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(54) **HOLDING AND STORAGE DEVICE FOR ROPE.**

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Description

The present invention relates to a holding and storage device for mooring or towing rope, comprising a storage drum for the rope when it is not in use, and a holding device in the drum for attaching a rope end to the drum.

A similar device is known from SE-A-195 895, the drum of this device being intended for a winch to be built into a freely suspended elevator cage for a main shaft elevator. The end of the elevator cable is attached to a hook welded to the drum surface and most of the force transmitted from the cable to the drum is taken up by friction between the drum and a plurality of cable turns. The drum must be sufficiently strong to withstand the full cable force and the torque created thereby.

The invention is intended for fitting on a fixed or a floating structure for the purpose of mooring a second floating structure to the first structure by means of one rope.

Storing of a mooring line on a drum or on a conveyor belt when the line is not in use, is known technology. A mooring drum is normally functioning as a holding device when the line is in operation and the drum is then locked by a brake or similar.

The substantial part of the rope tension is transmitted to the drum by friction through several rope turns, and the possible remaining tension is normally held by a rope lashing or a clamping device. The largest drawback of a usual mooring drum is that the rope normally must be bent over a fairlead forward of the drum, which fairlead may cause rope wear in the contact surface, especially for fibre rope.

When using conveyor belts for storage of the mooring rope, it is usual that the bight of the rope is pulled in on the conveyor belt in such a way that the line is stored in a long U. The inner end of the mooring line can then be continuously connected to its holding device.

Holding devices for the termination of large mooring ropes offshore are often brackets with links or hinges, permitting rope deflection in both directions perpendicular to the normal hawser pulling direction. Fixed brackets or chain stoppers are also frequently used as holding devices on ships, but the rope has then been attached to a chain which is led further through a fairlead to the holding device.

Terminations for mooring ropes are normally eye splices fitted on a thimble, grooved sheave or bolt, but designs similar to sleeves also exist. Steel wire rope is often cast in to a conical sleeve.

The purpose of this invention is to provide a device which can hold the inner end of a mooring line, which can allow the mooring line to change lead according to the relevant mooring directions without necessitating contact between the line and guide plates or rollers, and which can allow the complete mooring line with thimbles and auxiliary lines to be spooled on a drum for storage between the mooring operations with a minimum of handling.

According to the invention, this is obtained by means of a holding and storage device as defined in the introductory paragraph, which is further characterized in that the rope is to be completely wound off the drum in the active mooring or towing condition, and that the holding device comprises a pivot support means for the rope end termination, the pivot axis of said pivot support means being substantially perpendicular to a plane extending through the axis of rotation of the drum and said pivot support means at least when the rope is subjected to maximum mooring or towing tension, thus permitting the rope and its end termination to pivot substantially in said plane.

Accordingly, the desired effect may be obtained by hinging the rope termination to a strengthened part of a drum, the strengthening being further transferred into the bearings of the drum. When the device according to one embodiment of the invention is in operation, the rope tension is acting radially to the drum surface. (In contrast, the rope tension on a conventional mooring drum is acting tangentially to the drum surface). When the rope is stored, the function is similar to a conventional mooring drum. When first the drum is put in rotation, the rope termination will swing about 90 degrees to the drum. Thereafter, the rope will be spooled onto the drum as usual.

The rope termination must be able to swing in both directions perpendicular to the pulling direction when the rope is in operation. The drum axis can function as one of these degrees of freedom, and the other degree of freedom will then be in the longitudinal direction of the drum. When the rope is to be spooled, the rope termination must be swung to tangential direction. This may mean bending of the rope from the radial to the tangential direction. However, this will be a cumbersome operation. The most suitable embodiment, therefore, is to arrange a first hinge axis parallel to the drum axis and near to the drum barrel surface. If the axis is positioned slightly more than a half rope diameter inside the drum barrel surface, the hinging arrangement and the rope termination can be recessed into the drum barrel surface when the rope is stored in such a way that further spooling is easier to arrange.

Hinging in the second direction must be as close to the first hinge as possible, in order to avoid large size of the hinging mechanism including the rope termination, which is first spooled onto the drum when the rope is to be stored. A cardan

joint or a gyro suspension can give a very compact hinging arrangement, and a ball joint can solve the same problem.

In a rope termination consisting of an eye splice around a thimble or a sheave which can turn on a bolt, this turning can be the one degree of freedom. If the bolt is turing with the thimble, it can always be oriented in the tension direction, and thereby be used as a loadcell for tension measurement. A preferred solution with such eye splice and thimble is shown in the figures, where:

Figure 1 is a side view of a device according to the present invention in the active holding condition, sectioned along line I-I in Figure 2;

Figure 2 is a plan view of the device in Figure 1, sectioned along the line II-II in Figure 1;

Figure 3 is a side view of the device in Figure 1 in the passive storage condition, sectioned along line III-III in Figure 4;

Figure 4 is a plan view of the device in Figure 3;

Figure 5 is a view similar to that in Figure 1 of a second embodiment of the present invention; and

Figure 6 is a plan view, partly in section, of the device shown in Figure 5.

