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(54) IMPROVED RUDDER FOR A BOAT AND ASSEMBLY METHOD THEREOF

(57) A rudder for a boat comprising a rudder blade (3) rotatable about a first axis (A), an actuator assembly (5) to move the rudder blade (3) and a coupling (4) interposed between the actuator assembly (5) and the rudder blade (3). In particular, the coupling (4) comprises a movable element (11) defining the axis (A), a first body (6) coupled to the movable element (11) to define a second axis (B) transverse, preferably perpendicular, to the first axis (A) and having a first connecting flange (9), and a second body (7) coupled to the movable element (11) and connected to the first body (6) by means of a second connecting flange (9); said connecting flanges (9) are configured so that an intersection (I) between the first and the second axis (A, B) lies within a thickness (S1) of an annular element (31) within which the bodies (6, 7) are housed and to which the flanges (9) are fixed or of the first and second connecting flange (9) coupled to each other.

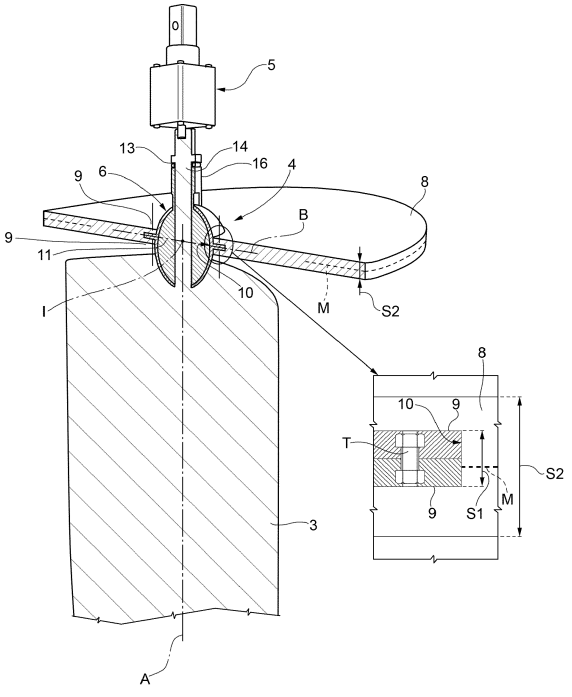

FIG. 2

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Description

[0001] The present invention refers to a rudder for a boat, in particular a sailing yacht, also occasionally subject to sailing or manoeuvring conditions in port in a tilted attitude with respect to the design water line. In particular the design water line is horizontal.

[0002] It is known that a rudder having a tiltable rudder blade is associated with a sailing yacht in order that the latter remains substantially vertical also while proceeding tilted, in particular with a roll angle.

[0003] In particular when the rudder blade is tiltable it is important that an effective inexpensive seal has been provided to prevent seepage of seawater into the hull of the boat.

[0004] Furthermore, when the rudder blade is tiltable, the connection area with the hull must be particularly robust to withstand the high hydrodynamic loads.

[0005] The object of the present invention is to provide a rudder for a boat able to meet at least partly the above requirements.

[0006] The object of the present invention is achieved by means of a rudder according to claim 1.

[0007] The invention will now be described with reference to the accompanying drawings, which illustrate a non-limiting implementation example thereof, in which:

- figure 1 is a side schematic view of a sailing yacht provided with a rudder according to the present invention;
- figure 2 is a section of the rudder blade along a plane of symmetry of the latter;
- figures 3a and 3b are detailed perspective views of the rudder according to the present invention shown from the outside of the boat of figure 1 and from the inside of said boat respectively;
- figures 4a and 4b are detailed perspective views from the inside of the boat to illustrate respective assembly stages of an emergency device to control the rudder blade;
- figure 5 is an exploded view of a second embodiment of the present invention; and
- figure 6 is a frontal view of the embodiment of figure 5.

[0008] In figure 1, the number 1 illustrates, as a whole, a sailing yacht 1 having a rudder 2 comprising a rudder blade 3, a coupling 4 and an actuator assembly 5 to move the rudder blade 3 by means of the coupling 4.

[0009] Preferably the coupling 4 comprises a pair of shells 6, 7 fixed to a portion of hull 8 of the boat 1 respectively towards the inside and towards the outside of the hull 8. The shells 6, 7 are rigidly and in a fluid-tight manner fixed to the portion 8, for example by means of gluing and/or a threaded connection sealed by means of a mastic and/or silicone and/or by means of partial embedding in the portion of hull 8, in particular in the polymer matrix, filled with filiform reinforcing elements, which constitutes the hull. In said regard the coupling 4 comprises two connecting flanges 9 extending respectively from the shells 6, 7 and which, once assembled, define the anchoring of the coupling 4 to the portion 8. Preferably, a seat 10 of the portion 8 surrounds the connecting flanges 9 and the connecting flanges 9 are coupled to each other in a disassemblable manner, for example by means of a plurality of bolts T. The shells 6, 7 house a movable support 11 to which the rudder blade 3 is rotatably fixed. In particular, the shells 6, 7 contact and guide the movable support 11 and project with respect to the portion 8 both towards the outside of the hull and towards the inside as illustrated in figure 2. Furthermore, the movable support 11 and/or at least one of the shells 6, 7 comprises a system of seals (not illustrated in further detail) to prevent the seawater seeping from the shell 7 through the opening 10 towards the bilge of the hull. For example said fluid-tight seal is made like the seals of the shut-off ball valve.

