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(54) **MARINE FALL PIPE SYSTEM PROVIDING AN INTERMEDIATE OPENING, AND MARINE VESSEL COMPRISING SUCH FALL PIPE SYSTEM**

MEERESFALLROHRSYSTEM MIT ZWISCHENÖFFNUNG UND MEERESFAHRZEUG MIT SOLCH EINEM FALLROHRSYSTEM

SYSTÈME DE TUYAU DE DESCENTE MARIN FOURNISSANT UNE OUVERTURE INTERMÉDIAIRE, ET NAVIRE COMPRENANT UN TEL SYSTÈME DE TUYAU DE DESCENTE MARIN

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EP 3 268 540 B1

Description

FIELD OF THE INVENTION

[0001] The invention relates to a marine fall pipe system constructed for placing blocks of stone and/or rock on a seabed and configured for suspension from a marine vessel, the fall pipe system comprising a substantially tubular fall pipe having an open end for discharging the blocks of rock and/or stone.

BACKGROUND OF THE INVENTION

[0002] Marine fall pipe system are known, for instance, from patent publication WO 2014/098576 A1 and can be applied for placing rock at the bottom of the sea to keep in place and protect a pipeline. During use it may occur that the fall pipe becomes blocked when some larger blocks of rock/and/or stone interfere with one another in the fall pipe such that they remain stuck. Additional blocks will build up within the fall pipe on the blockage that has occurred. This will considerably add to the weight and load of the fall pipe. As a result the fall pipe may break and become lost at the seabed. In the event that the fall pipe would not break it may become so heavy that the hoisting systems for the fall pipe are not able to handle the load, which may also cause loss of the fall pipe.

SUMMARY OF THE INVENTION

[0003] It is an objective of the invention to provide a marine fall pipe system with which additional load due to a blockage can be prevented.

[0004] It is another or alternative objective of the invention to provide a marine fall pipe system that will not become lost upon occurrence of a blockage in the fall pipe.

[0005] At least one of the above objectives is achieved by a marine fall pipe system constructed for placing blocks of stone and/or rock on a seabed and configured for suspension from a marine vessel, the fall pipe system comprising a substantially tubular fall pipe having an open end for discharging the blocks of rock and/or stone, and the fall pipe system comprising an opening arrangement constructed such as to allow opening the substantially tubular fall pipe to provide an intermediate opening at a position along its length for discharging the blocks of stone and/or rock at said position from the fall pipe. When a blockage occurs the intermediate opening can be opened at an appropriate position along the fall pipe by the opening arrangement so as to discharge the blocks of rock and/or stone above the blockage. The input of new blocks into the fall pipe will be stopped. Only the blocks of rock and/or stone of the blockage and possibly some blocks on top of that will add to the load of the fall pipe, which is only a minor load.

[0006] In an embodiment the opening arrangement is constructed such as to allow to locally discontinue the

fall pipe to provide an opening.

[0007] In yet another embodiment the fall pipe comprises substantially tubular fall pipe segments that are each by at least one attachment element attached to and suspended from at least one longitudinal suspension element, one or more of the connection elements being disconnectable from the longitudinal suspension element to provide the opening arrangement and the intermediate opening when disconnected.

[0008] In yet another embodiment the one or more connection elements comprise explosion bolts.

[0009] In yet another embodiment the one or more connection elements comprise a predetermined weakened part at which the connection element will break at a load exceeding a predetermined load.

[0010] In yet another embodiment the fall pipe comprises substantially tubular fall pipe segments, at least one of the tubular fall pipe segments comprising a predetermined weakened part at which the tubular segment will break at a load exceeding a predetermined load to provide the opening arrangement and the intermediate opening when broken.

[0011] In an embodiment the opening arrangement is constructed such that the blocks or stone and/or rock are directed at least partially sideways from the fall pipe at the intermediate opening.

[0012] In yet another embodiment the fall pipe comprises substantially tubular fall pipe segments, at least one of the tubular fall pipe segments comprising a slide-out mechanism to provide the opening arrangement and the intermediate opening when slid-out.

[0013] In an advantageous embodiment the fall pipe comprises

- substantially tubular fall pipe segments configurable to provide at least first and second fall pipe sections of fall pipe segments; and
- a suspension module configured to be suspended from the marine vessel and configured for suspending the second fall pipe section of fall pipe segments from the suspension module so as to continue the first fall pipe section of fall pipe segments, such that the first fall pipe section and the suspension module with the second fall pipe section each are independently suspended from the marine vessel the suspension module being configured to allow shifting sideways at least one of a bottom fall pipe segment of the first fall pipe section and a top fall pipe segment of the second fall pipe section such that an end of the first fall pipe section provides the intermediate opening and any blocks of rock and/or stone passing through the first fall pipe section are not discharged into the second fall pipe section.

[0014] In an embodiment the suspension module is configured to allow shifting sideways and lifting the bottom segment of the first fall pipe section.

[0015] In an embodiment the suspension module com-

prises a segment holding arrangement configured for holding the bottom fall pipe segment of the first fall pipe section.

[0016] In yet another embodiment the fall pipe segments comprise bottomless buckets configurable to provide a fall pipe section of bottomless buckets attached to and suspended from a suspension set of at least one longitudinal suspension element, such that an open bottom side of a bucket above a bottom bucket of the fall pipe section opens into an open top side of an adjacent bucket there below, and an open top side of a bucket below a top bucket of the fall pipe section receives an open bottom side of an adjacent bucket there above.

[0017] In an embodiment an external perimeter of a bottom side of the bottomless buckets is smaller than an internal perimeter of a top side of the bottomless buckets.

[0018] In an embodiment the buckets have a substantially conical shape.

[0019] In an embodiment the suspension set of the second section of bottomless buckets is suspended from the suspension module and/or the suspension set of the first section of bottomless buckets is suspended from the marine vessel.

[0020] In an embodiment the suspension set of the second section of bottomless buckets continues in the suspension set of the first section of bottomless buckets, and the suspension module is configured for releasably holding the suspension set.

[0021] In an embodiment the suspension module comprises a suspension set holding arrangement configured for holding the suspension set above the top bucket of the second fall pipe section.

[0022] In an embodiment the longitudinal suspension element comprising one of a cable, chain or wire.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] Further features and advantages of the invention will become apparent from the description of the invention by way of non-limiting and non-exclusive embodiments. These embodiments are not to be construed as limiting the scope of protection. The person skilled in the art will realize that other alternatives and equivalent embodiments of the invention can be conceived and reduced to practice without departing from the scope of the present invention. Embodiments of the invention will be described with reference to the accompanying drawings, in which like or same reference symbols denote like, same or corresponding parts, and in which

Figure 1 shows part of a vessel carrying an embodiment of a fall pipe system according to the invention; Figure 2 shows a detail of the fall pipe system of figure 1;

Figure 3a shows a suspension module according to the invention as incorporated in the fall pipe system of figure 1;

Figure 3b shows a suspension holding arrangement

of the suspension module of figure 3a;

Figure 3c shows a bucket holding arrangement of the suspension module of figure 3a;

Figure 3d schematically shows a top section of the fall pipe shifted sideways at the suspension module of figure 3a;

Figure 4 schematically shows a large-scale view of a marine vessel provided with a fall pipe system according to the invention;

Figures 5a and 5b shows another embodiment of a fall pipe systems in which a blockage has occurred; Figures 6a and 6b show another embodiment of a fall pipe system according to the invention;

Figures 7a and 7b show part of yet another embodiment of a fall pipe system according to the invention; and

Figures 8a and 8b show part of yet another embodiment of a fall pipe system according to the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0024] Figure 1 shows part of a marine vessel 10 on which a fall pipe system is arranged. A fall pipe 100 made up of various fall pipe segments 110 suspends down from the vessel through a shaft 11 in the vessel to a large depth just above a sea bed SB. The shaft may also be referred to as a moon pool. The fall pipe segments need not be lowered through a moon pool, but could also be lowered next to a marine vessel in an alternative embodiment. Blocks of stone and/or rock R are provided by a conveyer 12 arranged on the vessel to a top end of the fall pipe and subsequently drop down the tubular fall pipe, as indicated by unlabeled arrows shown above the conveyer and within the fall pipe. The blocks of stone and/or rock R are discharged from the bottom end opening of the last (bottom) fall pipe segment 110.2B of the fall pipe to be positioned on the sea bed SB.

[0025] A driver arrangement 140 may be provided at the end of the fall pipe for positioning the end of the fall pipe at the correct position of the sea bed. The driver arrangement can be coupled to a fall pipe segment or be supported by alternative means, such as a floating arrangement or additional suspension wires. The driver arrangement 140 may also be left out.

[0026] The tubular fall pipe segments 110 are connected to one another by a suspension set of longitudinal suspension elements in the form of chains, wires, or (steel) cables, 120, which also serve to lift and lower the fall pipe segments using hoisting arrangement 130 on the marine vessel 10 through shaft 11 or otherwise. Individual fall pipe segments may be added and connected to the steel cables or chains 120 at the top end of the fall pipe, as required, when the fall pipe is lowered and disconnected and removed again when the fall pipe is being lifted. Any other suitable manner of providing or storing the fall pipe segments may be employed as well, such as storing and feeding segments 110 already attached to chains 120.

[0027] Figure 2 shows some fall pipe segments 110 with connecting chains 120 of the fall pipe in more detail. A fall pipe segment 110 comprises a substantially conical shaped bottomless bucket 111. The bottomless buckets can be made of any suitable material like, for instance, steel or a medium density grade polyethylene, such as, for instance, Rigidex HD3850UA, supplied in pellet form for use in a rotational molding process to actually manufacture the bucket. The bottomless buckets 111 are attached to the chains 120 such that a top side of one bucket 111 overlaps with a bottom side of an adjacent bottomless bucket 111. An external perimeter and cross-section of the bottom side of the buckets 111 is smaller than an internal perimeter and cross-section of the top side of the buckets such that a gap G is left open between the top side of one bucket and the bottom side of an adjacent bucket. Water may flow through the gaps G as indicated by the arrows. One bucket projects into an adjacent bucket that is neighboring there below. Such configuration guarantees a reliable transport of rock downwards, while providing a flexible fall pipe system made up from the bottomless buckets 111. The conical shape of the buckets also allows the buckets to be nested into one another for the reduction of storage space on, for instance, the vessel 10.

[0028] At their top sides the buckets have, in the embodiment shown, a collar 112 with an arrangement 113 for attachment to the (steel cable or) chain 120, which is known as such, such that the bottomless bucket suspends from the chains 120. A position of a fall pipe segment 110 is therefore fixed with respect to the chains 120 and substantially fixed with respect to adjacent fall pipe segments although it allows some movement of adjacent fall pipe segments 110 with respect to one another for providing flexibility to the fall pipe.

[0029] At about the middle of the fall pipe 100 a suspension module 200 is provided, which divides the fall pipe 100 in an upper or first fall pipe section 101 and a lower or second fall pipe section 102. The suspension module 200 is shown in more detail in figures 3a, 3b and 3c. It is suspended from longitudinal suspension elements in the form of cables or chains 220 and can be raised and lowered through hoisting arrangement 230 on the marine vessel 10. The hoisting arrangements 130, 230 are positioned one above the other on the vessel in the embodiment shown. The cables (or chains) 220 bear the weight of the suspension module and the lower (second) fall pipe section 102 of buckets 110. The bottomless buckets 110 of both the upper (first) and lower fall pipe sections 101, 102 are, in the embodiment disclosed, suspended from one suspension set of chains 120, the suspension set of one fall pipe section being continued in the suspension set of the other fall pipe section.

