Turret locking system

Field of the invention

The present invention relates to floating vessels having a turret that can be locked into a fixed position.

Background of the invention and prior art

On floating vessels, such as a FPSO-vessel, there is arranged a so-called turret, through which risers and control cables are pulled in and hung up, and to which anchor lines are fastened. The inner part of the turret lies geostationary, without substantial rotation (i.e. typically within ±10°), relative to the vessel that can rotate around the turret. When pulling in risers, control cables and when fastening anchoring lines, it is preferable to lock the turret to the vessel so that winches requiring space can be mounted on the vessel instead of on the turret. It is also of interest to lock the turret during special operations, such as maintenance of the turret bearing and when arranging preliminary tubing or hose feed-throughs related to subsea operations, or transfer of fluids or power from the vessel to the turret.

A previously known embodiment of a locking system for a turret is an annular gear having a toothed rack integrated in an inner or outer bearing ring on the turret, having a small pinion driven by a motor arranged against the annular gear. The motor drives the bearing around and maintains the position. However, this system requires space, the motor and gear must be located within the turret where the space is very limited. Such gear systems are further designed primarily to turn the turret under the resistance of friction in the bearings, which means under significantly lower loads than what is relevant for a robust turret locking system. Alternative embodiments of a locking system is the use of hydraulic cylinders or large stay tighteners or wires arranged between the ship and turret, which arrangements are connected between a part of the turret extending up and outside the turret bearing, out over the deck or support structure of the turret, and other fastening means that typically must be arranged at deck level. Also the alternative embodiments are relatively space-requiring, especially as a relatively comprehensive fastening system on deck level is used, and arrangements mounted on the rotating support structure forming a part of the turret around which the vessel can rotate freely according to the weather conditions. This hinders utilization of valuable space for mounting of equipment and pipe arrangement on the geostationary part of the turret. With typical forces in the order of 100 to 200 metrical tons required to maintain the turret locked relative to the vessel when weather-induced forces act to rotate the turret out of position, it is difficult for some of the above embodiments to

have a sufficiently tight and accurate locking, and for other embodiments the turret must be set into an accurate position before locking can be effected.

There is a demand for a simple system for locking of a turret under high load, requiring less space, not extending upwards and taking up space where it is desirable to arrange piping and equipment, having larger positional accuracy, and which is simpler to bring into effect for locking.

Summary of the invention

According to an aspect of the present invention, there is provided a turret locking system comprising a turret having a stopping ring mounted, characterized in that the stopping ring is mounted to an inner bearing of the turret, and thereby rotates passively (is geostationary) with an inner part of the turret, and

a locking device is arranged outside the edge of the stopping ring, said locking device can be brought radially into adapted grooves in the stopping ring to thereby effect locking of the stopping ring in a fixed position relative to the vessel.

The turret locking system according to the invention allows use of winch systems arranged both on the support structure of the vessel and the turret, it is adapted for simple engagement and locking of a turret under high load, with great positional accuracy, and the low space-requirement provides space where it is desirable to arrange piping and other equipment.

The stopping ring is preferably fastened on an inner (needle/roller) ball bearing ring on the turret, with bolts fastening both the ball bearing and the stopping ring. Alternatively the bearing can be mounted below the turret support structure, and then the locking ring can preferably be mounted on the underside. The locking device is preferably a hydraulically operatable locking pin, which by hydraulic drive can be brought radially into engagement with a stopping ring for engagement into dedicated grooves along the edge of the stopping ring, so that the stopping ring can be locked in desired positions. With the locking system according to the present invention the inner bearing ring is stiffened, and a robust locking system taking up small space is provided. The locking system is constructed so that dedicated feed-throughs for risers, signal cables, hoses and wires are correctly positioned. Thereby a winch arranged on the deck level of the vessel can in a relatively simple way be used for pulling in and hanging up operations.

The locking device is preferably bolted to a welded fundament.

In an alternative embodiment a hydraulically operated caliper having brake pads is arranged, onto or at the locking pin or separately, so that the outward extending stopping ring functions as a disk in a disk brake, which allows the turret to be kept in a randomly chosen position. Said embodiment can be combined with the above described turret locking system.

Drawings

The present invention is illustrated with figures, of which

Figure 1 illustrates a turret locking system according to the invention,

Figure 2 illustrates a turret locking system according to the invention, with a cross-section through a turret, and

Figures 3 and 4 illustrate a locking system according to the invention.

Detailed description

Reference is made to Figure 1 illustrating a turret locking system according to the invention. More specifically, a stopping ring 1 and a locking device 2 are illustrated. On Figure 1 the inner part of a turret has been taken out to illustrate the elements of the locking system of the invention more clearly. It appears clearly that the stopping ring 1 is mounted on top of an inner bearing 3, fastened with bolts.

The locking device 2 is in the illustrated embodiment a locking pin 2 which is brought into engagement in dedicated grooves 1a in the stopping ring.

Figure 2 is a cross-section through a simple turret, where the elements stopping ring 1, and locking device 2 are illustrated, of which the stopping ring 1 is fastened on the upper side of an inner bearing of the turret. The figure also illustrates two risers 4 hung up in the turret, and two fastened anchoring lines 5.

Figure 3 illustrates in closer detail the locking pin of the locking device as illustrated on the Figures 1 and 2. The locking device comprises a hydraulically operated pin 6. The tip has an inclined, tapered end, as two cut outs 7 of about 15° have been made in the tip to facilitate bringing in of the locking pin in the stopping ring while the stopping ring is moving. The locking pin has an angle at the end that together with the inner resistance against an axial movement of the locking pin, provides a weak self-locking effect, but at the same time restricting the required force to pull the locking pin out if this should be required at an uncontrolled situation, for example at extreme error of the direction of the vessel. A load sensor is preferably arranged with the locking device.

Figure 4 illustrates in further detail a locking system according to the invention.

Claims

1. Turret locking system, comprising a turret having a stopping ring mounted, characterized in that the stopping ring is mounted to an inner bearing of the turret, and thereby rotates passively with an inner part of the turret, and

a locking device is arranged outside the edge of the stopping ring, the locking device can be brought radially into adapted grooves in the stopping ring to thereby effect locking of the stopping ring in a fixed position relative to the vessel.

2. Turret locking system according to claim 1, characterized in that the stopping ring is fastened above an inner bearing ring on the turret, with bolts fastening both the ball bearing ring and the stopping ring.

3. Turret locking system according to claim 1, characterized in that the locking device is a hydraulically operatable locking pin.

4. Turret locking system according to claim 1, characterized in that the stopping ring has grooves around the outer circumference arranged so that the grooves coincide with feed-throughs for riser, hoses, wires and anchoring line fixation points of the turret, so that a winch mounted on the vessel can be utilized for pulling in of risers, wires, anchoring lines, etc.