

DESCRIPTION**WATER-INTAKE APPARATUS AND DRAINAGE APPARATUS****Technical Field**

5 The present invention relates to a water-intake apparatus and a drainage apparatus, and more particularly to a water-intake apparatus which is suitable for taking in water from a river or the like in which water level is largely fluctuated and sand or the like tends to be accumulated, and a drainage apparatus
10 which is suitable for draining water from a river or the like in which water level is largely fluctuated and sand or the like tends to be accumulated.

Background Art

15 Conventionally, when water is taken in from a river or the like in which water level is largely fluctuated and a large amount of sediment such as sand is present, in many cases, a civil engineering structure (structures) is constructed and a water-intake apparatus such as a vertical pump is installed on
20 the civil engineering structure. Further, in order to protect a water-intake apparatus or a drainage apparatus such as a pump from sand or the like, a water passage is provided from a water-intake position of a river or the like, and sand or the like is prevented from entering the water-intake apparatus or
25 the drainage apparatus by the civil engineering structure. Alternatively, a material having a high hardness and a high abrasion resistance is used for components of a water-intake apparatus or a drainage apparatus which contact water, thereby preventing the components from being worn due to entering of
30 sand or the like. Further, when maintenance of a water-intake apparatus such as a pump is performed, a crane installed on the civil engineering structure or a large-sized movable crane is used to hoist the water-intake apparatus such as a pump or other

equipment and transfer such water-intake apparatus onto a certain place where maintenance of the water-intake apparatus is performed.

However, in a case where a civil engineering structure
5 (structures) is constructed in advance and a water-intake apparatus such as a vertical pump is installed, or in a case where a water passage is provided from a water-intake position of a river and sand or the like is prevented from entering a water-intake apparatus by a civil engineering structure
10 (structures), or in a case where a crane installed on a civil engineering structure or a large capacity mobile crane is used for maintenance of a water-intake apparatus, it is necessary to provide a large-scale civil engineering structure (structures) and a large capacity mobile crane, and hence a large construction
15 cost and a construction site are required. Further, in order to remove the accumulated sand, a large restoration cost is required.

Further, it is necessary not only to use equipment such as a crane for maintenance work but also to perform difficult
20 work including hoisting of the water-intake apparatus such as a pump and reinstallation of the water-intake apparatus after its maintenance. Further, erosion is generated by a large quantity of sand which has entered the pump, and a rotating member such as a pump impeller is damaged. Furthermore, in a case where
25 a material having a high hardness and a high abrasion resistance is used for components of a water-intake apparatus which contact water, water-intake equipment such as a pump becomes expensive, and hence the overall water-intake apparatus becomes expensive.

30 Disclosure of Invention

The present invention has been made in view of the above drawbacks. It is therefore an object of the present invention to provide an inexpensive water-intake apparatus and an

inexpensive drainage apparatus which can be easily installed without requiring large-scale engineering work, can be protected from sediments such as sand, and can be maintained in a good operational condition with easy maintenance.

5 In order to achieve the above object, according to the present invention, there is provided a water-intake apparatus comprising: an equipment installation tube having a lower end which is submerged in water; a submersible motor pump provided in the equipment installation tube; a suction pipe connected
10 to a suction port of the submersible motor pump; a delivery pipe connected to a discharge port of the submersible motor pump and extending through the equipment installation tube to a predetermined location; and a floating apparatus for supporting a suction port of the suction pipe in the water.

15 According to the present invention, there is provided a drainage apparatus comprising: an equipment installation tube having a lower end which is submerged in water; a submersible motor pump provided in the equipment installation tube; a suction pipe connected to a suction port of the submersible motor pump;
20 a delivery pipe connected to a discharge port of the submersible motor pump and extending through the equipment installation tube to a predetermined location; and a floating apparatus for supporting a suction port of the suction pipe in the water.

 According to a preferred aspect of the present invention,
25 the equipment installation tube is provided on an inclined surface. The inclined surface may be an inclined surface of a bank of a river, and an inclined surface of a lake, a swamp or the like.