The figures show the device fitted on a ship 13, or on a quay.

Figure 1 and 2 show a situation wherein for instance a shuttle tanker (not shown) is moored to the stern of a storage tanker 13 with a hawser 1. The eye splice of the hawser is put around the thimble 2 which is fixed to the bolt 3, and which can turn in the bracket 4 to orient itself in the hawser pulling direction. Thereby the bolt 3 also can be used as a loadcell for measurement of the hawser tension. The bracket 4 is hinged in two bearing brackets 5, 5', 20 which are fixed to the bracket 6, which is hinged in two bearing brackets 7, 7', which are supported on the deck 14. These details 2 - 7 are all dimensioned according to the breaking load of the hawser 1, acting within defined angles which for instance can be +/- 15 degrees vertically, and +/- 60 degrees to the side relative to the shown horizontal direction of the rope 1.

The large bracket 6 can rotate freely in its bearing brackets 7, 7', while the small bracket 4 can turn the angle A which is slightly above 90 degrees until it stops in the recess 8 in the drum 9. The small bracket 4 can also turn to orient itself in the hawser pulling direction, but the substantial part of this orientation will be by turning of the large bracket 6.

The drum 9 is a light weight design which is dimensioned for pulling in and storing slack hawser.

The drum 9 is fixed on a bracket 6, and turns consequently on the same axis. A gear box 10 has a pinion 11 which can be coupled for engagement with a gear wheel 12 on the drum 9, and turn this when the rope 1 shall be spooled on. If it is arranged a cut out for the drum 9 in the deck, the bearing brackets 7, 7' can be much lower, and it will then be more simple to transfer the large hawser forces into the deck 14.

Figure 1 shows a section through the device slightly outside the bearing bracket 5, and is seen towards the hawser 1. The cylindric drum barrel is also sectioned, but because of the thin dimension, the drum barrel is shown with a single line.

Figure 2 is a horizontal section slightly above the large bracket 6, and seen downwards.

Figure 3 is a vertical section through the thimble 2 when rope etc. is being spooled on the drum 9. The small bracket 4 is turned against the recess 8, and is thereby below the cylindrical barrel of the drum 9. The part of the hawser adjacent to the thimble 2 is led further from the recess 8 in a groove 15 to the cylindrical drum barrel surface. The complete hawser 1 is spooled on together with the thimble 24, and the chain 16 which has been held in a chain stopper acting as a holding device onboard the shuttle tanker. The chain has also been led through a fairlead onboard the shuttle tanker, because the hawser would have been subject to chafing demage during the passage of a fairlead. Figure 3 and 4 show the situation when starting spooling on a rope 17 which serves as a messenger line when the chain 16 shall be transferred to the shuttle tanker.

On figure 4 it is seen that the pinion 11 is engaged and is driving the drum 9 through the gear wheel 12.

Figure 5 shows the bracket 6 connected to a torsional bar 18. The shaft 19 in the bracket 6 is hollow. The section is arranged similar to figure 1, and shows the same details. The bracket 6 can turn the angle a from "No torsion" to "Max torsion" where it is horizontal. The bracket 6 is engaged to the torsion bar 18 when this is exposed to "No torsion", and can turn until it approaches the angle B. The force K multiplied with the arm C gives the torsional angle D. When the torsional angle D approaches B, the arm C is approaching O, and thereby the torsional angle D always will be less than B.

The purpose of this spring action is to increase the hawser elasticity.

Figure 6 shows the respective members of the torsional spring mechanism, but in order to illustrate the members better, the mechanism is not engaged. Apart from the shaft which is sectioned in center, the remaining part of this figure is sectioned similar to figure 2.

The shaft 19 for the bracket 6 can rotate freely in the bearing of the bearing brackets 7 and 7'. Outside the bearing bracket 7', the shaft 19 has

fitted coupling dogs 20. A dog clutch 21 which is sliding on a key 22 on the torsion bar 18, is shown disengaged, but it is in mesh with the coupling dogs 20 when engaged. In the opposite end the torsion bar 18 is rigidly connected to the bearing bracket 7 through a tube 23. The procedure for use of the system will be as follows :

Connection to the floating structure which shall be moored, for instance a shuttle tanker, is established in advance by means of a line which is substantially thinner than the messenger line 17. The end of the messenger line 17 is attached to the connecting line, and the messenger line is pulled over to the shuttle tanker while the drum 9 is rotated to render line.