[0010] The movable support 11 guides the rotation of the rudder blade 3 about an axis A belonging to a plane of symmetry of the latter so as to correct the heading of the boat 1. Furthermore, the movable support 11 is guided by the shells 6, 7 to allow a rotation of the rudder blade 3 and of the axis A about an axis B parallel to a plane containing the keelson L of the boat 1. Normally the plane of the keelson L is also a plane of symmetry of the hull of the boat 1, which, in design conditions, is a vertical plane. In particular, an intersection I between the axes A and B lies within an overall thickness S1 of the connecting flanges 9 after the coupling by means of the bolts T (figure 2). Preferably, when the rudder 2 is mounted onto the portion 8, the connecting flanges 9 intercept a centerline surface M of the thickness S2 of the portion 8.

[0011] In order to avoid seepage of marine water below decks, the rudder 2 is further provided with a seal 13 arranged between the movable element 11 and a shaft 14 of the rudder blade 3 housed rotatably in the movable element 11 to avoid the marine water seeping into the bilge in the interstice between the movable element 11 and the shaft 14. For example the seal 13 comprises one or more seal rings.

[0012] Preferably, to guide the rudder blade 3 in rotation with respect to the axis B, the shell 6 and/or the shell 7 define a guide 15 that engages a projection 16 of the movable element 11. In particular the projection 16 is in relief with respect to the shell 6 and houses the shaft 14. Preferably the projection 16 has a transverse section which engages in the guide 15, for example by means of a prismatic coupling, so as to block the rotation of the movable element 11 about the axis A. Furthermore the projection 16 supports the seal 13.

[0013] The guide 15 is advantageously a groove having curved planar sides substantially concentric with the axis B and the projection 16 projects through the groove. In particular, the projection 16 is guided by the sides of the latter in the rotation about the axis B and is blocked by said sides in the rotation about the axis A.

[0014] According to a preferred embodiment of the present invention, the movable element 11 and the shells 6, 7 come into contact along surfaces of spherical segments defined by means of a respective plurality of concentric circles about the axis B, but other three-dimensional contact surfaces generated by a plurality of circles concentric to the axis B can also be considered.

[0015] To control the rudder blade 3 about the axes A and B, the actuator assembly 5 comprises an actuator 17 to command the rotation about the axis A and an actuator 18 independent of the actuator 17 to command the rotation about the axis B. In particular, the actuator 17 is carried by the movable element 11 and the actuator 18 connects the portion 8 to the movable element 11. In particular, the actuator 18 is rotatable and the actuator 19 is linear and can comprise a fluid cylinder or a screw/nut screw assembly or a recirculating ball screw associated with a rotary engine. Preferably one or both the actuators 17 and 18 are irreversible, i.e. they maintain the position acquired when they are not electrically/hydraulically energized even when a considerable load is applied on the rudder blade 3. In this way it is possible to reduce the absorption of energy. Furthermore both the actuators 17, 18 comprise a socket for a manual control in the event of breakdown of the electric/hydraulic power supply system.

[0016] In particular, figure 4 illustrates the connection to the actuator 17 of an emergency bar to rotate the rudder blade 3 about the axis A in the event of breakdown of the power supply system.

[0017] In particular, the actuator 17 comprises a connection 19 operatively connected to the rudder blade 3 for the rotation of the latter and connectable to an end portion 20 of an emergency bar of the rudder (not illustrated as a whole). Preferably, the end portion 20 and the connection 19 are connected by means of a rigidly shaped coupling to the rotation and are fixed to each other by means of a pin 21.

[0018] The advantages offered by the rudder 2 according to the present invention are the following.

[0019] By means of the connecting flanges 9, the coupling 4 defines a preassembled unit which can be easily mounted on board the boat 1. In particular, the connecting flanges 9 define an anchoring area for balancing the loads between the rudder blade 3 and the hull of the boat 1. In particular, the movable element 11 discharges the reaction force to the fluid-dynamic loads of the rudder blade 3 onto both the shell 6 and the shell 7 so as to distribute the latter on both sides of the portion 8. Theoretically, if the intersection I between the axes A and B coincides with the centerline M of the thickness S2, the stresses on the portion 8 are minimum and can be considered acceptable if the thickness S1 of the connecting flanges intercepts the centerline M (figure 2).

[0020] Lastly it is clear that modifications or variations can be made to the rudder described and illustrated here without departing from the protective scope as defined by the attached claims.

[0021] The rudder 2 can also be mounted on a motor boat.

[0022] The connecting flanges 9 can have different geometries. In particular one of the two connecting flanges 9 can be partially shaped in a complementary manner to the hull to form part of the quick-work and be lapped by the water. For example, with reference to figure 4, one of the two connecting flanges, for example the lower flange, can define the entire portion of hull indicated by the number 8 and, at the same time, act as a support for fixing the actuator 18.

