

SUCTION DREDGER FOR USE ON UNDERWATER HARD SOIL LAYER

Field of the Invention

The present application relates to the technical field of bridge construction equipment, in particular to a suction dredger for use on an underwater hard soil layer.

Background of the Invention

Generally, in the construction of deep-water open caisson foundation of bridge, the soil layer at the bottom of the open caisson foundation needs to be sucked off before the open caisson is performing soil-unloading sinking, or during the construction of the steel cofferdam, the sinking method of the conventional double-walled steel cofferdam in the overburden is mostly selected as mud-suctioning sinking. Therefore, the suction dredger is widely used in bridge construction.

In related art, air suction dredging facilities are widely used due to its simple construction process, low investment, low cost, and fast mud-taking speed. The conventional air suction dredger is mainly composed of suction dredging head, suction dredging pipe and high-pressure air pipe, and the main principle thereof is to use large internal and external pressure difference to suck sediment through the suction dredging head. However, due to the small disturbance to the overburden, the effect of the mud suction of this kind of suction dredger is relatively poor, which affects the quality and efficiency of the mud suction. At present, in order to improve the quality and efficiency of the mud suction of the suction dredger, some auxiliary structures are often added on the suction dredging head, such as mixing rod, which is configured to rotate at a certain speed while the suction dredging head sucks the mud, so as to stir the sludge around the suction dredging head, so as to ensure better effect of the mud suction. In addition, it can also better clean the sludge adsorbed on the suction dredging head.

However, at present, the hard soil layers are sometimes encountered in the bridge construction, the existing suction dredgers usually work on the upper surface of the soft soil layers, and cannot achieve good effect of the mud suction when working on the upper surface of the hard soil layers; and in addition, there often exists sundries, such as large block stones, at the bottom of the water, which are easy to block the suction dredging head and affects the effect of the mud suction to a great extent.

Summary of the Invention

The embodiment of the present application provides a suction dredger for use on an

underwater hard soil layer, so as to solve the problem in the prior art that when a suction dredger works on an underwater hard soil layer, the effect of the mud suction is poor and blockages are common.

In the first aspect, the present invention provides a suction dredger for use on an underwater hard soil layer, comprising:

a mud suctioning mechanism, which comprises a pressurizing assembly and a suction dredging pipe, the suction dredging pipe is penetrated on the pressurizing assembly and two ends thereof at least partially extend out of the pressurizing assembly, a side wall of a pipe section of the suction dredging pipe located in the pressurizing assembly is provided with a plurality of pressurization holes that are inclined upward in the direction from the outer wall to the inner wall, and the pressurizing assembly is configured to discharge mud water mixtures in the suction dredging pipe by means of the pressurization holes;

a mud-breaking mechanism, which comprises at least two mud-breaking assemblies, the mud-breaking assemblies are arranged on the bottom of the mud suctioning mechanism and are configured to crush the underwater hard soil layer to assist the suction dredging pipe in suctioning mud; and

a blockage-prevention assembly, which is arranged on the bottom of the suction dredging pipe, and the blockage-prevention assembly is configured to prevent the suction dredging pipe from experiencing blockages during a suction process.

In some embodiments, the pressurizing assembly comprises:

an air collecting box, which comprises an air collecting cavity, and the air collecting box is configured such that: the suction dredging pipe is penetrated on the air collecting box and the pressurization holes located on the suction dredging pipe all communicate with the air collecting cavity; and

a high-pressure air pump, which is arranged above the air collecting box, and is connected with the top of the air collecting box through a pipeline, and communicates with the air collecting cavity, and the high-pressure air pump is configured to inject air with a high flow rate into the air collecting cavity to discharge the mud water mixtures in the suction dredging pipe.

In some embodiments, the mud-breaking mechanism comprises:

a diversion pipe, which is arranged in the air collecting cavity, at least two water outlets are arranged on a pipe section of the diversion pipe at intervals, and each of the water outlets is connected with one of the mud-breaking assemblies; and

a high-pressure water pump, which is arranged above the air collecting box, and is connected with one end of the diversion pipe through a pipeline.

In some embodiments, the mud-breaking assembly comprises a water jet pipe and a nozzle arranged at an end of the water jet pipe, the water jet pipe communicates with the corresponding water outlet, a connection between the water jet pipe and the water outlet is also provided with a rotating part, the rotating part is connected with a driving motor, and the driving motor is configured to drive the rotating part to rotate to adjust an angle of the water jet pipe.

In some embodiments, the blockage-prevention assembly is detachably clamped with the suction dredging pipe, one end of the blockage-prevention assembly away from the suction dredging pipe is in a serrated shape, and a grid in the shape of a well is arranged in the blockage-prevention assembly.

