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(54) **Door assembly**

(57) A door assembly of the translating motion type is provided comprising a rebate (2), a door (1) moveable relative to the rebate, a hinge arm (5), a first toothed wheel (11) located at the hull end (7) of the hinge arm (5), a second toothed wheel (12) at the door end (6) of the hinge arm (5), a loop (13) tensioned around and meshing with teeth of the first and second toothed wheels (11, 12) comprising a first loop section (14, 15) extending between the first toothed wheel (11) and the second toothed wheel (12) and a second loop section (15) extending between the first toothed wheel (11) and the second toothed wheel (12) facing the first loop section, and adjustable loop tensioners included in the first and second loop sections for adjusting tension of the loop about the toothed wheels (11, 12).

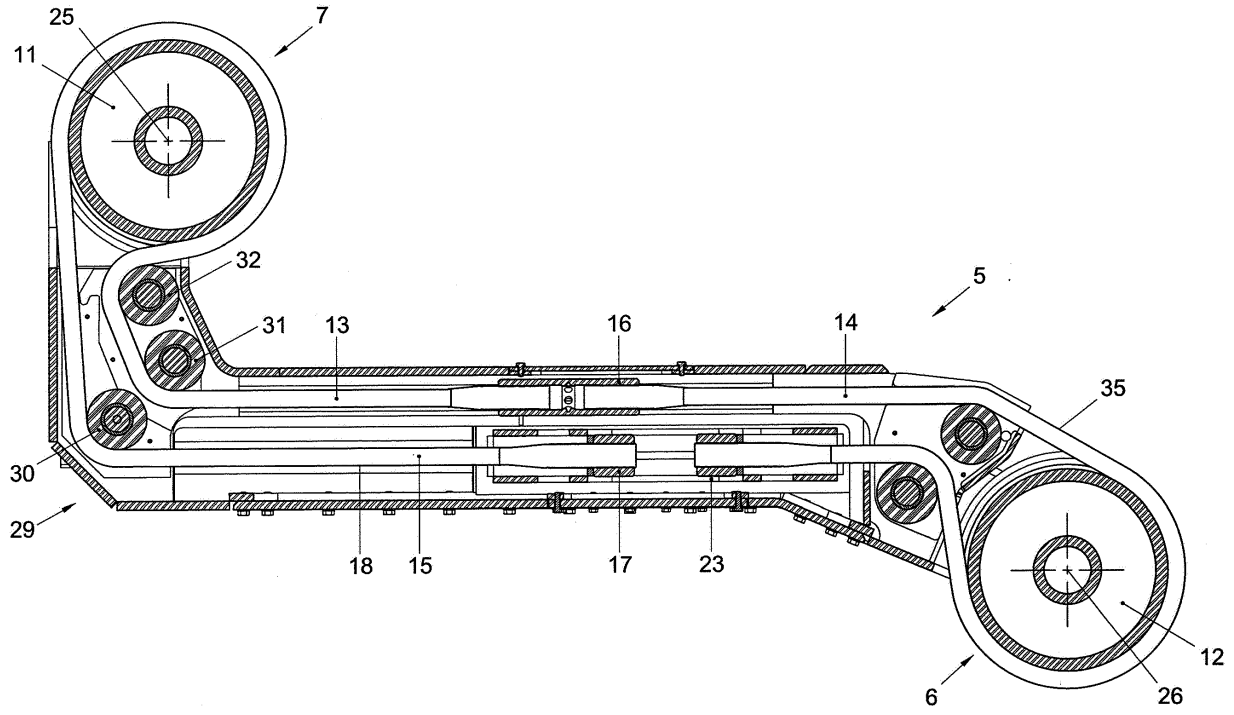

Fig. 3

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Description

[0001] The invention relates to a door assembly according to the introductory portion of claim 1.

[0002] Such a door assembly is known from U.S. patent 5 289 615. The door disclosed in this document is a translating-motion type aircraft door. During opening and closing of the door along a curved trajectory defined by the distance between the hinge axes of the door and the rebate relative to the hinge arm or arms, the loop meshing with teeth of the first and second toothed wheels maintains the second toothed wheel in a constant orientation relative to the first toothed wheel. Since the first and second toothed wheels are fixed against rotation relative to the rebate and, respectively, the door, the loop also maintains the door in a constant orientation relative to the rebate. Thus, the door remains parallel to the rebate as it is opened.

