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CA 2449627 C 2008/04/01

(11)(21) 2 449 627

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2002/06/11
(87) Date publication PCT/PCT Publication Date: 2002/12/19
(45) Date de délivrance/Issue Date: 2008/04/01
(85) Entrée phase nationale/National Entry: 2003/12/05
(86) N° demande PCT/PCT Application No.: NO 2002/000206
(87) N° publication PCT/PCT Publication No.: 2002/100713
(30) Priorité/Priority: 2001/06/12 (NO20012898)

(51) Cl.Int./Int.Cl. *B63B 35/26* (2006.01),
A01K 63/02 (2006.01)

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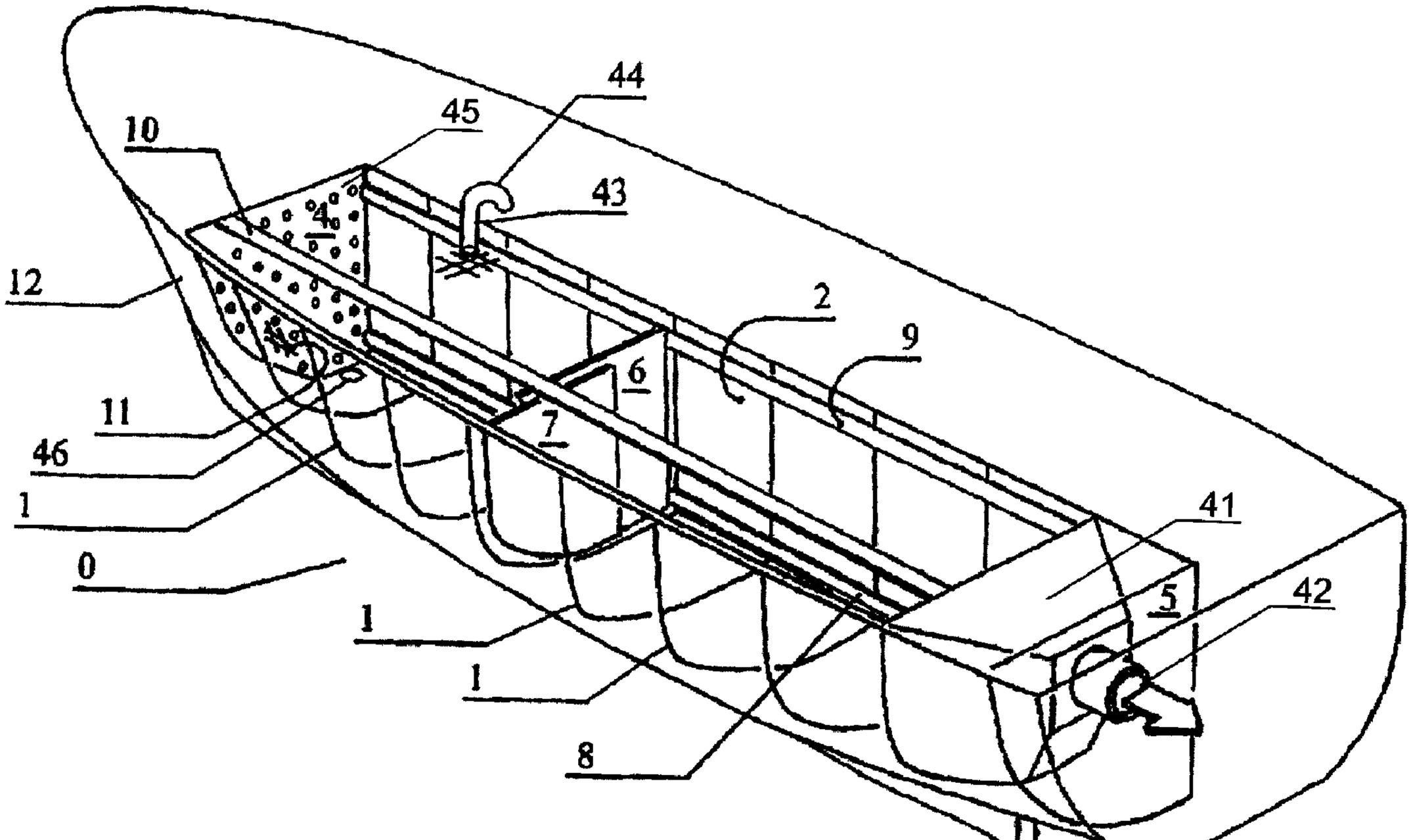
(54) Titre : DISPOSITIF DESTINE AU DEPLACEMENT DE POISSON VIVANT LORS DU DECHARGEMENT D'UN NAVIRE DE TRANSPORT DE POISSON

(54) Title: DEVICE FOR DISPLACEMENT OF LIVE FISH DURING UNLOADING OF A FISH CARRIER



(57) Abrégé/Abstract:
The invention is a device for displacement of live fish in a well room (0) in a fish carrier, in which said well room is sideward limited by a generally smooth inner skin (11) in a (preferably double curved) hull over frame profiles (1) of varying moulded breadth, and in the ends limited by a forward frame bulkhead (4) and an aft frame bulkhead (5), and in the top limited by a well deck (3), with a transverse, preferably perforated sliding bulkhead (6) arranged for running in said well room (0) generally along said vessel's main axis to desired positions between said forward frame bulkhead (4) and said aft frame bulkhead (5). The invention is characteized by

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(57) Abrégé(suite)/Abstract(continued):
at least one sideward sliding bulkhead (7) arranged generally laterally running on said sliding bulkhead (6) and arranged for running with an edge near said frame profiles (1), for covering a cross section area in said well room (0).

ABSTRACT

The invention is a device for displacement of live fish in a well room (0) in a fish carrier, in which said well room is sideward limited by a generally smooth inner skin (11) in a (preferably double curved) hull over frame profiles (1) of varying moulded breadth, and in the ends limited by a forward frame bulkhead (4) and an aft frame bulkhead (5), and in the top limited by a well deck (3), with a transverse, preferably perforated sliding bulkhead (6) arranged for running in said well room (0) generally along said vessel's main axis to desired positions between said forward frame bulkhead (4) and said aft frame bulkhead (5). The invention is characteized by at least one sideward sliding bulkhead (7) arranged generally laterally running on said sliding bulkhead (6) and arranged for running with an edge near said frame profiles (1), for covering a cross section area in said well room (0).

DEVICE FOR DISPLACEMENT OF LIVE FISH DURING UNLOADING OF A FISH CARRIER.

Introduction.

This invention relates to a fish carrier with a sliding bulkhead. The fish carrier is used for transporting live fish, such as salmon, cod or other fish.

Statement of problem; known art.

