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(71) Applicant: **Tideway B.V.**
4817 ZG Breda (NL)

(72) Inventor: **Bols, Lucas Jan Adriaan Maria**
2380 Ravels (BE)

(74) Representative: **Brouwer, Hendrik Rogier**
Arnold & Siedsma
Sweelinckplein 1
2517 GK Den Haag (NL)

(54) **Device and method for filling a flexible bag with material, and device and method for depositing the filled bag on the bottom of a water mass**

(57) The invention relates to a device (1) for filling a flexible bag (5) with material (50). The device comprises a stiff receptacle (3) with an entrance (31) through which a bag can be temporarily received in the receptacle (3), and an exit (32) through which a bag provided with the material can be released from the receptacle (3) under the action of gravity forces; retaining means (34) adapted to hold the bag during filling thereof with the material, to keep the bag open to receive the material through the entrance (31), and to release the bag once filled; and conveying means (4, 40) for conveying the material to the entrance (31). The invention also relates to a method for filling a flexible bag with material, and to a device and method for depositing bags filled with material on the bottom of a water mass.

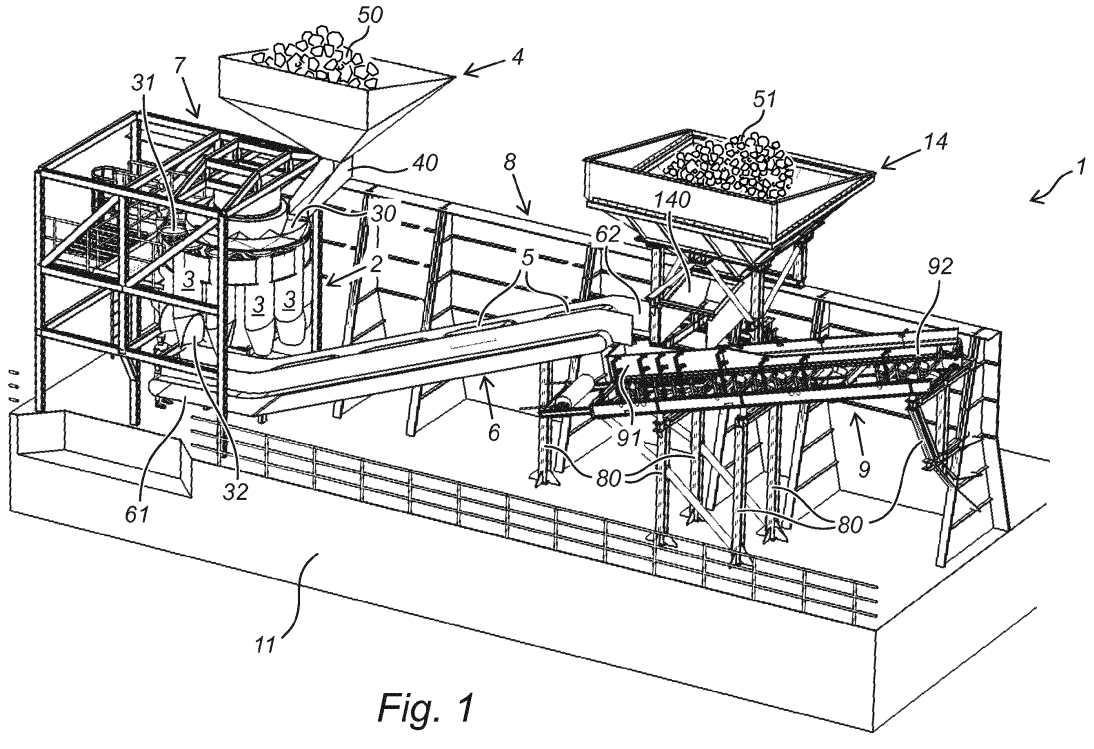

Fig. 1

EP 2 783 992 A1

Description

[0001] The present invention relates to a device for filling a flexible bag with material. The invention also relates to a method for filling a flexible bag with material, and to a device and method for depositing the filled bags on the bottom of a water mass.

[0002] In recent years more and more structures that partly extend above the water surface are placed at sea. An example of such structures are wind turbines. The base and the seabed in the vicinity of the base of such structures must be protected against erosion and swell. The base of offshore structures may for instance also comprise a number of piles driven into the seabed to form a foundation. Since the piles locally resist flow, an amplified flow velocity is generated around the piles. This excess flow velocity causes scour of the unprotected seabed around the piles and this may reduce the bearing force of the foundation. In order to arrange scour protection, a layer of large rocks with sizes up to 800 kg and more is typically deposited onto the seabed in the vicinity of the base of such structures. Prior to this, a layer of smaller sized material may be applied onto the seabed. A suitable device for depositing rocks at a defined location on the bottom of a water mass comprises a vessel provided with a fall pipe that extends with a substantial vertical component into the water mass, and supply means for supplying rocks to the upper end of the fall pipe.

[0003] Since these large rocks cannot be installed using the state of the art fall pipe systems, and are more complex with respect to for instance handling and production, it is proposed to use flexible bags that are filled with material, instead of using large rocks. The bags are filled with material particles having a substantially smaller size than large rocks, but a filled bag will act similarly to a large rock. A disadvantage of using flexible bags filled with material is that to date filling and transporting such bags is tedious and time-consuming.

[0004] The present invention has for its object to provide a device for filling a flexible bag with material, that does not have the above stated disadvantages and that may be applied onsite. Another object of the invention is to provide an efficient method for filling a flexible bag with material, and to provide a device and method for depositing the filled bags on the bottom of a water mass.

[0005] These and other objects are achieved by providing a device according to claim 1. In particular, a device for filling a flexible bag with material is provided, the device comprising a stiff receptacle with an entrance through which a bag can be temporarily received in the receptacle, and an exit through which a bag provided with the material can be released from the receptacle under the action of gravity forces; retaining means, adapted to hold the bag during filling thereof with the material, to keep the bag open to receive the material through the entrance, and to release the bag once filled; and conveying means for conveying the material to the entrance.

[0006] The material used in filling the bags can be any material suitable for the purpose, and may for instance comprise block objects, such as natural rocks and/or human made objects like concrete blocks, granular materials such as sand, stones, crushed stones, polymer or metal granules, blast furnace products, debris, and combinations of the mentioned materials.

[0007] In an embodiment of the invention, a device is provided wherein the retaining means comprises a tensioning mechanism adapted to tighten an upper rim of the bag around a rim of the receptacle entrance.

[0008] Another embodiment of the invention provides a device wherein the retaining means comprises a release mechanism adapted to release the tightening tension of the upper rim of the bag.

[0009] Yet another embodiment of the invention relates to a device wherein the tensioning and release mechanisms are combined.

[0010] In a preferred embodiment of the device according to the invention, the combined tensioning and release mechanism comprises a tensioning member provided with a holding means for a bag drawstring, and an actuating member adapted to actuate the tensioning member from a first position in which a bag drawstring attached to the holding means is tensioned, to a second position in which the tension of the bag drawstring is released and the drawstring freed from the holding means.

[0011] Typically, a drawstring of a bag is attached to the tensioning member in the second position and then tensioned around the rim by bringing the tensioning member in the first position to retain the bag and keep it open. After the bag has been filled with material, the drawstring is freed from the rim by bringing the tensioning member back to the second position which releases the tension in the drawstring while the bag is still in the receptacle. The filled bag is finally released from the retaining means under the action of gravity, in which final step the tensioning member is in the second position again. Actuating the tensioning member may for instance be carried out by pivoting the tensioning member around a pivot.

[0012] Another embodiment of a device in accordance with the invention comprises a plurality of receptacles. In a preferred embodiment, drive means are provided for moving the at least one receptacle.

[0013] A convenient device in accordance with the invention is provided, wherein the receptacles are aligned along the circumference of a circle to form a carrousel. Such a carrousel, preferably shaped as the chamber cylinder of a revolver gun, preferably comprises drive means for rotating it around a central axis, i.e. the axis of symmetry of the carrousel.

[0014] In order to be able to fill bags in a continuous process, an embodiment of the device according to the invention comprises an intermediary distributor that is at an entrance side thereof connected to the conveying means and at an exit thereof connects to the entrance of a corresponding receptacle with which it is aligned.

[0015] In order to make the process of filling bags more reliable, an embodiment of the device according to the invention makes use of one or more intermediary distributors that are funnel shaped.

