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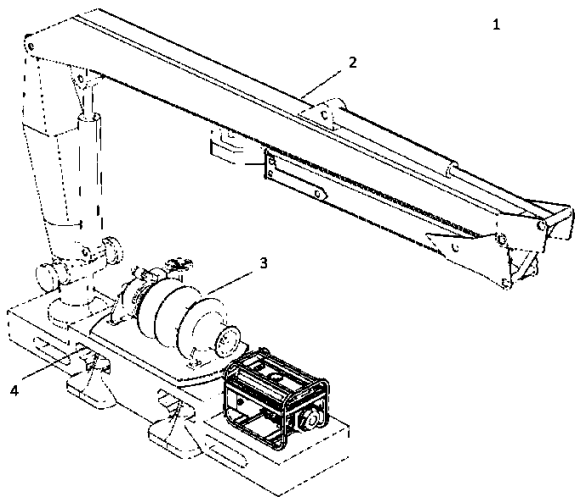
(54) Title **Automated transportable mooring unit and a system comprising multiple automated transportable mooring units**

(56) References Cited: WO 95/18038 A1, EP 0183847 A1, KR 2013/0134838 A, JP S6251096 U

(57) Abstract

Automated transportable mooring unit (1) comprising; - a rope handling crane (2) with a grasp unit to collect and deliver a rope, and - one or more winch(es) (3), - a crane and rope handling control system, - a communication device, - a locking and unlocking mechanism (4) for fixing/ releasing the unit (1) to/from the port infrastructure. A system comprises multiple automated transportable mooring units communicating with each other.



Field of the invention

The present invention concerns an automated transportable mooring unit and a system comprising multiple automated transportable mooring units.

Background of the invention

Today vessels require crew on both the quai and the vessel to moor or unmoor a vessel in port. This is a labour intensive operation where ship crews transfer ropes to shore crews who then fasten the ropes by hand and/or using costly deck machinery.

Furthermore todays vessels have costly mooring equipment that increases their capital costs and this equipment is not used when they are at sea.

Therefore mooring of vessels is usually done by use of stationary ship equipment and methods that are labor intensive and not automated. Semi automatic quai side mooring systems are however known. Benefits of automation include increased speed of operation, higher efficiency and precision, and improved repeatability.

A mooring system for a vessel comprising a robot arm is disclosed in WO2012060511 A1. It is described rails arranged which allows the mooring system to move thereon. The mooring device is thereby transportable but limited to the location of the rails.

JP2006232046 A discloses a mooring device capable of mooring a ship to a quay without using a mooring wire. There is used a tiltable telescopic arm for mooring.

WO 95/18038 A1 concerns a method of manipulating a connecting element in shipping. It discloses a portable mooring unit consisting of a crane with a gripper for handling of a hawser, a winch, a control and communication unit. The mooring unit comprises sensors such that the hawser can be attached automatically.

GB1591646 discloses a system for mooring a vessel to an off-shore tower. The mooring device can be operated from the vessel by radio means.

These devices mentioned above further pose the problem that they are expensive, require a large amount of quai side space, and are permanently fastened to the quai side not providing the required flexiblity for varying ship sizes and types. Furthermore these systems do not provide a holistic tensioning system to ensure safe and proper mooring.

Furthermore remote/autonomous vessels will begin to enter service in the near future. These vessels inherently have the problem of making rope connections as some

or all of the crew will no longer be present.The purpose of the present invention is to provide a device and a method that addresses at least one of these problems while retaining the benefits of prior art.

Summary of the invention

The proposed invention disclose a system of several mooring units that are automated and capable of communicating with each other to ensure safe and proper mooring, and where each mooring unit is a compact and integrated device which is easy to move and also to be fastened/released to/from the port infrastructure. The improvements compared to the prior art are achieved according to the invention by providing an automated transportable mooring unit, according to claim 1, comprising;

- a rope handling crane with a grasp unit to collect and deliver a rope, and
- one or more winch(es),
- a crane and rope handling control system,
- a communication device,
- a locking and unlocking mechanism for fixing/ releasing the unit to/from the port infrastructure, where the locking and unlocking mechanism is adapted for fixing/ releasing the unit to/from one bollard, multiple bollards or other existing port infrastructure.

In another aspect the present invention relates a system, according to claim 13, comprising multiple automated transportable mooring units.

Further embodiments of the invention are disclosed in the dependent claims.

Brief description of the drawings

The invention will be described in greater detail below by means of exemplary embodiments with reference to the accompanying drawing, in which:

Figure 1 shows an automated transportable mooring unit according to the invention.

Figure 2 shows a system comprising multiple automated transportable mooring units according to the invention.

