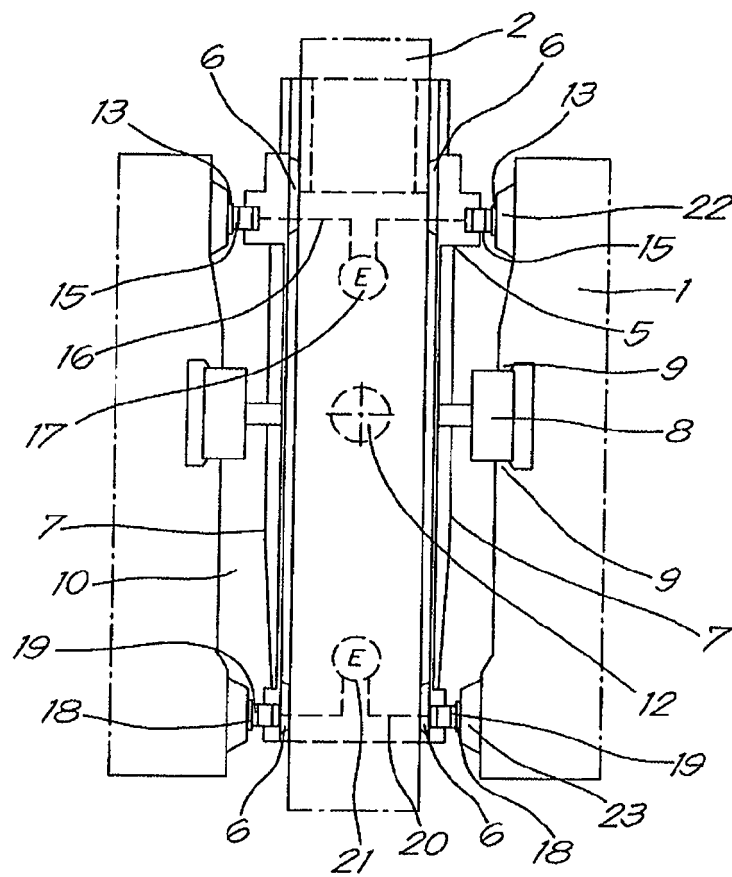


Fig. 2

Description

[0001] The present invention relates to a vessel.

[0002] More specifically, the invention is intended for a vessel provided with a spud that is mounted on a spud carriage, such as a cutter-suction dredger, or 'cutter-suction dredge', for example that is used in the dredging industry.

[0003] A cutter-suction dredger is a vessel that is used for deepening waterways, ports, etc, by loosening a hard, for example rocky, bed by means of a powerful cutting head and then sucking up the loosened residues. They can include relatively large pieces of stone and other hard materials.

[0004] To this end a cutter-suction dredger is provided with a cutting arm on its underside, also known as a ladder, at the end of which the cutting head is provided. A driveshaft for the cutting head runs along or through this cutting arm and a suction pipe for the material to be removed from the water bed, in which suction pipe a pump is affixed. In view of the large forces that occur during cutting, such a cutting arm is constructed as a heavy steel construction.

[0005] In order to prevent the cutter-suction dredger from being pushed away by these forces, such that there are insufficient counterforces for the good operation of the cutting head, such a cutter-suction dredger is provided with a spud on its front that is driven vertically into the bed and thereby presents a counterforce for the cutting head.

[0006] To enable a certain surface area to be deepened, such a spud is generally mounted on a spud carriage that is placed on rails in or on the vessel and which can be moved hydraulically in the longitudinal direction of the vessel. As a result, with a single positioning of the spud, the rest of the cutter-suction dredger, thus including the cutting head, can cover a certain zone and the spud has to be moved far less often.

[0007] Such a construction has the disadvantage that it is rather sensitive to movements of the vessel. Because the spud is fixed to the bed during use and is also firmly connected to the vessel, movements of the vessel easily lead to high forces on the connection between the spud and the vessel. Rolling movements of the vessel in particular hereby lead to stresses on this connection that can damage the vessel or the spud.

[0008] As a result a cutter-suction dredger can only be used on a relatively calm water surface, such that the cutter-suction dredger can only operate for a proportion of the time, as operations must be stopped in rather unfavourable sea states or rather unfavourable weather.