[0023] In a simplified version the axis B is fixed, but the axis B can also be movable by appropriately shaping the guide 15.

[0024] Since the opening 10 can be surrounded by localised reinforcements such as bosses or ribs, the surface of the centerline M is defined without considering said localised reinforcements, i.e. as a theoretical continuation of the centerline surface considering application of the mean thickness S2 of the quick-work in the stern area in the immediate vicinity of the opening 10.

[0025] The rudder 2 can be mounted in the stern like a rudder or in other parts of the hull for the purpose of steering the direction of the boat.

[0026] Furthermore, the rudder , when the actuator assembly 5 is electric, has an electrical connection interface for an electronic control unit for controlling the route, for example an automatic steering control unit.

[0027] Figure 5 illustrates a rudder 30 according to a further embodiment of the present invention. The rudder of figure 5 comprises elements for which, in the case of functional equivalence or identity, the same reference numbers will be used as those already used for corresponding elements described in the preceding paragraphs.

[0028] The rudder 30 comprises an annular element 31 within which bodies 6, 7 are housed and on which the flanges 9 are fixed, for example by means of screws 32, bolts or other threaded elements. Preferably, the bodies 6, 7 are arranged on opposite sides of the movable element 11 along the axis B and are tightened to each other for example by means of screws 33, bolts or other threaded elements. When the bodies 6, 7 are joined by the screws 33, the flanges 9 define a circular edge (figure 5) when seen in a plan view. The flanges 9 can also have edges that follow plan view profiles different from a circular profile.

[0029] In particular, the movable element 11 defines a revolution surface 34 which revolves about the axis B, and the coupling via the revolution surface 34 and the bodies 6, 7 guides the rotation of the movable element 11 about the axis B. The revolution surface 34 has a generatrix not in the form of a circumference arc and, in the case of a generatrix in the form of a circumference arc, said arc is not equal to 180° so that the revolution 34 is not spherical. The revolution surface 34 coupled with the bodies 6, 7 defines the axis of rotation B without any contribution by the projection 16.

[0030] When the bodies 6, 7 are joined together, a peripheral seat 35 is defined which faces the movable element 11 and surrounds the revolution surface 34. The peripheral seat 35 houses a seal ring (not illustrated) to define a seal against infiltrations of water. Said seal is furthermore provided between the bodies 6, 7 and the annular element 31 by known means, for example frontal seals and/or mastic etc.

[0031] When mounted on board the boat 1, the annular element 31 intercepts the centerline M as illustrated for the flanges 9 in figure 2. In particular, the annular element 31 has the thickness S1. When mounted on board the boat 1, a portion of the revolution surface 34 is lapped by the water and protrudes towards the rudder blade 3 with respect to the quick-work.

[0032] The annular element 31 can also be discoid and is attached to the hull 8 both by means of threaded connections and by means of incorporation within the thickness S2 of the hull 8 (figure 2) .

[0033] The actuator assembly 5 described previously and illustrated in figures 2-4 can also be applied to the rudder 30.

[0034] Also in the case of the rudder 30, the axis B is close to the centerline M of the thickness S2 so as to minimise the loads applied to the hull 8 when the actuator assembly 5 moves the rudder blade 3 about the axis B.

Claims

1. A rudder for a boat comprising a rudder blade (3) rotatable about a first axis (A), an actuator assembly (5) to move the rudder blade (3) and a coupling (4) interposed between the actuator assembly (5) and the rudder blade (3), **characterized in that** the coupling (4) comprises a movable element (11) defining the axis (A), a first body (6) coupled to the movable element (11) to define a second axis (B) transverse, preferably perpendicular, to the first axis (A) and having a first connecting flange (9), and a second body (7) coupled to the movable element (11) and connected to the first body (6) by means of a second connecting flange (9); said connecting flanges (9) are configured so that an intersection (I) between the first and the second axis (A, B) lies within a thickness (S1) of an annular element (31) within which the bodies (6, 7) are housed and to which the connecting flanges (9) are fixed or a thickness (S1) of said first and second connecting flange (9) coupled to each other.

2. A rudder according to claim 1, **characterized in that** it comprises a peripheral seat (35) defined by the first and second body (6,7) when the flanges (9) are fixed to the annular element (31) and facing the movable element (11); and **in that** a fluid seal between the movable element (11) and the bodies (6, 7) comprises a seal ring housed in the peripheral seat (35).

3. A rudder according to claims 1 or 2, **characterized in that** the first and the second body (6, 7) are arranged on opposite sides of the movable element (11) along the second axis (B) and **in that** the movable element (11) comprises a revolution surface (34) revolving about the second axis (B) and **in that** the coupling between the first and second body (6, 7) and the revolution surface (34) guides the rotation of the movable element (11) according to the axis (B).

4. A rudder according to claim 1, **characterized in that** one between the first and the second body (6, 7) defines a guide (12) engaging with a projection (16) of the movable element (11) to define the rotation about the second axis (B).

5. A rudder according to claim 4, **characterized in that** the guide (12) and the projection (16) are prismatically coupled to block the rotation of the movable element (11) about the first axis (A).