[0003] Door assemblies of this type are also used as ship doors to that allow to provide access to a ship via a side of the hull. For instance in ships intended for research at sea, such as investigation or exploration, a door in a side of the hull allows access to the hull from a side to allow for instance a small vessel or equipment to be lowered into the sea from an arm projecting through the door opening. When this is performed at open sea, special measures are required to prevent door movements that would disturb the operation performed via the door opening and in particular banging of the door against the hull of the ship. Moreover, when the door is open, the area around the door opening should preferably be free from obstacles as much as possible.

[0004] A drawback of this known door is that a relatively complicated construction is provided for adjusting the orientation of the door relative to the rebate, which construction is moreover by itself a potential source of play, in particular under influence of wear and tear under adverse atmospheric conditions to which ship doors are usually subjected.

SUMMARY OF THE INVENTION

[0005] It is an object of the present invention to provide a door assembly of the translating motion type, with a more simple solution for adjusting the orientation of the door relative to the rebate and in which play due to wear of the door orientation mechanism can easily be avoided.

[0006] According to the invention, this object is achieved by providing a hinge assembly according to claim 1.

[0007] The second loop tensioner in the second loop section constitutes a very simple mechanism allowing to change the relative lengths of the first and second loop sections and thus, via the orientation of the second toothed wheel relative to the first toothed wheel, the orientation of the door relative to the rebate. A particular advantage of providing a second tensioner for adjusting the orientation of the door relative to the rebate is that play in the adjustment mechanism can easily be compensated for by adjusting the tension of the loop.

[0008] Particular embodiments of the invention are set forth in the dependent claims.

[0009] Further objects, features, effects and details of the invention are described below.

BRIEF DESCRIPTION OF THE DRAWING

[0010]

Fig. 1 is a perspective view of an example of a door assembly according to the invention with the door in a closed position;

Fig. 2 is a perspective view of the door of Fig. 1 in an open position;

Fig. 3 is a cross-sectional view of the hinge arm of the lower hinge assembly of the door of Fig. 1; and

Fig. 4 is a transparent view in perspective of the hinge arm of Fig. 3.

DETAILED DESCRIPTION

[0011] As shown in Figs. 1 and 2, a door assembly includes a door 1 and a rebate 2 that is fixedly mounted in a hull of a ship (not shown). The rebate may also be a rebate mounted in another structure, such as a fuselage of an airplane or the coachwork of a vehicle. The door 1 is suspended relative to the rebate via two hinge assemblies 3, 4. The upper hinge assembly 4 has a hinge arm hinged to the door and the rebate as is known in the art and is not equipped with a mechanism for controlling the orientation of the door 1 relative to the rebate 1 about the hinge axes. The lower hinge assembly 3 is equipped with a mechanism for keeping the door 1 parallel to the rebate 2 as it is opened and closed. It is however also possible to provide all hinge assemblies via which the door is suspended with mechanisms for controlling the orientation of the door 1 relative to the rebate 1 about the hinge axes.

[0012] The door 1 is further provided with cylinders 10 co-operating with openings in the rebate 2 for locking the door in the closed position. The hinge assembly 3 has a hinge arm 5 having a door end 6 and a rebate end 7. A door hinge 8 connects the door end 6 of the hinge arm 5 to the door 1. A rebate hinge 9 hinges the rebate end 7 of the hinge arm 5 to the rebate 2.

[0013] A first toothed wheel 11 (best seen in Figs. 3 and 4) is located in a position coaxial with a hinge axis 25 of the rebate hinge 7 and fixed against rotation relative to the rebate 2. A second toothed wheel 12 is located in a position coaxial with a hinge axis 26 of the door hinge 8 and fixed against rotation relative to door 1. An endless loop 13 extends about the toothed wheels 11, 12 and has teeth meshing with teeth of the toothed wheels to prevent the loop 13 from slipping over the circumference of the toothed wheels 11, 12. In the present example, the loop 13 includes two chain sections and the toothed wheels 11, 12 are provided in the form of sprocket wheels

of which the teeth mesh with links of the chain sections. However, other flexible members for transferring a pulling force, such as a toothed belt or a string to which bead are fixed at regular intervals may also be provided instead of chain sections.