 According to a preferred aspect of the present invention, the equipment installation tube has an upper end positioned above
30 a water surface.

 According to the present invention, since the submersible motor pump is installed in the equipment installation tube, and water is taken in through the suction pipe whose suction port

is supported in the water by the floatation apparatus, sand does not enter the liquid contacting portion (components which contact water) of the pump section or the like of the submersible motor pump. Thus, erosion is not generated at the liquid contacting portion of the water-intake apparatus or the drainage apparatus, and the rotating member such as a pump impeller is not damaged or broken. Further, since the water-intake apparatus or the drainage apparatus such as a submersible motor pump can be mainly composed of the equipment installation tube installed on the inclined surface, the suction pipe, and the floatation apparatus for supporting the suction port of the suction pipe in the water, it is not necessary to construct a large-scale civil engineering structure (structures). Further, since sand or the like can hardly enter the water-intake apparatus or the drainage apparatus, it is not necessary to use an expensive material having a high abrasion resistance for the liquid contacting portion (components which contact water) of the water-intake apparatus or the drainage apparatus. Thus, an ordinary water-intake apparatus or drainage apparatus which is inexpensive can be used.

According to a preferred aspect of the present invention, the water-intake apparatus or the drainage apparatus further comprises a traction mechanism for moving the submersible motor pump up and down along an inclined surface of the equipment installation tube.

According to the present invention, since the submersible motor pump can be moved up and down along the inclined surface in the equipment installation tube by the traction mechanism, the submersible motor pump can be easily moved to the maintenance location on the ground when maintenance of the submersible motor pump is performed, and hence maintenance work is extremely facilitated. Therefore, large-sized equipment such as a crane is not required for maintenance work, and it is not necessary to construct the civil engineering structure (structures) and

to secure a large site for the civil engineering structure.

According to a preferred aspect of the present invention, a discharge port of the suction pipe is fixed to the lower end of the equipment installation tube, and when the submersible motor pump is moved to the lower end of the equipment installation tube along the inclined surface of the equipment installation tube, the suction port of the submersible motor pump is automatically connected to the discharge port of the suction pipe.

According to the present invention, when the submersible motor pump is moved downwardly to the lower end of the equipment installation tube, the suction port of the submersible motor pump is automatically coupled to the discharge port of the suction pipe. Therefore, installation work of the submersible motor pump is extremely facilitated.

According to a preferred aspect of the present invention, the submersible motor pump has wheels so that the center of the suction port of the submersible motor pump is aligned with the center of the equipment installation tube.

According to the present invention, because the submersible motor pump has wheels so that the center of the suction port of the submersible motor pump is aligned with the center of the equipment installation tube, the submersible motor pump is moved downwardly along the inner wall surface of the equipment installation tube so that the center of the suction port of the submersible motor pump is aligned with the center of the equipment installation tube at all times. Therefore, the position of the center of the suction port of the submersible motor pump is always constant, and hence the center of the suction port of the submersible motor pump is aligned with the center of the suction pipe, and the suction port of the submersible motor pump is connected to the discharge port of the suction pipe.

According to a preferred aspect of the present invention,

the suction port of the suction pipe is open in the water near the water surface.

According to the present invention, because the suction pipe is supported in such a manner that the suction port of the suction pipe is open in the water near the water surface, and water near the water surface hardly includes sand or the like (solid substance having a larger specific gravity than water or a smaller specific gravity than water) or includes a trace amount of sand or the like, the water which is taken in from the suction port hardly includes sand or the like or includes a trace amount of sand or the like, and hence the amount of sand or the like which enters the pump section of the submersible motor pump is minimized.

Brief Description of Drawings

FIG. 1 is a schematic view of an overall arrangement of a water-intake apparatus according to an embodiment of the present invention;

FIGS. 2A and 2B are views showing a lower part of an equipment installation tube in the water-intake apparatus according to the embodiment of the present invention, and FIG. 2A is a cross-sectional view of the equipment installation tube and FIG. 2B is a cross-sectional view taken along line II-II of FIG. 2A;

FIG. 3 is a schematic view showing a traction mechanism of the water-intake apparatus according to the embodiment of the present invention;

FIG. 4 is a schematic view showing the state in which a submersible motor pump of the water-intake apparatus according to the present invention is transferred to the maintenance place; and

FIG. 5 is a perspective view of a guide rail of the water-intake apparatus according to the present invention.

