(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 169 199**
B1

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **13.01.88**

(51) Int. Cl.[4]: **E 02 F 3/90**, E 02 F 3/92, E 02 F 7/10

(21) Application number: **84901091.3**

(22) Date of filing: **13.02.84**

(86) International application number:
PCT/GB84/00038

(87) International publication number:
WO 84/03115 16.08.84 Gazette 84/20

(54) **DREDGING APPARATUS.**

(30) Priority: **14.02.83 GB 8304002**

(43) Date of publication of application:
29.01.86 Bulletin 86/05

(45) Publication of the grant of the patent:
13.01.88 Bulletin 88/02

(84) Designated Contracting States:
BE DE FR GB NL

(56) References cited:
AT-B- 237 541
DE-B-1 095 667
NL-A-7 704 823
US-A-3 971 148
US-A-4 143 921
US-A-4 333 828
Coastal Engineering, Volume I - Introduction, W.W. Massie Costal Engineering Group Delft University
Pumping Manual 6th Ed., Trade and Technical Press Ltd. Morden England

(73) Proprietor: **ARROL, Simon James**
Elm Lodge Crowtree Lane
Louth Lincolnshire LN11 9LJ (GB)

(72) Inventor: **ARROL, Simon James**
Elm Lodge Crowtree Lane
Louth Lincolnshire LN11 9LJ (GB)

(74) Representative: **Cline, Roger Ledlie et al**
EDWARD EVANS & CO. Chancery House 53-64 Chancery Lane
London WC2A 1SD (GB)

EP 0 169 199 B1

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European patent convention).

Courier Press, Leamington Spa, England.

Description

The invention relates to the excavation of solid/liquid mixtures and, in particular, although not exclusively, to the excavation of solid matter lying below liquid. Apparatus according to the invention, which may form an integral part of a dredger, allows silt and other soft deposits to be excavated and to be fed into and along a pipeline in the form of a solid/liquid mixture.

Grab-crane dredgers excavate silt in its *in situ* state, but have to load the material into barges alongside for subsequent disposal. They excavate for only about 20% of the time; for the rest of the time, the crane is hoisting, slewing, dumping or lowering the grab-bucket. Bucket-ladder dredgers provide a more continuous operation and excavate silt with little addition of water, but must generally discharge into barges alongside for subsequent disposal. These dredgers are large, costly, noisy and expensive to run. Vacuum chamber dredgers, such as the dredgers made by the Italian company Pneuma S.P.A., use an evacuated chamber on a river bed or sea bed to suck up silt in almost its *in situ* state. Once full, the chamber is pressurised with compressed air which forces the silt along a discharge pipeline to the surface. This system has never achieved significant commercial success, being costly, bulky, difficult to handle, and expensive on energy.

Various forms of suction dredging apparatus have also been devised for dredging materials and subsequently conveying them in suspension along pipelines. In these cases, the silt or other material is mixed with the overlying water and pumped away in the form of a solid/liquid suspension by a centrifugal pump. As a result, the suction dredging apparatus suffers from the disadvantage that to be pumpable the silt must be diluted to form a mixture comprising about 80% water and about 20% silt and the eventual necessity for disposal of this collected water often causes problems. Indeed, if the material has eventually to be loaded into barges or vehicles, the effective load carried is only 20% of the whole.

A modified suction apparatus, made by the US corporation Mudcat Inc., addresses the problem of excess water collection and this apparatus comprises a dredge head for gathering a solid/liquid mixture and pumping means for transferring the mixture gathered by the dredge head. In this apparatus, the dredge head is fitted with two counter-rotating open augers or screws, provided with blades, which feed towards a centrally placed suction mouth of a centrifugal pump.

The augers help convey material towards the suction mouth in a direction at right angles to the direction of travel of the apparatus. However, the rate at which the augers convey a mixture of silt and water is not specifically designed to match the capacity of the centrifugal pump, but rather to ensure that material lying away from the pump mouth can be transported in close enough for it to be sucked up, and that the augers, with their attached blades, can cut up fibrous obstructions such as weeds; the apparatus being extensively used for cleaning out ditches and canals.

While the open augers help to laterally transport the silt and water mixture into the general area of the centrifugal pump suction mouth, there is no positive feed pressure to that pump. The suction/flow rate characteristics of the centrifugal pump used are such that clear water is also sucked in with the silt, so resulting in considerable dilution, although not quite as much as suffered by conventional suction apparatus.

It is intended, by means of the present invention, to overcome the problems of known dredging apparatus in a simple and convenient manner.

