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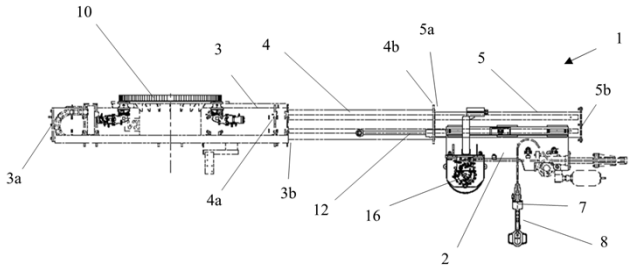
(54) Title **Extendable davit arrangement**

(57) Abstract

The invention relates to a davit arrangement (1, 20) arranged suspended over one or more boats or cargo devices (B, C) onboard a ship or similar vessel for launching or storing the one or more boats or cargo devices (B, C), the davit arrangement (1, 20) comprises a telescopically displaceable davit arm (3, 4, 5) and a hoisting arrangement (6) for hoisting and lowering the one or more boats or cargo device (B, C). The davit arrangement comprises a carrier (2) slidable connected to the davit arm (3, 4, 5), said hoisting arrangement (6) being further connected to the carrier (2). The invention further relates to a method for transporting a boat or a cargo device using the davit arrangement (1, 20).



EXTENDABLE DAVIT ARRANGEMENT

Technical Field

The present invention relates to a davit arrangement with a telescopically displaceable davit arm, which is arranged suspended over an associated boat or cargo for movement of the boat or cargo from a storing position to a launching position or vice versa. In particular, the invention relates to a davit arrangement with a carrier to positioning a hoisting device for lowering and hoisting of the boat or cargo.

The invention further relates to a method for transporting a boat of cargo using the davit arrangement.

Background Art

The known davit arrangements that are arranged suspended over an associated boar or cargo at a height substantially above the deck of the ship, so that it is possible to secure a relatively free deck space under the davit device.

The known davit devices have further a hoisting device that is extendable in a telescope part by a carrier arm that may be moved in a groove in a stationary secured telescope part.

The known davit devices however have a fixed position for the hoisting device so that when lifted, the boat or cargo is unable to be moved either at a center position of a davit arrangement or to a position at the end point of a davit arm. The known davit arrangements have thus a restricted moving area for the boat or cargo to the moved.

The invention provides an arrangement and method for easy launching or storage of a boat or cargo device by using a fully in-reach and outreach of the davit arm.

The arrangement may further reduce the steps from hoisting to storing or vice versa by directly position or retrieve the boat from the storage area before/after

launching.

The arrangement may further be compact by requiring minimal space for the rotational movement of the davit arrangement for the reposition the davit arrangement from launching/storage to storage/launching position.

Summary of invention

The invention relates to a davit arrangement arranged suspended over one or more boats or cargo devices onboard a ship or similar vessel for launching or storing the one or more boats or cargo devices, the davit arrangement comprises a davit housing with a telescopically displaceable davit arm and a hoisting arrangement for hoisting and lowering the one or more boats or cargo device. The invention being distinctive in that the davit arrangement comprises a carrier slidable connected to the davit arm, said hoisting arrangement being further connected to the carrier.

The movement of the carrier with hoisting arrangement makes the davit arrangement accessible for hoisting and lowering in its full reach. The carrier is fixedly attached to the carrier and is moved within the davit arm for an optimal position for hoisting and lowering a boat or cargo.

Preferably, the carrier is adapted to be slidable moved by a carrier hydraulic actuator.

Preferably the davit arm comprises an outer davit arm and an inner davit arm, said inner davit arm being arranged inside of the outer davit arm.

Preferably the davit arm further comprises an intermediate davit arm.

Preferably, said carrier is adapted to be suspended from an opening in the lower half of the inner davit arm.

Preferably, the carrier is adapted to be slidably moved from an end position within the inner davit arm to an opposite end position within the inner davit arm.

Preferably, the davit housing is connected to a turntable and further suspended

from a roof or other overhanging structure for rotational movement of the davit arrangement with respect to the roof or other overhanging structure.

By connecting the davit arrangement to the overhanging structure via a turntable, the davit arrangement may operate in a compact area.

Together with the fully in-reach position, the davit arrangement is able to rotate the wire around its own axis, ie the axis A. This requires a minimum of space when the opposite handling of the boat or cargo (ie lowering or hoisting) is to be performed in a different angle.

It is thus possible to perform the rotation of the davit arrangement to a different angle without the necessity to lower the boat or cargo as an intermediate step.

The procedure may thus be performed with only one hoisting procedure and one launching procedure. There is no need for an intermediate hoisting and lowering for the rotation of the davit arrangement.

Preferably, said turntable is adapted to rotate the davit arrangement 360° around a vertical axis extending through the center of the turntable.

Preferably, the hoisting arrangement comprises a winch connected to the carrier and a hoisting wire with a suspending hook.

Preferably, the hoisting arrangement comprises a swivel joint arranged between the hoisting wire and the hook.

Preferably, the davit arrangement comprises a further telescopically displaceable davit arm, carrier and a hoisting arrangement for two points hoisting and lowering of one or more boat or cargo devices.

The invention further relates to a method for transporting a boat of a cargo device using the davit arrangement, the method comprises the steps of:
a) moving the carrier together with the telescopic davit arm to an extended position being an outreach storage or launching position for hoisting or lowering a boat or cargo device,
b) moving the carrier together with the telescopic davit arm to a retracted

position being an in-reach position.

The in-reach position being a position where the a boat or cargo is arranged in a center position (A) of the turntable

Preferably, the method further comprises

c) rotation of the davit arrangement to position the davit arm in a position for opposite movement of the boat or cargo device than the hoisting or lowering in step a),

d) moving the carrier together the telescopic davit to an extended position being outreach launching or storage position for opposite movement of the boat or cargo device than the hoisting or lowering in step a).

The positioning in c) may be different angles within the 360° circle of the turntable. One possible angle being for instance 180°, ie lateral opposite positions for the launching and the storage of the boat or cargo.

Further features and objects of the invention will become apparent from the subsequent description with reference to the enclosed drawings

Brief description of drawings

Figure 1-2 shows the davit arrangement according to the invention in the innermost position, viewed from the side.

Figure 3 shows the davit arrangement according to the invention in the innermost position, viewed from behind.

Figure 4 shows the davit arrangement according to the invention in the innermost position, viewed from above.

Figure 5-7 shows the davit arrangement according to the invention in the innermost position, perspective viewed from above from various angles.

Figure 8-9 shows the davit arrangement according to the invention in the innermost position, perspective viewed from below from various angles.

Figure 10 shows the davit arrangement according to the invention in the outermost position, viewed from the side.

Figure 11-14 shows the davit arrangement according to the invention in the outermost position, perspective viewed from various angles.

Figure 15a shows the maximum innermost position and outermost position of a davit arrangement according to a prior art davit arrangement.

Figure 15b shows the innermost and outermost position of the davit arrangement according to the invention.

Figure 16 illustrates the functioning of the davit arrangement for storing or deploying a boat or a cargo.

Detailed description of the invention

There is defined three operational positions throughout the description.

The term “storage area” defined as the area where the boats or cargo are stored or initially placed, in a rest position.

The term “launching area” is defined as the area where the boat or cargo is intended to be position when moved from the “storage” by the davit arrangement. For a boat the launching area is this is normally the sea surface, for a cargo, the launching area may for instance be a deck space or similar surface for further transport by vessel, trailer etc.

The term “outreach launching position” is defined as the position when a carrier with hoisting arrangement has been moved to an outermost position. This position is may be above a launching area in order to hoist the boat or cargo up or down from/to this area.

An “outreach storage position” is defined as the position where the carrier is moved to an outermost position in order to store a boat or cargo in a storage area in connection with the davit arrangement, alternatively lift a boat of cargo from the storage area.

An “in-reach position” is defined as an intermediate position between the two previous defined positions, before/after the launching and storage of the boats or cargo. The carrier is in this position arranged in the innermost position of the davit arrangement. This position being a position where the hoisting arrangement is in a aligned with a center axis of the turntable.

The term “boat” is defined as any boat or similar devices adapted to be launch or parked by the davit arrangement. This may for instance be a lifeboat, or other similar boats that is suitable to be operated by the davit arrangement. The term “boat“ also includes unmanned surface vehicle (USV), unmanned and manned autonomous underwater vehicle (AUV) and cargo.

The term “cargo” is defined as any container or similar suitable to be moved by the davit arrangement to/from a storage area from/to a launching area.

The term “telescopic arrangement” refers to an arrangement that is extendable and retractable by slidingly moving inner and intermediate parts in respect to each other and an outer part. The features will be described in detail below.

The term “one-point davit arrangement” refers to an arrangement having one contact point to the boat for the launching/hoisting operation, ie it comprises one telescopic arrangement. For simplicity, a single telescopic arrangement is referred to as a one-point davit arrangement hereinafter in the description.

The term “two points davit arrangement” refers to an arrangement having two contact points to the boat for the launching/hoisting operation, ie it comprises two individually or correlatedly operated telescopic arrangements. Each of the individually telescopic arrangements may have the same design as the one-point davit arrangement. The following description refers to the arrangement with combined two telescopic arrangements as “the two-points davit arrangement”.

Figure 1-9 illustrates a davit arrangement 1 according to an embodiment of the invention in an in-reach position.

Figure 1-2 illustrates the davit arrangement 1, viewed from the side. Figure 2 is a cross-sectional view showing interior parts of the davit arrangement.

