

Description

[0001] The present invention relates to a dredging device and apparatus.

[0002] As is well known, there are various systems for dredging stone-like materials for construction use or other materials.

[0003] In accordance with the prior art, said systems provide for the use of clamshell, self-dumping or scraper bucket or the use of suction and flow dredging pump installed on self-moving watercraft or barges.

[0004] In particular, dredging work is performed according to two different operating modes:

- use of a bucket actuated by an excavator positioned ashore or on a watercraft;
- use of a suction-flow dredging pump, which may be provided with disintegrators; specifically, said dredging pump can be mounted on a watercraft or applied to hydraulic excavators or else it can be installed on machines suitable for lifting by means of mechanical arms or cables, actuated by mechanical, hydraulic or electrical actuators.

[0005] As is well known, buckets are containers applied to the arms of the excavators which, with appropriate movements, load and empty themselves.

[0006] Excavators that operate the various types of buckets can have cable or be hydraulically actuated. The latter are technically more advanced and allow a broad range of materials moving works, profiling, earthworks, and they can also perform other operations with the aid of additional hydraulic fittings, able to actuate devices supported by the arm of the excavator itself.

[0007] For these reasons, hydraulic excavators have, in fact, replaced cable excavators, which are also awkward to operate, bulky, noisy and uncomfortable for the operator.

[0008] However, while hydraulic excavators have an excellent cost/productivity ratio when working on dry land, they do have some important drawbacks when they are used to perform dredging work.

[0009] First of all, if it is necessary to dig at depths in the order of 5-7 below the free surface of the water, hydraulic excavators are in great difficulty, especially if they operate on sandbanks or on other material with poor cohesion.

[0010] To dredge such materials, one must take into account that, for the escarpment near which the excavator is located to be stable, it must have such a natural slope that the ratio between the depth of the escarpment and its distance from the edge is 1.2.

[0011] For example, to dig down to a depth of 5 meters below the free surface of the water, a distance of 10 meters must be kept from the edge of the escarpment.

[0012] In actuality, also computing a certain safety margin and the size of the excavator, a distance of about 13 meters is obtained from the centre of the excavator,

which thus must be provided with an arm having suitable length.

[0013] In fact, currently used arms are longer than the simple distance from the centre of the excavator and the digging area. Having to dig deep, it is necessary to take into account that the arm of the excavator does not work remaining perfectly rectilinear, but it has a certain curvature. Therefore, to obtain for instance the parameter of 5 metres of depth and 10 metres of distance from the edge of the escarpment, it is necessary to use an arm with a length of at least 15-16 metres.

[0014] These distances can be covered only using special arms provided with small buckets, in order to limit the load that bears on the arm at a great distance from the excavator.

[0015] The use of arms provided with small buckets, however, entails a productivity loss for the excavator. To overcome this drawback, large excavators are used, but they are very expensive and have poor fuel economy, thus driving upwards the cost of the excavated material.

[0016] Moreover, such excavators deposit the excavated material within their operating radius and, if said material needs to be stored or brought to an area for loading onto lorries, it must be moved again, driving costs yet further upwards.

[0017] With regard to excavators with cables, or drag-lines, they allow to cover greater distances and depths than those obtained with hydraulic excavators, exploiting the so-called "launch" operating mode. However, in this mode drag-line excavators are forced to use a scraper bucket, poorly suited to retain sandy material or other material that can easily disintegrate in water.

[0018] An additional drawback of drag-line excavators is that they require frequent maintenance and great manoeuvring ability on operators' part. Moreover, their transport is particularly complex because of the large road size, to such an extent that they require dismantling the excavators and transporting them in sections.

[0019] To complete the overview of the state of the art, we now mention the possibility of using excavators positioning them on boats or barges. This operating mode is generally adopted when the dredged material is loaded onto the same watercraft on which the excavator is positioned, and subsequently transported to a unloading area.

[0020] The operating mode described above is adopted in dredging operations in rivers and at sea, so there is a considerable distance between the loading point and the unloading point and when the value of the collected material offsets the cost of transportation.

