July 4, 1967 J. DE KONING 3,329,287

METHOD AND APPARATUS FOR SUCTION UNLOADING OF SAND BARGES

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FIG.1 (PRIOR ART)

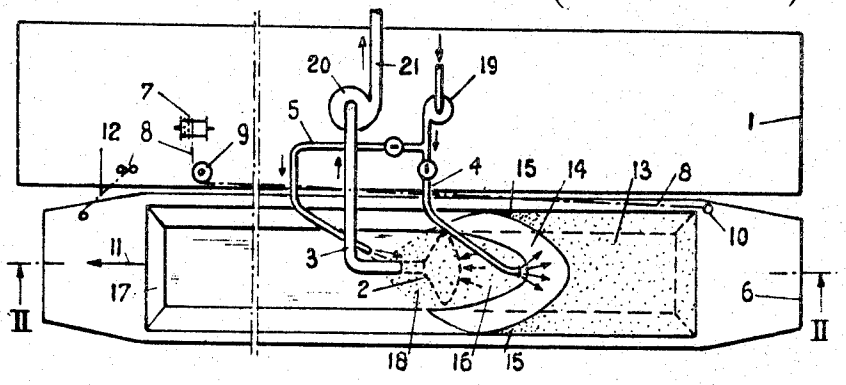


FIG.2 (PRIOR ART)

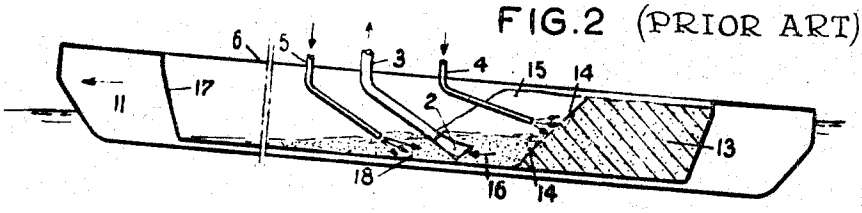


FIG.3

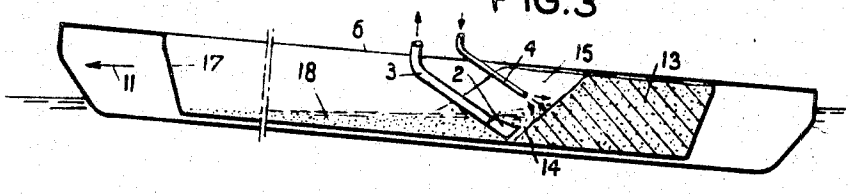
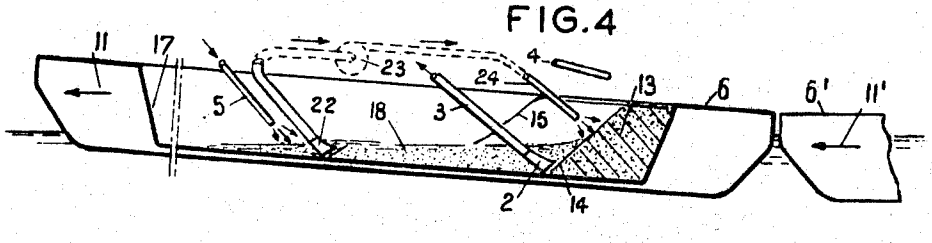


