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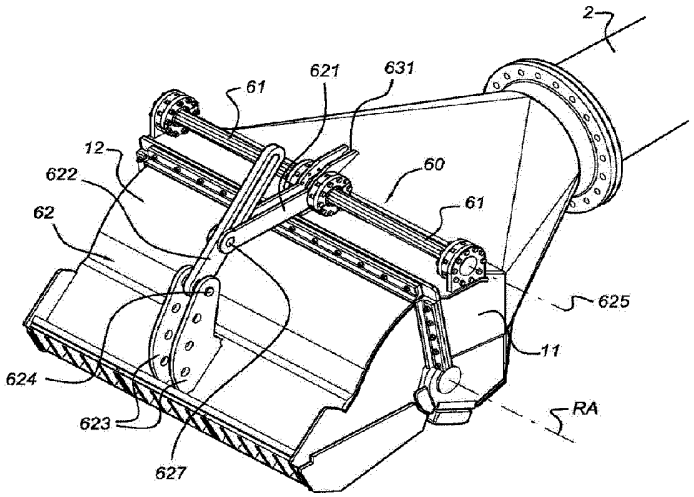
(54) **Dredging arrangement comprising a biasing device.**

(57) The invention relates to a dredging arrangement for dredging material from an underwater bottom (6). The dredging arrangement comprises a drag head body (11) and a visor (12), the visor (12) being connected to the drag head body (11) and is moveable with respect to the drag head body (11) over a predetermined range. The biasing device (60) is provided in between the drag head body (11) and the visor (12) exerting a biasing force on the visor (12) over a biasing portion of the predetermined range, the biasing portion being at least 25% of the range.



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Dredging arrangement comprising a biasing device

TECHNICAL FIELD

The invention relates to a dredging arrangement for dredging material from an underwater bottom. The invention further relates to a dredging vessel comprising such a dredging arrangement.

The invention also relates to a method for dredging material from an underwater bottom using such a dredging vessel.

BACKGROUND

Dredging is often done by dragging a drag head over an underwater bottom by a dredging vessel, such as a trailing suction hopper dredger vessel. The drag head is connected to the vessel by means of a suction pipe. The drag head is lowered to the underwater bottom by one or more hoisting wires. One or more pumps are provided to suck bottom material from the underwater bottom via the drag head, the suction pipe into a hopper of the dredging vessel.

Different dredging tools are known, for instance from US4249324, EP1786982 en US7895775.

Drag heads are known comprising a visor at their trailing end. The visor is rotatable about an axis rotation which is, in use, substantially perpendicular to a dredging direction and substantially horizontal or parallel to the underwater bottom being dredged. The visor may be mounted such that it can rotate freely about its axis of rotation.

US1840606 shows a casing and a drag (visor) which is rotatable about an axis of rotation which is substantially perpendicular to a dredging direction and substantially horizontal. On top of the drag are two lugs with slots, wherein lower pins of links are slideably engaged. The other end of the link is connected to the casing via spring shock absorber arrangements. The drag head can rotate freely until the lower pins of the links reach one end or the other of the slots. The spring shock absorber arrangement is provided to absorb the shock when the lower pins reach an end of the slots. In US1840606 the visor moves freely within its moving range.

A disadvantage of freely moving visors is that the visor will not always follow the contour of the underwater bottom (trenches, dunes) as it is only held against the

underwater bottom by its weight. Also, such a drag head will give a limited penetration depth of the visor (resulting in less production), due to the limited own weight of the visor. Placing additional weights on the visor is usually not a cost effective solution as it requires more hoisting power when lifting the drag head out of the water. Alternatives are known to overcome this problem.

For instance, it is known to fix the visor in a desired rotational position. This solution provides suboptimal results in case of changing dredging conditions, such as changing dredging depths as a result of swell, tidal motions, changing draught of the vessel when being loaded or unloaded, depth of the underwater bottom etc. and changing soil characteristics (e.g. hard packed or loosely packed etc.). This solutions also can result in lift of the heel of the drag head (leading part) from the soil when positioned to deep (resulting in less production). Also a fixed visor will not be able to cope with obstacles and may get damaged..

Another known solution is to control the rotational position of the visor using hydraulic actuators. However, this is an expensive and complex solution, which requires control effort. Hydraulic systems are prone to leakage and malfunction.

SUMMARY

It is an object to provide an improved dredging arrangement.

Therefore, according to an aspect, there is provided a dredging arrangement for dredging material from an underwater bottom, the dredging arrangement comprises a drag head body and a visor, the visor being connected to the drag head body and is moveable with respect to the drag head body over a predetermined range, **characterized in that** biasing device is provided in between the drag head body and the visor exerting a biasing force on the visor over a biasing portion of the predetermined range, the biasing portion being at least 25% of the range.

The predetermined range may be adjustable and may be defined by mechanical stops being provided limiting the movement of the moveable parts.

The force is applied such that the visor is pushed towards the underwater bottom. The visor may comprise a plurality of teeth mounted on a row substantially parallel to the axis of rotation. The force exerted by the biasing device pushes these teeth into the underwater bottom.

This visor can move freely over the remaining portion of the rotational range, but may also be controlled over the remaining portion of the rotational range, for instance by hydraulics or the like.

By using biasing device, a force is applied to the visor resulting in more penetration depth, while maintaining compliance to give way to heavy objects.

According to an embodiment the biasing portion is at least 40% of the rotational range.

According to an embodiment the biasing portion is at least 60% of the rotational range.

According to an embodiment the biasing portion is 80% or 100% of the rotational range.

A larger biasing range makes dredging easier, as less control is necessary during dredging to take into account changing dredging conditions, e.g. dredging depths.

According to an embodiment the visor is rotatable with respect to the drag head body about a rotational axis, the predetermined biasing range being a predetermined rotational range, the rotational axis, in use, being substantially parallel to the underwater bottom and perpendicular to a dredging direction, and the predetermined biasing range being a predetermined rotational biasing range. The visor may be connected to a trailing side of the drag head body.

The predetermined rotational range may for instance be set by two mechanical stops limiting the freedom of rotational movement of the visor, for instance to a range of 20°, 30°, 40°, or 50°.

Alternatively, visors may be used which are moveable in another manner, such being sliceable, translational or are arranged to perform a combination of a rotational and translational movement.

The range may in this case for instance be 50°, wherein the biasing portion of the range is 20° (40%).

According to an embodiment the biasing device exerts a force on the visor such that the visor is pushed into a downward direction. In use, the visor is pushed towards the underwater bottom.

In case of a rotational visor, the visor is pushed to rotate such that the visor effectively moves downwards.

The biasing device is with one end connected to the visor and with another end connected to another part of the dredging arrangement such as the drag head body or lower end of the suction pipe such that the biasing device can apply a force onto the visor. The biasing force pushes the visor in a (rotational) downward direction.

The biasing device is preferably mounted on top of the dredging arrangement.

According to an embodiment the biasing portion of the range is an upper portion of the range and the visor moves freely in a remaining lower portion of the range.

The biasing force is preferably applied over the upper portion of the (rotational) range. The lower portion of the (rotational) range will typically be used when the dredging arrangement is hoisted or positioned on a rest position on deck of vessel. The lower portion of the (rotational) range will also be used when the dredging arrangement meets a dip in the underwater bottom.