During transport of live, adult fish in fish carriers, the fish must be unloaded, usually to a fish slaughterhouse. One efficient way to unload the fish is to have a sliding bulkhead which forces the fish towards one end of the tank, whereafter the water level is usually lowered and the crowded fish then having very limited space will be led out of the ship via a canal and a pump system. The fish is transported out to intermediate fish storage cages or tanks onshore. Such a sliding bulkhead requires that the tank for it to run through, has an even width and height so that no gap occurs between the sliding bulkhead's side edges and the tank's walls, bottom floor, and ceiling. As such, a sliding bulkhead will not work for a doubly curved inner skin following the frame profiles and the ship's outer skin of the ship's hull, i.e. an inner skin which runs along the frame profiles and the outer skin, i.e. an inner skin having varying separations from the vessel's centreline. Sliding bulkheads according to the known art will also not work if the separation between the tank deck and an inclined tank floor is varying. The limitation of longitudinally running generally prismatic wells involves a non-optimal usage of the hull's volume, and a straight inner wall is built so that the tank gets a volume loss towards the outer skin of the vessels, and that the bulkheads in the ends of the tank must be placed closer than strictly necessary to each other, where the curvature of the vessel requires that the prismatic tanks must have their ends. Cultivated fish may be regarded as domestic animals and should be treated in an acceptable way with respect to domestic animal care. Today's method involves lowering the water level in the tank so that the fish must be pumped up from a lower level, incurs that the fish becomes stressed, and is also not desired from a viewpoint of domestic animal care. In particular, it is known that salmon does not tolerate to be exposed to underpressure and may easily develop haematosis along the spine and may thus easily have reduced commercial value. Thus, pumping which

incurs underpressure should be avoided. Further, the lowering of the water level inside the tank results in that a free water surface inside the vessel, which may be a disadvantage to the vessel's stability. Usually, fish carriers are provided with starboard and port well tanks separated by a longitudinal bulkhead along the centreline of the vessel because one single free water surface inside the vessel is undesirable. The longitudinal bulkhead also improves the vessel's mechanical strength. Unloading water from only one of the starboard tank or the port tank is in itself a disadvantage. Today's practice of lowering the water level in a tank requires much pump energy. Diesel electric generators provide electricity for pumps for discharging water from the tanks, and this self-provided energy from the vessel's generators may be much more expensive than corresponding electrical energy from a land-based electrical supply network. Discharging the tanks of water during unloading of fish may in the known art constitute a loss of energy, and is also unnecessarily time-consuming.

According to an aspect of the present invention there is provided a device for displacing live fish in a well tank in a fish carrier, in which the well tank is laterally limited by a generally smooth inner skin in a (preferably doubly curved) hull inside frame profiles of varying moulded breadth, and in its ends limited by a forward frame bulkhead and an aft frame bulkhead, and in the top limited by a well deck, with a lateral, preferably perforated slideable bulkhead arranged to run along preferably the vessel's longitudinal axis in desired positions between the forward frame bulkhead and the aft frame bulkhead, characterized by:

at least one laterally slideable bulkhead arranged generally running in a lateral direction on the sliding bulkhead and arranged to run with an edge near the frame profiles, in order to cover the cross section area in any intermediate position of the well tank.

In a favourable implementation of the invention, the sliding bulkhead has a profile generally comparable to either the smaller of the forward or aft frame bulkheads or the smallest of the frame profiles of the well tank.

The laterally slideable bulkhead should advantageously have an edge profile generally corresponding to the frame profiles and a width smaller than or equal to the sliding bulkhead itself, and at least of equal breadth to the difference between the sliding bulkhead and the broadest of the frame profiles or forward or aft frame bulkheads, so that there would be no need for more, telescoping laterally slidable bulkheads, even though such a solution can be imagined. In an advantageous embodiment of the invention the sliding bulkhead is arranged to run along a bottom rail extending in the direction with the long axis of the ship, and a corresponding parallel running top rail.

According to another aspect of the present invention there is provided a device for displacing live fish in a well room in a fish carrier, in which the well room is sideward limited by a generally smooth inner skin in a generally doubly curved hull over frame profiles of varying moulded breadth, and limited in its ends by a forward frame bulkhead and an aft frame bulkhead, and in its top preferably limited by a well deck, with a transverse bulkhead arranged for running in the well room along the vessel's main axis to desired positions between the forward frame bulkhead and the aft frame bulkhead, comprising at least one sideward sliding bulkhead arranged generally laterally running on the bulkhead and arranged for running with an edge along the frame profiles, for filling a varying cross section area of the well room in every intermediate position between the forward and the aft frame bulkheads.

According to another aspect of the present invention there is provided a method for displacing fish from a well room in a well boat with the well room being sideward limited by a generally smooth hull over frame profiles of varying moulded breadth, and in its ends limited by a forward frame bulkhead and an aft frame bulkhead, and in its top limited by a well deck, with a transverse bulkhead arranged for running in the well room generally along the main axis, to desired positions between the forward frame bulkhead and the aft frame bulkhead, wherein a sideward sliding bulkhead is moved in a lateral direction on the transverse bulkhead so that it runs with an edge near the frame profiles from the forward bulkhead towards the aft frame bulkhead and fills a cross-section area of the well room while the transverse and sideward sliding bulkheads run in the vessel's longitudinal direction for displacing fish toward the aft frame bulkhead.

Introduction to the drawings

Fig. 1 illustrates a perspective view of a vessel having a well room drawn without a deck, outer skin, and inner skin, at the actual portion of said vessel. A sliding bulkhead according to the invention is illustrated as situated near midship in a port side well room.

Fig. 2 illustrates a perspective view as seen from the stern end of said well room, looking forward towards the forward frame bulkhead of the well room. The frame profiles and the sliding bulkhead are illustrated in somewhat more detail, with guide rails and toothed racks for movement of the sliding bulkheads.

Fig. 3a illustrates a vertical plane section across the ship and according to the invention, drawn relative to different frame profiles and extending athwartship of a longitudinal bulkhead or a centre bulkhead

Fig. 3b illustrates a drive unit and a toothed rack for guidance and displacement of a sliding bulkhead.

Fig. 4 is a section of a preferred embodiment of the sliding bulkhead according to the invention, as seen towards the guidance rails on the longitudinal bulkhead.

A description of a preferred embodiment of the invention.