In some embodiments, the blockage-prevention assembly comprises a connecting head and at least three curved blockage-prevention parts, the connecting head is annular and rotatably connected with the bottom of the suction dredging pipe, one ends of all the curved blockage-prevention parts are arranged on the connecting head at intervals, and the bottom of the suction dredging pipe is within a vertical projection area of all the curved blockage-prevention parts, and a plurality of blockage-prevention heads are arranged on both sides of each of the curved blockage-prevention parts at intervals.

In some embodiments, an included angle between the pressurization hole and a horizontal plane is not less than 45° .

In some embodiments, the top of the suction dredging pipe is also connected with a mud discharge pipe, the mud discharge pipe is L-shaped, and a corner thereof is arc-shaped.

In some embodiments, the suction dredging pipe and the mud discharge pipe are connected by means of a connecting flange, and the air collecting box is also connected with a pipeline located at the top thereof by means of a connecting flange.

In some embodiments, the number of the mud-breaking assemblies is 4 to 8.

The beneficial effects of the technical solution provided in the present application are as follows:

The embodiment of the present application provides a suction dredger for use on an underwater hard soil layer, wherein the pressurizing assembly can form air with a high flow rate in the suction dredging pipe by means of the pressurization holes, the bottom of the mud suctioning mechanism is provided with a mud-breaking mechanism that can break the underwater hard soil layer, in addition, the bottom of the suction dredging pipe is also provided with the blockage-prevention assembly that can effectively prevent the suction dredging pipe from blocking during the suction process. Therefore, when the suction dredger is located in the underwater hard soil layer, the effect of the mud suction of the suction dredger is greatly

improved compared with the traditional suction dredger, which is mainly reflected in that due to the setting of the mud-breaking mechanism, the hard soil layer can be easily adsorbed, and due to the setting of the blockage-prevention assembly, the pipe blockage caused by large soil blocks and hard stones can be effectively avoided during the suction process, so as to ensure the smooth progress of the mud suction and the effect of the mud suction.

Brief Description of the Drawings

In order to better illustrate the technical solution in the embodiments of the present application, the following will briefly introduce the drawings needed in the description of the embodiments, and it is obvious that the drawings in the following description are part of embodiments of the present application, for those of ordinary skill in the art, other drawings may also be obtained based on these drawings without any inventive effort.

Fig. 1 is a partial structural diagram of a suction dredger for use on an underwater hard soil layer in the embodiment of the present application;

Fig. 2 is a sectional view at 1-1 in Fig. 1 in the embodiment of the present application;

Fig. 3 is a sectional view at 2-2 in Fig. 1 in the embodiment of the present application;

Fig. 4 is a sectional view at 3-3 in Fig. 1 in the embodiment of the present application;

Fig. 5 is a structural diagram of a mud-breaking assembly of a suction dredger for use on an underwater hard soil layer in the embodiment of the present application;

Fig. 6 is a structural diagram when a suction dredger for use on an underwater hard soil layer does not install a blockage-prevention assembly in the embodiment of the present application;

Fig. 7 is a structural diagram when a blockage-prevention assembly of a suction dredger for use on an underwater hard soil layer is in use in the embodiment of the present application;

Fig. 8 is a structural diagram of a blockage-prevention assembly of a suction dredger for use on an underwater hard soil layer in the embodiment of the present application;

Fig. 9 is a schematic diagram of distribution of pressurization holes of a suction dredger for use on an underwater hard soil layer in the embodiment of the present application;

In the figures: 10-suction dredging pipe, 11-pressurization hole, 12-air collecting box, 13-mud discharge pipe, 20-mud-breaking assembly, 21-diversion pipe, 22-water jet pipe, 23-nozzle, 3-blockage-prevention assembly.

Detailed Description of the Embodiments

In order to make the purpose, technical solutions and advantages of the embodiments of the

present application clearer, the technical solutions in the embodiments of the present application will be described clearly and completely in combination with the drawings in the embodiments of the present application. Obviously, the described embodiments are only a part of the embodiments of the present application, not all of the embodiments. Based on the embodiments in the present application, all other embodiments obtained by a person of ordinary skill in the art without inventive efforts shall fall within the protection scope of the present application.

The embodiment of the present application provides a suction dredger for use on an underwater hard soil layer, which can solve the problem in the prior art that when a suction dredger works on an underwater hard soil layer, the effect of the mud suction is poor and blockages are common.