The davit arrangement 1 comprises a davit housing 19 and a carrier 2 slidable arranged in the davit housing 19. The davit housing 19 further comprises an outer davit arm 3, an inner intermediate davit arm 4 and an inner davit arm 5. The davit arms 3, 4, 5 are arranged telescopically as indicated in the figure. The outer davit arm 3 is an integrated part of the housing 19. The collective term of the inner, intermediate and outer davit arms is named telescopic davit arm 3, 4, 5. It is to be noted that the telescopic davit arm 3, 4, 5 may comprise only the

inner and outer davit arm 3, 5. There may also be a number of inner intermediate davit arms 4. The invention is not restricted to three davit arm parts 3, 4, 5.

The davit arrangement 1 has further a hoisting arrangement 6 suspended from the davit arrangement 1. The davit arrangement 1 may further have a shock absorber 9 and a hydraulic tube guideway 11 as illustrated in the figure. In addition, the davit arrangement may comprise a turntable 10 for connection with a roof or other overhanging structure.

The hoisting arrangement 6 may further comprise a winch 16. The winch 16 is fixedly attached to the carrier 2. The hoisting arrangement 6 may further comprise a hoisting wire 15, a spelter socket 22, a hook 8 and a lifting ring 21. This is per se known. The hoisting arrangement 6 may further comprise a swivel joint 7. The swivel joint 7 may be positioned between the hook 8 and the hoisting wire 15 to allow rotational movement of the hook 8 relative the hoisting wire 15.

The shock absorber 9 is further attached to the carrier 2. The shock absorber 9 may be a tension type shock absorber and is known per se.

The hydraulic tube guideway 11 is intended to support hydraulic tubes that supplies hydraulic oil to various part of the system and make sure that the tubes do not come into contact/ or be damaged by the moving parts.

The turntable 10 is disclosed at the top part of the davit arrangement 1. The turntable is connected to the housing 19. The turntable 10 is further connected to a roof or other overhanging construction (not shown). The turntable is arranged so that the davit arrangement 1 may rotate 360° with respect to the roof or overhanging construction in order to position the extendable parts of the davit construction.

Figure 2 is a cross-sectional view showing interior parts of the davit arrangement. The figure shows in detail the interior of the davit arrangement 1.

The inner intermediate davit arm 4 is slidably arranged within the outer davit arm 3. The inner intermediate davit arm 4 is moved by a first cylinder piston arrangement, hereinafter called first hydraulic actuator 14 where one end of the first hydraulic actuator 14 is attached to the outer davit arm 3 and the other end

is attached to the inner intermediate davit arm 4. This provides a slidingly movement of the inner intermediate davit arm 4 along the longitudinal direction of the outer davit arm 3.

Likewise, the inner davit arm 5 is slidably arranged within the inner intermediate davit arm 4. The inner davit arm 5 is moved by a second cylinder piston, hereinafter called a second hydraulic actuator 13 where one end of the second hydraulic actuator 13 is attached to the inner intermediate davit arm 4 and the other end is attached to the inner davit arm 5. This provides a slidingly movement of the inner davit arm 5 along the longitudinal direction of the inner intermediate davit arm 4.

The davit arrangement 1 further comprises a third piston cylinder, hereinafter called carrier hydraulic actuator 12. The carrier hydraulic actuator 12 is arranged between the inner davit arm 5 and the carrier 2 as indicated in the figure. This means that one end of the carrier hydraulic actuator is attached to the inner davit arm 5 (at an end point 5a) and the other end is connected to the carrier 2 to provide a slidingly movement of the carrier 2 with respect to the inner davit arm 5.

In the in-reach position as shown in the figures 1-9, the first, second and carrier hydraulic actuator 14, 13, 12 are in a retracted innermost position. The inner intermediate davit arm 4, the inner davit arm 5 and the outer davit arm 3 is as a consequence arranged in the retracted innermost position.

The hook 8 is in this position extending vertically along a centerline A of the turntable as indicated in the figure. This means that the hoisted wire 15 and/or hook 8 will rotate around its own axis when the davit arrangement 1 is rotated by the turntable.

Figure 3-9 illustrates the davit arrangement in the in-reach position from various positions. None of the these shows the hydraulic actuators that are arranged within the davit arrangement.

Figure 4 illustrates the davit arrangement from above and illustrates how the turntable 10 is in connection with toothed gear wheel(s) or pinion 17 to facilitate the rotational movement. The turntable 10 has two circular rings that is slidably connected. The outer ring is connected to the roof or other overhanging

structure, while the inner ring is attached to the davit housing 19. The pinion 17 of in contact with the outer ring to provide the rotational movement of the davit arrangement 1, 20. The turntable is known per se.

Figure 5-9 further shows the davit arrangement in the in-reach position in different perspective view from above and from below. Figure 6 illustrates a motor 18 to power the rotational movement of the turntable 10.

Figure 10- 14 illustrates the davit arrangement according to the embodiment from fig. 1-9 in an outreach position. This position both refers to the outreach storage position and the outreach launching position, as the only difference in the two positions are the way the davit arms 4, 5 extends.

Figure 10 illustrates the outreach position viewed from the side. The inner intermediate davit arm 4 and the inner davit arm 5 are in this position extended to the outermost position.

In addition, the carrier is 2 moved to an outermost position in the inner davit arm 5. This can be shown in the figure 10 where the carrier hydraulic actuator 12 is extended. The carrier 2 is thus moved from an end point 5a (figure 11) of the inner davit arm 5 towards an opposite end 5b of the inner davit arm 5. The davit arm 5b is the free end extending out of the davit arrangement as shown in the figure 10.

Figure 11-12 illustrates the davit arrangement in the outreach position, perspective view. The figures are also cross-sectional view to illustrate in greater detail the first, second and carrier hydraulic actuators 14, 13, 12 and their extended position to extend the davit arms 3, 4, 5 telescopically and in addition move the carrier 2 towards the free end of the inner davit arm 5b.

Figure 11 illustrates further the end point 4a, 5a of the intermediate and inner davit arm 5 arranged respectively within the outer davit arm 3 and the inner intermediate davit arm 4. The figure also illustrates the end point 3a which is an integrated part of the housing 19.

Figure 13 and 14 illustrates the same perspective view of the outreach position as figure 11 and 12. However in these illustrations, the first and second hydraulic actuators 14, 13 are not shown, only the carrier hydraulic actuator 12 between the inner davit arm 5 and the carrier 2 is indicated in fig. 13.

Figure 15a illustrates the possible outreach of a prior art davit arrangement figure 15b illustrates the possible outreach for the davit arrangement according to the invention. The respective circle of 15a and 15b illustrates the position of hook in the outermost position for the prior art davit arrangement and the davit arrangement according to the invention.

As illustrated in the figures, the prior art davit arrangement has a narrower operational diameter than the invention. This is due to the possibility for the carrier 2 of the davit arrangement according to the invention to move independently within the davit arm 3, 4, 5. This would thus result in the outreach position ie when the davit arms 3, 4, 5 are extended in the outermost position as indicated in the figure 11-14, the carrier 2 may at the same time be moved along the inner davit arm 5 from a position within close to the point end 5a of the inner davit arm 5 to the opposite free end 5b of the davit arm 5. The winch 16 and hook 8 are connected to the carrier 2 and thus moved outwardly together with the carrier 2.

Optionally a prior art davit arrangement may a hook that is arranged at the free end of the davit arm. However, this would result in a davit arrangement where the hook and lifting ring is unable to be positioned at the center position at the center of the turntable.

The presently invention thus fulfills both criteria by the same davit arrangement. Both a fully in-reach position at the center of the davit arrangement and a fully outreach position where the hook may extend to a greater distance away from the center. This will further relate to a greater rotational circle.

The figure 16a and figure 16b further illustrates the functioning of the invention. Figure 16a and 16b illustrates the davit arrangement 1 according to the above described invention with one davit device. This is illustrated by a boat B that is suspended from the hook 8 and lifting ring 21 in a single point. The figure further illustrates a davit arrangement 20 having two davit devices suspending a cargo C in a two-point suspension. It is to be noted that the suspended devices constitute only examples. A boat may be suspended in a two-point suspension and a cargo C may be suspended in a single point suspension. Figure 16a shows the davit arrangement 1, 20 viewed from above.

Figure 16b shows the corresponding davit arrangement 1, 20 viewed from behind/in front, ie the direction perpendicularly of the travelling distance of the davit arrangement 1, 20.

The figure illustrates the three main positions; in-reach position where the boat B or cargo C is arranged in center position A. This position is represented by the reference number B, C and 2 for the respective boat, cargo and carrier 2.

To illustrate and distinguish the outreach launching position from the other positions, the reference number B', C' and 2' are used as reference number for the boat, cargo and the carrier 2.

Likewise, to illustrated and distinguish the outreach storage position from the above positions, the reference number b'', c'' and 2'' are used as reference number of the boat, cargo and the carrier 2.

The boat B, the cargo C and the carrier 2 are thus the same features, only positioned in different positions in the figures.

As illustrated in the figure 16a and 16b, the davit arrangement 1, 20 may move a boat B or cargo C from a launching position to a storage position, via an in-reach position. The boat B' or cargo c' in the launching position is hoisted by the hoisting arrangement 6 to a position elevated from the sea surface or other surface where the boat B or cargo C has been positioned prior/after to the hoisting.

In this position the davit arrangement 1, 20 is in the outreach launching position. This means that the davit arrangement 1, 20 is extended to the outermost position where the davit arms 3, 4, 5 are telescopically extended.

From this position the davit arms 3, 4, 5 are retracted so that the inner and inner intermediate davit arms 4, 5 are retracted within the outer davit arm 3. The carrier 2 with the boat B or cargo C is at the same time moved to a center position A. This is performed by retracting the carrier hydraulic actuator 12, that is arranged between the inner davit arm 3 and the carrier 2. The carrier 2 is suspended through an opening 23 (fig 8) in the lower half of the inner davit arm 5. This means that a part of the carrier 2 is arranged at the interior of the inner davit arm 5 and bearing against parts of the bottom part of the inner davit arm in a slidingly manner.

