SAND DREDGING APPARATUS
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This invention relates to vessels known as sand dredges such as are equipped with pumping apparatus for raising sand and gravel from the water and loading the material in the hold of the vessel. In the past, it has been the practice to raise sand, gravel, or other desired material, by suction pumping from the bed of a body of water and conveying this quite fluid material consisting of more water than sand, to the hold of the vessel in the same liquid state in which it is raised up to the vessel, the water constituting the vehicle by which the solid matter is carried. The great difficulty in this practice was the hazard of carrying the large shifting liquid cargo to port over rough water. Furthermore, the great amount of waste material carried in such a load in proportion to the percentage of desired and usable material greatly increased the cost of such operations.

Recently, attempts have been made to separate the water from the solid matter desired before loading the material in the hold of the vessel and actually stowing the sand in the hold in a comparatively dry state, while the water used as a carrying vehicle is discharged over the side of the vessel. This invention relates particularly to an improvement in apparatus for automatically separating the water and sand, or gravel, or dewatering the material dredged and stowing it in the hold in a comparatively dry state, thereby overcoming the objectionable hazard of transporting a liquid load and obtaining the economies in operating cost resulting from the ability to handle a load of material, the larger proportion of which is usable and very little waste.

One of the features of this invention is the provision of but one pair of dewatering hoppers located at the stern of the sand dredging vessel and adapted to be used alternately to separate the sand and water, these being the only two dewatering hoppers used. The sand which has been dewatered is then carried to the various parts of the hold to be stowed by a belt conveyor system, novel in design, which insures an even loading of the material necessary to maintain an even keel.

Another feature of this invention constitutes a novel sand sealer through which the fluid is discharged from the flumes into which it has been pumped into the dewatering hoppers. A sand sealer is provided at each of the plurality of spouts through which the fluid is discharged into the dewatering hoppers and automatically acts to seal any one of the spouts not being used in a manner in which it will not interfere with the operation of any of the other of the plurality of spouts in the system. This invention contemplates also the use of a combination gravel and sand dredging and screening system utilizing the same suction pump and flume, and the same hoppers, conveyor and stowing system for both sand dredging and gravel dredging operations.

Another feature of this invention is the provision of a rock crushing mechanism for converting the oversize stone and gravel pumped into the flume which is not of sufficiently reduced size to pass through the screening mechanism.

For the purpose of illustrating the present invention, one preferred embodiment thereof will now be given, but it is to be understood that the invention is not to be limited by the present illustration. The scope of the invention may be deter-mined from an understanding of the present disclosure and an appreciation of the advantages which the invention produces in this illustrative embodiment.

Various additional features and advantages are specifically mentioned herein will readily appear to one skilled in the art as the description proceeds.

The following description will be more readily understood by referring to the accompanying drawings, in which

Fig. 1 is a fragmentary, diagrammatic plan view of the deck of a sand dredging vessel embodying the improved dewatering and screen selecting sand and gravel apparatus of this invention.

Fig. 2 is an enlarged vertical cross-sectional view taken on the line 2-2 of Fig. 1, more or less diagrammatic and illustrating the improved apparatus of this invention mounted on the deck of the sand dredging vessel.

Fig. 3 is an enlarged vertical diagrammatic side view taken on the line 3-3 of Fig. 1.

Fig. 4 is an enlarged detailed view of one of the conveyor belt support rollers taken on the line 4-4 of Fig. 3.

Fig. 5 is an enlarged cross-sectional view of one of the discharge spouts of the flume and the sand sealer of this invention taken on line 5-5 of Fig. 3.

Fig. 6 is an enlarged cross-sectional view of the spout and sand sealer taken on the line 6-6 of Fig. 6.

Fig. 7 is an enlarged horizontal sectional view of the spout taken on the line 7-7 of Fig. 5.
Fig. 8 is an enlarged cross-sectional view of the tripper hopper taken on the line 8—8 of Fig. 3, and Fig. 9 is an enlarged fragmentary detail plan view of one of the vibrating gravel selecting screens.

Referring now to the drawings in detail, in which like reference characters designate like parts throughout the several views, there is illustrated in Figs. 1, 2 and 2a, a sand dredging vessel comprising a hull 11 of standard construction, a suction pipe 12 extending from the hull downwardly into the water which is connected with a centrifugal, or other suitable pump 13, operated by an electric motor 14, or in some other suitable manner. A flume 15 is suitably mounted cross-wise over the top of the deck of the vessel and is connected with the centrifugal pump 13 to receive material therefrom through a pipe 16.