[0014] The loop 13 has first and second sections 14, 15 extending from generally opposite first and second sides of the first sprocket wheel 11 to generally opposite sides of the second sprocket wheel 12. In the first section 14, a first adjustable tensioner 16 is included and in the second section 15, a second adjustable tensioner 17 is included. Both the first and second tensioners 16, 17 are independently adjustable for adjusting the tension of the loop 13 about the sprocket wheels 11, 12. In the present example, the tensioners are provided in the form of threaded nuts adjustable along threaded rods. Such tensioners are known as such and therefore not described in detail.

[0015] The hinge assembly 5 is further equipped with a first drive cylinder 19 having a piston 20 and a tube 21 (see Fig. 4). The piston 20 is fixed to a rod 22 in line with the tube 21 and sealingly contacts an inner wall surface of the tube 21. The piston 20 separates chambers in the tube 21 on the rebate side and the door side of the piston 20, which chambers communicate with pressure feeding lines of a hydraulic or pneumatic drive system. The tube 21 is movable along the rod 22 in its longitudinal direction parallel to a portion 18 of the loop 13 along which it extends. Outer ends 27a, 27b of the rod 22 are fixed to the hinge arm 5. A second drive cylinder 24 identical to the first drive cylinder 19 is located on an opposite side of the portion 18 of the loop 13.

[0016] The tubes 21 of the first an second drive cylinders 19, 24 are interconnected via a bridge member 23. The first and second rods 22 form a pair of guides along which the first and second tubes 21 and the bridge member 23 are movable. The bridge member 23 is connected to tensioner 17 of the loop 13, so that movement of the bridge member 23 relative to the hinge arm 5 causes the loop 13 to be entrained in circulatory sense relative to the hinge arm 5.

[0017] The hinge arm 5 of the hinge assembly 3 has an L-shaped form of which one leg extends transversely to a plane defined by the rods 22. At a corner 29 where the legs of the L-shape meet, idler pulleys 30-32 are located for guiding the loop 13 around the corner 29. A free end portion 35 of the L-shape remote from to the corner 29 and the transverse leg is curved away from the side of the leg at which the transverse leg extends and is provided with further idler pulleys 33, 34 that guide the loop 13 along the arm 5 and to the second sprocket wheel 12.

[0018] In the closed position shown in Fig. 1, an inflatable rubber seal under pressure seals off the slot between the door 1 and the rebate 2 and locking cylinders 10 lock the door 1 to the rebate 2. Prior to opening the door 1, the pressure is released from the seal until a sensor indicates a sufficient predetermined level of low pressure. Subsequently, the locking cylinders 10 are retracted.

[0019] To open the door 1, the drive cylinders 19, 24 are driven by supplying a pressurized fluid into chambers in the tubes 21on the rebate side of the pistons 20. This cause the loop 13 to be pulled around the first sprocket wheel, so that the hinge arm 5 rotates about the centre line of the first sprocket wheel 11 to the open position. As the hinge arm 5 moves from the closed door position to a fully open door position, the door 1 moves along a trajectory parallel to the rebate 2, because the loop engaging the second sprocket wheel 12 prevents rotation about the door hinge axis 26 of the second sprocket wheel 12, which is fixed to the door 1, relative to the first sprocket wheel 11, which is fixed to the rebate 2. The L-shaped form of the hinge arm 5 allows the door 1 to be moved to a position close to the hull. When the door 1 is in the fully open position the locking cylinders (not shown) may extended to lock the door 1 in the open position.

[0020] Thus, the loop 13 controls the orientation of the door 1 relative to the rebate 2 when the door 1 is opened and closed. In particular in view of tight sealing requirements, the orientation of the door 1 should be accurately adjusted to allow the door 1 to be closed reliably and easily. Also, play in the connection between the rebate 2 and the door 1 should be avoided as it would allow the door to move freely, which would in turn entail increased loads exerted on the hinge mechanism. By adjusting the tensioners 16, 17 so that the length of the first loop section 14 increases and the length of the second loop section 15 decreases, the orientation of the door 1 with respect to the rebate 2 can be adjusted. The adjustment can for instance be executed with the door closed.