The boat B or cargo C is now positioned in the in-reach position, ie the position where the hook 8 and/or lifting ring 21 is arranged in the center A position of the turntable 10 as previously illustrated in figure 3.

In this in-reach position, the davit arrangement 1, 20 is able to rotate while the boat B or cargo C maintains in the center position A. This is performed by the turntable 10. To maintain the same positioning of the boat B or cargo C it is preferable to have the swivel joint 7 arranged between the hook 8 and/ or lifting ring 21 and the hoisting wire 15. This makes it possible to rotate the swivel joint 7 while keeping the hook with the boat B or cargo C steady.

It is thus possible to rotate the davit arrangement without performing any steps of lowering the boat B or cargo C before rotation the davit arrangement to a position for opposite launching or hoisting.

When the davit arrangement 1, 20 has been rotated 180° the davit arrangement is arranged diametral opposite and the davit arm 3, 4, 5 is able to extend telescopically in the opposite direction to an outreach storage position. In this position the boat B or cargo is arranged in a position elevated from a storage position for the boat B or cargo C. The boat B or cargo C may further be lowered into the storage position by the hoisting arrangement 6.

The invention has been described with a rotation of the turntable of 180°. Other operation angles are also possible, for instance -/+90°. The remaining operation of the davit arrangement 1, 20 will be the same as describe above.

The above description relates to a movement of the boat or cargo from the sea surface or other final destinations to the storage position where the boat of cargo is to be stored. However, it is to be understood that the opposite procedure is possible, ie the movement of the boat B or cargo C from storage to launching by performing the opposite procedure.

Figure list:

1 - davit arrangement, with one suspension point,

2 - carrier,

3 - outer davit arm,

3a, 3b - end points of the outer davit arm,

4 - inner intermediate davit arm,

4a, 4b - end points of the inner intermediate davit arm,

5 - inner davit arm,

5a, 5b - end points of the inner davit arm,

6 - hoisting arrangement,

7 -Swivel joint,

8 - hook,

9 - shock absorber,

10 - turntable,

11 - hydraulic tube guideways,

12 - carrier hydraulic actuator,

13 - second hydraulic actuator,

14 - first hydraulic actuator,

15 - hoisting wire,

16 - winch,

17 - toothed gear wheel or pinion,

18 - motor,

19 - housing,

20 - davit arrangement with two suspension point,

21 - lifting ring,

22 - spelter socket,

23 – opening,

A – centerline,

B – boat,

C - cargo.

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Claims

1. A davit arrangement (1, 20) arranged suspended over one or more boats or cargo devices (B, C) onboard a ship or similar vessel for launching or storing the one or more boats or cargo devices (B, C), the davit arrangement (1, 20) comprises a davit housing (19) with a telescopically displaceable davit arm (3, 4, 5) and a hoisting arrangement (6) for hoisting and lowering the one or more boats or cargo device (B, C), **characterised in** that the davit arrangement comprises a carrier (2) slidable connected to the davit arm (3, 4, 5), said hoisting arrangement (6) being further connected to the carrier (2).

2. The davit arrangement (1, 20) according to claim 1, wherein the carrier (2) is adapted to be slidable moved by a carrier hydraulic actuator (12).

3. The davit arrangement (1, 20) according to claim 1 or 2, wherein the davit arm (3, 5) comprises an outer davit arm (3) and an inner davit arm (5), said inner davit arm (5) being arranged inside of the outer davit arm (3).

4. The davit arrangement (1, 20) according to claim 3, wherein the davit arm (3, 4, 5) further comprises an intermediate davit arm (4).

5. The davit arrangement (1, 20) according to claim 3 or 4, wherein said carrier (2) is adapted to be suspended from an opening (23) in the lower half of the inner davit arm (5).

6. The davit arrangement (1, 20) according to any one of the claims 3-5, wherein the carrier (2) is adapted to be slidably moved from an end position (5a) within the inner davit arm (5) to an opposite end position (5b) within the inner davit arm (5).

7. The davit arrangement (1, 20) according to any one of the claims 1-6, wherein the davit housing (19) is connected to a turntable (10) and

further suspended from a roof or other overhanging structure for rotational movement of the davit arrangement (1, 20) with respect to the roof or other overhanging structure.

8. The davit arrangement (1, 20) according to claim 7, wherein said turntable (10) is adapted to rotate the davit arrangement (1) 360° around a vertical axis (A) extending through the center of the turntable (10).

9. The davit arrangement (1, 20) according to any one of claims 1-8, wherein the hoisting arrangement (6) comprises a winch (14) connected to the carrier (2) and a hoisting wire (15) with a suspending hook (8).

10. The davit arrangement (1, 20) according to claim 9, wherein the hoisting arrangement (6) comprises a swivel joint (7) arranged between the hoisting wire (15) and the hook (8).

11. The davit arrangement according to any one of claims 1-10, wherein the davit arrangement (20) comprises a further telescopically displaceable davit arm (3, 4, 5), carrier (2) and a hoisting arrangement (6) for two points hoisting and lowering of one or more boat or cargo devices (B, C).

12. A method for transporting a boat of a cargo device (B, C) using the davit arrangement (1, 20) according to any one of the claims 1-11,

a) moving the carrier (2) together with the telescopic davit arm (3, 4, 5) to an extended position being an outreach storage or launching position for hoisting or lowering a boat or cargo device (B, C),

b) moving the carrier (2) together with the telescopic davit arm (3, 4, 5) to a retracted position being an in-reach position.

13. The method according to claim 10, wherein the method further comprises

c) rotation of the davit arrangement to position the davit arm in a position for opposite movement of the boat or cargo device than the hoisting or lowering in step a),

d) moving the carrier (2) together the telescopic davit (3, 4, 5) to an extended position being outreach launching or storage position for opposite movement of the boat or cargo device (B, C) than the hoisting or lowering in step a).

