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(54) Cargo-accommodating arrangements on ships for bulk cargo.

(57) A vessel (1, 3) has holds (4) which define volumes of rotation for receiving cargo. The holds (4) are rotatable about their axes, which are horizontal, by suitable means during loading and unloading of flowable cargo. Axial openings (12) allow access for loading and unloading. Helical guides (7) act like Archimedean screws to move the cargo axially when the holds (4) are rotated during loading and unloading. Loading and unloading of cargo may thus be greatly speeded up and can continue in all weathers. Manpower requirements are reduced, and the atmosphere within the holds (4) may be controlled.

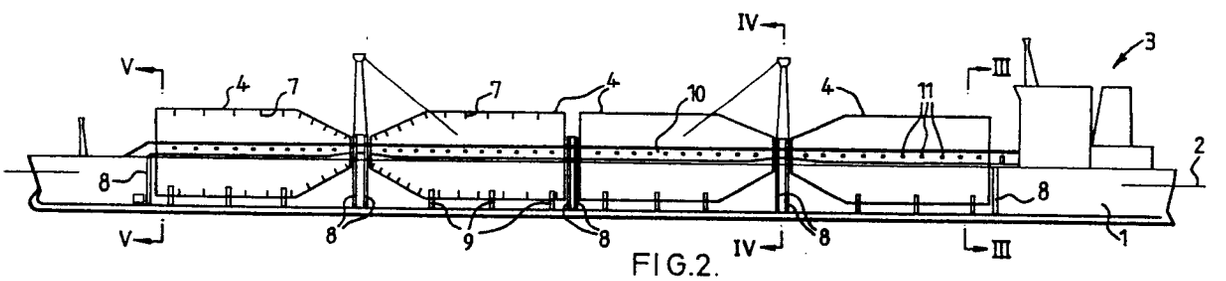

FIG.2.

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IMPROVEMENTS IN OR RELATING TO WATER-BORNE VESSELS

The present invention relates to water-borne vessels, such as cargo ships for transporting solid flowable (bulk) cargo.

Conventional bulk cargo ships have holds formed within the hull of the ship and extending below the main deck. Hatches are provided in the deck for loading and unloading of bulk cargoes. However, loading and unloading operations through such hatches can only be performed at relatively low speeds. As the cost of operation or hiring of ships of this type is based on a daily or weekly rate, the comparatively long period spent in port during loading and unloading can represent a substantial proportion of the cost of using the ship, particularly in the case of comparatively short voyages between loading and unloading when the ship is at sea for a relatively short period.

In order to reduce unloading times, there is in use a ship having a plurality of holds in the form of hoppers. The holds are loaded with bulk cargo in the conventional way through hatches in the main deck. However, for unloading, the holds have a tapered bottom leading to an outlet below which is provided one or more conveyor belts. Thus, the cargo is discharged through the bottoms of the hoppers onto the or each conveyor and is transported in the fore-aft direction below the holds. At one end of the holds, there is provided an ascending run of the conveyor and a cooperating overlying belt for raising the bulk cargo to the level of the main deck. The cargo is discharged from between the belts onto a conveyor which transports it to quay-side facilities or for transhipment into other vessels.

Although this arrangement increases the rate of unloading, the need for a vertical run in the conveyor is disadvantageous as such runs are difficult and expensive to provide and cannot handle many types of bulk cargo, such as powder and slurry. Also, unloading facilities are provided at a single location serving all holds, so that only a single type of cargo may be handled at any one time.

GB-A-2169245 discloses an assembly for holding cargo comprising cylindrical tank which is rotatable about a horizontal access. A torque partition member divides the tank into upper and lower semi-cylindrical compartments which are connected to pipes for filling and emptying these compartments. This allows a liquid cargo to be loaded in the upper compartment while simultaneously unloading a liquid cargo from the lower compartment. This causes a torque on the tank which rotates it about its horizontal access so that the two compartments slowly change places during a loading and unloading operation. However, such an arrangement is not capable of handling bulk cargos but is only suitable for liquid cargos.