[0021] Furthermore, if wear of the tensioners 16, 17 causes play in the loop 13, such play can be eliminated in a simple manner by readjustment of the tensioners 16, 17 of one of the tensioners 16, 17. Thus, the mechanism for adjusting the angle of the door 1 relative to the rebate 2 is not only simple, but also allows to any play occurring therein to be eliminated in a simple manner. A further advantage of easy removal of play is that the adjustment structure to not have to be manufactured to very tight manufacturing tolerances.

[0022] The length of the drive cylinders 19, 24 determines the distance about which the loop 13 can be moved. The rod 22 extending through the tube 21 is preferably at least twice as long as the tube 21 to allow the piston 20 to be displaced over the full length of the tube 21..

[0023] When the door 1 is to be closed, the low pressure of the seal is checked and indicated with a sensor. Subsequently the locking cylinder locking the door in it open position are retracted. The chambers in the tubes 21 on the rebate side of the pistons 20 are brought in communication with a discharge conduit and pressurized fluid is fed to the chambers on the door side of the pistons 20. This causes the tubes 21 an the bridge member 23 to move to the rebate end of the hinge arm 5, thereby entraining the loop 13 and causing the hinge arm 5 to

rotate about the centre line 25 of the first sprocket wheel 11. When the door 1 is closed, the locking cylinders 1 are extended and the seal is inflated.

[0024] Because the drive cylinders are arranged in a position spaced transversely from the loop section to which its tube or rod is connected, the drive cylinder does not add to the length of the loop around the toothed wheels, so the drive system can be accommodated in a relatively short hinge arm. It is observed that, while this arrangement of the drive cylinder is particularly advantageous for accommodating the second loop tensioner, it an also be applied advantageously with a single loop tensioner only.

[0025] By moreover providing two of said drive cylinders on opposite sides of the loop section to which the tubes or rods of the drive cylinders are connected, a balanced and relatively flat construction is obtained. For slenderness in direction transverse to the hinge axes, it is also advantageous if, moreover, the drive cylinder or cylinders is or are spaced in longitudinal direction of the hinge axes relative to the loop section to which the tube or rod of the drive cylinder or cylinders is or are connected.

[0026] While the invention has been illustrated and described in detail in the drawing and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments.

[0027] For instance, instead of one hinge assembly, as described above, the door assembly may be equipped with two or more hinge assemblies. Either one or more of the hinge assemblies can be equipped with a drive cylinders an/or a door orientation control mechanism. Furthermore, the drive means for mechanically opening the door may also be dispensed with or provided separate from the hinge assemblies via which the door is suspended from the rebate. Also, in particular if the door is relatively light, one of the tensioners may be an elastic tensioner so that only one tensioner needs to be adjusted to adjust the orientation of the door relative to the rebate.

[0028] Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims.

Claims

1. A door assembly comprising:

a rebate (2);
a door (1) moveable relative to the rebate between a closed position closing off the rebate (2) and an open position allowing passage through the rebate (2);
a hinge arm (5) hinged to the rebate (2) at its rebate end (7) about a rebate hinge axis (25) and hinged to the door (1) at its door end (6) opposite its rebate end about a door hinge axis (26);
a first toothed wheel (11) located at the hull end (7) of the hinge arm (5) and having a central axis (25) coaxial with the rebate hinge axis (25), the first toothed wheel (11) being fixed against rotation relative to the rebate;
a second toothed wheel (12) at the door end (6) of the hinge arm (5) and having a central axis (26) coaxial with the door hinge axis (26), the second toothed wheel (11) being fixed against rotation relative to the door;
a loop (13) tensioned around and meshing with teeth of the first and second toothed wheels (11, 12) comprising a first loop section (14, 15) extending between a first side of the first toothed wheel (11) and a first side of the second toothed wheel (12) and a second loop section (15) extending between a second side of the first toothed wheel (11) and a second side of the second toothed wheel (12), the first and second sides of the toothed wheels (11, 12) facing in generally opposite directions; and
an adjustable loop tensioner included in the first loop section for adjusting tension of the loop about the toothed wheels (11, 12);
characterized by a second loop tensioner (17) in the second loop section.

2. A door assembly according to claim 1, wherein the second loop tensioner is adjustable for adjusting tension of the loop about the toothed wheels (11, 12).