[0009] The purpose of the present invention is to provide a solution to the aforementioned and other disadvantages by providing a vessel, preferably a cutter-suction dredger, that is provided with a spud carriage for suspending a spud therein, whereby this spud carriage can move with respect to the rest of the vessel in the longitudinal direction of the vessel, whereby on both

sides, viewed in the longitudinal direction of the vessel, the spud carriage is provided with a compressible damper to enable a rotation of the spud carriage with respect to the rest of the vessel around an axis that extends in the longitudinal direction of the vessel.

[0010] Thanks to the dampers, if necessary, thus if forces acting thereon are greater than permitted, the spud carriage can rotate around a longitudinal axis to a limited extent, while a good transmission of force from the vessel to the spud, that is required for the good operation of the cutting head, is maintained.

[0011] As a result such a vessel can be used in much higher sea states than previously without the risk of damage to the vessel or the spud, and thus can be used effectively for a greater percentage of the time.

[0012] Hereby the aforementioned dampers, at their side oriented towards the rest of the vessel, are preferably provided with a sliding block and the vessel is provided with slide strips that extend in the aforementioned longitudinal direction and which are oriented towards the sliding blocks, whereby, in a situation in which the position of the vessel is horizontal and the position of the spud is vertical, all the said sliding blocks rest against the slide strips.

[0013] As a result, in a neutral situation the spud carriage is firmly fastened to the vessel.

[0014] In a further preferred embodiment the spud carriage is constructed such that a damper is only compressed if a force exerted on a damper exceeds a threshold value.

[0015] This has the advantage that at lower forces there is no possibility of movement.

[0016] This can be achieved in a preferred embodiment by the dampers comprising hydraulic cylinders that are coupled to a hydraulic circuit with an expansion tank, whereby the hydraulic circuit is under a raised pressure that determines the said threshold value.

[0017] This can also be achieved in an alternative preferred embodiment by the dampers being closed viscous fluid dampers that are filled with an elastomer.

[0018] Viscous fluid dampers are known dampers that are provided with a movable piston, which, when a force is exerted thereon, pushes a fluid through a narrow opening, whereby the viscous losses that are coupled thereto dampen the force.

[0019] Such an opening can also be made in the piston itself, whereby the piston with a cylinder divides the fluid into two parts.

[0020] If this is filled with an elastomer, a certain threshold force first has to be exceeded before the fluid can flow, and the damping effect can thus occur. With a force below this threshold force the damper acts as a fixed incompressible block.

[0021] In a preferred embodiment the spud carriage is rotatable with respect to the rest of the vessel around an axis that extends in the longitudinal direction of the vessel.

[0022] In a further preferred embodiment the spud car-

riage is provided with one or more wheels on each side to enable movement in the longitudinal direction with respect to the rest of the vessel, and with a minimum of two aforementioned dampers, whereby on each side at least one damper is higher than the wheels and at least one damper is lower than the wheels.

[0023] In this way in the event of a rolling movement the forces are always distributed over at least two dampers so that a better distribution of forces is obtained.

[0024] In a further preferred embodiment the damping characteristics of the dampers are adjustable.

[0025] As a result these damping characteristics can be adjusted to the water depth.

[0026] With a greater water depth a stiffer damping can be set without the risk of damage, because a limited level of bending of the spud is possible, so that in a greater water depth smaller differences in the angle between the vessel and the part of the spud that runs through the spud carriage will occur.

[0027] With the intention of better showing the characteristics of the invention, a preferred embodiment of a vessel according to the invention is described hereinafter by way of an example, without any limiting nature, with reference to the accompanying drawings, wherein:

Figure 1 schematically shows a side view of a vessel according to the invention;

Figure 2 shows a cross-section along II-II of a section of the vessel of figure 1 on a larger scale;

Figure 3 shows a top view according to F3 of a section of the vessel of figure 1 on a larger scale;

figure 4 schematically shows a perspective view of a component of the vessel of figure 1; and

figure 5 shows the vessel in a view according to figure 3 in a different usage situation.

[0028] The cutter-suction dredger 1, or cutter suction dredge, shown in figure 1 is a ship that is provided with a spud 2 near its front and a cutting arm with a cutting head 3 at its back.

[0029] The cutting arm can be raised and lowered again by means of a lifting device. In the operating situation of figure 1 in which the cutting arm is lowered and the cutting head 3 is used for loosening bed material from a hard seabed 4 there must be a counterforce for the cutting head 3, for which reason the spud 2 is provided, which is driven into the bed before the cutting head 3 is switched on.