According to the invention, there is provided a water-borne vessel comprising at least one hold shaped substantially as a body of rotation about a horizontal access and means for rotating the or each hold about its horizontal access, the or each hold having an axially disposed opening for loading and unloading cargo, characterised in that the or each hold substantially defines a volume of rotation for receiving cargo.

Preferably the interior of the body of rotation is provided with a generally helical guide coaxial with the axis of rotation. Such a guide is essentially like an Archimedean screw for transporting flowable solid cargo parallel to the axis of rotation. The pitch of the helix may vary along the length thereof. Means may be provided for rotating the hold selectively in either direction.

Preferably the axis of rotation is aligned in the fore-aft direction of the vessel. The axis is preferably above the water line of the vessel, for instance at or near the level of the main deck.

The hold may be cylindrical, and may have a frusto-conical portion at one or both ends.

Preferably an aperture for loading and/or unloading is provided at or near the axis at one or both ends of the hold. A conveyor or pipeline may be mounted on the ship adjacent the aperture for loading and/or unloading. The conveyor may be pivoted about a generally vertical axis adjacent the aperture so as to swingable outboard of the ship for loading and unloading. In general, a plurality of rotatable holds will be provided. In the case where such holds have a loading/unloading aperture at one end, the holds may be arranged in pairs with the apertures facing each other and a respective conveyor disposed between each such pair of apertures.

Preferably a fixed inspection tunnel is provided within the hold parallel to and adjacent, for instance just above, the axis of rotation. When the axis of rotation is aligned in the fore-aft direction, and several holds are provided, the tunnel may extend continuously through all such holds and form a structural member of the vessel. The tunnel may carry one or more manipulatable booms, for instance hydraulically driven, having at their free ends scraping or cleaning means for scraping or cleansing the internal sides of the hold. The scraping means may also serve to reduce climbing of powder cargo up the side of the hold during rotation.

Preferably, reverse guides are provided under the tunnel for directing the cargo opposite its direction of motion imparted by the helical guide. These reverse guides may, for instance, constitute part of a helix mounted on the underside of the tunnel.

Each hold may be set in a floodable compartment, so that rotation may be facilitated by the partial buoyancy thus provided.

It is thus possible to provide a ship for carrying bulk cargo having a sufficiently wide angle of repose to allow it to slide when dry or as a slurry. All-weather loading and unloading is possible at much greater rates than with previously known arrangements. Such a ship requires less ship-board and on-shore manpower. Bulk cargo which may be transported by such a vessel includes powder, flour, crushed solids, ores, coal, fertiliser and its components, grain, oil cake, and other raw or processed materials.

It is also relatively easy to avoid cargo related risks, for instance of explosion, fire, or production of noxious gases because the atmosphere within the hold can be controlled or regulated. For instance, air within the hold may be dried prior to loading of cargo which may be damaged or react dangerously to a humid atmosphere. Air within the hold could readily be replaced by an inert gas or a gaseous mixture poor in oxygen. Examples or cargoes which benefit from a controlled atmosphere are: certain iron ores deprived of oxygen when formed as reduced iron ore pellets, which release hydrogen when in contact with atmospheric humidity; bulk grain which creates substantial quantities of dust susceptible to catching fire or exploding; and certain types of coal which, if insufficiently cooled before loading, are liable to heat and spontaneous combustion in the presence of oxygen.

The invention will be further described, by way of examples, with reference to the accompanying drawings, in which:

Figure 1 is a side view of a vessel constituting a preferred embodiment of the invention;

Figure 2 shows a vertical longitudinal section through part of the vessel of Figure 1;

Figures 3 to 5 are transverse sectional views taken on the lines III-III, IV-IV, and V-V, respectively;

Figure 6 is a plan view of the vessel of Figure 1; and

Figures 7 to 10 are various sectional views illustrating details of the vessel of Figure 1.