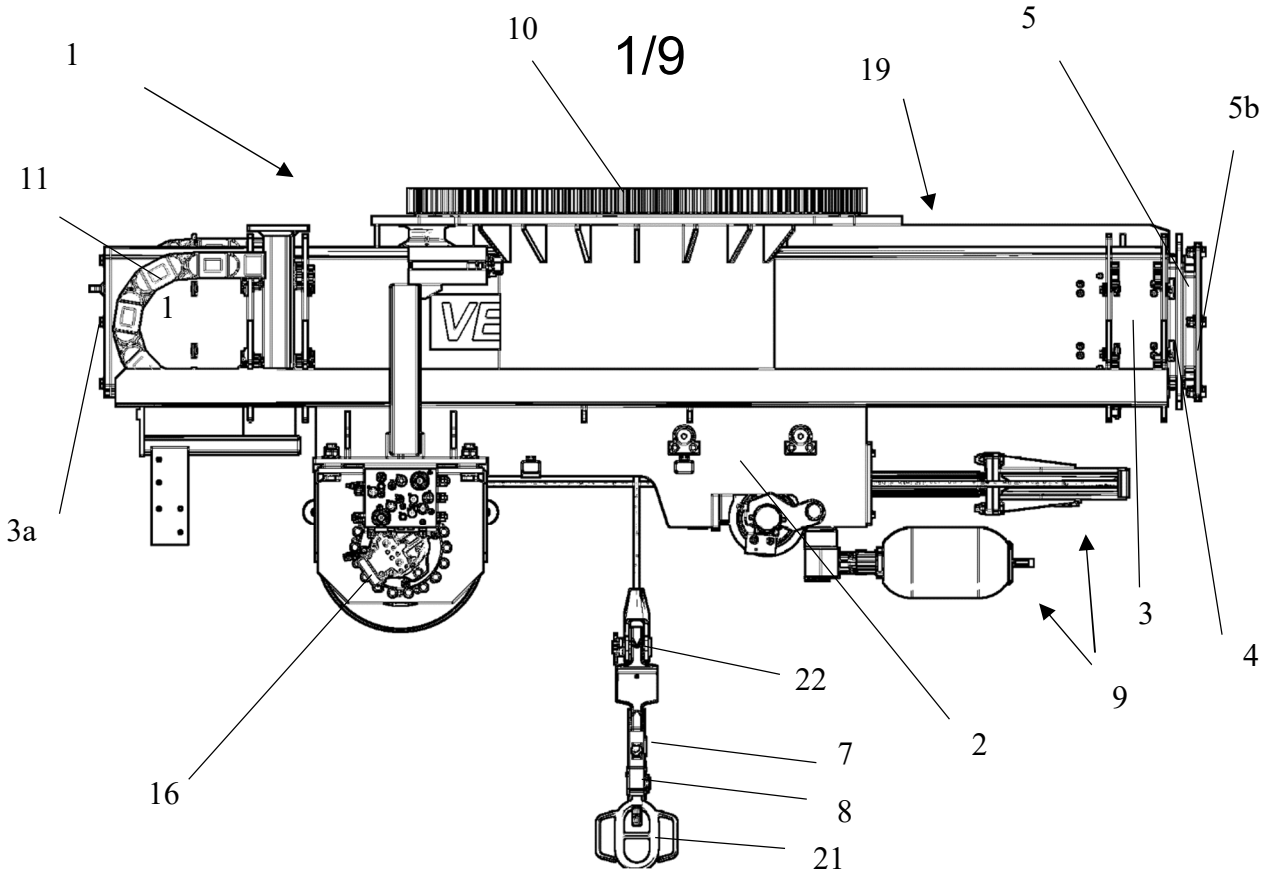

Fig. 1

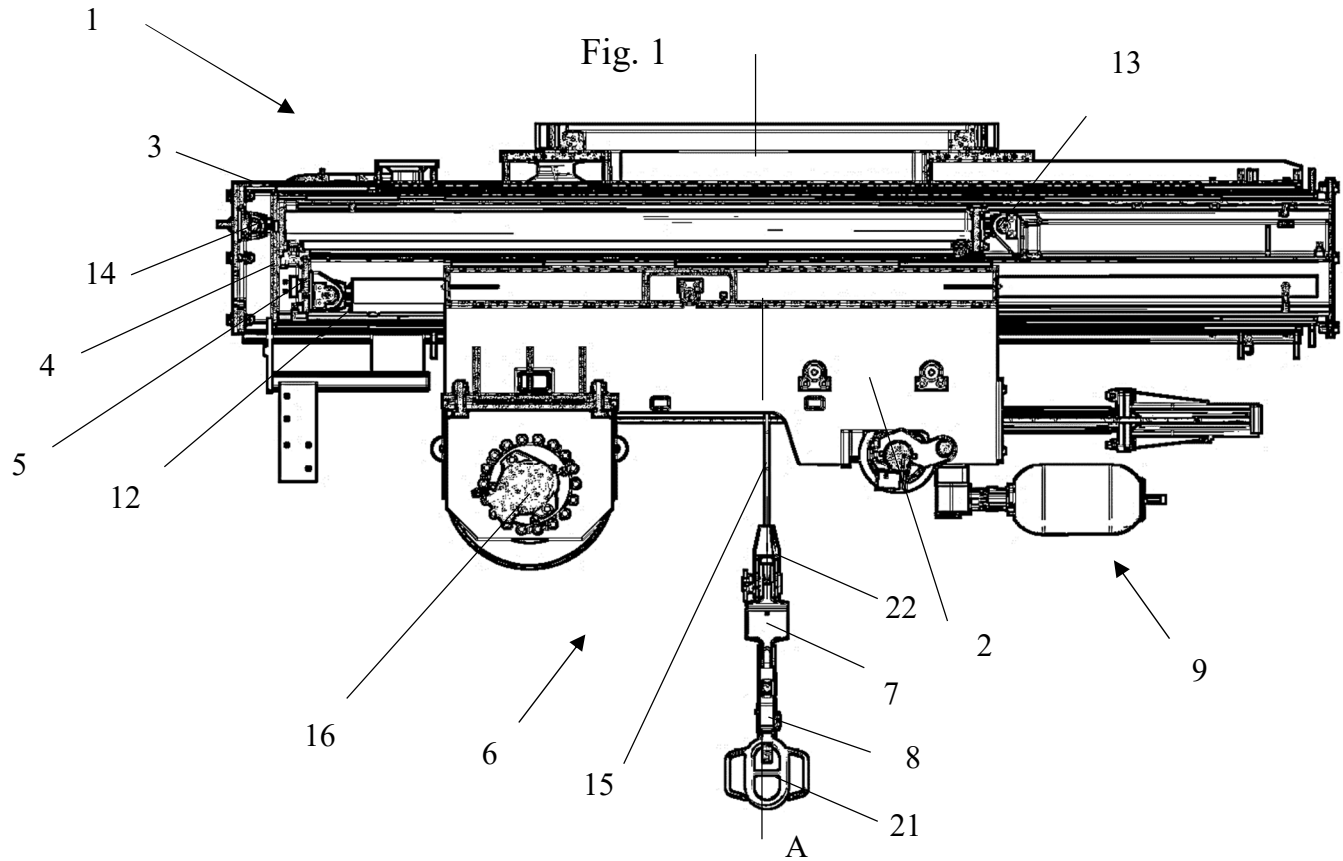

Fig. 2

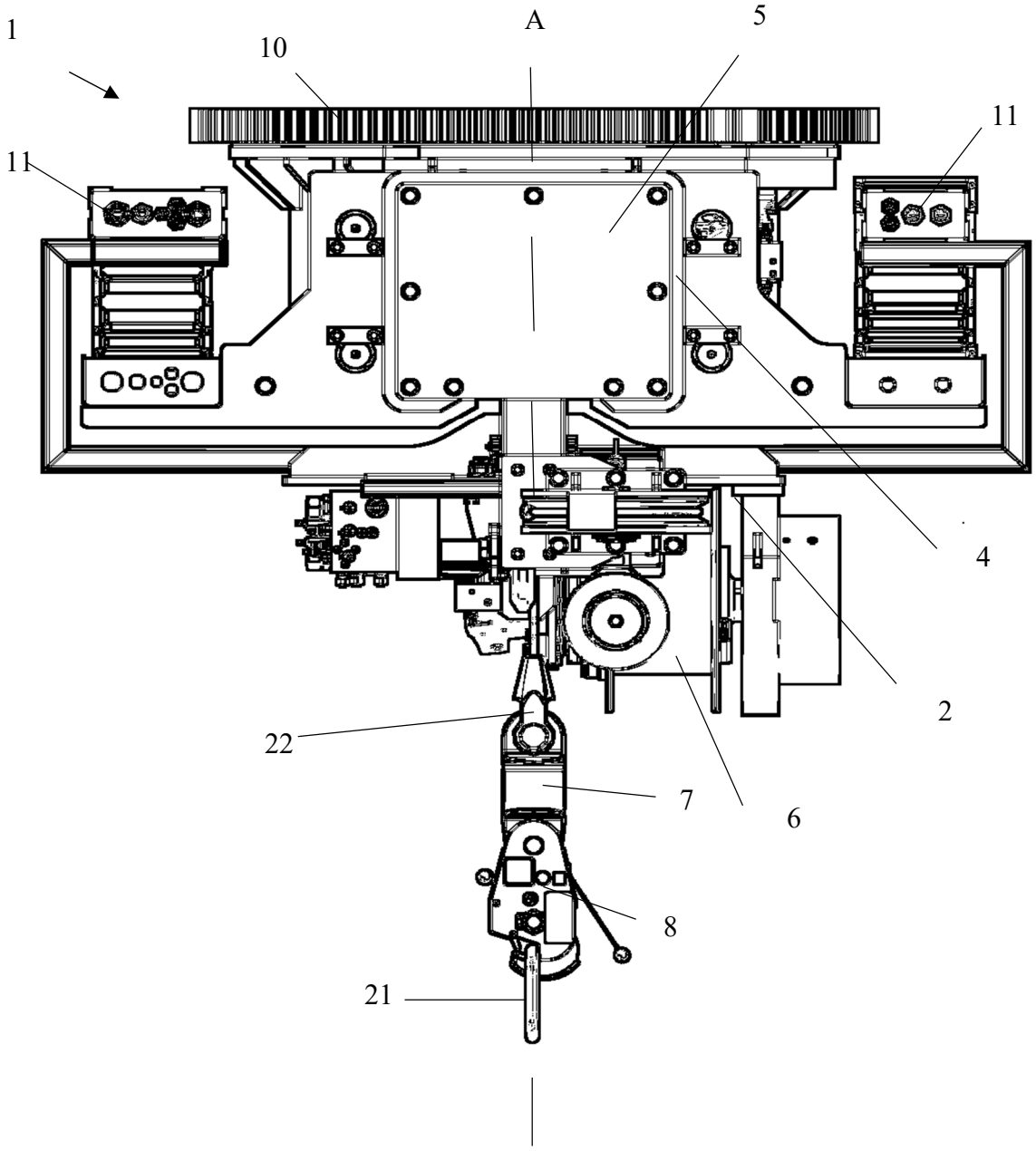

Fig. 3

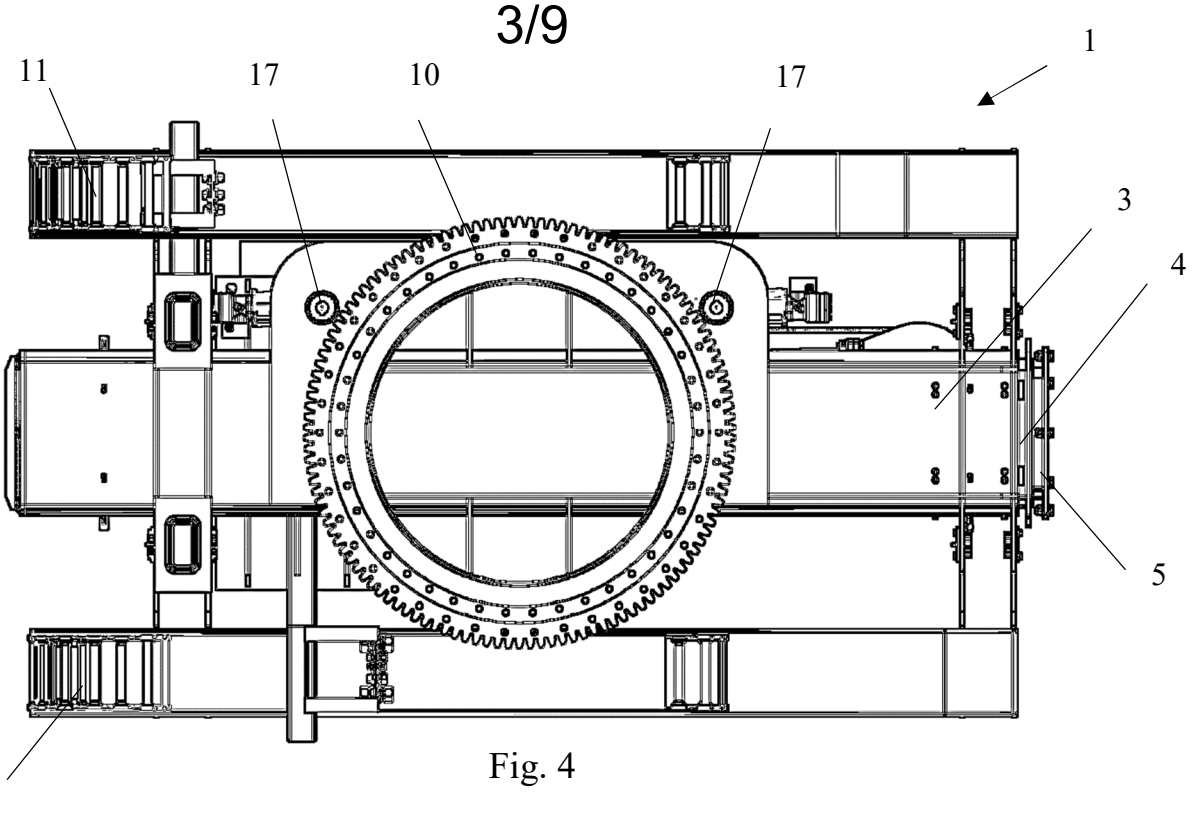