[0021] A second known operating mode for executing dredging work, as mentioned above, consists of using a suction-flow pump.

[0022] Frequently, the suction-flow dredging pumps are installed aboard watercraft, to be able to thrust the dredged material to considerable distances with a pipeline supported by variously shaped floats. Moreover, this operating mode allows to perform the unloading or stor-

age operations in a single collection point.

[0023] An important drawback of the boat/suction-flow dredging pump complex is its high cost.

[0024] A second disadvantage of this kind of pumps is their poor transportability from one site to another, which forces operators to provide for their dismantling to complete the transport operation.

[0025] Therefore, the acquisition and use of dredging pumps is economically viable for sites that last a long time and that have globally high production. In small dredging operations, in particular in inner regions with respect to riverine areas or in other area where it is possible to move by navigation, the use of dredging pumps is not very profitable.

[0026] In accordance with a known embodiment variant, there are suction-flowing dredging pumps applicable to the arms of hydraulic excavators, instead of the bucket.

[0027] The main drawback of the aforementioned technical solution is the limited distance which can be reached by the arm of the excavator and the consequent reduced depth that can be attained.

[0028] An object of the present invention is to eliminate the aforementioned drawbacks, proposing a dredging device and apparatus able to perform dredging work at greater distances and/or depths than the prior art.

[0029] Another object of the present invention is to propose a dredging device and apparatus that are easily manoeuvrable by an operator.

[0030] A further object of the present invention is to provide a dredging device and apparatus that can be rapidly moved from one digging area to another, in order not to remain buried by material that may slide onto them during deep dredging.

[0031] Another object of the present invention is to propose a dredging device and apparatus that have a broad operating range for dredging, being able to unload the dredged material even at considerable distance from the digging area.

[0032] Yet a further object of the present invention is to provide a dredging device that is easy to maintain and able to be installed on an excavator, in order to reduce investments for the acquisition of costly specific dredging means.

[0033] Another object of the present invention is to provide a dredging device and apparatus that are easy to transport.

[0034] An additional object of the present invention is to obtain the aforesaid results within the context of a rational, reliable embodiment.

[0035] Said objects are fully achieved by the dredging device and apparatus of the present invention, which are characterised by the contents of the appended claims.

[0036] These and other objects shall become more readily apparent from the description that follows of a preferred embodiment illustrated, purely by way of non

limiting example, in the accompanying tables in which:

- Figure 1 shows a front view of a dredging device in accordance with the present invention;
- Figures 2a, 2b, 2c and 2d show four front views of a constructive detail of the dredging device shown in Figure 1, in four different embodiment variants;
- Figure 3 shows an axonometric view of the device shown in Figure 1;
- Figure 4 shows a front view of a dredging apparatus in accordance with the present invention.

[0037] With particular reference to Figures 1 and 3, the dredging device in accordance with the invention is globally designated by the number 1.

[0038] The device 1 comprises an operative arm 2 whereto are connected dredging means 3, able to be immersed in a liquid, typically in river or sea water.

[0039] In absolutely new and original fashion, the operative arm 2 is so shaped as to generate a hydrostatic buoyancy whose value is just lower than the sum of the weights of the arm itself and of the dredging means, so that said means are submerged deep into the liquid by effect of the difference between the sum of said weights and the hydrostatic buoyancy.

[0040] The dredging means 3 comprise at least a dredging pump.

[0041] In particular, in the preferred embodiment illustrated herein, the dredging means 3 comprise an auxiliary arm 5 having a first end 5a hinged to the operative arm 2 and a second, free end 5b, whereto is fastened a dredging pump 6. Preferably, said dredging pump 6 is a suction-flow dredging pump.

[0042] In accordance with a first embodiment variant, not shown herein, the operative arm 2 and the auxiliary arm 5 are internally hollow and they have such a volume as to determine a hydrostatic buoyancy that is just lower than the sum of the weights of the arms 2 and 5 of the dredging pump 6.

