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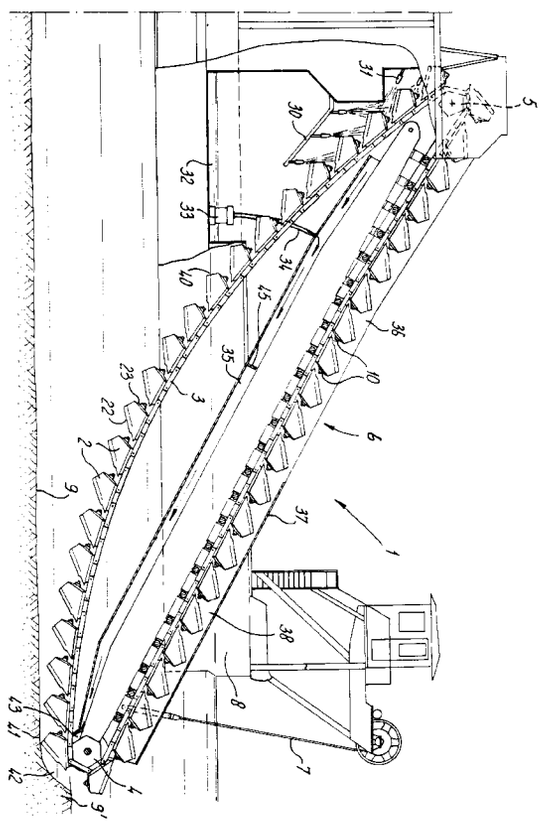
(54) Bucket dredger with spill collection means.

(57) The invention relates to a bucket dredger (1), comprising a ladder assembly (6,3) which extends between an excavating end and a discharge end and has an endless conveyor (3) and a ladder (6) located between the upper and lower part thereof, the continuous conveyor (3) being provided with at least one scoop element (2) and an reverse unit (4) for the continuous conveyor (3) being fitted at the excavating end. To counteract turbidity of the water as a consequence of spillage, a gutter (35) is fitted beneath the ladder, which gutter (35) has its orifice behind or between the reverse unit (4). Furthermore, the upper part is enclosed between side plates (36) which are arranged essentially vertically. That section of the upper part which is located underwater preferably runs through a tunnel formed by the gutter (35), the side plates (36) and a cover (37). The lower part runs through a rinsing chamber located above water level.



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The invention relates to a bucket dredger, comprising a ladder assembly which extends between an excavating end and a discharge end and has an endless conveyor and a ladder located between the upper and lower part thereof, the endless conveyor being provided with at least one scoop element and an reverse unit for the endless conveyor being arranged at the excavating end.

A bucket dredger of this type having bucket-like scoop elements is generally known and has the great advantage that, using said dredger, a uniform, flat and accurate bottom profile can be obtained and that bulky refuse causes little inconvenience to a bucket dredger which has scoop elements. However, when a bucket dredger is used, the so-called "spill" (that is to say spoil which is swept out of or from the scoop elements) causes the water to become very cloudy because, inter alia, fine soil particles are brought into suspension and swirl away, which particles then disperse through the water and settle again elsewhere. This is undesirable, for example, when dredging sludge contaminated with heavy metals and other hazardous substances, since pollutants have the tendency to adhere to fine soil particles in particular, and in the event of spillage and turbidity will therefore disperse through the water.

For the above reasons, when contaminated sludge is dredged, in practice it is not bucket dredgers which are used, but suction dredgers or grab dredgers, which in theory should cause little turbidity. Suction dredgers have the disadvantage that, because water is sucked up as well, a large volume has to be dealt with, that bulky refuse can cause the suction device to seize or malfunction, and that the accuracy and flatness of the bottom profile obtained leaves something to be desired. With grab dredgers too it is very difficult to obtain an accurate and flat bottom profile and where there is bulky refuse, such as a block of wood, the jaws do not always close completely, with the result that spoil, such as sludge, can flow out of the jaws and the contamination can disperse.

