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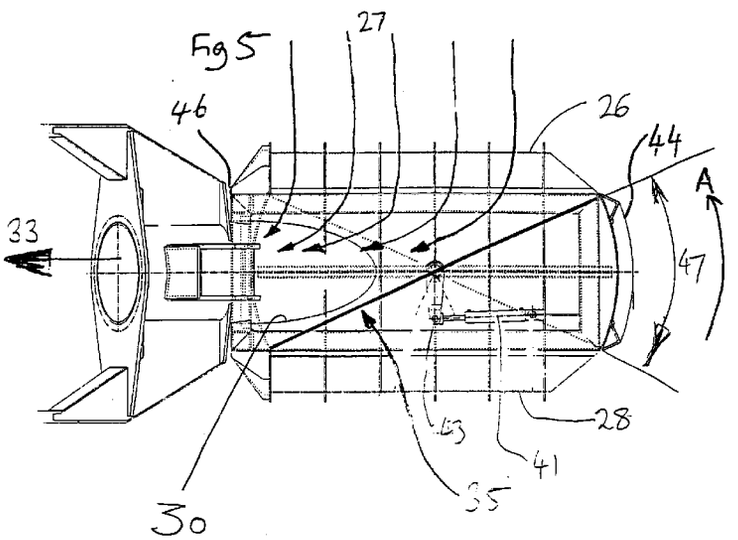
(54) Suction head for a dredging apparatus

(57) The present invention relates to a suction head (13), and in particular, a suction head (13) for fitting to a dredging apparatus for dredging silty soils, clay, sand or the like.

The suction head (13) comprises at least one side wall, two openings facing in different directions arranged therein through which dredged soil may pass, a base, a suction hole for connection to a soil collection pipe for extraction of the soil therethrough, and a guiding plate (35) within the head selectively to connect one of the openings to the suction hole.

The suction head (13), in use, is mounted on the end of a ladder (15) of a dredging ship, or the like.



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Description

[0001] The present invention relates to a suction head, and in particular, a suction head for fitting to a dredging apparatus for dredging silty soils, clay, sand or the like (hereinafter called soil).

[0002] A suction head for dredging apparatus is disclosed in EP-A-0,430,316, but this head incorporates a cutter which involves a large number of moving parts, including continuously moving cutter blades and a shielding system for preventing undesired turbidity of the water due to the whirling cutter blades

[0003] One aim of the present invention is to provide a suction head for dredging apparatus that accurately and controllably removes a layer of soil, but which does not significantly disturb the surrounding soil layers or raise the local turbidity of the surrounding water which could result in bringing the soil into suspension. Another aim is to provide a dredging apparatus fitted with a suction head wherein the depth of dredging can be accurately controlled, and which removes soil with a minimum amount of water entering the suction head of the dredging apparatus.

[0004] According to the present invention we provide a suction head for a dredging apparatus, the suction head comprising at least one side wall, two openings facing in different directions arranged therein through which dredged soil may pass, a base, a suction hole for connection to a soil collection pipe for extraction of the soil therethrough, and a guiding plate within the head selectively to connect one of the openings to the suction hole. Preferably, the guiding plate is hinged about a central pivot axis under the control of a hydraulic cylinder, between a first position in which one opening is connected to the suction hole, and a second position in which the second opening is connected to the suction hole.

[0005] Preferably, the head is generally rectangular in plan, and has a front wall and a rear wall, each with a left hand and a right hand end when viewed from in front of the front wall with one opening extending between the left hand ends of the front and rear walls and the other opening extending between the right hand ends of said walls, so that said openings are opposite one another and each is defined by the top, bottom, front and rear walls of the head. Preferably, the pivot axis of the guiding plate extends vertically through a central region of the head between the top and bottom thereof. The suction hole may be located at least partly in said rear wall, and said guiding plate when in its first position extends between the left hand end of the front wall and the right hand end of the rear wall, and when in its second position, extends between the right hand end of the front wall and the left hand end of the rear wall.

[0006] The suction head preferably includes a cutting edge associated with each opening for defining the dredging depth in a layer of soil. Typically, each cutting edge defines a lower perimeter of each opening.