[0030] As shown in figures 2 and 3, the spud 2 is clamped in a spud carriage 5 by means of a top and bottom clamp 6.

[0031] The spud carriage 5 is provided on each side 7 with two sets of wheels 8, such that the spud carriage 5 can move in the longitudinal direction L in a carriage space 10 on rails 9 that are affixed in the cutter-suction dredger 1, thus forwards and backwards with respect to the rest of the cutter-suction dredger. The spud carriage 5 is connected thereto by a hydraulic drive 11 on the

cutter-suction dredger 1.

[0032] A horizontal shaft 12 extending in the longitudinal direction L is affixed between the sets of wheels 8, on which the rest of the spud carriage 5 is tiltably suspended. This shaft 12 is indicated in figures 2, 3 and 5 with a dashed line.

[0033] Close to its top the spud carriage 6 is provided on both sides 7 with two sliding blocks, i.e. a first sliding block 13 and a second sliding block 14.

[0034] These sliding blocks are affixed on hydraulic cylinders 15, more specifically one hydraulic cylinder 15 for the first sliding block 13 and three hydraulic cylinders 15 for the second sliding block 14. The sliding blocks 13, 14 can thereby be pushed in.

[0035] These top hydraulic cylinders 15 are connected via a top hydraulic circuit 16 to an expansion tank 17, in which, by means of a gas, for example nitrogen, a high pressure, for example 350 bar is set. The nitrogen circuit needed for this is not shown in the drawings.

[0036] Close to its underside the spud carriage 5 is provided on each side 7 with a third sliding block 18, that is affixed on four hydraulic cylinders 19. These bottom hydraulic cylinders 19 are connected via a bottom hydraulic circuit 20 to a bottom expansion tank 21 in which a high pressure is set in a similar way.

[0037] The hydraulic circuits 16, 20 are provided with valves to form a flow resistance for flowing hydraulic fluid.

[0038] The carriage space 10 is provided on its inside with the aforementioned rails 9 for the wheels 8, and with top slide strips 22 and bottom slide strips 23, which extend horizontally. The sliding blocks 13, 14, 18 and the slide strips 22, 23 are made of a hard and durable metal.

[0039] The dimensions of the various components are such that on a flat horizontal water surface, the hydraulic cylinders 15, 19 are practically fully extended when the sliding blocks 13, 14, 18 rest against the slide strips 22, 23.

[0040] The operation of the cutter-suction dredger 1 is as follows.

[0041] By means of the hydraulic drive 11 the spud carriage 5 is placed in its rearmost position, as shown in figure 3. A partial circular movement is then made by the cutter-suction dredger 1 with the cutting head 3 around the spud 2, so that a track of bed material with a shape of a partial circle is loosened by the cutting head 3. The spud 2 prevents the cutter-suction dredger 1 moving forwards during this operation.

[0042] Then the hydraulic drive 11 brings the spud carriage 5 a certain distance forwards in the carriage space 10, whereby the spud carriage 5 rides over the rails 9 with its wheels 8, and slides with the sliding blocks 13, 14, 18 over the slide strips 22, 23.

[0043] As a result the rest of the cutter-suction dredger 1 moves backwards with respect to the spud 2.

[0044] Hereafter a partial circle of bed material is loosened.

[0045] This is repeated until the spud carriage 5 is in its foremost position, after which the spud 2 is pulled out

of the seabed 4, the spud carriage 5 is placed in its rear-most position again, and the spud 2 is driven into the seabed 4 again at a new position, so that the method described above can take place again and a subsequent seabed 4 section can be loosened.

[0046] When, as shown in figure 2, the position of the cutter-suction dredger 1 is horizontal, the sliding blocks 13, 14, 18 rest against the slide strips 22, 23.

[0047] When the cutter-suction dredger 1 makes a rolling movement due to the movement of the water surface, thus a rotation movement around an axis that runs in the longitudinal direction L, a force is exerted on the sliding blocks 13, 14, 18 concerned by the top slide strip 22 on a side 7 and the bottom slide strip 23 on the other side 7, and thereby on the hydraulic cylinders 15, 19 to which these sliding blocks 13, 14, 18 are fastened.