According to an embodiment the biasing device is adjustable to set the biasing force being exerted.

By adjusting the biasing force, the behavior of the visor can be adjusted. For instance, in case the biasing device is set to exert a relatively high preloading force, the visor will be pushed into the underwater bottom relatively deeply, resulting in a relatively large dredging depth. The visor will in that case be relatively stiff when an obstacle is met, such as a rock.

It will be understood that depending on the biasing device used, the actual biasing force may vary over the biasing portion of the (rotational) range. However, by adjusting the biasing force, the biasing force can be increased or decreased over the entire biasing portion.

According to an embodiment the biasing device comprises spring devices, the spring device being loaded in the biasing portion of the range such that the spring device exerts a biasing force on the visor.

A spring device is an advantageous device of providing a biasing device. Also, spring devices have the advantage that they can deal with shocks in a reliable manner, for instance when the drag head is dragged over an obstacle, such as a stone or the like.

Also, spring devices may be employed wherein the biasing force increases over the biasing portion of the (rotational) range towards the upper position of the visor. Spring devices are suitable for creating a predetermined force characteristic along the (rotational) range.

Also, spring devices have the advantages that no external power supply is needed.

According to an embodiment the spring device comprises one or more torsion springs.

According to an embodiment the spring device comprises one or more coil springs.

The coil springs may be orientated such that their longitudinal direction is parallel to the dredging direction or at an upward angle with respect to the dredging direction. In case of a rotational visor, the longitudinal direction may be perpendicular to the axis or rotation. The coil spring can be at an angle with respect to the horizontal direction.

The coil springs may be compression springs, i.e. when unloaded, neighboring coils do not touch each other. The coil springs are constructed and mounted such that they are compressed over at least the above defined (rotational) biasing portion of the range.

Of course, other suitable spring devices may be used, such as rubber devices.

According to an embodiment the biasing device is mounted between the visor and the drag head body or lower end of a suction pipe.

The suction pipe may be connected to the drag head body, or may be integrally formed with the drag head body.

The preloading device may be connected to the drag head body or lower end of the suction pipe in any suitable manner. The connection may be a direct connection or may be established by means of a connection member. The connection may be a rotational connection allowing rotational movement of the biasing device about an axis of rotation parallel to the rotational axis of the visor with respect to the drag head body or lower end of the suction pipe.

The biasing device may be connected to the visor directly. The biasing device may be connected to the visor by means of a rotational connection allowing rotational movement of the biasing device about an axis of rotation parallel to the rotational axis of the visor with respect to the visor.

Alternatively or additionally, the connection allows sliding or lateral movement.

According to an embodiment the biasing device is connected to the dredging arrangement by means of a force transmitting construction.

The force transmitting construction comprises two or more rotatably connected beams which transfer the force from the preloading means to the visor. Alternatively or additionally, the force transmitting constructions allows sliding or lateral movement.

According to an embodiment the force transmitting construction is adjustable to set the moment of force exerted on the visor by the biasing device.

According to an embodiment, the force transmitting construction is adjustable to set the predetermined range.

According to an embodiment, the moveable part is a visor and the biasing device is arranged to exert a biasing force resulting in a moment of force acting on the visor which is, averaged over the biasing portion at least 50% of the moment of force acting on the visor as a consequence of gravity acting on the visor.

Preferably, the moment of force acting on the visor which is, averaged over the biasing portion at least 75% or at least 100% of the moment of force acting on the visor as a consequence of gravity acting on the visor.

According to an aspect there is provided a dredging vessel comprising a dredging arrangement for dredging material from an underwater bottom according to any one of the preceding claims and a suction pipe connecting the dredging arrangement to the dredging vessel.

According to an aspect there is provided a method for dredging material from an underwater bottom using a dredging vessel comprising a dredging arrangement, the dredging arrangement comprising a drag head body and a visor, the visor being moveable with respect to the drag head body over a predetermined range,

wherein the method comprises

- lowering the dredging arrangement to an underwater position with the drag head positioned on the underwater bottom,

- dredging by dragging the drag head over the underwater bottom in a dredging direction by means of a dredging vessel,

characterized by the dredging arrangement comprising a biasing device provided in between the drag head body and the visor exerting a biasing force on the visor over a biasing portion of the predetermined range, wherein the method comprises,

- adjusting the biasing device to set the biasing force being exerted.

As described above, the visor may be rotatable with respect to the drag head body, may be provided at the trailing end and the predetermined range may be a

predetermined rotational range. Adjustment is preferably done prior to lowering the dredging arrangement.

According to an embodiment the biasing device is connected to the dredging arrangement by means of an adjustable force transmitting construction, and the method comprises,

- adjusting the force transmitting construction to set the moment of force exerted on the visor by the biasing device.

The force characteristic (force as a function of the position of the visor within the range) can be adjusted prior to lowering the dredging arrangement.

Adjustment is preferably done prior to lowering the dredging arrangement.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments will now be described, by way of example only, with reference to the accompanying schematic drawings in which corresponding reference symbols indicate corresponding parts, and in which:

FIG. 1 schematically shows completed dredging vessel and a dredging arrangement,

Fig.'s 2a – 2c schematically show a perspective, top and side view of a dredging arrangement according to an embodiment,

Fig. 3 schematically shows a side view of a dredging arrangement according to an embodiment,

Fig.'s 4a – 4b schematically show graphs describing the embodiments.

The figures are only meant for illustrative purposes, and do not serve as restriction of the scope or the protection as laid down by the claims.

DETAILED DESCRIPTION

Fig. 1 schematically depicts a dredging vessel 1 according to an embodiment. The dredging vessel 1 comprises a drag head 10 which is attached to the dredging vessel 1 via a suction pipe 2. The suction pipe 2 comprises a hinge point half way the suction pipe 2.

The drag head 10 and the suction pipe 2 are shown in a lowered position with the drag head 10 resting on an underwater bottom 6. In use, the dredging vessel 1 sails in a dredging direction DD and drags the drag head 10 over the underwater bottom 6.

The drag head 10 and the suction pipe 2 are connected to a wire 4, the wire 4 being controlled by wire controller 5. Half way the suction pipe 2, the suction pipe 2 may be connected to a further wire 4' controlled by further wire controller 5'. The further wire controller and wire controller are mainly used for lifting and lowering the suction pipe 2.

The wire controller 5 comprises a first wire control device, in this case formed by a controllable winch 51 and a second wire control device.

The wire controller 5 may further comprise a control unit 55 or the like to control the first, second and further wire control devices. The control unit 55 may be a standalone control unit or may be arranged to cooperate with other remote control units. The control unit 55 may be a computer. The control unit 55 may also be arranged to receive instructions from an operator via a user interface.

The second wire control device may be a heave compensator, in this case formed by a number of pulleys 52, at least one of the pulleys 52 being moveable in a direction perpendicular to the rotational axis of the pulley 52 by an actuator 53. In Fig. 1, the actuator 53 is an hydraulic actuator comprising a cylinder and a piston which can move up and down the cylinder. The moveable pulley 52 is connected to the cylinder. The actuator 53 is also under control of the control unit 55.