US-A-3,146,537 discloses a bucket dredger which is provided with a two-part ladder assembly, around which an endless chain provided with buckets runs. The upper ladder section is provided with a plate which runs directly below the buckets and along which the buckets scrape and push spoil upwards. The side plates fixed to the upper ladder section extend only a little above the said plate and can hardly prevent any spill falling from the plate.

EP-A-0,532,490 discloses a dredger device which has a ladder located between an upper and a lower part of a conveyor for removing dredgings without turbulence. The conveyor comprises an endless chain which has scraper plates attached thereto. The scraper plates push spoil upwards through a funnel formed around the lower part, said scraper plates scraping along the bottom of the funnel. According to said EP-A-0,532,490, bucket dredgers are completely unsuitable for dredging sludge without turbulence.

For dredging harbours and navigation channels, stringent requirements are applied in respect of the flatness and accuracy of the bottom profile, whilst the sludge is often severely contaminated and contains a large amount of bulky refuse. In these cases the use of bucket dredgers is therefore desirable, but the production of turbidity must be counteracted.

The aim of the present invention is to provide a bucket dredger of the type mentioned in the preamble, with which dredger turbidity as a consequence of spillage is counteracted, in order thus as far as possible to prevent the dispersal of contaminated sludge.

This aim is achieved according to the invention in that the ladder is fitted with a gutter extending beneath the upper part, which gutter essentially extends from the discharge end to the excavating end of the ladder. The gutter collects the spill and carries the latter away towards the excavating end of the ladder, where the spill is dumped on the bed at the reverse unit. In this way turbidity of the water column below the ladder is reduced, whilst the turbidity as a consequence of dumping of the spill at the reverse unit located underwater is slight because the gutter orifice is at the bed. The spill can then be dredged up again by a scoop element, which preferably is bucket-like. Depending on the composition of the spoil and of the spill, it can be advantageous to arrange the gutter outlet behind or between/in the reverse unit.

To prevent spill falling outside the gutter it is advantageous, according to the invention, if the upper part is enclosed between side plates which are arranged essentially vertically and extend above a scoop element passing along the upper part. Preferably, said vertical side plates extend along part of the reverse unit located at the excavating end.

According to an advantageous embodiment of the invention, a cover which extends between the side plates is fitted over at least that section of the ladder which is underwater during dredging. With this arrangement, the gutter, the side plates and the cover form so to speak a tunnel, through which a scoop element filled with spoil is conveyed upwards, so that the spill does not disperse freely in the water and all spill is returned to the scooping end via the tunnel and gutter.

According to a further advantageous embodiment of the invention, that section of the lower part which is located above water runs through a rinsing chamber containing rinsing means, which chamber is located between two side walls and is provided on its underside with a collection trough, discharge means being provided to convey rinsing water from the collection trough to, for example, the gutter. A scoop element emptied at the discharge end is rinsed clean in said rinsing chamber, so that spoil still "sticking" to said scoop element is removed therefrom. In this way

said spoil which is still "stuck" is prevented from passing into the water, and causing turbidity, as the scoop element is conveyed through the water to the bottom. With this arrangement, the rinsing means preferably comprise pumping means to spray water under high pressure through injection nozzles against the buckets. Furthermore, spoil falling from the buckets of its own accord is also caught in the collection trough, so that said spoil does not pass into the water.

In the case of bucket dredgers customary hitherto, the bottom is generally dredged out 20 to 30 cm deeper than needed to compensate for spill falling back onto the bottom. Because virtually all spill is collected with the bucket dredgers according to the invention, this additional dredging depth can be appreciably reduced, so that the efficiency of the bucket dredger according to the invention is improved.

The invention will now be explained in more detail below with the aid of an illustrative embodiment shown in the drawing.

In said drawing the figure shows a diagrammatic side view, partially in cross-section, of part of a bucket dredger according to the invention.

The figure shows part of a bucket dredger 1, comprising a platform 8 on which a ladder 6 bucket-like scoop elements 2 (designated buckets below) is installed. The buckets 2 are fixed to an endless chain 3, which runs round a hexagon 4 at the excavating end of the ladder and round a pentagon 5 at the discharge end of the ladder. At the excavating end the ladder is suspended on ladder wires 7, with the aid of which the dredging depth is adjustable.