FIG.4



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METHOD AND APPARATUS FOR SUCTION UNLOADING OF SAND BARGES

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FIG.5

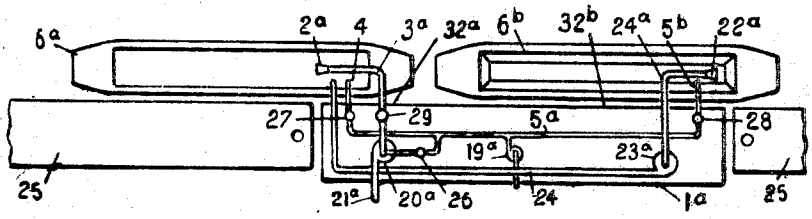


FIG.6

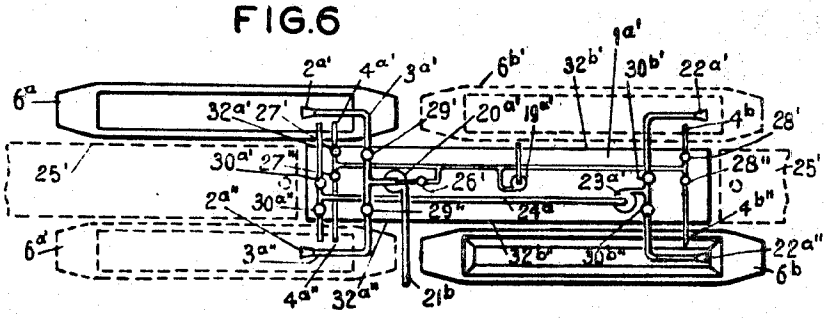
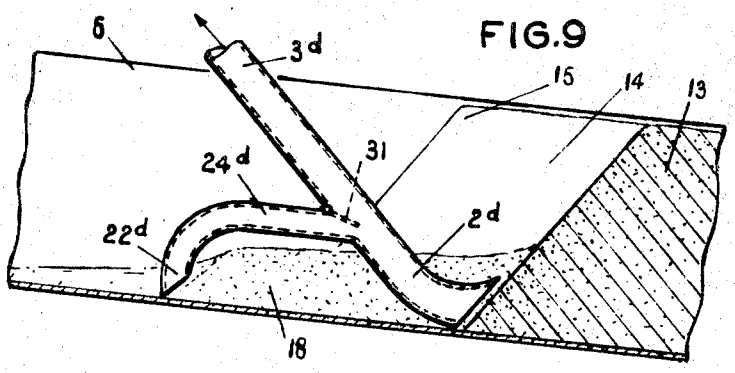


FIG.9



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METHOD AND APPARATUS FOR SUCTION UNLOADING OF SAND BARGES

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FIG.7

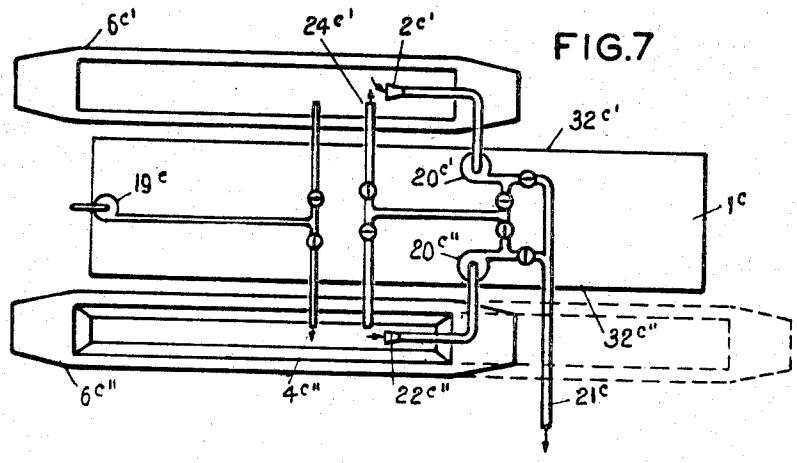
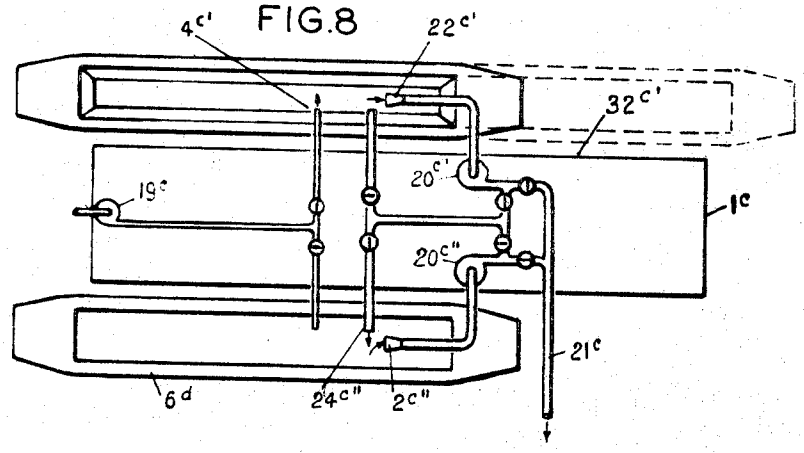


