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(54) SUCTION HEAD FOR A DREDGING VESSEL AND THE RELATED METHOD

SAUGKOPF FÜR EINE BAGGERSCHIFF UND ENTSPRECHENDES VERFAHREN

EMBOUT DE DRAGAGE POUR UN ENGIN DE DRAGAGE ET PROCÉDÉ ASSOCIÉ

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(73) Proprietor: **Baggerwerken Decloedt en Zoon
8400 Oostende (BE)**

(72) Inventor: **VAN WELLEN, Erik
B2000 Antwerpen (BE)**

(74) Representative: **Brouwer, Hendrik Rogier et al
Arnold & Siedsma
Bezuidenhoutseweg 57
2594 AC The Hague (NL)**

(56) References cited:

EP-A1- 1 653 010	DE-A1- 4 226 492
DE-A1- 4 405 451	JP-A- 2001 098 576
JP-A- 2005 048 756	JP-A- 2009 034 653
US-A- 4 795 217	US-A1- 2010 299 972

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Description

[0001] The invention relates to a suction head for a dredging vessel. The invention likewise relates to a dredging device comprising a dredging vessel adapted for movement in a direction of movement, a dredge pump placed on the dredging vessel and having a suction connection, a suction conduit connecting the suction head to the suction connection of the dredge pump, and support means placed between the dredging vessel and the suction head for supporting the suction conduit. The invention further relates to a method for dredging ground using this suction head.

[0002] Dredging devices of the above stated type are for instance known from EP-A-0892116. The known suction head comprises a tube construction which can be connected to a suction conduit of a dredging vessel and has side walls, an upper wall and a lower wall directed toward the bottom. The rear wall, for instance in the form of a rotatable visor, is further provided with a toothed beam which runs transversely of the direction of movement and which is provided on the bottom side with teeth for dislodging material for dredging from the bottom. A series of wear heel pieces together forming the heel plate are arranged on the underside (the bottom side) of the tube construction at the position of the connection to the visor. During use such a suction head is dragged forward over or in the bottom for dredging, wherein the suction head rests via the heel plate on the underwater bottom and wherein the teeth dislodge the bottom and the loosened bottom material is suctioned away via the suction conduit, for instance to a bin present on the dredging vessel. Such a suction head is therefore also referred to as trailing hopper suction head.

[0003] Owing to the suction action of the suction conduit an underpressure will be built up in the suction head which depends on, among other factors, the extent of sealing of the suction head. The built up underpressure provides for suction of dredged bottom material, wherein, inevitably, water is likewise suctioned in from the outside.

[0004] EP 1653010 A1 relates to a drag head with cutting tools for penetrating an underwater bottom according to the preamble of independent claim 1. The described drag head reduces the cutting resistance of the underwater bottom by providing the drag head with nozzles. First nozzles are intended to eliminate the pore pressure of the bottom material, while second nozzles dilute the dislodged bottom material in order to facilitate suctioning thereof. The known suction head has the drawback that the dredging efficiency may decrease during dredging. This is a particular problem in the dredging of underwater bottoms comprising clay, loam and other cohesive materials.

[0005] DE 4226492 A1 describes a trailing suction hopper dredger for increasing the depth of a relatively hard bottom layer. Provided upstream of the drag head are nozzles which inject water under high pressure into the underwater bottom and thereby weaken it. According to

figure 11 of DE 4226492 A1 the nozzles can be situated on a rotatable plate, wherein the axes of the rotating nozzles run parallel to the rotation axis of the rotating plate.

[0006] The present invention has for its object to provide a suction head for a dredging vessel with which underwater bottoms, particularly bottoms comprising clay, loam and other cohesive materials, can be dredged with an improved efficiency compared to the known suction head. Within the context of this application efficiency is understood to mean the volume of bottom material which can be dredged per unit of time and per unit of power.

[0007] Provided according to the invention is a suction head for a dredging vessel comprising a construction of side walls and a rear wall running substantially transversely of the direction of movement of the suction head, which construction is connectable to a suction conduit of the dredging vessel and is provided with cutting tools for penetrating into an underwater bottom, wherein the suction head further comprises at least one nozzle for ejecting a liquid jet under pressure, and the at least one nozzle is rotatable around a rotation axis which does not coincide with the axis of the nozzle (or the liquid jet in stationary position of the nozzle), wherein the at least one nozzle is moreover directed toward the interior of the suction head in order to eject a liquid jet into the interior. The invented suction head has been found able to dredge bottoms with an improved efficiency compared to the known suction head. Good results are achieved particularly in the case of underwater bottoms comprising clay. Providing the suction head with rotatable nozzles achieves that the bottom for dredging or underwater bottom parts already suctioned in and present in the suction head can be cut into smaller portions in efficient manner, whereby the risk of blockage is found to decrease noticeably.

[0008] The non-coincidence of the rotation axis of the at least one nozzle with the axis of the at least one nozzle does not - according to an embodiment of the invented suction head - preclude the rotation axis and the axis intersecting each other at a point. This creates a cone-like swirling pattern of the ejected liquid jets, so greatly enhancing efficiency.

[0009] Provided in an embodiment of the invention is a suction head wherein the rotation axis is eccentric to the axis of the nozzle (or the liquid jet in stationary position of the nozzle).

[0010] The at least one nozzle can in principle be located in and in the vicinity of the suction head, and the ejected liquid jet can in principle be directed at random. According to the invention however, the suction head is characterized in that the at least one nozzle is directed toward the interior of the suction head in order to eject a liquid jet into the interior. Because the at least one nozzle rotates, the ejected liquid jet covers a large part of the interior of the suction head. Due to the action of the liquid jet or jets a large part of the bottom material which may be present in the suction head is cut into smaller portions, which can then be discharged more easily via the suction

pipe connected to the suction head.

[0011] A further embodiment of the suction head according to the invention is characterized in that the nozzles form a series, the series of nozzles being disposed in a straight line running transversely of the direction of movement of the suction head. The bottom material possibly present in the suction head is hereby cut in the transverse direction of the suction head by the action of the liquid jets ejected from the series of nozzles, wherein these liquid jets preferably overlap and reinforce each other.

[0012] Although the number of nozzles in the suction head according to the invention can be chosen within broad limits, it is advantageous for the suction head to comprise between two and twenty nozzles, which still more preferably form a series disposed in a straight line running transversely of the direction of movement of the suction head.

[0013] Yet another embodiment of the suction head according to the invention is characterized in that the cutting tools form a series, the series of cutting tools being disposed in a straight line running transversely of the direction of movement of the suction head, and wherein the nozzles are located above the series of cutting tools. It has been found that such an embodiment can prevent premature damage and/or blockage of the nozzles. The useful life of the cutting tools can also be extended in this embodiment, and time can be saved in that on average fewer broken or blunted cutting tools have to be replaced.