[0043] In accordance with a second embodiment variant, shown in Figures 1 and 3, the device 1 comprises at least one floating body 4 integrally connected to the operating arm 2, positioned superiorly thereto.

[0044] The floating body 4 has such a volume as to determine, when it is immersed in the liquid, a hydrostatic buoyancy that is slightly lower than the sum of the weight of the operating arm 2 and of the auxiliary arm 5 with the weight of the dredging pump 6 and of a discharge pipeline 62.

[0045] In accordance with possible embodiment variations, not illustrated herein, the floating body/bodies may also be connected inferiorly or laterally to the operative arm 2 and/or to the auxiliary arm 5.

[0046] The operative arm 2 is actuated by a hydraulic or pneumatic actuator (not shown).

[0047] With particular reference to Figures 1 and 4, the device 1 can be connected to a mechanical arm 51 of a self-propelled machine, typically an excavator 52,

thereby defining a single dredging apparatus, globally designated by the number 50.

[0048] In the illustrated example, the operative arm 2 of the device 1 is hinged to an end of the mechanical arm 51 of the excavator 52, instead of the bucket (not shown).

[0049] Preferably, the operative arm 2 is actuated by a same actuator 53, typically hydraulic, which normally actuates the bucket.

[0050] Specifically, the operative arm 2 is connected to a command rod 54 by means of a mechanical transmission. In the illustrated example, the command rod 54 is directly operated by the actuator 53 and the mechanical transmission is of the type operating exclusively by traction.

[0051] With particular reference to Figures 1 and 2a, the mechanical transmission is preferably a chain 55a having a first end link 60 connected to the command rod 54 and a second end ring 61 connected to a pivot pin 56 fastened to the operative arm 2.

[0052] In accordance with the embodiment shown in Figure 2b, the mechanical transmission may be constituted by two connecting rods 55b, 55c, hinged to each other and respectively connected to the pivot pin 56 of the operative arm 2 and to the command rod 54.

[0053] In accordance with an additional embodiment shown in Figure 2c, the mechanical transmission is obtained by means of a plate-like body 55d, whereon were obtained a hole 75 and a slot 85, able to be coupled respectively to the command rod 54 and to the pivot pin 56 connected to the operative arm 2.

[0054] In a possible embodiment, not shown herein, the auxiliary arm 5 may be actuated by a hydraulic actuator and, between the operative arm 2 and the auxiliary arm 5, there may be a mechanical transmission of the type shown in Figures 2a, 2b, 2c described above.

[0055] In accordance with a fourth embodiment shown in Figure 2d, the mechanical transmission is obtained by means of a pair of links 90, 91 connected by a steel cable 92. Specifically, the link 90 is connected to the pivot pin 56 fastened to the operative arm 2, whilst the link 91 is connected to the command rod 54 (or vice versa).

[0056] With particular reference to Figure 3, to the pump 6 is connected the discharge pipeline 62, of the highly flexible type, suitable for transporting the dredged material.

[0057] Said pipeline 62 preferably extends along the whole auxiliary arm 5 and the operative arm 2 and it is supported in multiple points by both rigid and elastic supports. After reaching the end of the auxiliary arm 5 and the end of the operative arm 2, the pipeline 62 moves away to be connected to a floating pipe 63, thereby forming a single discharge line of the dredging pump.

[0058] The region of the auxiliary arm 5 and of the operative arm 2 whereat the discharge pipeline 62 moves away from the arm itself can be variable, according to operative requirements. At the separation region, the

discharge pipeline 62 must always be supported in such a way as to prevent the formation of kinks which may compromise its integrity when the operative arm 2 is lifted out of the water.

[0059] The connection between the discharge pipeline and the floating pipe preferably occurs by means of a quick coupling joint, in such a way as to enable an easy disengagement of the pipeline itself, in order to render the dredging apparatus independent and to facilitate its accessibility by an operator, e.g. for maintenance requirements.

[0060] The operation of the dredging apparatus 50 constructed in accordance with the present invention shall now be described.