The drag head 10 comprises two main parts: the drag head body 11 and the visor 12. The drag head body 11 is on one side connected to the suction pipe 2 via appropriate connection means 13. The drag head body 11 and the (lower end of the) suction pipe 2 may also be formed as one piece.

The drag head body 11 may have any suitable shape and its main purpose is to form a chamber in which an underpressure can be created to vacuum up dredging material from the underwater bottom 6. A pump 21 may be provided to create the required underpressure. The pump 21 may be positioned on board of the dredging vessel 1 (as shown in Fig. 1) and/or at or nearby the drag head 10. The drag head 10 may comprise jet nozzles 22 to create a water jet to loosen the underwater bottom 6. A jet pump 23 and a jet pipe lane 24 may be present.

The visor 12 is a moveable part of the drag head 10.

The visor 12 is moveable with respect to the drag head body 11 to change the dredging characteristics of the drag head 10. In the embodiment shown, the visor is provided on the trailing end of the drag head 10 and is rotatable about a rotational axis RA, which runs perpendicular to the plane of the drawing of Fig. 1, i.e. parallel to the underwater bottom 6 and substantially perpendicular to a dredging direction DD. Rotating the visor 12 to a lower position (counter clockwise in Fig. 1), results in deeper dredging and a higher sand-water ratio.

The drag head 10 may further comprise a valve 14. As shown in Fig.1, the valve 14 is attached to the visor 12 and is arranged to open and close an opening 18 in the visor 12. Alternatively, the valve 14 may be attached to the drag head body 11 and be arranged to open and close an opening 15 in the drag head body 11.

In Fig. 1 the drag head 10 is only shown schematically. Details of the drag head 10 in accordance with the embodiments of the invention are shown in Fig. 2a - 2c and in Fig. 3.

Fig.'s 2a – 2c show the dredging arrangement according to an embodiment in more detail.

Fig. 2a schematically shows a perspective view of a dredging arrangement for dredging material from an underwater bottom 6. The dredging arrangement comprises the drag head body 11 and the visor 12connected to the drag head body 11 in a moveable manner. As shown in Fig. 2a, the visor is rotatable about a rotational axis RA, but alternative relative movements of the visor 12 and the drag head body 11 are also possible, such as a translational movement, possibly in combination with a rotational movement.

The visor 12 is moveable along a predefined path and has a predefined freedom of movement, indicated with the term range. According to the embodiment shown in Fig. 2a – 2c and 3 the visor is rotatable with respect to the drag head body 11 over a rotational range, which typically is 50°.

A biasing device 60 is provided on top of the dredging arrangement connected to the visor 12 and the drag head body 11 arranged to generate and apply a biasing force between the drag head body 11 and the visor 12. The biasing force pushes the visor 12 in a rotational downward direction, into the underwater bottom 6.

The biasing force is applied over a predetermined portion of the range, for instance over the upper 25% of the range. In the example mentioned above, in which the rotational range typically is 50°, this results in a biasing force being applied to the visor 12 over the upper 12.5°. Of course, the biasing portion may be any suitable percentage, such as 40%, 60%, 80, or 100%. In the remainder of the range (except in case of 100%), the visor 12 is not biased.

Different biasing devices 60 may be used, such as torsion spring 61 or coil springs 63.

A force transmitting construction 62 may be provided to mount the biasing device, such as the torsion spring(s) 61 or coil spring(s) 63, to the dredging arrangement and ensure that the biasing force is applied to the visor 12. This will be explained in more detail below.

Fig. 2a shows torsion springs 61on top of the dredging arrangement in a direction perpendicular to the dredging direction DD and substantially parallel to the underwater bottom 6 (in use). A lever 621, part of the force transmitting construction 62 is mounted to the torsion springs 61 perpendicular to the torsion springs 61 towards a trailing end of the dredging arrangement. The lever 621 is rotatable about longitudinal axis 625.

The force transmitting construction 62 further comprises a connection rod 622, which is rotatable connected to a distal end of the first lever 621 forming axis of rotation 627.

As shown in Fig. 2a, a connector is provided as part of the force transmitting construction 62 on top of the visor 12, in this case formed by two lugs 623. The lugs 623 are rotatable connected to the connection rod 622 forming axis of rotation 624.

The connection rod 622 and the lever 621 are connected by means of a rotatable and slideable connection. The connection rod comprises a slot extending over a top portion of the connection rod 622 to which the lever 621 is slideably connected, for instance by means of a bolt.

As more clearly indicated in Fig. 2c, schematically depicting a side view of the dredging arrangement, the lever 621 has an arm L1, and the connection rod 622 has an arm L2.

The force transmitting construction 62 is adjustable to set the moment of force exerted on the visor 12 by the biasing device 60. Adjustments may be made to change

the location where the connection rod 622 is attached to the connector in this case formed by the two lugs 623.

Adjusting the force transmitting construction also allows to set the predetermined range. Stops may be provided to limit the movement of the visor, for instance, stops may be provided to limit movements of lever 621, thereby setting a maximum range for the visor 12. The stops may be provided to prevent overload of the springs 61, 63.

For instance, if axis of rotation 624 is in the upper opening provided by lugs 623 (as shown in the figures), the range may be 20°, in which the visor 12 is biased (biasing portion of 100%).

If axis of rotation 624 is in the second highest opening provided by lugs 623, the range may be 30°, the upper 20° of which may be biased (biasing portion of 66, 6%).

If axis of rotation 624 is in the second lowest opening provided by lugs 623, the range may be 40°, the upper 20° of which may be biased (biasing portion of 50%).

If axis of rotation 624 is in the lowest opening provided by lugs 623, the range may be 50°, the upper 20° of which may be biased (biasing portion of 40%).

Spring devices may be used, such as a torsion spring 61, which generate an increasing force when being deformed. The same applies for a coil spring (an example of which is provided with reference to Fig. 3).

The biasing force is therefore not constant over the portion of the range. This may be at least partially overcome by positioning axes of rotation 624 and 625 with respect to axis of rotation RA of the visor 12 and by choosing length L1 and L2 carefully, i.e. such that rotation of lever 621 about axis of rotation 625 as a function of the rotation of the visor around axis of rotation RA is such that it cancels out the behavior of the spring. The typical behavior of a torsions spring is given by a linear relation between angle of rotation and torque (see Fig. 4a). In order to achieve a constant force being exerted on the visor 12, a preload can be applied to the torsion springs 61. The ratio D of the change in angle of the torsion spring as a function of the change in visor angle, D $=(d\ angle_{spring} / d\ angle_{visor})$, is preferably such that it cancels out the spring behavior. An approximated example can be seen in graph 4b, showing ratio D along the vertical and the angle of the visor 12 along the horizontal. Point C is determined by the preload and the desired force. Slope α is determined by the spring stiffness and the applied preload.

Effectively there is a gear ratio between the torsion spring 61 and the visor 12 that changes when the force transmitting device 62 is adjusted. In case of torsion springs the moment of force on the spring times gear ratio is the moment of force on visor.

As can be seen from Fig.'s 2a – 2c, the biasing force is applied in the upper portion of the range in which the visor can move. In the lower portion of the range, the visor 12 can move without being influenced by the biasing device 60 as lever 621 can slide freely through the slot of connection rod 622.