[0007] Preferably, in use, the suction head is mounted on a lower end of a ladder associated with a dredger, or the like to form a dredging apparatus, the ladder being pivotally connected at its upper end about a horizontal axis to the dredger. By lowering the ladder, the dredging depth can be controlled. Between the suction head and the ladder, a hinge is provided, and an hydraulic cylinder is fitted, in such a way that the head can be tilted with respect to the ladder; in this way the suction head is kept horizontal. This system also makes it possible to control the angle between suction head and bottom to be dredged, in such a way that a slope can be dredged.

[0008] The dredging process consists of swinging the dredging apparatus about a vertical axis in one direction from one side to the other by means of the dredger's anchor wires and winches. During the swinging movement, the suction head is pushed through the soil layer so that the soil enters the head through one of the suction openings. This soil is then pumped away by means of a suction pipe connected to the suction hole, via a dredgepump installed on the ladder, or in the dredger. This soil is then discharged into barges, or is pumped through a floating pipeline to a containment facility.

[0009] Advantageously, the openings in the head oppose each other such that a sweeping dredging action can effectively operate in both swing directions.

[0010] At the end of the swing, the dredger is moved forwards by means of its spudsystem or by means of anchor wires, and a new swing in the other direction can be executed. By dredging subsequent part circular sectors, a soil layer can be removed over a given surface.

[0011] When swinging from left to right, the opening at the right side of the suction head is open, and connected to the suction pipe. When swinging in the other direction, the opening at the right side has to be closed, and the opening at the left side is to be connected to the suction pipe. This may be achieved by swinging the plate mounted in the suction head by means of the hydraulic cylinder mounted on the suction head. The plate thus closes off one side opening, while at the same time connecting the other side opening to the suction pipe.

[0012] The size of the openings is preferably adjustable to define the height of the dredged layer. To achieve this, a hinged flap may be connected to at least part of a perimeter wall of each opening or a plate may be fitted to, or removed from, the opening. For example, by fitting or removing one or more steel plates at the upperside of the opening, the height of the opening can be increased or decreased. Alternatively, a hinged flap is installed at the upperside of the opening. This flap is moved by means of an hydraulic cylinder in such a way that the height of the opening is adjustable.

[0013] In order to control and monitor the dredging process, monitoring systems or instrumentation may be provided:

1. To measure the angle to the horizontal plane of

the ladder, and the draught of the dredger;

2. To measure the angle to the horizontal plane of the suction head;

By combining these measurements, the dredging depth (i.e. depth of suction head cutting edge) can be calculated and can therefore be displayed to an operator.

3. To measure the position of flap(s) or plate(s) controlling the height of the openings. This enables the height of the openings to be calculated and displayed to the operator.

[0014] These measurements and displays enable the operator to control dredging depth, and the dredged layer thickness.

[0015] Furthermore, it is possible to integrate the control of the dredge-pump in the system in such a way that the delivery of the pump exactly matches the volume of the dredged soil flowing into the suction head. This avoids entry of unnecessary quantities of water into the system. In this way, the dredged soil is diluted as little as possible, in order to reduce the amount of contaminated soil to be treated afterwards, or to be transported.

[0016] Several embodiments of dredging apparatus according to the present invention are now described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a side view showing a dredging apparatus with a suction head resting on an area to be dredged;

Figure 2 illustrates a tilting action of the suction head;

Figure 3 is a front view showing a suction head removing a layer of soil from the area to be dredged;

Figure 4 is a side view of the suction head of figure 1 to a larger scale;

Figure 5 is a plan view of the suction head of figure 4; and

Figure 6 is a lateral section through an alternative construction of suction head with openings of a variable size.

[0017] Referring to figure 1, there is shown a dredging apparatus 11 suitable for mounting on a dredger, not shown. The dredging apparatus comprises a suction head 13 mounted on a lower end of a ladder 15, the upper end of which is arranged to be pivotally mounted on a dredger about a pivot axis 21. The suction head 13 is mounted via a tilting mechanism 17 such that the suction head can be tilted relative to the ladder 15 as illustrated in figure 2. This allows the suction head (13) to be kept substantially horizontal, irrespective of the orientation of the ladder 15 or to be maintained at an appropriate angle to follow the contours of the area to be dredged. Alternatively, it allows dredging to be undertaken on a slope which is not horizontal. The tilting mechanism 17 is driven by a cylinder 19, but other drive means could be utilised. The pivot axis 21 allows the ladder 15 to be moved in an arc such that the suction head can be raised and lowered to control the dredging depth.