Suitable screening and discharge spouts 17 are located in the bottom of the flume 15 and are of novel construction producing a sand sealing feature which will be more particularly described hereinafter. These spouts are designed to discharge material into a pair of de-watering hoppers 18, placed side by side cross-wise of the vessel. The hoppers are made up of two parts, a funnel shaped interior receiving member 19, the sides of which are drilled sieve-like to allow water to drain into a larger funnel shaped exterior flume 20 surrounding the lower part of the hopper. This flume is connected at its lower end in a suitable manner with discharge or waste outlets 22 which empty over the side of the vessel.

A discharge port 23, at the lower end of each hopper, is adapted to be closed by a suitable gate-valve 24, preferably manually operable, but which may be motor driven if desired. The discharge ports 23, of the de-watering hoppers, are positioned above a pair of reversible conveyor belts 25 of any standard design which are inclined upwardly toward each other and toward the center of the vessel.

The conveyor belts 25 are adapted to rotate forwardly in a manner to move the material dropped from the de-watering hoppers 18 to a centrally disposed conveyor belt 26 which runs lengthwise of the vessel and one end of which is disposed directly beneath the lower ends of the conveyor belts 25. The conveyor belt 26 is carried on a suitable system of rollers to extend from a point slightly in back of the discharge ports 23 of the hoppers over a roller mounted in a tripper hopper box 28, which is mounted on wheels and adapted to be rolled over the center of the hatches, as best shown in Figs. 1 and 3. The belt 26 extends along the deck above the hatchways to the forward end of the vessel and passes over a suitable pulley or roller at that end which may be driven by an electric motor 30, or in any other suitable manner. The receiving tripper hopper 28 shown in Figs. 3 and 8 is provided with a pair of flexible conduits or chutes 31 which extend downwardly into the hold of the vessel and are used to distribute and stow the material equally to both sides of the keel of the vessel. The tripper hopper 28 may be mounted upon rails 32 extending longitudinally across the vessel over the hatchways, if desired, to provide a means of readily moving the tripper hopper from one hatchway to the next.

In Fig. 8 is illustrated another feature of this tripper hopper which consists in having the bottom formed in a ridge or peak to divide the material received from the endless belt 26 into equal parts, distributed to each side of the hold of the vessel by means of the flexible conduit 31. A suitable gate 27 is pivotally hinged or mounted in some other suitable manner above the hopper as best shown in Fig. 8, for the purpose of directing the flow of material to either one or the other of the conduits 31 when desired to stow the material on one particular side of the hold of the vessel. As shown in Fig. 8 the gate is in an upright position and the material will therefore flow to both of the conduits 31, the gate may be tilted however to either of the positions shown in the dotted lines to close off one of the conduits 31 and cause flow of material to the other. In connection with the belt-conveyor system another detail is provided in a roller 33, illustrated in Figs. 3 and 4, positioned slightly above the rails 32 and to the rear thereof, to receive and carry the endless belt 26 when the tripper hopper is moved to a position over one of the hatchways at the forward end of the vessel to prevent injury to the belt in sagging. A pair of side skirts 34 are provided to further align the sand or gravel on the endless belt 26 at the start of its movement upwardly toward the tripper hopper. The skirt boards are hinged and rest on the belt 26 if power is lost when it is at the forward end of the vessel and the belt lowered over the rollers 32.

Referring now to Fig. 1 of the drawings, it will be noted that the flume 15 is branched into two sections extending crosswise of the deck of the vessel and so positioned above the de-watering hoppers 18 that each section will be available to discharge sand bearing water into the de-watering hoppers 18 and when it is desired to stow sand only in the hold of the vessel, both of the sections of the flume 15 are utilized.

We come now to another feature of this invention, namely, the gravel screening and selecting mechanism which is combined to operate with the sand dredging mechanism just described. A gate valve 40 is provided at the fork of the branched flume 15. This valve is used to close off the front section as illustrated in Fig. 1. Chutes 41 are then secured to the spouts 17 of the rear section of the flume after removal of the screens from the spouts so that larger particles of stone and gravel may be dredged. These spouts are positioned to discharge the material dredged, which in this instance, will constitute relatively coarser particles of stone and gravel, through the chute or belt driven vibrating screens 42, such as are well known in the art. An electric motor 43 drives the vibrating screens which are usually made up of a pair or more of wire mesh frames decked over each other and vibrated by the rotation of eccentric parts to shake the smaller gravel or stones, of a size predetermined by the grade of screen wire used, into the lower deck 44 of the screen, which will be the smallest sized screen and which acts as a chute from whence the material is discharged into the hopper 18 as best shown in Fig. 3. Downwardly hinged gates 47 are provided in the rear walls of the hoppers 18 which swing inwardly to allow the passage of gravel from the lower deck 44 of the vibrating screen and close when the gravel screening mechanism is not in use, as shown by the dotted lines in Fig. 2.