Fig. 4

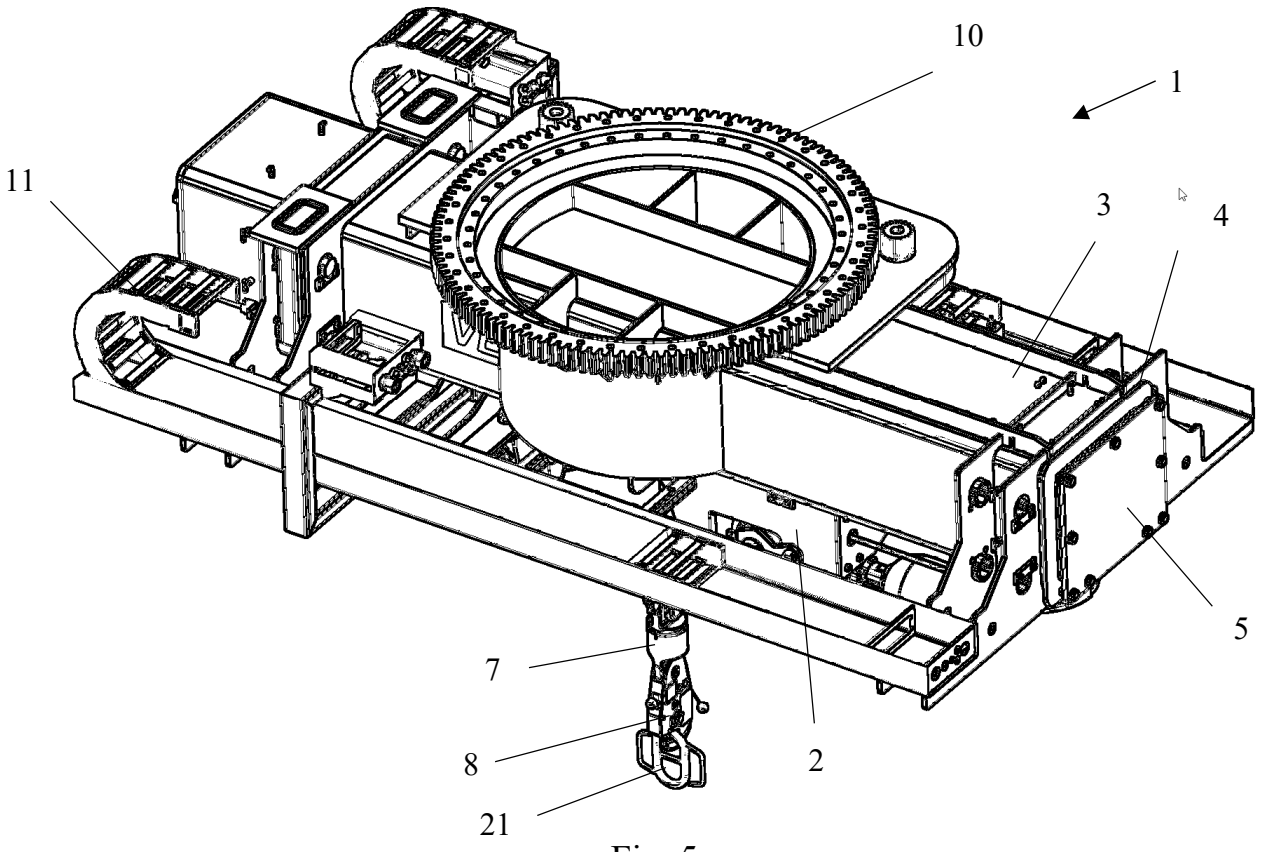

Fig. 5

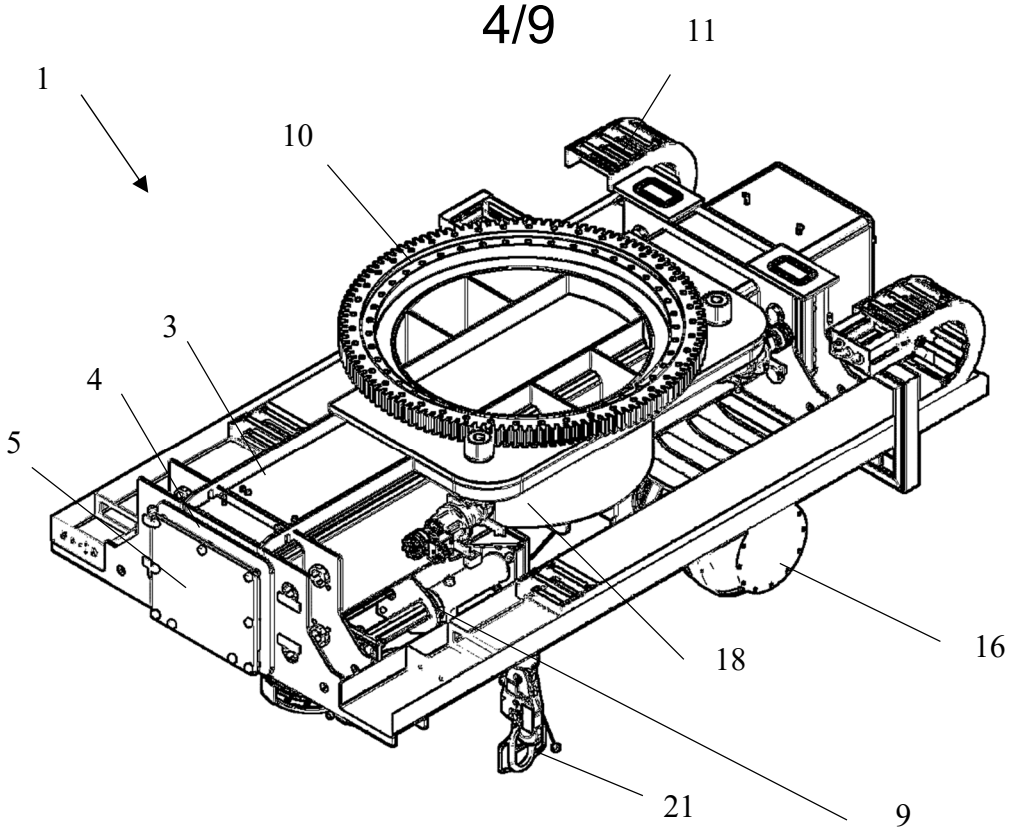

Fig 6

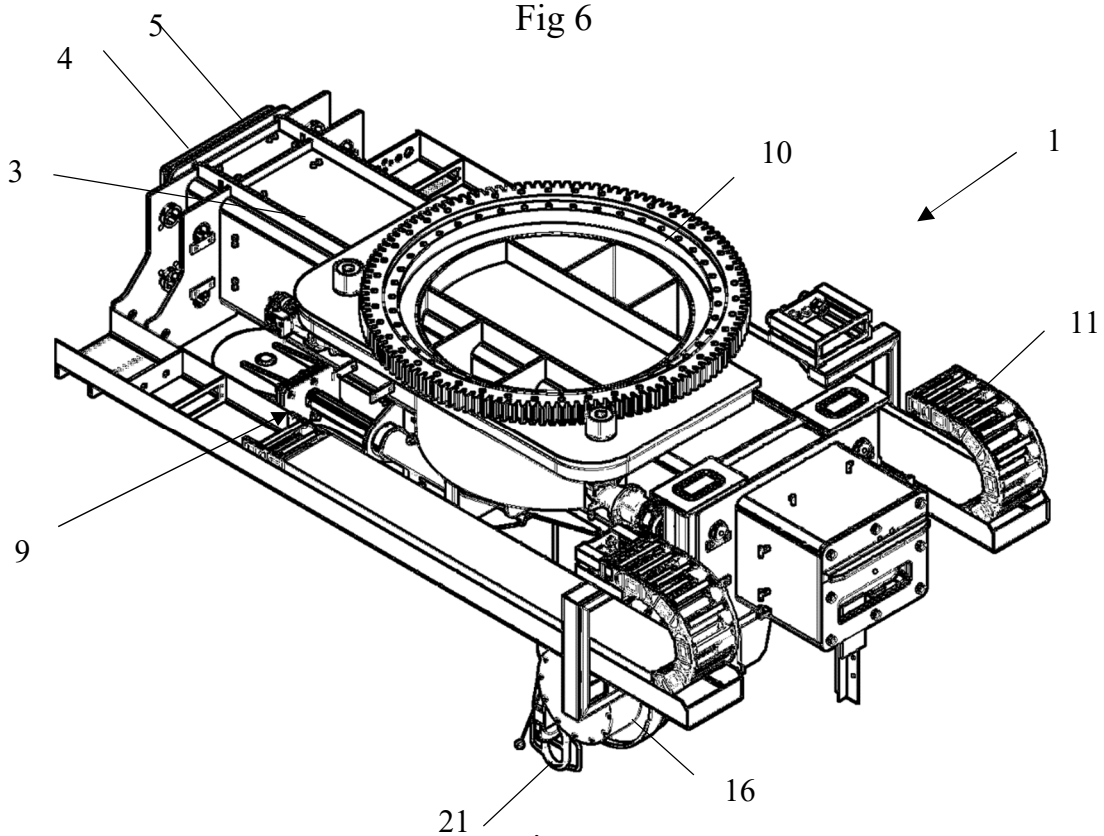

Fig. 7