The vessel shown in Figure 1 comprises a bulk cargo ship having a hull 1 with a loaded water level 2. The hull carries conventional superstructure indicated at 3. The hull also supports a plurality (four shown in the drawings) of rotatable holds 4. Each hold is essentially cylindrical with a frusto-conical end, with the axes of the holds being aligned and directed in the fore-aft direction of the hull 1. The holds 4 are arranged in two pairs, with the frusto-conical ends of the holds of each pair facing each other and being provided therebetween with a derrick 5 supporting a conveyor 6 which is pivotable about a vertical axis.

The arrangement of the holds 4 is shown in more detail in the cross-sectional view in Figure 2. The holds 4 of the forward pair are shown in longitudinal cross-section and have formed on their interior curved surfaces spiral or helical guide walls 7. These walls 7 may be in the form of continuous helixes or may comprise a plurality of guide plates spaced apart along a helical path. These helical walls 7 are coaxial with the holds and the pitch of the helix increases longitudinally from the frusto-conical end to the blunt end of each hold.

Bulk heads 8 are arranged in pairs between adjacent pairs of the holds 4 with a single bulk head being provided at the fore and aft ends of the set of holds. Rollers or wheels 9 are provided for rotatably carrying the holds 4. Means for rotating the holds selectively in either direction for loading and unloading, respectively, are also provided within the vessel but not shown in the drawings.

An observation tunnel 10 which is fixed with respect to the hull 1 extends from the superstructure 3 to the forward end of the vessel and passes through each of the holds 4. The tunnel 10 provides reinforcement to the structure of the vessel while permitting inspection of the cargo via a plurality of sealed portholes 11. The tunnel has a cross-sectional size sufficient to permit reasonably free movement of personnel within the tunnel.

As shown in Figure 3, the observation tunnel is arranged asymetrically, ie with its axis above the axis of the hold 4.

Figures 4 and 6 illustrate the position of the conveyor 6 for loading or unloading when the vessel is docked. The plan view of Figure 6 illustrates the arc of the extremity of the discharging arm when pivoted about its vertical axis. Figure 6 also illustrates the helical guide walls and, in particular, the gradual change of pitch axially thereof.

In order to help to support the weight of the holds 4 during loading and, particularly, unloading operations, compartments within the hull may be partially flooded as shown in Figure 5. The buoyancy of the hold reduces the frictional forces acting on the hold, so that less powerful means for rotating the hold may be provided.

Each of the holds 4 is provided with a loading and unloading aperture at the smaller end of the frusto-conical portion. As illustrated in Figure 8, this aperture 12 is provided with a lower cover which is movable on upstanding vertical guides 13 between an upper position shown at 14 for closing the aperture and a lower position shown at 15 for

opening the aperture. In addition, there is an upper cover part (not shown) for completely closing and sealing the hold 4. This upper part is preferably fixed to the observation tunnel 10 so as to be movable between its open and closed positions.

As shown in Figure 9, the common axis of the holds 4 is disposed above the main deck level 16 so that the observation tunnel 10 is effectively disposed at a level on top of the deck. The helical guide walls 7 are not shown in Figure 9 for the sake of clarity. Guide plates 17 are fixed to the bottom of the tunnel 10 inside each of the holds 4. The plates 17 are used to assist in distributing the cargo during loading and unloading operations when the hold 4 is rotating. The plates 17 are arranged on a common helical path about the tunnel 10 but with only the lower portions of this helix being represented by the guide plates. The twist of such a helix is opposite that of the helical guide walls 7 so as to provide a recirculating flow of the cargo below the tunnel 10 within the hold 4 when the hold is rotating. This assists the distribution of the cargo during loading and unloading operations.

Spotlights 18 are provided on the exterior of the tunnel 10 and may be fixed or remotely movable so as to illuminate the hold and the cargo for the purposes of inspection from the observation tunnel 10. Spotlights may also or alternatively be provided inside the tunnel so as to shine through the portholes under manual direction, thus removing the need for remote control. Access hatches - (not shown) may be provided in the tunnel 10 within each hold and a lowerable stairway (not shown) may also be provided to permit personnel to enter the hold.

As shown in Figure 10, the blunt ends of the holds 4 are provided with overlapping seals 19 so as to permit the holds 4 to rotate while the tunnel 10 remains fixed. The holds 4 are thus completely sealable from the exterior and the atmosphere within the holds may be controlled in accordance with the requirements of the cargo being carried. For instance, a dehumidified atmosphere or an inert gas or reduced-oxygen atmosphere may be provided according to the needs of the cargo.