Figure 1 illustrates a preferred embodiment of the invention with a sliding bulkhead for displacement of live fish in a well room (0) in a fish carrier. The well room is laterally limited by a generally smooth-walled inner skin (11) of a preferably "doubly curved hull", i.e. a hull having doubly curved surface, said inner skin being arranged along frame profiles (1) of varying moulded breadth. In the forward and aft

ends of the well room (0) the well room is limited by means of a forward frame bulkhead (4) and a corresponding aft frame bulkhead (5), and limited in the top by means of a well deck (3). A sliding bulkhead (6), preferably perforated and arranged in an athwartship direction, is arranged to run longitudinally in the well room, mainly along the vessel's main axis, and may be stopped in desired positions between the forward frame bulkhead (4) and the aft frame bulkhead (5). At least one laterally moveable sliding bulkhead (7) is arranged for running generally in an athwartship direction with respect to the sliding bulkhead (6). The purpose of the laterally moveable sliding bulkhead (7) being able to be displaced laterally with respect to the longitudinal axis of the hull, is that the laterally sliding bulkhead (7) shall run, in the vessel's, and thereby in the well room's longitudinal direction, with a profiled edge corresponding to and close to the smooth inner skin (11) of the well room. It is considered an advantage of the invention that the well room, in fact, should be provided with an inner skin (11), as it would be disadvantageous if the laterally sliding bulkhead runs against the inner side of the outer skin (12) and is retracted somewhat for passing each naked profile frame rib. The sliding bulkheads according to the invention can be halted in any intermediate position between the forward and the aft frame bulkheads (4,5), as long as the laterally sliding bulkhead is extended toward the inner skin (11) of the hull's side.

In a preferred embodiment of the invention the sliding bulkhead (6) has a profile generally similar to the smallest/narrowest of the frame bulkheads (4,5), or the smallest of the frame profiles (1). This is well illustrated in Fig. 2. In an even more preferred embodiment of the invention the laterally sliding bulkhead (7) has an edge profile generally corresponding to the frame profiles (1) and a breadth which is smaller or equal to the sliding bulkhead (6), and at least as broad as the difference between the sliding bulkhead (6) and the widest of the frame profiles (1) or the frame bulkheads (4,5). The laterally sliding bulkhead (7) can not be broader than the sliding bulkhead (6) without modifications if the sliding bulkhead (6) shall have the same width as the forward frame bulkhead (4), as the two sliding bulkheads (6,7) would not otherwise be able to approach and come in close contact with the forward frame bulkhead (4). Because the frame profiles, and thus the inner skin (11) in a doubly curved hull sidewall, vary from one frame profile to the next frame profile, one particular laterally sliding bulkhead profile will not be perfectly adapted to more than

one frame profile. This may be remedied by means of elastic flaps arranged extending from the edge of the laterally sliding bulkhead's profile. These flaps arranged around the sliding bulkhead (6) and the laterally sliding bulkhead (7) prevent fish from passing between the sliding bulkhead (6) or the laterally sliding bulkhead (7) and the frame profiles (1), a longitudinal bulkhead (2), or the above extending well deck (3). Brushes may replace the flexible flaps, but brushes are regarded somewhat disadvantageously because of the very large associated material surface that may constitute a substrate for extensive scaling/fouling due to bacterial and algal growth.

The sliding bulkhead (6) is arranged for running along a bottom rail (8) and a corresponding, parallel running top rail (9) that extends along the vessel's longitudinal direction. The sliding bulkhead (6) is provided with a drive unit (28) arranged for displacing the sliding bulkhead (6) along the bottom rail (8), preferably by means of a rack gearing / cogged-wheel propulsion along a toothed rail (18). This is illustrated in Fig. 2. The sliding bulkhead (6) may also be provided with a longitudinally running drive unit (29) arranged for displacing the sliding bulkhead (6) along the top rail (9), preferably by means of rack gearing / cogged-wheel propulsion along a toothed rail (19). Advantageously, the sliding bulkhead (6) is also provided with a longitudinally running drive unit (30) arranged for displacing the sliding bulkhead (6) also along a rail (10) extending along and under the well deck (3), preferably by means of rack gearing propulsion along a toothed rail (20). In a preferred embodiment of the invention, the toothed rail (18) is an integral part of the bottom rail (8). Further, the toothed rail (19) is preferably integrated in the top rail (9) and the toothed rail (20) integrated in the rail (10). Having three longitudinally running guide rails (8, 9, 10) and synchronized drift along the rails, one may avoid that the sliding bulkhead warps out of the ideal vertical, transversal position with respect to the vessel's longitudinal axis.

In one possible embodiment according to the invention, the rack gearing propulsion along the toothed racks (18) and (19) or also (20) may take place by means of rack gearing propulsion with power transfer via toothed gear transmissions and preferably cardan transmission axles from a common drive unit (29) as illustrated in Figs. 3 and 3b. This feature will reduce the number of components in the propulsion apparatus, and is thus advantageous because the propulsion apparatus,

according to a preferred method by means of the illustrated solution, will reside under water.

If the vessel is equipped with a well room (0) running longitudinally and covering the entire breadth of the vessel, it may be required to arrange both a starboard and a port laterally sliding bulkheads (7) on a centrally running sliding bulkhead (6). Even if this is possible, it is less desirable to build a vessel having only one well room covering the ships breadth. Due to safety concerns and due to the vessel's strength, a vessel with a size larger than some limit will require a centrally running bulkhead or a longitudinal bulkhead (2) in the vessel. At the inner edge of a sliding bulkhead (6), the inner edge will run adjacent to such a longitudinal bulkhead or centre bulkhead (2), such that for each sliding bulkhead (6) only one laterally sliding bulkhead (7) will be required to run along either starboard or port hull side's frame profiles (1). This situation is illustrated in the attached Figures 1, 2, and 3.

We now refer to Fig. 3a and the right portion of Fig. 4 in which is illustrated a lateral drive unit (17) arranged for displacing or moving the laterally sliding bulkhead (7) in a transversal or lateral direction with respect to the sliding bulkhead (6). In a preferred embodiment of the invention there is arranged a horizontally directed doubly acting hydraulic cylinder (17) on the sliding bulkhead (6), and the cylinder's interacting piston rod (27) arranged with an attachment to the laterally sliding bulkhead (7). There are generally horizontally directed guide rails (16) arranged on the sliding bulkhead (6) for horizontal guiding of corresponding guide rails (26) arranged on the laterally sliding bulkhead (7). A section of such guide rails is illustrated in the left portion of Fig. 4.

In a vessel which is being planned for construction according to the present invention the bottom is slightly inclined and lower toward the stern end. In order to compensate for the gap which will arise between a horizontally running sliding bulkhead (6) and the inclined bottom of the well room (0), there is arranged a bottom running flap (47) which is hinged from the lower edge of the sliding bulkhead (6) and provided with rollers (48) arranged for running along the bottom part of the well room or the frame profiles, all in order to increase the draught of the sliding bulkhead (6) as it runs along an inclined bottom profile in the well room's (0) bottom, or along the bottom portion of the inner skin (11) over the frame profiles (1) if the inner skin (11) itself constitutes an essential portion of the bottom of the well room.