A plurality of water spray nozzles 45 are located above the vibrating screens 42 and are adapted to spray water on the material undergoing the vibrating screening operations so as to wash the mud and the undesirable accumulation from the gravel being screened. This refuse is discharged, together with the water used as a carrying va...
hicle for raising the gravel to the flume, through the discharge and refuse outlet 22 over the side of the vessel. Suitable trap doors 46 are provided in the top of the chutes 41 to provide access for the removal of any obstructions which might tend to block or clog the chutes. The gravel which is discharged into the hoppers 18 after going through the screening process will flow through the discharge ports 23 at the bottom of the hoppers, when the gate valves 24 therein are opened, and be received by the conveyor belts 25 and carried to the transversely extending center conveyor belt 26 at the top of the tripper hopper 28 and thereafter discharged through the flexible conduit chutes 31 into the hold of the vessel in the same manner in which the sand was discharged therein.

An additional feature of the gravel selecting and screening mechanism just described is provided in the form of a rock crusher 50, best shown in Fig. 3. This structure comprises any suitable well known type of rock grinding mechanism or converter which may be operated by an electric motor if desired, or in any other suitable manner. The oversize gravel or stone which will not pass through the inclined vibrating screens 42 remains on the top deck of the screening and will flow and be shaken to the lower end thereof and engage a partition board 49 extending across the top deck of the screening as shown in Fig. 9. This oversize material is directed by the board 49 into a chute 51 which conveys this gravel and stone to the rock crusher where it is ground up and reduced in size. An endless elevator belt 52 suitably mounted on a series of gears or pulleys and driven by the motor which operates the rock crusher is provided with a plurality of buckets or carriers 53 for raising the crushed rock after it has been reduced in size by the rock crushe and dumping or delivering this material into a chute 54 which returns it to the motor driven vibrating screens to pass through the screening and selecting process again. By this method, the larger stone and gravel is conveyed into useable size rather than discharged through the waste chute 22.

A novel feature of this invention is the provision of what is termed a sand sealer in place of the type of discharge spout which has peculiar advantages and novelties which are found to be very advantageous in the art. This sand sealer is best illustrated in Figs. 5, 6, and 7, and consists in having the spout 17 formed into a bell shaped housing, wider at the bottom than at the top portion.

A screening box 57 is secured to the bottom of the flume 15 in a suitable manner and a screen 58 is mounted at the upper part of the screen box 57 for screening out the larger parts of gravel when sand is being dredged. The bell shaped spout is suitably secured to the bottom of the screen box 57 and communicates therewith through a comparatively restricted opening 56 at the upper portion thereof. A relatively larger discharge opening 55 is formed at the lower end of the spout, and the bottom of the bell shaped spout is flanged inwardly at 54 to assist in trapping sand and particles suspended in the inflowing water received from the flume. This will be noted that the bell shaped spout is particularly formed having its sides converging inwardly at the upper portion thereof. This is for the purpose of trapping sand as will more fully be described hereinafter. A shut off gate-valve 60 is pivotally mounted at the back of the spout at 61 and has a forwardly projecting ear 62 at its opposite end which is supported by an arm 63 and slides thereon. It will be noted that the flume 15 is slightly inclined to promote the flow of the material from one end to the other thereof. When one of the hopper or either of them is being filled too rapidly it may be desirable to close one of the spouts 17 to reduce the rate at which the material is being supplied to the de-watering hopper.