When the messenger line has passed over the bow of the shuttle tanker, it is connected to a winch which starts pulling in the messenger line. The drum 9 is switched from feeding out to braking off rendered line. Braking can be executed through the gear box 10, or through a drum brake which is not shown. Special attention is made to hold sufficient tension in the messenger line 17 when the chain 16 and the thimble 24 shall be pulled off the drum 9, in such a way that the chain is not falling off the drum because of it's own weight. This is the position shown in fig. 3 and 4. If the chain is secured to the drum, the drum is stopped and the lashing removed.

The messenger line is pulling the chain 16 and the thimble 24 off the drum 9 and further over board, while the drum 9 continues to render hawser 1 under brake action.

When the hawser 1 is pulled off the drum 9, the drum will stop by itself when the direction of the large bracket 6 is in line with the direction of the hawser. The brake is disengaged and the mooring operation is completed in this end of the hawser.

If the torsion spring mechanism 18 is desired used, the drum is rotated backwards the angle B as shown on fig. 5. The dog clutch 21 is engaged with the claws 20 as shown on fig. 6, and the bracket 6 will then turn within the angle B and give spring action in the hawser.

On board the shuttle tanker the chain 16 is pulled in to the chain stopper and locked, and thereby the shuttle tanker is moored.

When the mooring periode is completed, the procedure is reversed. The shuttle tanker releases the chain 16 and is rendering the messenger line 17. The pinion 11 is coupled for engagement with the gear wheel 12, and the gear box 10 is putting the drum 9 into rotation for pulling in hawser 1. During the first 90 degrees rotation of the drum 9 until the large bracket 6 is pointing vertically upwards, the small bracket 4 with thimble 2 will automatically turn against the recess 8 in the drum 9. Further spooling of the hawser 1 can then be on the approximately cylindric drum barrel surface. The hawser 1 is preferably spooled side by side to the one drum flange and back. Approximately the whole hawser 1 will then be spooled on one side of the drum, and the space demanding thimble 24 can be positioned on the drum surface followed by the chain 16 in the space to the other flange. The end of the chain 16 adjacent to the messenger line 17 can either be secured to the drum barrel surface before further spooling, or the messenger line 17 can be kept relatively tight during spooling of the first wraps in order to prevent that the chain is falling off the drum 9 caused by it's own weight. The remaining part of the messenger line 19 and possible smaller forerunning lines are spooled on top of the hawser and the chain 16. The complete spooling operation can be simplified by assistance of a spooling device which is activated when necessary.

The distinctive characteristic of this invention is that the rope (1) is entering the cylindric drum surface (9) in such a way that it is running radially from the drum surface when it is loaded.

Claims

1. A holding and storage device for mooring or towing rope, comprising a storage drum (9) for the rope (1) when it is not in use, and a holding device in the drum for attaching a rope end (2) to the drum, **characterized in that** the rope (1) is to be completely wound off the drum (9) in the active mooring or towing condition, and that the holding device comprises a pivot support means (3) for the rope end (2), the pivot axis of said pivot support means (3) being substantially perpendicular to a plane extending through the axis of rotation of the drum (9) and said pivot support means (3) at least when the rope (1) is subjected to maximum mooring or towing tension, thus permitting the rope (1) and its end termination (2) to pivot substantially in said plane.

2. A device according to claim 1, **characterized in that** the pivot support means (3) is supported in a first bracket means (6) which constitutes a strengthened part of the drum.

3. A device according to claim 2, **characterized in that** the pivot support means (3) is supported in a second bracket means (4), which in turn is pivotally supported in said first bracket means (6), the pivot axis of said second bracket means (4) lying in said diametral plane near the barrel surface of the

drum (9) and being parallel to the axis of rotation of the drum.

4. A device according to claim 3, **characterized in that** the pivot axis of said pivot support means (3) is perpendicular to a plane through the pivot axis of said second bracket means (4).

5. A device according to any one of the preceding claims, **characterized in that** the rope end termination comprises an eye splice of the rope (1) positioned around the periphery of a sheave (2) with a groove for the rope, said sheave (2) being journalled on the pivot support means (3).

6. A device according to claim 5, **characterized in that** a thimble is used in place of the sheave (2).

7. A device according to any one of the preceding claims, **characterized in that** the pivot support means is a bolt (3).

8. A device according to one of claims 3 - 7, **characterized in that** the barrel surface of the drum (9) comprises a recess (8) for receiving said second bracket means (4) when the rope (1) is spooled on the drum (9).

9. A device according to any one of the preceding claims, **characterized in that** it comprises selectively connectable means (10,11,12) for driving the drum (9) in rotation.