[0014] The number of cutting tools of the suction head according to the invention can be chosen within broad limits. The number of cutting tools in a series preferably amounts to at least ten, more preferably at least fifteen and most preferably at least twenty. The number of series preferably lies between one and ten, more preferably between one and fifteen, and the number of series most preferably amounts to two. With this preferred variant a good compromise is made between the dredging efficiency and the power required to drag the suction head over and/or in the bottom in the direction of movement.

[0015] Yet another embodiment according to the invention provides a suction head, wherein it comprises a heel plate which runs substantially transversely of the direction of movement of the suction head and with which the suction head can support on the underwater bottom, and the at least one nozzle is mounted on the heel plate, wherein in a further preferred embodiment this nozzle is directed toward the interior of the suction head in order to eject a liquid jet into the interior. Because the heel plate is generally located on the upstream side (relative to the direction of movement of the suction head) of the cutting tools, in such an embodiment the liquid jets will be ejected into the suction head substantially in the downstream direction. It has been found that this can bring about more efficient cutting of bottom material possibly present in the suction head.

[0016] A further embodiment of the suction head according to the invention comprises at least one nozzle

which is oriented in the direction of the underwater bottom in order to eject a liquid jet into this bottom. One or more of such nozzles can fluidize or otherwise loosen the underwater bottom at the position of the impact of the liquid jets, whereby the problem of blockage of the suction head could occur less.

[0017] Although it is possible according to the invention to provide the suction head with cutting tools in the form of the known teeth, other types of cutting tool can if desired be used, such as for instance teeth or tipped bits which are rotation-symmetrical on at least their free outer end. The toothed beam can if desired be provided with coupling means, such as for instance holders in which the cutting tools can be accommodated.

[0018] According to the invention the suction head comprises at least one rotating nozzle for injecting a liquid under pressure, preferably water. Depending on the properties of the bottom material for dredging, the nozzles can operate at relatively low pressures, preferably of a maximum of 50 bar, more preferably a maximum of 30 bar, and most preferably a maximum of 15 bar. The liquid jets generated by the nozzles under such pressures are particularly adapted to spray clean the cutting tools and the space in the interior of the suction head, in other words, remove bottom material and other materials therefrom. A good suctioning of dislodged bottom material is hereby achieved. According to the invention the nozzles can in principle be disposed in front of, behind or at the position of the cutting tools. It is also possible to provide the cutting tools themselves with rotating nozzles.

[0019] In addition, it is also possible to provide (high-pressure) nozzles which can operate under considerably higher pressures of 200 to 1000 bar and more. The liquid jets generated by the rotating nozzles under such high pressures are adapted to cut up partially suctioned-in bottom material still present in the interior of the suction head. The flow rate of such high-pressure nozzles will generally be lower than the flow rate required for the low-pressure nozzles.

[0020] The invention further relates to a dredging device comprising a dredging vessel adapted for movement in a direction of movement, a suction head according to the invention connected to the dredging vessel, a dredge pump placed on the dredging vessel and having a suction connection, a suction conduit connecting the suction head to the suction connection of the dredge pump, and support means placed between the dredging vessel and the suction head for supporting the suction conduit. Bottom material, and particularly bottom material comprising substantially clay, can be suctioned up in efficient manner using the dredging device according to the invention.

[0021] The invention therefore also relates to a method for dredging bottom material under water with a dredging vessel equipped with a suction head according to the invention, wherein the suction head is dragged in a direction of movement over a bottom for dredging, this such that substantially only the cutting tools make contact with

the bottom, and wherein the at least one nozzle is set into rotation and a liquid jet is ejected therefrom under pressure.

[0022] In an embodiment of the method according to the invention a liquid jet is ejected from the at least one nozzle before the cutting tools make contact with the underwater bottom and/or before the suction head is lowered onto the underwater bottom. Initial blockage of the suction head is hereby at least partially prevented.

[0023] The suction head according to the invention is particularly suitable for dredging an underwater bottom comprising substantially clay.

[0024] The suction head and method according to the invention will now be further elucidated on the basis of the following description of preferred embodiments and figures, without the invention being limited thereto. In the figures:

figure 1 is a schematic cross-sectional view of a dredging device according to the invention;
 figure 2 is a schematic side view of an embodiment of a suction head according to the invention;
 figure 3 is a schematic side view of another embodiment of a suction head according to the invention;
 figure 4 is a schematic side view of yet another embodiment of a suction head according to the invention;
 figure 5A is a schematic perspective view of an embodiment of a nozzle according to the invention;
 figure 5B is a schematic cross-section along the line A-A' of the nozzle shown in figure 5A;
 figure 6A is a perspective view of a liquid jet ejected by a dual nozzle according to the invention;
 figure 6B is a perspective view of liquid jets ejected by a series of dual nozzles according to the invention;
 and finally
 figure 6C is a top view of the liquid jets shown in figure 6B ejected by a series of dual nozzles according to the invention.

[0025] Figure 1 shows a dredging vessel 1 which is provided with a motor, not shown in the drawing, for driving a propeller 2 via a propeller shaft for the purpose of propelling dredging vessel 1. Also present are devices, not shown in the drawings, for steering dredging vessel 1, such as a rudder and transversely placed propellers for facilitating manoeuvring.

[0026] A dredge pump, not shown in the drawings, is arranged in dredging vessel 1. Arranged against a side wall of the dredging vessel is a suction conduit 3, one end of which is connected to the suction connection of the dredge pump. In the present embodiment the suction conduit 3 comprises two members 3a and 3b which are connected to each other by means of a coupling allowing some relative angular displacement. The connection between upper member 3a of suction conduit 3 and the vessel also allows angular displacement in the vertical plane and about the axis. For support of the movable end

of upper member 3a of suction conduit 3 this member is connected to a cable 4a, the other end of which is connected to a winch 5a. For support of the movable end of lower member 3b of suction conduit 3 this member is likewise connected to a cable 4b, the other end of which is connected to a winch 5b. It is thus possible using winches 5a, 5b to vary the height of suction conduit 3. It will be apparent that, also subject to the depth of the basin for dredging, the number of members of suction conduit 3 can be increased or decreased, with a corresponding adjustment of the number of cables 4 and winches 5.