In the use of a common straight walled or funnel shaped spout the closing of the gate-valve results in a very undesirable eddying, boiling and turbulent bounding of the liquid material as it rushes over the unused spout with a resultant vibration and shaking of the flume causing undue wear of the flume and associated screens, spouts and shut-off gates. Furthermore, the rebounding action of the material as it reaches the closed spout results in blocking of the chute preventing flow of material to the spouts disposed farther down the flume. In cases where an open top flume is used it results in loss of material over the sides of the flume. Upon closing of the gate valve 60 the peculiarly designed bell shaped spout of this invention will quickly become filled with sand. The restricted opening 56 traps the solid particles of sand which settle and accumulate at the bottom of the closed spout and the water will swirl out and on down the flume while the sand remains. This action of trapping the sand will be greatly aided by the flange 54, the edges of which engage particles of sand in the inrushing water and retain them. The path of inflow of the water in the bell shaped housing will be downwardly in the center of the spout as directed by the internally restricted upper inlet opening 56 and thence upwardly, after striking the gate 60, along the inclined sides being forced out along this path by the inrushing center stream of sand bearing water. This action results in the particles of sand being baffled by the converging sides of the spout and remaining therein as the water passes out and on down the flume. When the bell spout 17 is filled the screen box 57 will be filled in a like manner, and as the sand packs under the screen 58 that particular discharge spout 17 will be closed off from the rest of the system to prevent the undesirable eddying and bounding of the water and material rushing by the closed spout. A trap door 66 is provided in the top of the flume above each of the sand sealing spouts 17 to provide ready access for repairs or removal of any obstructions.

In operating the dewatering and dredging apparatus, hereinafore described, it will be found preferable to close one of the hoppers by shutting the gate-valve 24 at the bottom thereof and allowing the hopper to become filled with the material dredged and pumped up to the flume. The gate 60 of the spouts 17 may then be closed over the particular dewatering hopper which has been so filled and the other dewatering hopper filled in a similar manner. While the second hopper is being filled, the water will drain through the sleeve-like receiving funnel 19, separate from the sand and escape through the waste spouts 22 over the side of the vessel.

Upon filling of the second hopper or nearing the completion of said filling, the gate or valve 24 of the first filled hopper in which the sand 145 is now dewatered, may be opened and the conveyor belt system started into operation to convey the comparatively dry sand to the transversely extending conveyor belt 26, from whence it will be discharged through the tripper hopper 28.
equally to both sides of the hold through the flexible conduits 31 as hereinbefore described. As the second hopper becomes filled and the first one emptied, this procedure may be reversed, that is, the first one closed to be refilled as the de-watered material of the second hopper is discharged onto the conveyor belts, and alternately thereafter one hopper will be filled and dewatered as the other is discharging onto the conveyor belt.

When gravel is being dredged and the gate valve 40 closed, the screen 46 are removed from the screen box 37 in the rearward branch of the flume and the chutes 41 are attached to the bottom of the spout 17. The gravel then passes through the flume 15, and chutes 41 onto the vibrating screen 42, the selected and proper size gravel entering the hoppers 18 by means of the chutes 44, through the gates 47 and the vehicular water and undersized refuse material is being discharged through the waste outlet 22 over the side of the vessel. The oversized gravel flows through the chutes 51 to the rock crushe or crusher 50 and is returned to a reduced state to the screen as hereinbefore described by means of the endless elevator or conveyor 52. It will be noted that the pair of crosswise extending conveyor belts 25 below the hoppers are reversible and may be reversed when it is desired to discharge material directly into the hold immediately below the hoppers.

The invention herein disclosed provides a combination sand and gravel dredging and screening system wherein the sand is dewatered and delivered to the hold of the vessel in a comparatively dry state before being washed, screened and removed from the vehicular water before delivery to the hold of the vessel.

The improved apparatus of this invention is simple, in form and efficient and economical in operation having two hopper units which are located near the stern of the vessel which dewater all of the sand which is stored in the hold and an automatic conveyor belt system for storing the material in the hold whereby the largest amount of the water raised by the dredge pump is removed from the sand before it is stored in the hold, resulting in nearly an entirely usable cargo over coming all of the difficulties which existed in transporting a liquid load. The use of but one pair of hoppers positioned near the stern of the vessel assures a maximum amount of deck room. The combined gravel-selecting mechanism utilizing the same flumes, the same hoppers and the same conveyor belt and automatic stowing apparatus results in many economies and enlarges greatly the utility of a single dredging vessel. The novel sand sealing device prevents eddying of the material as it is pumped swiftly by any of the unused spouts and eliminates the resultant vibrating and shaking of the flume destructive to the flume, screens, spouts and gate-valves reducing maintenance work.

It will readily appear that the above described apparatus embodies the principles set forth and accomplishes the advantages stated therefor and that the disclosed apparatus, embodying the invention, accomplishes an improved and better dredging, separating and loading action than devices heretofore known.

The scope of the present invention is set forth in the appended claims.

