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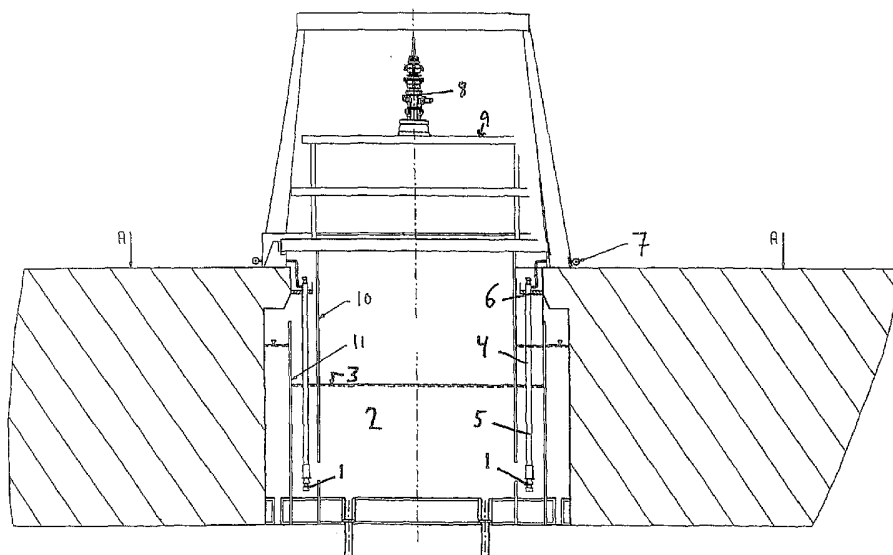
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(54) Title: DEVICE FOR COOLING WATER SUPPLY



(57) Abstract: Device for supply of cooling water to a process on board a vessel, said vessel containing a turret and laying in substance fixedly positioned on the surface by spread anchoring or dynamic positioning, such that the vessel can rotate freely around the turret that in substance is without rotation, in that the cooling water in form of seawater by use of a riser system is brought to at least one upward open intake room in the turret, which intake room preferably has lowered water level compared to the sea surface, from which intake room cooling water can be brought further to the process. The device is distinguished in that it comprises: at least one pump lowered into the intake room in the turret, with fluid connection from the at least one pump to the process, to pump cooling water from the intake room to the process, wherein both the pump and the fluid connection are arranged stationary in relation to the deck of the vessel.



— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

170904-EH

Device for cooling water supplyField of the invention

The present invention relates to a device for supply of cooling water to a process on board a vessel. More particularly, the present invention relates to a device for supplying cold cooling water from an intake room with lowered water level compared to the sea level, into a turret arranged on board the vessel, to a process installation or other installations with cooling demand on the vessel. The invention is in particular relevant for vessels with a LNG-plant, for which there is demand for a large quantity of cold seawater to cool the natural gas to LNG-conditions.

Background of the invention and prior art

The construction and function of a typical turret is described in the international patent application publication PCT/NO00/00447, which contains description of a system to supply cooling water to a cooling system on board a vessel for production of hydrocarbons, particularly a floating vessel with a LNG-plant on board. The turret according to said publication comprises a device for transferring seawater from an annulus arranged between the turret and the hull of the vessel and in connection with passage ways in the hull, wherein a device sealing against the seawater is arranged on each side of the annulus. The transfer of seawater takes place via a swivel unit located into an intake room in the hull of the vessel, such that the components of the device are more or less difficult to access for overhaul and replacement.

With the term turret in connection with the present invention it is meant any turning body that can be arranged within a vessel to receive risers, in that the turret and risers in substance are without rotation while the vessel can rotate freely around the turret, and an intake room for cooling water can be arranged with lowered water level within the turret.