6. A rudder according to any of the claims from 4 to 5, **characterized in that** the first and the second body (6, 7) comprise respective shells protruding with respect to the coupling flanges (9).

7. A rudder according to any of the preceding claims, **characterized in that** the actuator assembly (5) comprises a first actuator (17) carried by the movable element (11) to rotate the rudder blade (3) about the first axis and a second actuator (18) to connect the hull (8) to the movable element (11) and rotate the latter about the second axis (B).

8. A rudder according to claim 7, **characterized in that** at least one between the first and the second actuator (17, 18) is configured to maintain its position under load when not energised.

9. A boat comprising a rudder according to any one of the preceding claims, **characterized in that** said first and second connecting flange (9) or annular element (31) intercept a centerline (M) of a thickness (S2) of a hull (8) of the boat.

10. A boat according to claim 9, **characterised in that** the intersection (I) substantially coincides with the centerline (M) .

11. A boat according to any of the claims 9 or 10, **characterized in that** one of said first and second connecting flange (9) or said annular element (31) defines a portion of hull form of the boat lapped by the water.

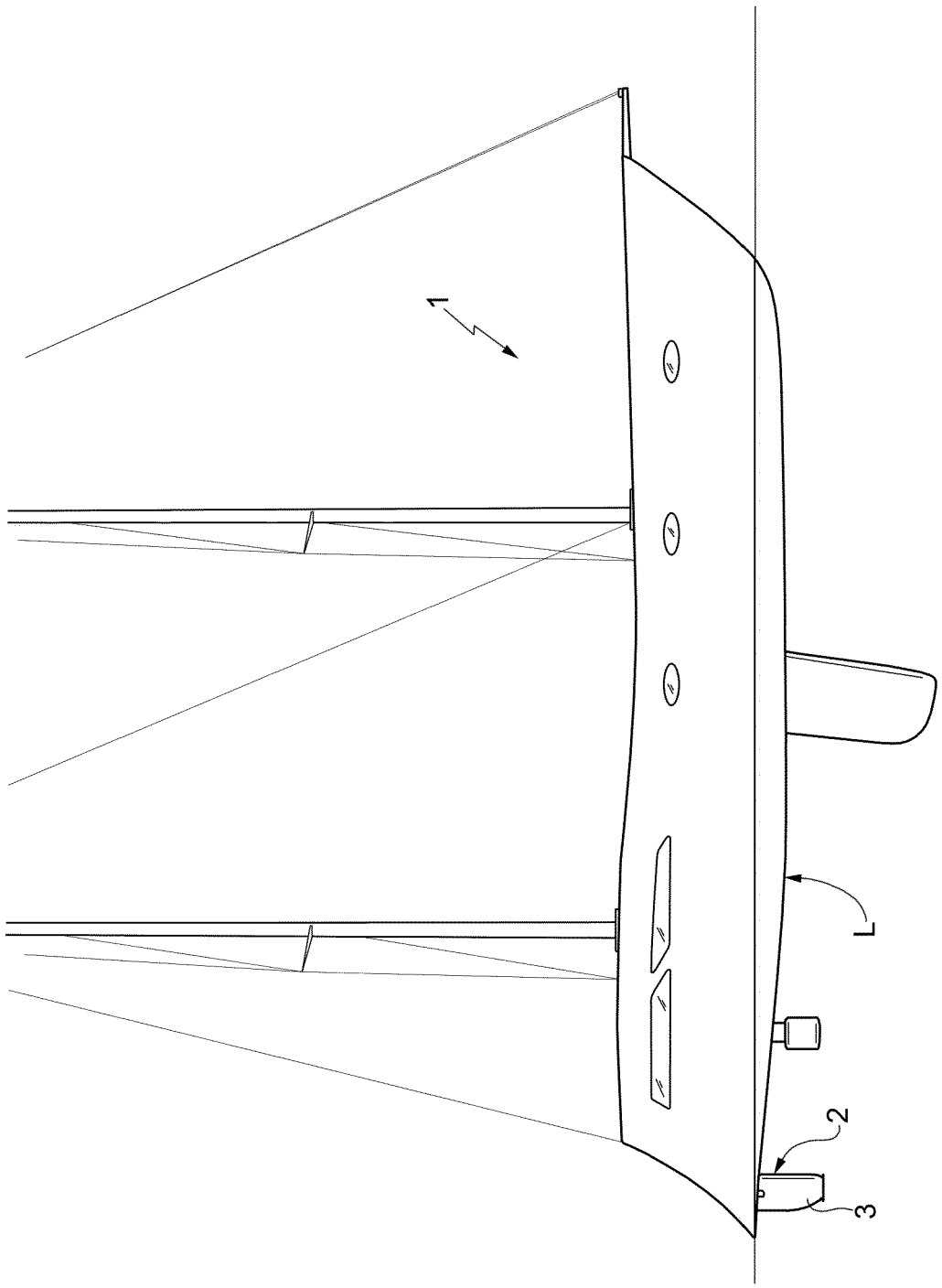


FIG. 1

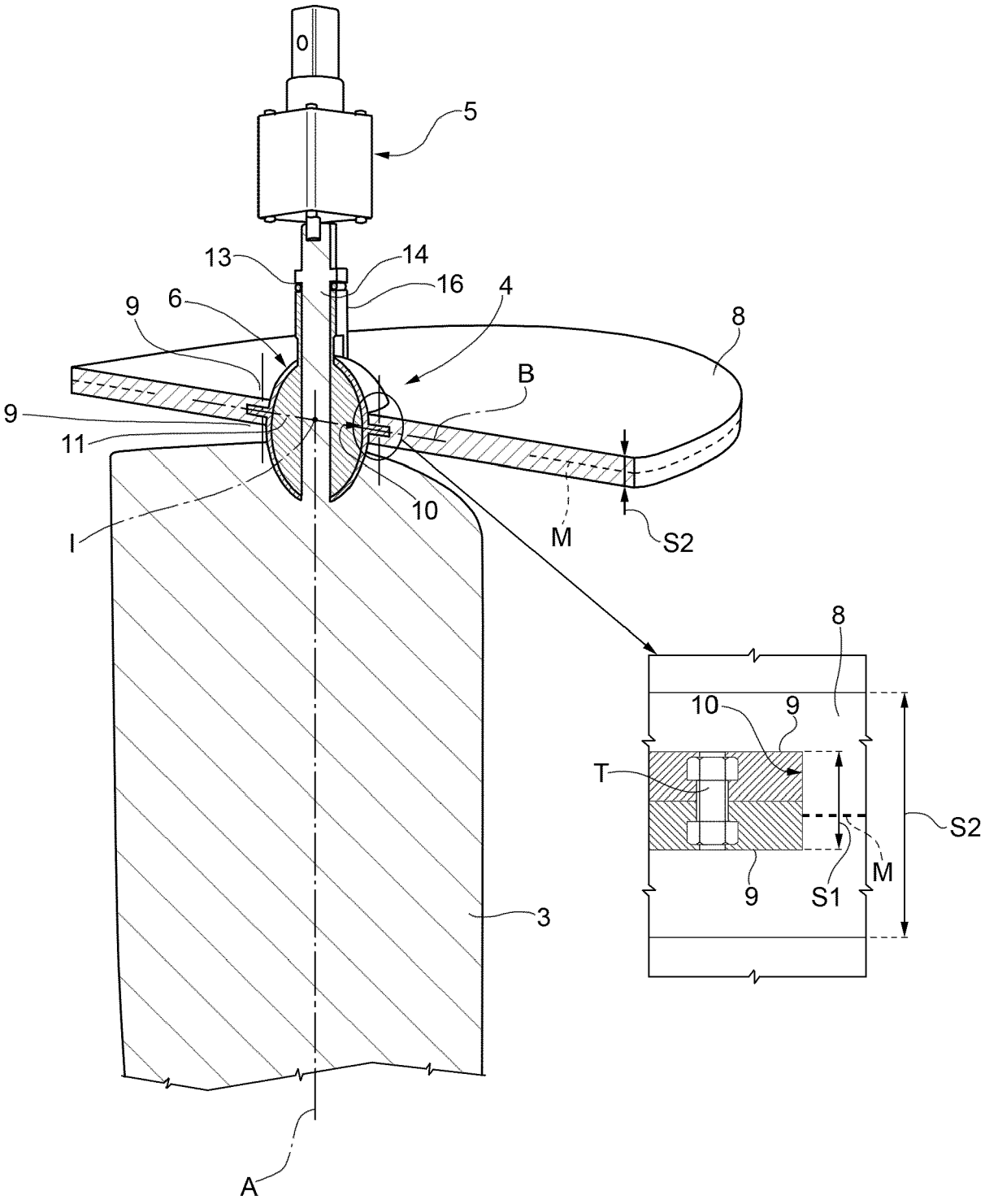
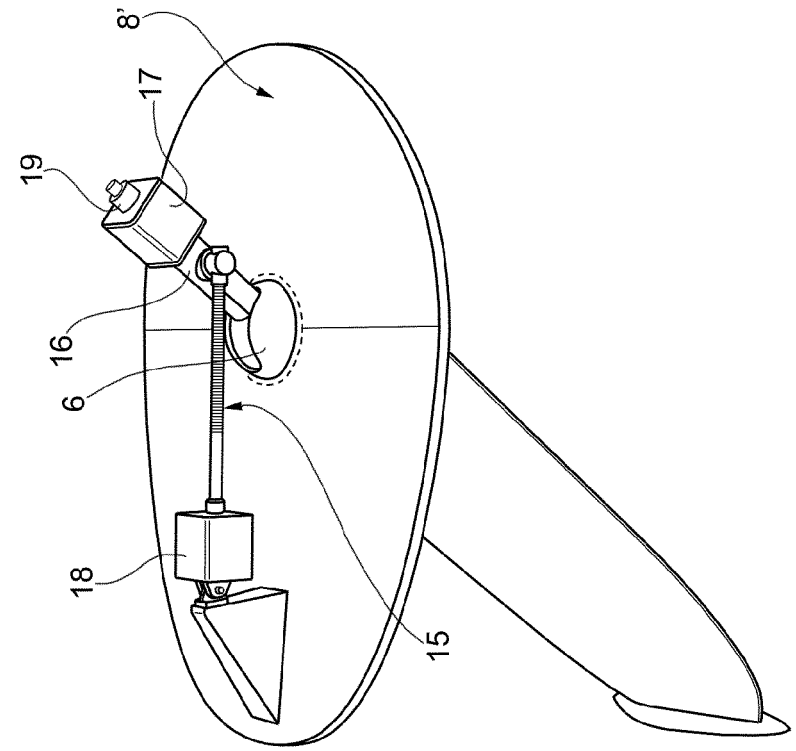
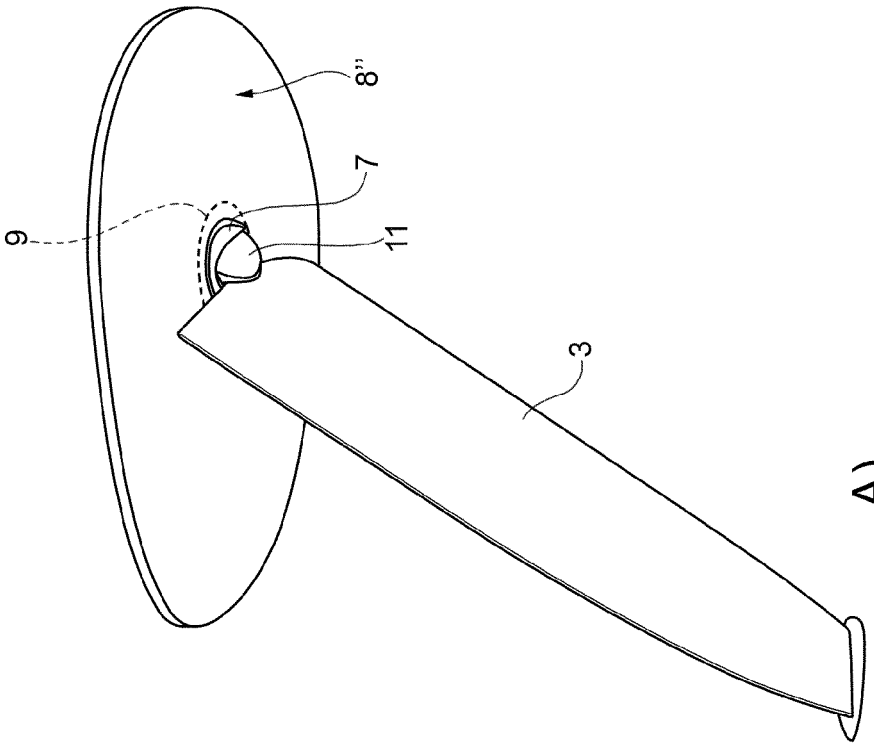