[0030] The suspension module 200 comprises a suspension set holding arrangement 210 for holding the suspension set of cables or chains 120. The holding arrangement 210 is shown in more detail in figure 3b and comprises two blocks 211 that can be driven towards one

another by hydraulic cylinders 212 so as to grab and hold the chains 120 of the suspension set. The holding arrangement 210 of the embodiment disclosed is specifically suited for holding chains. Other embodiments can be envisioned as well for the holding arrangement 210 for holding chains or cables.

[0031] When the fall pipe 100 has not yet been lowered from the vessel, both the driver arrangement 140 and suspension module 200 are located on the marine vessel 10 near the top suspension point of the fall pipe. To deploy the lower fall pipe section, bottomless buckets 110 attached to the suspension set are passed through a central opening 245 in a bucket holding arrangement 240 of the suspension module 200 and lowered into the sea when further unwinding chains from the hoisting arrangement 130 and lowering the driver arrangement. A diameter of the opening 245 allows passing of buckets 110 at that moment. After some time all the buckets 110 of the lower (second) fall pipe section 102 have passed through the central opening 245 of the suspension module. The blocks 211 of the suspension set holding arrangement 210 will then close by activating the hydraulic cylinders 212 so as to grab and hold the cables or chains 120 of the suspension set just above the top bucket 110.2T of the lower fall pipe section 102. By holding the cables or chains 120 at this position the suspension module 200 holds the top bucket 110.2T and bears the weight of the lower fall pipe section 102.

[0032] Figure 3c shows a situation just after closure of blocks 211 of suspension set holding arrangement 210. Chains 120 of the suspension set of the lower fall pipe section 102 below the suspension module 200 show to be taut, whereas the chains 120 of the suspension set of the upper fall pipe section just above the suspension module show some slack due to further advancing of a next bottomless bucket. The central opening 245 of the bucket holding arrangement 240 of the suspension module is then decreased in diameter by an inward movement of two semi circularly shaped parts 246, which is again effected by hydraulic cylinders (not shown). Figure 3c shows the situation after inward movement of parts 246 to provide a central opening 245 with decreased diameter to allow holding a bottomless bucket.

[0033] Bottomless buckets 110 are subsequently further provided towards suspension module 200 to yield the top (first) fall pipe section 101. A last (bottom) bucket 110.1B of the top fall pipe section is held in reduced diameter opening 245 of the suspension module. The suspension module is lowered into the sea followed by further bottomless buckets 110 of the top fall pipe section 101. The suspension module is lowered by unwinding suspension cables 220 from hoisting arrangement 230. The weight of the upper fall pipe section 101 is born by the hoisting arrangement 130, while the weight of the suspension module and lower fall pipe section 102 is born by the hoisting arrangement 230. Holding the bottom bucket 110.1B in reduced diameter opening 245 keeps the bottom end of the top fall pipe section in place with

respect to the suspension module.

[0034] Figures 1 and 3a show that three buckets 110 are nested into one another on top of the suspension module 200. This is to allow for some variation in length of the top fall pipe section 101 with respect to a distance between suspension module 200 and the vessel 10.

[0035] The bottom bottomless bucket 110.1B of the first fall pipe section 101 can be moved sideward in the suspension module 200 by a sideward movement of the bucket holding arrangement 240. Figure 3a shows a guiding groove 241 for the sideward movement of the holding module 240, which can be moved by one or more hydraulic cylinders that are not shown in the drawings. The guiding groove 246 provides for a sideward and upward movement of the holding module 240 and therefore of the bottom bucket 110.1B of the first fall pipe section. The upward and sideward movement of the bucket holding arrangement 240 allows the bottom bucket 110.1B to be moved upward and sideward with respect to the top bucket 110.2T of the second fall pipe section 102. Any material passing through the top fall pipe section 101 is then not discharged into the bottom fall pipe section 102, which is advantageous in case there is a blockage in the lower fall pipe section. Such blockage is further described below with reference to figures 5a and 5b. The material passing through the upper fall pipe section 101 is directly discharged into the sea through intermediate opening 170 that is the end of the first fall pipe section 101. This is schematically shown in figure 3d. No additional weight is then added to the fall pipe 100. A blockage may be detected by appropriate sensors for chain load measurement, for instance, added to the hoisting systems 130, 230, or by other suitable sensors fitted to the fall pipe for this purpose.

[0036] Figure 4 shows a schematic large-scale view of a marine vessel 10 provided with a fall pipe system 100 according to the invention. The vessel is travelled to a location where stone and/or rock is to be placed on the bottom of the sea. The stone and/or rock may be taken with the vessel, provided by another vessel or supplied in another suitable manner. At the desired location the stone or rock is provided to the sea bed using the fall pipe system. The blocks of stone and/or rock R are placed at a sea depth SD of, for instance, about 1,500 meter. Figure 4 also shows the influence of dynamic loads due to, for instance, water currents. The example of figure 4 shows one current closer to sea level in a direction CD1 and another water current near to the sea bed SB in an opposite direction CD2. Such water currents may pose horizontal loads on the fall pipe system, which can be handled by the fall pipe system as disclosed.

[0037] Figures 5a to 8b show another type of fall pipe system 100, which does not have a suspension module as has been described with respect to the previous figures. The fall pipe system of figure 5a does have a single section of fall pipe segments 110 in the form of bottomless buckets. The fall pipe segments 110 are again connected to a chain 120, which can be lifted and lowered by hoisting

arrangement 130. The driver arrangement is suspended from another set of longitudinal suspension elements in the form of cables 320, and is lifted and lowered by hoisting arrangement 330 provided on the vessel 10. The fall pipe 100 and driver arrangement are thus independently suspended from the vessel. Blocks R of rock and/or stone are provided by conveyer 12 into the fall pipe and are discharged at the end of the fall pipe on the seabed SB. A blockage of blocks R has occurred in one of the tubular segments, as better shown in the enlarged detail of figure 5b.

[0038] In the embodiment shown in figures 6a and 6b an intermediate opening 170 is provided in the fall pipe by providing a discontinuity in the fall pipe by breaking the connection 113 with the chain 120, of the fall pipe section in which the blockage has occurred. Alternatively, the connection of a fall pipe segment 110 (shortly) above the fall pipe segment having the blockage with the chain 120 may be broken. Connections of multiple fall pipe segments can be broken as well. The fall pipe segment(s) of which the connection 113A has been broken will drop down on the fall pipe segments there below, of which the connections 113 with the chain 120 are still intact to provide the intermediate opening 170 as shown in figure 6b. A connection to be broken is designated by reference sign 113A and a corresponding fall pipe segment by reference sign 110A, which fall pipe segment 110A provides for the opening arrangement. The blocks R that are still being supplied from the top end of the fall pipe will be discharged through the intermediate opening 170 out of the fall pipe in the direction of the arrows shown and do not further add to the weight and therefore load of the fall pipe and carrying hoisting arrangement 130.

[0039] The connections 113A that are to be disconnected can be designed such that they will break when a certain predefined load is exceeded. This can be achieved by material selection and/or configuration design. The connections may also be provided with fracture bolts that will break at a predefined load. Disconnection will then automatically occur when exceeding such predefined load. Alternatively, the connections 113A to be disconnected can be provided with explosion bolts that can be activated when a blockage is detected in the fall pipe to break the connection. A general detection system may be provided and individual explosion bolts activated from the vessel. A detection system may also be provided per tubular fall pipe segment and coupled with the connections 113A of the respective tubular fall pipe segment having the explosion bolts.

[0040] In yet another embodiment shown in figures 7a and 7b one or more tubular segments 110A are provided with a slide-out mechanism 180 to allow providing an intermediate opening in the fall pipe. The slide-out mechanism 180 shown in figures 7a and 7b comprises two wall parts 181, 182 that can be pivoted about respective pivot axes 181.1, 182.1. Rotation of wall part 182.1 is driven by a hydraulic or pneumatic activation cylinder 183, but any other suitable means can be employed as

well. The cylinder could be preloaded and released upon activation of an explosion bolt. A preloaded spring can be employed as will. Rotation of wall part 181 drives rotation of wall part 182 through the connection 184 between both wall parts. Wall part 182 provides the actual intermediate opening 170 from the tubular segment and therefore from the fall pipe 100. Wall part 181 directs the blocks of rock and/or stone falling downwards in the fall pipe sideways out through the intermediate opening 170 in the direction of the arrow in figure 7b. Activation may be triggered by an acoustic underwater signal or an umbilical cable. A small power pack or accumulator may be provided at the respective fall pipe segment(s) to power activation.

[0041] Figures 8a and 8b show yet another embodiment of a fall pipe system according to the invention, in which the opening arrangement comprises weakened parts 190 in some or all tubular fall pipe segments 110. In figures 8a and 8b the fall pipe segment 110A comprises weakened parts 190, which run in the vertical direction from a top part of the fall pipe segment 110A to the bottom edge. When a blockage occurs as shown in figure 8a, an outward force will be exerted on the wall of fall pipe segment 110A, causing the weakened parts 190 to break as shown in figure 8b. The weakened parts are designed to break at a predefined load. The blocks will then leave the fall pipe 100 sideways and downwards in the direction of the arrows shown through intermediate opening 170. In an alternative embodiment the weakened part or weakened parts may run around the tubular fall pipe segment in, for instance, a horizontal plane. When a blockage occurs, part of the fall pipe segment will drop down on a fall pipe segment there below, and an intermediate opening is created.

[0042] An embodiment of the invention has been disclosed with one specific type of fall pipe and fall pipe segments. The invention may be employed with other types of fall pipes and fall pipe segments as well. Various other embodiments of the invention will be apparent to the skilled person when having read the above disclosure in connection with the drawing, all of which as within the scope of the invention and accompanying claims.

Claims

1. A marine fall pipe system (100) constructed for placing blocks of stone and/or rock (R) on a seabed (SB) and configured for suspension from a marine vessel (10), the fall pipe system comprising a substantially tubular fall pipe (100) having an open end for discharging the blocks of rock and/or stone, and the fall pipe system comprising an opening arrangement constructed such as to allow opening the substantially tubular fall pipe to provide an intermediate opening (170) at a position along its length for discharging the blocks of stone and/or rock at said position from the fall pipe.