In a preferred embodiment of the invention, a funnel plate (41) is arranged near the aft frame bulkhead (5). The funnel plate's (41) narrower opening is directed aft, directed away from the sliding bulkhead (6). During transport with fish in the well room, the sliding bulkhead (6) is placed near the forward frame bulkhead (4), and the fish may move freely in the well room (0). For unloading the fish, the sliding bulkhead (6) is displaced aft toward the aft frame bulkhead (5) toward an outlet channel (42) in the end of the funnel plate (41), as an outlet for fish. The outlet channel (42) is at the inlet provided with a closing device for preventing fish from being in the outlet channel when the outlet channel is not used for unloading fish.

According to an advantageous embodiment of the invention there is arranged a water outlet shaped as a pipe (43) with a gooseneck (44) from the top of the well room (0). Water enters the well room (0) via other inlet channels (46) for increasing the water column pressure in the well room (0) for more efficient unloading of fish through the outlet channel (42). Such a gooseneck pipe (43) can be used by the unloading personnel for inspecting that sufficient amounts of water are pumped in, so a small surplus of water is discharged through the gooseneck (44). Additionally, such a gooseneck pipe on top of the well room may contribute to assure that no free surface is formed on the water inside the well room (0). A perforated plate (45) is in a preferred embodiment of the invention arranged near the forward frame bulkhead (4), in which between the perforated plate (45) and the bulkhead is arranged at least one inlet channel (46) for water, preferably a bottom valve (46). Oxygen-rich sea water is required to be pumped into the well room, also during transport of the fish. Flaps on the inlet channels near the bow may guide water in through the bottom valves (46) while the ship is running through the sea. At the same time, water may run out from the aft end of the well room (0), e.g. through corresponding bottom valves, so that pumps are not necessarily running for exchanging water during the transport itself.

In the well deck (3) of a preferred embodiment of the invention, well hatches (52) (not illustrated) may be arranged in which perforated plates (53) may be arranged in level with the ceiling surface of the well deck, so that the sliding bulkhead (6) and the laterally sliding bulkhead (7) may pass the hatches (52) without creating a passage channel via the well hatches (52) above the sliding bulkheads' edge.

The drive unit (28, 29, 30) may comprise synchronized drive electric motors, pneumatic motors, hydraulic motors, or guided wires, for driving forward or aft the sliding bulkheads.

CLAIMS:

1. Device for displacing live fish in a well room in a fish carrier, in which said well room is sideward limited by a generally smooth inner skin in a generally doubly curved hull over frame profiles of varying moulded breadth, and limited in its ends by a forward frame bulkhead and an aft frame bulkhead, with a transverse bulkhead arranged for running in the well room along said vessel's main axis to selected positions between said forward frame bulkhead and said aft frame bulkhead, comprising:

at least one sideward sliding bulkhead arranged generally laterally running on said transverse bulkhead and arranged for running with an edge along said frame profiles, for filling a varying cross section area of said well room in every intermediate position between said forward and said aft frame bulkheads.

2. Device according to claim 1, in which said transverse bulkhead is a sliding bulkhead arranged for running in the well room along said vessel's main axis to selected positions between said forward frame bulkhead and said aft frame bulkhead and wherein a top of the well room is limited by a well deck.

3. Device according to claim 1 or 2, in which said transverse bulkhead has a profile with the same general shape as the smaller of said frame bulkheads or the smaller of the frame profiles.

4. Device according to any one of claims 1 to 3, in which said at least one sideward sliding bulkhead has an edge profile corresponding to the frame profiles and a breadth less or equal to said transverse bulkhead, and at least as broad as the difference between said transverse bulkheads and the broadest of said frame profiles or said frame bulkheads.

5. Device according to any one of claims 1 to 4, in which the transverse bulkhead is arranged for running along a bottom rail and a corresponding parallel running top rail.

6. Device according to claim 5, in which the transverse bulkhead is provided with a drive unit arranged for displacing the transverse bulkhead along the bottom rail.

7. Device according to claim 6, in which said drive unit is arranged for displacing the transverse bulkhead along the bottom rail by means of a toothed gear along a cogged rail.

8. Device according to claim 7, in which said cogged rail is an integral part of said bottom rail.

9. Device according to any one of claims 4 to 7, in which the transverse bulkhead is provided with a longitudinally running driving gear arranged for displacing the transverse bulkhead along said top rail.

10. Device according to claim 9, in which the longitudinally running driving gear is arranged for displacing the transverse bulkhead along said top rail by means of a toothed gear along a toothed rack.

11. Device according to claim 10, in which said toothed rack is an integral part of said top rail.

12. Device according to claim 4, in which said transverse bulkhead is provided with a longitudinally running drive gear arranged for displacing said transverse bulkhead along a rail extending along and under a well deck.

13. Device according to claim 12, in which said longitudinally running drive gear is arranged for displacing said transverse bulkhead along a rail along said rail extending along and under the well deck by means of a toothed gear along a toothed rack.

14. Device according to claim 13, in which said toothed rack constitutes an integral part of said rail.

15. Device according to any one of claims 9 to 14, in which the toothed gear propulsion along the toothed racks takes place by means of toothed gear propulsion with power transmission via angular transmissions.

16. Device according to claim 15, in which the power transmission is via cardan transmission axles from a common driving gear.

17. Device according to any one of claims 1 to 16, in which the transverse bulkhead's inner edge runs along a longitudinal bulkhead or longitudinal central bulkhead, so that the sideward sliding bulkhead only runs along starboard or port hull side's frame profiles.

18. Device according to any one of claims 1 to 17, in which a transverse drive gear is arranged for displacing said sideward sliding bulkhead laterally with respect to said transverse bulkhead.

19. Device according to claim 18, with a horizontally directed double action hydraulic cylinder arranged on said transverse bulkhead and said cylinder's cooperating piston rod arranged at said sideward sliding bulkhead.

20. Device according to claim 18 or 19, in which generally horizontally arranged guide rails are arranged on said transverse bulkhead for horizontally guiding of corresponding guide rails on said sideward sliding bulkhead.

21. Device according to any one of claims 1 to 20, having separate, independent transverse bulkheads having corresponding sideward sliding bulkheads, said independent transverse bulkheads arranged separately in well rooms on starboard and port side of a longitudinal central bulkhead.

22. Device according to any one of claims 1 to 21, having several longitudinal well rooms separated by two or more longitudinal bulkheads, in which at least one of starboard or port well room is provided with a bulkhead with a corresponding sideward sliding bulkhead.