The operation of a bucket dredger of this type is generally known. The buckets are conveyed round anticlockwise (seen according to the figure) with the aid of the chain. Successively, they are brought, with their scoop opening 22 essentially facing downwards, into the water at 40, an air bubble being present in the bucket, conveyed further to 41, where they scrape over the excavated part of the bottom 9, and then, while turning around the hexagon 4 at 42, scoop up spoil from that part of the bottom 9' still to be excavated. In the case of the installations disclosed in the prior art, the air bubble present in the buckets 2 will essentially escape from the buckets 2 during scraping and scooping. This escape of the air bubble leads to appreciable turbidity, especially when the spoil is fine, and consequently to dispersal of fine spoil. Moreover, this escape of air has an adverse effect on the efficiency since spoil which has been scooped up escapes from the bucket when air escapes. After scooping, the filled buckets are conveyed upwards to pentagon 5, where they are emptied, usually shaking, into, for example, a chute (not shown). The emptied buckets 2 are then guided downwards again, into the water and to the bottom 9, 9'. Using a bucket dredger of this type, the bottom to be dredged is generally worked in strips by moving the bucket dredger backwards and forwards essentially perpendicular to the plane of the drawing in the figure with the aid of anchored cables.

In accordance with NL-A 93.00481 and a European Patent Application, in the name of the Applicant, filed at the same time as the present Application, a venting device 10 is fixed to the bucket base 23 of each bucket 2, which bucket base is located essentially opposite the scoop opening 22. Many of the venting devices disclosed in the prior art are usable per se for a venting device of this type. To counteract turbidity, and thus dispersal of relatively fine sludge particles, it is important that the venting device allows the air contained in the bucket to escape therefrom before the bucket is filled with spoil, such as sludge, at the bottom 9, 9'. Venting preferably takes place as the bucket comes into the water at 40, since this then prevents air bubbles originating from the bucket from rising in the water. An advantageous embodiment of the venting device is described in the abovementioned Netherlands Patent Application and European Patent Application filed at the same time.

After the buckets have been scooped full, spoil will fall out of the buckets as so-called "spill" as they are raised. Said spill, which contains a large amount of fine spoil, causes turbidity if it comes into the water. As explained above, this is undesirable in the case of, inter alia, contaminated sludge. In order to counteract this turbidity caused by spill, a gutter 35 is arranged beneath the ladder 6, between the ascending and descending parts of the chain. Said gutter 35 collects the spill and carries the spill away towards the excavating end of the ladder, where the spill passes out of the gutter 35 onto the bottom at 43. In this way turbidity of the water column above that part of the bottom 9 which has already been excavated is counteracted and the spill flowing back to the bottom at the hexagon 4 can be dredged up again by the buckets. This re-dredging can occur either immediately or when a subsequent strip ("cut") is dredged.

To prevent spill falling outside the gutter 35, on the ascending part of the chain the buckets are enclosed between side plates 36 fixed to the ladder 6, and preferably also connected to the gutter 35. Said side plates 36 extend essentially over the entire ladder length, from near the pentagon 5 located at the discharge end to near, or even alongside, the hexagon 4 located at the excavating end. At their tops, the side plates 36 are provided, at least insofar as said plates are located in the water during dredging, with a cover 37 which joins the side plates 36 to one another, so that in the water the filled buckets are conveyed upwards as it were through a tunnel 38 enclosed by the gutter 35, the side plates 36 and the cover. This substantially prevents spill from being able to disperse in the water. All spill is returned to the excavating end, where it is deposited on the bottom, after which the spill can be dredged up again.

When the filled buckets are emptied at the pentagon 5, there will be residual spoil adhering in and to the buckets. To prevent said spoil from being washed off the buckets 2, and causing turbidity, as the buckets 2 are brought through the water to the bottom 9, 9', the buckets are rinsed clean with the aid of water under high pressure. To this end, injection nozzles 31 and 30 are fitted, to spray the buckets clean from the outside and from the inside respectively. The rinsing water and the spoil falling from and rinsed off the buckets is collected in a trough 32 and pumped by means of a pump 33 via pipe 34 into the gutter 35. Via gutter 35, the rinsing water is fed, with spoil and spill, to the hexagon 4 in the manner described above.