2. The fall pipe system according to claim 1, wherein the opening arrangement is constructed such as to allow to locally discontinue the fall pipe (100) to provide the intermediate opening (170).
3. The fall pipe system according to the preceding claim, wherein the fall pipe (100) comprises substantially tubular fall pipe segments (110) that are each by at least one attachment element (113, 113A) attached to and suspended from at least one longitudinal suspension element (120), one or more of the connection elements being disconnectable from the longitudinal suspension element to provide the opening arrangement and the intermediate opening (170) when disconnected.
4. The fall pipe system according to the preceding claim, wherein the one or more connection elements (113A) comprise explosion bolts.
5. The fall pipe system according to claim 3, wherein the one or more connection elements (113A) comprise a predetermined weakened part at which the connection element will break at a load exceeding a predetermined load.
6. The fall pipe system according to claim 2, wherein the fall pipe (100) comprises substantially tubular fall pipe segments (110, 110A), at least one of the tubular fall pipe segments (110A) comprising a predetermined weakened part at which the tubular segment will break at a load exceeding a predetermined load to provide the opening arrangement and the intermediate opening (170) when broken.
7. The fall pipe system according to claim 1 or 2, wherein the opening arrangement is constructed such that the blocks or stone and/or rock (R) are directed at least partially sideways from the fall pipe (100) at the intermediate opening (170), optionally the fall pipe (100) comprising substantially tubular fall pipe segments (110, 110A), at least one of the tubular fall pipe segments (110A) comprising a slide-out mechanism to provide the opening arrangement and the intermediate opening (170) when slid-out.
8. The fall pipe system according to claim 1 or 7, wherein the fall pipe comprises
 - substantially tubular fall pipe segments (110) configurable to provide at least first and second fall pipe sections (101, 102) of fall pipe segments; and
 - a suspension module (200) configured to be suspended from the marine vessel and configured for suspending the second fall pipe section (102) of fall pipe segments from the suspension

- module so as to continue the first fall pipe section (101) of fall pipe segments, such that the first fall pipe section (101) and the suspension module (200) with the second fall pipe section (102) each are independently suspended from the marine vessel (10) the suspension module (200) being configured to allow shifting sideward at least one of a bottom fall pipe segment (110.1B) of the first fall pipe section (101) and a top fall pipe segment (110.2T) of the second fall pipe section (102) such that an end of the first fall pipe section provides the intermediate opening (170) and any blocks of rock and/or stone passing through the first fall pipe section (101) are not discharged into the second fall pipe section (102).
9. The fall pipe system according to the preceding claim, wherein the suspension module (200) is configured to allow shifting sideward and lifting the bottom segment (110.1B) of the first fall pipe section (101).
10. The fall pipe system according to claim 8 or 9, wherein the suspension module (200) comprises a segment holding arrangement (240) configured for holding the bottom fall pipe segment (110.1B) of the first fall pipe section (101).
11. The fall pipe system according to any one of claims 8 - 10, wherein the fall pipe segments comprise bottomless buckets (110) configurable to provide a fall pipe section (101, 102) of bottomless buckets attached to and suspended from a suspension set of at least one longitudinal suspension element (120), such that an open bottom side of a bucket above a bottom bucket (110.1B, 110.2B) of the fall pipe section opens into an open top side of an adjacent bucket there below, and an open top side of a bucket below a top bucket (110.1T, 110.2T) of the fall pipe section receives an open bottom side of an adjacent bucket there above, optionally an external perimeter of a bottom side of the bottomless buckets (110) being smaller than an internal perimeter of a top side of the bottomless buckets, optionally the buckets (110) having a substantially conical shape, optionally the suspension set of the second section (102) of bottomless buckets being suspended from the suspension module (200) and/or the suspension set of the first section (101) of bottomless buckets is suspended from the marine vessel (10).
12. The fall pipe system according to the preceding claim, wherein the suspension set of the second section (102) of bottomless buckets continues in the suspension set of the first section (101) of bottomless buckets, and the suspension module (200) is configured for releasably holding the suspension set.
13. The fall pipe system according to claim 11 or 12, wherein the suspension module (200) comprises a suspension set holding arrangement (210) configured for holding the suspension set above the top bucket (110.2T) of the second fall pipe section (102).
14. The fall pipe system according to any one of claims 3 - 5 or 11 - 13, wherein the longitudinal suspension element comprising one of a cable, chain or wire.
15. A marine vessel (10) comprising a fall pipe system (100) according to any one of the preceding claims.

Patentansprüche

1. Marines Fallrohrsystem (100), welches ausgebildet ist, um Blöcke aus Stein und/oder Fels (R) auf einem Meeresboden (SB) anzuordnen, und welches konfiguriert ist, um von einem Wasserfahrzeug (10) herunterzuhängen, wobei das Fallrohrsystem ein im Wesentlichen rohrförmiges Fallrohr (100) mit einem offenen Ende zum Auslassen der Blöcke aus Fels und/oder Stein aufweist, und wobei das Fallrohrsystem eine Öffnungsanordnung aufweist, die so ausgebildet ist, dass sie gestattet, das im Wesentlichen rohrförmige Fallrohr zu öffnen, um eine Zwischenöffnung (170) an einer Position entlang seiner Länge vorzusehen, um die Blöcke aus Stein und/oder Fels an der Position aus dem Fallrohr auszulassen.
2. Fallrohrsystem gemäß Anspruch 1, wobei die Öffnungsanordnung so ausgebildet ist, dass sie gestattet, das Fallrohr (100) lokal zu unterbrechen, um die Zwischenöffnung (170) vorzusehen.
3. Fallrohrsystem gemäß dem vorhergehenden Anspruch, wobei das Fallrohr (100) im Wesentlichen rohrförmige Fallrohrsegmente (110) aufweist, die jeweils durch zumindest ein Befestigungselement (113, 113A) an mindestens einem längs verlaufenden Aufhängungselement (120) angebracht sind und davon herunterhängen, wobei eines oder mehrere der Verbindungselemente von dem längs verlaufenden Aufhängungselement getrennt werden können, um die Öffnungsanordnung und die Zwischenöffnung (170) vorzusehen, wenn diese getrennt sind.
4. Fallrohrsystem gemäß dem vorhergehenden Anspruch, wobei das eine oder die mehreren Verbindungselemente (113A) Sprengschrauben bzw. Sprengbolzen aufweisen.
5. Fallrohrsystem gemäß Anspruch 3, wobei das eine

- oder die mehreren Verbindungselemente (113A) einen vorbestimmten geschwächten Teil aufweisen, bei dem das Verbindungselement bei einer Last brechen wird, welche eine vorbestimmte Last überschreitet.
6. Fallrohrsystem gemäß Anspruch 2, wobei das Fallrohr (100) im Wesentlichen rohrförmige Fallrohrsegmente (110, 110A) aufweist, wobei zumindest eines der rohrförmigen Fallrohrsegmente (110A) einen vorbestimmten geschwächten Teil aufweist, bei dem das rohrförmige Segment bei einer Last brechen wird, welche eine vorbestimmte Last überschreitet, um die Öffnungsanordnung und die Zwischenöffnung (170) vorzusehen, wenn es zerbrochen ist.
7. Fallrohrsystem gemäß Anspruch 1 oder 2, wobei die Öffnungsanordnung so ausgebildet ist, dass die Blöcke aus Stein und/oder Fels (R) zumindest teilweise seitwärts aus dem Fallrohr (100) bei der Zwischenöffnung (170) geleitet werden, wobei optional das Fallrohr (100) im Wesentlichen rohrförmige Fallrohrsegmente (110, 110A) aufweist, wobei zumindest eines der rohrförmigen Fallrohrsegmente (110A) einen Herausschiebemechanismus aufweist, um die Öffnungsanordnung und die Zwischenöffnung (170) vorzusehen, wenn er herausgeschoben ist.
8. Fallrohrsystem gemäß Anspruch 1 oder 7, wobei das Fallrohr Folgendes aufweist:
- im Wesentlichen rohrförmige Fallrohrsegmente (110), die konfigurierbar sind, um zumindest erste und zweite Fallrohrabschnitte (101, 102) der Fallrohrsegmente vorzusehen; und
 - ein Aufhängungsmodul (200), welches konfiguriert ist, um von dem Wasserfahrzeug herunterzuhängen, und welches konfiguriert ist, um den zweiten Fallrohrabschnitt (102) der Fallrohrsegmente von dem Aufhängungsmodul herunterhängen zu lassen, um den ersten Fallrohrabschnitt (101) der Fallrohrsegmente fortzusetzen, so dass der erste Fallrohrabschnitt (101) und das Aufhängungsmodul (200) mit dem zweiten Fallrohrabschnitt (102) jeweils unabhängig von dem Wasserfahrzeug (10) herunterhängen, wobei das Aufhängungsmodul (200) konfiguriert ist, um eine seitliche Verschiebung von zumindest einem unteren Fallrohrsegment (110.1B) des ersten Fallrohrabschnittes (101) und eines oberen Fallrohrsegmentes (110.2T) des zweiten Fallrohrabschnittes (102) zu gestatten, so dass ein Ende des ersten Fallrohrabschnittes die Zwischenöffnung (170) vorsieht, und irgendwelche Blöcke aus Fels und/oder Stein, welche durch den ersten Fallrohrabschnitt (101) hindurchgehen, nicht in den zweiten Fallrohrabschnitt (102) ausgegeben werden.
9. Fallrohrsystem gemäß dem vorhergehenden Anspruch, wobei das Aufhängungsmodul (200) konfiguriert ist, um eine seitliche Verschiebung und ein Anheben des unteren Segmentes (110.1B) des ersten Fallrohrabschnittes (101) zu gestatten.
10. Fallrohrsystem gemäß Anspruch 8 oder 9, wobei das Aufhängungsmodul (200) eine Segmenthalteanordnung (240) aufweist, die konfiguriert ist, um das untere Fallrohrsegment (110.1B) des ersten Fallrohrabschnittes (101) zu halten.
11. Fallrohrsystem gemäß irgendeinem der Ansprüche 8-10, wobei die Fallrohrsegmente bodenlose Eimer (110) aufweisen, die konfigurierbar sind, um einen Fallrohrabschnitt (101, 102) aus bodenlosen Eimern vorzusehen, die an einem Aufhängungsatz von mindestens einem längs verlaufenden Aufhängeelement (120) angebracht sind und von diesem herunterhängen, so dass eine offene Unterseite eines Eimers über einem unteren Eimer (110.1B, 110.2B) des Fallrohrabschnittes sich in eine offene Oberseite eines benachbarten Eimers darunter öffnet, und wobei eine offene Oberseite eines Eimers unter einem oberen Eimer (110.1T, 110.2T) des Fallrohrabschnittes eine offene Unterseite eines benachbarten Eimers darüber aufnimmt, wobei optional ein Außenumfang einer Unterseite der bodenlosen Eimer (110) kleiner ist als ein Innenumfang einer Oberseite der bodenlosen Eimer, wobei optional die Eimer (110) eine im Wesentlichen konische Form haben, wobei optional der Aufhängungsatz des zweiten Abschnittes (102) der bodenlosen Eimer von dem Aufhängungsmodul (200) herunterhängt und/oder wobei der Aufhängungsatz des ersten Abschnittes (101) der bodenlosen Eimer von dem Wasserfahrzeug (10) herunterhängt.
12. Fallrohrsystem gemäß dem vorhergehenden Anspruch, wobei der Aufhängungsatz des zweiten Abschnittes (102) von bodenlosen Eimern in dem Aufhängungsatz des ersten Abschnittes (110) von bodenlosen Eimern fortgesetzt wird, und wobei das Aufhängungsmodul (200) konfiguriert ist, um den Aufhängungsatz in lösbarer Weise zu halten.
13. Fallrohrsystem gemäß Anspruch 11 oder 12, wobei das Aufhängungsmodul (200) eine Aufhängungsatzhalteanordnung (210) aufweist, die konfiguriert ist, um den Aufhängungsatz über dem oberen Eimer (110.2T) des zweiten Fallrohrabschnittes (102) zu halten.
14. Fallrohrsystem gemäß irgendeinem der Ansprüche

3-5 oder 11-13, wobei das längs verlaufende Aufhängungselement ein Kabel bzw. Drahtseil, eine Kette oder einen Draht aufweist.

15. Wasserfahrzeug (10), welches ein Fallrohrsystem (100) gemäß irgendeinem der vorhergehenden Ansprüche aufweist.

Revendications

1. Système de tuyau de descente marin (100) construit pour placer des blocs de pierre et/ou de roche (R) sur un fond marin (SB) et configuré pour être suspendu à partir d'un navire marin (10), le système de tuyau de descente comprenant un tuyau de descente sensiblement tubulaire (100) ayant une extrémité ouverte pour décharger les blocs de roche et/ou de pierre, et le système de tuyau de descente comprenant un agencement d'ouverture construit pour permettre l'ouverture du tuyau de descente sensiblement tubulaire afin de fournir une ouverture intermédiaire (170) dans une position le long de sa longueur pour décharger les blocs de pierre et/ou de roche à ladite position du tuyau de descente.
2. Système de tuyau de descente selon la revendication 1, dans lequel l'agencement d'ouverture est construit de manière à permettre d'interrompre localement le tuyau de descente (100) afin de fournir l'ouverture intermédiaire (170).
3. Système de tuyau de descente selon la revendication précédente, dans lequel le tuyau de descente (100) comprend des segments de tuyau de descente (110) sensiblement tubulaires qui sont chacun reliés par au moins un élément de fixation (113, 113A) fixé à au moins un élément de suspension longitudinal (120) et suspendu à celui-ci, un ou plusieurs des éléments de connexion pouvant être déconnectés de l'élément de suspension longitudinal pour fournir l'agencement d'ouverture et l'ouverture intermédiaire (170) lorsque déconnecté(s).
4. Système de tuyau de descente selon la revendication précédente, dans lequel les un ou plusieurs éléments de connexion (113A) comprennent des boulons explosifs.
5. Système de tuyau de descente selon la revendication 3, dans lequel les un ou plusieurs éléments de connexion (113A) comprennent une partie affaiblie prédéterminée au niveau de laquelle l'élément de connexion va se rompre sous une charge dépassant une charge prédéterminée.
6. Système de tuyau de descente selon la revendication 2, dans lequel le tuyau de descente (100) com-

prend des segments de tuyau de descente sensiblement tubulaires (110, 110A), au moins l'un des segments de tuyau de descente tubulaires (110A) comprenant une partie affaiblie prédéterminée au niveau de laquelle le segment tubulaire va se rompre sous une charge dépassant une charge prédéterminée pour fournir l'agencement d'ouverture et l'ouverture intermédiaire (170) après ruptures.