[0016] An advantageous embodiment of the invented device comprises a plurality of intermediary distributors aligned along the circumference of a circle to form a carrousel, wherein at least some of the intermediary distributors are aligned with a corresponding receptacle, preferably also aligned along the circumference of a circle to form a carrousel. In a preferred embodiment, the device comprises drive means for moving the at least one intermediary distributor, wherein, more preferably, the drive means are adapted to move the at least one intermediary distributor at about the same speed as a corresponding receptacle.

[0017] The invention further relates to a method for filling a flexible bag with material, the method comprising temporarily positioning a bag in a stiff receptacle through an entrance thereof, holding the bag and keeping the bag open by retaining means, conveying the material to the entrance and filling the open bag through the entrance of the receptacle, releasing the bag once filled by releasing the retaining means, and releasing the bag provided with the material from the receptacle through an exit thereof under the action of gravity forces.

[0018] The bags to be filled with the material may be any type of bag that is flexible enough to conform to some extend to a shape of a bottom or structure to which it is applied. A bag filled with material is preferably closable, for instance by providing it with a drawstring at its upper rim, and with some closing mechanism that maintains the tension in the drawstring. A filled bag is preferably suspendable by a lifting means such as crane, where the drawstring acts as suspension rope, but this is not essential for the invention.

[0019] The bag may be made of natural materials, such as jute or the like, or from a synthetic polymer material, such as polyester, polyamide, polyethylene or polypropylene. The bag may be made from a sheetlike (continuous) material or may comprise a woven, knitted or netted structure of yarns. The yarns may be natural or synthetic fiber yarns, or may be made from a metal, such as steel. The mesh size of a woven, knitted or netted bag is preferably relatively small, forming a tight structure, such that the material is kept inside the bag. The mesh size between yarns is preferably lower than 3 times the yarn diameter and more preferably about equal to the yarn diameter.

[0020] The amount of material in a bag can be varied at will and depends on the application, on the size of the material particles, on the desired size of the filled bags, and other factors. The size of the filled bags may also vary widely, but the size preferably ranges from 400 to 1200 kg, which roughly corresponds to a volume ranging from 0,25 m^3 to 0,75 m^3, and more preferably from 600 to 1000 kg. The receptacles according to the invention have dimensions, such as a diameter in case of a cylindrical receptacle, that are adapted to the desired size of a filled bag.

[0021] Changing the amount of filling and the size of the material particles in a bag, as well as the porosity of the bag material itself, allows to tune the deformation capacity or flexibility of the filled bag, which may be important in influencing the functionality of the scour protection. A certain deformation capacity or flexibility tends to favour scour protection.

[0022] The material contained in the filled bags preferably has - although not limited thereto - an average particle diameter from 25-125 mm and a specific density that is large enough to prevent the filled bag from being dragged when installed on a seabed.

[0023] The invention also relates to a device for depositing bags filled with material on the bottom of a water mass, comprising a vessel provided with a bag filling device according to the invention, wherein the exit of a receptacle connects (directly or indirectly) to the water mass.

[0024] A useful embodiment of the device according to the invention is characterized in that the exit of a receptacle connects to supply means provided on the vessel for supplying the flexible bags filled with material to the water mass.

[0025] Another particularly useful device according to the invention is characterized in that the exit of a receptacle connects to the upper end of a fall pipe, provided on the vessel and extending with a substantial vertical component into the water mass. It should be noted that the invention is by no means restricted to the use of a fall pipe and any other method of depositing bags filled with material on the bottom of a water mass is applicable. The description of embodiments of the invention that use a fall pipe are only intended to illustrate the invention.

[0026] Still another embodiment provides a device wherein the fall pipe is connected at its upper end to the vessel by a gripper, the gripper comprising a support construction for the fall pipe adjustable at an angle to the vertical direction by means of fall pipe angle adjusting means. In a thus formed device for depositing the filled bags konto the bottom of a water mass the position of the underside of the fall pipe can be precisely determined. This is because the fall pipe angle adjusting means provide the option of properly determining the angle of the support structure to the vertical direction, whereby the angle at which the fall pipe extends relative to the vertical direction is likewise properly determined. It hereby becomes possible to accurately control the whole position of the fall pipe, and thereby the position of the underside of the fall pipe. The chance of damage to a structure to be protected against scour is greatly reduced as a result of this accuracy. To transport the (bags filled with) material to the top side of the fall pipe use is preferably made of a conveyor belt. The upper part of the fall pipe or of the upper fall pipe segment therefore preferably takes a funnel-like form, wherein the conveyor belt drops the (bags filled with) material into the funnel-like part.

[0027] The device is used in a method for depositing bags filled with material on the bottom of a water mass, whereby the method comprises filling a flexible bag provided in a stiff receptacle with material, and supplying the bag filled with material through the exit of the receptacle to the water mass.

[0028] The device may also be used supplementary and to advantage in a method for depositing materials with different sizes. This may be needed to form a layer of block objects with relatively low size first on a water mass bottom or foundation, and then on top thereof form a protective layer of materials of relatively high size. The device in such an embodiment is characterized in that the exit of a receptacle connects to the entrance end of a conveyor or other conveying means, which at its outer end connects to the entrance end of another conveyor or other conveying means, that with its outer end connects to the upper end of a fall pipe, provided on a vessel and extending with a substantial vertical component into the seawater. Second (secondary) conveying means in the form of a hopper, provided with a feeder, are positioned at the entrance end of the second conveyor and allow to convey other materials, such as the smaller sized material to form the filter layer to the upper end of the fall pipe. After the filter layer has been applied, filled bags are fed to the upper end of the fall pipe with the aid of both conveyors.

[0029] A pile foundation is typically protected by first depositing a filter layer of relatively fine material onto the bottom, and then providing the piles in the bottom through the filter layer. After the piles have been provided in the bottom, the protective layer of coarser material is applied onto the filter layer, to provide effective scour protection. An additional advantage of the present invention is that it becomes possible by using bags filled with block objects of smaller size than the coarser material to actually deposit one layer of filled bags only and then provide the foundation piles through the filled bags. The sole layer applied offers sufficient scour protection. Providing the piles through the filled bags is readily performed since some bags will rupture and the relatively small sized block objects contained therein will easily be displaced by the pile. Providing a pile through a layer of coarse material is to this date considered unfeasible.

[0030] It is also possible to provide a method in accordance with an embodiment wherein the bag filled with material is supplied from the exit of the receptacle to supply means provided on the vessel that supplies the bag with material to the water mass. An embodiment of the method wherein the bag filled with material is supplied from the exit of the receptacle to the upper end of a fall pipe, provided on the vessel and extending with a substantial vertical component into the water mass, which fall pipe supplies the flexible bag with material to the water mass is preferred. Depending on the depths at which the rocks must be deposited, the fall pipe can extend to great depth, and to so great a depth that it is structurally less attractive to make use of a fall pipe formed by a single part. In such situations it is attractive for the fall pipe to comprise at least two mutually connecting segments.

[0031] In order to ensure the accuracy of the position of the underside of the fall pipe, it is to be recommended that the segments of the fall pipe are connected rigidly to each other. It is however also possible to connect the subsequent fall pipe segment pivotally to the upper fall pipe segment, and to connect the successive segments making use of adjusting means which are adapted to adjust the angle between successive segments of the fall pipe. The angular position of the fall pipe relative to the vessel is preferably controlled for the purpose of maintaining the position of the underside of the fall pipe.

[0032] A device in accordance with the invention allows to produce a plurality of bags filled with block objects on site and in a continuous manner at a high production rate. Typical production rates of 125 to more than 600 filled bags of 800 kg each per hour are possible. The filled bags produced may be used on site immediately to provide a foundation of a structure with an effective scour protection.

[0033] The present invention will be further elucidated hereinbelow with reference to the accompanying figures. Herein:

figure 1 is a schematic perspective view of a device according to an embodiment of the invention;
figure 2 is a schematic side view of the embodiment shown in figure 1;
figure 3 is a schematic top view of the embodiment shown in figure 1;
figure 4 is a schematic perspective view of a receptacle carrousel according to an embodiment of the invention;
figure 5 is a schematic cross-sectional view of a receptacle according to an embodiment of the invention;
figure 6A is a schematic top view of the carrousel shown in figure 4;
figure 6B is a schematic side view of the carrousel shown in figure 6A;
figure 7 is a schematic top view of a receptacle carrousel provided with a distributor in accordance with an embodiment of the invention;
figures 8A-8D are schematic side views of a bag retaining means in accordance with an embodiment of the invention; and
figure 9 is a schematic side view of a device for depositing block objects on the bottom of a water mass in accordance with an embodiment of the invention.