Fig. 3 shows an alternative embodiment, wherein the torsion springs 61 are no longer present and instead a linear spring 63 is provided, such as a coil spring 63, attached to a protrusion 631. The torsion springs 61 are replaced with a rod which is rotatable about its longitudinal body axis 625. The protrusion 631 may be formed as part of lever 621.

The coil spring 63 is mounted between the protrusion and the drag head body 11 or the lower end of the suction pipe 2.

It will be understood that the dredging arrangement shown in Fig. 2a – 2c and in Fig. 3 can be used in combination with the dredging vessel 1 shown in Fig. 1.

The use of the embodiment will now be described in more detail. The embodiments described can be used in a method for dredging material from the underwater bottom. Such a method may involve use of a dredging vessel 1 as described with reference to Fig. 1 and dredging arrangements described with reference to Fig.'s 2a – 3.

Dredging may be started by lowering the dredging arrangement to the underwater position until the drag head 10 is positioned on the underwater bottom 6. Lowering may be done using the wire controller 5 described above.

Next, dredging may be done by dragging the drag head 10 over the underwater bottom 6 in a dredging direction DD by sailing the dredging vessel in the dredging direction.

The biasing device 60 may be set to set the biasing force being exerted. For instance, the torsion springs or the linear spring may be adjusted to set the biasing force. Torsion springs 61 may for instance be set by rotating the torsion springs 61 with respect to the dredging arrangement.

However, adjusting the biasing device 60 may also comprise replacing the springs with alternative springs, having a different force characteristic or changing the amount of springs.

Furthermore, the force transmitting construction may be adjusted to set the moment of force exerted on the visor 12 by the biasing device 60 may be set. For instance, the location where the connection rod 622 is attached to the connector, e.g. the two lugs 623, may be adjusted.

The descriptions above are intended to be illustrative, not limiting. It will be apparent to the person skilled in the art that alternative and equivalent embodiments of the invention can be conceived and reduced to practice, without departing from the scope of the claims set out below.

CONCLUSIES

1. Baggerinrichting voor het baggeren van baggermateriaal van een onderwater gelegen bodem (6), waarbij de baggerinrichting een sleepkoplichaam (11) en een vizier (12) omvat, waarbij het vizier (12) verbonden is met het sleepkoplichaam (11) en beweegbaar is ten opzichte van het sleepkoplichaam (11) over een vooraf bepaald bereik, met het kenmerk dat een voorspaninrichting (60) is verschaft tussen het sleepkoplichaam (11) en het vizier (12) welke een voorspankracht op het vizier (12) uitoefent over een voorspangedeelte van het vooraf bepaalde bereik, waarbij het voorspangedeelte ten minste 25% van het bereik is.

2. Baggerinrichting volgens conclusie 1, waarbij het voorspangedeelte ten minste 40% van het bereik is.

3. Baggerinrichting volgens conclusie 1, waarbij het voorspangedeelte ten minste 60% van het bereik is.

4. Baggerinrichting volgens conclusie 1, waarbij het voorspangedeelte ten minste 80% of 100% van het bereik is.

5. Baggerinrichting volgens een van de voorgaande conclusies, waarbij het vizier draaibaar is ten opzichte van het sleepkoplichaam (11) rond een rotatieas (RA), waarbij het vooraf bepaalde bereik een vooraf bepaald rotatiebereik is, waarbij de rotatieas (RA), tijdens gebruik, in hoofdzaak parallel is aan de onderwater bodem (6) en loodrecht op een baggerrichting (DD), en waarbij het vooraf bepaalde bereik een vooraf bepaald rotatiebereik is.

6. Baggerinrichting volgens een van de voorgaande conclusies, waarbij de voorspaninrichting (60) een kracht uitoefent op het vizier (12) zodanig dat het vizier in een neerwaartse richting wordt geduwd.

7. Baggerinrichting volgens een van de voorgaande conclusies, waarbij het voorspangedeelte van het bereik een bovenste gedeelte van het bereik is en het vizier (12) vrij beweegt in een overblijvend lager gedeelte van het bereik.

8. Baggerinrichting volgens een van de voorgaande conclusies, waarbij de voorspaninrichting (60) instelbaar is om de voorspankracht die wordt uitgeoefend in te stellen.

9. Baggerinrichting volgens een van de voorgaande conclusies, waarbij de voorspaninrichting (60) een veerinrichting (61, 63) omvat, waarbij de veerinrichting (61, 63) zodanig gespannen is in het voorspangedeelte van het bereik zodanig dat de veerinrichting (61, 63) een voorspankracht uitoefent op het vizier (12).

10. Baggerinrichting volgens conclusies 9, waarbij de veerinrichting één of meerdere torsieveren (61) omvat.

11. Baggerinrichting volgens conclusies 9, waarbij de veerinrichting één of meerdere spiraalveren (63) omvat.

12. Baggerinrichting volgens een van de voorgaande conclusies, waarbij de voorspaninrichting (60) is bevestigd tussen het vizier (12) en het sleepkoplichaam (11) of het onderste eind van een zuigbuis (2).

13. Baggerinrichting volgens een van de voorgaande conclusies, waarbij de voorspaninrichting (60) is verbonden met de baggerinrichting door middel van een krachtoverbrengende constructie (62).

14. Baggerinrichting volgens conclusie 13, waarbij de krachtoverbrengende constructie (62) instelbaar is voor het instellen van het krachtmoment dat door de voorspaninrichting (60) op het vizier (12) wordt overgebracht.

15. Baggerinrichting volgens een van de conclusies 13 – 14, waarbij de krachtoverbrengende constructie (62) instelbaar is voor het instellen van het vooraf bepaalde bereik.

16. Baggerinrichting volgens een van de voorgaande conclusies, waarbij het beweegbare gedeelte een vizier (12) is en de voorspaninrichting (60) is ingericht voor het uitoefenen van een voorspankracht welke resulteert in een krachtmoment die werkt op het vizier (12) welke, gemiddeld genomen over het voorspangedeelte ten minste 50% van het krachtmoment is dat werkt op het vizier (12) ten gevolge van zwaartekracht die op het vizier (12) werkt.

17. Baggerschip (1) omvattende een baggerinrichting voor het baggeren van materiaal van een onderwater gelegen bodem (6) volgens een van de voorgaande conclusies en een zuigbuis (2) welke de baggerinrichting met het baggerschip (1) verbindt.

18. Werkwijze voor het baggeren van materiaal van een onderwater gelegen bodem (6) met gebruik van een baggerschip (1) omvattende een baggerinrichting, waarbij de baggerinrichting een sleepkoplichaam (11) en een vizier (12) omvat, waarbij het vizier (12) beweegbaar is ten opzichte van het sleepkoplichaam (11) over een vooraf bepaald bereik, waarbij de werkwijze omvat

- het laten zakken van de baggerinrichting naar een onderwater gelegen positie met de sleepkop (10) gepositioneerd op de onderwater gelegen bodem (6),
- het baggeren door het slepen van de sleepkop (10) over de onderwater gelegen bodem (6) in een baggerrichting (DD) door middel van een baggerschip (1),

gekenmerkt doordat de baggerinrichting een voorspaninrichting (60) omvat verschaft tussen het sleepkoplichaam (11) en het vizier (12) welke een voorspankracht uitoefent op het vizier (12) over een voorspangedeelte van het vooraf bepaald gedeelte, waarbij de werkwijze omvat

- instellen van de voorspaninrichting (60) voor het instellen van de uitgeoefende voorspankracht.