7. Système de tuyau de descente selon la revendication 1 ou 2, dans lequel l'agencement d'ouverture est construit de sorte que les blocs de pierre et/ou de roche (R) sont dirigés au moins partiellement latéralement à partir du tuyau de descente (100) au niveau de l'ouverture intermédiaire (170) facultativement le tuyau de descente (100) comprenant des segments de tuyau de descente sensiblement tubulaires (110, 110A), au moins l'un des segments de tuyau de descente tubulaires (110A) comprenant un mécanisme coulissant pour fournir l'agencement d'ouverture et l'ouverture intermédiaire (170) après coulissement.
8. Système de tuyau de descente selon la revendication 1 ou 7, dans lequel le tuyau de descente comprend
 - des segments de tuyau de descente sensiblement tubulaires (110) configurables pour fournir au moins des premier et second tronçons de tuyau de descente (101, 102) de segments de tuyau de descente ; et
 - un module de suspension (200) configuré pour être suspendu à partir du navire marin et configuré pour suspendre le second tronçon de tuyau de descente (102) de segments de tuyau de descente au module de suspension de manière à poursuivre le premier tronçon de tuyau de descente (101) de segments de tuyau de descente, de telle sorte que le premier tronçon de tuyau de descente (101) et le module de suspension (200) avec le second tronçon de tuyau de descente (102) sont chacun indépendamment suspendus à partir du navire marin (10), le module de suspension (200) étant configuré pour permettre un décalage latéral d'au moins un parmi un segment de tuyau de descente inférieur (110.1 B) du premier tronçon de tuyau de descente (101) et un segment de tuyau de descente supérieur (110.2T) du second tronçon de tuyau de descente (102), de sorte qu'une extrémité du premier tronçon de tuyau de descente fournit l'ouverture intermédiaire (170) et de quelconques blocs de roche et/ou de pierre passant à travers le premier tronçon de tuyau de descente (101) ne sont pas évacués dans le second tronçon de tuyau de descente (102).

9. Système de tuyau de descente selon la revendication précédente, dans lequel le module de suspension (200) est configuré pour permettre de décaler latéralement et de soulever le segment inférieur (110.1B) du premier tronçon de tuyau de descente (101). 5
10. Système de tuyau de descente selon la revendication 8 ou 9, dans lequel le module de suspension (200) comprend un agencement de maintien de segment (240) configuré pour maintenir le segment de tuyau de descente inférieur (110.1B) du premier tronçon de tuyau de descente (101). 10
11. Système de tuyau de descente selon l'une quelconque des revendications 8 à 10, dans lequel les segments de tuyau de descente comprennent des godets sans fond (110) configurables pour fournir un tronçon de tuyau de descente (101, 102) de godets sans fond fixés et suspendus à un ensemble de suspension d'au moins un élément de suspension longitudinal (120), de sorte qu'un côté inférieur ouvert d'un godet au-dessus d'un godet inférieur (110.1B, 110.2B) du tronçon de tuyau de descente s'ouvre sur un côté supérieur ouvert d'un godet adjacent situé en dessous, et un côté supérieur ouvert d'un godet situé au-dessous d'un godet supérieur (110.1T, 110.2T) du tronçon de tuyau de descente reçoit un côté inférieur ouvert d'un godet adjacent au-dessus, facultativement, un périmètre extérieur d'un côté inférieur des godets sans fond (110) étant plus petit qu'un périmètre intérieur d'un côté supérieur des godets sans fond, facultativement, les godets (110) ayant une forme sensiblement conique, facultativement, l'ensemble de suspension du second tronçon (102) de godets sans fond étant suspendu à partir du module de suspension (200) et/ou l'ensemble de suspension du premier tronçon (101) de godets sans fond est suspendu à partir du navire marin (10). 15
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12. Système de tuyau de descente selon la revendication précédente, dans lequel l'ensemble de suspension du second tronçon (102) de godets sans fond se prolonge dans l'ensemble de suspension du premier tronçon (101) de godets sans fond, et le module de suspension (200) est configuré pour maintenir l'ensemble de suspension de manière libérable. 45
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13. Système de tuyau de descente selon la revendication 11 ou 12, dans lequel le module de suspension (200) comprend un agencement de maintien d'ensemble de suspension (210) configuré pour maintenir l'ensemble de suspension au-dessus du godet supérieur (110.2T) du second tronçon de tuyau de descente (102). 55
14. Système de tuyau de descente selon l'une quelconque des revendications 3 à 5 ou 11 à 13, dans lequel l'élément de suspension longitudinal comprend l'un d'un câble, d'une chaîne ou d'un fil.
15. Navire marin (10) comprenant un système de tuyau de descente (100) selon l'une quelconque des revendications précédentes.