[0048] As long as the rolling movement is limited, the pressure exerted on the hydraulic circuits 16, 20 by the hydraulic cylinders 15, 19 does not exceed the set pressure, in this example 350 bar, and the hydraulic cylinders 15, 19 are not pushed inwards.

[0049] The forces that are coupled with such a limited rolling movement are absorbed by the construction of the cutter-suction dredger 1, the spud 2 and the spud carriage 5.

[0050] When the rolling movement becomes greater, the pressure exerted by the hydraulic cylinders 15, 19 on the hydraulic circuits 16, 20 exceeds the set pressure, the hydraulic cylinders 15, 19 concerned are pushed inwards and the hydraulic fluid is driven towards the expansion tanks 17, 21.

[0051] The spud carriage 5, together with the spud 2, hereby rotates on its horizontal shaft 12, so that the spud carriage 5 is in an oblique position in the carriage space 10. This is shown in figure 5.

[0052] The hydraulic cylinders 15, 19 hereby act as dampers for severe rolling movements and protect the construction against damage.

[0053] By adjusting the said valves in the hydraulic circuits 16, 20 and the pressure in the expansion tank 17, 21, the damping characteristics of the dampers can be adjusted in different conditions in order not to get any unnecessary movements of the spud carriage 5, but also to prevent damage.

[0054] It hereby applies that stiffer damping is possible at a greater water depth. This can be adjusted manually on the basis of a depth meter on the cutter-suction dredger 1. A signal from such a depth meter can be automatically used by a control unit in order to adjust the damping characteristics.

[0055] For clarity only one spud 2 is shown above. However, normally a cutter-suction dredger 1 also has an auxiliary spud that is solidly connected to the cutter-suction dredger 1, thus not via a spud carriage 5 as described above.

[0056] This auxiliary spud is useful when the spud carriage 5 comes to its foremost position and has to be put back to the starting position. To this end the spud 2 must

be released from the bed, which means that the position of the cutter-suction dredger 1 could change.

[0057] This is prevented by now using the auxiliary spud when the spud carriage 5 must be moved.

5 [0058] In the above, the hydraulic system is shown summarily. For optimum operation it is desirable for both hydraulic circuits 16, 20 to communicate to ensure that a transverse movement of the wheels 8 is prevented. Necessary cooling, controls and other components of the hydraulic circuits 16, 20 are not shown either.

10 [0059] In an alternative embodiment, instead of the hydraulic cylinders 15, 19 that are connected to expansion tanks 17, 21 via hydraulic circuits 16, 20, closed dampers are used in which a piston in a cylinder, filled with an elastomer, can move and damping is obtained because the elastomer is pushed through a narrow opening when the piston moves. However, such a movement will only take place when a certain force on the piston is exceeded, on account of the nature of the elastomer.

15 [0060] Hereby the hydraulic circuits and expansion tanks can be omitted.

20 [0061] The present invention is by no means limited to the embodiment described as an example and shown in the drawings, but a cutter-suction dredger according to the invention can be realised in all kinds of forms and dimensions without departing from the scope of the invention.

30 Claims

1. Vessel (1) that is provided with a spud carriage (5) for fastening a spud (2) therein, whereby this spud carriage (5) can move with respect to the rest of the vessel (1) in the longitudinal direction (L) of the vessel (1), **characterised in that** on both sides (7) the spud carriage (5) is provided with a compressible damper (15, 19) to enable a rotation of the spud carriage (5) with respect to the rest of the vessel (1) around a geometric axis that extends in the longitudinal direction (L) of the vessel (1).
2. Vessel according to claim 1, **characterised in that** the aforementioned dampers (15, 19) are provided with one or more sliding blocks (13, 14, 18) on their side oriented towards the rest of the vessel (1).
3. Vessel according to claim 2, **characterised in that** the vessel (1) is provided with slide strips (22, 23) that extend in the aforementioned longitudinal direction (L) and which are oriented towards the sliding blocks (13, 14, 18).
4. Vessel according to claim 3, **characterised in that**, in a situation in which the position of the vessel (1) is horizontal and the position of the spud (2) is vertical, all the said sliding blocks (13, 14, 18) rest against the slide strips (22, 23).