[0061] First of all, the operative arm 2, whereto the auxiliary arm 5 and the pump 6 are connected, is connected to the mechanical arm 51 of the excavator 52.

[0062] Subsequently, the mechanical arm of the excavator is lifted and the discharge pipeline 62 of the pump 6 is engaged to the floating pipe already readied in the water. The connection between the pipeline and the pipe preferably occurs by means of the quick coupling joint.

[0063] Thereafter, activating the descent movement of the mechanical arm 51 of the excavator 52, the operative arm 2, the auxiliary arm 5 and the pump 6 are immersed in the water.

[0064] The operative arm 2 and/or the auxiliary arm 5, being shaped in such a way as to receive a hydrostatic buoyancy that is just lower than the sum of their weights with the weight of the pump 6, allow a complete extension both of the arm 51 of the excavator, and of the operative arm itself, without overloading it.

[0065] Therefore, the only loads that actually bear down on the mechanical arm of the excavator are the difference between the hydrostatic buoyancy generated by the operative arm 2 and possibly by the auxiliary arm 5 and the total weight, given by the weight of the operative arm, by the weight of the auxiliary arm, by the weight of the pump 6, by the weight of the discharge pipeline 62 and by the weight of any floating body.

[0066] The lightening of the load bearing on the mechanical arm of the excavator by effect of the floating of the operative arm 2 allows rapidly to lift the auxiliary arm 5 and hence the pump 6, when the operator realises that an excessive quantity of material is being aspirated or when material slides onto the pump, thereby preventing potentially dangerous situations for the integrity of the dredging apparatus 50.

[0067] The invention achieves important advantages.

[0068] First of all, a dredging apparatus and device in accordance with the present invention allow a considerable increase in dredging distance and depth in water with respect to known solutions, described above. Moreover, by effect of the lightening of the structural loads induced by the hydrostatic buoyancy generated by the complex of the operative arm 2 and auxiliary arm 5, such a dredging apparatus significantly reduces the con-

sumption of energy needed to actuate the mechanical arm of the excavator.

[0069] Secondly, the connection between the discharge pipeline 62, coming from the dredging pump 6, and the floating pipe provides the mechanical arm 51 with great freedom of motion, both in elevation and training.

[0070] Advantageously, the technical solution mentioned above allows easily to move the dredging apparatus and easily to access the pipeline and the pump, e.g. for maintenance and repair purposes.

[0071] An additional advantage is the considerable depth achievable by the dredging pump 6. The entire length of the auxiliary arm 5 and of the operative arm 2 can be exploited to reach the desired depth, because they can be placed in completely vertical position (Figure 1).

[0072] Another important advantage is the possibility of mounting the device 1 on existing excavators, thereby reducing investments for the acquisition of expensive specific means, which are not usable for other purposes.

[0073] Advantageously, a dredging device and apparatus in accordance with the present invention can easily be transported, with no need to be dismantled in numerous sections.

[0074] Another advantage is the presence of a mechanical transmission operating exclusively by traction, interposed between the operative arm 2 and the mechanical arm 51 and connected to them. Said mechanical transmission prevents the mechanical arm 51 from thrusting the operative arm 2 (and hence the auxiliary arm 5) deep, preventing the dredging pump 6 from sinking excessively into the material to be dredged, becoming clogged.

[0075] The operative arm 2, the auxiliary arm 5 and the pump 6, therefore, drop deep into the water solely by effect of the difference between their own weight and the hydrostatic buoyancy generated by the operative arm and by the auxiliary arm, if present.

[0076] A similar mechanical transmission can also be interposed between the operative arm 2 and the auxiliary arm 5.

Claims

1. A dredging device (1), comprising:

at least one operative arm (2);
dredging means (3) connected to said operative arm (2) and able to be immersed in a liquid,

characterised in that said operative arm (2) is so shaped as to generate a hydrostatic buoyancy whose value is just lower than the sum of the weights of the arm and of the dredging means (3), so that the latter are immersed deep into the liquid by effect of the difference between the sum of said

weights and the hydrostatic buoyancy.