I claim:

1. In a vessel for dredging and transporting material such as sand and gravel, means to pump the material on board the vessel, a pair of flumes extending crosswise of the vessel to receive the material, a pair of dewatering hoppers disposed below flumes positioned on the deck crosswise of the vessel, means to allow flow of material from the dewatering hoppers alternately to each of said hoppers, a valve gate at the bottom of each of said hoppers to alternately empty the dewatered material from the hoppers and a belt conveyor system adapted to distribute the material evenly to all parts of the hold.

2. In a vessel for dredging and transporting material such as sand and gravel a pair of transversely disposed dewatering hoppers, means to pump the material on board the vessel, transversely disposed flumes to receive the material and distribute it to the pair of dewatering hoppers, means to allow the flow of dewatered material from the hoppers, belt conveyors to receive the material from the hoppers, a plurality of hatchways in the deck of said vessel, a wheeled tripper box associated with said conveyor system, and rails to carry said box extending longitudinally of the deck of said vessel over the hatchways to facilitate the positioning of the tripper box over each of the hatchways successively to distribute the material evenly to both sides of the keel of the vessel.

3. In dredging apparatus having a pump to raise sand bearing water to a flume from whence it is discharged into dewatering hoppers, a screened discharge spout disposed in said flume adapted to discharge the dredged material into the dewatering hoppers comprising a screen box, a bell shaped outlet in the conduits below said outlet, a gate pivotally mounted at the bottom thereof adapted to close said outlet, the walls of said outlet converging inwardly at the upper end to provide a restricted opening therein to form said trap whereby sand particles will rapidly be separated from the vehicular water and fill the entire discharge spout with sand.

4. In sand dredging apparatus means to pump vehicular water bearing particles of sand suspended therein on board a vessel, flumes to receive said material, dewatering hoppers below said flumes adapted to receive material therefrom, screened discharge spouts in said flumes to discharge the material therefrom into said hoppers comprising outlets having a closure therein and restricted at the upper end and flared outwardly at the lower end thereof whereby by sand will rapidly be separated from the vehicular water and fill the housing when the outlet is closed.

5. In dredging apparatus provided with a flume and a hopper to receive dredged material therefrom, a discharge spout comprising a screened box, an outlet formed below said box having a restricted opening at the upper end thereof and a gate valve closure at the lower end of said outlet.

6. In dredging apparatus provided with a flume and hopper to receive dredged material therefrom, a discharge spout comprising a screened box, a bell shaped outlet formed below said box having the walls thereof converged inwardly toward the upper end of said outlet and a gate valve closure at the lower end of said outlet.

7. In dredging apparatus provided with a flume and hopper to receive dredged material therefrom, a discharge spout comprising a bell shaped outlet converging inwardly at the upper portions thereof, an inwardly extending peripheral dam formed at the lower portion of said outlet, and a
gate valve closure at the lower end of said outlet.

6. In a vessel for dredging and transporting material, such as sand and gravel, means to pump the material on board the vessel, a flume disposed crosswise of the vessel to receive the material, dewatering hoppers disposed below the flume and positioned on the deck crosswise of the vessel, means to allow flow of material from the flume to the hoppers, valves to allow flow of material from said hoppers after the material has been dewatered and a system of belt conveyors to receive the material from the hoppers and distribute it evenly to the various parts of the hold of the vessel.

9. In a vessel for dredging and transporting material, such as sand and gravel, means to pump the material on board the vessel, a flume disposed crosswise of the vessel to receive the material, dewatering hoppers disposed below the flume and positioned on the deck crosswise of the vessel, means to allow flow of material from the flume to the hoppers, means to allow the solid material to flow from the hoppers after the material has been dewatered, a pair of belt conveyors under each hopper adapted to convey the material received therefrom to the center of the vessel, and a second belt conveyor extending lengthwise of the vessel and the length of the hold thereof adapted to receive material from the first mentioned conveyors to distribute it evenly to all parts of the hold.

10. In a vessel for dredging and transporting material, such as sand and gravel, means to pump the material on board the vessel, flumes disposed crosswise of the vessel to receive the material, dewatering hoppers disposed below the flumes and positioned on the deck crosswise of the vessel, means to allow flow of material from the flumes to the hoppers, means to allow the dewatered material to flow from the hoppers when the water has been separated from the solid matter, belt conveyors to receive the material from the hoppers, a plurality of hatchways in the deck of said vessel and a tripper box associated with said conveyor system and adapted to be positioned alternately over each of said hatchways to divide the flow of material evenly to both sides of the keel of the vessel.

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