In use, in order to load a cargo into the holds, the cargo is supplied to the free ends of the conveyors 6 which transport the cargo onto the vessel at the facing adjacent ends of the pairs of holds 4. The cargo is dispensed from the shipboard ends of the conveyors 6 into the holds 4, either one hold at a time or both holds simultaneously. The holds 4 are rotated so that the helical guide plates 7 act as Archimedean screws and draw the cargo received through the end aperture axially along the hold. When the level of the cargo at the blunt end of the hold reaches the level of the plates 17 or other guide means, the cargo begins to "circulate" longitudinally within the hold, mainly within the cylindrical portion thereof, so as to prevent excessive build up of cargo at the blunt end and aid distribution along the length of the hold. When the level of cargo reaches the load line within the hold, which is below the bottom of the tunnel 10, rotation is stopped and the covers are placed so as to seal the aperture 12.

When the vessel is to be unloaded, the covers are removed and the holds 4 are rotated in directions opposite that during loading so that the helical guide wall 7 acts as an Archimedean screw and dispenses the cargo through the aperture 12 onto the adjacent conveyor 6 for removal from the vessel. The plates 17 or similar means provide recirculation of the cargo while the hold is sufficiently full for these plates to be disposed within the cargo so as to prevent excessive output or clogging of the aperture 12.

It is thus possible to increase the rate of loading and unloading of bulk material to a very substantial degree with respect to previously known vessels for bulk cargo. Thus, the time in port of the vessel can be significantly reduced and this in turn leads to a substantial reduction in operating cost. Although the vessel is more expensive to construct than conventional bulk cargo vessels, the difference in price can be recovered rapidly, because its time can be utilised more efficiently. The vessel may obtain preference from harbour authorities over conventional vessels because of more rapid turn-around time in port and more efficient use of port facilities. Loading need not be interrupted for rain because rain does not enter the holds. Time need not be lost or money spent on trimming the cargo with shore appliances.

The proportion of working time spent at sea can be substantially increased because of the significant reduction in time in port for loading and unloading. Further, the requirements for onboard and onshore personnel during loading and unloading operations is reduced, again leading to substantial savings in cost. It is possible to trim the cargo while at sea by rotating or adjusting the positions of the holds 4.

By providing cleaning means within each hold, the manpower required for cleaning and the time taken can also be significantly reduced. For instance, hydraulically actuated arms 20 may be provided on the top of the tunnel 10 within each hold with scrapers or other cleaning means disposed at the free ends so that the internal surfaces of the holds can be scraped or cleaned by rotating the holds 4 and manipulating the hydraulic arms.

Because the apertures 12 are above the water line 2 of the vessel when loaded, there is no need for vertical handling of the cargo, so that expensive and unreliable vertical conveyors can be dispensed with.

Claims

1. A water-borne vessel comprising at least one hold shaped substantially as a body of rotation about a horizontal axis and means for rotating the or each hold about its horizontal axis, the or each hold having an axially disposed opening for loading and unloading cargo, characterised in that the or each hold (4) substantially defines a volume or rotation for receiving cargo.

2. A vessel as claimed in claim 1, in which the horizontal axis is aligned in the fore-aft direction of the vessel (1,3).

3. A vessel as claimed in claim 1 or 2, in which the horizontal axis is above the water line (2) of the vessel (1,3).

4. A vessel as claimed in any one of the preceding claims, in which the or each hold (4) has a cylindrical portion.

5. A vessel as claimed in claim 4, in which the or each hold (4) has a frusto-conical end portion.

6. A vessel as claimed in any one of the preceding claims, in which generally helical guide means (7) is fixed to the interior of the or each hold (4) and is coaxial with the horizontal axis.

7. A vessel as claimed in claim 6, in which the guide means comprises at least one generally helical wall (7) upstanding from an internal surface of the or each hold (4).