3. A door assembly according to claim 1, wherein the second loop tensioner is elastically deformable for elastically tensioning the loop about the toothed wheels (11, 12)

4. A door assembly according to any of the claims 1-3, further comprising at least one drive cylinder including a rod and a tube in line with the rod, the rod being displaceable in longitudinal direction relative to the tube, the tube or the rod being coupled to the hinge arm (5) and the rod or, respectively the tube being coupled to the first or second loop section, wherein the cylinder is arranged in a position transversely spaced from the loop section to which its tube or rod is connected.

5. A door assembly according to claim 4, comprising two of said drive cylinders on opposite sides of the loop section to which the tubes or rods of the drive cylinders are connected.

6. A door assembly according to claim 4 or 5, wherein the at least one drive cylinder is spaced in longitudinal direction of the hinge axes relative to the loop section to which the tube or rod of the drive cylinders is connected.

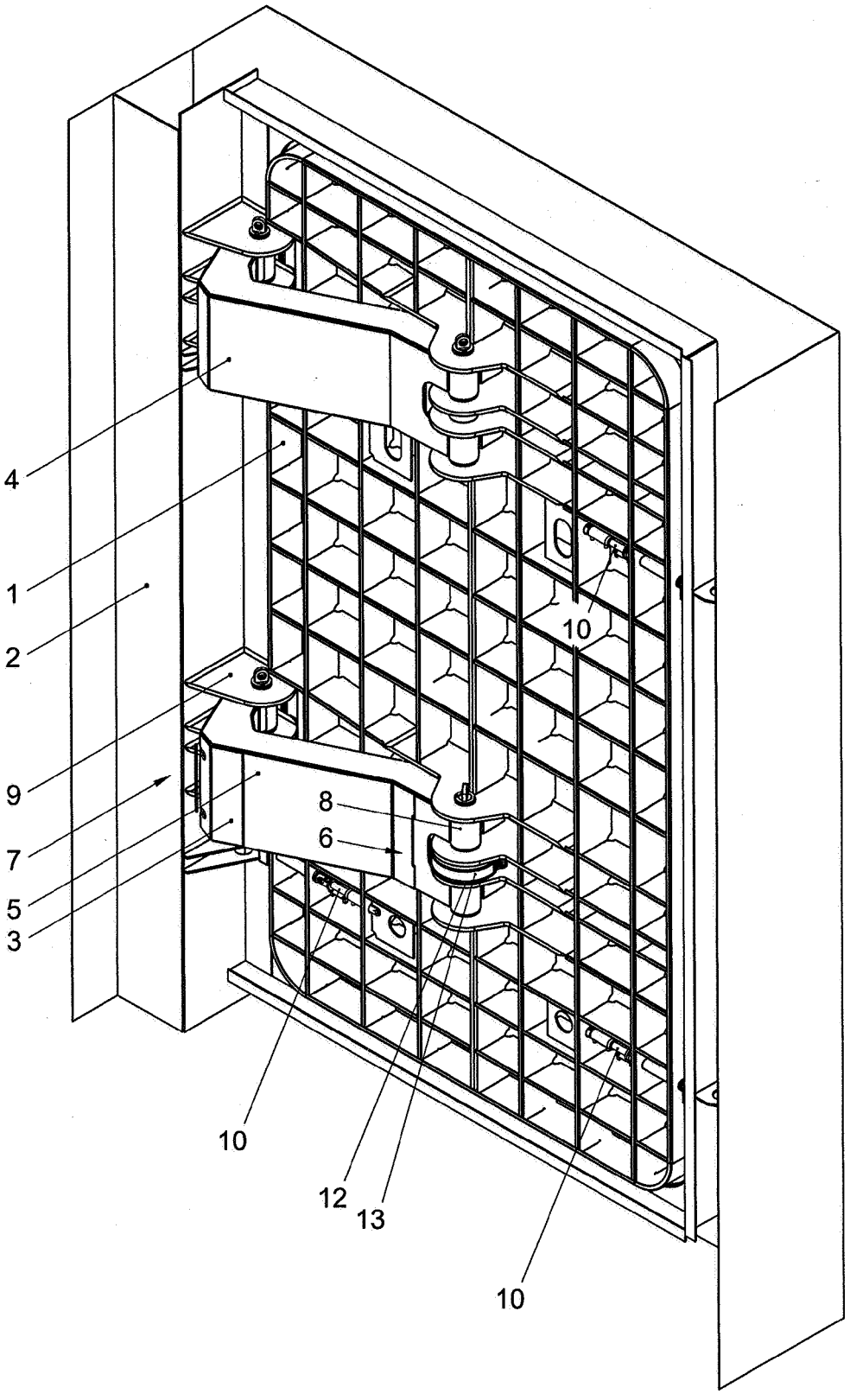

Fig. 1

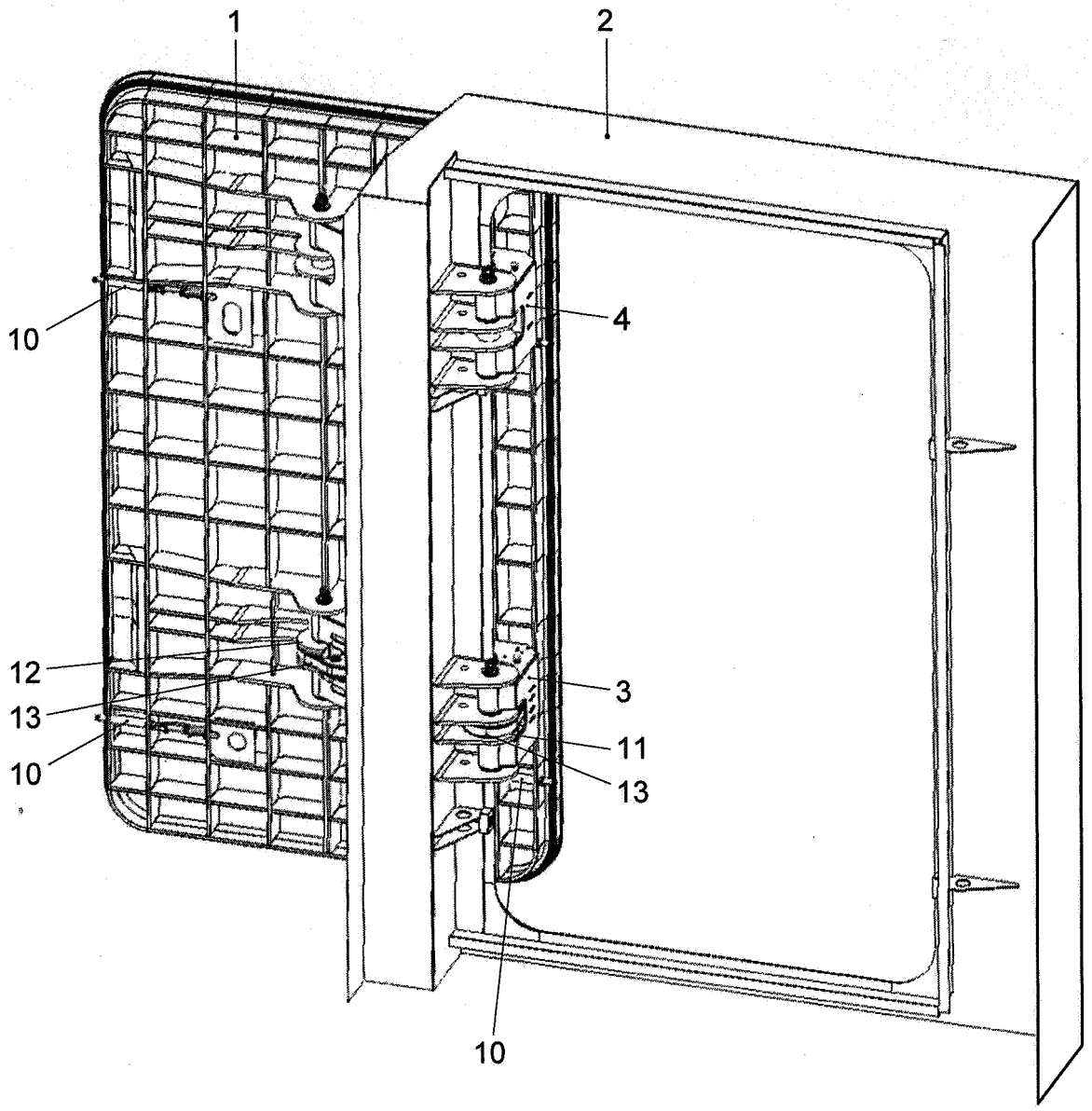