[0034] Referring to figure 1, a device 1 for filling flexible bags 5 with block objects 50, such as stones, is shown. The device 1 comprises a revolving carrousel 2 of plural stiff receptacles 3, conveying means in the form of a hopper 4, provided with a feeder 40, preferably a vibratory feeder, for conveying the block objects 50 to an entrance 31 of the receptacles 3, possibly through an intermediate

distributer 30, used to continue the bag filling process. In the embodiment shown, flexible bags 5 once filled with material, which in the exemplified embodiment constitutes block objects 50 are released from the receptacles 3 through an exit 32 of the receptacles 3 under the action of gravity forces, and are deposited onto supply means for the bags 5 in the form of a conveyor belt 6, that connects to the exit 32 at an entrance end 61 thereof. Conveyor belt 6 then transports the filled bags 5 further to a desired location. The revolving carrousel 2 of stiff receptacles 3, the hopper 4 and other components that will be described in more detail below are supported by a support frame 7. A support structure 7 is provided to support some device components. Support structure 80 for instance provides support for the hopper 14, provided with feeder 140. A wall 8 of optional material holds is also shown.

[0035] Device 1 is preferably used in a device for depositing block objects 50 on the bottom of a water mass, such as a seabed 10 (see figure 9). To this end, an embodiment of the invented device 1 for filling bags is positioned on deck of a vessel 11. In one embodiment, the carrousel 2 is positioned partly overboard such that the exit 32 of one or more receptacles 3 directly connects to the water mass, and bags filled with block objects are directly dumped into the water and sink onto the seabed 10. In another embodiment, the exit 32 of a receptacle 3 connects to the entrance end 61 of conveyor belt 6 provided on the vessel 11, which conveyor belt 6 dumps the flexible bags 5 with block objects 50 into the seawater by connecting its outer end 62 directly to the water mass. In yet another embodiment, the exit 32 of a receptacle 3 connects to the entrance end 61 of conveyor 6, which at its outer end 62 connects (see figure 9) to the upper end 121 of a fall pipe 12, provided on the vessel 11 and extending with a substantial vertical component into the water mass, or, as shown in combined figures 1 and 9, to the entrance end 91 of another conveyor 9 that with its outer end 92 connects to the upper end 121 of the fall pipe 12 for conveying the block objects 50 to the upper end 121 of the fall pipe 12. In the latter embodiment, the device 1 preferably further comprises a second conveying means in the form of a hopper 14, provided with a feeder 140. The hopper 14 is positioned at the entrance end 91 of the second conveyor 9 and allows to convey other materials, such as smaller sized material 51 to form a filter layer on the seabed 10, to the upper end 121 of the fall pipe 12.

[0036] The embodiment of the invented device shown in the figures as an example provides a method for depositing block objects 50 on a seabed 10, comprising filling a flexible bag 5 with the block objects 50 and supplying the bag 5 filled with block objects 50 through the exit 32 of a receptacle 3 to the water mass, preferably through a fall pipe 12. Referring to figure 9, a sea is shown with a seabed 10 on which a wind turbine designated as a whole with reference number 20 has been placed. Wind turbine 20 comprises a foundation in the form of a plurality of piles 203 onto which a jacket structure 204 is arranged. Jacket structure 204 debouches above the water surface 207 into a windmilltower 205 on which a nacelle 206 is placed. Nacelle 206 is provided with a shaft on which the blades (not shown) of the wind turbine are mounted. In order to protect foundation 203 against erosion and scour, a mass of filled bags 5 is deposited against foundation base 203 and in the immediate vicinity thereof.

[0037] For the purpose of depositing the filled bags 5, use is preferably made of a vessel 11, provided with a fall pipe 12. The fall pipe 12 extends with a substantial vertical component at an angle 130 to the vertical direction 140 from vessel 11 and comprises a number of fall pipe segments 120, wherein the lower part of each fall pipe segment is connected in a substantially rigid manner to the upper part of a following (further downward) fall pipe segment 120. The coupled fall pipe segments 120 form a fall pipe 12, the lower segments of which extend below water surface 207 at an angle 130 to the vertical direction 140. The angle 130 may be zero but is preferably different from zero. Fall pipe 12 is in the example shown connected at its upper end to vessel 11 by a gripper 150, comprising a support construction 151 for the fall pipe 12 that is pivotally connected to vessel 11 by means of a pivot connection 152. In the embodiment shown in figure 9, the upper end 121 of the fall pipe 12 connects to the outer end 92 of conveyor 9, which supplies the filled bags 5 to the upper end 121 of the fall pipe 12. For clarity, the other components of the device 1 according to the invention, such as the revolving carrousel 2 of plural stiff receptacles 3, the hopper 4, and the conveyor belt 6 are not shown in figure 9.

[0038] Referring now to figures 4, 5 and 6, a stiff receptacle 3 in accordance with an embodiment of the invention comprises an elongated cylindrical casing 33 of a stiff material such as steel. The casing 33 has an opening at its top end 331 providing an entrance 31 through which a bag 5 can be temporarily received, as shown in figure 5, and through which block objects 50 can be introduced into the bag 5. Casing 33 is at its bottom end 331 provided with an exit 32 through which a bag 5 provided with block objects 50 can be released from the casing 33 under the action of gravity forces F. The bottom end 332 of the casing 33 may be cylindrical or may provide a wall part with a certain slant angle 333 with the vertical direction 140 to facilitate deposition of the filled bags 5 onto the conveyor belt 6.

[0039] As shown in figures 4 and 6, a plurality of interconnected receptacles 3 is regularly arranged along the circumference of a virtual circle 22 to form a carrousel 2. In the embodiment shown, the number of receptacles 4 is ten but any other number may also be used. The carrousel 2 is rotated around an axis 21, coinciding with the centre of the circle 22, by suitable drive means (not shown). It should be noted that other arrangements of receptacles 3 are also within the scope of the invention, such as a linear line-up of a plurality of receptacles 3 for instance. The carrousel 2 is thus rotated around the axis

21, preferably at a substantially constant speed. Preferred revolving speeds range form 1 to 20 cm/sec although other speeds are possible. It is also possible to rotate the carrousel 2 intermittently, in which embodiment the carrousel 2 is temporarily halted or rotated at a lower speed. The direction of rotation (clockwise or anticlockwise) of the carrousel 2 depends on the relative locations of bag loading (placement of a bag 5 in the receptacle 3), and bag discharge (release of a bag 5 from a receptacle 3), but it is understood that the sequence of bag charging, bag filling and bag discharging is preferably observed in that order.

[0040] The device according to an embodiment of the invention further comprises a plurality of intermediary distributors 301 that are aligned along the circumference of a circle to form a carrousel 30, as is best seen in figure 7. An intermediary distributor 301 may in a suitable position connect to the feeder 40 of the hopper 4 through which the objects 50 are conveyed to the receptacle 3. Each intermediary distributor 301 forms a funnel that extends from a ridge 302 between distributors 301 downwards towards an exit opening 303 provided in a bottom part of the distributor 301. The exit opening 303 of some distributors 301 (the 5 distributors 301 positioned at the right halve of the circle in figure 7, i.e. between about the 12 hour and 6 hour position of the carrousel 30 viewed from above) connect to the entrance 31 of a corresponding receptacle 3 with which it is aligned. In the embodiment shown, the number of distributors 301 is eight but any other number may also be used. As with carrousel 2, carrousel 30 of distributors 301 is rotated around an axis 304, coinciding with the centre of the circle, by suitable drive means (not shown). The drive means preferably move the intermediary distributor carrousel 30 at the same peripheral rotational speed as the receptacle carrousel 2.

[0041] Since the rotation axes 21 of the receptacles carrousel 2 and of the distributors carrousel 30 do not coincide but are off-set instead and their circle diameters differ, some of the distributors 301, in particular those positioned at the left halve of the circle in figure 7, i.e. between about the 6 hour and 12 hour position of the carrousel 30 viewed from above) will not connect to the entrance 31 of a corresponding receptacle 3. This allows to apply empty bags 5 to the receptacles 3, as will be explained further below.

[0042] As shown in figures 5 and 8, the device further comprises retaining means 34 that are connected to an upper wall part of casing 33 in the embodiment shown. The bag retaining means 34 are adapted to hold a bag 5 during filling thereof with the block objects 50, to keep the bag 5 open to be able to receive the block objects 50 through the entrance 31 of the receptacle 3 in which the bag 5 is received, and finally to release the bag 5 once it has been filled with a sufficient amount of block objects 50. These and other functions may also be fulfilled by two or more retaining means, and need not be combined into one retaining means 34, as is the case in the present preferred embodiment.