In Norwegian patent application NO 2001 5345 an invention is described for which a device is provided for transfer of seawater from the turret to the rest of the vessel, wherein said transfer takes place at deck level, which inter alia results in easy access for replacement or maintenance of components. The device of NO 2001 5345 is distinguished in that it is comprising

- a toroide-shaped body which is stationary arranged on the deck of the vessel, concentric with the axis of rotation of the vessel,

- a number of outlets for the transfer of water from the turret to the toroide body, the outlets being coupled to means for transferring water supplied to the turret from the seawater hoses, a container body which communicates with the toroide body to receive

water supplied thereto from the outlets, and a means which is coupled to the turret outlets and is provided with sealing means to prevent water leakage from the toroide body.

The toroide body or toroide is an annular volume used as transfer tank for cooling water.

The above mentioned device has turned out to result in disadvantages by being very demanding with respect to space, and problems occur in form of splashing at heavy sea, capsizing or listing of the vessel. It has turned out that the pumps have to be thoroughly adjusted mutually to avoid that the toroide body is emptied for water, such that the prior art device is very sensitive for operational disturbances, why an inappropriately large suckback tank is required.

An objective of the present invention is to provide a device resulting in that said disadvantages completely or partly are avoided.

Summary of the invention

The objective of the invention has now surprisingly been met by providing a device for supply of cooling water to a process on board a vessel, said vessel containing a turret and laying in substance fixedly positioned on the surface by spread anchoring or dynamic positioning, such that the vessel can rotate freely around the turret that in substance is without rotation, in that cooling water in form of seawater by use of a riser system is brought to at least one upward open intake room in the turret, which intake room preferably has lowered water level compared to the sea surface, from which intake room cooling water can be brought further to the process. The device of the present invention is distinguished in that it is comprising: at least one pump lowered into the intake room in the turret, with fluid connection from the at least one pump to the process, to pump cooling water from the intake room to the process,

wherein both the pump and the fluid connection are arranged stationary in relation to the deck of the vessel.

Thus rotation will take place between the at least one pump having fluid connection to the process and the intake room within the turret.

With the vessel laying in substance fixedly positioned it is meant a position that is fixed as achievable by use of anchoring or dynamic positioning, with the stiffness of the riser system and anchoring as a normal determining factor, which means maximum drift within a few degrees angular deviation for the risers.

With a turret in substance without rotation, it is meant a rotation within the limitations as determined by connected risers and anchoring, which normally means within about 360°.

With lowered water level it is meant that the surface of water within the turret is lower than the surface of the sea, for example 10-35 m lower than the surface of the sea. A lowered water level within an intake room in the turret results in possibility for using a

riser system without integrated pumps, however, this is not a limitation for the present invention.

The advantages with the device of the invention can be summarized as follows:

There will be no water pipes on deck, which saves space and results in a smaller and less expensive turret.

There is no need for a swivel, cables and junction boxes for electric power, and the process swivel becomes simpler, less expensive and occupies less space.

There is no need for a swivel for control signals and cables to sensors for monitoring of the pumps within the turret, and the utility swivel becomes simpler and less expensive.

There is no need for crane and working space for servicing the pumps on the turret, which instead takes place from the vessel.

The lifting pumps are also booster pumps, thus the number of pumps is reduced by 30-50 % dependent on the total amount of water.

Reduced requirement for control valves and air shutters, the number reduced 30-50 %.

Increased operational regularity because fewer components may fail.

Simple start and shut down, independent for each pump, and without series connected pumps that must be coordinated.

No toroide, with sealing system, on deck.

No need to dump cold seawater in the surface.

The turret/annular volume contains much water, which results in inertia in the system and stability.

Self regulating adjustment of the lowering of the water level within the turret is possible, since increased pumping results in lowered water level and increased differential pressure and thereby increased inflow of cold seawater through the risers.

A suckback tank between the process plant and the turret is not required.

Drawings

The invention is illustrated with one sheet of drawing having two figures, wherein Fig. 1 illustrates a cut of a turret, with a device according to the present invention.

Fig. 2 illustrates a sketch seen from above of a turret having a device according to the present invention.

Detailed description

The device according to the invention preferably comprises at least two pumps, having pipe connection from each pump to the process plant, to achieve sufficient operational stability, such that production can be maintained at shut down of one pump. Usually it is most preferred with more than two pumps, for example 4, 6, 8 or 10 pumps, which should be considered in each case. For example it appears to be most preferable technical and economical to use 8 pumps in a specific embodiment with a LNG-plant on the vessel.