8. A vessel as claimed in claim 6, in which the guide means comprises a plurality of wall portions disposed along at least one generally helical path and upstanding from an internal surface of the or each hold (4).

9. A vessel as claimed in claim 7 or 8, in which the pitch of the or each generally helical wall (7) or generally helical path increases with distance from the opening (12).

10. A vessel as claimed in anyone of claims 6 to 9, including fixed reverse guides (17) disposed within the or each hold (4) and arranged to guide cargo in an axial direction opposite that of the generally helical guide means (7).

11. A vessel as claimed in claim 10, in which the reverse guides comprise a plurality of wall portions (17) disposed along part of at least one generally helical path which is coaxial with the horizontal axis of the or each hold (4) and which has a pitch opposite that of the generally helical guide means (7).

12. A vessel as claimed in any one of the preceding claims, comprising a plurality of holds - (4) arranged in at least one pair with the openings - (12) of the holds (4) of the or each pair being disposed adjacent each other and adjacent loading and unloading means (6).

13. A vessel as claimed in claim 12, in which the or each loading and unloading means comprises a conveyor (6) swingable outboard of the vessel.

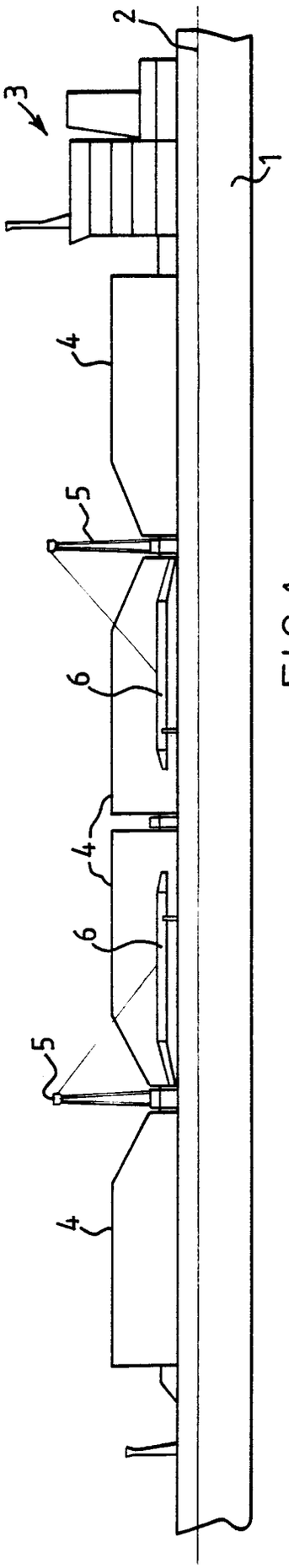

FIG.1.

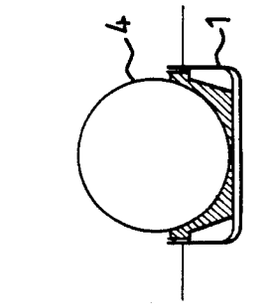

FIG.5.

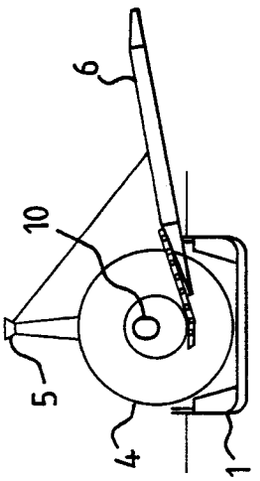

FIG.4.

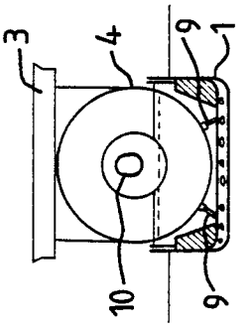

FIG.3.