In Fig. 16.5 of page 79 of the introductional lecture notes "Coastal Engineering — Volume 1" edited by W. W. Massie of Coastal Engineering Group of Delft University of Technology, revised edition 1982, there is disclosed dredging apparatus comprising a dredge cutter head forming a solid/liquid mixture from a volume of solids to be dredged and positive displacement pumping means for transferring the mixture formed by the dredge head and a closed conduit between the dredge head and the pumping means. This dredge head however simply dislodges the solids from their settled position into the surrounding liquid, leaving the pumping means to draw the solid/liquid me mixture into the closed conduit.

The present invention has an improved dredge head including means for gathering the mixture and forcing the gathered mixture through the closed conduit at a first pressure, the pumping means being operable to discharge the mixture at a second pressure higher than said first pressure. In this way, the dredge head and the pumping means each act on the solid/liquid mixture to force it towards the discharge outlet of the dredging apparatus. The positive displacement pumping means preferably comprise a hydraulically-operated piston pump such as those frequently used for pumping thick sludge, moist concrete, and other viscous material.

Advantageously, the capacity of the positive displacement pumping means is compatible with the capacity of the dredge head. This means that when the apparatus is operating under optimum or near optimum conditions, solid material is delivered by the dredge head to the positive displacement pumping means with a minimal addition of the overlying liquid.

In spite of this, it is inevitable that occasions will arise, particularly when excavating solid matter lying below liquid, when a high proportion of liquid is delivered by the dredge head to the positive displacement pumping means. This may occur when only a shallow layer of silt is available to the dredge head or when the dredge head moves into deep water. It is therefore useful to provide a density sensor for measuring the density of the mixture transferred by the positive displacement pumping means and a dump valve which is provided on the discharge side of the

positive displacement pumping means and which is responsive to the density sensor for diverting the mixture from a discharge pipeline extending downstream of the positive displacement pumping means when the density of the mixture falls below a predetermined value.

An embodiment of the invention is hereinafter described, by way of example, with reference to the accompanying drawing.

The drawing is a schematic side-elevational view of a dredging apparatus according to the invention.

As shown in the drawing, a dredge head 1 is mounted on a dredge ladder 7 suspended from a dredger 8 floating in sea water 9 for movement through a silt deposit forming the sea bed 10.

Inside the dredge head 1, protected from the ingress of potentially damaging debris by steel guards (not shown), is a screw conveyor comprising two horizontally-mounted, interlacing archimedean-type screws 6 (only one of which is shown). The screws 6 are driven in counter rotation by an electric or hydraulic motor 11 so as to gather silt with minimum of disturbance and dilution and to convey a mixture of silt and water at a low first pressure via a flexible tube 12 and through further debris screens in a stonebox 13 to a positive-displacement piston-pump 2 mounted on the underwater dredge ladder 7 and driven by a hydraulic piston-cylinder assembly 14. This pump 2 discharges the mixture of silt and water at a second pressure, typically up to 70 Bar, through a discharge pipeline 4 to a remote discharge point 15. Behind the pump 2 is a density sensor 3 for measuring the density of the mixture. Thus, if the dredge head 1 moves into an area of deeper water 9, then clear water rather than a mixture of silt and water will be passed by the pump 2. To prevent this clear water diluting the mixture which has been already pumped, the density sensor 3 will activate a dump valve 5 which will divert the unwanted water or weak mixture out of the main discharge pipeline 4 through a dump line 16.

The prime power source for the underwater-mounted electric or hydraulic motor 11 and the hydraulic piston-cylinder assembly 14 is mounted on the dredger 8 in conventional manner. It should be noted that the throughput of the positive displacement pump 2 used in this application is nearly constant. This is not true of a centrifugal pump used in known suction dredging apparatus where, in a given situation, throughput increases with a decrease of the mixture's specific gravity, viscosity, or friction in the suction intake zone, so resulting in an even more diluted mixture.

The positive displacement pump 2 has available enough power to maintain a constant flow rate at all times and the screw conveyor is matched to it to ensure that the mixture is fed to it at a positive first pressure. This is achieved through a co-ordinated design of the dredge head 1 and the positive displacement pump 2, taking into account gravities, viscosities, pipeline velocities, thixotropic behaviour of the silt, and shaft speeds. However, in practice, a given dredger will have only one permanently mounted pump 2 to tackle various materials, but the advantage of this type of chosen pump is its ability to handle without modification a wide variety of materials with differing characteristics. This is not necessarily true of centrifugal pumps.

Where enough silt is not available for collection by the dredge head 1 to produce the positive first pressure at the positive displacement pump 2, then the problem of dilution of the discharge is handled by the dump valve 5. This has the ability to control absolutely the minimum silt/water concentration acceptable in the discharge pipeline 4, a ratio which often differs from one type of work to another.