The pumps and pipe connections are preferably free hanging from a support frame fastened to the deck of the vessel or they are built into a supporting frame.

Alternatively the pumps and lines for fluid connection are preferably suspended with rollers or sliding bearings towards the turret and is fixedly fastened to the vessel hull/deck.

In a preferred embodiment of the device according to the invention the pumps and pipes for fluid connection are suspended with roller bearings to the turret and are axially displaceable fastened to the vessel hull by being fastened with roller bearings to a rail that is arranged perpendicular and radial to the rotation of the turret surface. Thereby it is possible with a construction giving easy deployment and retrieval of pumps and lines. The lines can preferably be flexible hoses. The lowest parts of the rails can be free hanging down into the intake room, while the upper part is fastened to the hull and deck of the vessel. The orientation of the rail is parallel with the rotational axis of the turret, and with a slope from the parallel axis radially outwards or inwards, or in other words, the rails are perpendicular to the rotational tangent of the turret surface. If the rail is to be brought further out over the deck of the vessel, the orientation thereon can be chosen freely.

Preferably at least one swivel device is arranged in the turret, where two further risers, lines or cables are connected, to handle rotation between the further connections and the vessel.

Preferably a maximum flow rate from the pumps by the lowest acceptable water level within the intake room in the turret corresponds to the flow rate that can be delivered through the riser system at said water level, without pumps in the riser system, such that a self regulating adjustment of the water level within the turret can be achieved.

If desired a valve can be arranged in the turret to regulate the water level and thereby the flow rate of water from the riser system to the intake room, and a suckback tank can be arranged upstream of the process plant, however, none of said devices are required or obligatory.

The device according to the invention is preferably part of a riser system that provides about 50000 m³/h cold seawater to an intake room with lowered water level within the turret, for further transport to a LNG-plant arranged on the vessel, by using eight submerged pumps having fluid communication to said LNG-plant.

The further description is made with reference to the figures. On Figure 1 a typical device according to the present invention is illustrated, the illustrated cut showing two pumps 1 deployed in an intake room 2 having lowered water level 3. The pumps are freely hanging down into the intake room, in a framework 4, such that the lower part of the framework 4, with pumps 1 and the lower part of pipe 5 for fluid communication, hang stationary and freely down into the intake room. The upper part 6 of the framework is fastened to the hull of the vessel and deck construction. Openings upwards from the intake room are not required to be larger than achieving sufficient venting and space for retrieval and deployment of equipment, and access for personnel. The process plant is connected to point 7. A swivel device 8 is placed on a swivel deck 9 to handle rotation of further risers (not illustrated) and cables than the cooling water riser system delivering water to the intake room.

On Figure 2 the same device as illustrated on Fig. 1 is illustrated, but viewed from above. The embodiment has arranged in total eight pumps 1, of which three are indicated on Figure 2. Further, the interior of the turret 10 and outer part 11, which also can be seen on Figure 1, are illustrated. An access route 12 to the pumps is indicated on the figure, likewise the storage devices 13.

Start and shut down can be undertaken relatively simple since the pumps can be operated independently, without series connected pumps that must be coordinated. By start-up the intake room within the turret can be filled with water corresponding to the sea level, such that the water level is lowered slowly as water is pumped to the process, and the inflow through the riser system commences slowly. With a valve device in the inlet from the riser system the start-up can preferably be undertaken with lowered water level in the intake room of the turret, such that cold seawater can be provided more quickly.