Detailed description

Figure 1 illustrates an automated transportable mooring unit 1, for transferring a rope between a quay and a vessel and controlling the mooring lines throughout the stay of the vessel. The invention also discloses a system of several mooring units 1, as illustrated in Figure 2.

The mooring unit 1 as illustrated in Figure 1 comprises one or more winch(es) 3. It is a compact and integrated transportable unit and can therefore easily be moved to different locations in the port. This can be done with assistance of a truck, trailer, and/or a fork lift or other transport devices.

The compact transportable mooring unit 1 comprises a rope handling crane 2 with a grasp unit to collect and deliver a rope 3. The mooring unit 1 also comprises a crane and rope handling control system. The crane and rope handling system is capable of operating autonomously or remotely by an operator from shore. It is integrated with the mooring winch 3 system and equipped to allow for paying out or taking in the rope while connecting or disconnecting. In one embodiment the crane and rope handling system it is capable of operating remotely by an operator from the vessel. The operator can access system through a remote control platform or a worldwide web internet based platform or similar. The ship can then access control through a web based platform.

The crane 2 is provided with sensors and/or cameras to identify ropes, chains, winches, spools, bollards, and crew members, and other relevant mooring instruments/devices. The crane 2 may grasp and release a rope and it is able to collect and deliver the rope from a winch, a spool, a bollard, a flat surface, or from a hand of a crew member. The crane is able to wrap the rope around a fixed point and return it to the winch or a bollard on the quay.

The mooring unit 1 includes a communication device, where the communication device may be any available equipment such as wifi, blue tooth, 3G/4G, radio, or other.

The mooring unit comprises a drum, drive, and control system, and sensors to detect the tension of the ropes, angle of the ropes, and environmental factors. It communicates with a control system which operates autonomously or remotely to tighten or loosen mooring ropes based on demands of the rope handling crane 2, changes in tension, or changes in environmental conditions. The winch or winches thereby allow the ropes to be tightened or loosened to ensure the secure placement of the vessel.

The winch 3 is in one embodiment provided on a vertically rotating platform. By use of a vertically rotating platform it allow for ropes to come off the drum perpendicular to the drum axis.

The mooring unit 1 further comprises a locking and unlocking mechanism 4 for fixing/ releasing the unit 1 to/from the port infrastructure. The locking mechanism will allow the mooring unit 1 to fix itself to existing infrastructure such as bollards, multiple bollards or other existing port infrastructure. The locking/unlocking mechanism is versatile to avoid adapting the equipment to the type of bollard it is locking on to. This device can be hydraulic, electric, and or mechanical. In an embodiment the mooring unit locks itself to existing infrastructure with an electro-magnet in combination with a mechanical locking clamp redundantly securing the grip to the infrastructure. The port infrastructure may also be upgraded to accommodate the locking mechanism. A specially designed infrastructure locking platform is provided at some locations.

The mooring unit 1 is powered by batteries and/or a small internal combustion genset and/or shore power connection.

To be able to moor all types of vessels properly the inventions also concerns a system comprising multiple automated transportable mooring units 1 as illustrated in Figure 2. Because the mooring units 1 are compact they can easily be transported and positioned at suitable locations to properly moor any type of vessels. The mooring units 1 are able to communicate with each other and/or by a centralized overall remote control system. By a communication device such as wifi, blue tooth, 3G/4G, radio, etc. the mooring unit 1 can communicate with other similar units such that they can tighten or loosen in tandem to ensure proper and secure positioning of the vessel. The remote centralized control device is located onshore at a distance so that the signals reach the mooring units, or at a constructed mooring island or on the vessel.

While the invention has been described with reference to specific examples and embodiments, the scope of the invention is determined by the accompanying claims.

Claims

1. Automated transportable mooring unit (1) comprising;
   - a rope handling crane (2) with a grasp unit to collect and deliver a rope, and
   - one or more winch(es) (3),
   - a crane and rope handling control system,
   - a communication device,
   - **characterized by**
   - a locking and unlocking mechanism (4) for fixing/ releasing the unit (1), to/from the port infrastructure, where the locking and unlocking mechanism (4) is adapted for fixing/ releasing the unit (1) to/from one bollard, multiple bollards or other existing port infrastructure.

2. Automated transportable mooring unit (1) according to claim 1 **characterized by** that the locking and unlocking mechanism (4) is adapted for fixing/ releasing the unit (1) to/from a specially designed infrastructure locking platform provided.

3. Automated transportable mooring unit (1) according to any of claim 1-2 **characterized by** that the locking and unlocking mechanism (4) is actuated mechanically, electrically, hydraulically, and/or magnetically.

4. Automated transportable mooring unit (1) according to any of the preceding claim **characterized by** that the crane (2) is provided with sensors and/or cameras to identify mooring equipment, mooring devices and/or instruments.