10. A device according to any one of claims 3 - 9, **characterized in that** it comprises torsion spring means (18) and coupling means (20,21,22) for selectively connecting said torsion spring means (18) to the shaft (19) of the drum (9), the torsion spring means (18), when in the connected condition, biasing the drum (9) through a predetermined angle (B) of rotation to the maximum mooring tension position.

Patentansprüche

1. Halte- und Lagervorrichtung für Festmach- oder Schleppkabel, welche eine Lagertrommel (9) für das Kabel (1), wenn dieses nicht in Verwendung steht, und eine Haltevorrichtung in der Trommel zum Befestigen eines Kabelendes (2) an der Trommel aufweist, dadurch gekennzeichnet, daß das Kabel (1) im aktiven Festmach- oder Schleppzustand zur Gänze von der Trommel (9) abgewickelt sein muß, und daß die Haltevorrichtung ein Drehlagermittel (3) für das Kabelende (2) umfaßt, wobei die Drehachse des Drehlagermittels (3) im wesentlichen senkrecht zu einer Ebene verläuft, welche sich durch die Drehachse der Trommel (9) und des Drehlagermittels (3) erstreckt, zumindest wenn das Kabel (1) einer maximalen Festmach- oder Schleppspannung ausgesetzt wird, wodurch ermöglicht wird, daß sich das Kabel (1) und sein Ende (2) im wesentlichen in dieser Ebene drehen.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß das Drehlagermittel (3) in einem ersten Trägermittel (6) gelagert ist, welches einen verstärkten Teil der Trommel darstellt.

3. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß das Drehlagermittel (3) in einem zweiten Trägermittel (4) gelagert ist, welches seinerseits drehbar im ersten Trägermittel (6) gelagert ist, wobei die Drehachse des zweiten Trägermittels (4) in der Diametralebene in der Nähe der Zylinderoberfläche der Trommel (9) liegt und parallel zur Drehachse der Trommel verläuft.

4. Vorrichtung nach Anspruch 3, dadurch gekennzeichnet, daß die Drehachse des Drehlagermittels (3) zu einer Ebene, die durch die Drehachse des zweiten Klammermittels (4) verläuft, senkrecht steht.

5. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß der Kabelendenabschluß einen Augenspleiß des Kabels (1) umfaßt, welcher um den Umfang einer Seilscheibe (2) mit einer Rille für das Kabel angeordnet ist, wobei die Seilscheibe (2) am Drehlagermittel (3) mittels Achszapfen gelagert ist.

6. Vorrichtung nach Anspruch 5, dadurch gekennzeichnet, daß anstelle der Seilscheibe (2) eine Kausche verwendet wird.

7. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß das Drehlagermittel ein Bolzen (3) ist.

8. Vorrichtung nach einem der Ansprüche 3-7, dadurch gekennzeichnet, daß die Zylinderoberfläche der Trommel (9) eine Ausnehmung (8) zum Aufnehmen des zweiten Klammermittels (4) umfaßt, wenn das Kabel (1) auf die Trommel (9) aufgewickelt ist.

9. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß sie

selektiv anschließbare Mittel (10, 11, 12) zum Antreiben der Trommel (9) in einer Drehbewegung umfaßt.

10. Vorrichtung nach einem der Ansprüche 3-9, dadurch gekennzeichnet, daß sie ein Torsionsfedermittel (18) und Koppelmittel (20, 21, 22) zum selektiven Verbinden des Torsionsfedermittels (18) mit der Welle (19) der Trommel (9) umfaßt, wobei das Torsionsfedermittel (18) im verbundenen Zustand die Trommel (9) um einen vorgegebenen Rotationswinkel (B) zur maximalen Festmachspannungslage vorbelastet.

Revendications

1. Dispositif de maintien et de stockage pour corde d'amarrage ou de remorquage, comprenant un tambour de stockage (9) destiné à la corde (1) lorsqu'elle n'est pas utilisée, et un dispositif de maintien situé dans le tambour, servant à fixer une extrémité (2) de la corde au tambour, caractérisé en ce que la corde (1) doit être complètement déroulée du tambour (9) lorsqu'elle est dans l'état d'amarrage ou de remorquage actif, et en ce que le dispositif de maintien comprend un moyen de support pivotant (3) destiné à l'extrémité (2) de la corde, l'axe de pivotement dudit moyen de support pivotant (3) étant sensiblement perpendiculaire à un plan passant par l'axe de rotation du tambour (9) et dudit moyen de support pivotant (3), au moins lorsque la corde (1) est soumise à une tension d'amarrage ou de remorquage maximale, ce qui permet à la corde (1) et à son extrémité finale (2) de pivoter sensiblement dans ledit plan.

2. Dispositif selon la revendication 1, caractérisé en ce que le moyen de support pivotant (3) est monté dans un premier moyen formant support (6) qui constitue une partie renforcée du tambour.