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C l a i m s

1. Device for supply of cooling water to a process on board a vessel, said vessel containing a turret and laying in substance fixedly positioned on the surface by spread anchoring or dynamic positioning, such that the vessel can rotate freely around the turret that in substance is without rotation, in that the cooling water in form of seawater by use of a riser system is brought to at least one upward open intake room in the turret, which intake room preferably has lowered water level compared to the sea surface, from which intake room cooling water can be brought further to the process, characterized in that the device is comprising
 - at least one pump lowered into the intake room in the turret, with
 - fluid connection from the at least one pump to the process, to pump cooling water from the intake room to the process,
 - wherein both the pump and the fluid connection are arranged stationary in relation to the deck of the vessel.
2. Device according to claim 1, characterized in that it is comprising at least two pumps, with pipe connection from each pump to the process plant.
3. Device according to claim 1 or 2, characterized in that it is comprising more than two pumps, for example 4, 8 or 10 pumps.
4. Device according to anyone of the above claims, characterized in that said pumps and pipe connections are freely hanging from a support arrangement fastened to the deck of the vessel.
5. Device according to anyone of the above claims, characterized in that the pumps and pipes from the pumps to position above the turret is freely hanging by being built into a supporting framework.
6. Device according to anyone of the above claims, characterized in that the pumps and lines for fluid connection are suspended by roller bearings or sliding bearings to the turret and is fixedly fastened to the hull of the vessel.
7. Device according to claim 1 or 4,

characterized in that the pumps and lines for fluid connection are suspended by roller bearings towards the turret and are actually displaceable fastened to the hull of the vessel by being fastened with roller bearings to a rail arranged perpendicularly and radially to the rotation of the turret surface.

8. Device according to anyone of the above claims, characterized in that maximum flow rate from the pumps at the lowest acceptable water level for the pumps within the intake room in the turret corresponds to the flow rate that can be delivered through the riser system at said water level, without pumps in the riser system, such that a self-regulating adjustment of the water level within the turret is achieved.

9. Device according to claim 1, characterized in that riser system provides about 50000 m³/h cold seawater to an intake room with lowered water level within the turret, for further transport to an LNG-plant arranged on the vessel, by use of eight deployed pumps with fluid communication to the LNG-plant.

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Fig. 2

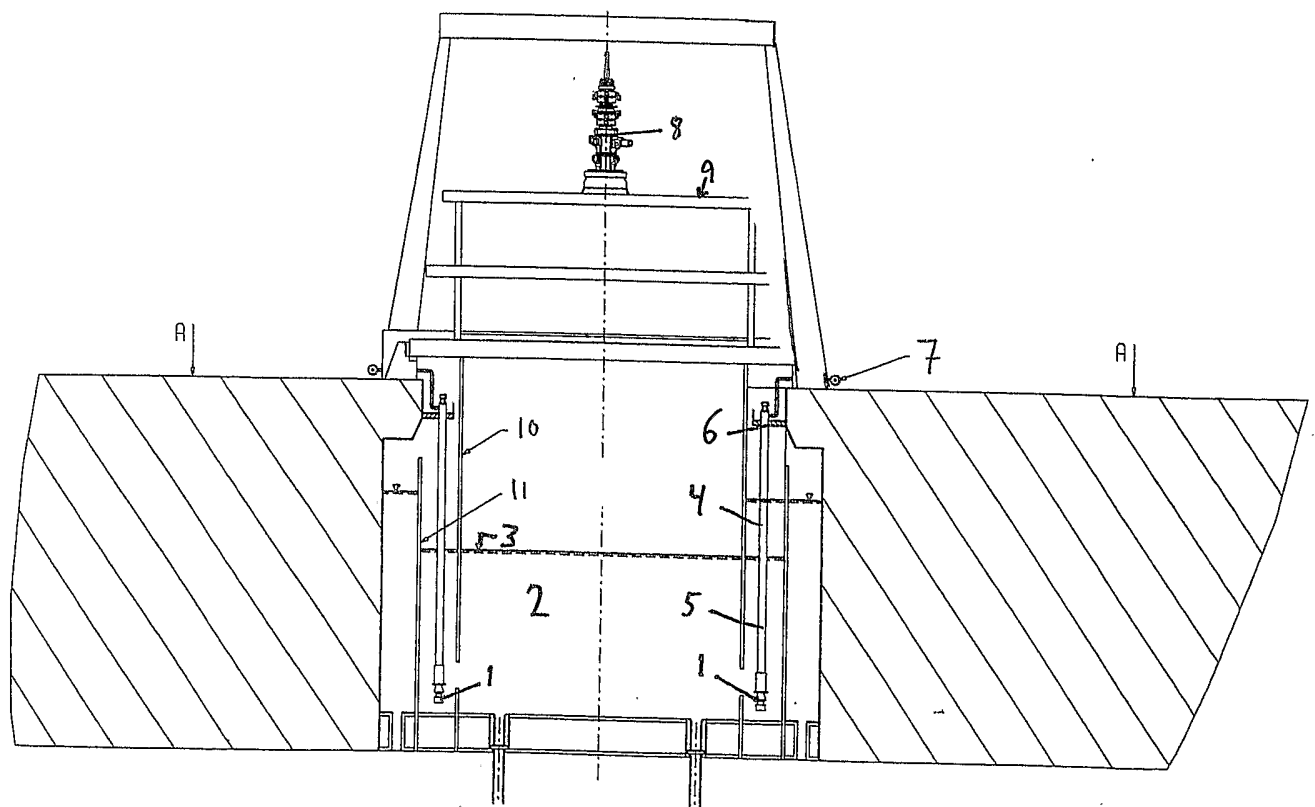
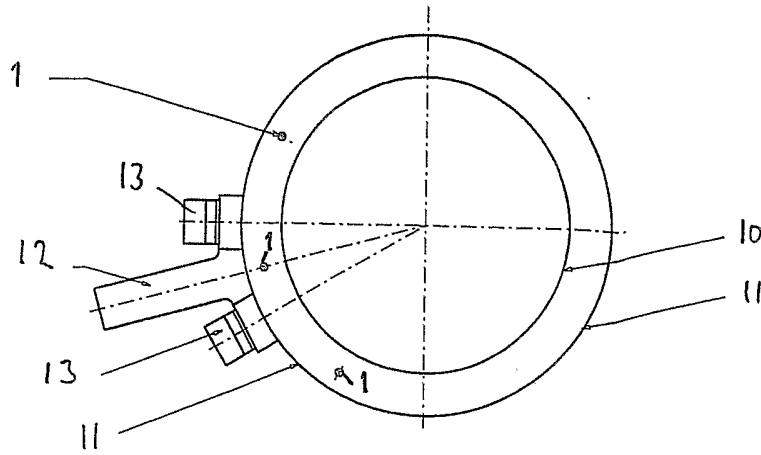


Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B63B 35/44

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B63B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,A	WO 03037703 A1 (STATOIL ASA), 8 May 2003 (08.05.2003), figures 2,3, abstract --	1
A	WO 0147768 A1 (DEN NORSKE STATS OLJESELSKAP AS), 5 July 2001 (05.07.2001), figures 2,6,7, abstract --	1
P,A	WO 03082663 A2 (SINGLE BUOY MOORINGS INC), 9 October 2003 (09.10.2003), figures 2,3, abstract --	1

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 54097984 A (KAWASAKI HEAVY IND LTD ET AL), 2 August 1979 (02.08.1979), figures 1,2, abstract --	1
A	GB 2372965 A (JOHN BROWN HYDROCARBONS LTD), 11 Sept 2002 (11.09.2002), figure 3, abstract -- -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

30/04/2004

International application No.

PCT/NO 2004/000029

WO	03037703	A1	08/05/2003	NO	313584 B	28/10/2002
				NO	20015345 D	00/00/0000

WO	0147768	A1	05/07/2001	AU	2412601 A	09/07/2001
				BR	0016623 A	03/09/2002
				CA	2395361 A	05/07/2001
				CN	1413156 T	23/04/2003
				GB	0212316 D	00/00/0000
				GB	2372236 A,B	21/08/2002
				NO	311513 B	03/12/2001
				NO	996449 A	25/06/2001
				US	2003138299 A	24/07/2003

WO	03082663	A2	09/10/2003	NONE		
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JP	54097984	A	02/08/1979	JP	1360027 C	30/01/1987
				JP	54108714 U	31/07/1979
				JP	61027235 B	24/06/1986

GB	2372965	A	11/09/2002	GB	0030256 D	00/00/0000
				GB	0129731 D	00/00/0000