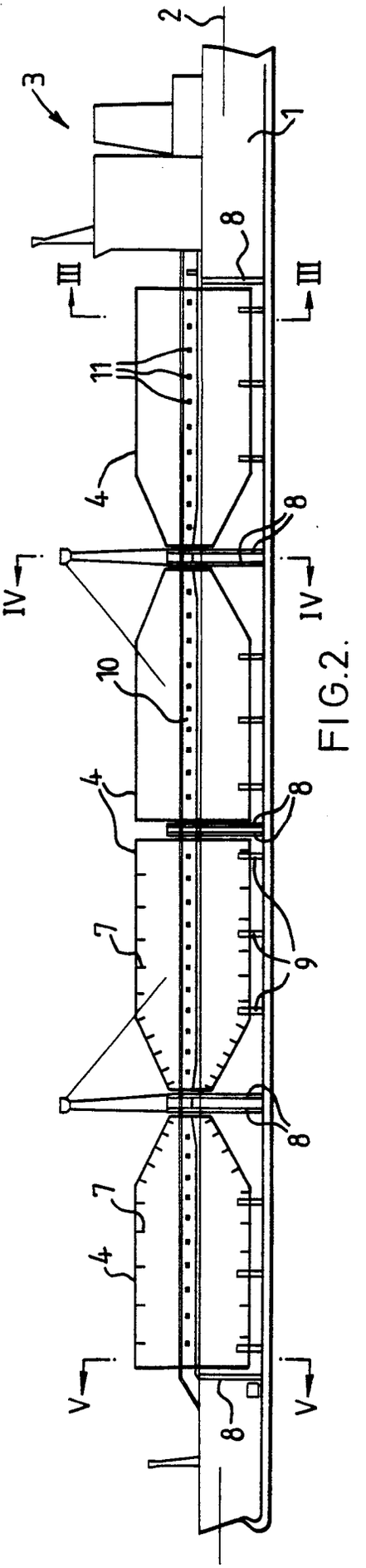

FIG.2.

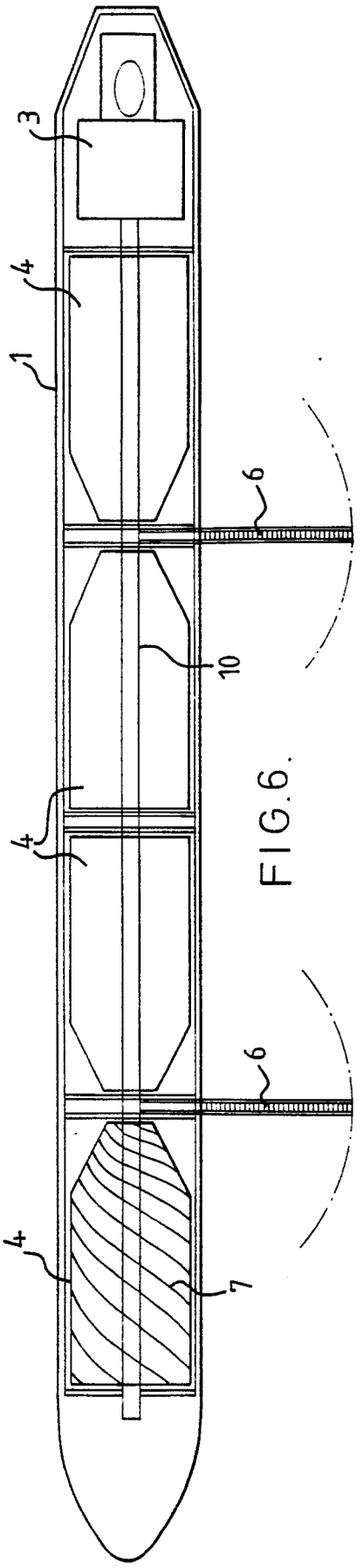

FIG.6.