As shown in Figs. 1-2, the suction dredger mainly comprises a mud suctioning mechanism, a mud-breaking mechanism and a blockage-prevention assembly 3. The mud suctioning mechanism comprises a pressurizing assembly and a suction dredging pipe 10, the suction dredging pipe 10 is penetrated on the pressurizing assembly and two ends thereof at least partially extend out of the pressurizing assembly, a side wall of a pipe section of the suction dredging pipe 10 located in the pressurizing assembly is provided with a plurality of pressurization holes 11 that are inclined upward in the direction from the outer wall to the inner wall, and the pressurizing assembly is configured to form an upward air flow with a high flow rate in the suction dredging pipe 10 by means of the pressurization holes 11, so as to discharge mud water mixtures in the suction dredging pipe 10. The mud-breaking mechanism comprises at least two mud-breaking assemblies 20, the mud-breaking assemblies 20 are arranged on the bottom of the mud suctioning mechanism and are configured to crush the underwater hard soil layer to assist the suction dredging pipe 10 in suctioning mud, so as to ensure the effect of suctioning the mud in the hard soil layer environment. The blockage-prevention assembly 3 is arranged on the bottom of the suction dredging pipe 10, and the blockage-prevention assembly 3 is configured to prevent the suction dredging pipe 10 from experiencing blockages during a suction process, generally, when sucking the mud, obstacles such as large soil blocks and hard stones may be sucked, and the blockage-prevention assembly 3 can effectively prevent pipeline blockage caused by such obstacles.

Specifically, the pressurizing assembly comprises: an air collecting box 12 and a high-pressure air pump. The air collecting box 12 mainly comprises an air collecting cavity, and the air collecting box 12 is configured such that: the suction dredging pipe 10 is penetrated on the air collecting box 12 and passes through the air collecting cavity, and the pressurization holes 11 located on the suction dredging pipe 10 all communicate with the air collecting cavity. The

high-pressure air pump is arranged above the air collecting box 12, generally on a horizontal plane, and is connected with the top of the air collecting box 12 through a pipeline, and communicates with the air collecting cavity, and the high-pressure air pump is configured to inject air with a high flow rate into the air collecting cavity to form an upward air flow with a high flow rate in the suction dredging pipe 10. The specific principle is as follows: when it is necessary to suck the mud, the high-pressure air pump is started to blow the air into the air collecting box 12, the high-pressure gas is collected in the air collecting cavity and passes through the pressurization holes 11. Since the directions of the pressurization holes 11 are all inclined upward, as shown in Fig. 9, the high-pressure gas generated by the high-pressure air pump finally enters the suction dredging pipe 10 by means of the pressurization holes 11 and flows upward to discharge the mud water mixtures in the suction dredging pipe 10, and the subsequent water continues to come in after discharge, so as to achieve the purpose of sucking the mud water mixtures outside the pipe into the pipe.

Specifically, as shown in Figs. 3-5, the mud-breaking mechanism mainly comprises: a diversion pipe 21 and a high-pressure water pump. From the perspective of structural design, the diversion pipe 21 is arranged in the air collecting cavity and is in a round shape, at least two water outlets are arranged on a pipe section of the diversion pipe 21 at intervals, the water outlets extend out of the air collecting box 12, and each of the water outlets is connected with one of the mud-breaking assemblies 20. The high-pressure water pump is arranged above the air collecting box 12, and is connected with one end of the diversion pipe 21 through a pipeline. The mud-breaking assembly 20 mainly comprises a water jet pipe 22 and a nozzle 23 arranged at an end of the water jet pipe 22, and the water jet pipe 22 communicates with the corresponding water outlet. The specific principle is as follows: before mud sucking, the underwater hard soil layer needs to be broken first, at this time, the high-pressure water pump is started, the high-pressure water pump pressurizes the water, and the high-pressure water is finally ejected through the nozzle 23 along the pipeline, the diversion pipe 21 and the water jet pipe 22, and the water column with high pressure has a large impact force, so in general, the hard soil layer under the water can be broken.

Specifically, a rotating part is arranged at the connection between the water jet pipe 22 and the water outlet, and the rotating part is connected with a driving motor. The driving motor is configured to drive the rotating part to rotate within a certain range to adjust an angle of the water jet pipe 22, so as to ensure that it is easier to break the surrounding soil layer when breaking the soil layer, increase the efficiency of the mud suction and ensure the effect of the mud suction. The number of the mud-breaking assemblies 20 is 4 to 8, and herein, the number of

the mud-breaking assemblies 20 is preferably four.