[0018] Referring now to figures 3 to 5, the suction head 13 comprises a top or upper wall 24, a base 40 or bottom wall 40, each of which are supported on box section members 42, a front wall 44, a rear wall 46, and extending between respective ends of the front and rear walls, a first opening 26 and a second opening 28. The box section members 42 are a prefered feature. However, other structural supports may be used, steel plates or angle bars, for example. Extending between upper and bottom walls 24, 40 is a pivot shaft 45 supporting a guiding plate 35 within the suction head 13. One end of a lever arm 43 is rigidly connected to the shaft 45 and its opposite end is connected to an actuating cylinder 41 for applying force to the lever arm 43 to swing the guiding plate 35 about its pivot shaft 45. The guiding plate 35 has a limited range of swing as indicated by arrow 47. A suction hole 30 is formed in the suction head 13, partly within the rear wall 46 and partly within the upper wall 24, to which hole 30 a suction pipe 31 is connected. However, the suction hole 30 may be formed only in the rear wall 46 or the upper wall 24. The dimensions of the suction head 13 may determine the position of the suction hole 30. The suction pipe 31 (only part of which is illustrated in Figure 4), is supported on the ladder 15, and is connected to a suitable dredge pump (not shown) which can be located on the ladder 15 or elsewhere within the dredger.

[0019] The dredging process consists of swinging the suction head 13 back and forth from one side to the other by means of the dredger's anchor wires and winches. During the swinging movement, the suction head 13 is pulled through an upper soil layer 23, soil from which enters the head through one of the suction head openings 26, 28 as illustrated by arrow 27 in Figure 3. This soil is then pumped away through the suction pipe 31 as illustrated by arrow 33 in Figure 5. This soil is then discharged into barges, not shown, or it may be pumped through a floating pipeline, not shown, to a containment facility.

[0020] At the end of the swing, the dredger is moved forwards by means of its spudsystem or by means of anchor wires, and a new swing in the other direction can be executed.

[0021] By dredging subsequent sectors, a soil layer can be removed to leave a dredged surface 25.

[0022] As can be seen from Figure 5, the plate 35

extends between the front wall 44 and rear wall 46 of the head 13 so that opening 26 is in communication with the suction hole 30, whereas the opening 28 is prevented from communication with the hole 30. When in this mode, to perform a dredging step, it will be necessary for the head 13 to be swung in the direction of the arrow A shown in Figure 5, so that dredged soil can enter the head as depicted by the arrows 27, and be sucked up into the suction pipe 31. When the head 13 reaches the limit of its swing, it must then be swung in the opposite direction. Before this occurs, the dredger must be advanced, and the opening 26 has to be closed, and the opening 28 at the opposite side of the head has to be connected to the suction pipe 31. This is achieved by swinging the guiding plate 35 in the suction head about its central shaft 45 using the hydraulic cylinder 41. The plate will thus close off the side opening 26, while at the same time connecting the other opening 28 to the suction pipe 31.

[0023] At the lower side of each opening 26, 28, a cutting edge 49 is provided. This cutting edge 49 defines the depth of the dredged surface 25.

[0024] Referring now to figure 6, the size of the openings 26, 28 can be adjusted in such a way that the height of the dredged layer of soil 23 can be adjusted. Alternatively, or in addition to this, the width of the openings may be adjustable. This height adjustment is achieved by hinged flaps 51 installed along an upper edge of the respective suction openings 26, 28. These flaps 51 may be moved by means of an hydraulic cylinder (not shown). Two different heights 53 are illustrated in figure 6.

[0025] Alternatively, by fitting or removing steel plates (not shown) along the upper edge of the suction openings 26, 28, for example, the height 53 of the openings 26, 28 can be increased or decreased.

[0026] Alternative methods of altering the size of the opening may be implemented.

[0027] Alternative guiding plate moving means can be provided. Further, the pivot shaft 45 need not be central to the guiding plate 35.