Fig. 1

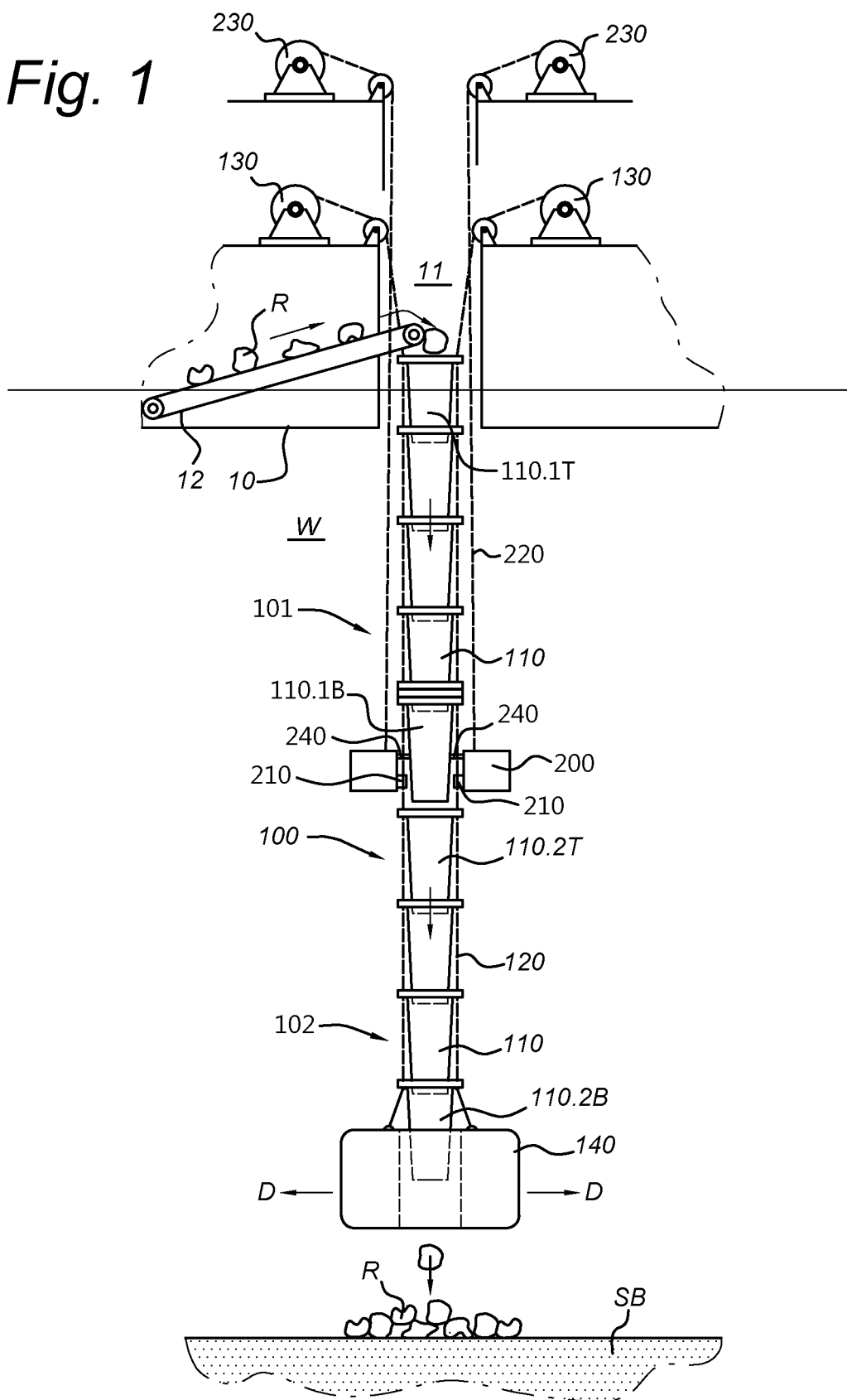


Fig. 2

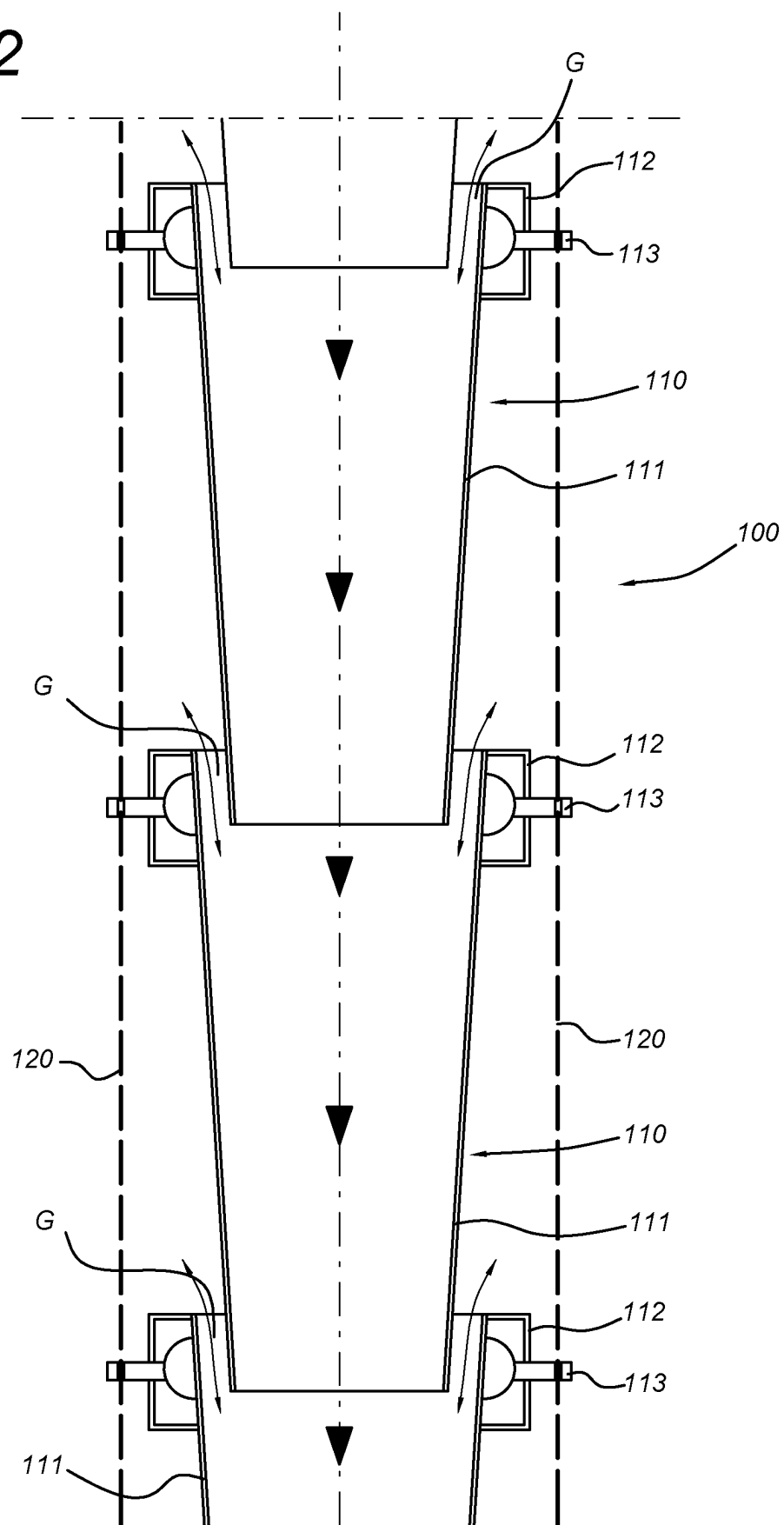
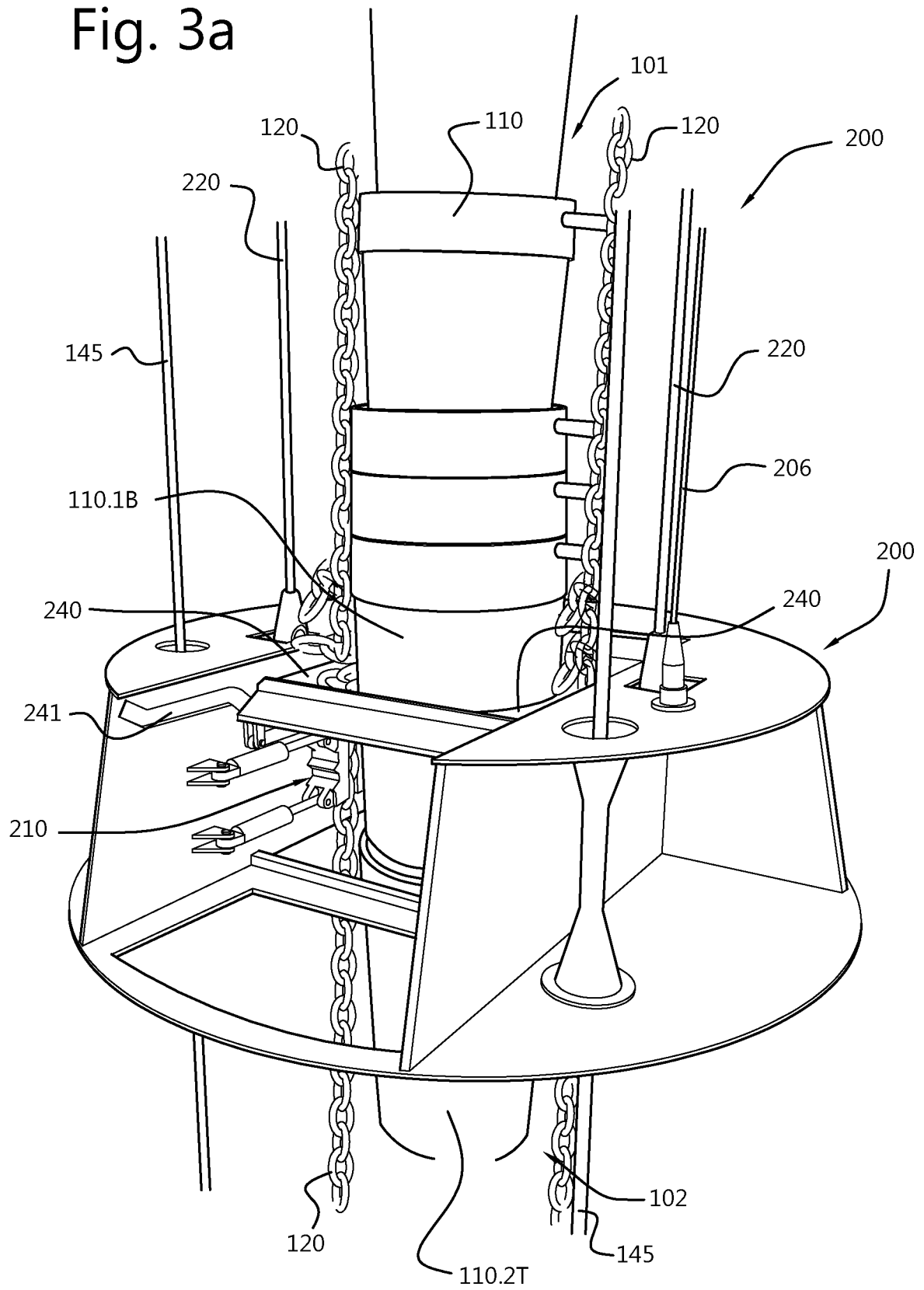