2. Device as claimed in claim 1, **characterised in that** said operative arm (2) is internally hollow.

3. Device as claimed in claim 2, **characterised in that** said operative arm (2) has such a volume as to determine a hydrostatic buoyancy whose value is just lower than the sum of the weights of the arm itself and of the dredging means (3).

4. Device as claimed in claim 1, **characterised in that** it comprises at least one floating body (4) integrally connected to said operative arm (2).

5. Device as claimed in claim 4, **characterised in that** said floating body (4) has such a volume as to determine, when it is immersed in the liquid, a hydrostatic buoyancy whose value is just lower than the sum of the weights of the arm itself and of the dredging means (3).

6. Device as claimed in either of the claims 4 or 5, **characterised in that** said floating body (4) is connected superiorly to the operative arm (2).

7. Device as claimed in either of the claims 4 or 5, **characterised in that** said floating body (4) is connected inferiorly to the operative arm (2).

8. Device as claimed in either of the claims 4 or 5, **characterised in that** said floating body (4) is connected laterally to the operative arm (2).

9. Device as claimed in claim 1, **characterised in that** said dredging means (3) comprise at least one dredging pump (6).

10. Device as claimed in claim 1, **characterised in that** said dredging means (3) comprise:

at least one auxiliary arm (5) connected to said operative arm (2);

at least one dredging pump (6) connected to said auxiliary arm (5).

11. Device as claimed in claim 10, **characterised in that** the auxiliary arm (5) is hinged to an end of the operative arm (2).

12. Device as claimed in claims 10 or 11, **characterised in that** it comprises a mechanical transmission for actuating the auxiliary arm (5), said mechanical transmission operating exclusively by traction and being interposed between said operative arm (2) and said auxiliary arm (5) connected to them.

13. Device as claimed in claim 12, **characterised in**

that said mechanical transmission is substantially a chain (55a).

and a second of said rod-like elements having an end connected to the mechanical arm (5) of the self-propelled machine (52).

14. Device as claimed in claim 12, **characterised in that** said mechanical transmission comprises a pair of rod-like elements (55b, 55c) hinged between them, a first of said rod-like elements (55b, 55c) having an end connected to the operative arm (2) and a second of said rod-like elements (55b, 55c) having an end connected to the auxiliary arm (5). 5
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15. Device as claimed in any one of the previous claims, **characterised in that** said operative arm (2) is actuated by at least one actuator. 15
16. Device as claimed in claim 15, **characterised in that** said actuator is hydraulic or pneumatic.
17. Device as claimed in claim 10, **characterised in that** said auxiliary arm (5) is internally hollow. 20
18. Device as claimed in claim 17, **characterised in that** said auxiliary arm (5) has such a volume as to determine a hydrostatic buoyancy whose value is just lower than the sum of the weights of the arm itself and of the dredging pump (6). 25
19. Device as claimed in claim 10, **characterised in that** it comprises at least one floating body integrally connected to said auxiliary arm (5). 30
20. Dredging apparatus, comprising a self-propelled machine (52) having at least one mechanical arm (51), **characterised in that** it comprises a dredging device (1) as claimed in any of the previous claims. 35
21. Apparatus as claimed in claim 20, **characterised in that** the operative arm (2) of the dredging device (1) is hinged to the mechanical arm (51) of the self-propelled machine (52). 40
22. Apparatus as claimed in claim 21, **characterised in that** it comprises a mechanical transmission for actuating the operative arm (2), said mechanical transmission operatively exclusively by traction and being interposed between said mechanical arm (51) of the self-propelled machine (52) and said operative arm (2) and connected to them. 45
23. Apparatus as claimed in claim 22, **characterised in that** said mechanical transmission is substantially a chain (55a). 50
24. Apparatus as claimed in claim 22, **characterised in that** said mechanical transmission comprises a pair of rod-like elements (55b, 55c) hinged to each other, a first of said rod-like elements (55b, 55c) having an end connected to the operative arm (2) 55