23. Device according to any one of claims 1 to 22, in which a funnel plate is arranged closing to said aft frame bulkhead, in which said funnel plate's narrower end is directed backward and away from said transverse bulkhead and being provided with an outlet channel generally at the end of said funnel shaped plate, said outlet channel for unloading of fish, in which said outlet channel's inlet is provided with a closing device for preventing fish from being in the outlet channel when the outlet channel is not used for unloading of fish.

24. Device according to claim 23, having a water outlet from the top of said well room via a pipe provided with a gooseneck for increasing the water column pressure in said well room for more efficient outlet of fish through said outlet channel.

25. Device according to any one of claims 1 to 24, with a bottom running flap hinged from a lower edge of said transverse bulkhead and provided with rollers arranged for running along a bottom portion of said frame profiles, for increasing

said transverse bulkhead's draught toward an inclined longitudinal profile of said frame profiles.

26. Device according to any one of claims 1 to 25, having brushes or flexible flaps arranged around said at least one sliding bulkhead for preventing fish from passing between the transverse bulkhead or the at least one sideward sliding bulkhead and the frame profiles, a longitudinal bulkhead, or the well deck.

27. Device according to any one of claims 1 to 26, in which a perforated plate is arranged close to said forward frame bulkhead, and an inlet channel for water.

28. Device according to claim 27, in which the inlet channel is a bottom valve arranged between said perforated plate and said forward frame bulkhead.

29. Device according to any one of claims 1 to 28, in which well hatches are arranged in said well deck, said well hatches having insertable perforated plates being in level with the ceiling plates of said well deck.

30. Device according to any one of claims 6 to 14, in which said drive unit comprises synchronized electric motors.

31. Device according to any one of claims 6 to 14, in which said drive unit comprises a pneumatic motor.

32. Device according to any one of claims 6 to 14, in which said drive unit comprise hydraulic motors.

33. Device according to any one of claims 6 to 14, in which said drive unit comprises guide wires for displacing said transverse bulkheads.

34. Method for displacing fish from a well room in a well boat with the well room being sideward limited by a generally smooth hull over frame profiles of varying moulded breadth, and in its ends limited by a forward frame bulkhead and an aft frame bulkhead, and in its top limited by a well deck, with a transverse bulkhead arranged for running in said well room generally along the main axis, to selected positions between said forward frame bulkhead and said aft frame bulkhead, wherein:

a sideward sliding bulkhead is moved in a lateral direction on said transverse bulkhead so that it runs with an edge near said frame profiles from said forward bulkhead towards said aft frame bulkhead and fills a cross-section area of said well room while said transverse and sideward sliding bulkheads run in said vessel's longitudinal direction for displacing fish toward said aft frame bulkhead.

35. Method according to claim 34, in which the transverse bulkhead is a perforated sliding bulkhead.

36. Method according to claim 34 or 35, in which said transverse and sideward sliding bulkheads are driven toward a funnel plate arranged near said aft frame bulkhead, so that fish are forced toward said funnel plate's narrower end and further forced out through an outlet channel.

37. Method according to claim 36, in which said outlet channel is at the end of said funnel plate.

38. Method according to claim 36 or 37, in which water is pumped into said well room so that water will rise in a water outlet from the top of said well room via a pipe having a gooseneck so that an increase of the water column pressure arises in said well room for more efficient unloading of fish through said outlet channel.