5. Vessel according to any one of the previous claims,
characterised in that the spud carriage (5) is constructed such that the dampers (15, 19) are only pushed in if a force exerted on the damper (15, 19) exceeds a threshold value. 5
6. Vessel according to any one of the previous claims,
characterised in that the dampers comprise hydraulic cylinders (15, 19) that are coupled to a hydraulic circuit (16, 20) with an expansion tank (17, 21). 10
7. Vessel according to claim 5 and 6, **characterised in that** the hydraulic circuit (16,20) is under a raised pressure, whereby this pressure determines the said threshold value. 15
8. Vessel according to any one of the claims 1 to 5,
characterised in that the dampers are viscous fluid dampers that are filled with an elastomer. 20
9. Vessel according to any one of the previous claims,
characterised in that the spud carriage (5) is provided with one or more wheels (8) on each side (7) to enable movement in the longitudinal direction (L) with respect to the rest of the vessel (1), and with at least two aforementioned dampers (15, 19), whereby on each side (7) at least one damper (15) is higher than the wheels (8) and at least one damper (19) is lower than the wheels (8). 25
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10. Vessel according to any one of the previous claims,
characterised in that it is a cutter-suction dredger (1). 35
11. Vessel according to any one of the previous claims,
characterised in that the damping characteristics of the dampers (15, 19) are adjustable. 40
12. Vessel according to claim 11, **characterised in that** the vessel (1) is provided with means to determine the water depth and to adjust the damping characteristics as a function of this water depth. 45

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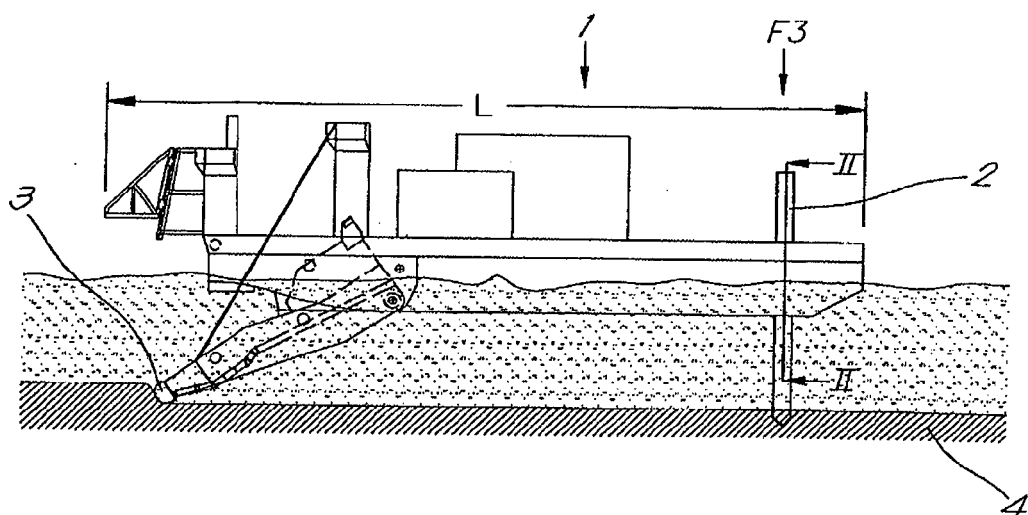