Fig. 1

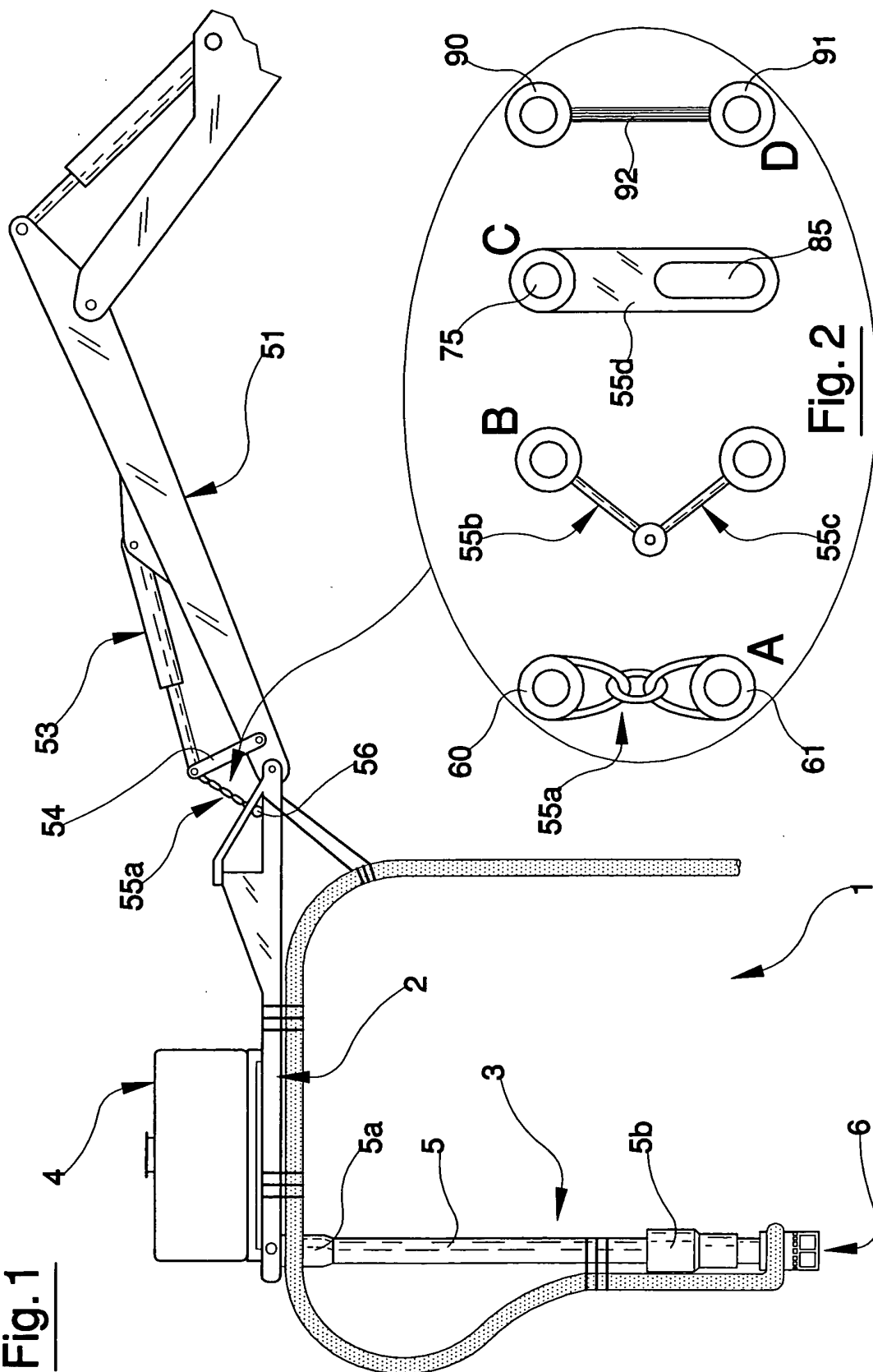


Fig. 2