[0027] A suction head 6 according to the invention is arranged on the free end of second member 3b of suction conduit 3. Referring to figure 2, an embodiment of suction head 6 is shown. Suction head 6 comprises a construction 7 which is connectable to suction conduit 3 and takes the form of a closed tube construction with side walls 7a, 7b (only 7a is visible), an upper wall 7c and a lower wall 7d facing toward the bottom. Arranged at the rear (the downstream side relative to the direction of movement P) of construction 7 is a visor 8 which is open only on the bottom side and which is connected to construction 7 for pivoting around a horizontal axis 9 and can thus be rotated up and downward by a hydraulic piston (not shown). Visor 8 is further provided with a toothed beam 10 running transversely of the direction of movement P and provided on the bottom side with teeth 11 for dislodging material for dredging from the bottom. Arranged on the underside of construction 7 is a series of wear heel pieces which together form a heel plate 12. In order to prevent lateral inflow of surrounding water, suction head 6 can also be provided with a number of lateral, knife-like wear strips 14. During dredging the known suction head 6 supports with heel plate 12 on the bottom, wherein visor 8 can rotate independently of construction 7. The desired penetration depth of teeth 11 into the bottom is controlled with the rotation of visor 8. Teeth 11 dislodge the bottom, and the loosened bottom material is suctioned away via suction conduit 3, for instance to a bin present on dredging vessel 1. In order to achieve the highest possible production, in the known suction head 6 the visor 8 is positioned independently of construction 7 so that the best possible sealing is achieved between visor 8 and the bottom.

[0028] According to the embodiment shown in figure 2, suction head 6 is further provided with a series of nozzle units 20. Nozzle units 20 form a series disposed in a straight line transversely of the direction of movement P of suction head 6. The nozzles (20a, 20b) of nozzle units 20 are disposed such that they are directed toward the interior of suction head 6 in order to eject liquid jets 22 into the interior.

[0029] As becomes apparent from the embodiment shown in figures 5A and 5B, each nozzle unit 20 comprises two nozzles (20a, 20b) which are rotatable around a rotation axis 21 of nozzle unit 20. Nozzle unit 20 comprises a fixed part 23 with which unit 20 can be fixed to a part of suction head 6, and a part 24 rotatable around

rotation axis 21. The rotation option can be embodied in any known manner. Nozzles (20a, 20b) are adapted to eject two liquid jets (22a, 22b) under pressure. Because during use the nozzle unit 20 is set into rotation around rotation axis 21, and rotation axis 21 does not coincide with the axes (23a, 23b) of nozzles (20a, 20b), the ejected liquid jets 22 will form a cone-like swirling pattern, as shown for instance in figure 6A. It is noted that the axes (23a, 23b) of nozzles (20a, 20b) coincide with the ejected liquid jets (22a, 22b) when nozzle unit 20 is in stationary position, wherein part 24 is not rotating around rotation axis 21. It will further be apparent that the hydraulic coupling between fixed part 23 and rotatable part 24 of nozzle unit 20 can be embodied in a manner known to the skilled person, for instance with a swivel. The liquid for liquid jets 22 is indeed preferably supplied via feed conduit 25 from a container (not shown) for the liquid under the required pressure. The embodiment shown in figures 5A and 5B comprise a nozzle unit 20 with two nozzles (20a, 20b) which are arranged diametrically opposite each other and disposed at a peripheral angle 30 of about 170 degrees. Any other angle is however also possible, wherein the angle can for instance be chosen subject to the properties of the underwater bottom for dredging. It will be apparent that nozzle unit 20 can if desired also be provided with only one nozzle 20a. All that is necessary here is that rotation axis 21 of nozzle unit 20 does not coincide with axis 23a of the relevant nozzle 20a. As shown in figure 5B, this does not preclude axis 23a and rotation axis 21 intersecting each other at a virtual intersection 31. It is also possible for a nozzle unit 20 to be provided with three or more nozzles (20a, 20b, ...).

[0030] In the embodiment shown in figure 2, nozzle units 20 are arranged on the likewise transversely extending toothed beam 10, just above teeth 11. It is also possible for the nozzle units to be situated between teeth 11 as seen in transverse direction. Teeth 11 do after all also form a series disposed in a straight line transversely of the direction of movement P of suction head 6.

[0031] In the embodiment shown in figure 3 nozzle units 20 are arranged on the likewise transversely extending heel plate 12, wherein the nozzles (20a, 20b) are oriented in the direction of the interior of suction head 6 in order to eject the liquid jets (22a, 22b) into the interior.

[0032] In the embodiment shown in figure 4 nozzle units 20 are on the one hand arranged on toothed beam 10 and on the other on the likewise transversely extending heel plate 12, wherein they are however oriented in the direction of the underwater bottom in order to eject a liquid jet 22c into this bottom.

[0033] Figure 6A shows the pattern of liquid jets (22a, 22b) produced by one nozzle unit 20 as shown in figures 5A and 5B and provided with two diametrically disposed nozzles (20a, 20b). Due to the rotation of nozzle unit 20 around axis 21 the liquid jets (22a, 22b) rotate around each other and form a swirling pattern.

[0034] Figures 6B and 6C show the pattern of liquid jets (22a, 22b) produced by a series of nine nozzle units

20 as shown in figures 5A and 5B which are disposed in line parallel to the transverse direction 32 and provided with two diametrically disposed nozzles (20a, 20b). Due to the rotation of each nozzle unit 20 around axis 21 the liquid jets (22a, 22b) of the mutually adjacent nozzle units 20 rotate around each other, whereby a fine cutting of the bottom material in suction head 6 can take place. The cutting density can be set as desired by adjusting the number of nozzles per unit of length.

[0035] Using the suction head 6 described in detail above an underwater bottom, and particularly an underwater bottom comprising clay, loam and/or other cohesive material, can advantageously be dredged, for which purpose the suction head is mounted on suction conduit 3 of dredging vessel 1 and lowered to the bottom and dragged thereover in the dragging direction P, this such that cutting tools 30 make contact with the bottom and nozzles (20a, 20b) are set into rotation around a rotation axis 21 and a liquid jet (22a, 22b) is ejected under pressure therefrom. This achieves that bottom material possibly accumulated in the interior of suction head 6 is cut quickly and efficiently, whereby blockage of suction conduit 3 is substantially prevented, or in any case counteracted.

[0036] The invention is not limited to the above described exemplary embodiments, and modifications can be made thereto to the extent these fall within the scope of the appended claims.

Claims

1. Suction head (6) for a dredging vessel (1) which moves the suction head (6) in a direction of movement over an underwater bottom, comprising a construction (7) of side walls and a rear wall (8) running substantially transversely of the direction of movement of the suction head (6), which construction is connectable to a suction conduit (3) of the dredging vessel (1) and is provided with cutting tools (11) for penetrating into an underwater bottom, wherein the suction head (6) further comprises at least one nozzle (20) for ejecting a liquid jet (22) under pressure, **characterised in that** the at least one nozzle (20) is rotatable around a rotation axis which does not coincide with the axis of the nozzle (20) or of the liquid jet (22) in stationary position of the nozzle (20), wherein the at least one nozzle is directed toward the interior of the suction head in order to eject a liquid jet into the interior.
2. Suction head as claimed in claim 1, wherein the rotation axis and the axis of the at least one nozzle (20) intersect each other at a point.
3. Suction head as claimed in claims 1 and 2, wherein the nozzles form a series, the series of nozzles being disposed in a straight line running transversely of the

direction of movement of the suction head.