3. Dispositif selon la revendication 2, caractérisé en ce que le moyen de support pivotant (3) est monté dans un deuxième moyen formant support (4), qui est à son tour monté pivotant dans ledit premier moyen formant support (6), l'axe de pivotement dudit deuxième moyen formant support (6) se trouvant dans ledit plan diamétral situé à proximité de la surface cylindrique du tambour (9) et étant parallèle à l'axe de rotation du tambour.

4. Dispositif selon la revendication 3, caractérisé en ce que l'axe de pivotement dudit moyen de support pivotant (3) est perpendiculaire à un plan passant par l'axe de pivotement dudit deuxième moyen formant support (4).

5. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que l'extrémité finale de la corde comprend une épissure à oeil de la corde (1) disposée autour de la périphérie d'un réa (2) pourvu d'une gorge destinée à la corde, ledit réa (2) étant monté tournant sur le moyen de support pivotant (3).

6. Dispositif selon la revendication 5, caractérisé en ce qu'une cosse est utilisée au lieu du réa (2).

7. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que le moyen de support pivotant est un boulon (3).

8. Dispositif selon l'une des revendications 3 à 7, caractérisé en ce que la surface cylindrique du tambour (9) comprend une cavité (8) destinée à loger ledit deuxième moyen formant support (4) lorsque la corde (1) est enroulée sur le tambour (9).

9. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce qu'il comprend des moyens (10, 11, 12) pouvant être reliés sélectivement, servant à entraîner en rotation le tambour (9).

10. Dispositif selon l'une quelconque des revendications 3 à 9, caractérisé en ce qu'il comprend un moyen formant ressort de torsion (18) et des moyens d'accouplement (20, 21, 22) servant à relier sélectivement ledit moyen formant ressort de torsion (18) à l'arbre (19) du tambour (9), le moyen formant ressort de torsion (18), lorsqu'il est à l'état relié, déplaçant le tambour (9) selon un angle de rotation (B) prédéterminé, vers la position de tension d'amarrage maximale.