[0043] The bag retaining means 34 in the embodiment shown in figure 8 comprises a tensioning member in the form of a circular disc 341, that is provided in its periphery with an indentation or notch 342, that acts as a holding means for a bag drawstring 52. Any shape able to move a notch 342 peripheral from its own axis will be suitable however, such as a crankshaft construction or the like, and the disc 341 is only one example of a suitable tensioning member. The disc 341 is rotatable around an axis 343 by an actuating member in the form of a hydraulic cylinder 344. Hydraulic cylinder 344 at a lower end connects fixedly to a housing 345, and at an upper end connects to the housing 345 such that its piston may be moved in the vertical direction 140. The piston connects to a connection rod 346 that is at another end connected to an eccentric position 347 of the disc 341. A vertical movement of the piston thus results in a rotation of the disc 341. The disc 341 can be pivoted from a position, shown in figure 8A, in which position the drawstring 52 of a bag 5 can be easily placed in the notch 342 when the notch 342 faces the bag 5, to a position, shown in figure 8C, wherein the bag drawstring 52 is tensioned. It should be clear that other similar combined tensioning and releasing mechanisms also fall within the scope of the invention.

[0044] In accordance with an embodiment of the invention, an empty bag 5 is introduced in a receptacle 3 through its entrance 31. This is conveniently performed by an operator 70, taking an empty bag 5 from a rack or roll (not shown) storage facility and placing the bag 5 in a receptacle 3, for instance at the 9 hour position of the carrousel 2 viewed from above, as best shown in figure 3. The bag 5 is preferably provided at an upper rim with a drawstring 52 which when pulled closes the bag 5. The operator 70 opens an empty bag 5 and positions the upper rim of the bag 5 around the upper rim 335 of a receptacle 3 in front of him. He then takes the drawstring 52 of the bag 5 and places it in the notch 342 of the disk 341 of the retaining means 34 in the position, shown in figure 8A. The disc 341 is then brought to the position, shown in figure 8C, wherein the bag drawstring 52 is tensioned around the rim 335 of the receptacle 3, as schematically shown in figure 5. With both carrousels 2 and 30 turning, a plurality of block objects 5 is then conveyed via the hopper 4 and feeder 40 to the distributor 301 that is aligned with the feeder 40, and from the distributor 301 to the entrance 31 of a receptacle 3 that is at that moment in alignment with the distributor 301. The block objects 50 are in this way dumped into the bag 5, held open by retaining it around the rim 335 of the receptacle 3 with the retaining means 34, until the bag 5 is sufficiently filled. This may require a number of passes under the feeder 40 or may be accomplished in one time, depending on the supply flow of block objects 50, and the rotation speed of the carrousel 2. When a bag 5 in a receptacle 3 is sufficiently filled the disc 341 will turn from the tensioned position, shown in figure 8C towards a release position

shown in figure 8A, either actively or under the weight of the filled bag 5. This releases the tension in the drawstring 52. During this transition, the bag 5 detaches from the upper rim 335 of the receptacle 3, and hangs with its drawstring 52 still attached to the disc 341. This tensions the drawstring 52 under the weight of the filled bag 5 and the bag 5 may in this way be closed automatically, for instance by providing the drawstring 52 with an automatic closure mechanism, known per se from clothing or sleeping bags for instance. The filled bag 5 is now hanging in the receptacle 3. When the disc 341 is fully in the release position (figure 8A), the drawstring slips from the notch 342 of the disc 341 and the bag 5 provided with block objects 5 is released from the receptacle 3 through the exit 32 thereof under the action of gravity forces F.

Claims

1. Device (1) for filling a flexible bag (5) with material (50), the device comprising a stiff receptacle (3) with an entrance (31) through which a bag (5) can be temporarily received in the receptacle (3), and an exit (32) through which a bag (5) provided with the material (50) can be released from the receptacle (3) under the action of gravity forces; retaining means (34), adapted to hold the bag (5) during filling thereof with the material (50), to keep the bag (5) open to receive the material (50) through the entrance (31), and to release the bag (5) once filled; and conveying means (4) for conveying the material (50) to the entrance (31).

2. Device according to claim 1, wherein the retaining means (34) comprises a tensioning mechanism adapted to tighten an upper rim of the bag (5) around a rim (335) of the receptacle (3) entrance (31).

3. Device according to claim 1 or 2, wherein the retaining means (34) comprises a release mechanism adapted to release the tightening tension of the upper rim of the bag (5).

4. Device according to claim 2 and 3, wherein the tensioning and release mechanisms are combined.

5. Device according to claim 4, wherein the combined tensioning and release mechanism comprises a tensioning member (341) provided with a holding means (342) for a bag drawstring (52), and an actuating member (344, 346) adapted to pivot the tensioning member (341) from a first position in which a bag drawstring (52) attached to the holding means (342) is tensioned, to a second position in which the tension of the bag drawstring (52) is released and the drawstring (52) freed from the holding means (342).

6. Device according to any one of the preceding claims, comprising a plurality of receptacles (3).

7. Device according to any one of the preceding claims, comprising drive means for moving the at least one receptacle (3).

8. Device according to claim 6 or 7, wherein the receptacles (3) are aligned along the circumference of a circle (22) to form a carrousel (2).

9. Device according to claim 7 or 8, wherein the conveying means (4) connect to an intermediary distributor (301), an exit (303) of which connects to the entrance (31) of a corresponding receptacle (3) with which it is aligned.

10. Device according to claim 9, comprising a plurality of intermediary distributors (301) aligned along the circumference of a circle to form a distributor carrousel 30, and drive means for moving the at least one intermediary distributor (301), wherein at least some of the intermediary distributors (301) are aligned with a corresponding receptacle (3).

11. Device according to claim 10, wherein the drive means are adapted to move the at least one intermediary distributor (301) at the same speed as a corresponding receptacle (3).

12. Device for depositing bags filled with material on the bottom of a water mass, comprising a vessel provided with a device according to any one of claims 1-11, wherein the exit of a receptacle connects to the water mass.

13. Device according to claim 12, wherein the exit of a receptacle connects to supply means provided on the vessel for supplying the flexible bags with material to the water mass.

14. Device according to claim 12 or 13, wherein the exit of a receptacle connects to the upper end of a fall pipe, provided on the vessel and extending with a substantial vertical component into the water mass.

15. Method for depositing bags filled with material on the bottom of a water mass, comprising providing a device in accordance with claim 12, filling a flexible bag with material by temporarily positioning a bag in a stiff receptacle through an entrance thereof, holding the bag and keeping the bag open by retaining means, conveying the material to the entrance and filling the open bag with the material through the entrance, releasing the bag once filled by releasing the retaining means, and releasing the bag provided with the material from the receptacle through an exit thereof under the action of gravity forces, and supplying the bag filled with the material through the exit

of a receptacle to the water mass.