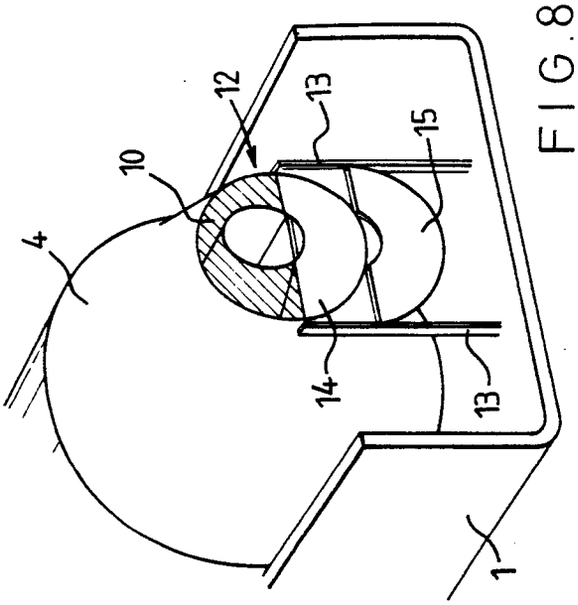

FIG.8.

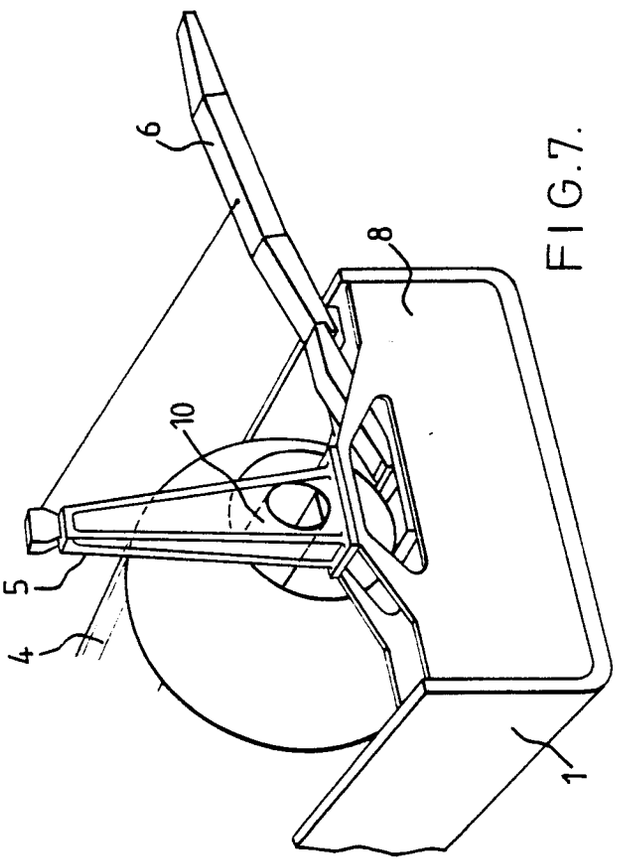

FIG.7.