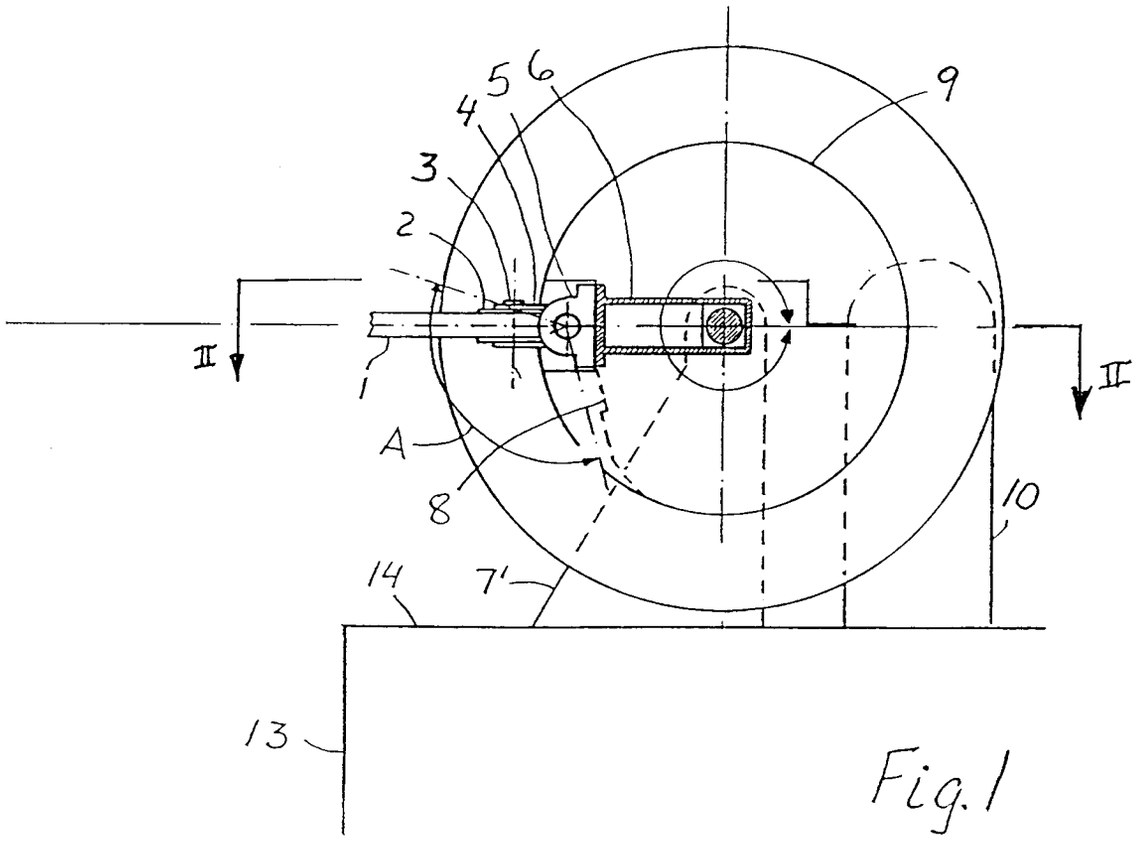


Fig. 1

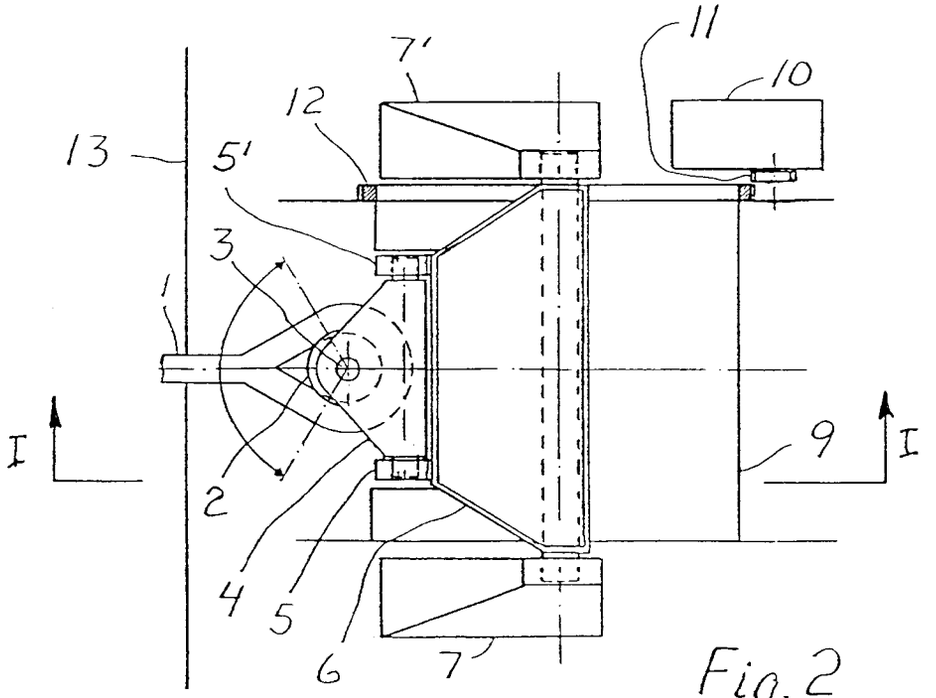


Fig. 2

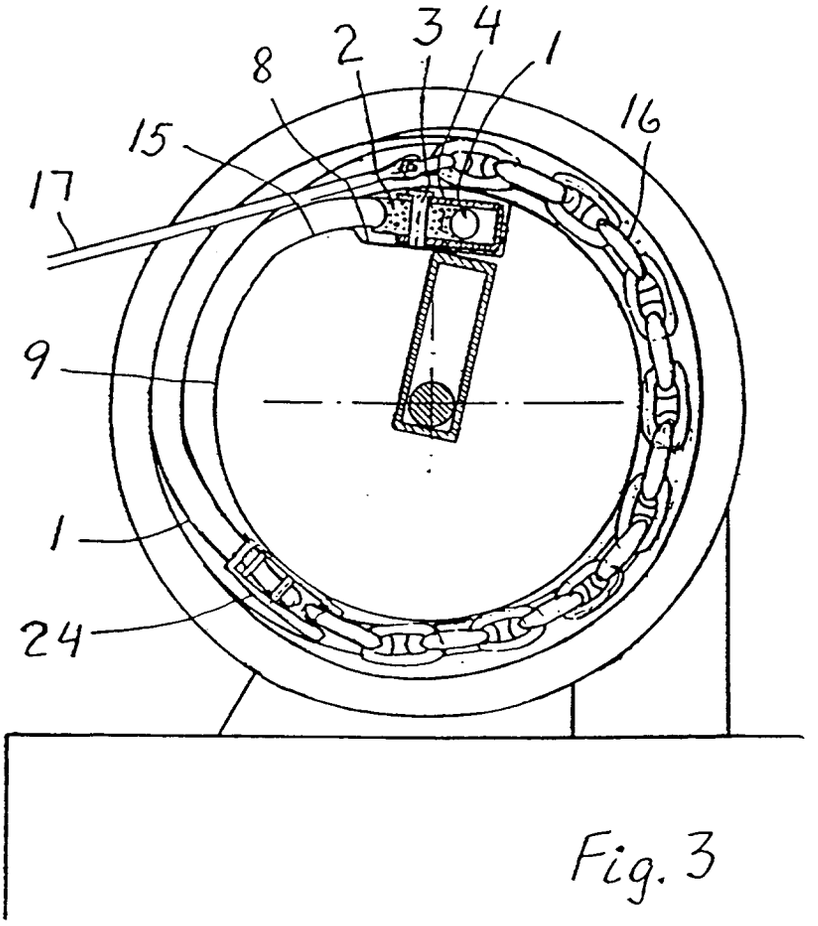