19. Werkwijze volgens conclusie 18, waarbij de voorspaninrichting (60) is verbonden met de baggerinrichting door middel van een instelbare krachtoverbrengende constructie (62), en de werkwijze omvat,

- het instellen van de krachtoverbrengende constructie voor het instellen van het krachtmoment dat door de voorspaninrichting (60) op het vizier (12) wordt uitgeoefend.

20. Werkwijze voor het baggeren van materiaal van een onderwater gelegen bodem (6) met gebruik van een baggerinrichting volgens een van de voorgaande conclusies 1 – 16.

Fig. 1

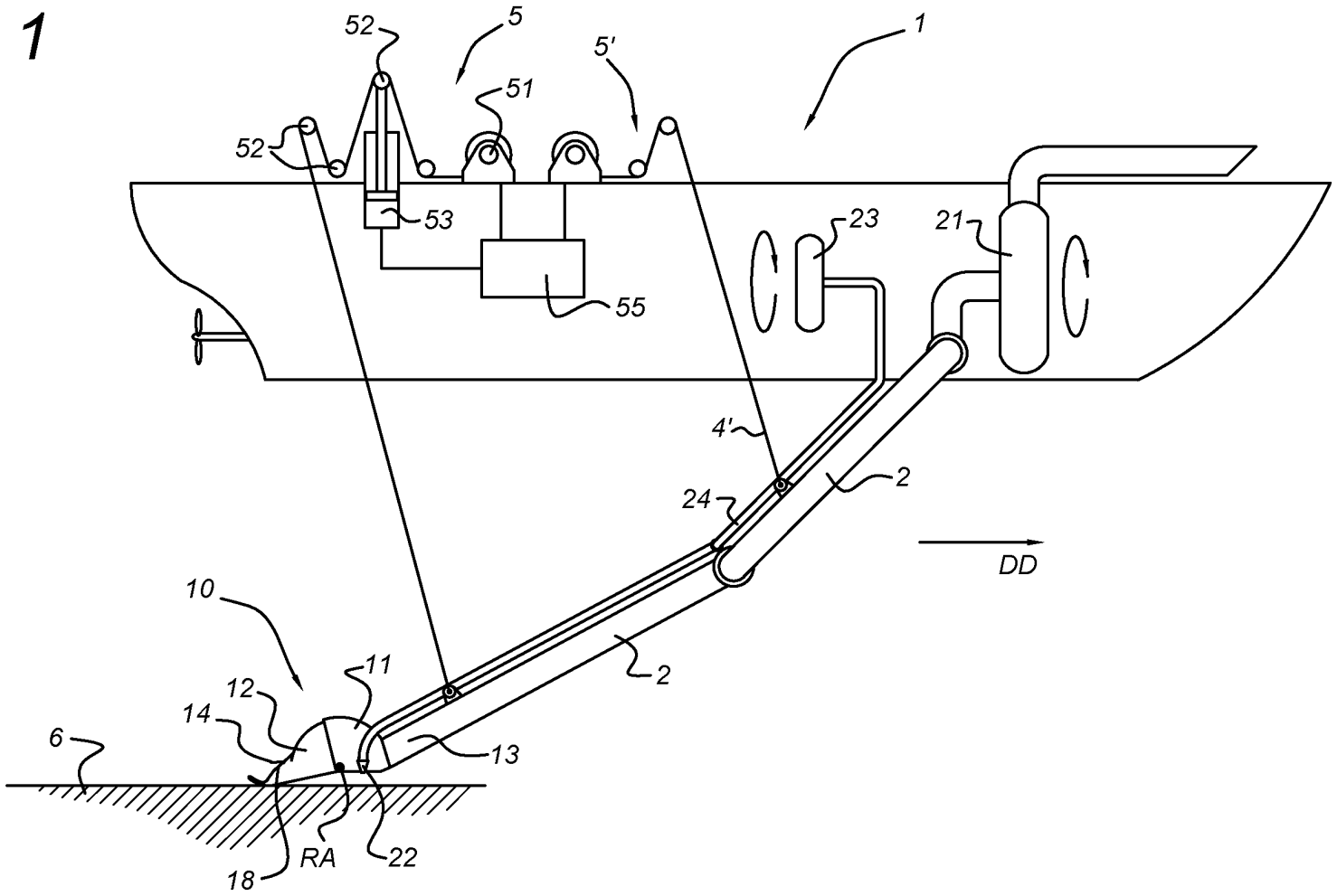


Fig. 2a

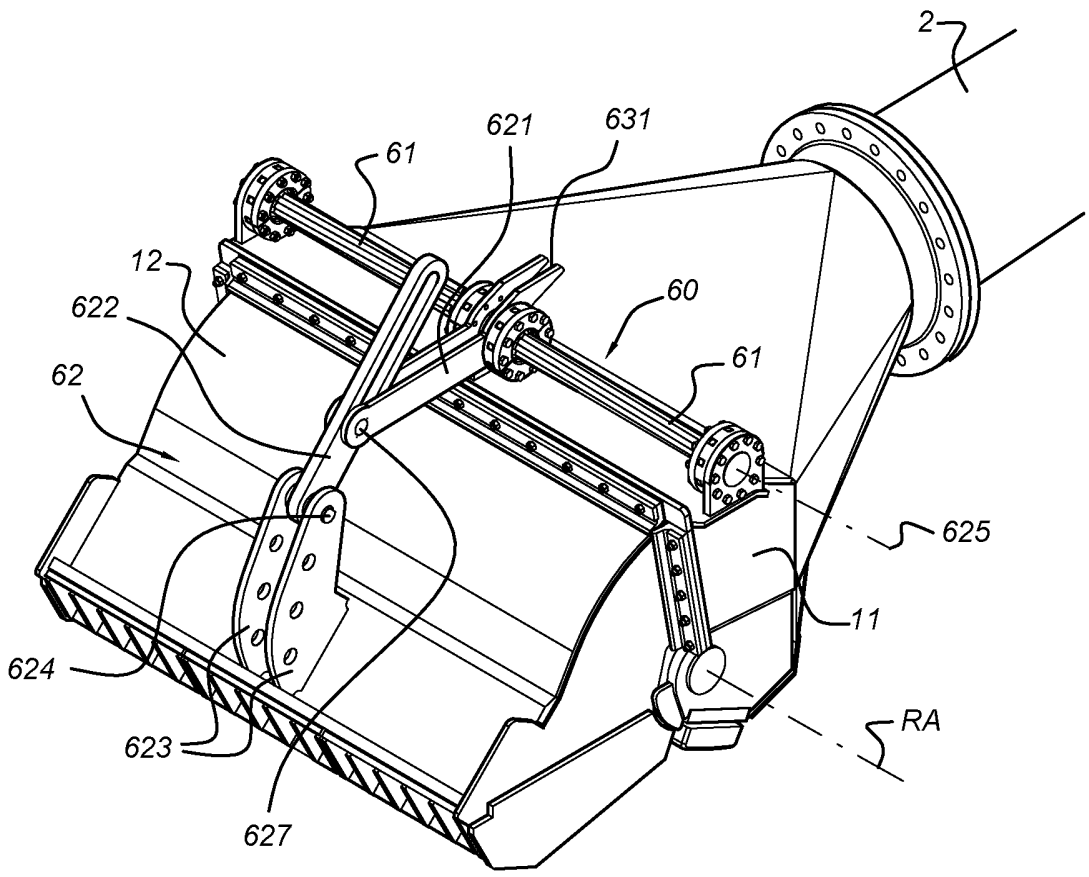


Fig. 2b

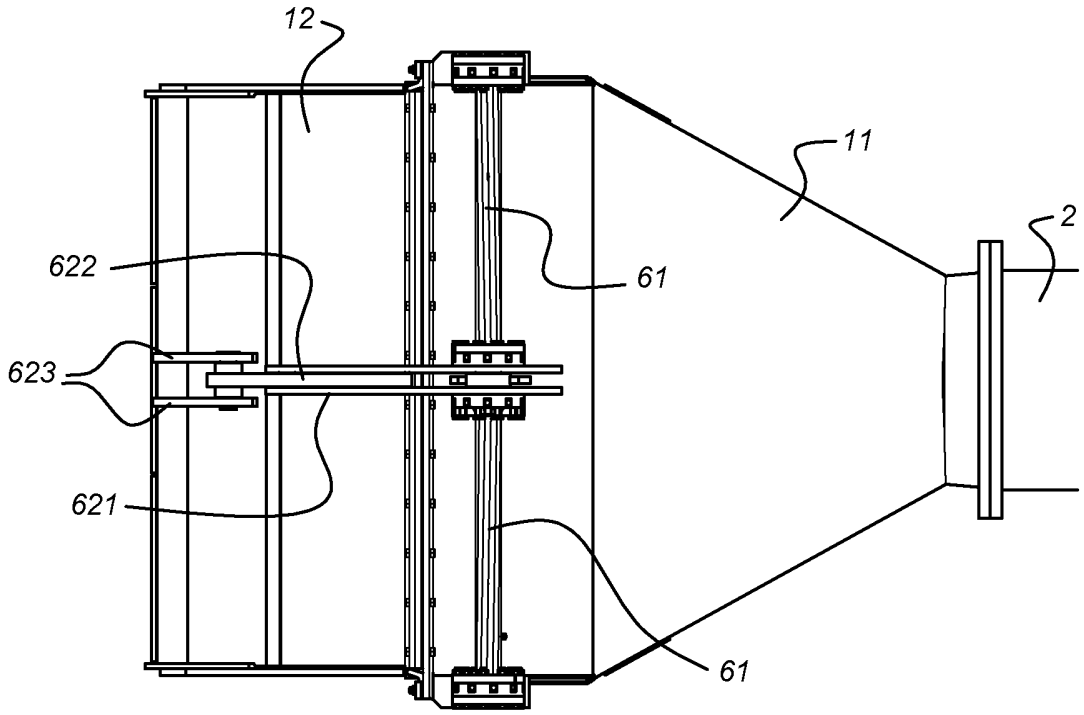


Fig. 2c

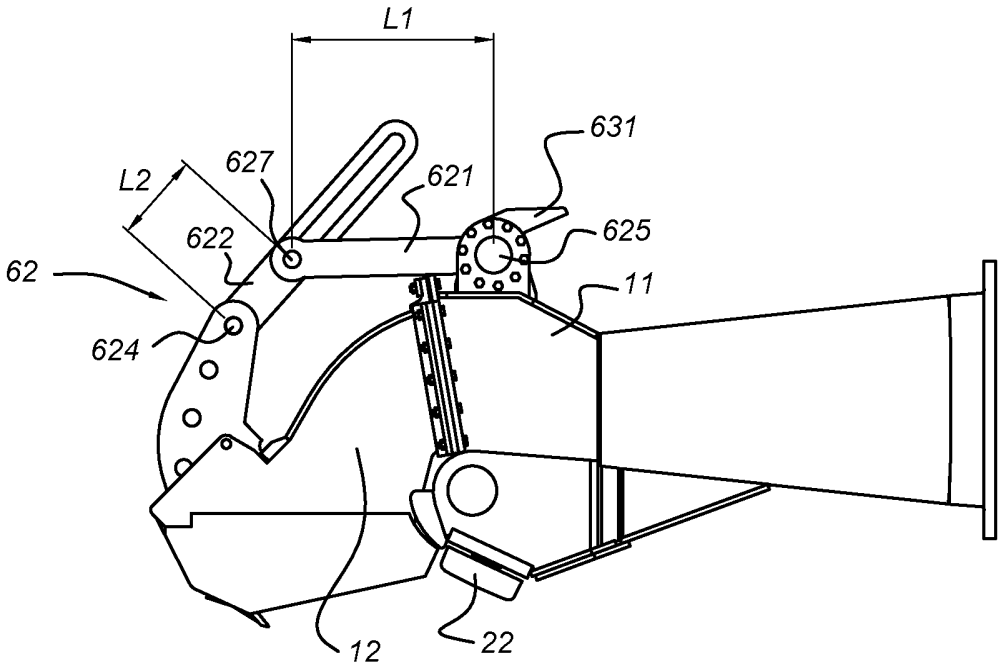


Fig. 3

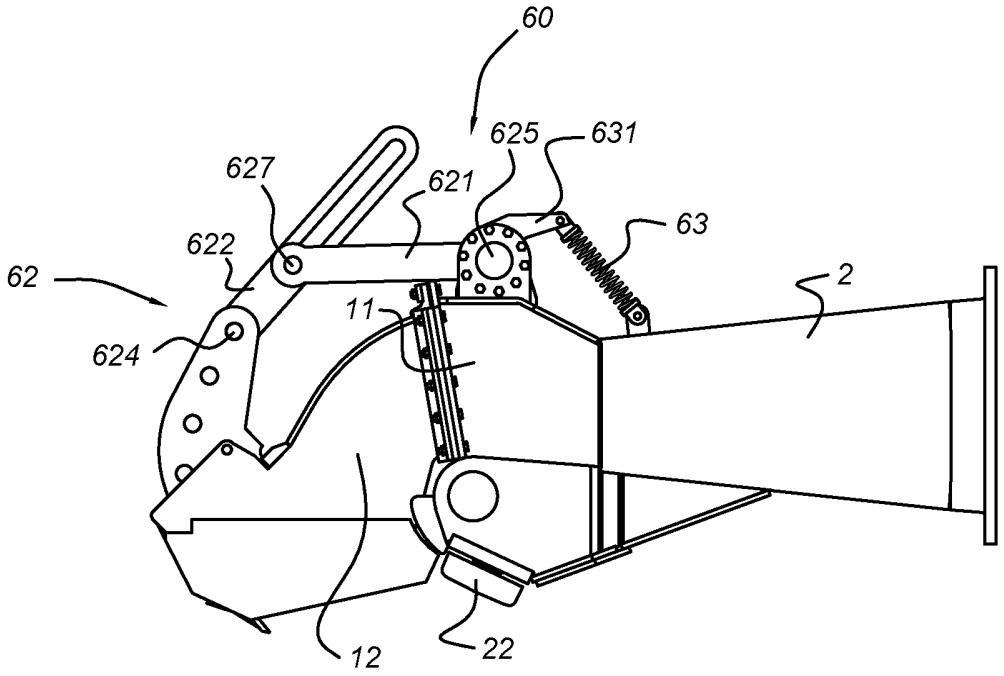


Fig. 4a

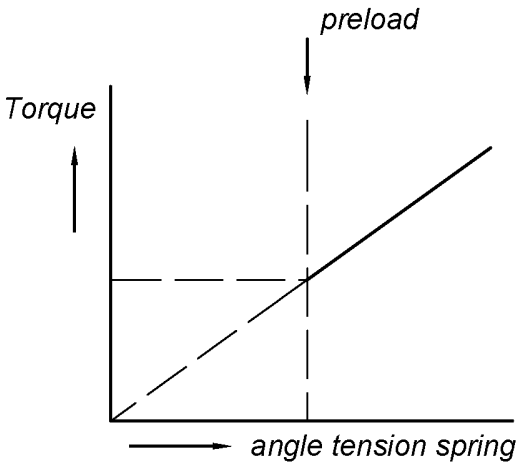
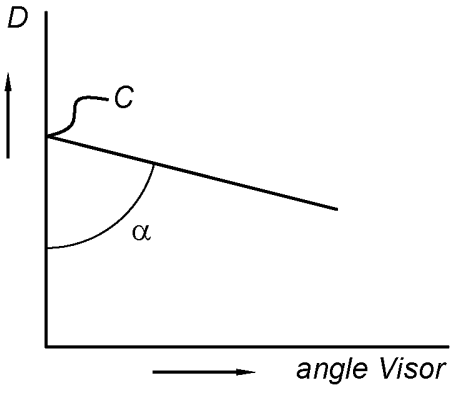


Fig. 4b



SAMENWERKINGSVERDRAG (PCT)

RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE
	P60434791NL
Nederlands aanvraag nr. **2010029**	Indieningsdatum **20-12-2012**
	Ingeroepen voorrangsdatum
Aanvrager (Naam) **IHC Holland IE B.V.**	
Datum van het verzoek voor een onderzoek van internationaal type **09-03-2013**	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr. **SN 59687**

I. CLASSIFICATIE VAN HET ONDERWERP (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)

Volgens de internationale classificatie (IPC)

E02F3/92 **E02F3/88** **E02F3/90**

II. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte minimumdocumentatie

Classificatiesysteem	Classificatiesymbolen
IPC	**E02F**

Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

III.	☐ **GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES**	(opmerkingen op aanvullingsblad)
IV.	☐ **GEBREK AAN EENHEID VAN UITVINDING**	(opmerkingen op aanvullingsblad)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2010029

A. CLASSIFICATIE VAN HET ONDERWERP
INV. E02F3/92 E02F3/88 E02F3/90
ADD.

Volgens de Internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC.

B. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte miminum documentatie (classificatie gevolgd door classificatiesymbolen)
E02F

Onderzochte andere documentatie dan de mimimum documentatie, voor dergelijke documenten, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

Tijdens het onderzoek geraadpleegde elektronische gegevensbestanden (naam van de gegevensbestanden en, waar uitvoerbaar, gebruikte trefwoorden)
EPO-Internal, WPI Data

C. VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	GB 2 128 663 A (BALLAST NEDAM GROEP NV; AMSTERDAM BALLAST BAGGER; LIESBOSCH BV) 2 mei 1984 (1984-05-02) * het gehele document * -----	1-6,8, 12-20
X,D	US 1 840 606 A (CARL SCHEFFAUER FREDERICK) 12 januari 1932 (1932-01-12) in de aanvraag genoemd * het gehele document * -----	1,5-13, 15,17, 18,20
X	US 4 123 859 A (DE KONING JAN) 7 november 1978 (1978-11-07) * het gehele document * -----	1-6,8, 12-20
X	US 4 150 502 A (SIJTHOFF JAN PIET T [NL]) 24 april 1979 (1979-04-24) * het gehele document * -----	1-6,8, 12-20
	-/--	

[X] Verdere documenten worden vermeld in het vervolg van vak C.

[X] Leden van dezelfde octrooifamilie zijn vermeld in een bijlage

° Speciale categorieën van aangehaalde documenten

"A" niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft

"D" in de octrooiaanvrage vermeld

"E" eerdere octrooi(aanvrage), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven

"L" om andere redenen vermelde literatuur

"O" niet-schriftelijke stand van de techniek

"P" tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

"T" na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvrage, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding

"X" de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur

"Y" de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht

"&" lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid	Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type
5 september 2013	
Naam en adres van de instantie European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	**De bevoegde ambtenaar** Laurer, Michael

2