4. Suction head as claimed in any of the foregoing claims, wherein it comprise between two and twenty nozzles. 5
5. Suction head as claimed in any of the foregoing claims, wherein the cutting tools form a series, the series of cutting tools being disposed in a straight line running transversely of the direction of movement of the suction head, and wherein the nozzles are located above the series of cutting tools. 10
6. Suction head as claimed in any of the foregoing claims, wherein it comprises a heel plate which runs substantially transversely of the direction of movement of the suction head (6) and with which the suction head can support on the underwater bottom, and the at least one nozzle is mounted on the heel plate. 15
7. Suction head as claimed in any of the foregoing claims, wherein it comprises at least one nozzle which is oriented in the direction of the underwater bottom in order to eject a liquid jet into this bottom. 20
8. Dredging device comprising a dredging vessel adapted for movement in a direction of movement, a suction head as claimed in any of the claims 1-7 connected to the dredging vessel, a dredge pump placed on the dredging vessel and having a suction connection, a suction conduit connecting the suction head to the suction connection of the dredge pump, and support means placed between the dredging vessel and the suction head for supporting the suction conduit. 25
9. Method for dredging bottom material under water with a dredging vessel equipped with a suction head as claimed in any of the claims 1-7, wherein the suction head is dragged in a direction of movement over a bottom for dredging, this such that substantially only the cutting tools make contact with the bottom, and wherein the at least one nozzle is set into rotation and a liquid jet is ejected therefrom under pressure. 30
10. Method as claimed in claim 9, wherein the nozzles form a series, the series of nozzles being disposed in a straight line running transversely of the direction of movement of the suction head. 35
11. Method as claimed in claim 9 or 10, wherein a liquid jet is ejected from the at least one nozzle before the cutting tools make contact with the underwater bottom. 40
12. Method as claimed in any of the claims 9-11 for dredging an underwater bottom comprising clay, loam and/or other cohesive materials. 45

Patentansprüche

1. Saugkopf (6) für ein Baggerschiff (1), das den Saugkopf (6) in einer Bewegungsrichtung über einen Unterwasserboden bewegt, wobei der Saugkopf eine Konstruktion (7) aus Seitenwänden und einer Rückwand (8) aufweist, die im Wesentlichen quer zur Bewegungsrichtung des Saugkopfes (6) verläuft, wobei die Konstruktion mit einem Saugrohr (3) des Baggerschiffs (1) verbindbar und mit Schneidwerkzeugen (11) versehen ist, um in einen Unterwasserboden einzudringen, wobei der Saugkopf (6) weiterhin mindestens eine Düse (20) zum Abgeben eines Flüssigkeitsstrahls (22) unter Druck aufweist, **dadurch gekennzeichnet, dass** die mindestens eine Düse (20) um eine Drehachse drehbar ist, die nicht mit der Achse der Düse (20) oder des Flüssigkeitsstrahls (22) in einer ortsfesten Position der Düse (20) übereinstimmt, wobei die mindestens eine Düse in das Innere des Saugkopfes gerichtet ist, um einen Flüssigkeitsstrahl in das Innere abzugeben. 5
2. Saugkopf nach Anspruch 1, wobei die Drehachse und die Achse der mindestens einen Düse (20) sich an einem Punkt überschneiden. 10
3. Saugkopf nach Anspruch 1 und 2, wobei die Düsen eine Reihe bilden, wobei die Reihe der Düsen in einer geraden Linie quer zur Bewegungsrichtung des Saugkopfs angeordnet ist. 15
4. Saugkopf nach einem der vorstehenden Ansprüche, wobei der Saugkopf zwischen zwei und zwanzig Düsen aufweist. 20
5. Saugkopf nach einem der vorstehenden Ansprüche, wobei die Schneidwerkzeuge eine Reihe bilden, wobei die Reihe von Schneidwerkzeugen in einer geraden Linie quer zur Bewegungsrichtung des Saugkopfs angeordnet ist und wobei die Düsen sich über der Reihe von Schneidwerkzeugen befinden. 25
6. Saugkopf nach einem der vorstehenden Ansprüche, wobei der Saugkopf eine Bodenplatte aufweist, die im Wesentlichen quer zur Bewegungsrichtung des Saugkopfes (6) verläuft und mit der der Saugkopf auf dem Unterwasserboden gestützt wird und wobei die mindestens eine Düse auf der Bodenplatte angebracht ist. 30
7. Saugkopf nach einem der vorstehenden Ansprüche, wobei der Saugkopf mindestens eine Düse aufweist, die in Richtung des Unterwasserbodens ausgerichtet ist, um einen Flüssigkeitsstrahl in diesen Boden abzugeben. 35
8. Baggereinheit, die ein Baggerschiff aufweist, das geeignet ist, um sich in einer Bewegungsrichtung zu 40

bewegen, ein Saugkopf nach einem der Ansprüche 1 bis 7, der mit dem Baggerschiff verbunden ist, eine Baggerpumpe, die sich auf dem Baggerschiff befindet und eine Saugverbindung aufweist, ein Saugrohr, das den Saugkopf mit der Saugverbindung der Baggerpumpe verbindet, und ein Stützmittel, das sich zwischen dem Baggerschiff und dem Saugkopf zum Stützen des Saugrohrs befindet.

9. Verfahren zum Baggern von Bodenmaterial unter Wasser mit einem Baggerschiff, das mit einem Saugkopf nach einem der Ansprüche 1 bis 7 ausgestattet ist, wobei der Saugkopf in einer Bewegungsrichtung so über einen Boden zum Baggern gezogen wird, dass im Wesentlichen nur die Schneidwerkzeuge den Boden berühren, und wobei die mindestens eine Düse in eine Drehbewegung versetzt wird und ein Flüssigkeitsstrahl unter Druck aus der Düse abgegeben wird.
10. Verfahren nach Anspruch 9, wobei die Düsen eine Reihe bilden, wobei die Reihe von Düsen in einer geraden Linie quer zur Bewegungsrichtung des Saugkopfes angeordnet ist.
11. Verfahren nach Anspruch 9 oder 10, wobei ein Flüssigkeitsstrahl aus der mindestens einen Düse abgegeben wird, bevor die Schneidwerkzeuge den Unterwasserboden berühren.
12. Verfahren nach einem der Ansprüche 9 bis 11 zum Baggern eines Unterwasserbodens, der Ton, Lehm und/oder andere bindige Materialien aufweist.