Specifically, as shown in Fig. 7 and Fig. 8, the blockage-prevention assembly 3 is in a cylinder shape, one end of which is detachably clamped with the suction dredging pipe 10, and the other end away from the suction dredging pipe 10 is in a serrated shape. In addition, a grid in the shape of a well is arranged in the blockage-prevention assembly 3. The principle of this blockage-prevention assembly 3 is as follows: since the end is in a serrated shape, when the large soil blocks are adsorbed, due to a certain speed, the end with serration is enough to break the soil blocks and prevent the soil blocks from blocking the pipeline. There are often some stones at the bottom of the water, some of which are large, and the grid in the shape of the well can effectively block these stones to prevent these stones from being blocked after being sucked into the pipeline and causing inconvenient cleaning.

Further, the blockage-prevention assembly 3 comprises a connecting head and at least three curved blockage-prevention parts. The connecting head is annular and rotatably connected with the bottom of the suction dredging pipe 10, one ends of all the curved blockage-prevention parts are arranged on the connecting head at intervals, and the end of the suction dredging pipe 10 is within a vertical projection area of all the curved blockage-prevention parts, and a plurality of blockage-prevention heads are arranged on both sides of each of the curved blockage-prevention parts at intervals. Specifically, the blockage-prevention principle of the blockage-prevention assembly 3 of this structure is as follows: during the mud suction process, the nozzle 23 ejects a water column with high pressure to break the hard soil layer, and the suction dredging pipe 10 sucks the mud water mixtures into the pipe. At this time, the connecting head continues to rotate, so as to drive the curved blockage-prevention parts connected with the connecting head to rotate. The curved blockage-prevention parts herein are three-dimensional curved structures, and the width of each of the curved blockage-prevention parts gradually narrows in the direction away from the suction dredging pipe 10, and blockage-prevention heads are arranged at intervals along the length direction on both sides of the curved blockage-prevention parts. A plurality of rotating curved blockage-prevention parts are equivalent to forming a blockage-prevention protection zone at the bottom of the suction dredging pipe 10. When the large soil blocks come over, the rotating curved blockage-prevention parts can easily break the soil blocks, and when the large stones come over, the stones may be knocked away or broken by the rotating curved blockage-prevention parts, which can effectively prevent these large obstacles from entering the pipeline of the suction dredging pipe 10 and causing blockage. In addition, the rotating curved blockage-prevention part can also play the role of breaking the hard soil layer to a certain extent, and assist the mud-breaking assemblies 20 to work together.

Specifically, an included angle between the pressurization hole 11 and a horizontal plane is not less than 45°, so as to ensure that the high-pressure gas from the pressurization holes 11 can move upward. As shown in Fig. 6, the top of the suction dredging pipe 10 is also connected with a mud discharge pipe 13. The mud discharge pipe 13 is L-shaped and the corner thereof is arc-shaped to facilitate the discharge of the mud water mixtures. The suction dredging pipe 10 and the mud discharge pipe 13 are connected by means of a connecting flange, and the air collecting box 12 is also connected with a pipeline located at the top thereof by means of a connecting flange.

In the description of the present application, it should be noted that the orientation or positional relationship indicated by the terms "upper", "lower", etc. are based on the orientation or positional relationship shown in the drawings, which is only for the convenience of describing the present application and simplifying the description, instead of indicating or implying that the pointed device or element must have a specific orientation, be configured and operated in a specific orientation, therefore it cannot be understood as a limitation of the present application. Unless otherwise clearly specified and limited, the terms "installation", "connected" and "connection" should be understood in a broad sense. For example, it may be a fixed connection, a detachable connection, or an integral connection; further may be a mechanical connection, or an electrical connection; further may be directly connected, or indirectly connected through an intermediate medium, or may be the internal communication between two components. For those of ordinary skill in the art, the specific meanings of the above-mentioned terms in the present application may be understood according to specific circumstances.

It should be noted that relational terms such as "first" and "second" are only for distinguishing one entity or operation from another entity or operation in the present application, and do not necessarily require or imply any such actual relationship or order between these entities or operations. Moreover, the terms "include", "comprise" or any other variants thereof are intended to cover non-exclusive inclusion, so that a process, method, article or device comprising a series of elements not only comprises those elements, but also comprises those that are not explicitly listed, or further comprises elements inherent to the process, method, article, or device. If there are no more restrictions, the elements defined by the sentence "comprising a..." does not exclude the existence of other same elements in the process, method, article, or device comprising the elements.

The above-mentioned are only the embodiments of the present application, so that those skilled in the art can understand or implement the present application. For those skilled in the art, various modifications to these embodiments will be obvious, and the general principles defined

herein can be implemented in other embodiments without departing from the spirit or scope of the present application. Therefore, the present application will not be limited to the embodiments shown in this document, but will be subject to the widest scope consistent with the principles and novel features applied herein.