It will be clear that many variants are conceivable within the scope of the invention:

- the ladder can comprise two or more ladder sections;
- the orifice 43 of the gutter can be located behind, just behind, between/in or in front of the reverse unit 42, and the gutter can be located beneath the lower part, and, with this arrangement, can optionally have its orifice a little behind the scoop end of the ladder, it then being possible for the tunnel also to contain a section of the lower part;
- the side plates do not per se have to extend above a passing scoop element if, for example, there is some distance between scoop element and side plate, and
- the discharge from the collection trough can optionally do without a pump and/or can issue somewhere other than in gutter 35. For example, the discharge can also be fed to a hopper barge lying alongside the bucket dredger, after which the spoil collected in said hopper barge can be removed for further treatment;
- it is also possible to fit baffle plates extending transversely to the gutter in the gutter 35, which baffles retain the sludge, so that the latter can be pumped away instead of flowing to the hexagon. A baffle plate 45 of this type is preferably located above water level, for example at the height of number 35. The turbidity at the excavating end is reduced by means of a baffle plate of this type. If the baffle plate is of a suitable height, water can flow downwards over the baffle plate with this arrangement, whilst spoil is retained.

Claims

1. Bucket dredger (1), comprising a ladder assembly (6,3) which extends between an excavating end and a discharge end and has an endless conveyor (3) and a ladder (6) located between the upper and lower part thereof, the endless conveyor (3) being provided with at least one scoop element (2) and a reverse unit (4) for the endless conveyor being arranged at the excavating end, characterised in that the ladder (6) is fitted with a gutter (35) extending beneath the upper part, which gutter (35) essentially extends from the discharge end to the excavating end of the ladder (6).

2. Bucket dredger according to Claim 1, characterised in that the gutter (35) has its orifice behind the reverse unit (4).

3. Bucket dredger according to Claim 1, characterised in that the gutter (35) extends to between the reverse unit (4).

4. Bucket dredger according to one of the preceding claims, characterised in that the upper part is enclosed between side plates (36) which are arranged essentially vertically and extend above a scoop element (2) passing along the upper part.

5. Bucket dredger according to Claim 4, characterised in that the vertical side plates (36) extend along part of the reverse unit (4) located at the excavating end.