Revendications

1. Tête d'aspiration (6) pour navire de dragage (1) qui déplace la tête d'aspiration (6) dans un sens de déplacement sur un fond subaquatique, comprenant une construction (7) de parois latérales et une paroi arrière (8) courant de façon sensiblement transversale au sens de déplacement de la tête d'aspiration (6), laquelle construction peut être reliée à un conduit d'aspiration (3) du navire de dragage (1) et est dotée d'outils de coupe (11) pour pénétrer dans le fond subaquatique, étant entendu que la tête d'aspiration (6) comprend par ailleurs au moins une buse (20) pour éjecter un jet liquide (22) sous pression, **caractérisée en ce que** l'au moins une buse (20) peut tourner autour d'un axe de rotation qui ne coïncide pas avec l'axe de la buse (20) ou du jet liquide (22) dans la position fixe de la buse (20), l'au moins une buse étant dirigée vers l'intérieur de la tête d'aspiration en vue d'éjecter un jet liquide dans l'intérieur.
2. Tête d'aspiration selon la revendication 1, dans laquelle l'axe de rotation et l'axe de l'au moins une

buse (20) se coupent l'un l'autre en un point.

3. Tête d'aspiration selon les revendications 1 et 2, dans laquelle les buses forment une rangée, la rangée de buses étant disposée en une ligne droite courant transversalement au sens de déplacement de la tête d'aspiration.
4. Tête d'aspiration selon l'une quelconque des revendications précédentes, étant entendu qu'elle comprend entre deux et vingt buses.
5. Tête d'aspiration selon l'une quelconque des revendications précédentes, dans laquelle les outils de coupe forment une rangée, la rangée d'outils de coupe étant disposée en une ligne droite courant transversalement au sens de déplacement de la tête d'aspiration, et dans laquelle les buses sont situées au-dessus de la rangée d'outils de coupe.
6. Tête d'aspiration selon l'une quelconque des revendications précédentes, étant entendu qu'elle comprend une tôle de pied qui court de façon sensiblement transversale au sens de déplacement de la tête d'aspiration (6) et avec laquelle la tête d'aspiration peut prendre appui sur le fond subaquatique, l'au moins une buse étant montée sur la tôle de pied.
7. Tête d'aspiration selon l'une quelconque des revendications précédentes, étant entendu qu'elle comprend au moins une buse qui est orientée en direction du fond subaquatique en vue d'éjecter un jet liquide dans ce fond.
8. Dispositif de dragage comprenant un navire de dragage adapté en vue de se déplacer dans un sens de déplacement, une tête d'aspiration selon l'une quelconque des revendications 1-7 reliée au navire de dragage, une pompe de dragage placée sur le navire de dragage et comportant un raccord d'aspiration, un conduit d'aspiration reliant la tête d'aspiration au raccord d'aspiration de la pompe de dragage, et des moyens de support placés entre le navire de dragage et la tête d'aspiration pour supporter le conduit d'aspiration.
9. Procédé permettant de draguer du matériau sur un fond sous l'eau avec un navire de dragage équipé d'une tête d'aspiration selon l'une quelconque des revendications 1-7, dans lequel la tête d'aspiration est traînée dans un sens de déplacement sur un fond en vue du dragage, ce de telle façon que pour ainsi dire seuls les outils de coupe entrent en contact avec le fond, et dans lequel l'au moins une buse est mise en rotation et un jet liquide en est éjecté sous pression.
10. Procédé selon la revendication 9, dans lequel les

buses forment une rangée, la rangée de buses étant disposée en une ligne droite courant transversalement au sens de déplacement de la tête d'aspiration.

11. Procédé selon la revendication 9 ou 10, dans lequel un jet liquide est éjecté de l'au moins une buse avant que les outils de coupe n'entrent en contact avec le fond subaquatique. 5
12. Procédé selon l'une quelconque des revendications 9-11 permettant de draguer un fond subaquatique comprenant de l'argile, du limon et/ou d'autres matériaux cohérents. 10