CLAIMS

1. A suction dredger for use on an underwater hard soil layer, comprising:

a mud suctioning mechanism, which comprises a pressurizing assembly and a suction dredging pipe (10), the suction dredging pipe (10) is penetrated on the pressurizing assembly and two ends thereof at least partially extend out of the pressurizing assembly, a side wall of a pipe section of the suction dredging pipe (10) located in the pressurizing assembly is provided with a plurality of pressurization holes (11) that are inclined upward in the direction from the outer wall to the inner wall, and the pressurizing assembly is configured to discharge mud water mixtures in the suction dredging pipe (10) by means of the pressurization holes (11);

a mud-breaking mechanism, which comprises at least two mud-breaking assemblies (20), the mud-breaking assemblies (20) are arranged on the bottom of the mud suctioning mechanism and are configured to crush the underwater hard soil layer to assist the suction dredging pipe (10) in suctioning mud; and

a blockage-prevention assembly (3), which is arranged on the bottom of the suction dredging pipe (10), and the blockage-prevention assembly (3) is configured to prevent the suction dredging pipe (10) from experiencing blockages during a suction process.

2. The suction dredger for use on the underwater hard soil layer according to claim 1, wherein the pressurizing assembly comprises:

an air collecting box (12), which comprises an air collecting cavity, and the air collecting box (12) is configured such that: the suction dredging pipe (10) is penetrated on the air collecting box (12) and the pressurization holes (11) located on the suction dredging pipe (10) all communicate with the air collecting cavity; and

a high-pressure air pump, which is arranged above the air collecting box (12), and is connected with the top of the air collecting box (12) through a pipeline, and communicates with the air collecting cavity, and the high-pressure air pump is configured to inject air with a high flow rate into the air collecting cavity to discharge the mud water mixtures in the suction dredging pipe (10).

3. The suction dredger for use on the underwater hard soil layer according to claim 2, wherein the mud-breaking mechanism comprises:

a diversion pipe (21), which is arranged in the air collecting cavity, at least two water outlets are arranged on a pipe section of the diversion pipe (21) at intervals, and each of the water outlets is connected with one of the mud-breaking assemblies (20); and

a high-pressure water pump, which is arranged above the air collecting box (12), and is connected with one end of the diversion pipe (21) through a pipeline.

4. The suction dredger for use on the underwater hard soil layer according to claim 3, wherein the mud-breaking assembly (20) comprises a water jet pipe (22) and a nozzle (23) arranged at an end of the water jet pipe (22), the water jet pipe (22) communicates with the corresponding water outlet, a connection between the water jet pipe (22) and the water outlet is also provided with a rotating part, the rotating part is connected with a driving motor, and the driving motor is configured to drive the rotating part to rotate to adjust an angle of the water jet pipe (22).

5. The suction dredger for use on the underwater hard soil layer according to claim 1, wherein the blockage-prevention assembly (3) is detachably clamped with the suction dredging pipe (10), one end of the blockage-prevention assembly (3) away from the suction dredging pipe (10) is in a serrated shape, and a grid in the shape of a well is arranged in the blockage-prevention assembly (3).

6. The suction dredger for use on the underwater hard soil layer according to claim 1, wherein the blockage-prevention assembly (3) comprises a connecting head and at least three curved blockage-prevention parts, the connecting head is annular and rotatably connected with the bottom of the suction dredging pipe (10), one ends of all the curved blockage-prevention parts are arranged on the connecting head at intervals, and the bottom of the suction dredging pipe (10) is within a vertical projection area of all the curved blockage-prevention parts, and a plurality of blockage-prevention heads are arranged on both sides of each of the curved blockage-prevention parts at intervals.

7. The suction dredger for use on the underwater hard soil layer according to claim 1, wherein an included angle between the pressurization hole (11) and a horizontal plane is not less than 45°.

8. The suction dredger for use on the underwater hard soil layer according to claim 2, wherein the top of the suction dredging pipe (10) is also connected with a mud discharge pipe (13), the mud discharge pipe (13) is L-shaped, and a corner thereof is arc-shaped.

9. The suction dredger for use on the underwater hard soil layer according to claim 8, the suction dredging pipe (10) and the mud discharge pipe (13) are connected by means of a connecting flange, and the air collecting box (12) is also connected with a pipeline located at the top thereof by means of a connecting flange.

10. The suction dredger for use on the underwater hard soil layer according to claim 1, wherein the number of the mud-breaking assemblies (20) is 4 to 8.