A system for monitoring the force in a mooring cable of a single-point mooring system and transmitting from the single-point mooring system to a ship moored thereto a signal related to the measured force whereby said ship can disconnect from said single-point mooring system when said signal exceeds a preset maximum value.
METHOD FOR MONITORING THE FORCES IN THE MOORING CABLE OF A SINGLE-POINT
MOORING SYSTEM

BACKGROUND OF THE INVENTION

The invention relates to a method for monitoring the mooring force in the mooring cable of a single-point mooring system for the loading and unloading of a ship and to an apparatus for carrying out this method.

Over the past decade, single-point mooring systems for the offshore mooring and loading or unloading of tankers have been put into use on a large scale. These known systems are used both for the loading or unloading of liquids, such as crude oil or oil products, and of gases such as natural gas.

Single-point mooring systems of the above-mentioned type are provided with a mooring cable by means of which a ship can be moored by its bow in such a manner that the ship can freely swing about the single-point mooring system. Examples of these known single-point mooring systems are described, for example, in the patent specifications pertaining to applicant's United Kingdom Pat. No. 977,451; No. 1,031,492 and No. 1,017,894. The single-point mooring systems described in the last-mentioned patent specifications are of the buoy type. It should be noted, however, that the invention can be applied equally well to single-point mooring systems in which the buoy is replaced by a column supported on the bottom of the sea, which column is rigidly secured to the sea bottom.

When the ship is moored to the single-point mooring system for loading or unloading purposes it is sometimes necessary to interrupt the loading or unloading operation and to unfasten the ship from the single-point mooring system because of deteriorating weather conditions. It is customary therefore during loading or unloading to keep a constant check on the weather conditions (wind force, current strength, wave height). In this way it is difficult, however, to determine the exact moment to disconnect the ship. If one is too cautious, the ship is unnecessarily disconnected from the single-point mooring system and lack of care entails the risk of damage being done to the ship or the single-point mooring system. For these reasons it is desirable for more objective facts to be available in order to determine with greater certainty whether, and if so when, the loading or unloading must be interrupted and the ship disconnected from the single-point mooring system. Since, moreover, the use of super tankers is steadily increasing, ships larger than the design ship have to be moored frequently to the single-point mooring system. Therefore, there is a growing need for qualitative recording and/or observation of the force occurring in the mooring cable between ship and buoy during spells of bad weather.

BRIEF SUMMARY OF THE INVENTION

The method according to the invention comprises measuring the mooring force, transmitting a signal from the single-point mooring system, which signal is a measure for the measured mooring force, receiving the transmitted signal on the shore or on board the ship, and disconnecting the ship from the single-point mooring system when the signal received indicates that the mooring force exceeds a certain predetermined maximum value.

The signal is preferably transmitted or received over a radio link. It will be understood, however, that in principle it is also possible to make use of an optical signal or a sound signal.

A single-point mooring system of the above-mentioned type is characterized according to the invention in that the single-point mooring system is provided with a tension dynamometer for measuring the mooring force and with means coupled to the tension dynamometer for producing a signal which is a measure for the measured mooring force.

BRIEF DESCRIPTION OF THE DRAWING

The invention will now be described in more detail with reference to the drawing showing one form of the invention.

Let it be assumed that a ship 2 is to be moored to and to be loaded or unloaded via a single-point mooring system 1 as mentioned above. Weather conditions being favorable (wind force, wave height, current strength), the ship 2 is fastened in the usual manner by its bow to a mooring cable 3 of the single-point mooring system. A floating hose 6 is coupled to the ship 2 and a start is made with loading or unloading liquid or gas via the single-point mooring system. The system shown is of the known buoy type, which is provided with a customary pipe length 5 and a customary pipe swivel 4. If during loading or unloading weather conditions deteriorate (increasing wind force and/or wave height and/or current strength) this will result in an increasing mooring force being exerted in the mooring cable 3 of the single-point mooring system. It is desirable to know the magnitude of the mooring force in the mooring cable 3 to be able to determine in a more objective manner whether or not the time has come to unfasten. A tension dynamometer 7 of a type known per se is provided between the buoy 1 and the mooring cable 3, by means of which the mooring force acting in the mooring cable 3 can be measured as and when desired.

