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PATENT SPECIFICATION

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(54) MONITORING SYSTEM FOR A MOORED FLOATING VESSEL

(71) I, SECRETARY OF STATE FOR TRADE AND INDUSTRY, London, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a monitoring system for a moored floating vessel.

When a floating vessel, particularly a large vessel such as a tanker over 100,000 tons, is moored to a jetty or buoy by a number of mooring ropes, changes in tidal, wind or ballast conditions may result in movement of the vessel such that one or more of the mooring ropes is overstrained, possibly to breaking point.

It is an object of this invention to provide an arrangement whereby the development of such a situation can be recognised and the position of the vessel can be corrected accordingly, with the minimum interference with normal mooring operations. A particular advantage of this invention is that a vessel can be loaded or unloaded for longer periods as the arrangement provides a more efficient warning system of the onset of hazardous conditions.

According to the invention a monitoring system is provided for a floating vessel moored by a plurality of mooring ropes to a plurality of relatively fixed and widely separated points and including a plurality of anchoring devices, each anchoring device including an attachment portion for engagement with an associated mooring rope, an anchoring portion for attaching the anchoring device to a separate one of said points, an intervening portion, and a tension responsive device forming at least part of the intervening portion arranged so as to produce a signal representing the tension in an associated mooring rope; and a monitoring station arranged to receive the signal produced by each tension responsive device and to indicate the tensions represented by each of the signals.

Preferably the monitoring station includes means for comparing the tensions represented by each of the signals with a predetermined value so as to provide a warning when a tension reaches the predetermined value.

Desirably each anchoring device is a releasable mooring hook, and the said relatively fixed points may be located on a jetty.

Preferably, each tension responsive device is a strain gauge device, each strain gauge device desirably having four strain gauges arranged to form an electrical bridge circuit connected to the monitoring station.

The monitoring station preferably has means for displaying visually the signal from each strain gauge device.

The invention will now be described by way of example only with reference to the drawings filed with the provisional specification in which:—

Figure 1 illustrates schematically a moored floating vessel;

Figure 2 illustrates a typical jetty hook, a mooring rope and a strain gauge device;

Figure 3 illustrates an electrical bridge circuit for a strain gauge device; and

Figure 4 illustrates a monitoring station having means for indicating the signal received from twenty four strain gauge devices.

In Figure 1 a ship 10 is moored to a jetty 11 by a number of mooring ropes 12 which are attached to anchoring devices 13 shown in more detail in Figure 2. Each device 13 comprises a base 14 rigidly attached to the jetty 11 and connected through a hook plate 15 to a hook 16; the hook plate 15 and hook 16 comprise releasable mooring hook, in this instance a quick-release jetty hook. A rope sling 17 of a mooring rope 18 is looped over the hook 16, a guard 19 can pivot to cover the hook 16 and rope sling 17, and the rope 18 is attached to the ship 10 in the direction indicated by arrow 20.

A strain gauge device 21 is bonded to the hook plate 15 and is connected electrically

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to the circuit shown in Figure 3. Each strain gauge device 21 contains in an electrical bridge circuit two active strain gauges 22, 23, which together provide a signal of suitable magnitude, two passive strain gauges 24, 25 which act as temperature compensation elements, and a shunt resistor 26 which compensates for the small differences in calibration from hook to hook and for the signal transmitting means, in this embodiment the resistances of the connecting cables, represented schematically at 27, 28, 29 and 30. Such a shunt resistor 26 allows each strain gauge 21 and jetty hook 15, 16 to be interchangeable in position on a jetty.

The strain gauge device 21 is supplied through an amplifier 31 with about 30 volts and 20 mA constant current and the voltage developed by the strain gauges 22, 23 is indicated by voltage V_0 which can be detected and indicated at the monitoring station.