FIG. 2



B)



A)

FIG. 3

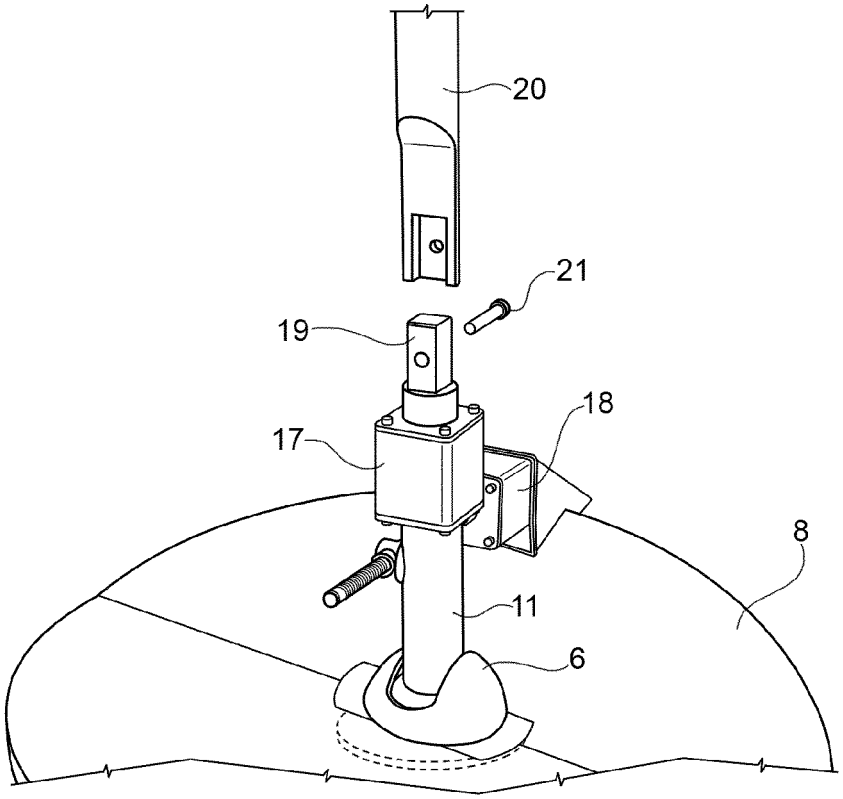


FIG. 4A