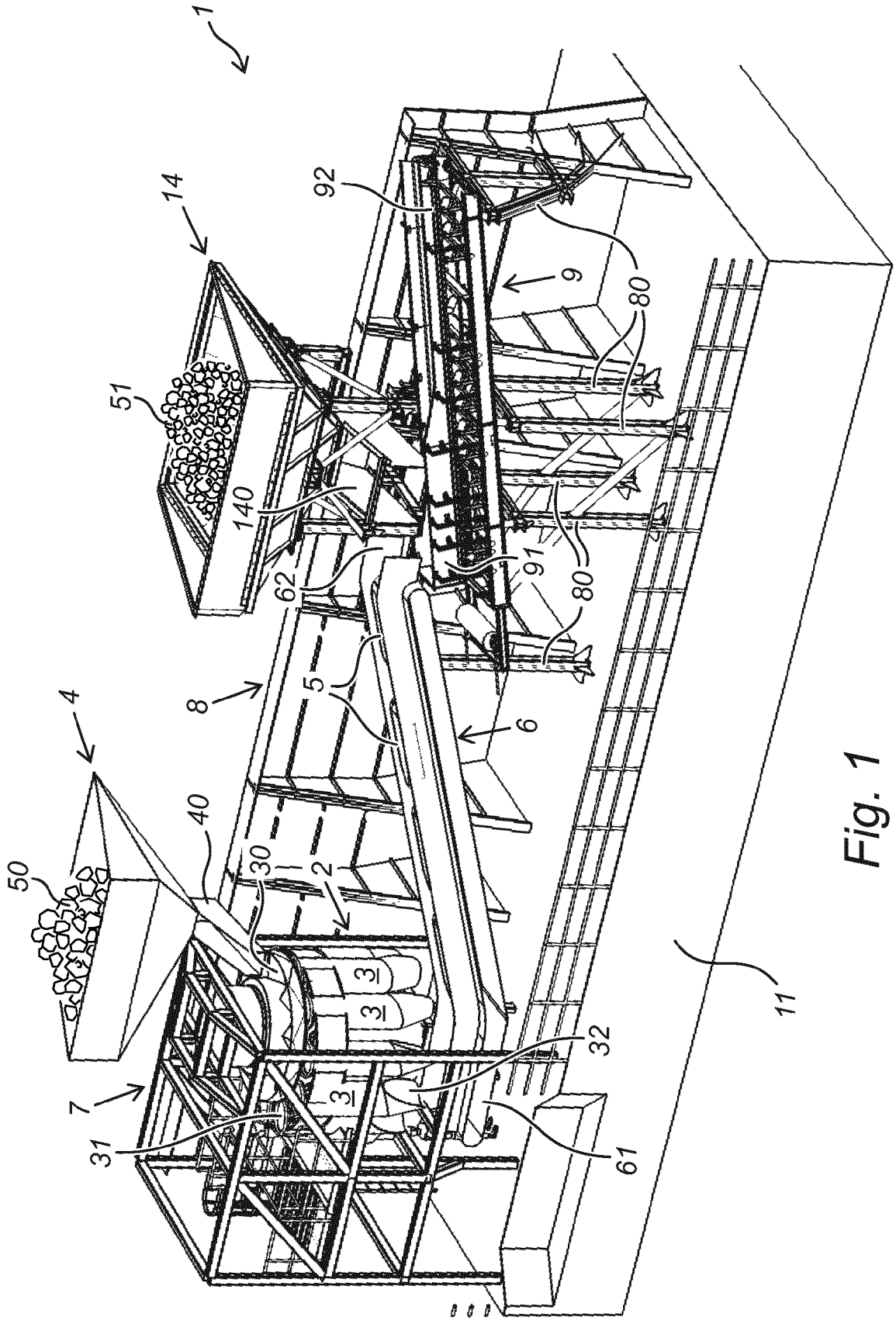

Fig. 1

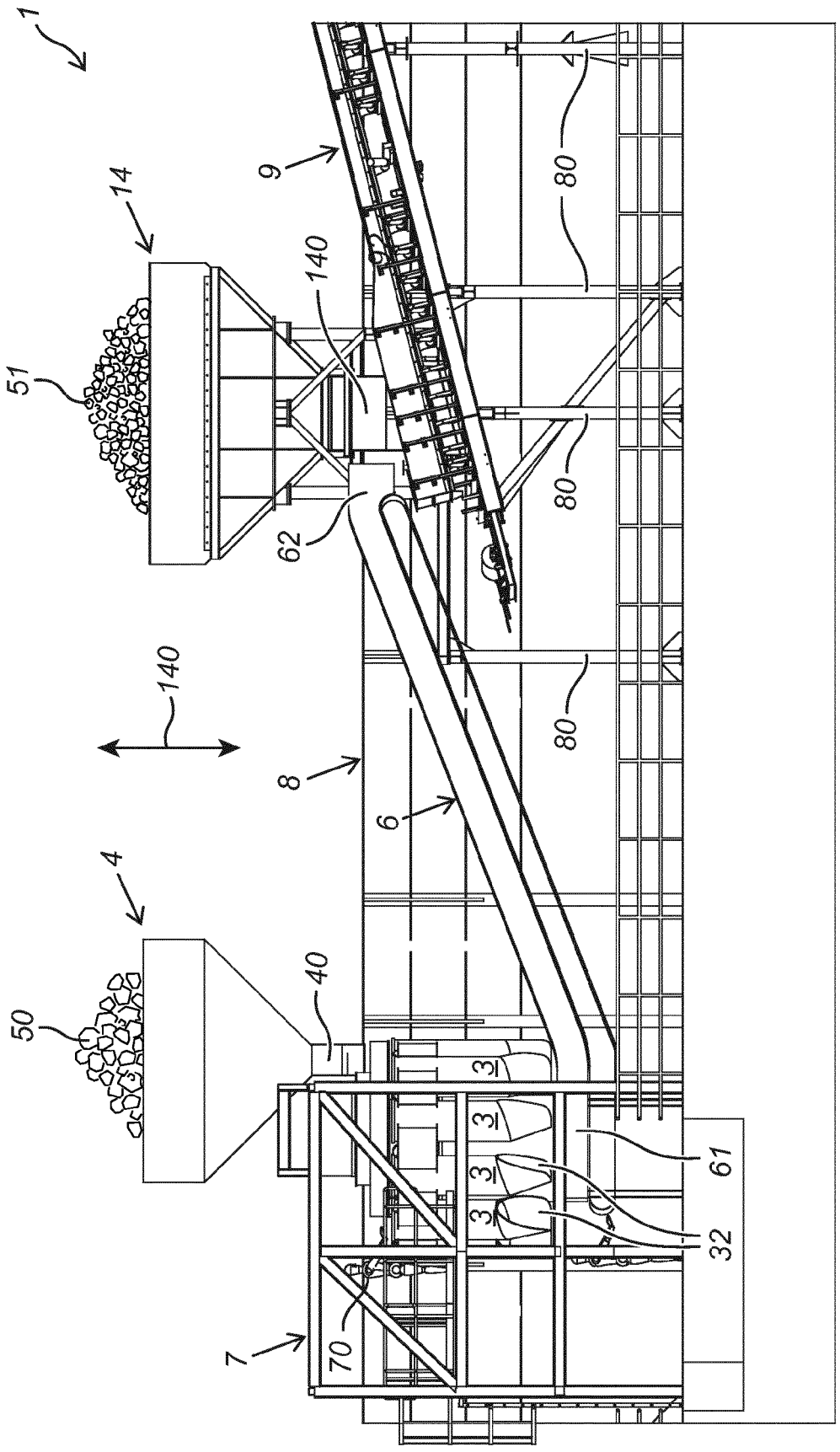

Fig. 2

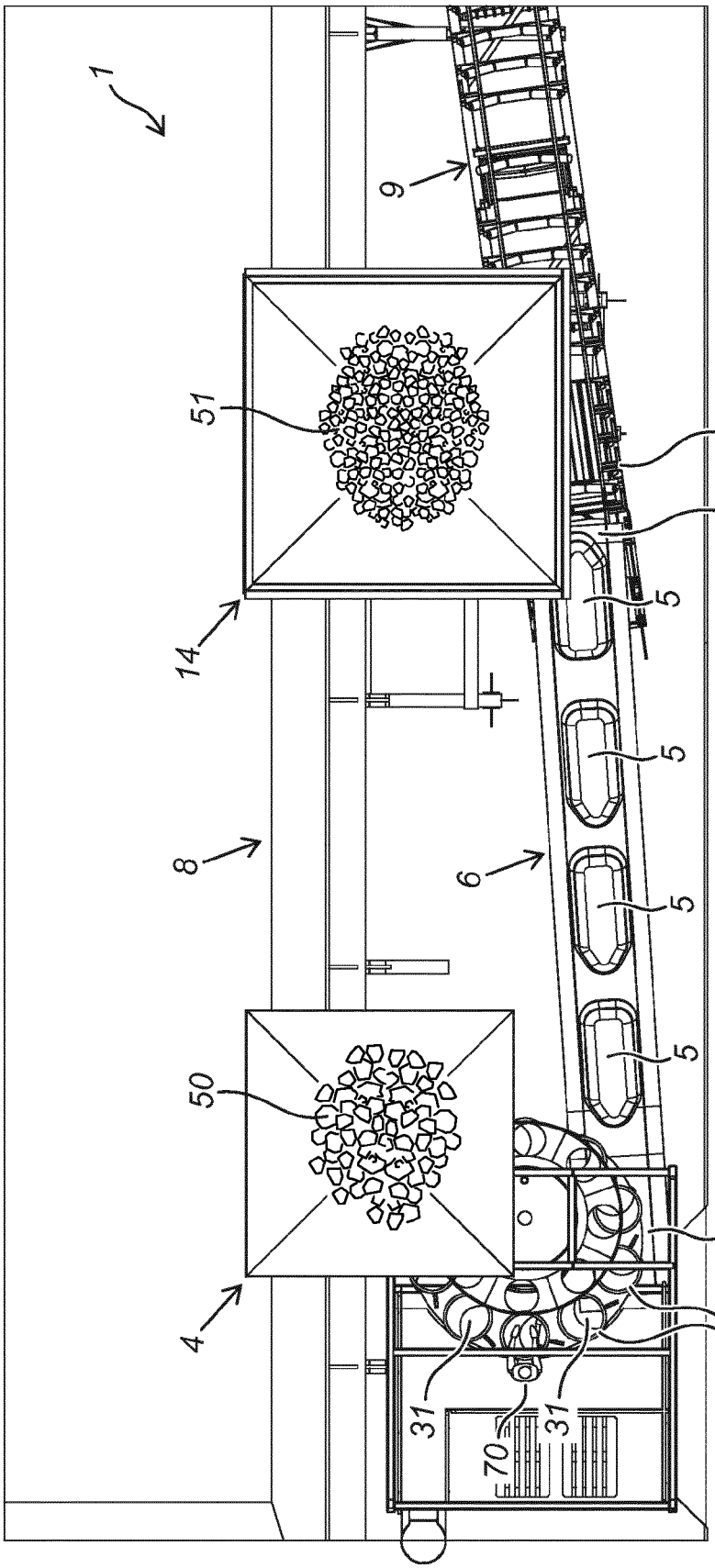

Fig. 3