FIG.8



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3,329,287

METHOD AND APPARATUS FOR SUCTION UNLOADING OF SAND BARGES

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Claims priority, application Netherlands, Apr. 7, 1964, 6,403,663
6 Claims. (Cl. 214—14)

This invention relates to a method of suction-unloading at least one floating barge filled with sand or some other type of spoil, a washing medium being introduced into the barge and sand together with said washing medium being pumped as a suspension out of the barge to the required destination by means of at least one suction nozzle, the barge being displaced with respect to the suction nozzle during suction-unloading.

In this known method it is inevitable that some of the sand initially in front of the suction nozzle will subsequently be spilt behind the nozzle. In the known method this spilt sand or spillage is washed back towards the suction nozzle with excess water and then sucked in by the nozzle together with the excess water. In this way the barge is always completely or substantially completely unloaded, while the suction nozzle is situated some distance away from the gap in the sand to enable the excess water and spilt sand to slow to a position in front of the suction nozzle. I propose to continuously keep the suction nozzle close to the gap in the sand and to move the barge continuously with respect to the suction nozzle during suction-unloading. This gives in some circumstances outstanding advantages despite the fact that the spilt sand remains in the barge. The present invention provides a still further developed method, which has the advantage that the suspension drawn in by the nozzle has a high sand concentration, while the barge is nevertheless completely or substantially completely emptied, this effect being achieved by the fact that a first part of the sand is pumped out of the barge to its destination in the form of a suspension having a high sand concentration, by means of a first suction nozzle, and the remainder of the sand is conveyed to a position near the first suction nozzle by means of a second suction nozzle.

According to the present invention, the spilt sand which remains in the barge in the method according to the above-mentioned proposal, can nevertheless be sucked in, so that the method can be advantageously applied in every case, i.e., even if the distance covered by the barges is considerable.

Preferably, during the period when the first part of the sand present in the barge is being sucked in by means of the first suction nozzle, the remainder of the sand in the same barge is being conveyed to the position near the first suction nozzle by means of the second suction nozzle.

When a number of full barges are being successively suction-unloaded, it is preferable for the first part of the sand to be pumped from a specific barge to its destination by means of the first suction nozzle as hereinbefore described, and then for the remainder to be delivered from said barge to the next barge in the form of a washing medium while the first part of the sand from the next barge is being pumped to its destination in the form of a high-concentration suspension.

Very fast operation is obtained by the alternate application of the two methods proposed in the preceding two paragraphs. The barges can then be continuously completely emptied by suction successively with very short change-over times.

The invention also covers the novel suction-unloading installation specially adapted to the method of the invention.

It should be pointed out that Dutch patent specification No. 96,078 describes a completely different method of obtaining sand or suction-unloading sand-filled barges, wherein in order to obtain a high-concentration suspension in a delivery pipe a single suction nozzle draws in a suspension having a low sand concentration, the suspension is pumped into a large settling tank constructed in the form of an overflow tank, a high-concentration suspension is pumped from the bottom of the large settling tank into a delivery pipe, while the suspension containing a low sand concentration, which has overflowed from the large settling tank to a smaller tank, is pumped back to a position near the suction nozzle. The high sand concentration of the suspension which it is required to pump into the delivery pipe is controlled by pumping a quantity of suspension out of the smaller tank into the bottom of the large settling tank. This known method is very complicated and in addition to four sand pumps requires two tanks, one of which is of enormous dimensions.

The invention will be explained with reference to the drawing in the following description, which includes additional features to those already mentioned.