Fig. 3

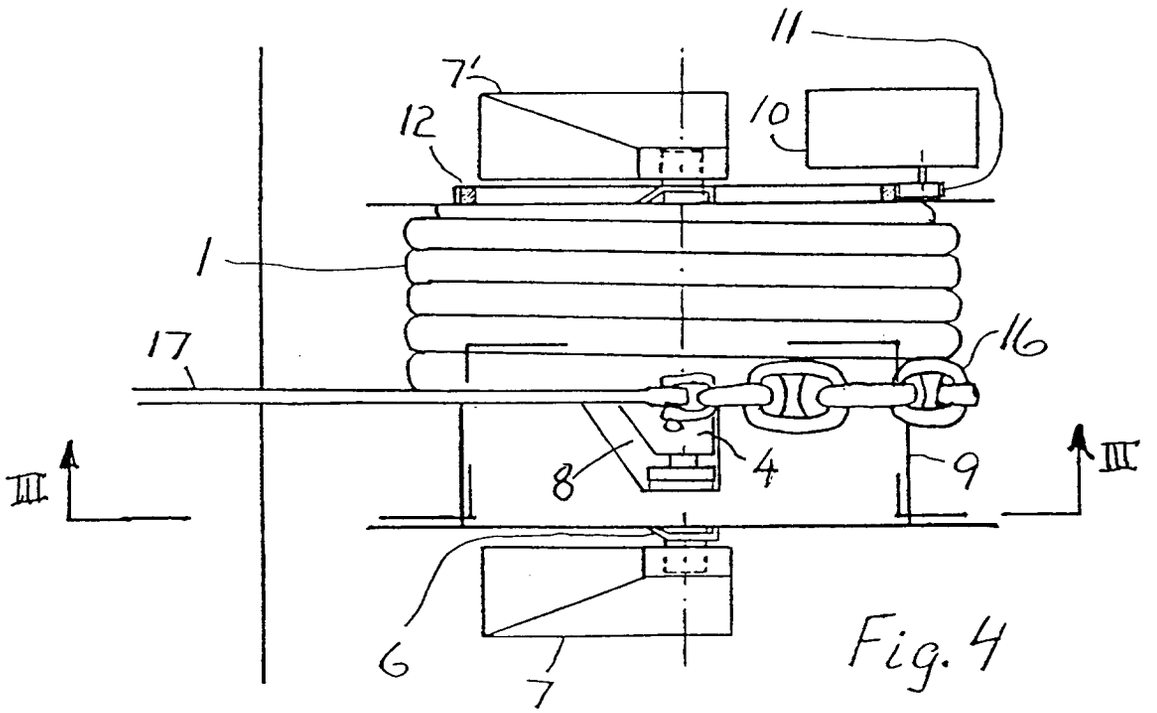
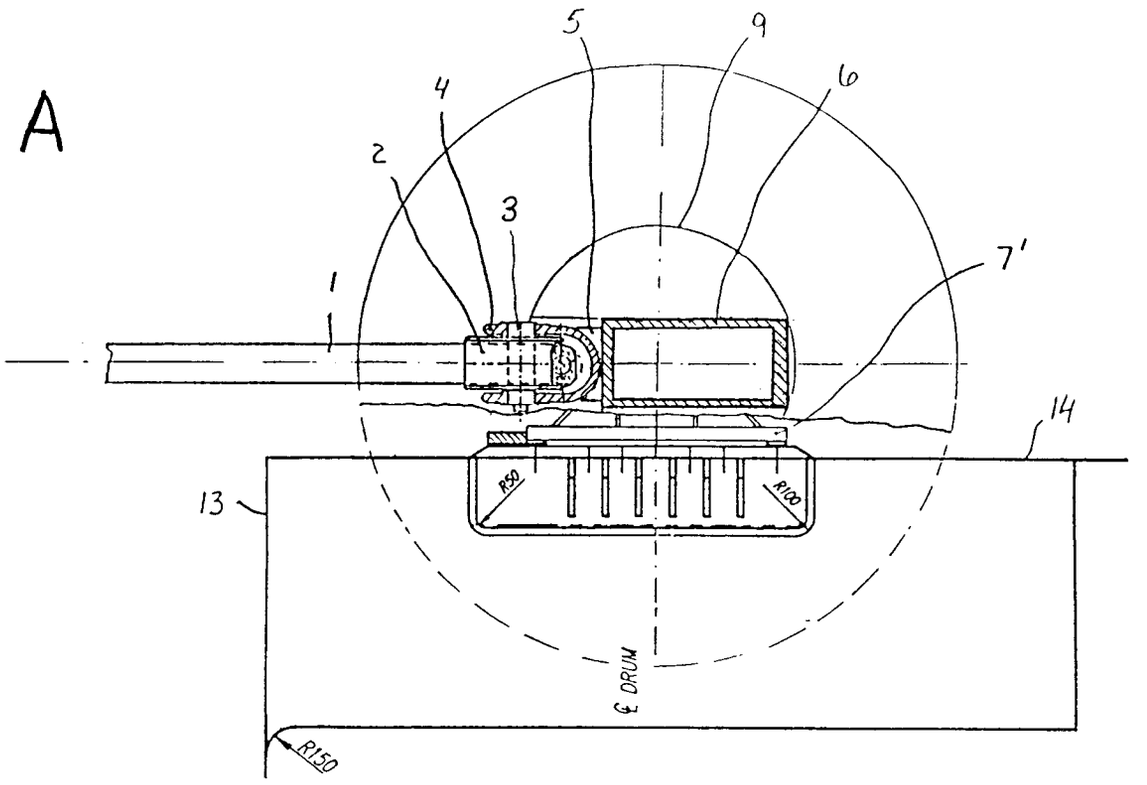