Fig. 3a



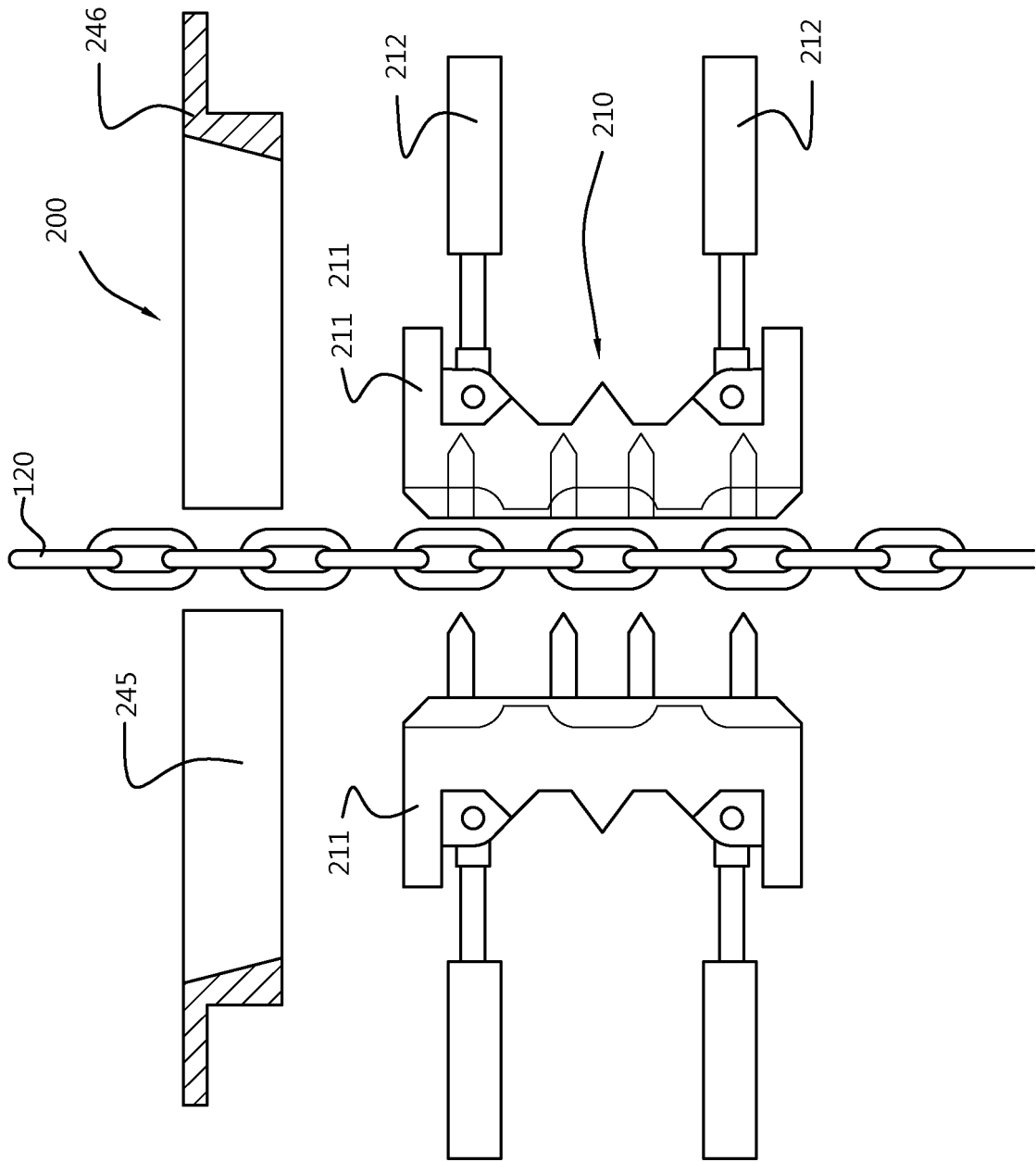


Fig. 3b

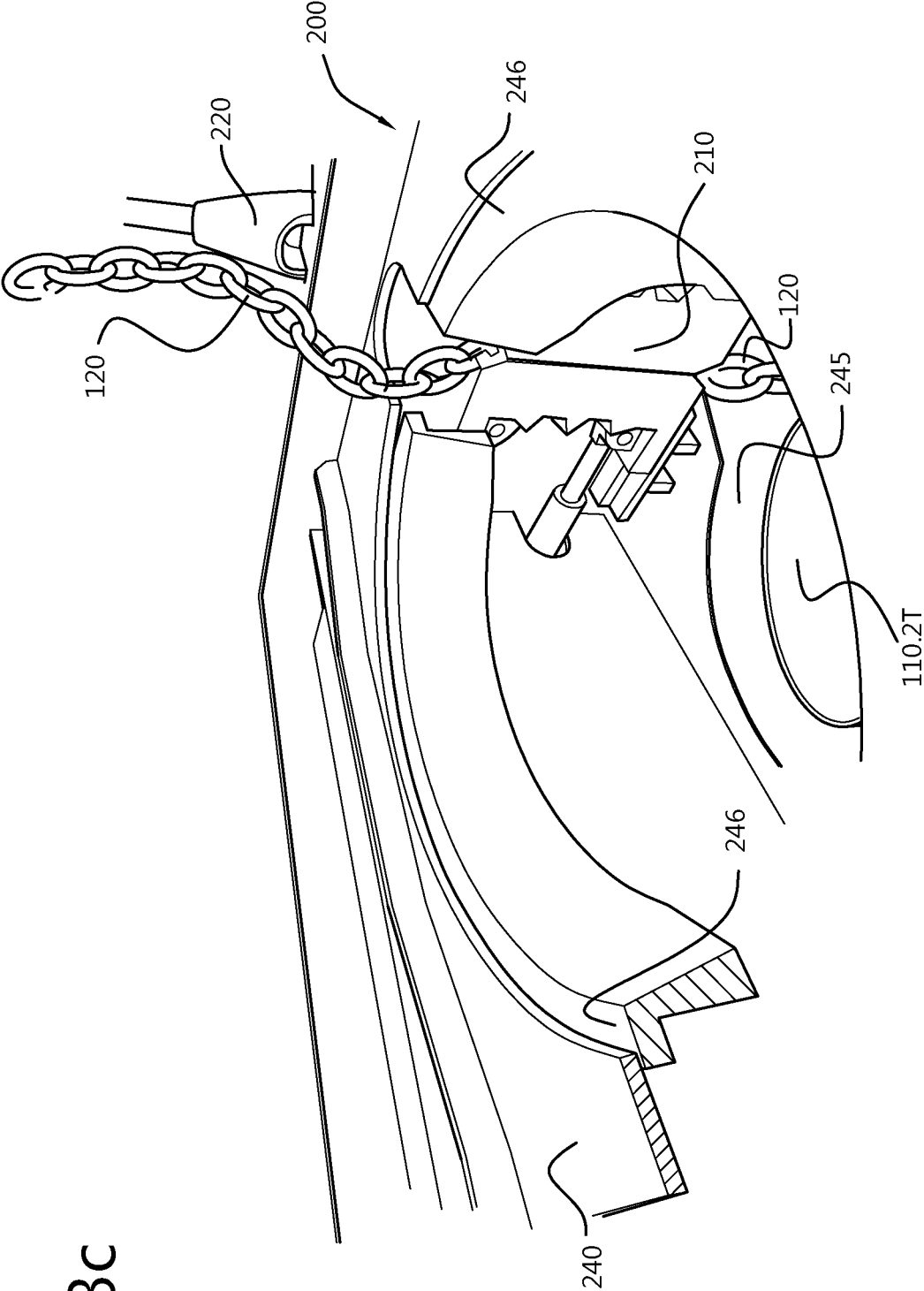


Fig. 3c

Fig. 3d

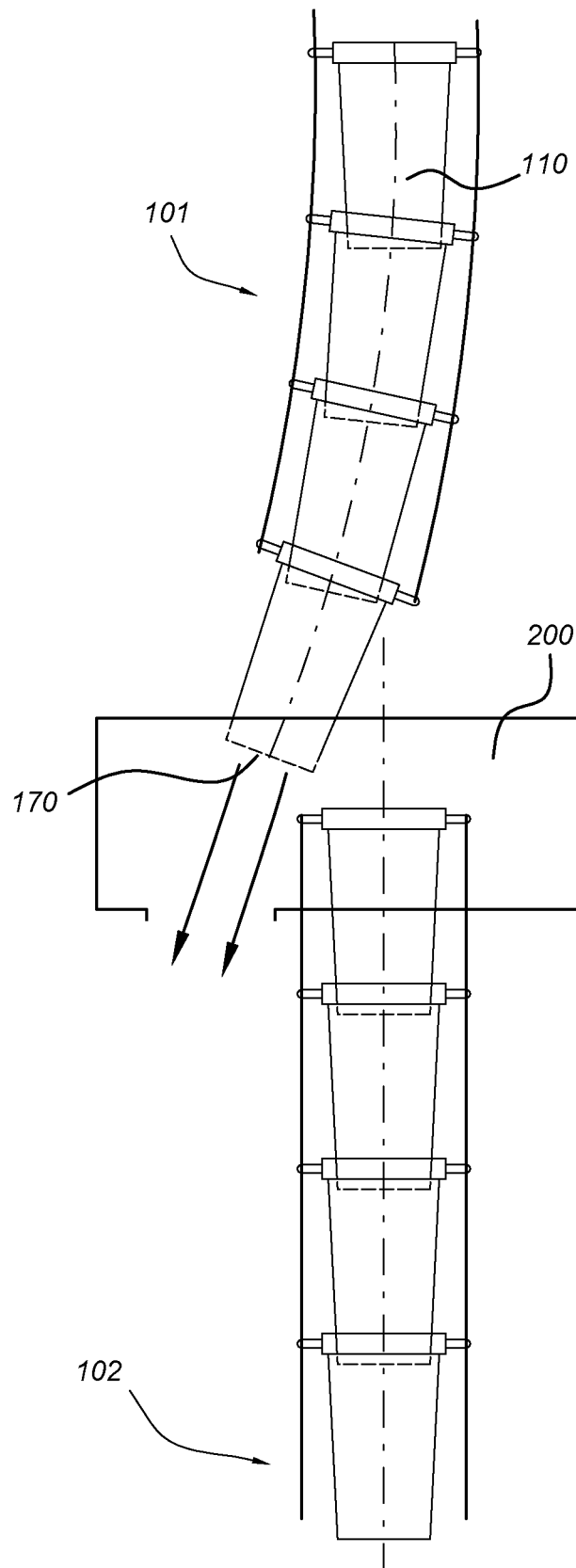


Fig. 4

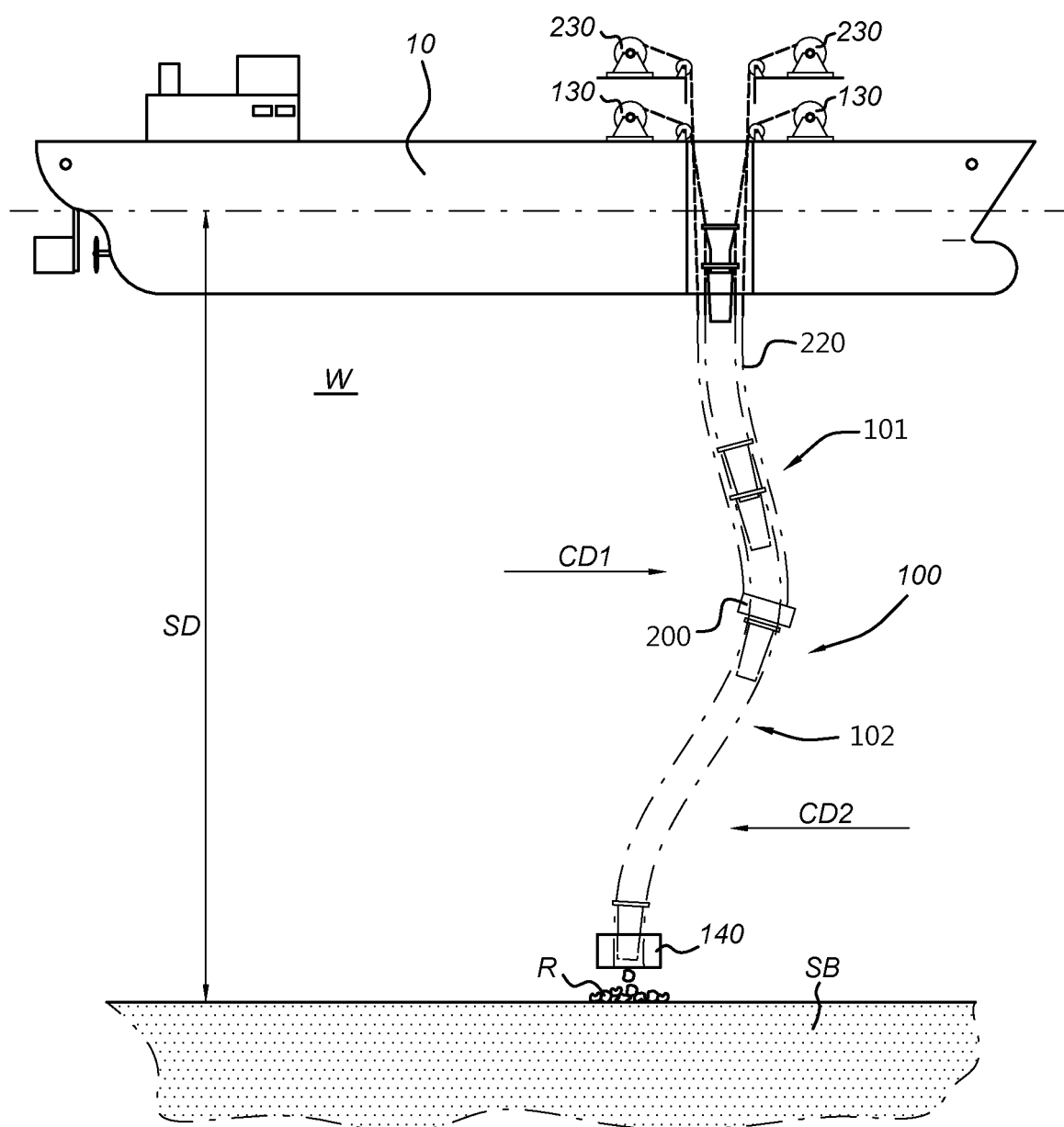


Fig. 5a