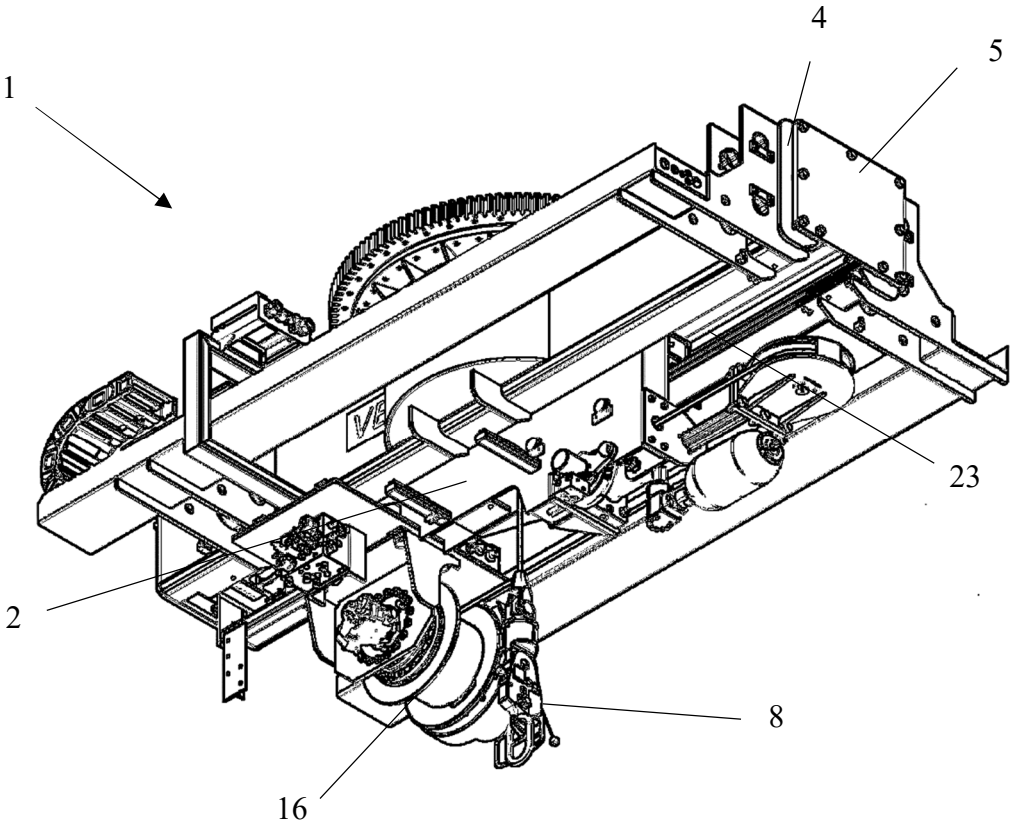

Fig. 8

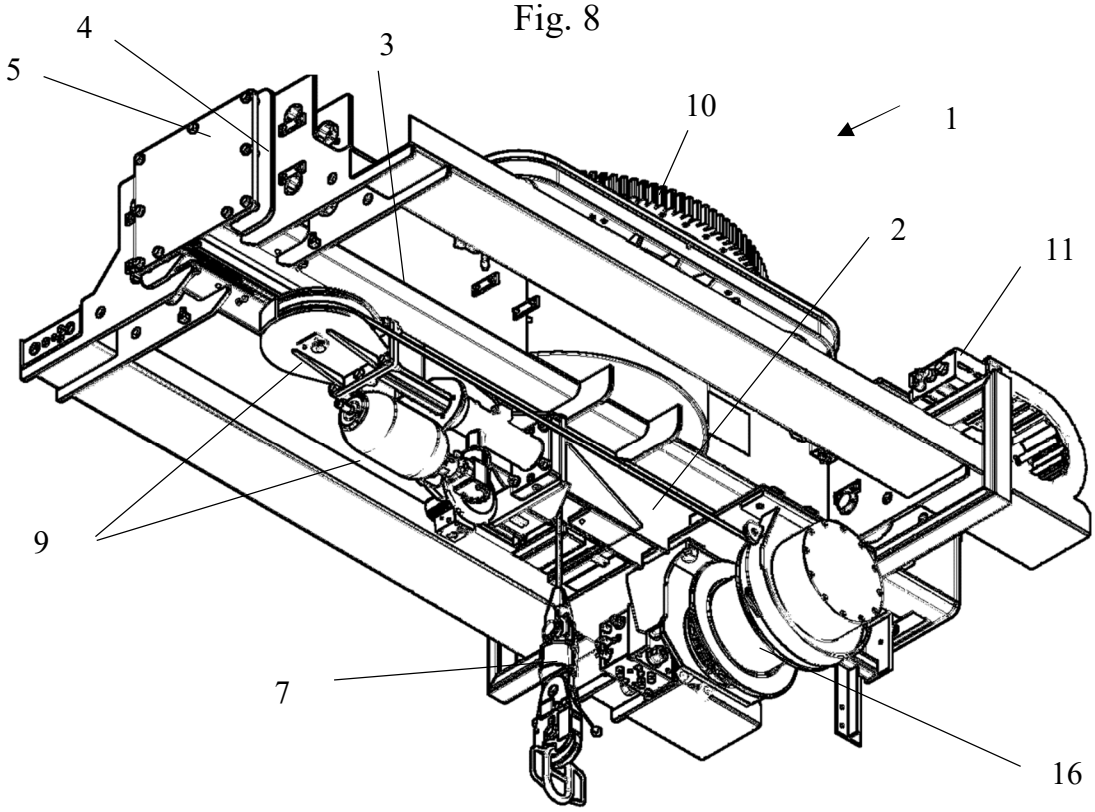

Fig. 9

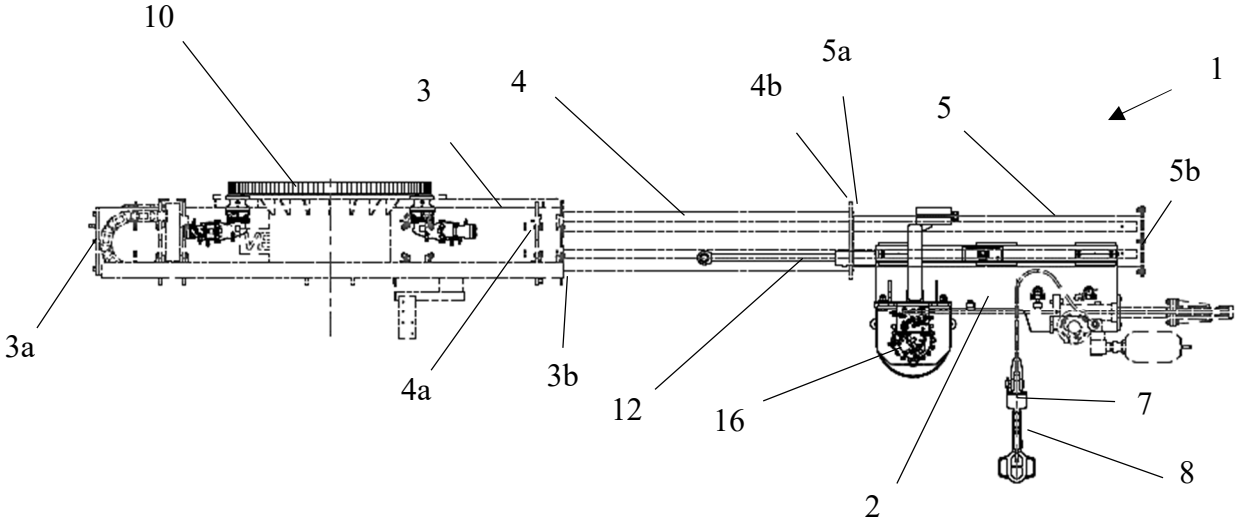

Fig. 10

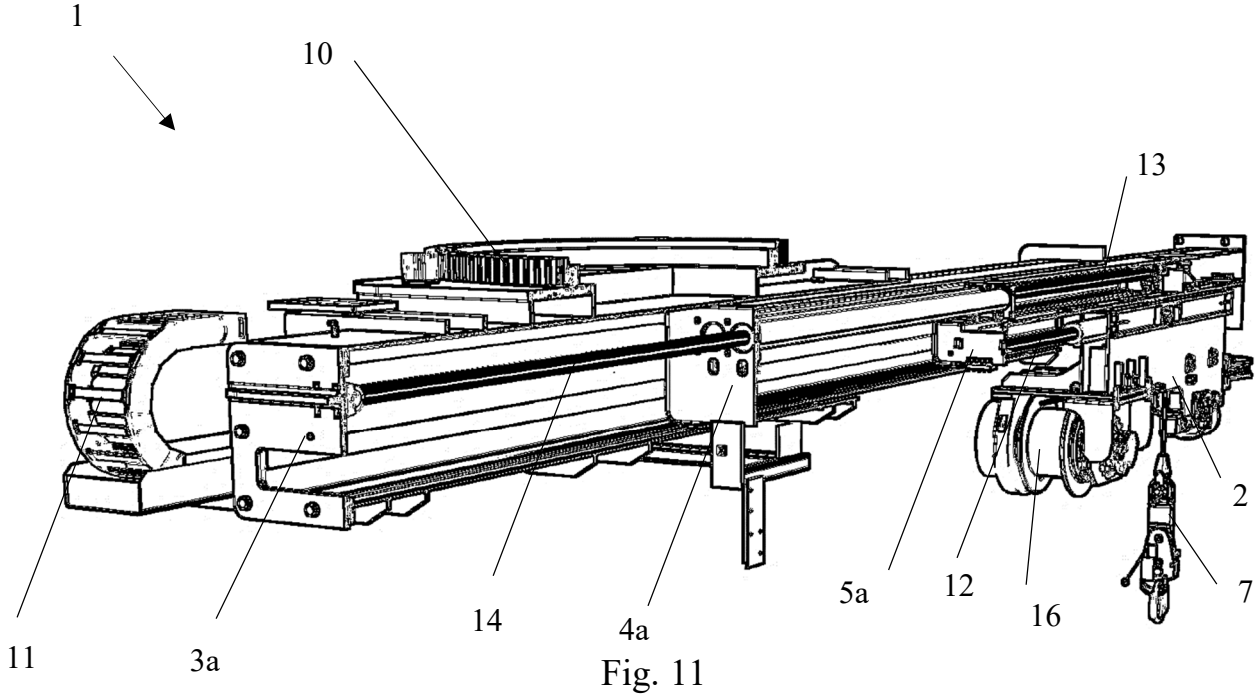