[0028] The advantages of the system are summarised as follows

1. Dredging depth can be accurately controlled.
2. The dredged layer thickness can be accurately controlled.
3. If the system with layer thickness adjustment by means of a flap with an actuating mechanism is installed, the layer thickness can be controlled. This enables adaptation of the dredged layer thickness to the actual thickness of the layer to be dredged, during the dredging process.
4. The suction openings are located at the sides only of the suction head. This means that deeper layers (i.e. below the cutting edge) will not be disturbed.
5. The sectional area of the suction head may be made small, and with a somewhat wing-like form with a smooth top and a flat bottom. This means that when the dredging apparatus is swung, the head will induce only a little turbulence in the water and in the deeper layers, thus avoiding substantial turbidity and/or dispersal of the soil.
6. By matching the control of a dredge-pump with the swing speed and layer thickness, the spoil flow can be controlled avoiding dilution of the dredged soil.
7. The system consists of very few moving parts, and can be sturdily constructed, making it almost insensitive to damage by external objects on the bottom, and/or to objects in the dredged layer.
8. The guiding plate inside the suction head is a simple and very effective way of switching over the flow from one side to the other side of the head.

[0029] The present invention has been described above purely by way of example. It should be noted that modifications in detail may be made within the scope of the invention.

Claims

1. A suction head (13) for a dredging apparatus (11), the suction head (13) comprising at least one side wall, two openings (26, 28) facing in different directions arranged therein through which dredged soil may pass, a base (40), a suction hole (30) for connection to a soil collection pipe (31) for extraction of the soil therethrough, and a guiding plate (35) within the head (13) selectively to connect one of the openings (26, 28) to the suction hole (30).

2. A suction head (13) according to claim 1, wherein the guiding plate (35) is hinged about a pivot axis (45) for pivoting between a first position in which one opening (26, 28) is connected to the suction hole (30), and a second position in which the second opening (28, 26) is connected to the suction hole(30).

3. A suction head (13) according to claim 2, wherein the guiding plate (35) is controlled by a hydraulic cylinder (41).

4. A suction head (13) according to claim 2, or claim 3, wherein the pivot axis (45) of the guiding plate (35) extends vertically through a central region of the head (13) between a top (24) and bottom (40) thereof.

5. A suction head (13) according to any preceding claim, wherein the head (13) is generally rectangular in plan, and has a front wall (44) and a rear wall (46), each with a left hand and a right hand end when viewed from in front of the front wall (44) with

one opening (28) extending between the left hand ends of the front and rear walls and the other opening (26) extending between the right hand ends of said walls, so that said openings (26, 28) are opposite one another and each is defined by the top (24), bottom (40, front (44) and rear walls (46) of the head (13).

6. A suction head (13) according to claim 5, wherein the suction hole (30) is located at least partly in said rear wall (46), and said guiding plate (35) when in its first position extends between the left hand end of the front wall (44) and the right hand end of the rear wall (46), and when in its second position, extends between the right hand end of the front wall (44) and the left hand end of the rear wall (46).

7. A suction head (13) according to any preceding claim, comprising a cutting edge (49) associated with each opening (26, 28) for defining the dredging depth in a layer of soil (23).

8. A suction head (13) according to claim 7, wherein each cutting edge (49) defines a lower perimeter of each opening (26, 28).

9. A suction head (13) according to any preceding claim, wherein the openings (26, 28) oppose each other.

10. A suction head (13) according to any preceding claim, wherein the suction head (13) is mounted on a lower end of a ladder (15) associated with a dredger, or the like, to form a dredging apparatus (11), the ladder (15) being pivotally connected at its upper to the dredger.

11. A suction head (13) according to claim 10, wherein between the suction head (13) and the ladder (15), a hinge (17) is provided, and an hydraulic cylinder (19) is fitted, in such a way that the head (13) can be tilted with respect to the ladder (15).

12. A suction head (13) according to any preceding claim, wherein the size of the openings (26, 28) is adjustable.

13. A suction head (13) according to claim 12, wherein a hinged flap (51) is connected to at least part of a perimeter wall of each opening (26, 28) for adjusting the size of the opening (26, 28).