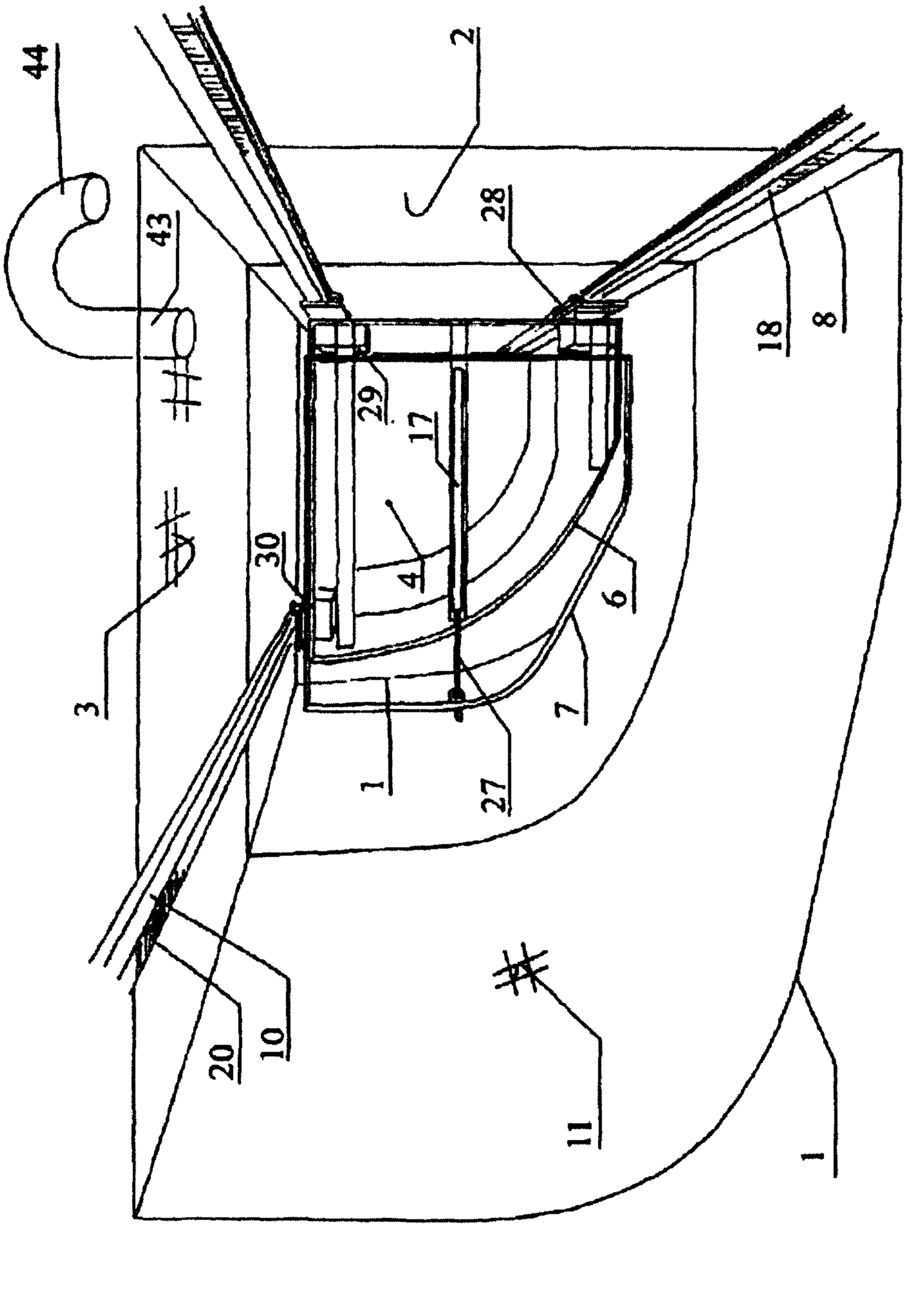
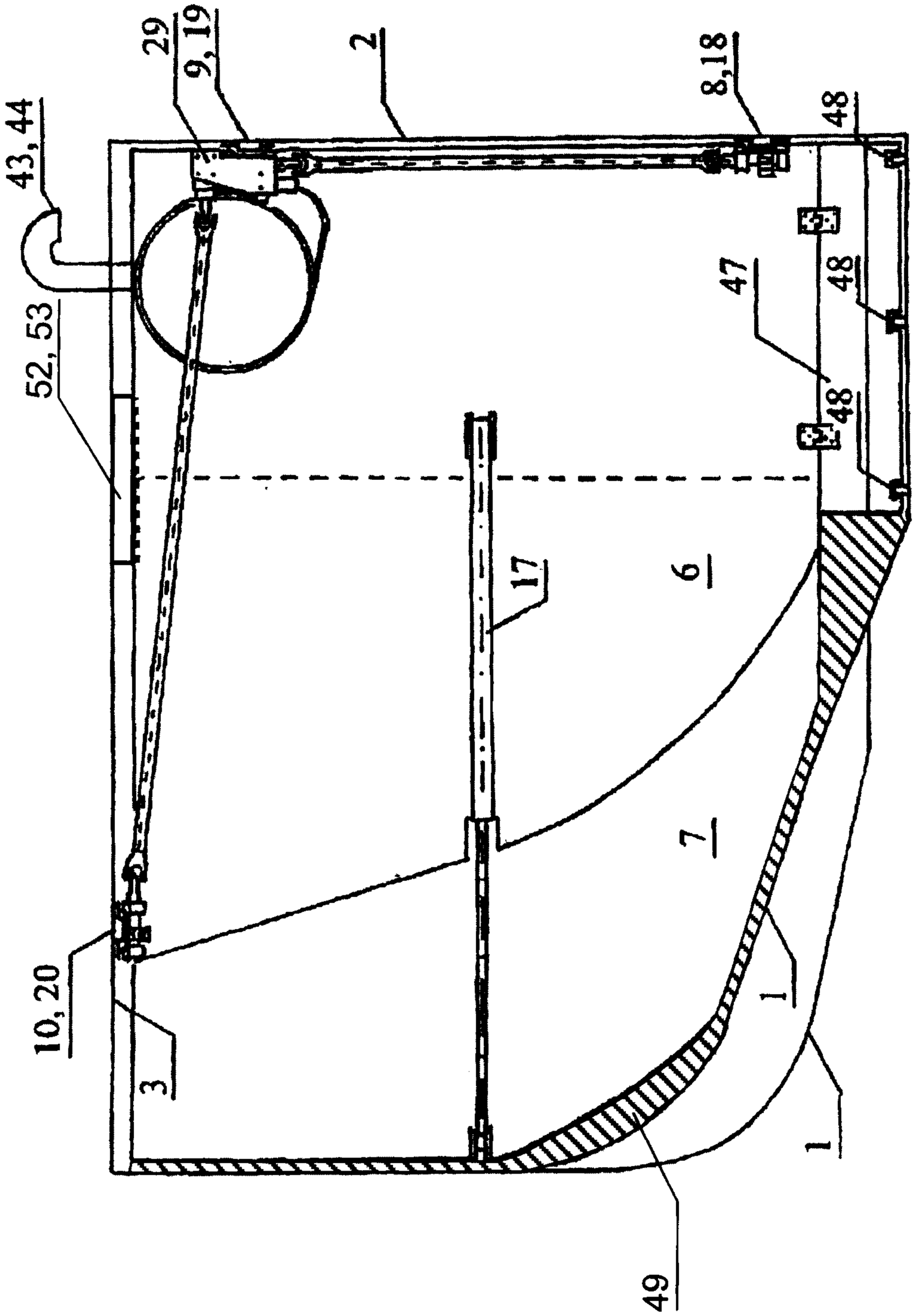