Fig. 2

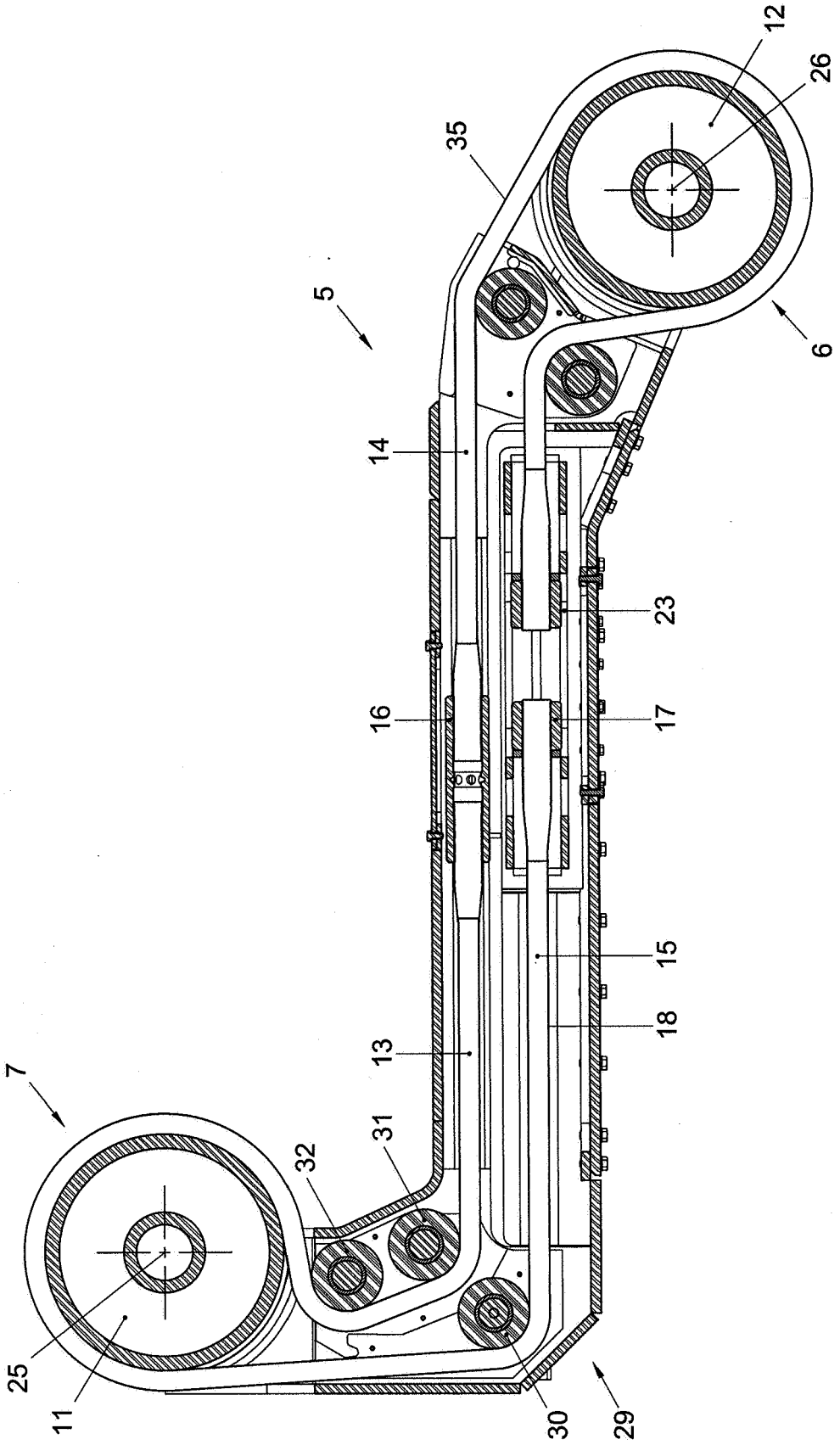

Fig. 3

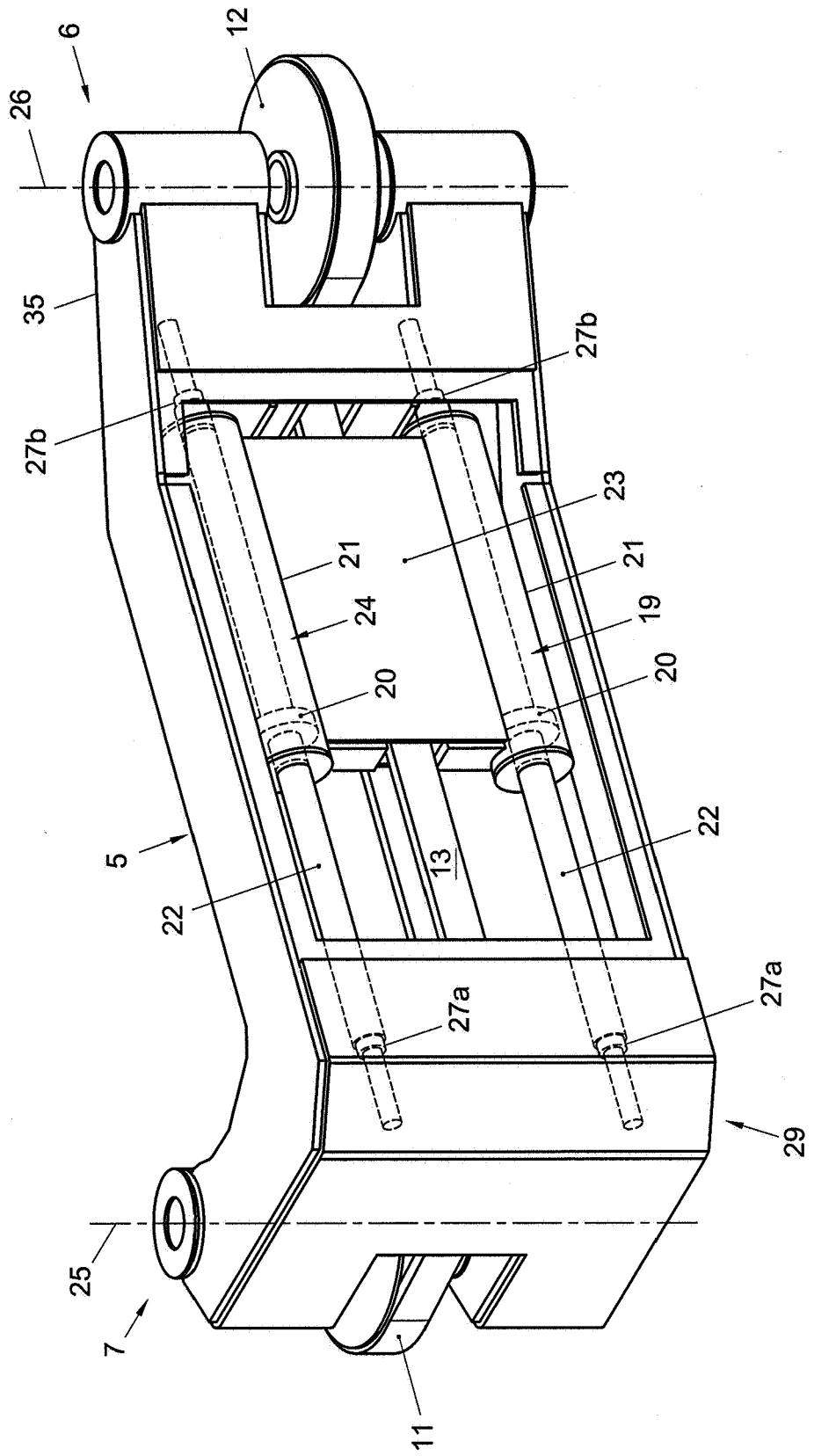

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 10 15 5692

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	US 5 289 615 A (BANKS EDDIE D [US] ET AL) 1 March 1994 (1994-03-01) * figure 2 * * column 2, lines 40-46 * * column 4, line 6 - column 7, line 16 *	1-3	INV. E05D3/12 E05D15/28
A	EP 1 544 098 A1 (LACROIX SOC E [FR]; D AVIAT LATECOERE SOC IND [FR] LACROIX SOC E [FR];) 22 June 2005 (2005-06-22) * paragraphs [0001] - [0004]; figure 4 * * paragraphs [0015] - [0026] *	1-6	

TECHNICAL FIELDS SEARCHED (IPC)

E05D
E05F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	6 August 2010	Klemke, Beate

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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4

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 15 5692

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06-08-2010

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EP 1544098 A1	22-06-2005	BR PI0405618 A	30-08-2005
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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