In Figure 4, 24 supply channels 33(1) to 33(24), each with an associated amplifier 34(1) to 34(24), supply 2 mA constant current to each of 24 strain gauge devices (not shown) the connections being represented schematically at reference 35. The signal from the strain gauge device associated with each channel is amplified by the associated amplifier 34 and fed to a visual display device 36 on the vessel 10 on which all 24 signals can be displayed simultaneously. To provide a warning, the visual display device 36 is connected to an alarm 37 which may be of any conventional type and may be arranged to give an audible or visible signal when a signal from any strain gauge device reaches a predetermined maximum or minimum level.

The visual display device 36 may be a meter displaying signal strength from a strain gauge device relative to a "danger level" signal, for example as a percentage of a high signal corresponding to a dangerously high tension. Alternatively, the device 36 may be a meter directly displaying signal strength so that an observer, knowing the danger level strength, may act when that level is approached. The danger level may be a high or a low level.

It will be understood that additional or alternative components may be added to the circuit of Figure 4. For example, the 24 signals may be displayed on a chart recorder or may be printed out on punch tape, if such a permanent record is required, and such display may be at the monitoring station on the vessel 10 or on shore.

Each strain gauge device and jetty hook

must be calibrated by conventional methods before use, and the appropriate shunt resistor 26 can then be connected into the device.

The circuits described with reference to Figures 3 and 4 relate to a strain gauge device bonded to the hook plate of a jetty hook. Similar circuits would be used when the means for measuring the tension at each anchoring device is a load cell in series with the shore end of a shore line.

WHAT I CLAIM IS:—

1. A monitoring system for a floating vessel moored by a plurality of mooring ropes to a plurality of relatively fixed and widely separated points and including a plurality of anchoring devices, each anchoring device including an attachment portion for engagement with an associated mooring rope, and anchoring portion for attaching the anchoring device to a separate one of said points, an intervening portion, and a tension responsive device forming at least part of the intervening portion arranged so as to produce a signal representing the tension in an associated mooring rope; and a monitoring station arranged to receive the signal produced by each tension responsive device and to indicate the tensions represented by each of the signals.

2. A monitoring system according to claim 1 in which the monitoring station includes means for comparing the tensions represented by each of the signals with a predetermined value so as to provide a warning when a tension reaches the predetermined value.

3. A monitoring system according to claim 1 or claim 2 in which each anchoring device is a releasable mooring hook.

4. A monitoring system according to any one of the preceding claims in which the relatively fixed points are located on a jetty.

5. A monitoring system according to any one of the preceding claims in which each tension responsive device is a strain gauge device.

6. A monitoring system according to claim 5 in which each strain gauge device has four strain gauges arranged to form an electrical bridge circuit connected to the monitoring station.

7. A monitoring system according to claim 6 in which the monitoring station has means for displaying visually the signal from each strain gauge device.

8. A monitoring system for a floating vessel substantially as hereinbefore described with reference to Figs 1 to 4 of the drawings filed with the Provisional Specification.



to the circuit shown in Figure 3. Each strain gauge device 21 contains in an electrical bridge circuit two active strain gauges 22, 23, which together provide a signal of suitable magnitude, two passive strain gauges 24, 25 which act as temperature compensation elements, and a shunt resistor 26 which compensates for the small differences in calibration from hook to hook and for the signal transmitting means, in this embodiment the resistances of the connecting cables, represented schematically at 27, 28, 29 and 30. Such a shunt resistor 26 allows each strain gauge 21 and jetty hook 15, 16 to be interchangeable in position on a jetty.

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2. A monitoring system according to claim 1 in which the monitoring station includes means for comparing the tensions represented by each of the signals with a predetermined value so as to provide a warning when a tension reaches the predetermined value.

3. A monitoring system according to claim 1 or claim 2 in which each anchoring device is a releasable mooring hook.

4. A monitoring system according to any one of the preceding claims in which the relatively fixed points are located on a jetty.

5. A monitoring system according to any one of the preceding claims in which each tension responsive device is a strain gauge device.

6. A monitoring system according to claim 5 in which each strain gauge device has four strain gauges arranged to form an electrical bridge circuit connected to the monitoring station.

7. A monitoring system according to claim 6 in which the monitoring station has means for displaying visually the signal from each strain gauge device.

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