5. Automated transportable mooring unit (1) according to any of the preceding claim **characterized by** that the crane (2) is provided with sensors and/or cameras to identify ropes, chains, winches, spools, bollards and human crew members.

6. Automated transportable mooring unit (1) according to any of the preceding claim **characterized by** that the crane and rope handling control system is:
   - capable of operating autonomously or remotely by an operator,
   - integrated with the mooring winch (3) system and equipped to allow for paying out or taking in the rope while connecting or disconnecting.

7. Automated transportable mooring unit (1) according to any of the preceding claim **characterized by** that the crane and rope handling control system is:
   - capable of operating remotely by an operator from the vessel who can access system through a world wide web internet based platform.

8. Automated transportable mooring unit (1) according to any of the preceding claims **characterized by** that the winch(3) comprises;
   - a drum, drive, and control system, and
   - sensors to detect the tension of the ropes, angle of the ropes, and environmental factors,
   - a control system which operates autonomously or remotely to tighten or loosen mooring ropes based on demands of the rope handling crane (2), changes in tension, or changes in environmental conditions.

9. Automated transportable mooring unit (1) according to any of the preceding claims **characterized by** that the winch (3) is provided on a vertically rotating platform to allow for ropes to come off the drum perpendicular to the drum axis.

10. Automated transportable mooring unit (1) according to any of the preceding claims **characterized by** that the unit is compact and transportable by use of but not limited to a fork lift, or a trailer, or an automated transport vehicle.

11. Automated transportable mooring unit (1) according to any of the preceding claims **characterized by** that the communication device is wifi, blue tooth, 3G/4G/4G LTE/5G, radio, physical connection or other.

12. Automated transportable mooring unit (1) according to any of the preceding claims **characterized by** that the unit is powered by batteries and/or a small internal combustion generator set and/or shore power connection.

13. System **characterized by** comprising multiple automated transportable mooring units (1) according to any of claims 1-12.

14. System according to claim 13 **characterized by** that the units (1) are communicating with each other and/or by a centralized overall remote control.

Patentkrav

1. Automatisert flyttbar fortøyningsenhet (1) omfattende;
   - en tauhåndteringskran (2) med en gripeenhet for å hente og levere et tau, og
   - én eller flere vinsj(er) (3),
   - en kran og et tauhåndteringsstyresystem,
   - en kommunikasjonsenhet,
   - **karakterisert ved**
   - en låse- og åpnemekanisme (4) for å feste/frigjøre enheten (1), til/fra havneinfrastrukturen, der låse- og åpnemekanismen (4) er tilpasset for å feste/frigjøre enheten (1) til/fra en fortøyningspåle, flere fortøyningspåler eller annen eksisterende havneinfrastruktur.

2. Automatisert flyttbar fortøyningsenhet (1) i henhold til krav 1 **karakterisert ved** at låse- og åpnemekanismen (4) er tilpasset for å feste/frigjøre enheten (1) til/fra en spesialdesignet infrastrukturlåseplattform tilveiebrakt.

3. Automatisert flyttbar fortøyningsenhet (1) i henhold til ett av krav 1-2 **karakterisert ved** at låse- og åpnemekanismen (4) blir aktivert mekanisk, elektrisk, hydraulisk og/eller magnetisk.

4. Automatisert flyttbar fortøyningsenhet (1) i henhold til ett av de foregående krav **karakterisert ved** som kranen (2) er tilveiebrakt med sensorer og/eller kameraer for å identifisere fortøyningsutstyr, fortøyningsenheter og/eller instrumenter.

5. Automatisert flyttbar fortøyningsenhet (1) i henhold til ett av de foregående krav **karakterisert ved** at kranen (2) er tilveiebrakt med sensorer og/eller kameraer for å identifisere tau, kjeder, vinsjer, spoler, fortøyningspåler og menneskelige besetningsmedlemmer.

6. Automatisert flyttbar fortøyningsenhet (1) i henhold til ett av de foregående krav **karakterisert ved** at kranen og tauhåndteringsstyringssystemet er:
   - i stand til å operere autonomt eller fjernstyrt av en operatør,

- integrert med fortøyningsvinsjsystemet (3) og utstyrt slik at tauet kan legges ut eller tas inn under tilkopling eller frakopling.

7. Automatisert flyttbar fortøyningsenhet (1) i henhold til ett av de foregående krav **karakterisert ved** at kran- og tauhåndteringsstyresystemet er:
   - i stand til å opereres eksternt av en operatør fra fartøyet som kan få tilgang til systemet via en world wide web internett-basert plattform.