Fig. 1

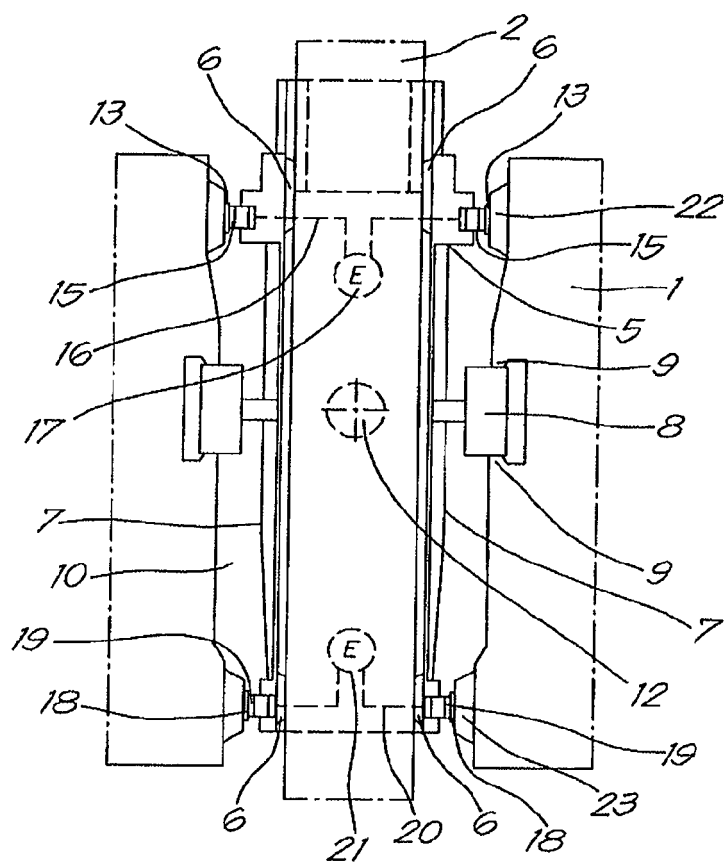


Fig. 2

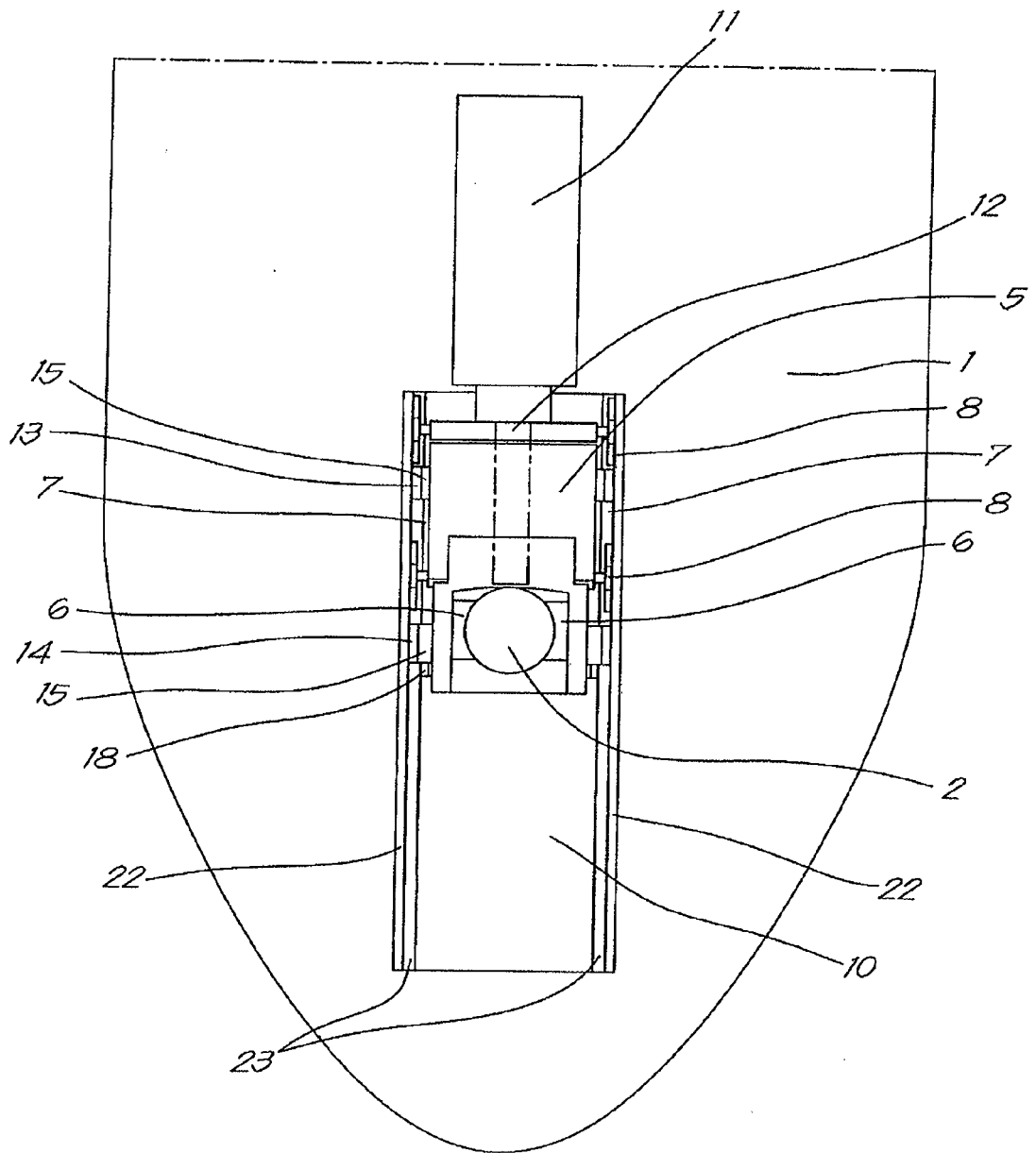


Fig. 3

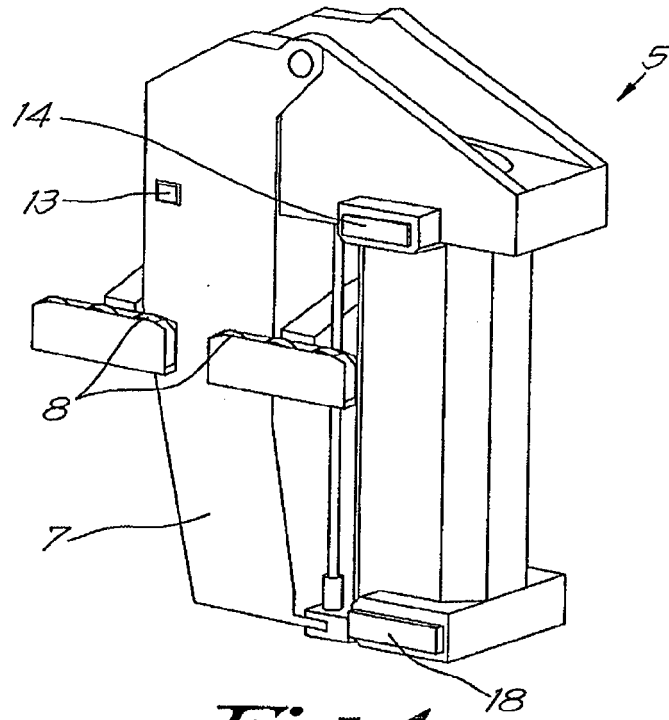


Fig. 4

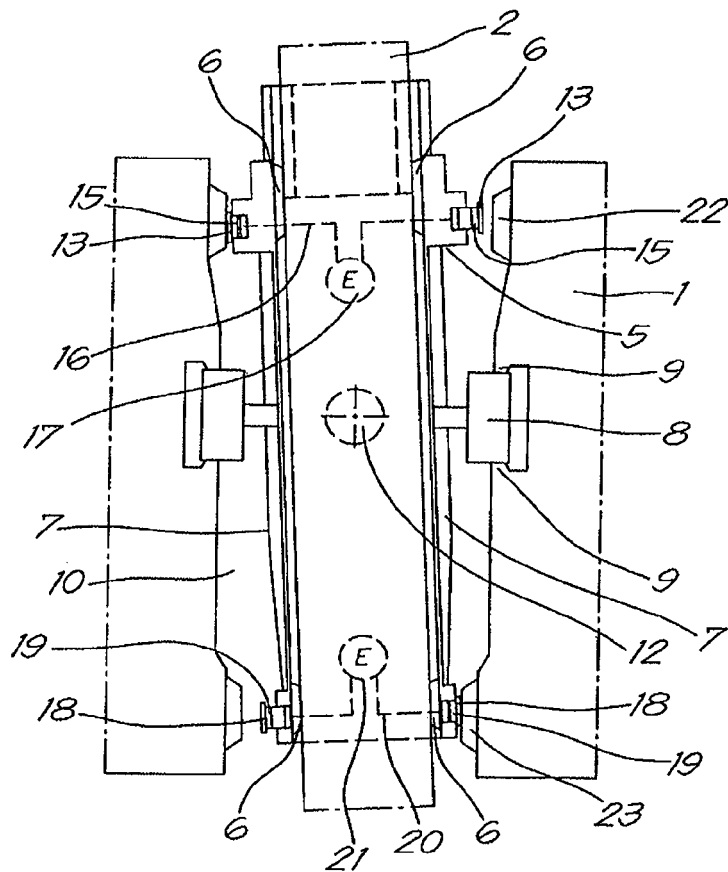


Fig. 5



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Application Number
EP 14 00 3869

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 20 March 2015	Examiner Bultot, Coralie
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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