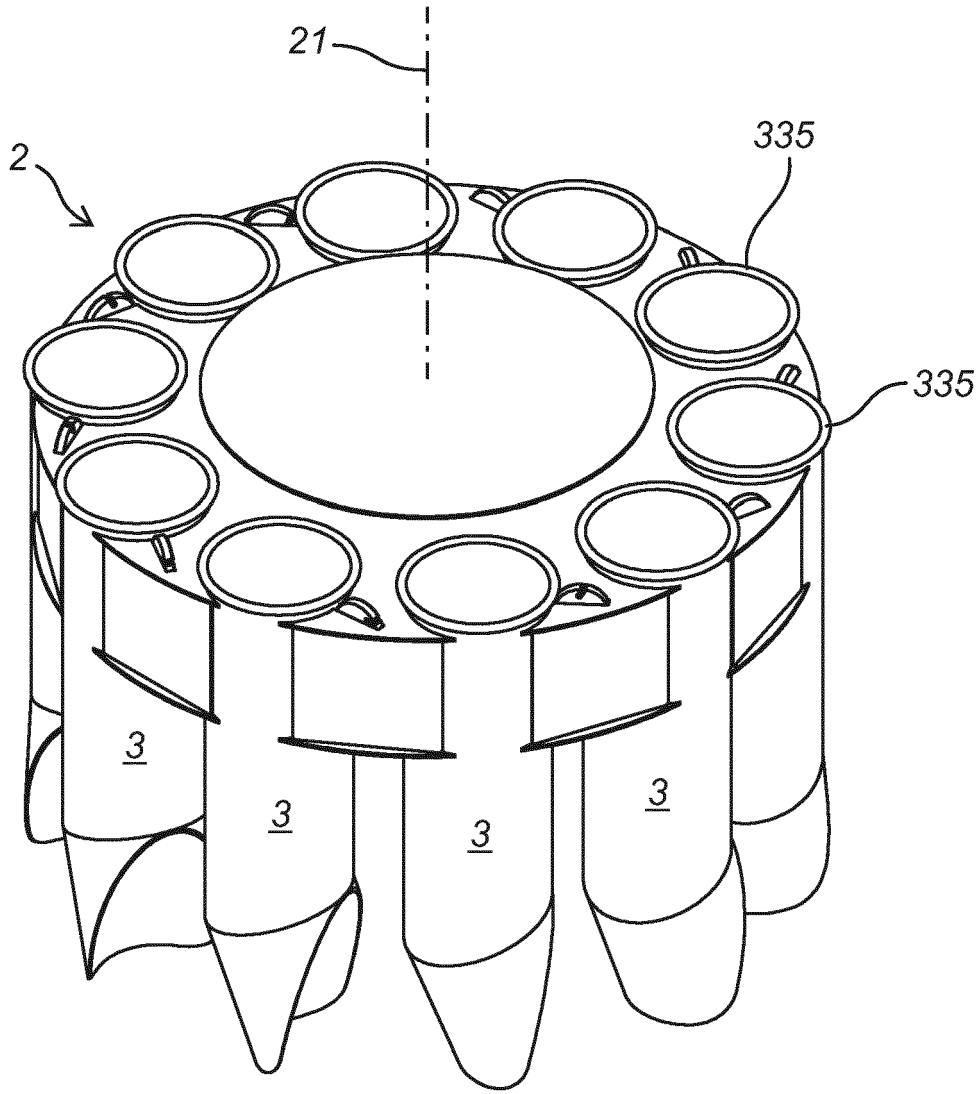

Fig. 4

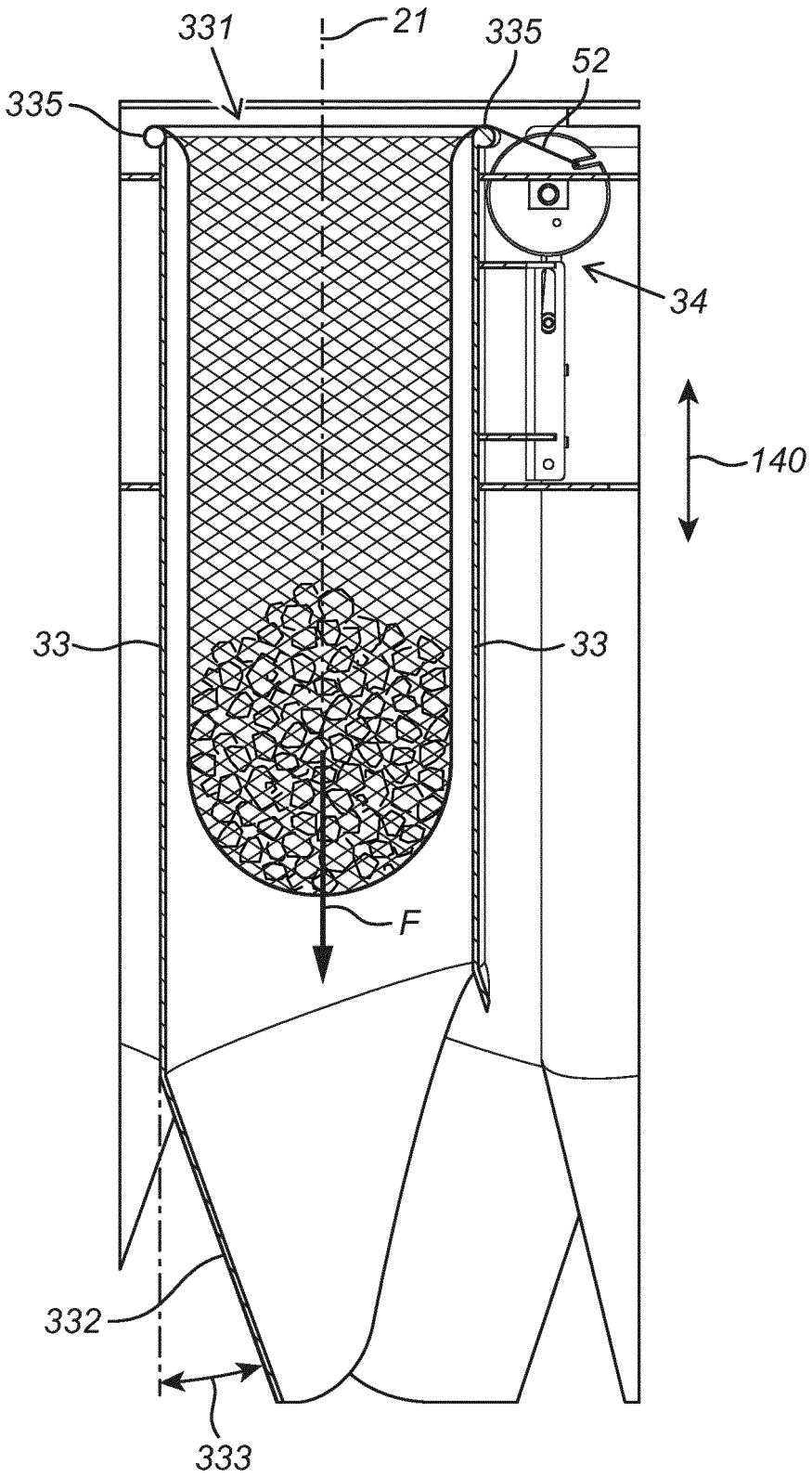

Fig. 5

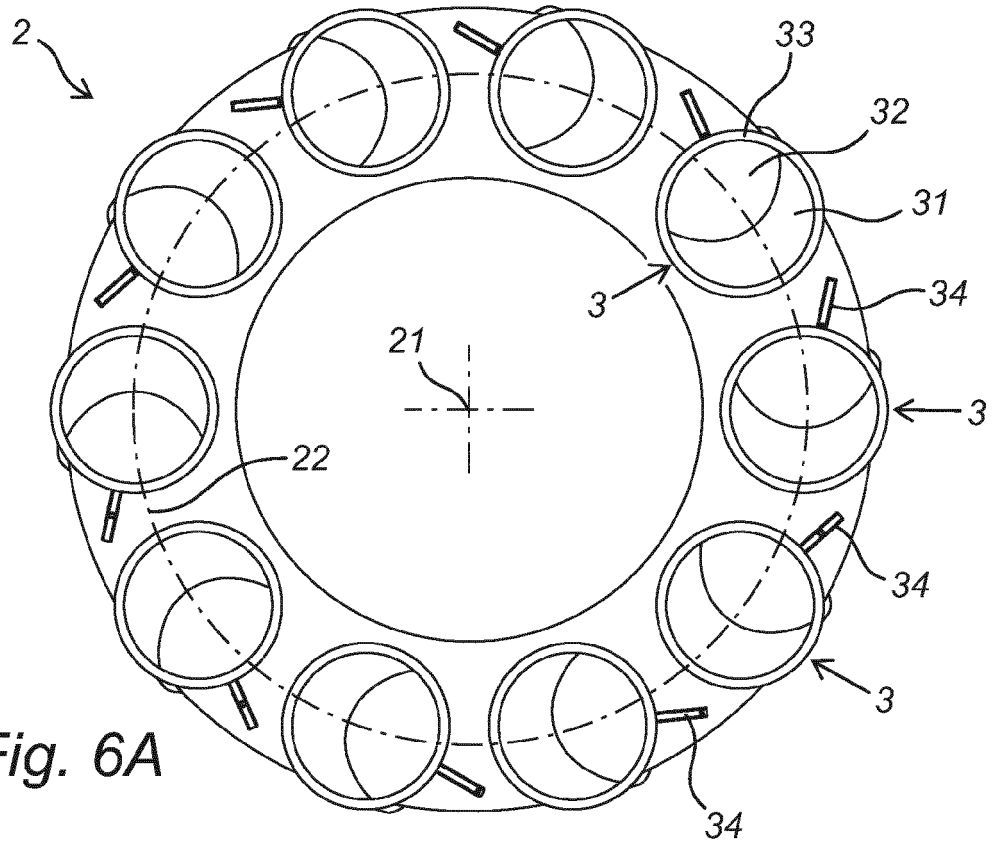

Fig. 6A