In the drawing:

FIG. 1 is a diagrammatic top plan view of a barge suction-unloader, showing the known method in which a barge moving alongside the suction-unloader is unloaded;

FIG. 2 is a cross-section on the line II—II in FIG. 1, the suction-unloader being omitted;

FIG. 3 is a similar cross-section to FIG. 2, showing the first step of the method according to this invention;

FIG. 4 is a similar cross-section to FIG. 2, showing the use of another method according to the invention;

FIGS. 5 and 6 are diagrammatic top plan views of a suction-unloading installation for the simultaneous unloading of two barges in accordance with two variants of the method according to the invention;

FIGS. 7 and 8 are diagrammatic top plan views of a suction-unloading installation for the simultaneous unloading of two barges according to another variant of the method according to the invention, the valves in the two figures being shown in different positions;

FIG. 9 is a partial cross-section through a barge unloaded by suction according to yet another variant of the method according to the invention.

In the known method illustrated in FIGS. 1 and 2, a suction unloader **1** comprising two water pipes **4** and **5** fed by a water pump **19**, a nozzle **2** at the end of a suction pipe **3**, and a sand pump **20** connected to the suction pipe **3**, draws the sand from a barge **6** and conveys it to its destination via a delivery pipe **21** connected to the sand pump **20**.

During suction unloading, the barge **6** is hauled successive distances in the direction of the arrow **11** through the agency of a cable **8** which is partly wound on a driven winch **7** and which runs via a guide sheave **9** on the suction unloader to a bollard **10** on the barge, the mooring line **12** securing the barge **6** to the suction unloader **1** being paid out successively.

When a barge **6** filled with solid sand **13** has tied up along the suction unloader **1**, the sand situated in the forepart of the barge is loosened with water from the water pipe **4** and then the suction nozzle **2** is lowered into the loosened sand. While this sand is sucked in together with the water from the pipe **4**, the nozzle **2** continuously descends as far as the bottom of the barge **6** where it sucks away the surrounding sand for some time. The sand sticking to the forepart edge **17** of the barge **6** is then washed towards the nozzle **2** by means of water from the pipe **5**. During this process, an increasing amount of sand arrives from the gap which has formed on the right of the suction nozzle in FIG. 1. This sand is taken up by the suspension **16** surrounding the suction nozzle. The said gap thus moves continuously away from the nozzle **2**. As soon as the forepart of the barge **6** has been emptied, the barge **6** is hauled along in the direction of the arrow **11** so that after such operation the suction nozzle is at a smaller distance from the gap. A concave gap **14** thus forms after a number of hauling operations, as show in FIGS. 1 and 2.

When the sand **15** adhering to the sides drops down, most of it will assume a position behind the suction nozzle **2** in the form of spillage sand **18**. As the suction nozzle **2** increasingly approaches the gap **14**, there will of course be an increasing amount of spillage **18**. The suction nozzle **2** is therefore kept a considerable distance away from the gap **14**. Also, the spillage **18** can readily be washed to a position in front of the nozzle **2** by means of water from the pipe **5**. As a result of this system, the suspension **16** in front of the nozzle has a relatively low sand concentration. The extraction of the last remnant of sand from the barge **6**, in particular, is at the expense of a very low sand concentration in the extracted suspension.

As shown in FIG. 3, with the method according to the invention, the nozzle **2** is held close to the gap **14**. The barge **6** is hauled continuously in order continuously to follow the gap **14** despite the fact that sand is continuously being sucked from and out of said gap, so that the suspension drawn in continuously has a high sand concentration. As a result of this new method there is a considerably larger amount of spillage **18** behind the suction nozzle **2**, but such spillage is not washed back with excess water as in the known method. In many cases, more particularly when the barge **6** is filled with fine sand and the barge route is relatively short, it is more economic to leave the spilt sand in the barge **6** and return the barge only partly unloaded to the dredging site, than to transport the sand through the delivery pipe with an excess of water at the expense of a considerable power loss. Preferably, however, as shown in FIGURE 4, the barge is in any case not returned to the dredging site only partly unloaded. The spilt sand **18** can in fact be very elegantly removed from the barge by sucking the same up as a suspension with, if necessary, a low concentration, by means of a second suction nozzle **22**, and conveying it to close to the first suction nozzle **2** by means of a second sand pump **23** and a pipe **24**.