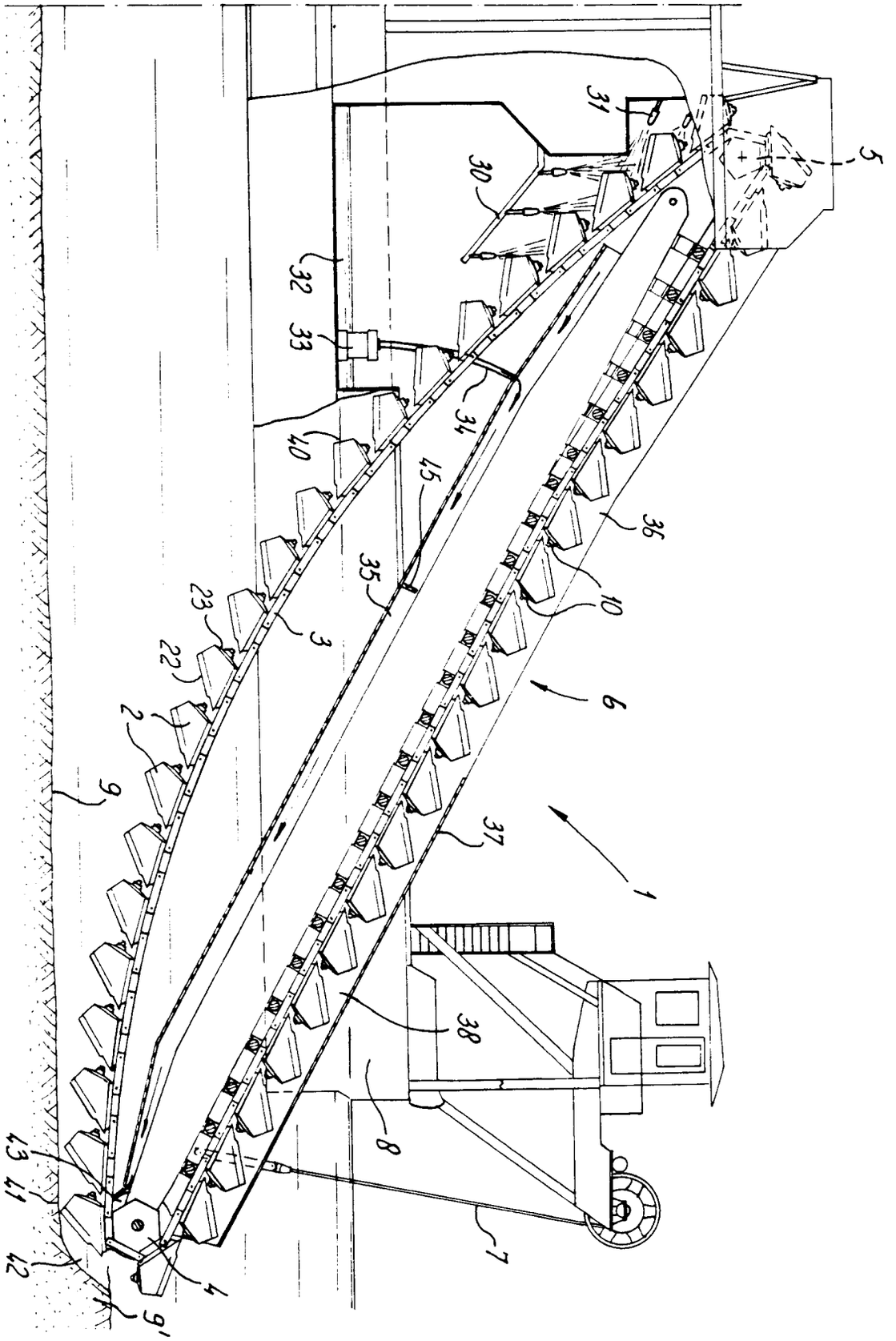
6. Bucket dredger according to one of Claims 4-5, characterised in that a cover (37) which extends between the side plates (36) is fitted over at least that section of the ladder (6) which is underwater during dredging.

7. Bucket dredger according to one of the preceding claims, characterised in that that section of the lower part which is located above water runs through a rinsing chamber containing rinsing means (30,31), which chamber is located between two side walls and is provided on its underside with a collection trough (32), discharge means (33,34) being fitted to discharge rinsing water from the collection trough 32).

8. Bucket dredger according to Claim 7, characterised in that the discharge means comprise a pump (33) and a pipe (34).

9. Bucket dredger according to one of Claims 7-8, characterised in that the rinsing means comprise pumping means to spray water under high pressure through injection nozzles (30, 31) against the buckets.

10. Bucket dredger according to one of the preceding claims, characterised in that a baffle plate (45) extending transversely to the gutter (35) is fitted in the gutter, preferably above water level.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EUROPEAN SEARCH REPORT

Application Number
EP 94 20 0707

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.5)
X,D Y	US-A-3 146 537 (E. VON BOLHAR) * column 3, line 38 - line 42 * * figures 1-3 * ---	1-3 4-6	E02F3/08 E02F3/14 E02F3/12
Y,D A	EP-A-0 532 490 (DREDGING INTERNATIONAL) * column 1, line 34 - line 41 * * column 2, line 37 - line 44 * * claim 1 * * figures 1,3,4 * ---	4-6 1	
A	NL-A-20 053 (F. HERNAMAN ET AL.) * page 1, line 48 - line 55 * * page 2, line 114 - page 3, line 2 * * figures * -----	7-9	

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

E02F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	6 June 1994	Estrela y Calpe, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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