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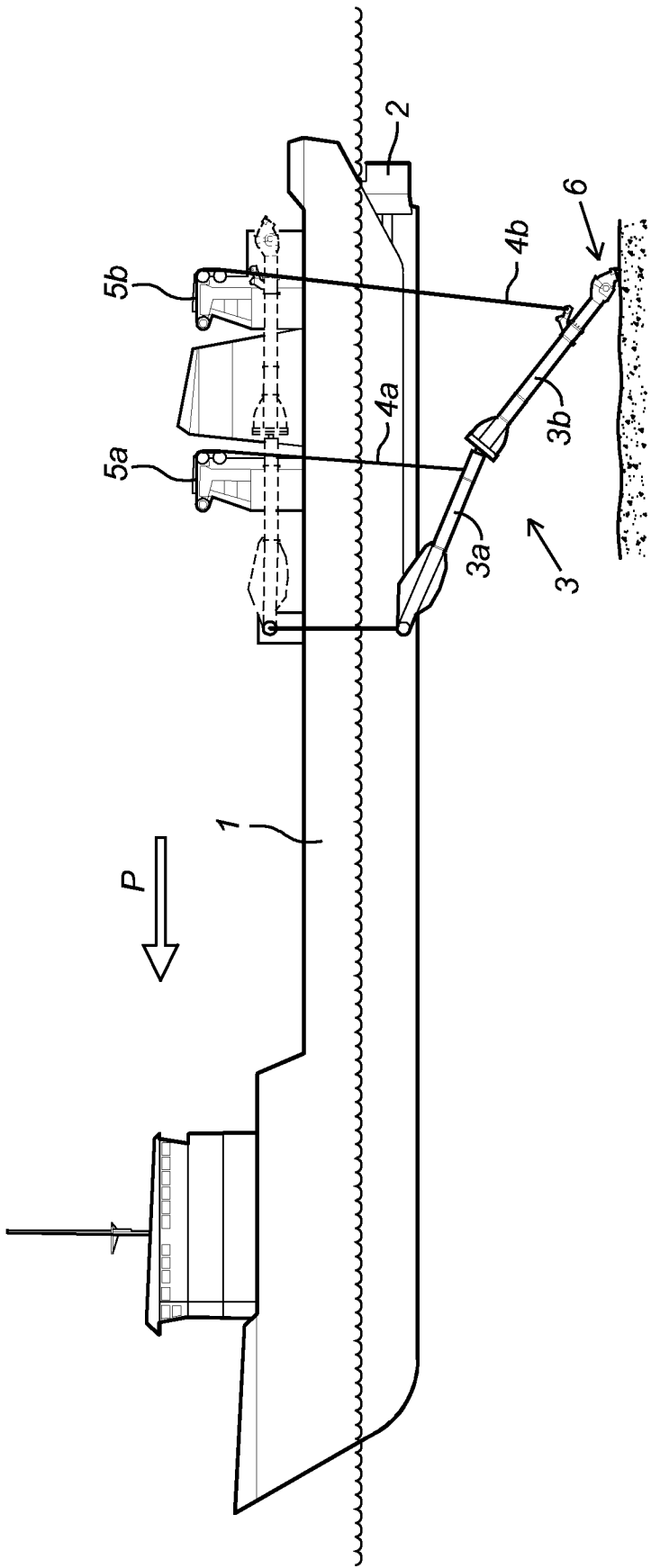
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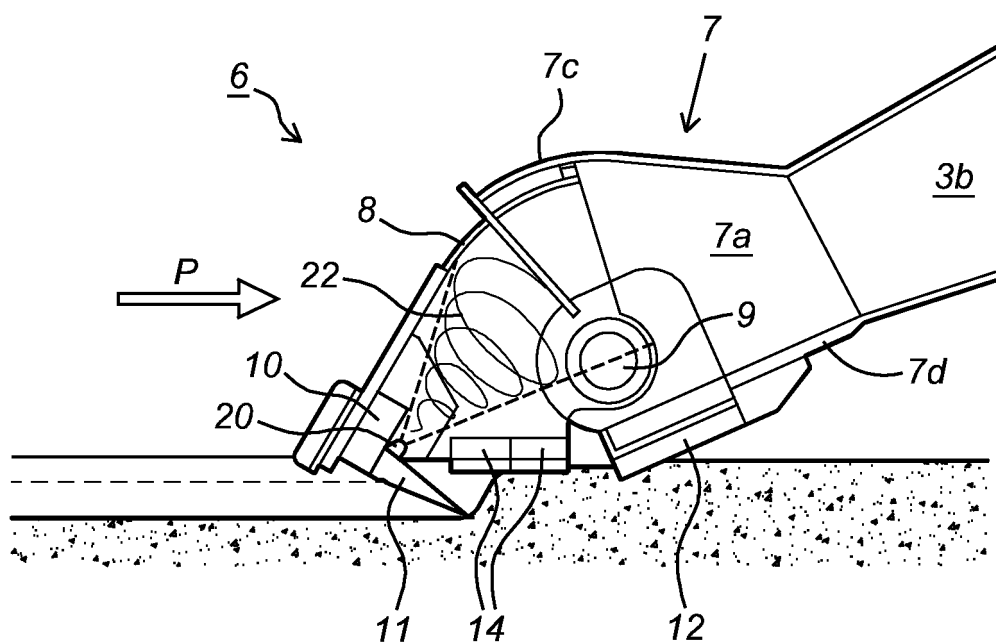