This first suction nozzle **2** and the second suction nozzle **22** may be located in the same barge **1** as shown in FIGURE 4 or the first suction nozzle **2***a* may be located in the one and the second suction nozzle **22***a* in the other of two barges described in connection with FIGURES 5 through 8. In addition to being conveyed directly to a position close to the first suction nozzle, the spilt sand can be so conveyed indirectly, for example via the slope of the solid sand. In this way the suspension acts as a washing medium and the water supply via the pipe **4** can be reduced or stopped. In this way a high sand concentration is obtained in front of the sand suction nozzle **2**. The pipe **3** should be of a length such that any overflow from the suction pipe or the sand pump **20** in conjunction with the vacuum and the required concentration are at the correct level so that the required concentration cannot be exceeded.

The floating suction unloader **1***a* illustrated in FIG. 5 is intended for the performance of a more developed method according to the invention and is completed by a spud barge **25** both ahead and astern. Two mooring stages are thus provided for the barges **6***a* and **6***b*. Apart from the usual sand pump **20***a*, which pumps the sand to its destination by means of the suction nozzle **2***a*, suction pipe **3***a* containing the valve **29**, and the delivery pipe **21***a*, and the usual water pump **19***a* which, when the valves **26**, **27** and **28** are open can pump water to the delivery pipe **21***a*, water pipe **5***a* and water pipe **5***b* respectively, the suction unloader **1***a* also includes a second sand pump **23***a* which can convey a suspension of water and sand from the barge **6***b* to the barge **6***a* by means of the second suction nozzle **22***a* and the pipe **24***a*.

The barges are unloaded by suction as follows: firstly, barge **6***b* is tied up to the suction unloader **1***a* in the position of barge **6***a* beneath the suction nozzle **2***a* and valve **27** is opened while water is pumped into the barge to act as a washing medium. The suction nozzle **2***a* is then lowered into the barge **6***b*, which is partly emptied as described in connection with FIG. 3, so that the spilt sand **18** remains in the barge because of the continuous displacement of barge **6***b* with respect to nozzle **2***a*. The barge **6***b* and the still completely full barge **6***a* are subsequently tied up in the positions shown in FIG. 5 and respectively beneath the second and first suction nozzles **22***a* and **2***a*. During this change of the barges, valve **29** is closed and valve **26** is opened to deliver water in the delivery pipe **21***a* to maintain conveyance in said pipe. After the barges have been changed over, valve **28** is opened to supply water to barge **6***b*, the spillage sand **18** is delivered to barge **6***a* by means of the second suction nozzle **22***a*, pump **23***a* and pipe **24***a*, and the sand from barge **6***a* is pumped to its destination, through the agency of nozzle **2***a*, suction pipe **3***a*, sand pump **20***a* and delivery pipe **21***a*, in the form of a high-concentration suspension, by the barges **6***b* and **6***a* being moved at a speed such that the suction nozzle **2***a* is continuously situated in a high-concentration suspension.

Of course the barge **6***b* must be moved at a constant speed if the barges **6***a* and **6***b* are situated fairly close together, to avoid obstruction of barge **6***a* by barge **6***b*. To this end, the two barges may for example be secured to a single haulage system. If desired, the suction nozzles **2***a* and **22***a* may be disposed far apart or on either side of the suction unloader if the barges **6***a* and **6***b* are required to be displaced at independent speeds.

When the furthest left portion of the barge **6***a* with reference to FIG. 5 has arrived at the nozzle **2***a*, a certain quantity of spilt sand **18** will be left in this barge, while the barge **6***b* is practically completely empty. Finally, barge **6***b* can disappear and barge **6***a* occupy its position, whereupon the process can be continuously repeated with other filled barges **6**.