Fig. 3

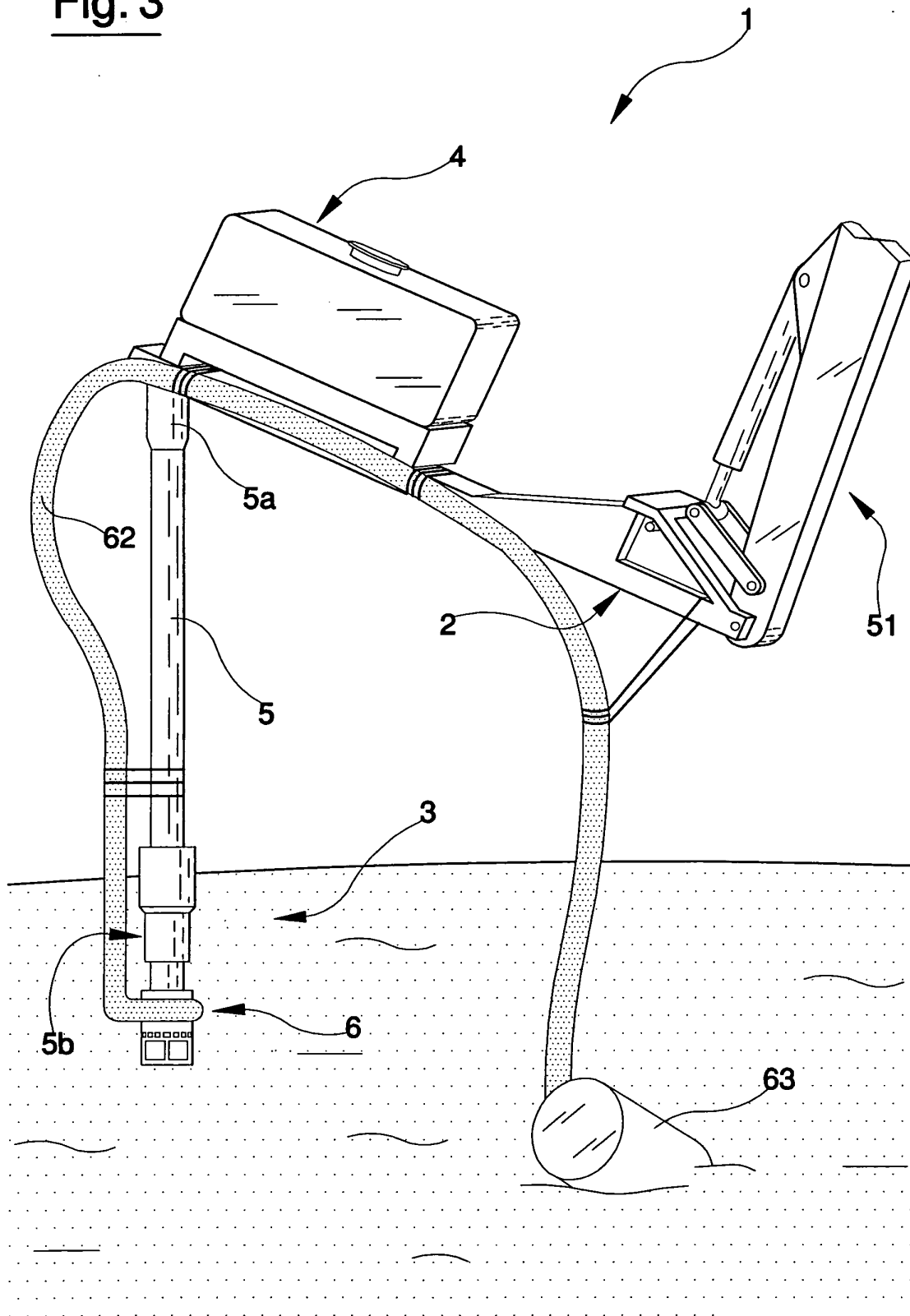


Fig. 4