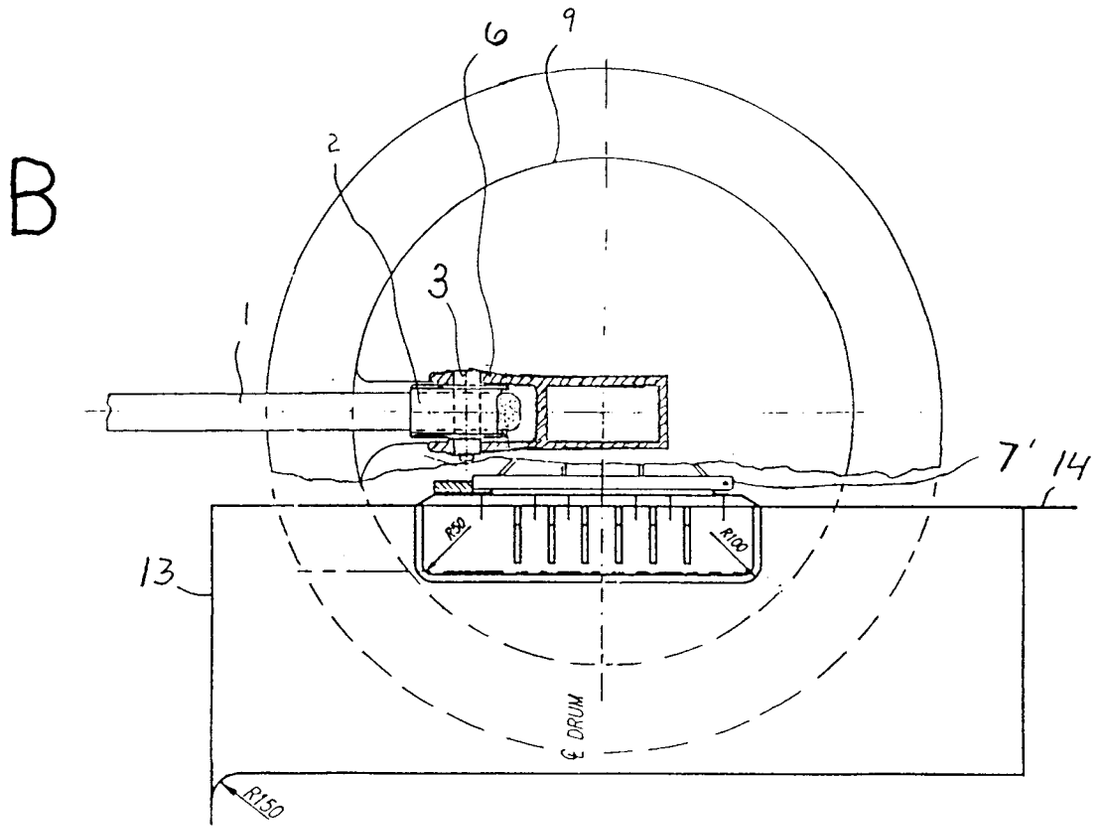


Fig. 4


A
5
9
6
4
2
3
1
7'
14
13
R50
R100
℄ DRUM
R150


B
6
9
2
3
1
7'
14
13
R50
R100
℄ DRUM
R150