In FIG. 6, the suction unloader **1***a'* is situated in the water at such a distance from the quay that barges **6** can be tied up on each side. In fact four mooring stations **32** are thus created for barges **6**, stations **32***a'* and **32***a''* being the same in principle as station **32***a*, while stations **32***b'* and **32***b''* are the same as station **32***b* in FIG. 5. With the valves **29'** and **29''** open, the sand pump **20***a'* and the suction nozzles **2***a'* and **2***a''* respectively can draw sand in a high concentration from the barges **6** at the respective stations **32***a'* and **32***a''*, while in the latter barges, with the valves **30***a'* and **30***a''* respectively open, and depending upon whether the valves **30***b'* and **30***b''* are open or closed, washing water together with spillage sand can be conveyed out of the barges **6** at the respective stations **32***b'* and **32***b''* by means of the said pump **23***a'* and the respective nozzles **22***a* and **22***a''*.

The spillage sand may or may not be pumped over crosswise.

An advantage of the suction unloader according to FIG.

6 is that during unloading of a still completely full barge and a barge filled with spillage sand at two of the four mooring stations, the barges **6** at the other mooring stations can be changed over so that a suction nozzle **2***a* and a sand suction nozzle **2***b* are always drawing sand. With this system of changing over the barges, no water without sand has to be pumped into the delivery pipe **21***b* during the barge changeover.

The suction unloader **1***c* shown in FIGS. 7 and 8 has a mooring station **32***c* on each side, such station being arranged in the same way as station **32** in FIG. 5. The connection of the sand suction nozzles **2***c*, sand pumps **20***c*, water pump **19***c*, pipes **24***c* and delivery pipe **21** is variable through the agency of a number of valves, as shown in FIGS. 7 and 8.

For the sake of clarity, the connecting pipe between the water pipe **19** and the sand pumps **20***c* has been omitted from these two figures.

The identical sand pumps **20***c* are each driven by a separate electric motor (not shown), the two motors being supplied with current by a single generator (not shown).

When the valves are in the position shown in FIG. 7, water is pumped into the barge **6***c* filled with spillage sand, the spillage sand is delivered out of this barge into the sand-filled barge **6***c'* through the agency of nozzle **22***c''*, sand pump **20***c''* and pipe **24***c'*, sand pump **20''** and pipe **24***c'*, and a suspension containing a high concentration of sand is transported to its destination from the barge **6***c'* through the agency of the nozzle **2***c'*, sand pump **20***c'* and delivery pipe **21***c*, while the two barges are being hauled along. When barge **6***c'* contains only spillage sand and the empty barge **6***c''* has been replaced by a completely full barge **6***d*, the functions of the suction nozzles and sand pumps are changed over by adjusting the valves to the positions shown in FIG. 8, water now being delivered from pipe **4***c'* into the barge **6***c'*, the spillage sand being delivered out of this barge into barge **6***d* through the agency of the suction nozzle **22***c'*, sand pump **20***c'* and pipe **24***c''*, and a suspension containing a high concentration of sand being again delivered to its destination through the agency of the suction nozzle **2***c''*, sand pump **20***c''* and delivery pipe **21***c*.

The pipe **24** leading from the second suction nozzle **22** to the first suction nozzle **2** need not necessarily contain a sand pump **23**. If the second suction nozzle **22***d* has its pipe **24***d* connected to the first suction nozzle **2***d* (see FIG. 9), the normal sand pump **20** will draw in a considerable amount of sand through the first suction nozzle **2***d* and a relatively considerable amount of water through the second nozzle **22***d*. If the barge **6** is drawn along too rapidly, a large plug of sand will form in the first nozzle **2***d* so that the resistance in the latter increases and more suspension is drawn in by the second nozzle **22***d*. This suspension containing a relatively low concentration of sand then dissolves sand from the top part of the first suction nozzle **2***d*. If the ratio of the resistances in the first suction nozzle **2***d* and the pipe **24***d*, and the exact speed of haulage of the barges are respectively suitably chosen, an optimum sand concentration can be obtained in the suspension conveyed by the delivery pipe **21**. For simple control of the latter ratio, for example, a valve **31** may be provided in pipe **24***d* and/or in the first suction nozzle **2***d*. A suitable place for this valve **31** is, for example, the point of conection of the pipe **24***d* and the first suction nozzle **2***d*.