If the dredged silt and water mixture is transferred to the deck of the dredger 8, it can be discharged along a floating pipeline or along a shore pipleine, as required.

Some of the advantages of apparatus according to this invention over existing dredging apparatus are as follows:—

(i) silt and similar material is dredged continuously with a minimum of disturbance and dilution;

(ii) a mixture of dredged material and liquid can be pumped at high concentration down a pipeline to a barge lying at a convenient location (e.g. outside a harbour) or to the shore. Booster pumps can be used as necessary;

(iii) pollution of dredged water courses is minimised;

(iv) the apparatus is quiet and energy efficient;

(v) because the dredged material is minimally diluted, disposal barges can be efficiently loaded (i.e. they will carry more solid dredged material, rather than the 20% dredged material and 80% water is loaded by a suction dredger);

(vi) because the dredged material is minimally diluted, the possibility of discharging ashore into farmland, marshes, and other reclamation areas becomes a practical option not otherwise available. The mixture of silt and water can be disposed of in a small area and, being relatively dry, is much easier to manage;

(vii) automatic operation of a dump valve maintains high discharge concentrations; and

(viii) the high concentration of the mixture enables small diameter pipeline to be used.

Claims

1. Dredging apparatus comprising:—

a dredge head (1) for forming a solid/liquid mixture from a volume of solids to be dredged;

positive displacement pumping means (2) for transferring the mixture formed by the dredge head (1);

a closed conduit (12,13) between the dredge head (1) and the pumping means (2); characterised by;

the dredge head (1) having means for gathering the mixture and forcing the gathered mixture through the closed conduit (12,13) at a first pressure; and

the pumping means (2) being operable to discharge the mixture at a second pressure higher than said first pressure.

2. Dredging apparatus, according to Claim 1, in which the pumping means comprise a hydraulically-operated piston pump (2).

3. Dredging apparatus, according to Claim 1, in which the capacity of the positive displacement pumping means (2) is compatible with the capacity of the dredge head (1).

4. Dredging apparatus, according to Claim 1, in which:—

a density sensor (3) is provided for measuring the density of the mixture transferred by the positive displacement pumping means (2);

a discharge pipeline (4) extends downstream of the positive displacement pumping means (2); and

a dump valve (5) provided on the discharge side of the positive displacement pumping means (2) is responsive to the density sensor (3) for diverting the mixture from the discharge pipeline (4) when the density of the mixture falls below a predetermined value.

5. A dredging apparatus, according to Claim 1, in which the dredgehead (1) comprises horizontally-mounted, interlacing archimedean-type screws (6).

Patentansprüche

1. Bagger, umfassend:

einen Baggerkopf (1) zur Bildung einer Feststoff- Flüssigkeitsmischung aus einem Feststoffvolumen, dass gebaggert werden soll;

Verdrängungspumpmittel (2) zur Ueberführung der vom Baggerkopf (1) gebildeten Mischung;

ein geschlossener Kanal (12,13) zwischen dem Baggerkopf (1) und den Pumpmitteln (2);

dadurch gekennzeichnet, dass

der Baggerkopf (1) Mittel zum Sammeln der Mischung und zum Drängen der gesammelten Mischung durch den geschlossenen Kanal (12,13) mit einem ersten Druck aufweist; und dass

die Pumpmittel (2) so betrieben werden können, dass sie die Mischung mit einem zweiten Druck entladen, der höher ist als der genannte erste Druck.

2. Bagger nach Anspruch 1, worin die Pumpmittel eine hydraulisch betriebene Kolbenpumpe (2) umfassen.

3. Bagger nach Anspruch 1, worin die Kapazität der Verdrängungspumpmittel (2) mit der Kapazität des Baggerkopfs (1) kompatibel sind.

4. Bagger nach Anspruch 1, worin

eine Dichtigkeitssensor (3) zum Messen der Dichte der von den Verdrängungspumpmitteln (2) überführten Mischung vorgesehen ist;

eine Auslassrohrleitung (4), die sich flussabwärts der Verdrängungspumpmittel (2) erstreckt; und

ein Ablassventil (5), das an der Auslasseite der Verdrägungspumpmittel (2) vorgesehen ist und auf den Dichtigkeitssensor (3) anspricht, um die Mischung von der Auslassrohrleitung (4) umzuleiten, wenn der Dichtegrad der Mischung unter einen vorher bestimmten Wert fällt.

5. Bagger nach Anspruch 1, worin der Baggerkopf (1) horizontal angebrachte ineinandergreifende Archimedische-Schrauben (6) umfasst.