14. A suction head (13) according to claim 13, wherein the hinged flap (51) is installed at the upperside of the opening (26, 28), and the flap (51) is moved by means of an hydraulic cylinder.

15. A suction head (13) according to claim 12, wherein at least one plate is fitted to, or removed from the opening (26, 28) to adjust the size of the opening (26, 28).

16. A suction head (13) according to any preceding claim, wherein monitoring systems and instrumentation are provided for controlling and monitoring the dredging process.

17. A suction head (13) according to claim 10 and 16, wherein the monitoring systems measure the angle to the horizontal plane of the ladder (15), the draught of the dredger and the angle to the horizontal plane of the suction head (13).

18. A suction head (13) according to claim 17 wherein the dredging depth is calculated and displayed to an operator.

19. A suction head (13) according to claim 16, claim 17 or claim 18, wherein the monitoring systems measure the position of flaps (51) or plates controlling the height of the openings (26, 28) and the height of the openings (53) is thereby calculated and displayed to an operator.

20. A suction head (13) according to any preceding claim, wherein a dredge-pump for providing suction to the suction head (13) is controlled in such a way that the delivery of the pump matches the volume of dredged soil flowing into the suction head (13).

21. A suction head (13) substantially as hereinbefore described with reference to the accompanying drawings.

22. A dredging apparatus (11) fitted with a suction head according to any one of claims 1to 21.

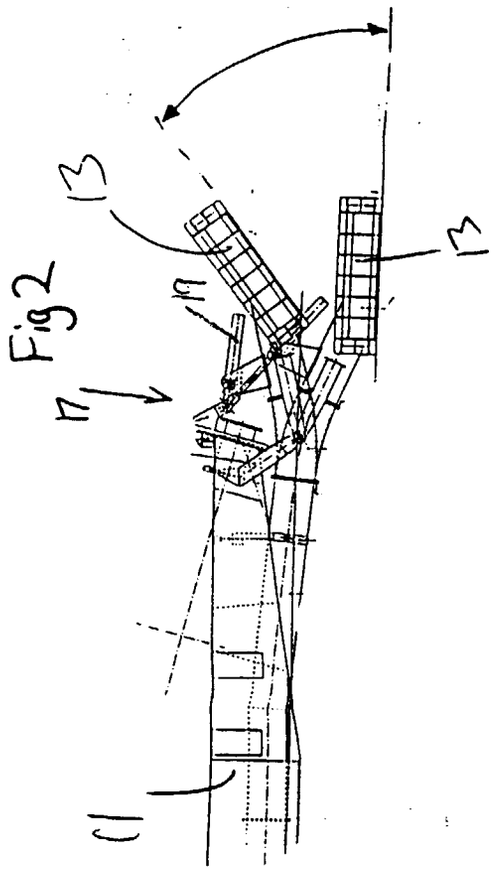

Fig 2

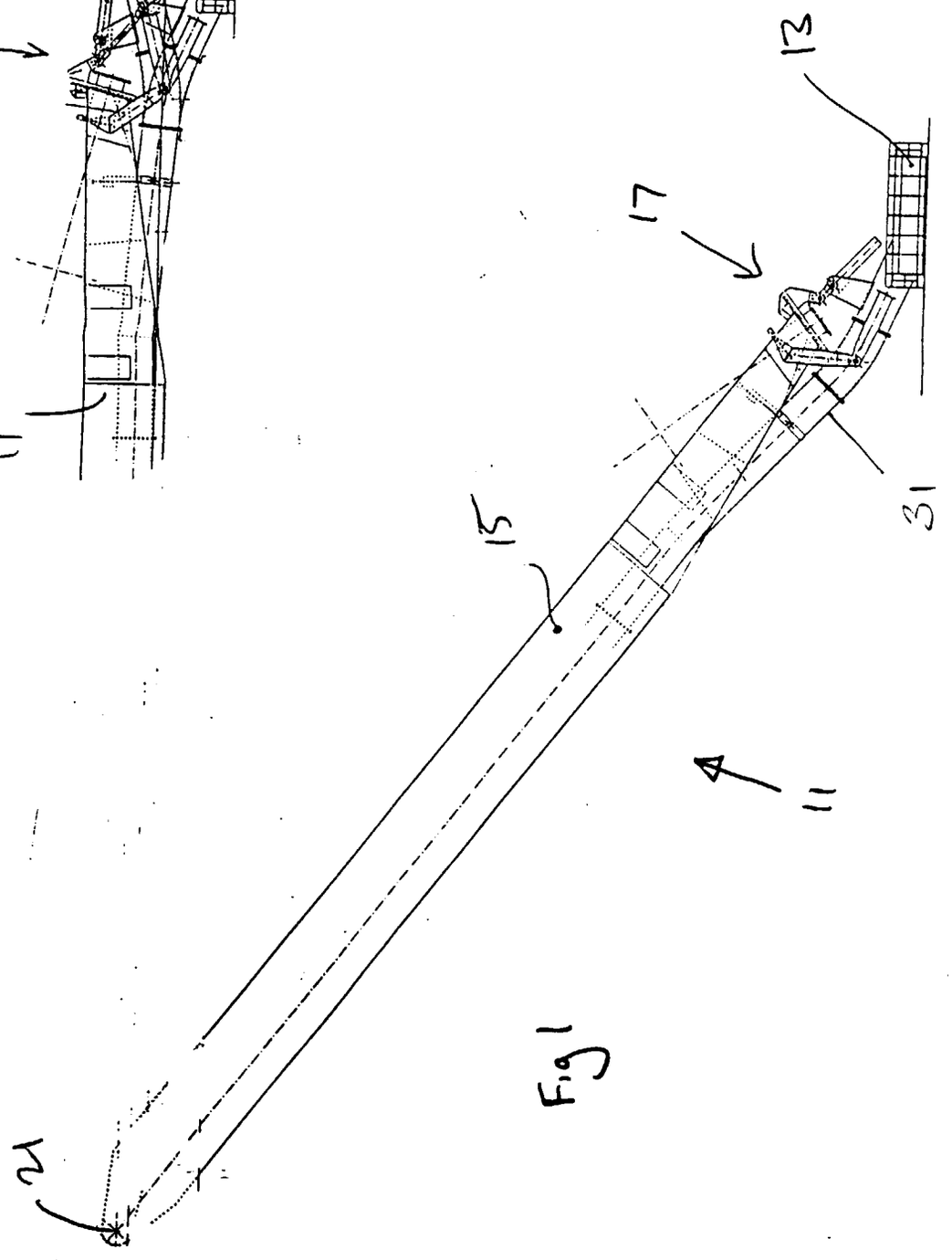

Fig 1

Fig 3

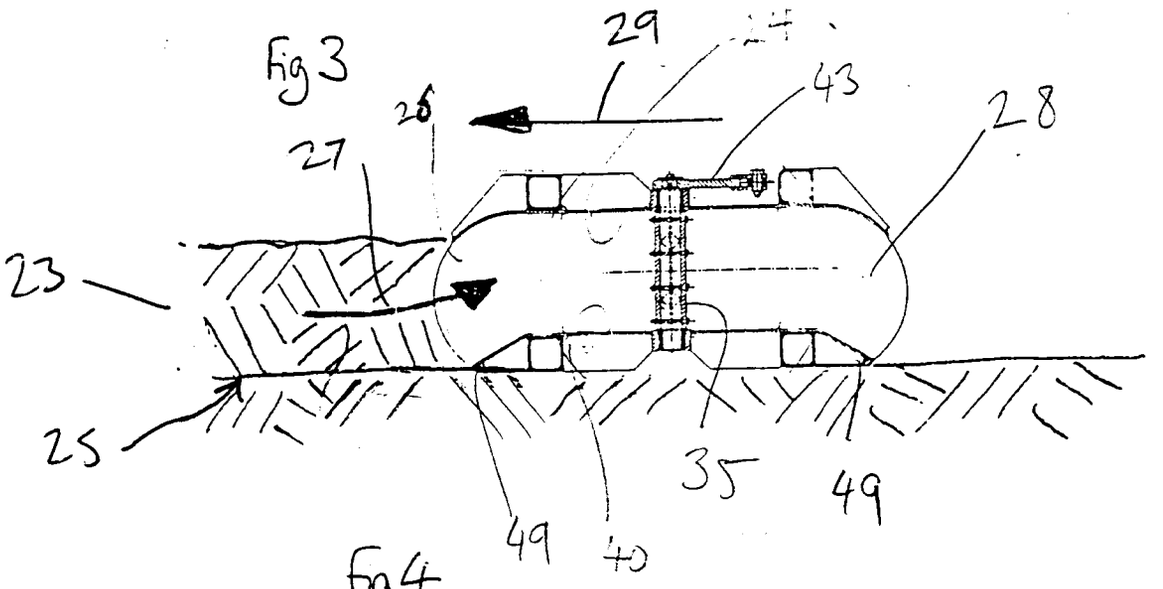

Fig 4

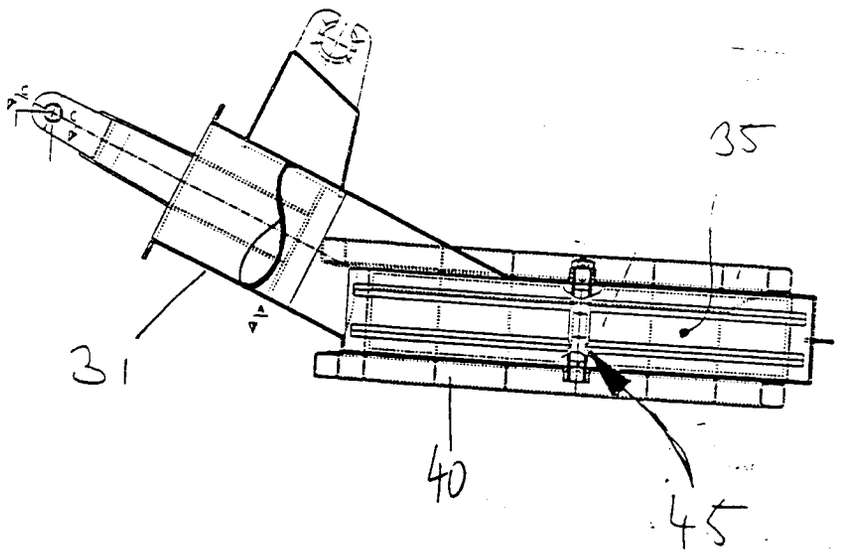

Fig 5

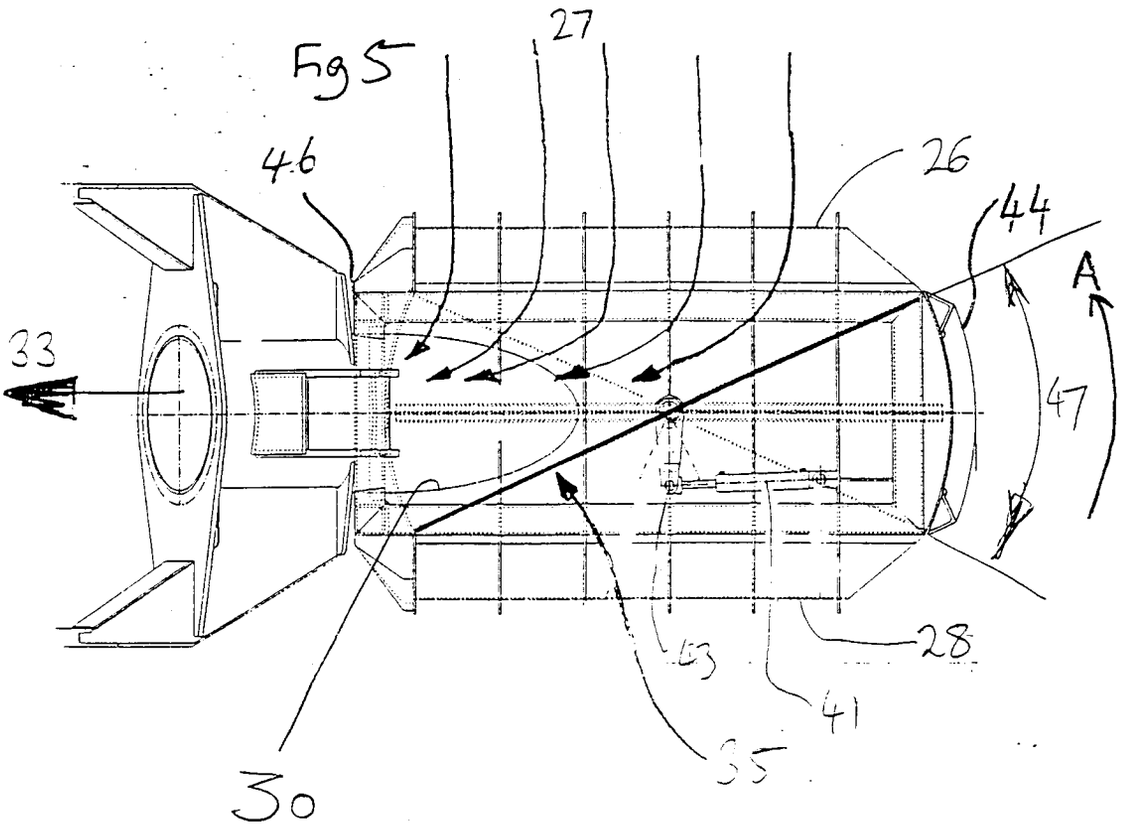
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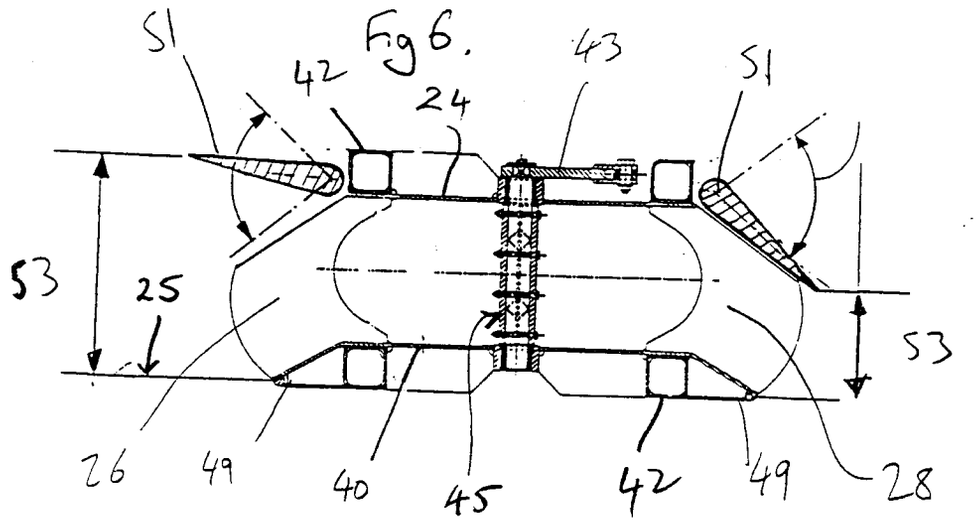
Fig 6.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EUROPEAN SEARCH REPORT

Application Number
EP 98 30 0098

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 4 227 323 A (QUIGG THOMAS O ET AL)	1-4,10, 21,22	E02F3/92 E02F3/90
A	* abstract * * figures * * detailed description * ---	16,19,20	
X	US 4 058 914 A (KISS SANDOR G)	1,2,4,9, 10,21,22	
A	* abstract * * figures 1-4 * * column 1, line 67 - column 2, line 60 * ---	5,6,20	
A	WO 89 00630 A (ORENSTEIN & KOPPEL AG) * figures 2,4 * * page 5, last paragraph - page 6, paragraph 3 * ---	7,8,10, 12-14	
A	US 3 774 323 A (VAUGHN J) * figures 1,3,5 * * column 2, line 45 - line 53 * * column 4, line 7 - line 47 * ---	1,2, 9-11, 20-22	TECHNICAL FIELDS SEARCHED (Int.Cl.6) E02F
A	NL 8 800 129 A (ALBERT PIETER BEREND UITERWIJK) * figures * ---	1,2,4,9	
A	EP 0 599 797 A (DREDGING INT) * figure 19 * * column 7, line 22 - line 37 * * figures 1-4 * ---	10,11	
A	FR 2 177 110 A (FALDI GIOVANNI) -----		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15 April 1998	Guthmuller, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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