An advantageous continuous suction process is possible if a number of barges **6** is hauled along in the same direction with respect to the two consecutive suction nozzles **2** and **22**. After a certain time, the position shown in FIG. 4 will occur, in which the two suction nozzles **2** and **22** are inserted into the same barge **6**. Some time later, after the suction nozzle **2** has reached the end of the barge **6** but has not necessarily run dry, said suction nozzle **2** is immediately transferred to the next barge **6'** which is in the ready position astern the barge **6**, while the suction nozzle **22** remains in the barge **6** to suck up the spillage sand **18**. The end of the pipe **24** is then also held over the barge **6'** so that the spillage sand can be injected into barge **6'** from barge **6** in the form of a suspension.

After insertion of the suction nozzle **2**, barge **6'** can immediately be hauled along with respect to this nozzle, because the sand sticking to the leading edge **17** behind the nozzle **2** is sucked in by the second suction nozzle which is subsequently introduced into the barge **6'**. It will be apparent that by successively unloading a number of barges **6** by suction in the above described manner a continuous suction process is obtained in which the barge changeover times are zero and the suspension drawn in by the first suction nozzle **2** continuously has a high concentration of sand, because said suction nozzle **2** is continuously in or close to the full gap **14** in the sand, while the barges are nevertheless satisfactorily unloaded because the spillage sand **18** and the sand sticking to the front and rear walls is sucked in by the second suction nozzle **22**.

I claim:

1. A method of suction-unloading at least one floating barge filled with sand or the like, the method comprising the steps of:

introducing a washing medium into the barge;

pumping the sand and the washing medium in suspension from the barge to a desired location by the action of successively employed first and second suction nozzles;

the barge being advanced with respect to the first suction nozzle in relation to the progress of the pumping operation;

the initial pumping operation of the first nozzle being of a suspension containing a high ratio of sand to pumping medium; and

further conveying the remaining sand to the location of the first nozzle by actuation of the second nozzle.

2. The method of claim **1**, wherein:

the pumping of the sand by action of the first nozzle and the conveyance of sand to said location by action of the second nozzle are carried out coextensively.

3. A method of suction-unloading a plurality of floating barges filled with sand or the like, the method comprising the steps of:

introducing a washing medium into an initial barge;

pumping the sand and the washing medium in suspension from the first barge to a desired location by action of a first suction nozzle;

introducing a washing medium into the remaining barges in succession;

pumping the sand and the washing medium from the succeeding barges to said desired location by action of successively employed suction nozzles;

the barges being advanced with respect to the said suction nozzles in relation to the progress of the pumping operation;

the initial pumping operation of the first nozzle of each barge being of a suspension consisting of a high ratio of sand to pumping medium; and

conveying the remaining sand of each barge to the next succeeding one thereof by the action of a second nozzle.

4. The method of claim **3**, wherein:

the actions of the second nozzles are performed simultaneously with the actions of the first nozzles.

5. The method of claim **3**, wherein:

the advance of the barges with respect to one another is continuous and is synchronized with the action of the respective suction nozzles.

6. Apparatus for the suction-unloading of floating barges filled with sand or the like, the apparatus comprising:

a washing pump having an inlet connected to a source of washing medium and an outlet;

a first sand pump having an inlet and an outlet leading to a sand accumulation region;

a first suction nozzle connected to the inlet of said first sand pump;

a discharge nozzle connected to the outlet of said washing pump and disposed to direct washing medium against a mass of sand within a barge at a point adjacent said first suction nozzle;

a second sand pump having an inlet and an outlet; a second suction nozzle connected to the inlet of said second sand pump and disposed to draw sand suspended in washing medium from a barge remote from said first suction nozzle; and

a second discharge nozzle connected to the outlet of said second sand pump and disposed to discharge sand suspended in washing medium against a mass of sand adjacent said first suction nozzle.

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