Fig. 11

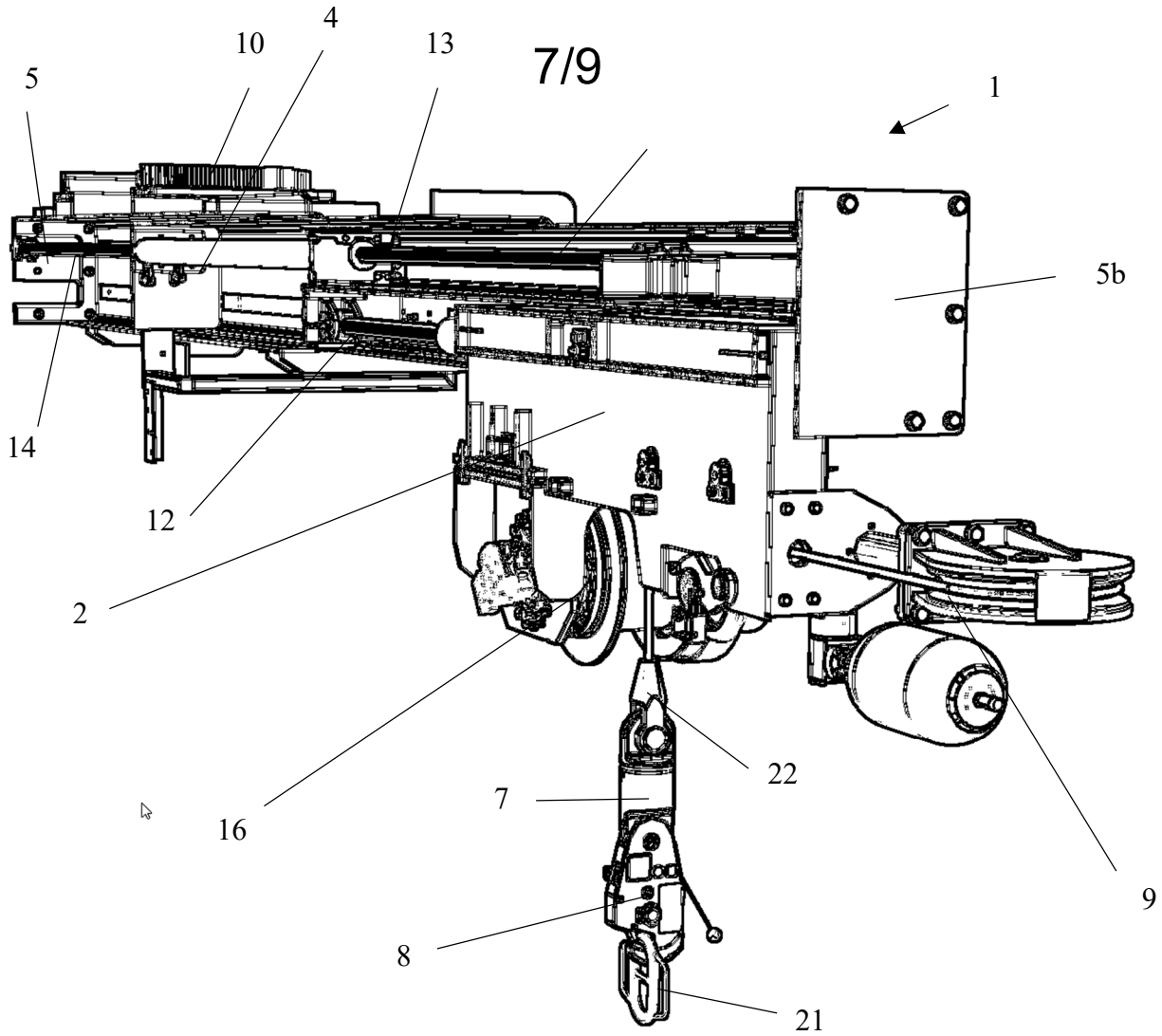

Fig. 12

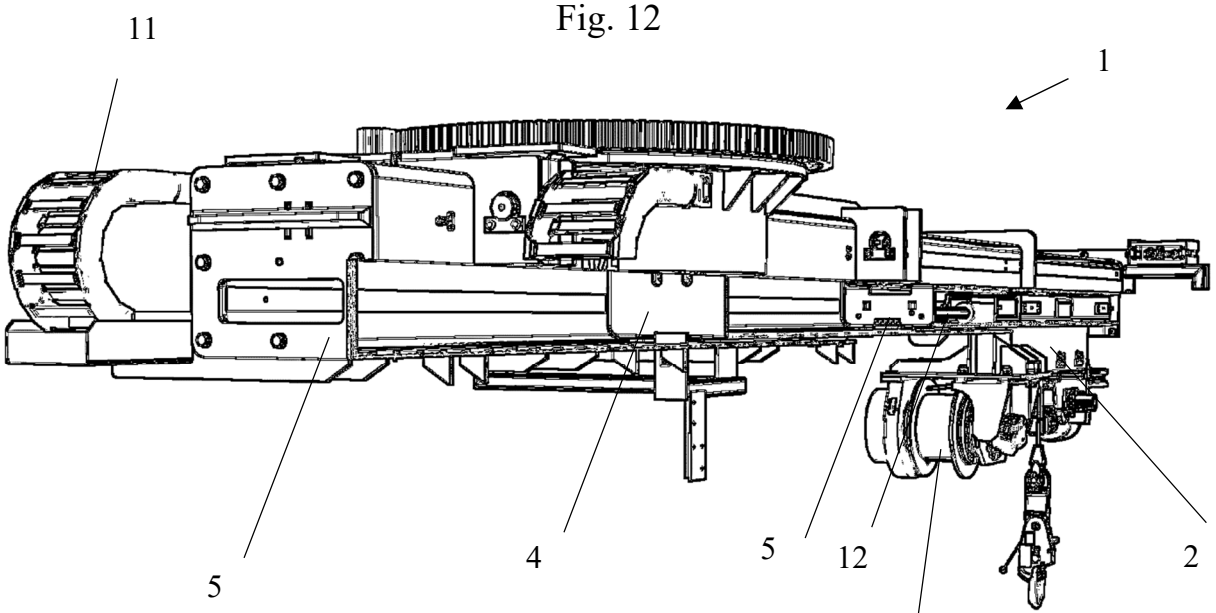

Fig. 13

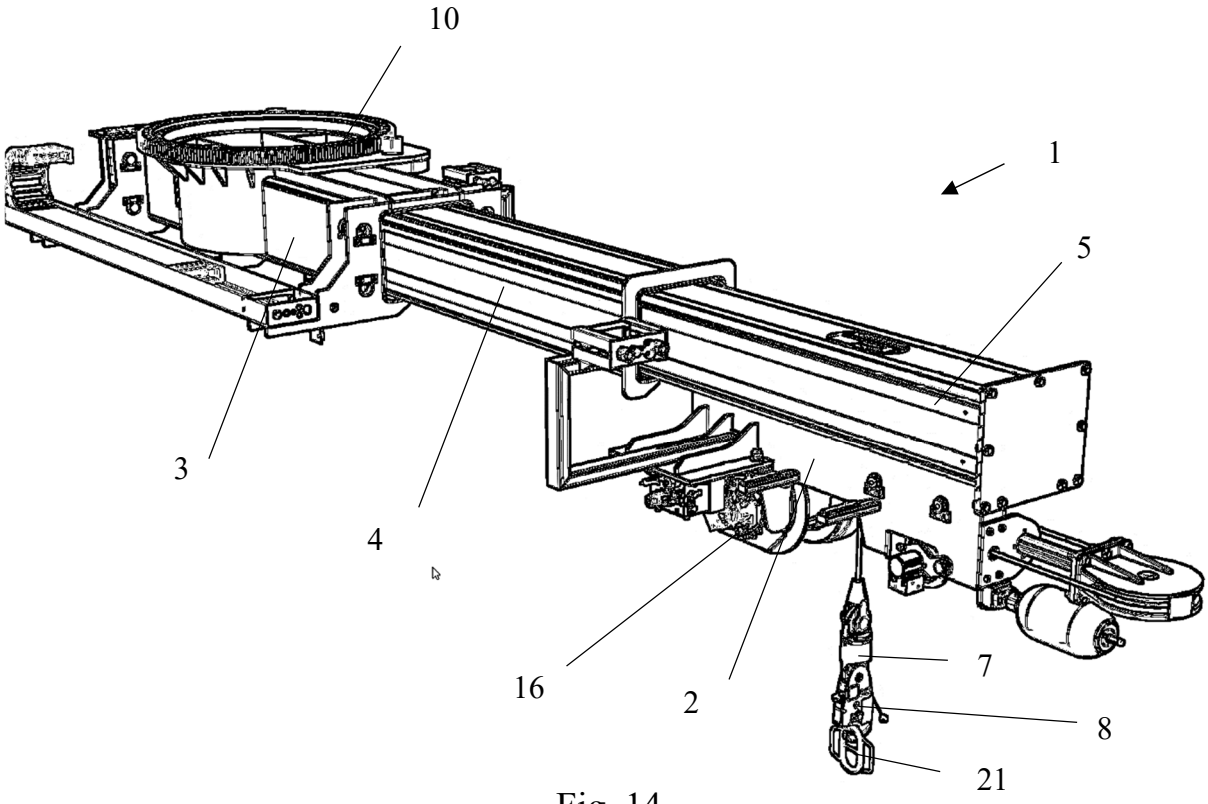

Fig. 14

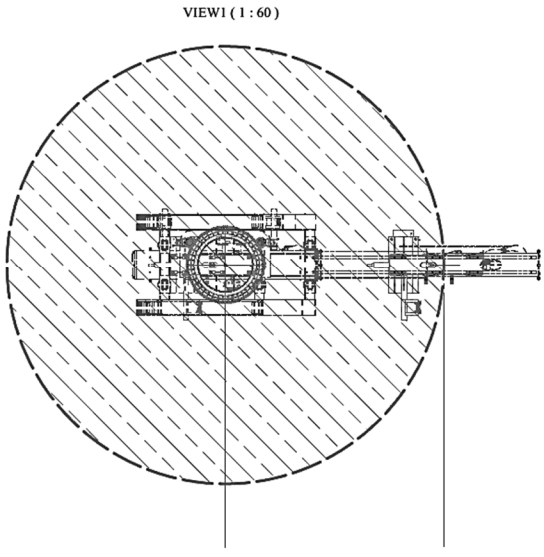