Fig. 2

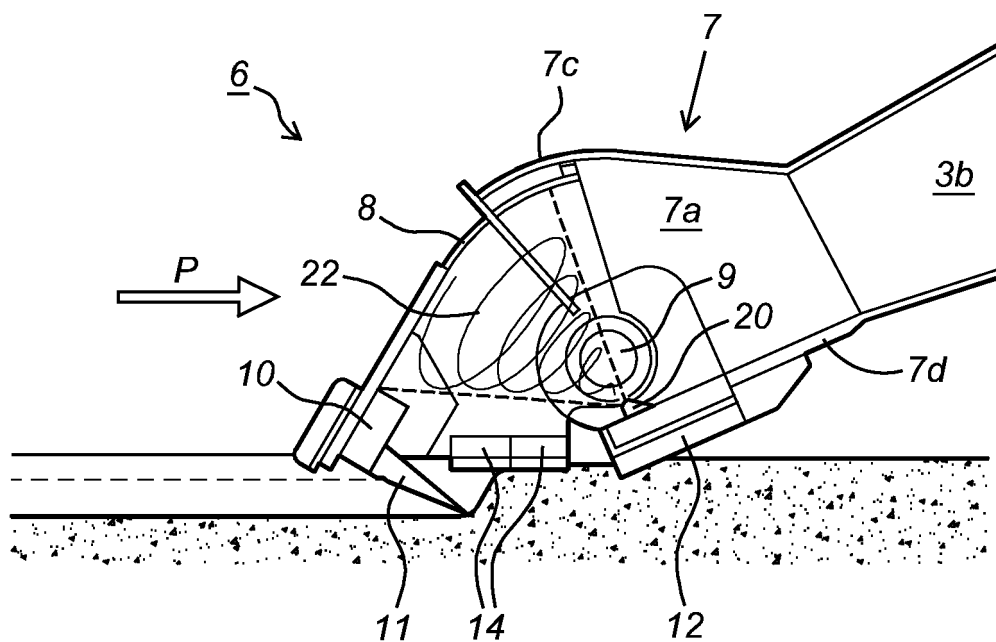


Fig. 3

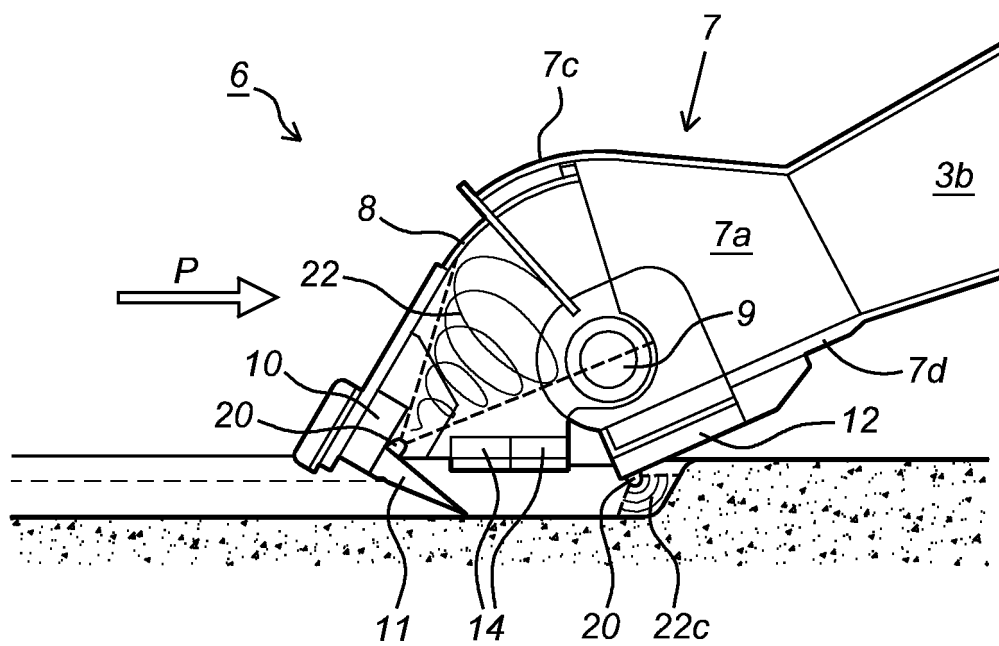


Fig. 4

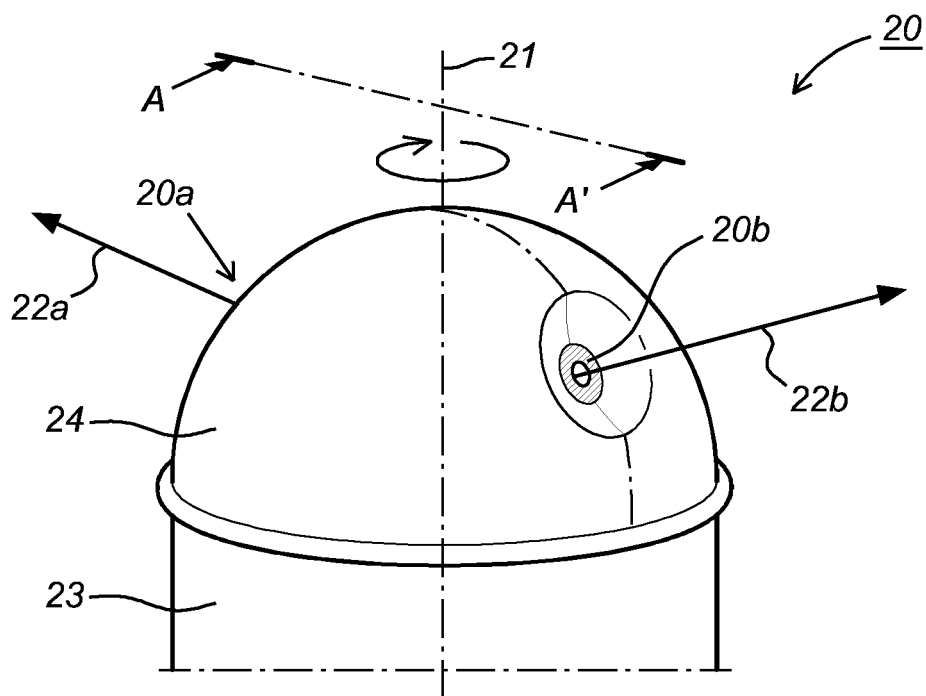


Fig. 5A

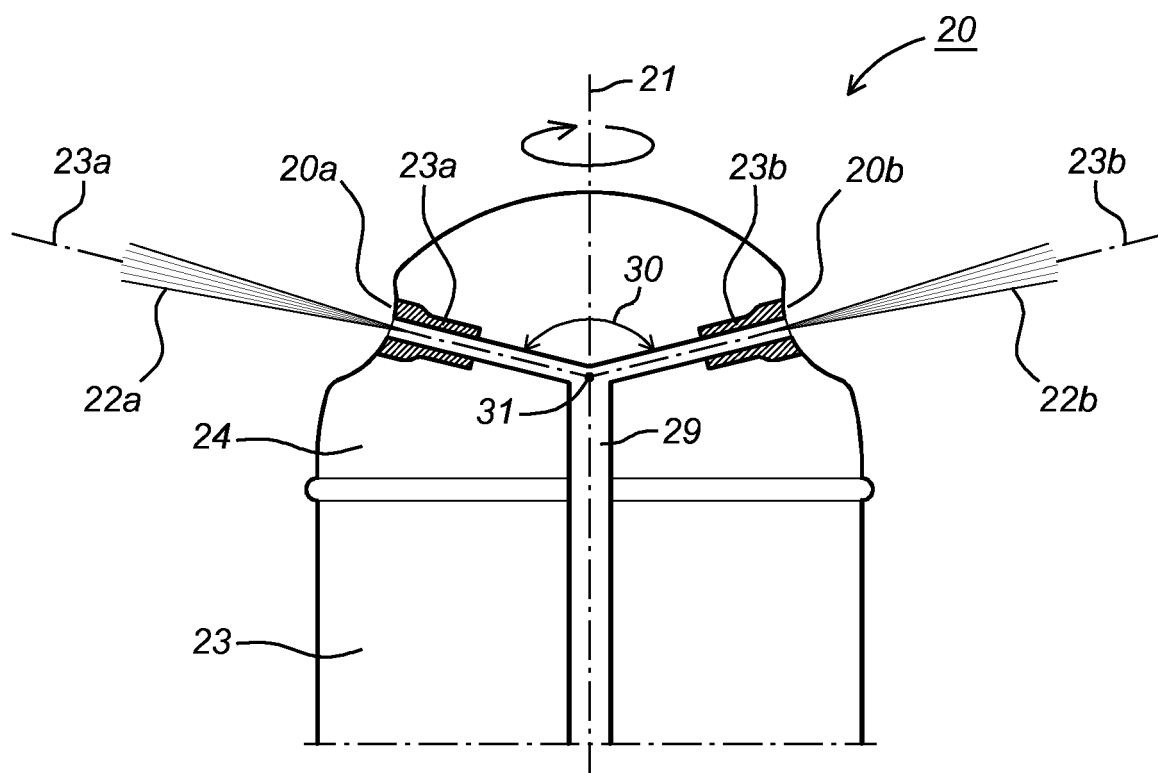


Fig. 5B

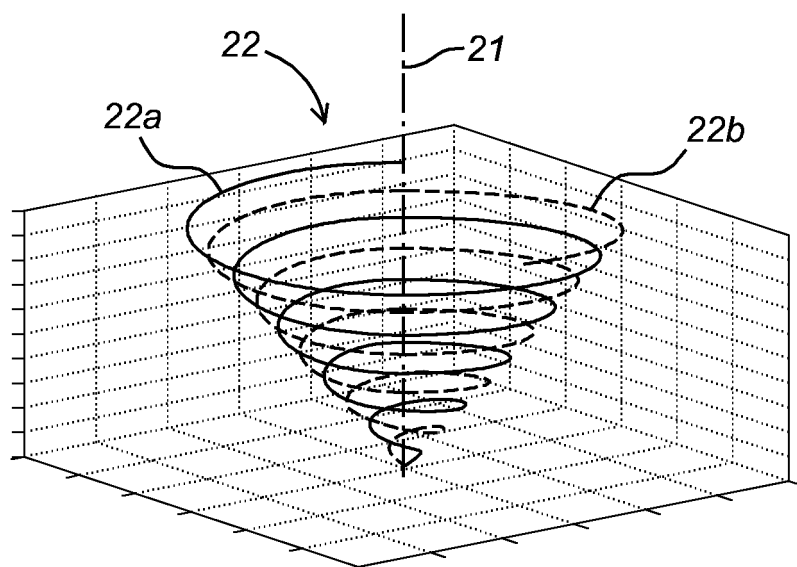