8. Automatisert flyttbar fortøyningsenhet (1) i henhold til ett av de foregående krav **karakterisert ved** at vinsjen(3) omfatter;
   - en trommel, drivverk og styringssystem, og
   - sensorer for å oppdage spenning i tauene, vinkel av tau og miljømessige faktorer,
   - et styringssystem som opererer autonomt eller fjernstyrt for å feste eller løsne fortøyningstauene basert på kravene til tauhåndteringskranen (2), endringer i spenning eller endringer i miljøforhold.

9. Automatisert flyttbar fortøyningsenhet (1) i henhold til ett av de foregående krav **karakterisert ved** at vinsjen (3) er tilveiebrakt på en loddrett roterende plattform for å tillate tau å slippe løs fra trommelen vinkelrett til trommelaksen.

10. Automatisert flyttbar fortøyningsenhet (1) i henhold til ett av de foregående krav **karakterisert ved** at enheten er kompakt og flyttbar ved bruk av, men ikke begrenset til, en gaffeltruck eller en trailer eller et automatisert transportkjøretøy.

11. Automatisert flyttbar fortøyningsenhet (1)) i henhold til ett av de foregående krav **karakterisert ved** at kommunikasjonsenheten er wifi, Bluetooth, 3G/4G/4G LTE/5G, radio, fysisk tilkobling eller annet.

12. Automatisert flyttbar fortøyningsenhet (1) i henhold til ett av de foregående krav **karakterisert ved** at enheten drives av batterier og/eller et lite indre forbrenningsmotorgeneratorsett og/eller landstrømtilkobling.

13. Systemet **karakterisert ved** at det omfattet flere automatiserte transportable fortøyningsenheter (1) i henhold til ett av krav 1-12.

14. Systemet ifølge krav 13 **karakterisert ved** som enhetene (1) kommuniserer med hverandre og/eller en sentralisert total fjernstyring.

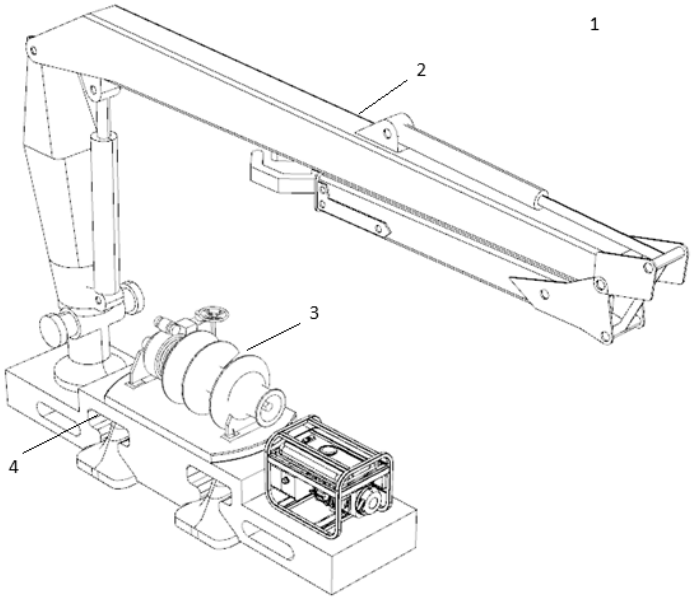


Fig. 1

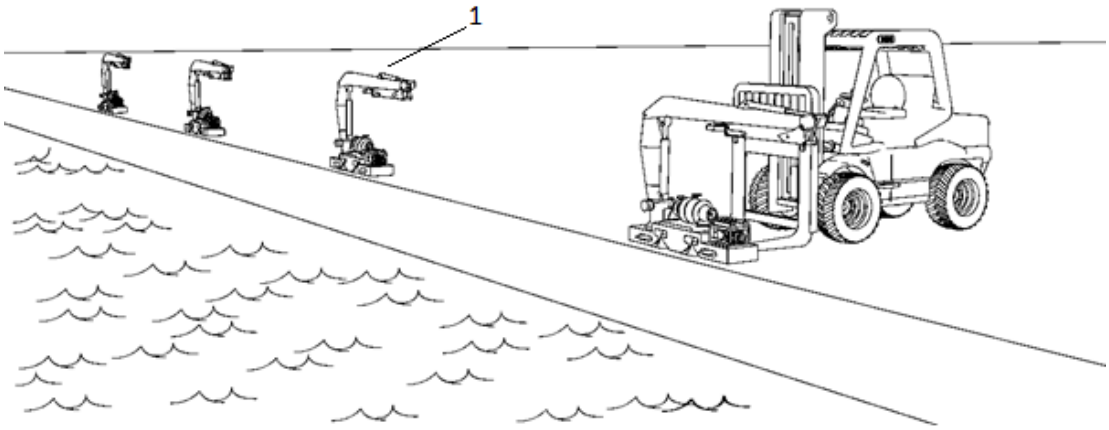


Fig. 2