Fig. 15a

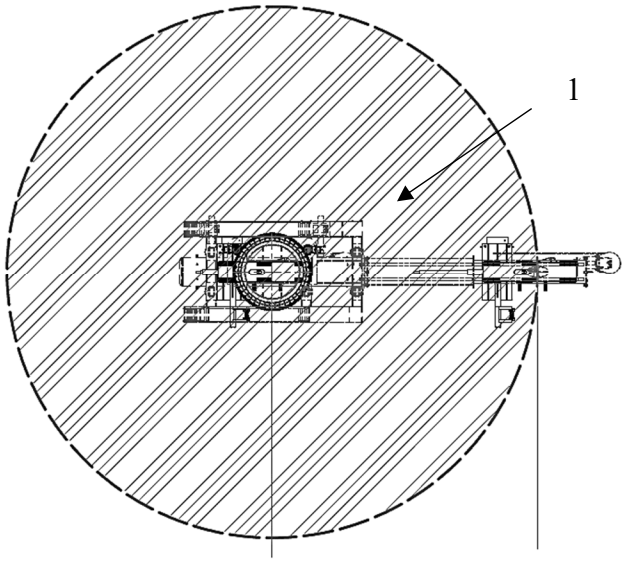

Fig. 15b

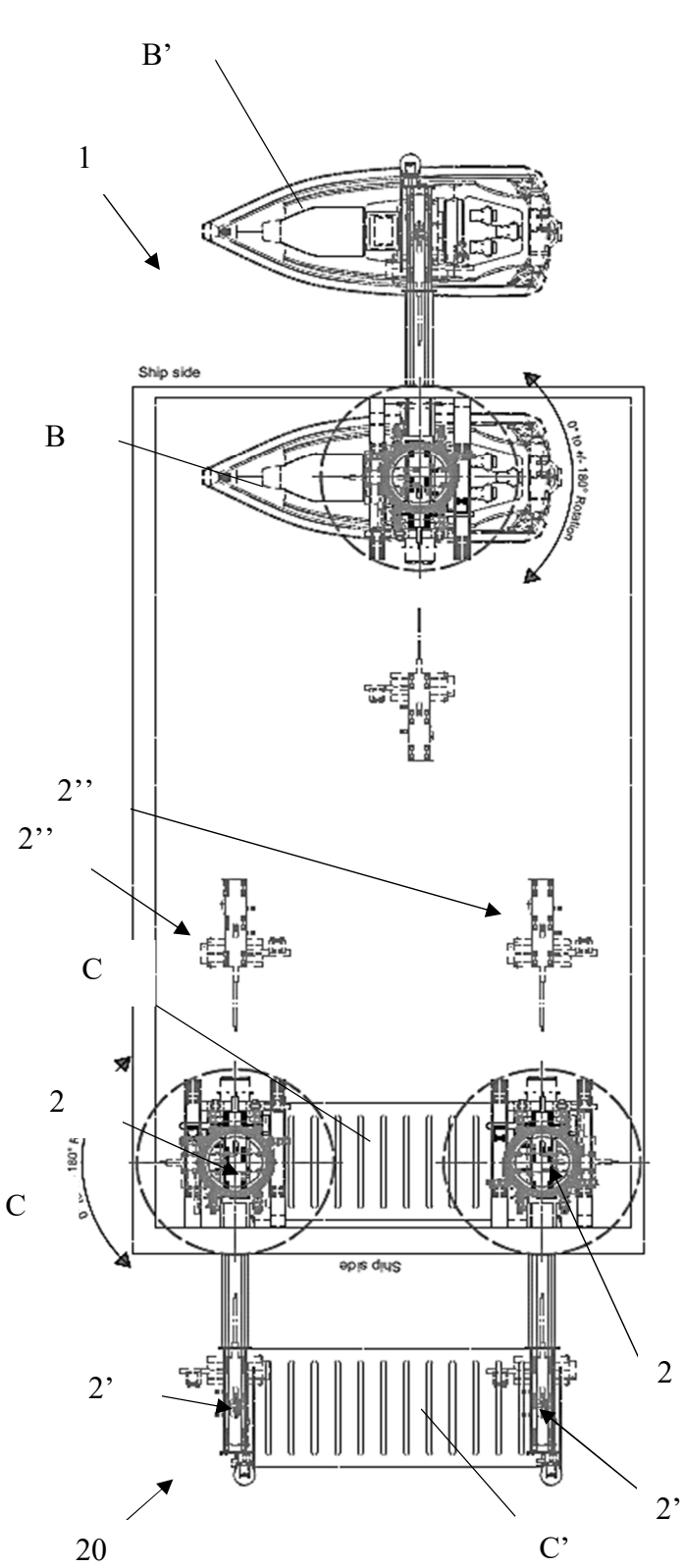

Fig. 16a

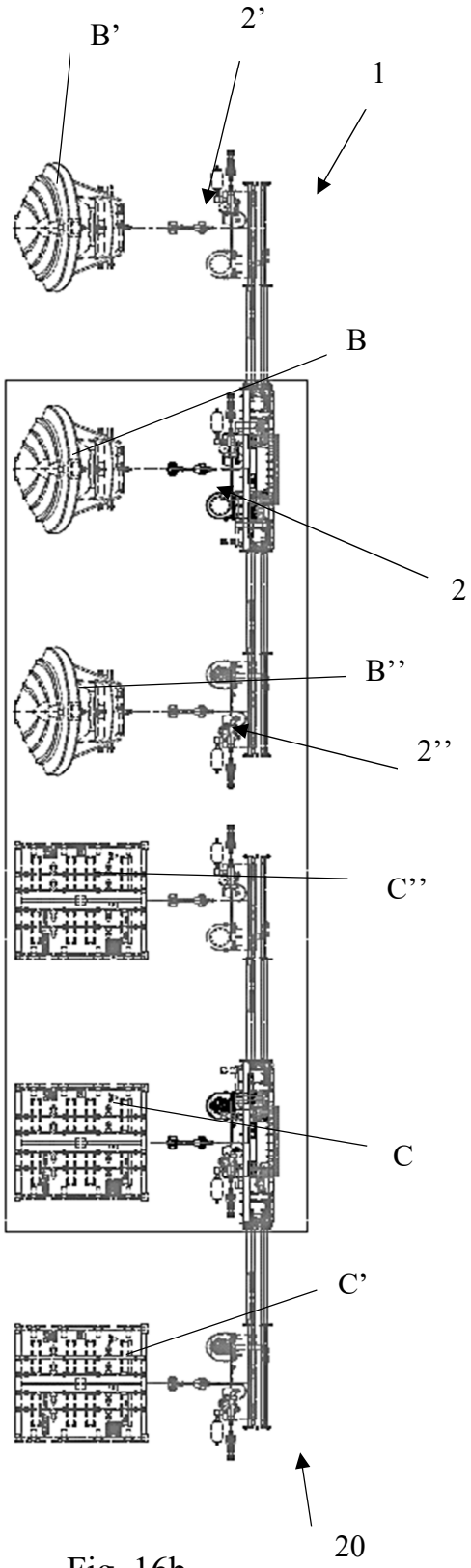

Fig. 16b