Fig. 2

Fig. 3 a



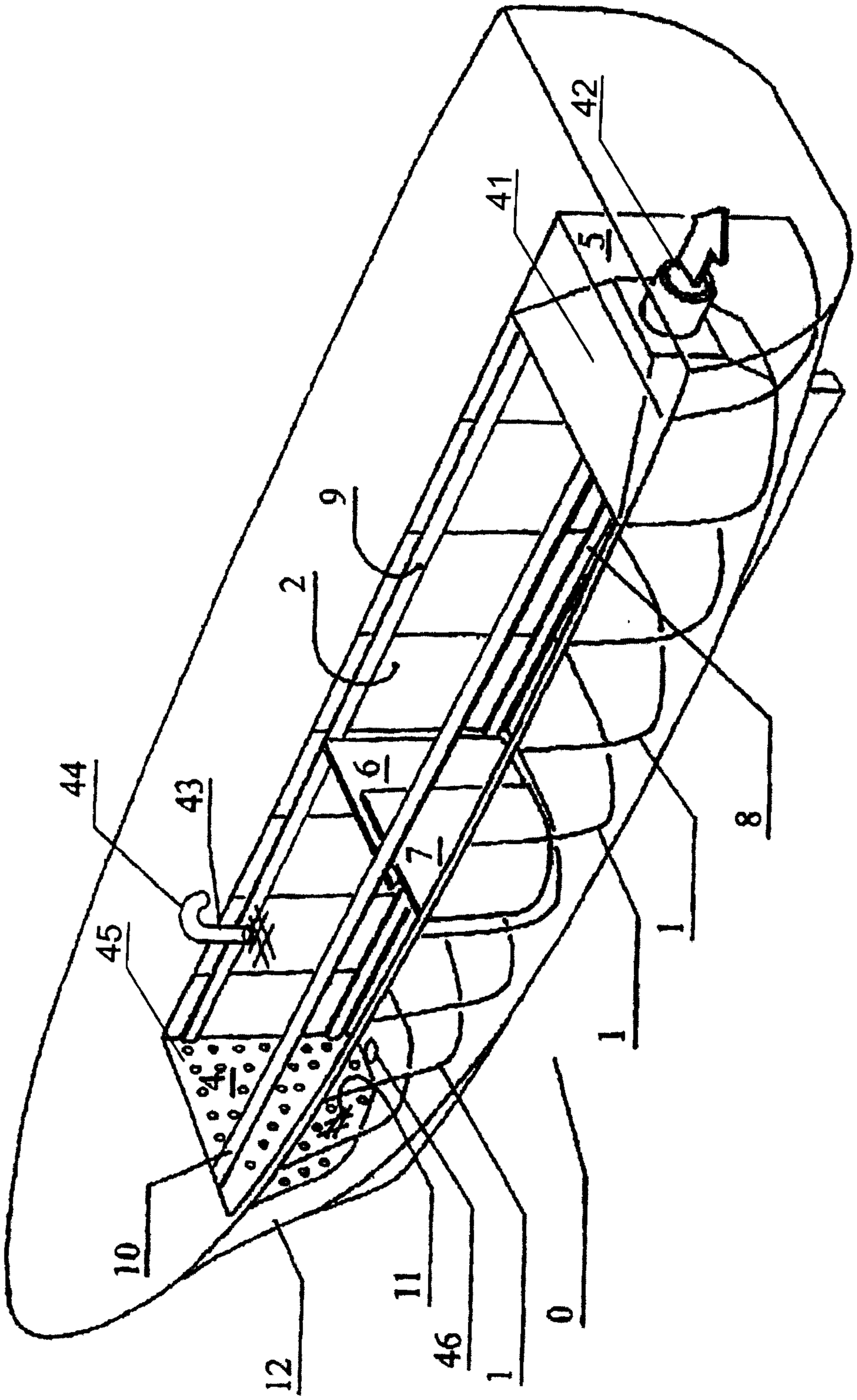
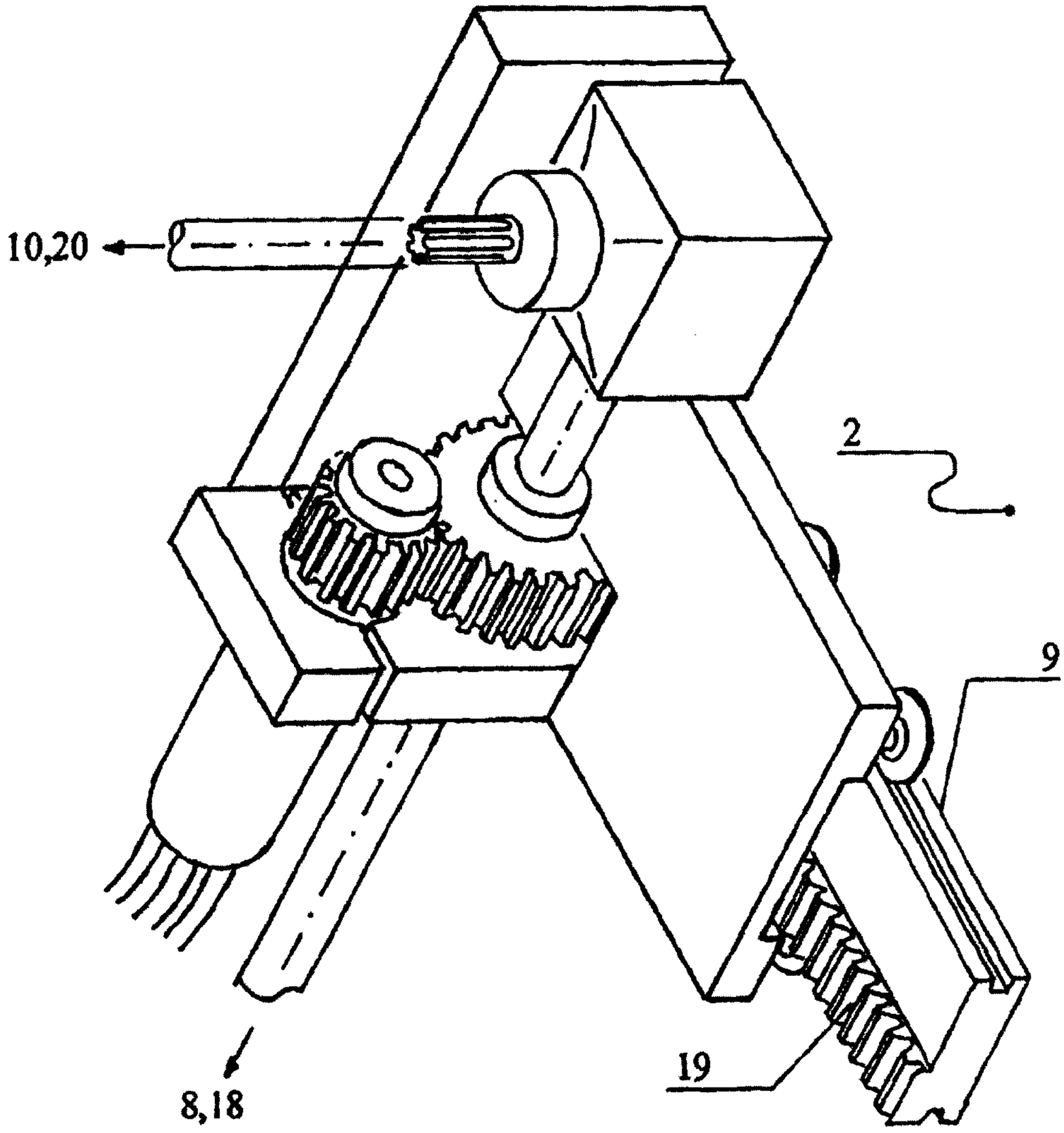