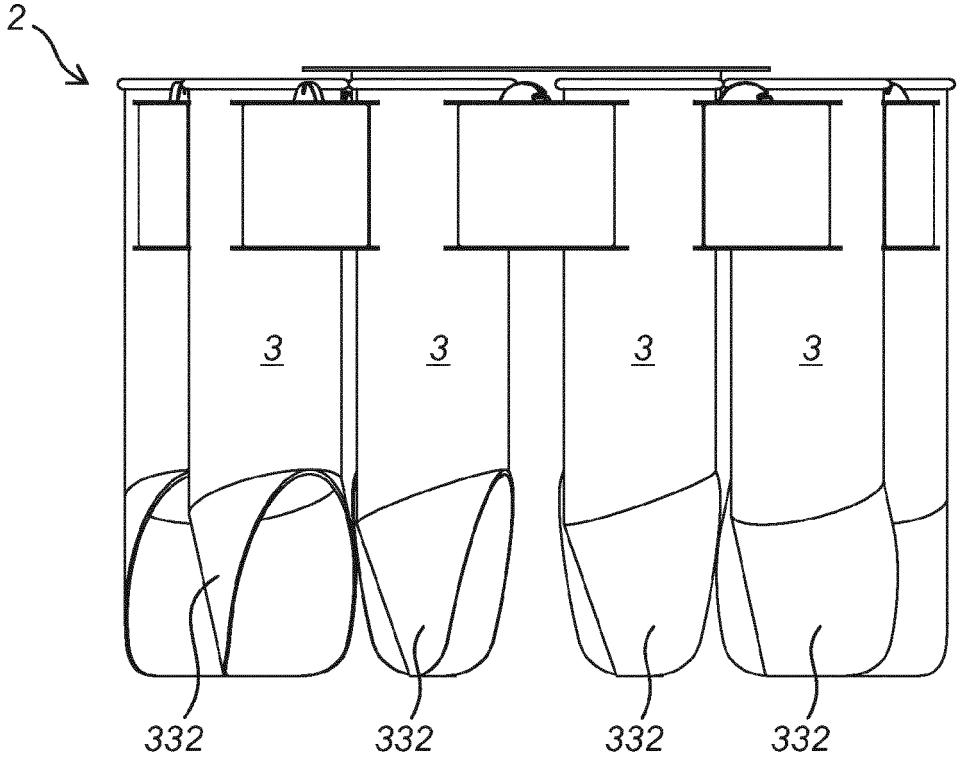

Fig. 6B

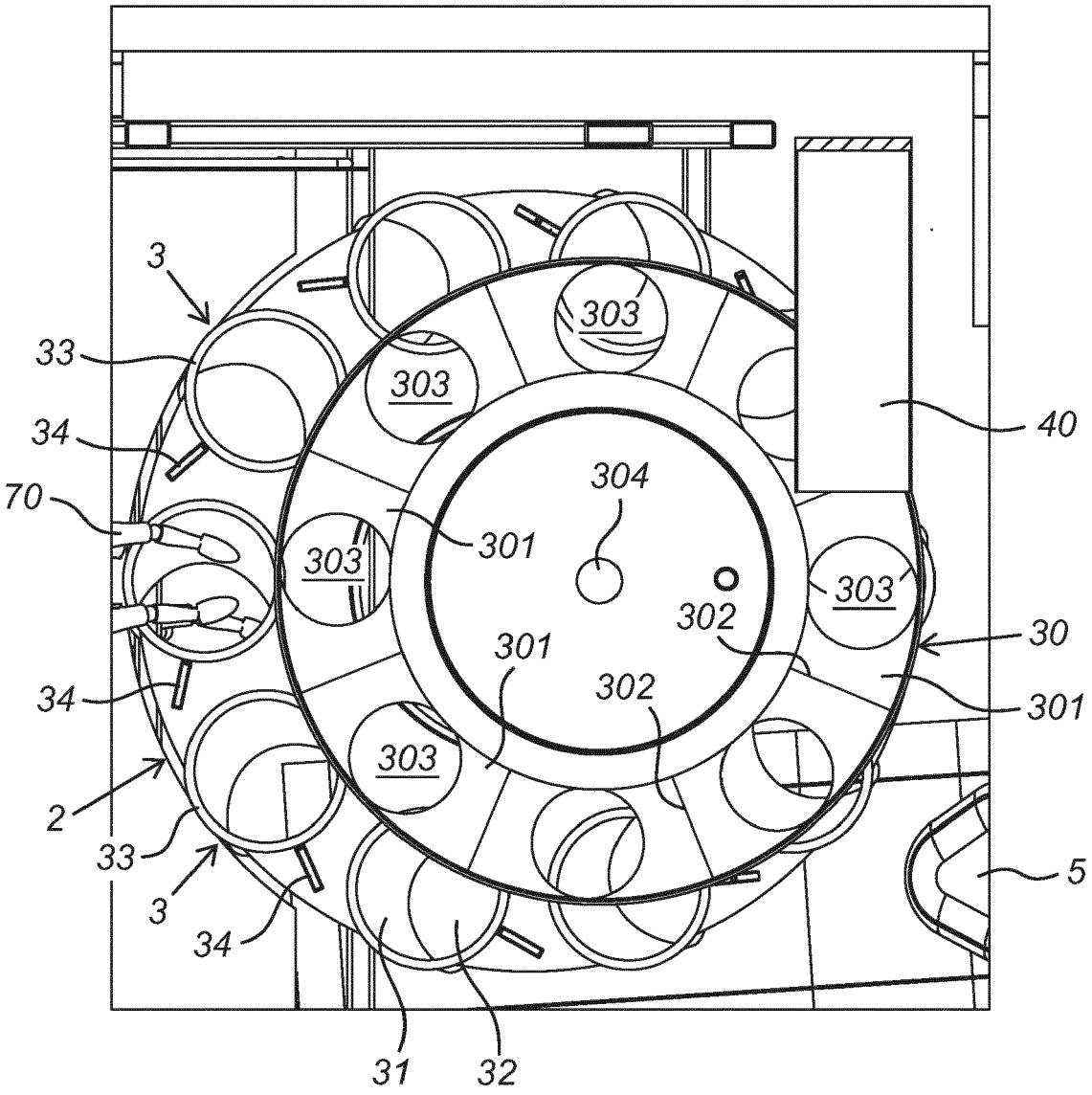
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Fig. 7