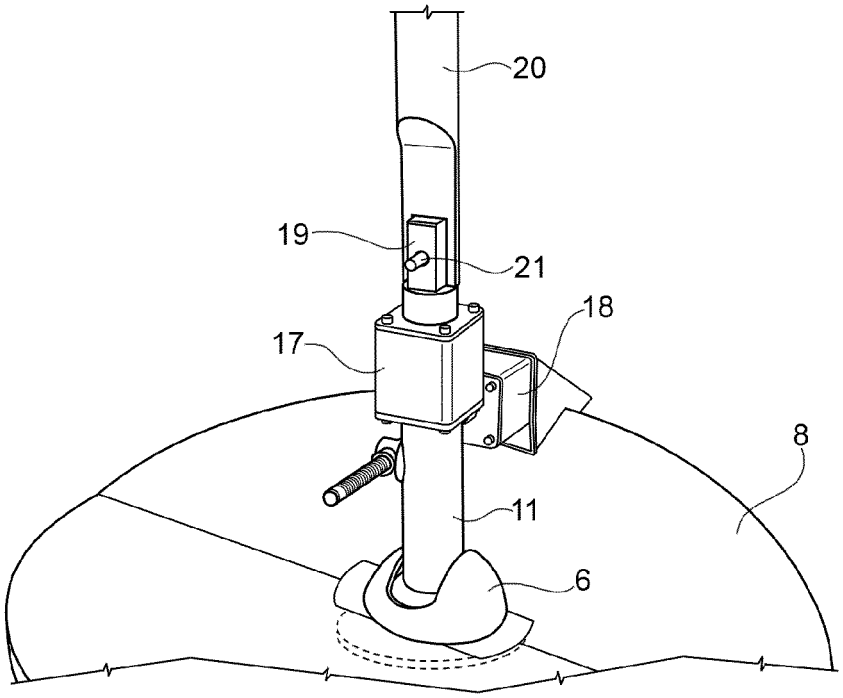
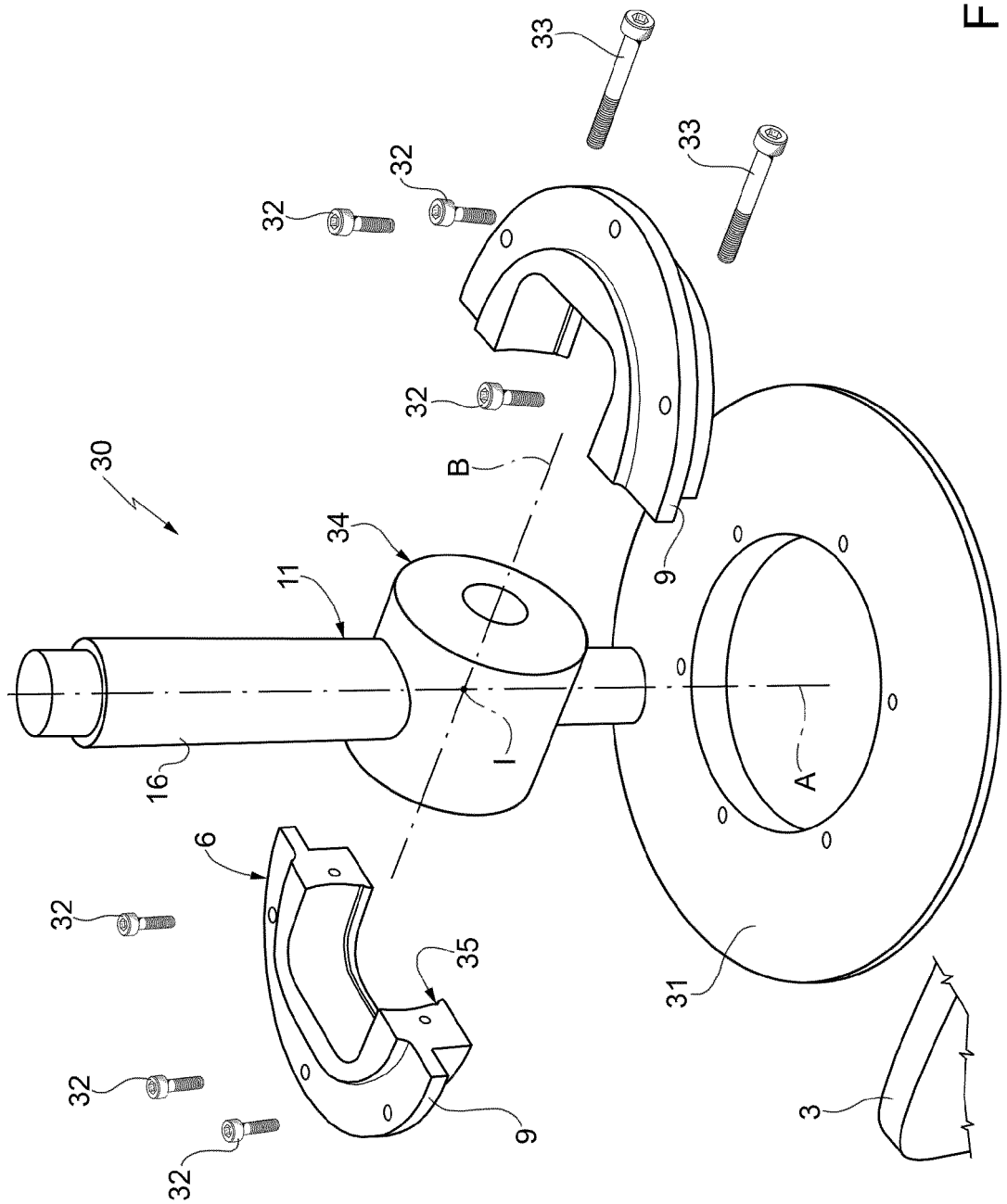