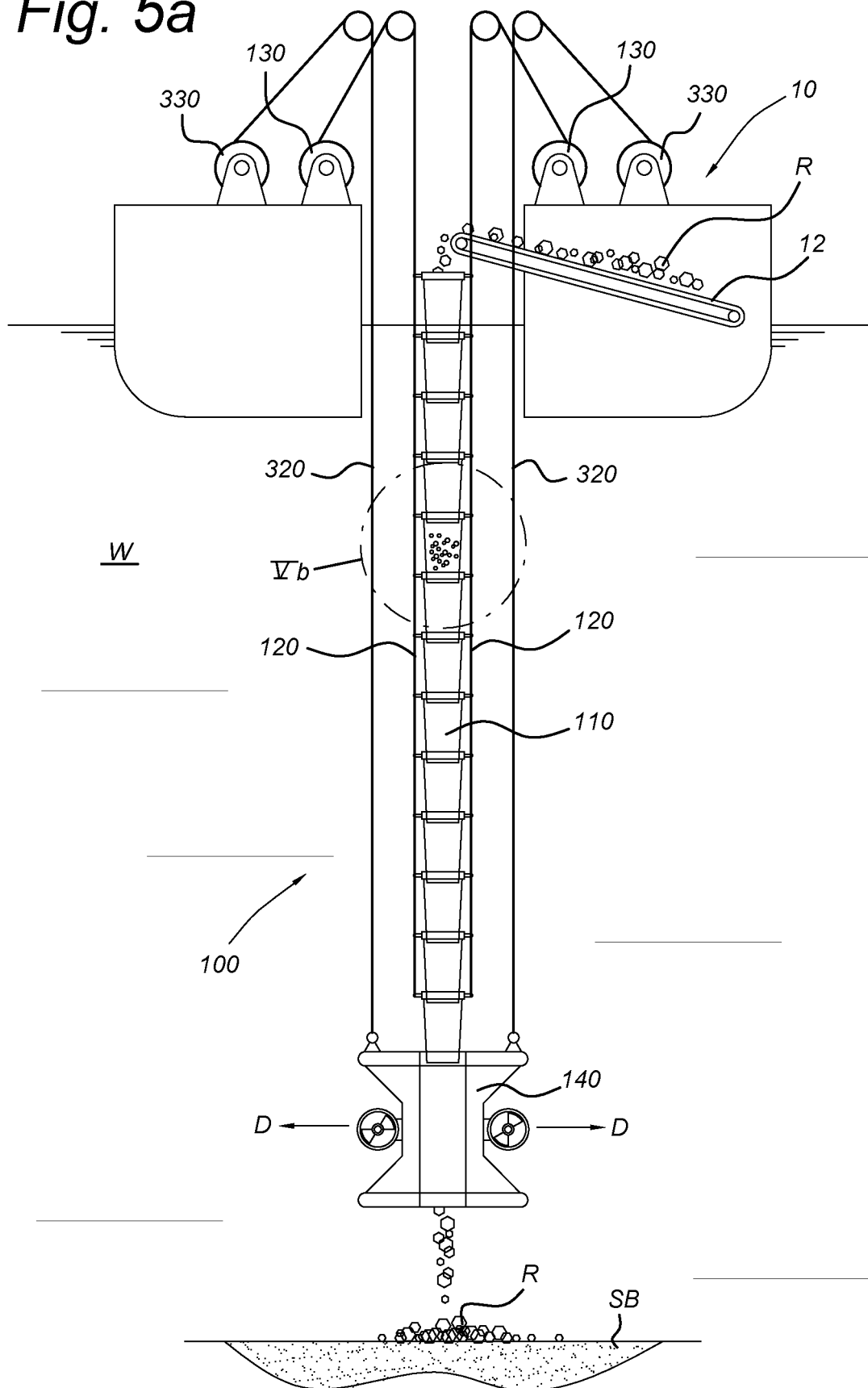


Fig. 5b

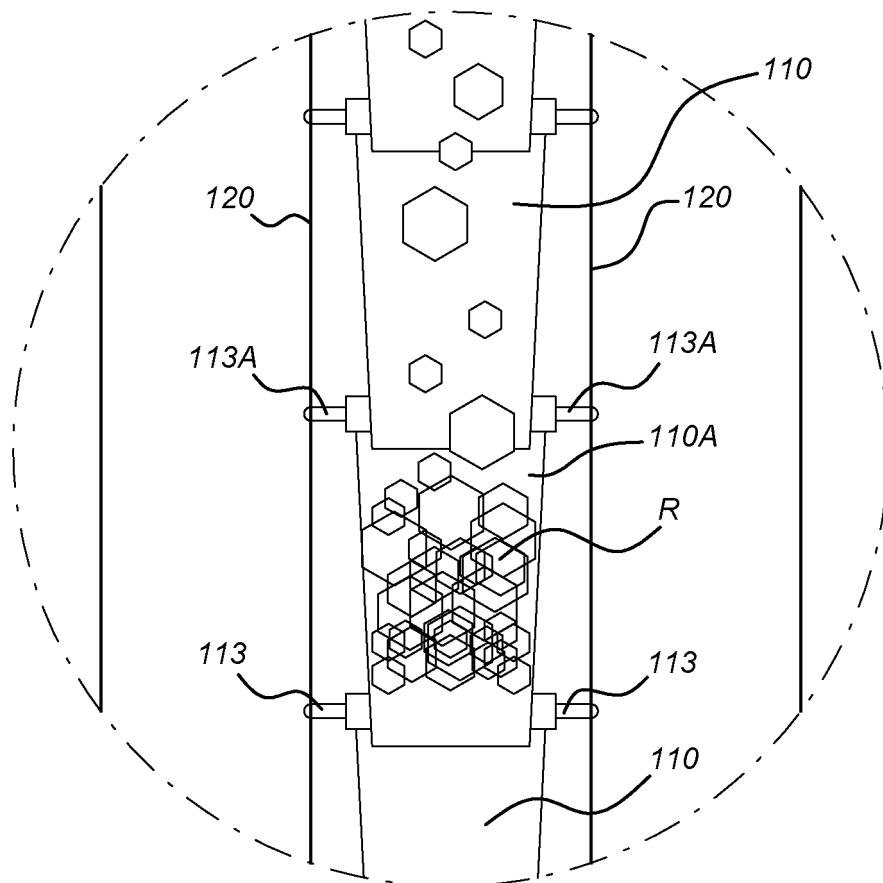


Fig. 6a

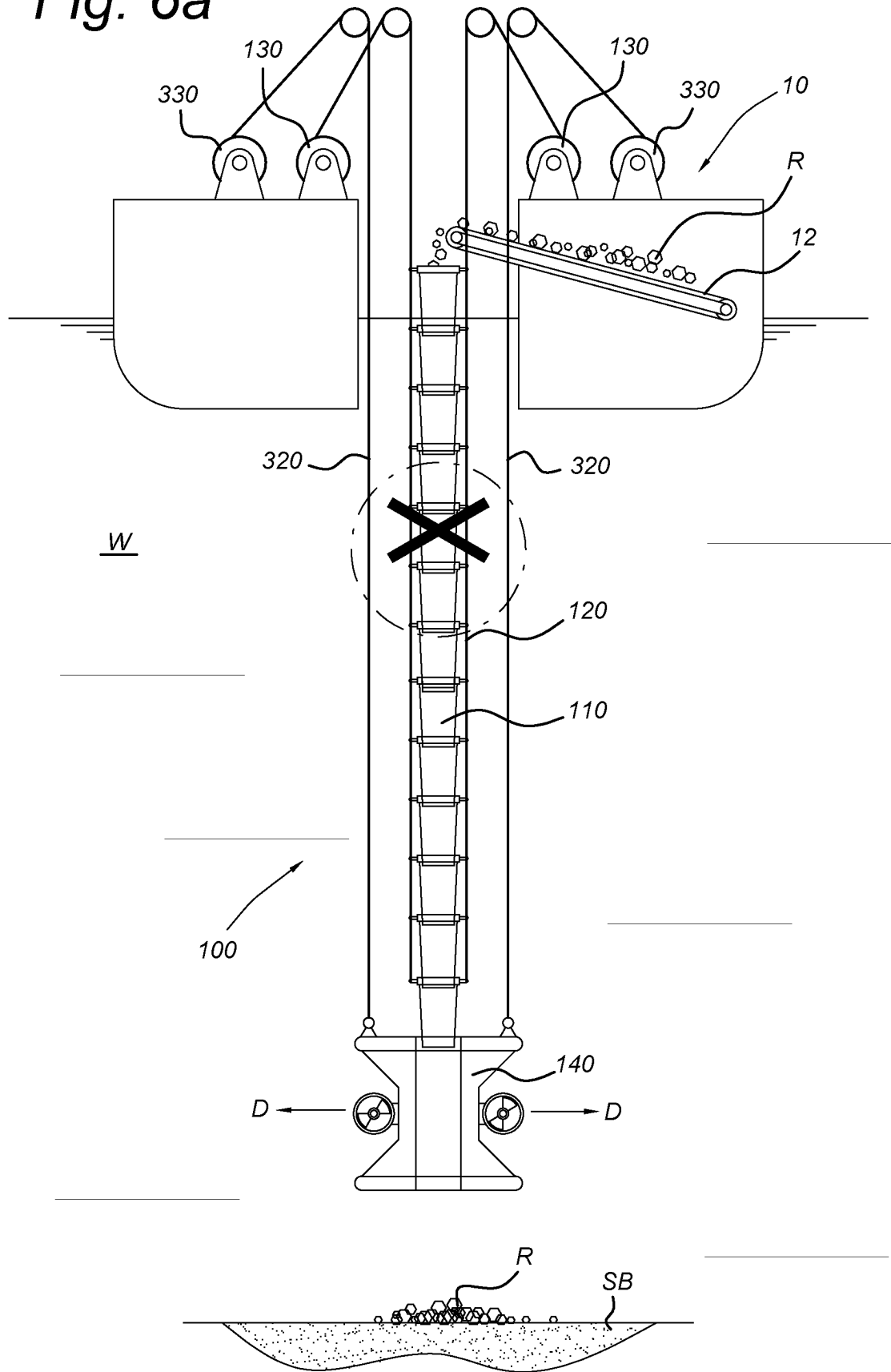


Fig. 6b

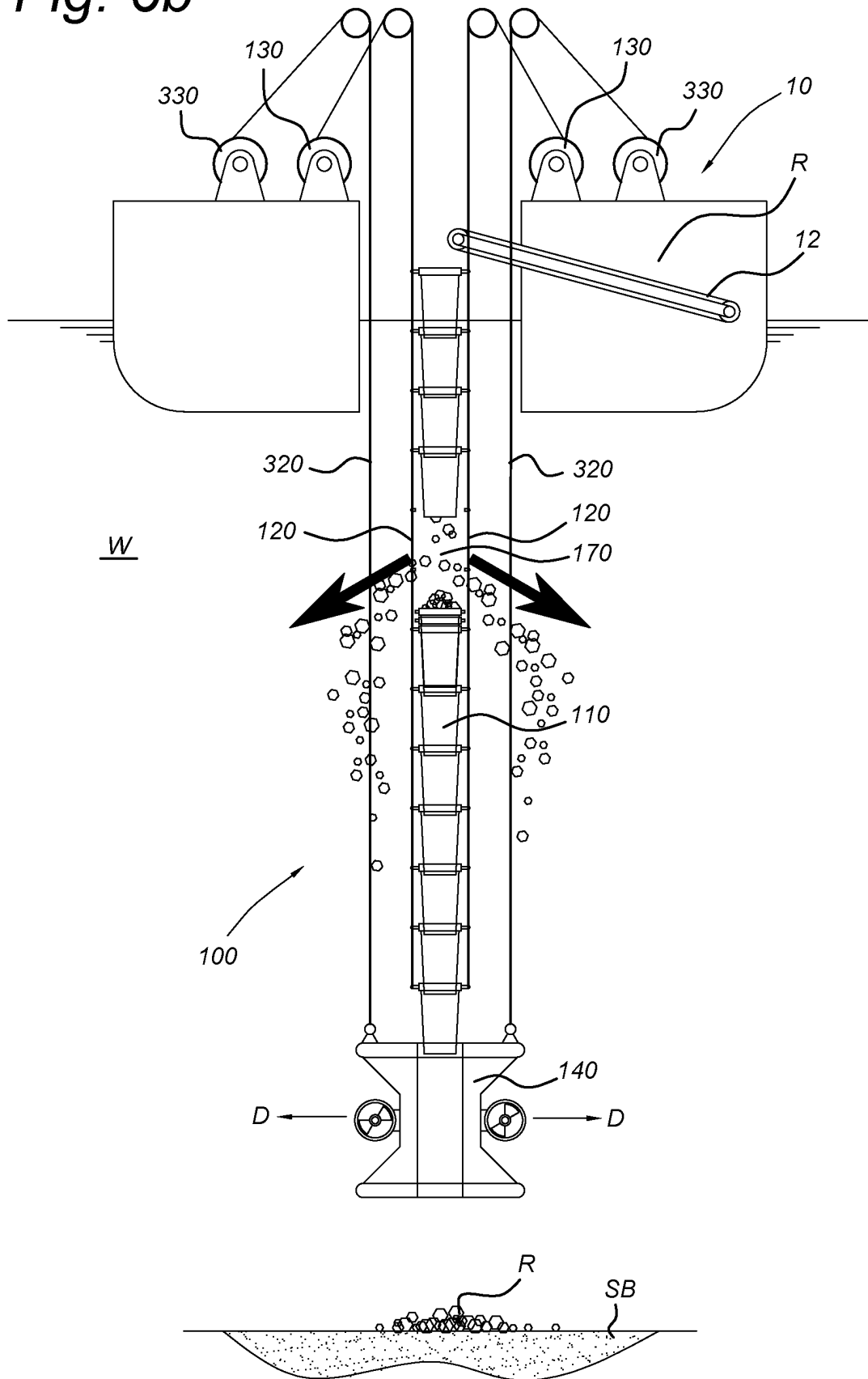


Fig. 7a

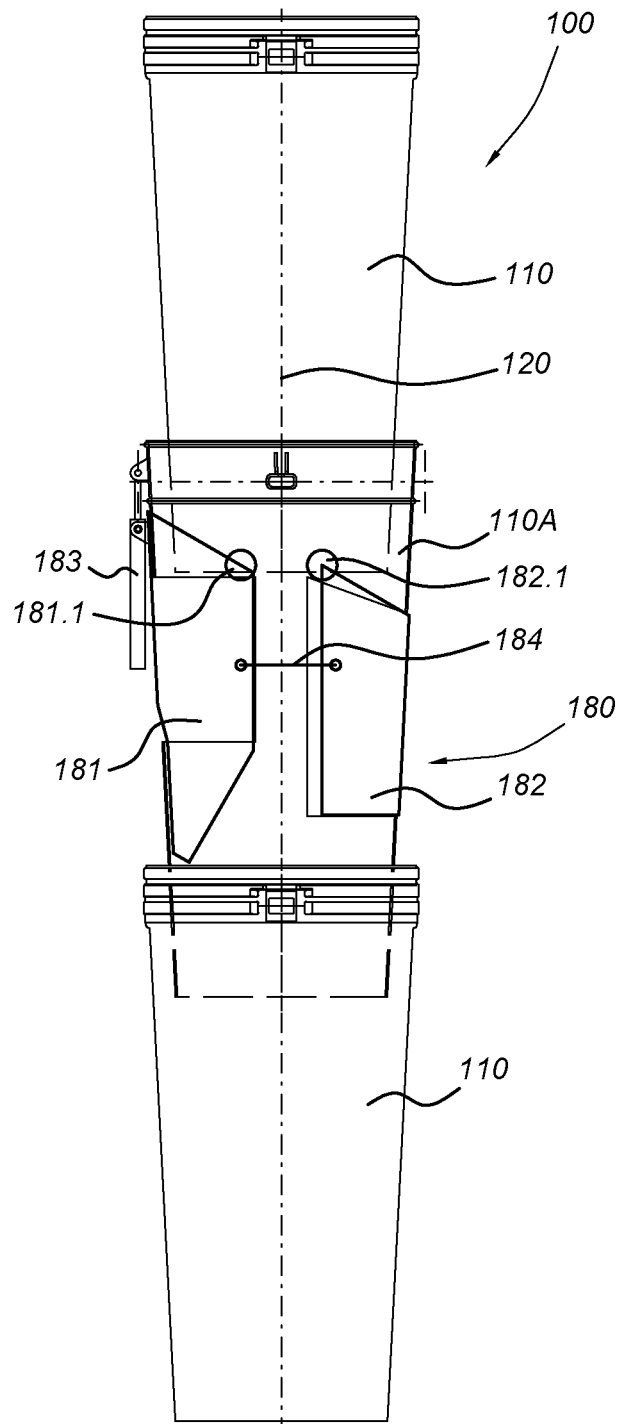


Fig. 7b