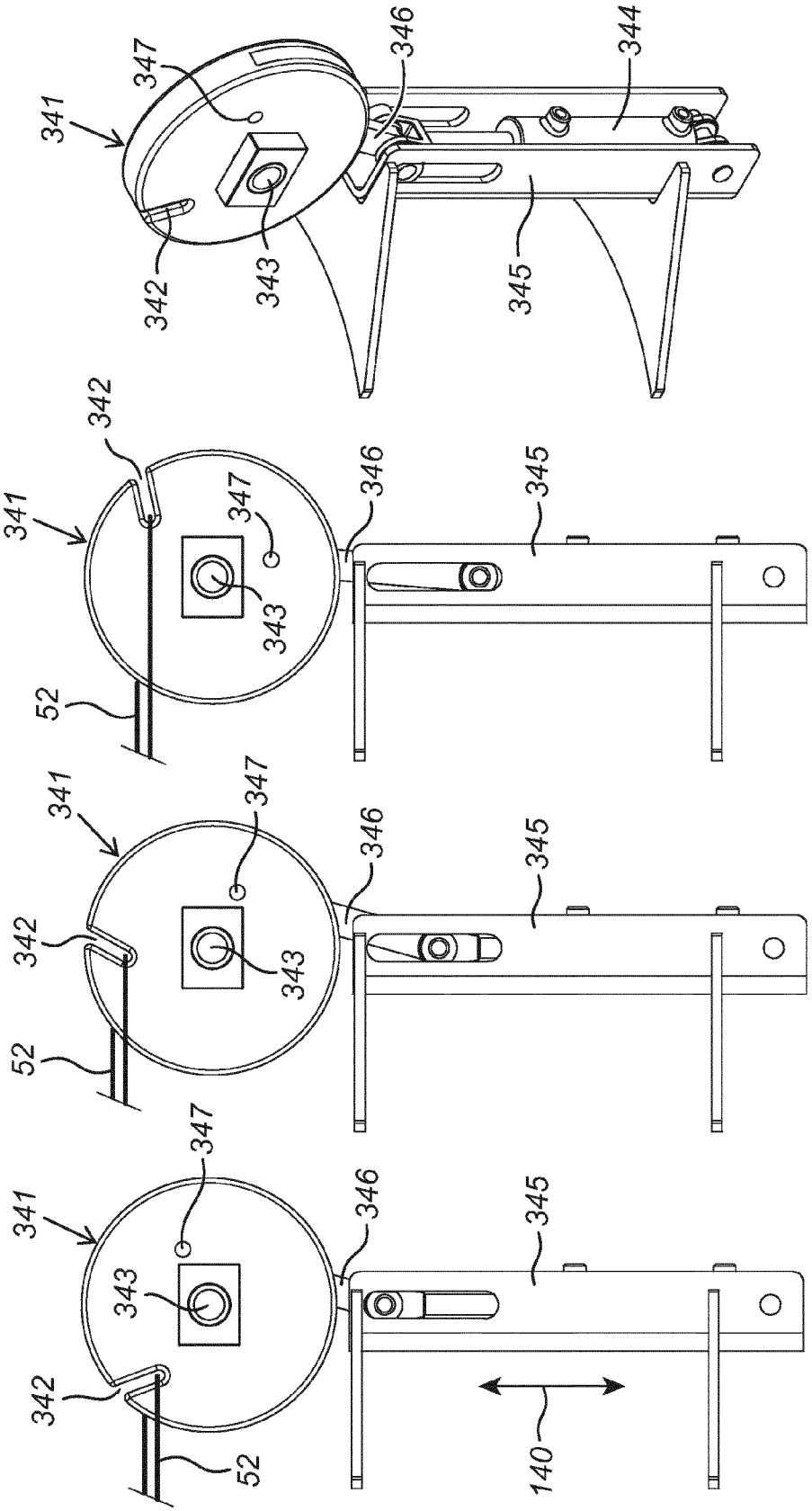

Fig. 8A

Fig. 8B

Fig. 8C

Fig. 8D

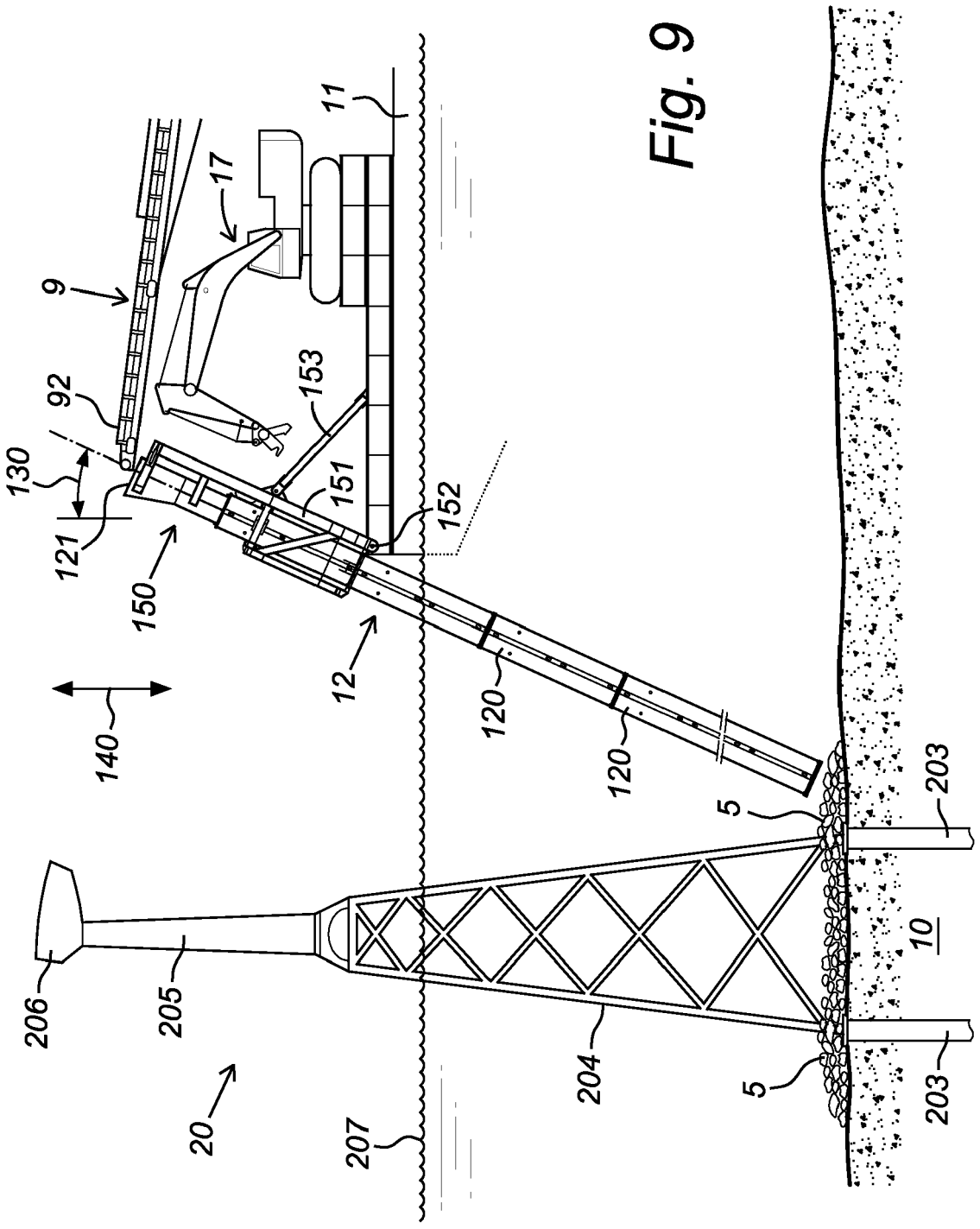
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Fig. 9

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EUROPEAN SEARCH REPORT

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EP 14 16 2049

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B65B
B65G
E02B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	30 May 2014	Schelle, Joseph

CATEGORY OF CITED DOCUMENTS

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