Revendications

1. Appareil de dragage comprenant:

une tête de dragues (1) pour former un mélange solide/liquide d'un volume de matières solides à être dragué;

un moyen de pompage volumétrique (2) pour transférer le mélange formé par la tête de dragues (1);

un conduit fermé (12, 13) entre la tête de dragues (1) et le moyen de pompage (2);

caractérisé en ce que

la tête de dragues (1) dispose d'un moyen afin de collecter le mélange et forcer le mélange collecté à travers le conduit fermé (12, 13) à une première pression; et

le moyen de pompage (2) prêt à être mis en service afin de décharger le mélange à une seconde pression plus haute que la dîte première pression.

2. Appareil de dragage suivant la revendication 1 dans lequel le moyen de pompage comprend une pompe à piston (2) hydrauliquement actionnée.

3. Appareil de dragage suivant la revendication 1 dans lequel la capacité du moyen de pompage volumétrique (2) est compatible avec la capacité de la tête de dragues (1).

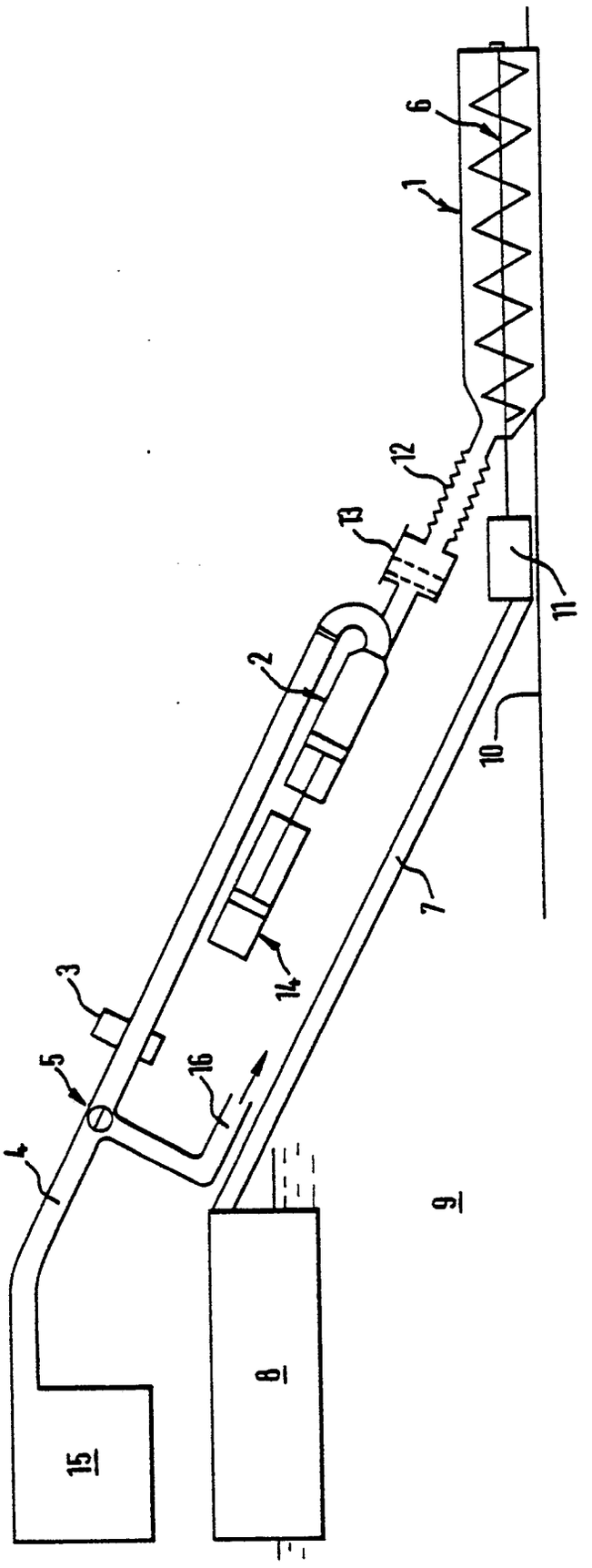
4. Appareil de dragage suivant la revendication 1 dans lequel:

un détecteur de densité (3) ets prévue afin de mesurer la densité du mélange transféré par le moyen de pompage volumétrique (2);

un pipe-line de décharge (4) s'étend en aval du moyen de pompage volumétrique (2); et

une soupape de décharge (5) prévue sur le côté de décharge du moyen de pompage volumétrique (2) repond au détecteur de densité (3) afin dévier le mélange du pipe-line de décharge (4) au cas où la densité du mélange tombe au-dessous d'une valeur prédéterminée.

5. Appareil de dragage suivant la revendication 1 dans lequel la tête de dragues (1) comprend des vis d'Archimède entrelacées mises en place horizontalement.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16