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2010029

C.(Vervolg). VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	NL 8 501 357 A (BOMMEL ADRIANUS VAN) 1 september 1986 (1986-09-01) * het gehele document * -----	1-6,8, 12-20
A,D	EP 1 786 982 A1 (DREDGING INT [BE]) 23 mei 2007 (2007-05-23) in de aanvraag genoemd * het gehele document * -----	1
A	JP S60 62567 U (.) 1 mei 1985 (1985-05-01) * figuren * -----	1

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2010029

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
GB 2128663 A	02-05-1984	AU 2021983 A	19-04-1984
		GB 2128663 A	02-05-1984
		NL 8203985 A	01-05-1984
		SE 8305657 A	16-04-1984
US 1840606 A	12-01-1932	GEEN	
US 4123859 A	07-11-1978	BE 845445 A2	24-02-1977
		DE 2637899 A1	10-03-1977
		FR 2322241 A1	25-03-1977
		GB 1529605 A	25-10-1978
		JP S5238751 A	25-03-1977
		JP S5816051 B2	29-03-1983
		NL 7510028 A	01-03-1977
		US 4123859 A	07-11-1978
US 4150502 A	24-04-1979	BE 849368 A2	13-06-1977
		DE 2657311 A1	30-06-1977
		EG 12838 A	31-12-1983
		FR 2335656 A1	15-07-1977
		GB 1567198 A	14-05-1980
		JP S5290141 A	28-07-1977
		NL 7514881 A	21-06-1977
		US 4150502 A	24-04-1979
NL 8501357 A	01-09-1986	GEEN	
EP 1786982 A1	23-05-2007	AR 050928 A1	06-12-2006
		AT 421001 T	15-01-2009
		AU 2005281768 A1	16-03-2006
		BE 1016291 A3	04-07-2006
		DK 1786982 T3	04-05-2009
		EP 1786982 A1	23-05-2007
		ES 2321119 T3	02-06-2009
		HK 1106565 A1	11-09-2009
		JP 5216324 B2	19-06-2013
		JP 2008512585 A	24-04-2008
		KR 20070050870 A	16-05-2007
		MY 142391 A	30-11-2010
		NZ 551606 A	31-07-2009
		PA 8644801 A1	24-03-2006
		PT 1786982 E	16-04-2009
		US 2007261275 A1	15-11-2007
		WO 2006027325 A1	16-03-2006
		ZA 200701140 A	27-08-2008
JP S6062567 U	01-05-1985	JP S6062567 U	01-05-1985
		JP S6343256 Y2	11-11-1988

OCTROOICENTRUM NEDERLAND

WRITTEN OPINION

File No.	Filing date *(day/month/year)*	Priority date *(day/month/year)*	Application No.
SN59687	20.12.2012		NL2010029

International Patent Classification (IPC)
INV. E02F3/92 E02F3/88 E02F3/90

Applicant
IHC Holland IE B.V.