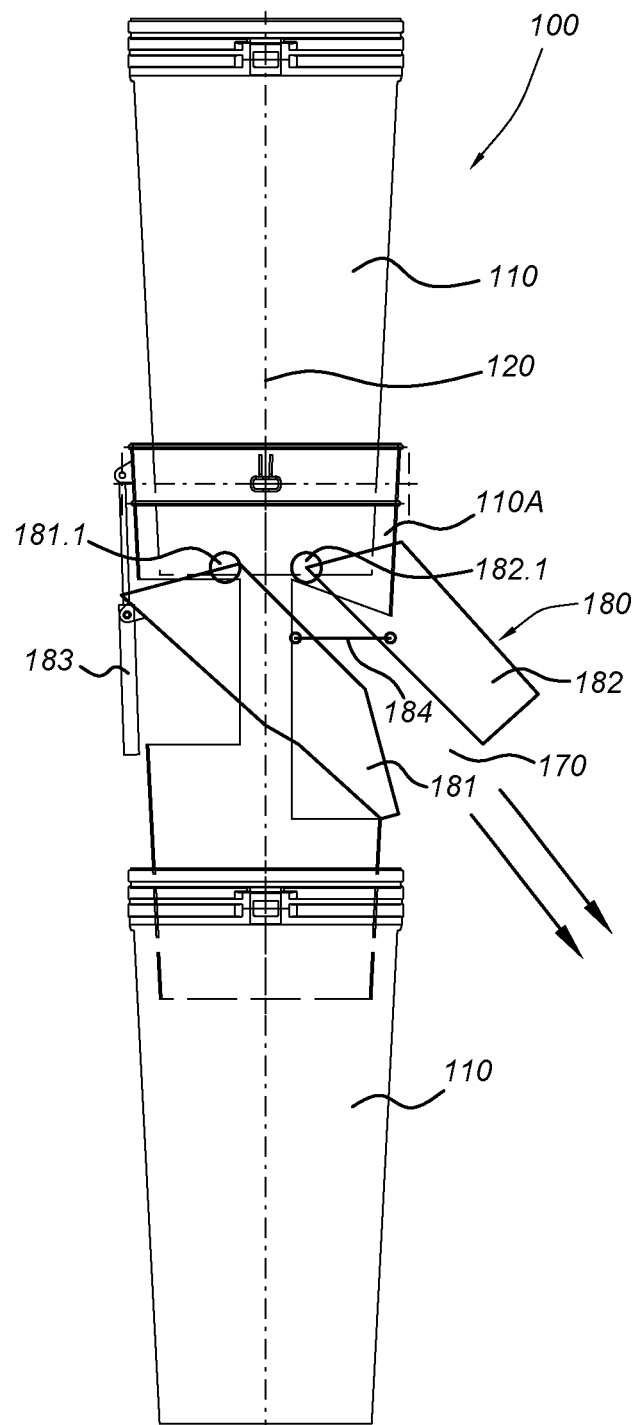


Fig. 8a

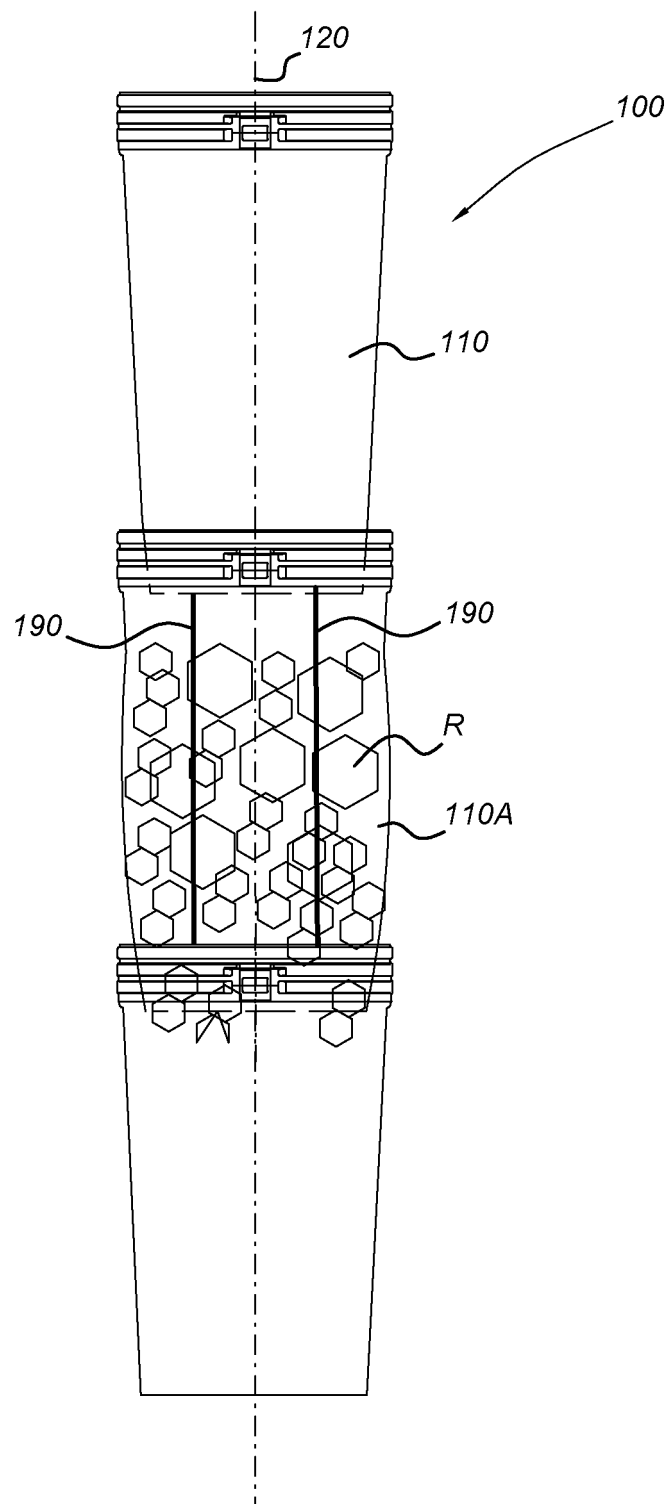
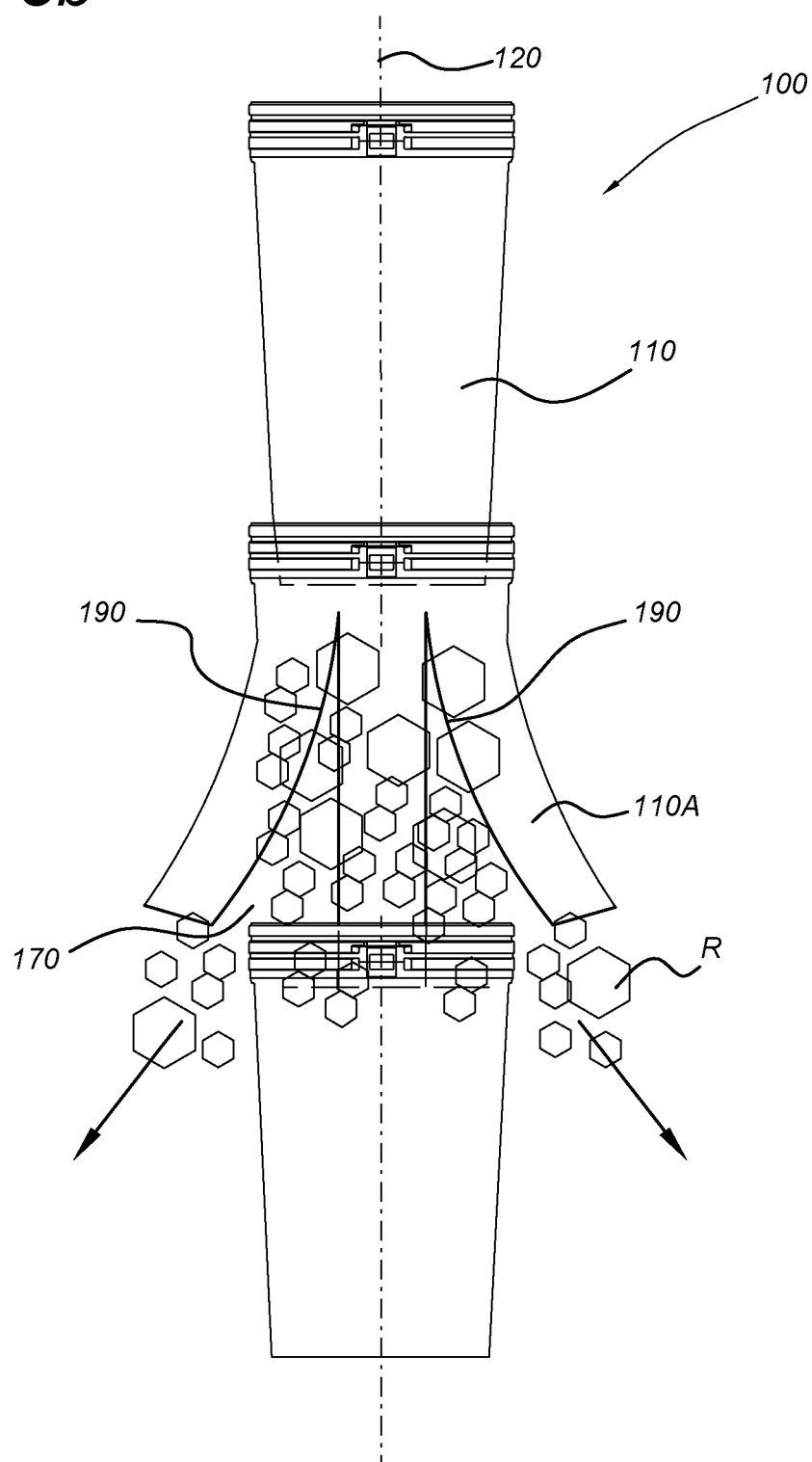


Fig. 8b



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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