Fig. 1

Fig. 3 b



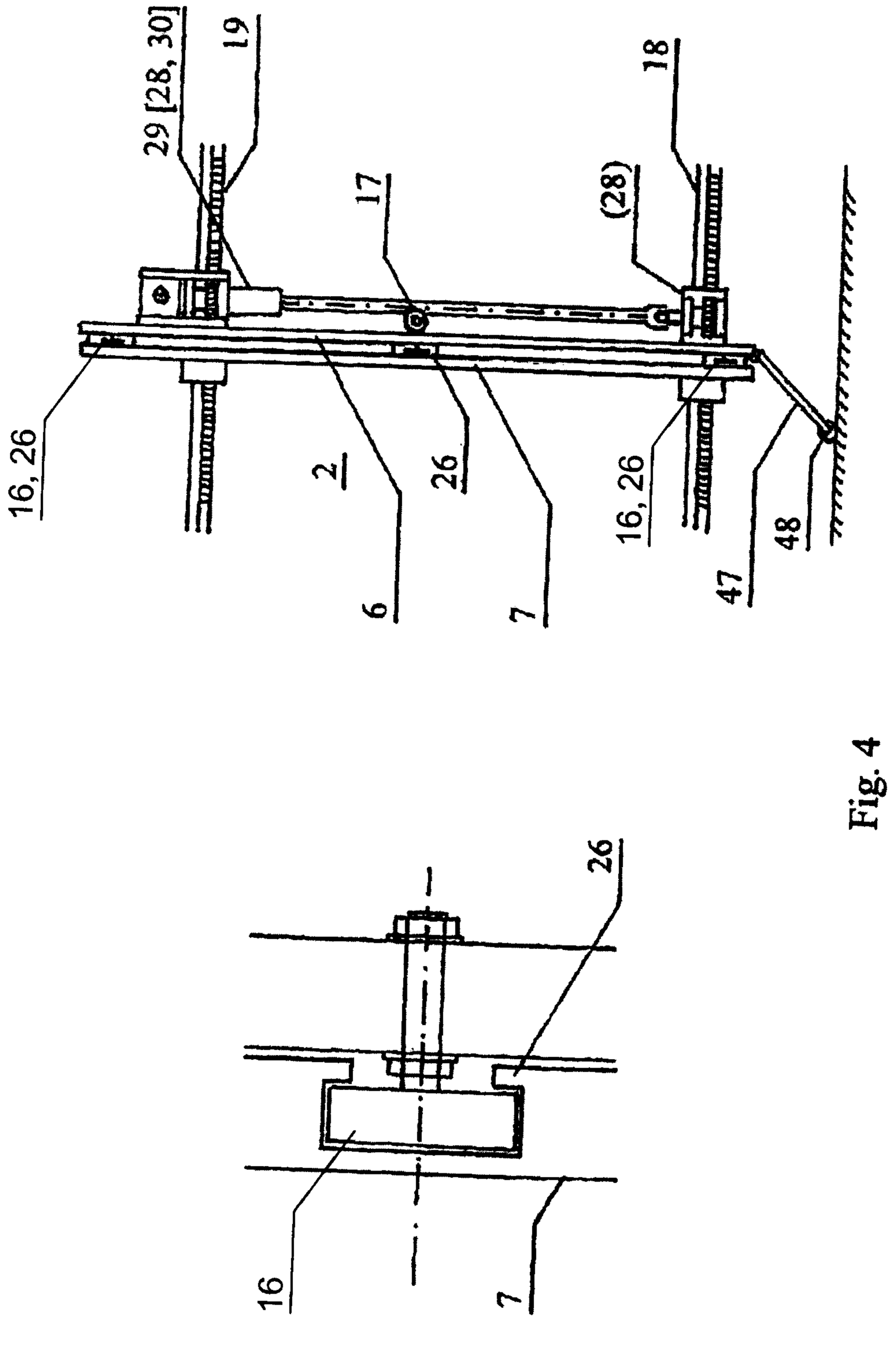
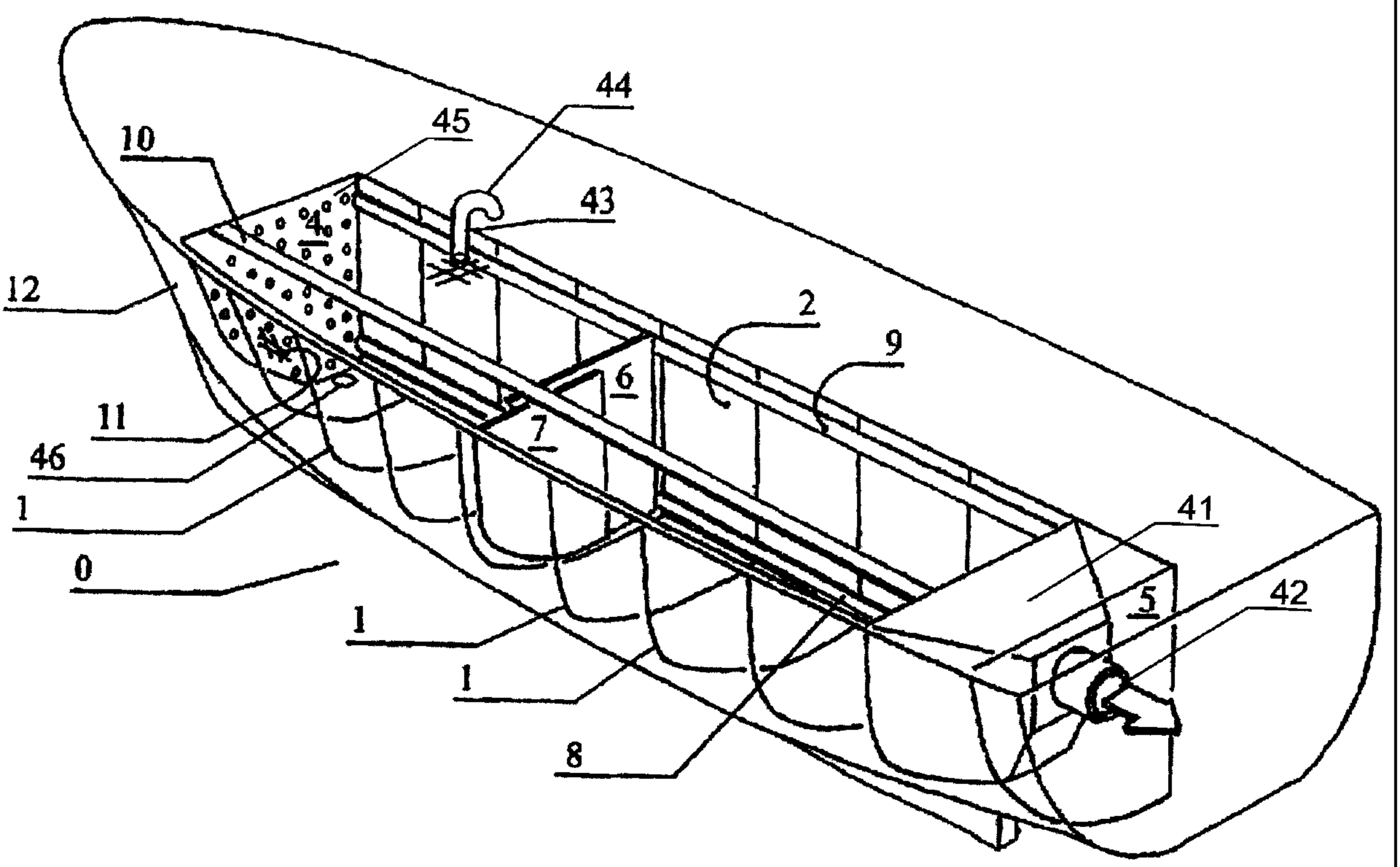


Fig. 4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