FIG. 4B

FIG. 5



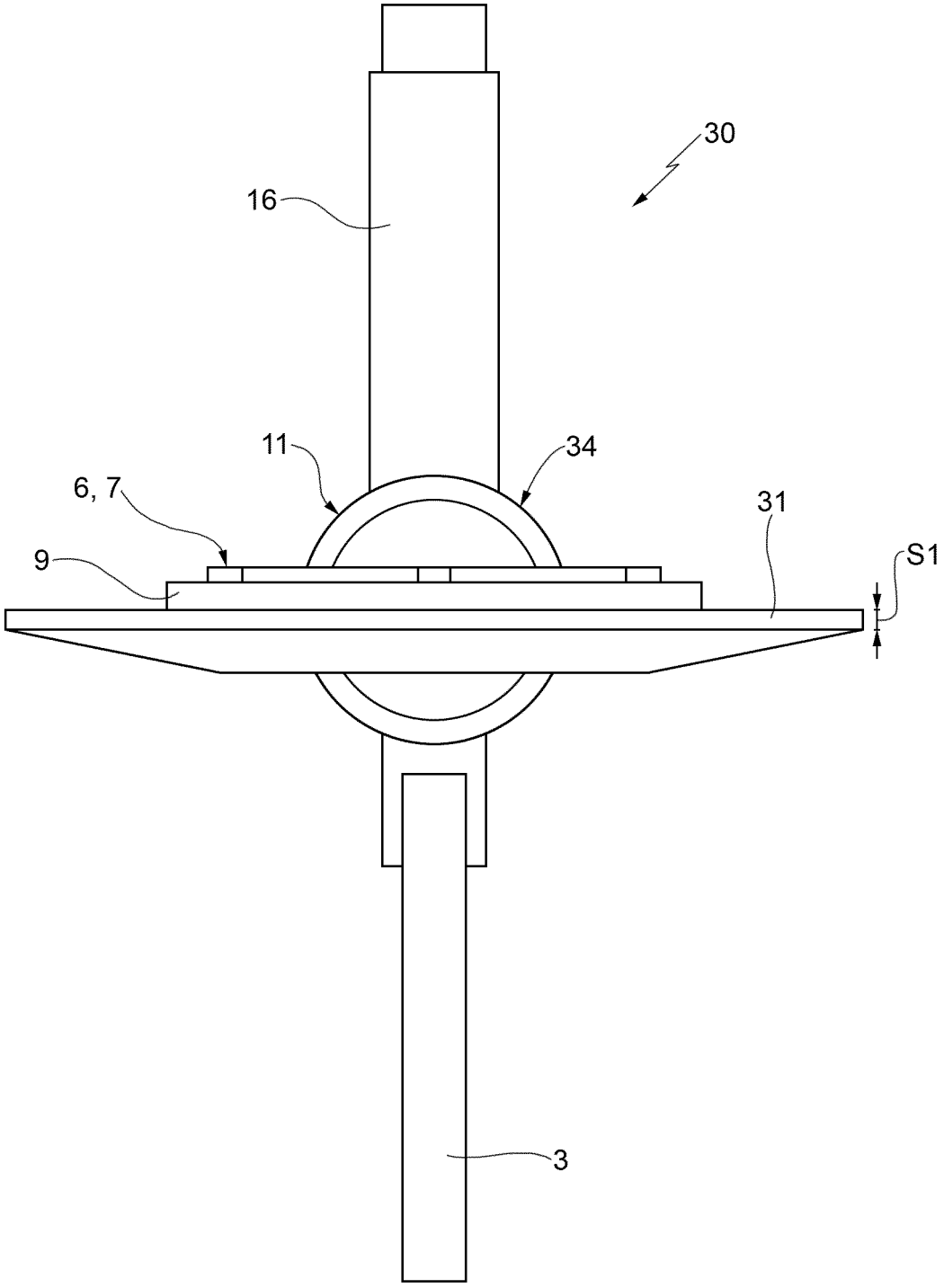


FIG. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 15 18 2221

DOCUMENTS CONSIDERED TO BE RELEVANT

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 February 2016	Brumer, Alexandre

CATEGORY OF CITED DOCUMENTS

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