This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the application
- ☒ Box No. VIII Certain observations on the application

	Examiner
	Laurer, Michael

Application number

WRITTEN OPINION

NL2010029

Box No. I Basis of this opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ on paper

   ☐ in electronic form

   c. time of filing/furnishing:

   ☐ contained in the application as filed.

   ☐ filed together with the application in electronic form.

   ☐ furnished subsequently for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes:	Claims	8, 13-20
	No:	Claims	1-7, 9-12
Inventive step	Yes:	Claims	
	No:	Claims	1-20
Industrial applicability	Yes:	Claims	1-20
	No:	Claims	

2. Citations and explanations

see separate sheet

Application number

WRITTEN OPINION

NL2010029

Box No. VIII Certain observations on the application

see separate sheet

Re Item IV

Lack of unity of invention

1 **Lack of novelty for the subject-matter of independent claim 1**

1.1 In the terms of independent claim 1, GB-A-2128663 (=D1) discloses een baggerinrichting (*11; figure 1*) voor het baggeren van baggermateriaal van een onderwater gelegen bodem (*17; figure 2*), waarbij de baggerinrichting (*11*) een sleepkoplichaam (*33*) en een vizier (*12, 21*) omvat, waarbij het vizier (*12, 21*) verbonden is met het sleepkoplichaam (*33*) en beweegbaar is ten opzichte van het sleepkoplichaam (*33*) over een vooraf bepaald bereik (*the cylinder stroke of hydropneumatic cylinder 28*),
waarbij een voorspaninrichting (*pneumatic cushion chamber 38 of cylinder 28*) is verschaft tussen het sleepkoplichaam (*33*) en het vizier (*12, 21*) welke een voorspankracht op het vizier (*12, 21*) uitoefent (*see page 1 lines 80 to 118*) over een voorspangedeelte van het vooraf bepaalde bereik (*the cylinder stroke of hydropneumatic cylinder 28*), waarbij het voorspangedeelte ten minste 25% van het bereik is (*in D1 the pressure acting on free piston 39 from chamber 38 equals the fluid pressure in chamber 40 causing a biasing force on piston 46; Depending on the chosen pressure in chamber 38 a biasing force may act about a range clearly higher than 25 % of the complete stroke range of the hydropneumatic cylinder*).
All the features are clearly known from D1. Thus, the claimed subject-matter may not be considered as novel.

1.2 Moreover, document US-A-1840606 (=D2, cited by the applicant) figure 3 in a special position such as when pins 14 rest in the lugs 13 in the extreme position "left side of slot 18 in figure 3" a downwardly biasing force from spring damper 5 is applied to the visor. In this position, which may be caused for instance from an increased dredging depth, D2 is regarded as novelty destroying to the subject-matter of claim 1, too.

1.3 The subject-matter of independent claim 1 does not comprise any novel features which could be regarded as special technical features over the available prior art. This results in a lack of unity objection for the dependent claims directly dependent to the independent claim and comprising different and/or not corresponding potential special technical features with different resulting technical effects and/or for solving different objective technical problems.
Claims 2-4, 6, 7, 16, 17:
directed to the known device of claim 1 wherein the biasing range (claims 2-4), the biasing direction (claim 6), the biasing force (claim 16) and the position of the biasing range (claim 7) are further defined.

Claims 5, 12:
directed to the known device of claim 1 wherein the typical form of the dredge head including the visor (claim 5) and the position of the biasing device (claim 12) is further defined.
Claims 8, 18-20:
directed to the known device of claim 1 or the related method wherein the biasing force may be controlled or adjusted, as a further definition.
Claims 9-11:
directed to the known device of claim 1 wherein the biasing device is further defined as a spring biasing device.
Claims 13-15:
directed to the known device of claim 1 wherein a force transmitting device is further defined offering for instance a special characteristic.

1.4 As the search effort for the non-unitary inventions was considered as negligible, no additional search fees were requested.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

2 **Novelty and inventive step**

Independent claim 1

2.1 As outlined before, the subject-matter of independent claim 1 may not be regarded as novel over at least one of documents D1 and D2.
This subject-matter is further known from US-A-4123859 (=D3) figures, US-A-4150502 (=D4) figure 16 and from NL-A-8501357 (=D5) figures 1 and 2.

Dependent claims 2-17

2.2 The features of the following dependent claims do not contribute to novelty over at least one of the above cited available prior art:
Claims 2-4:
As D1, D3, D4 and D5 are regarded as offering a 100% range for the biasing force all claimed intervals are already known.
Claim 5:
All documents D1-D5 disclose the defined typical dredging head;
Claim 6:
In all documents D1-D5 the biasing force is directed downwardly.
Claim 7:
These features may be seen in the disclosure of D2.

Claims 9-11:
The documents D2 and D5 show the claimed helical spring which at the same time already represents a torsion spring.
Claim 12:
In all documents D1-D5 the biasing device is arranged as claimed.

2.3 The features of the following claims do not contribute to an inventive step:
Claim 8:
The biasing means of all documents D1-D5 are at least implicitly adjustable, by increasing pressure in cushion or changing the spring, the pre-tensioning of the spring or solely the spring rate, etc.
Claims 13-15:
The claimed force transmitting devices may be seen in the lever arrangements of D2, D5 and the cushion design of D1 and D3-D4;
Claim 16:
D1 page 2 lines 2-10 already describes a force range which may be seen as implicitly falling within the claimed ambit.
Claim 17:
All documents D1-D5 disclose the claimed dredging vessel.

Independent method claim 18

2.4 As independent claim 18 does not define explicitly when the biasing device is adjusted (on the sea-floor or before the dredge head is lowered into the water), the at least implicitly adjustable biasing devices of D1-D5 render the method of claim 18 obvious, mutatis mutandis to arguments in view of claim 8.

Dependent claims

2.5 The features of the following claims may not contribute to an inventive step, as they are regarded as routine design modification in the scope of a skilled person.
Claim 19:
To chose the relevant cylinder parameters in D1, such as cushion pressure and cylinder dimensions are routine measures for the skilled person.
Claim 20:
All documents D1-D5 are already novelty destroying to the subject-matter of at least one of claims 1-16. Thus, method is at least not inventive over the prior art.

Re Item VIII

Certain observations on the application

3 The structure of the claims does not represent the structure of the "summary" of invention. Especially preferred embodiments which are described therein are not explicitly represented by the present claim structure or the claims itself.
In order to comply with the requirement of clarity the structure of the claims should be represented in the description.

4 The method claims 18-20 are mainly defined by material features of the apparatus claims. If the intention of these claims is based on such material features, the methods should be formulated as appendant on the relevant apparatus claims in order to be clear and concise.
Moreover, claim 20 explicitly includes the apparatus' of claims 1-16 with their material features. From this formulation the question arises whether such material features should be included twice and as such a further lack of clarity objection must be raised.