Fig. 6A

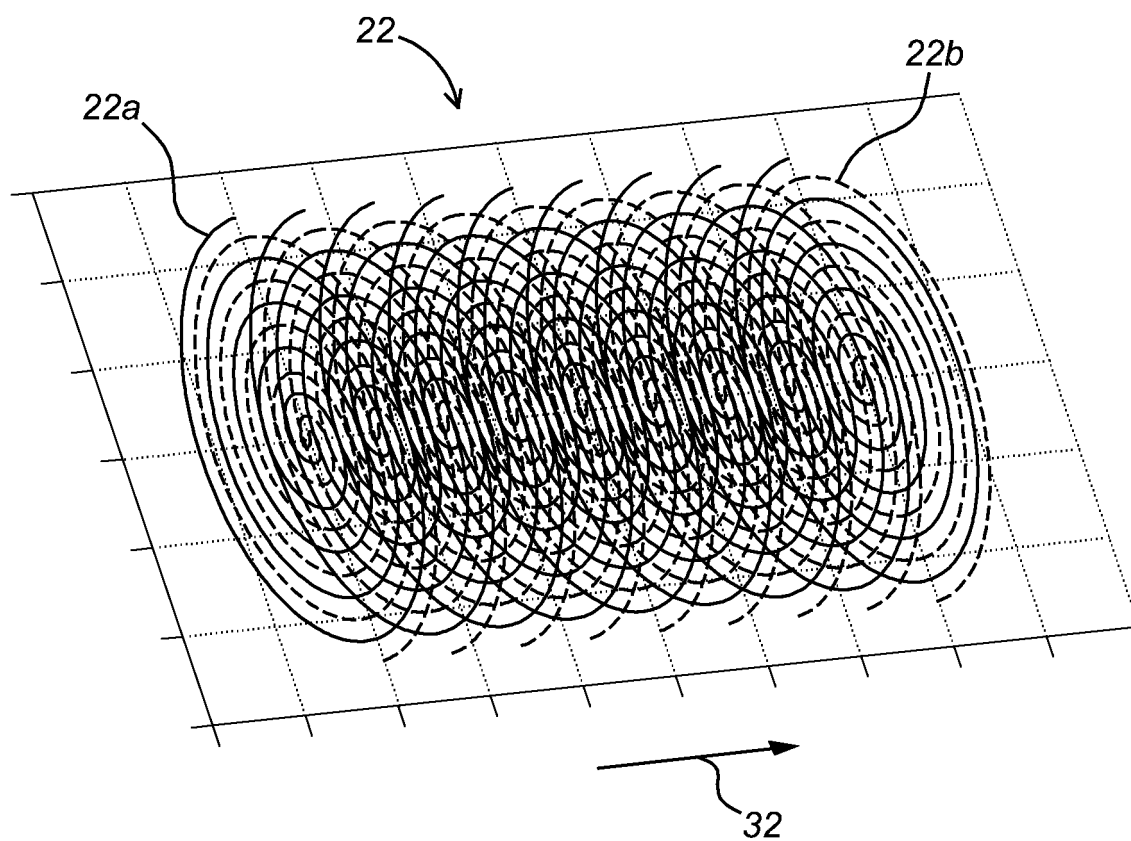


Fig. 6C

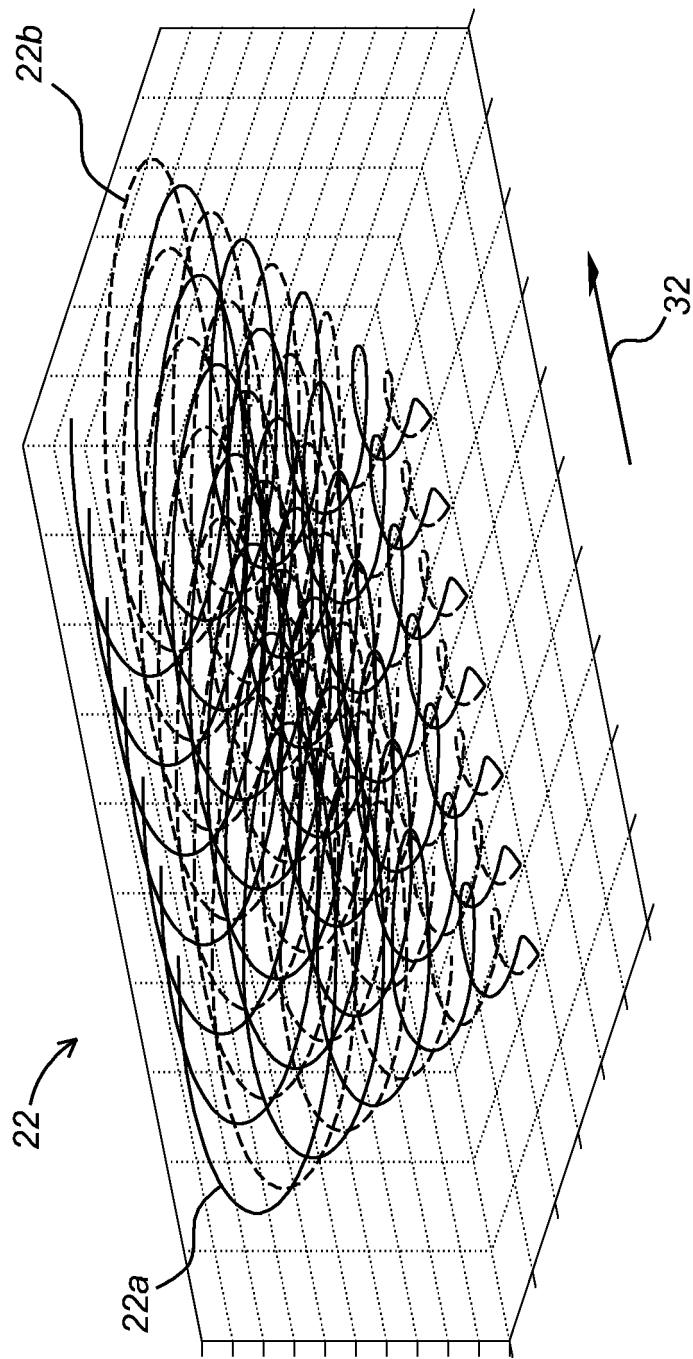


Fig. 6B

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 0892116 A [0002]
- EP 1653010 A1 [0004]
- DE 4226492 A1 [0005]