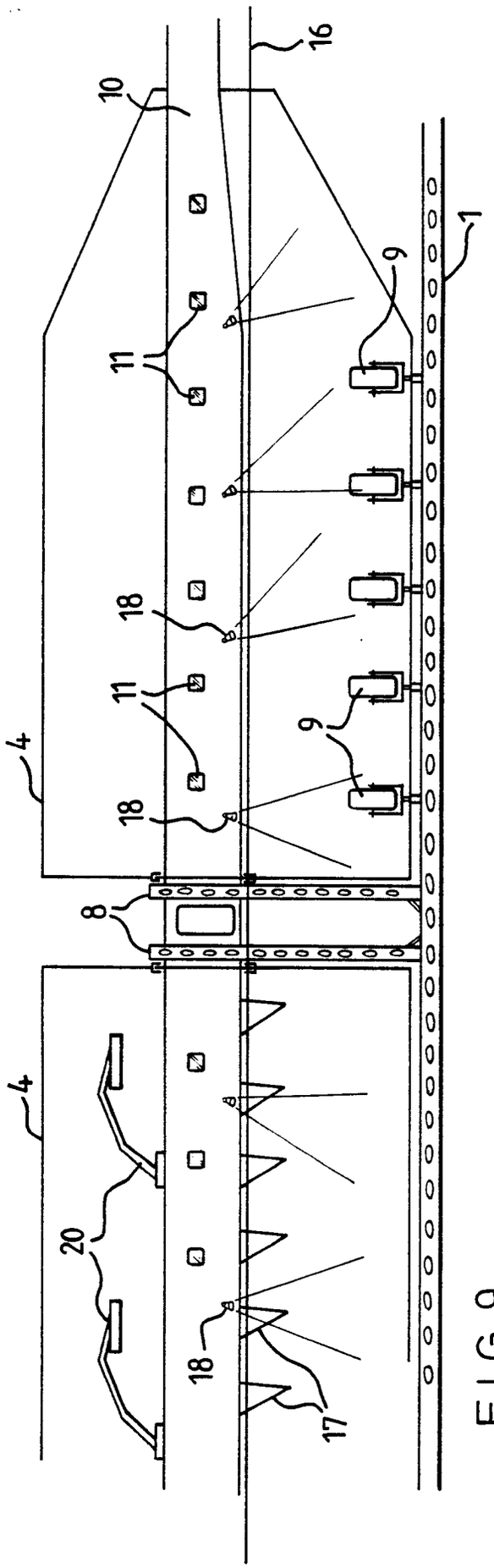

FIG.9.

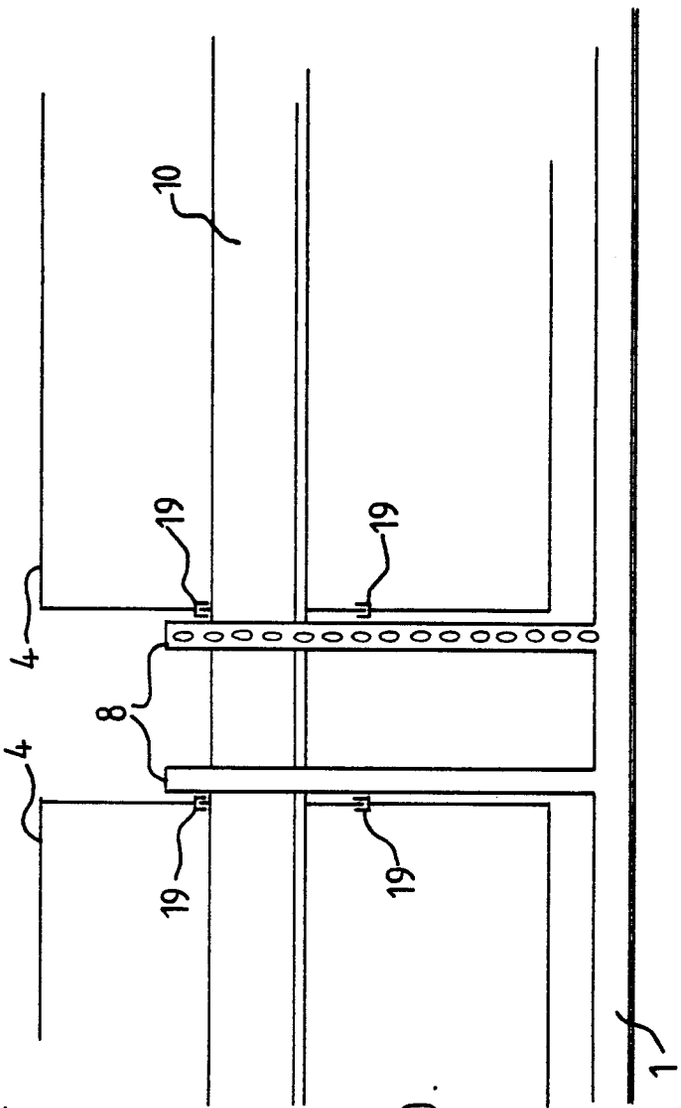

FIG.10.

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 86 30 6889

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
P,Y	US-A-4 574 721 (CHIEN) * Column 1, line 23 - column 2, line 12; claim 1; figures 1,6 *	1-4	B 63 B 25/04
Y	US-A-2 469 033 (A.T.C. DEAR) * Column 1, lines 15-26; column 1, line 48 - column 2, line 27; column 3, lines 34-38; figure 1 *	1-4	
A		6,7,9	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 63 B
B 65 G
B 65 F
A 01 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15-12-1986	VURRO,L.

CATEGORY OF CITED DOCUMENTS

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