The single-point mooring system 1 carries equipment for converting the measured values of the mooring force into electric signals, as well as radio transmitting equipment capable of transmitting corresponding radio signals to the coast or to the ship 2 moored to and single-point mooring system 1. The equipment is diagrammatically designated by reference numeral 8. This equipment 8 is coupled to the tension dynamometer 7, which is diagrammatically designated by the broken line 9. The signals transmitted by 8 are received by means of receiving equipment 10 on board the ship 2 (or on the shore, if desired), so that those on board the ship 2 (or on the shore, if desired) are constantly kept informed of the magnitude of the mooring force in the mooring cable 3. If the said mooring force exceeds a certain predetermined maximum value, those concerned on board the ship 2 (or on the shore, if desired) know that measures are to be taken or that the ship may have to be disconnected from the single-point mooring system until conditions are again favorable. If the signals are only received on the shore the ship will have to be warned by another method, for example, by radio or optically, that unfastening is essential. A simpler and more effective method consists in arranging for the signals (diagrammatically designated by a zigzag line 11) to be received directly by the moored ship 2, as shown in the figure.
To this end the mooring master, who as a matter of routine boards the ship from the shore to assist in the mooring and unmooring of the ship relative to the single-point mooring system, is provided with a special portable wireless receiving unit 10. With the aid of this unit he receives the signals 11 which are transmitted from the single-point mooring system 1; a dial on the portable receiving unit 10 shows the actual mooring force in tons. In this way the mooring master is constantly kept informed of the magnitude of the mooring force in the mooring cable 3. As soon as this mooring force exceeds the permissible value, he may in concert with the master of the ship 2 devise and take the measures required to prevent damage to the ship and the single-point mooring system.

The electrical equipment on the single-point mooring system 1 is preferably fed from a plurality of batteries present on the single-point mooring system 1. To prevent these batteries from discharging in too short a time, the electrical equipment on the single-point mooring system 1 is preferably not constantly in operation. It is attractive, for example, to provide the mooring master's portable wireless receiving unit 10 with a transmitter by means of which a radio signal can be transmitted to the single-point mooring system 1 in order to actuate the electrical equipment 8 on the single-point mooring system 1. The single-point mooring system 1 may also be provided with a time switch (not shown), which is capable of automatically putting the electrical equipment 8 out of action after a certain period.

The method and apparatus according to the invention have the advantage that optimum use can be made of the single-point mooring systems, and this yields considerable savings.

It should be noted that in many single-point mooring systems the ship is fastened by its bow to the mooring system with more than one mooring cable. In this case each mooring cable should be provided with a tension dynamometer, thus allowing the mooring master at any time to receive the signals indicating the mooring force in each mooring cable.

1 claim:

1. A method for monitoring the mooring forces in the mooring cable of a single-point mooring system for the loading and unloading of a ship wherein said ship is moored by its bow to the single-point mooring system by means of a single mooring cable in such a manner that the ship can freely swing about the single-point mooring system, said method comprising:
   - measuring the tension force in said mooring cable adjacent said single-point mooring system;
   - supplying said measured force to said single-point mooring system;
   - transmitting from said single-point mooring system to said ship a signal representing the measured force;
   - receiving on said ship said transmitted signal and converting said transmitted signal to a usable display; and
   - disconnecting said ship from said single-point mooring system when said received signal indicates that said measured force has exceeded a preset value.

2. The method of claim 1 wherein said signal is transmitted and received by radio.

3. The method of claim 2 wherein said transmission of the signal is triggered by the transmission of a signal to said single-point mooring system.

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