Best Mode for Carrying Out the Invention

A water-intake apparatus according to an embodiment of the present invention will be described below with reference to the drawings. FIG. 1 is a schematic view showing an overall arrangement of a water-intake apparatus according to an embodiment of the present invention.

As shown in FIG. 1, a tube 13 for installing equipment (hereinafter referred to as equipment installation tube 13) which is made of steel or the like is provided on an inclined surface 12 of a bank 11 of a river 10. The equipment installation tube 13 is cylindrical, and has a lower end submerged in the water and an upper end extending to the top of the bank 11 or its vicinity. A suction pipe 14 having a flexibility is fixed to the lower end of the equipment installation tube 13, and a suction port section 14b having a suction port therein of the suction pipe 14 is supported in a submerged state near a water surface 16 by a floatation apparatus 15.

A submersible motor pump 30 is provided in the lower part of the equipment installation tube 13, and a suction port section 31 having a suction port therein of the submersible motor pump 30 is connected to the suction pipe 14. A delivery pipe 33 is connected to a discharge port section 32 having a discharge port therein of the submersible motor pump 30, and the delivery pipe 33 extends through the equipment installation tube 13 and the top portion of the bank 11 to a predetermined location where water supply is required. The submersible motor pump 30 has wheels 34 so that the submersible motor pump 30 can move up and down in the equipment installation tube 13 along the inclined surface of the equipment installation tube 13 by a traction mechanism (described later on).

FIGS. 2A and 2B are views showing the lower part of the equipment installation tube, and FIG. 2A is a cross-sectional

view showing the lower part of the equipment installation tube and FIG. 2B is a cross-sectional view taken along line II-II of FIG. 2A. As shown in FIGS. 2A and 2B, the suction pipe 14 has a discharge port section having a discharge port therein which is fixed through a flange 14c to the lower end of the equipment installation tube 13. Further, an elastic packing (gasket) 17 is provided on an inner surface 13a of the lower end of the equipment installation tube 13.

The submersible motor pump 30 is moved downwardly as shown by the arrow B while it is in traction by the traction mechanism (described later on), and the suction port section 31 of the submersible motor pump 30 is brought into contact with the elastic packing 17 through a flange 31a of the suction port section 31, and hence the suction port section 31 of the submersible motor pump 30 is connected to the suction pipe 14. While the submersible motor pump 30 is in operation, the submersible motor pump 30 is strongly pressed against the lower end of the equipment installation tube 13 due to a pressing force produced by a pumping action for pumping water through the delivery pipe 33. Therefore, the flange 31a of the suction port section 31 is brought into intimate contact with the elastic packing 17 to maintain liquid-tightness.

The equipment installation tube 13 is cylindrical, and the submersible motor pump 30 is moved downwardly by the wheels 34 along the inner wall surface of the equipment installation tube 13 in such a state that the center of the suction port section 31 is aligned with the center of the equipment installation tube 13 at all times. Therefore, the position of the center of the suction port section 31 having the suction port is always constant, and hence the center of the suction port section 31 is aligned with the center of the suction pipe 14 attached to the equipment installation tube 13. The center of the suction pipe 14 is aligned with the center of the equipment installation tube 13. Further,

a guide means such as a guide rail for guiding the wheels 34 of the submersible motor pump 30 may be provided in the equipment installation tube 13.

FIG. 3 is a schematic view showing the traction mechanism for moving the submersible motor pump 30 up and down along the inclined surface (inner wall surface) of the equipment installation tube 13. One end of a rope 35 is fixed to the submersible motor pump 30, and the rope 35 extends via a guide pulley 36 provided on the top portion of the bank 11 toward a winch 37, and the other end of the rope 35 is fixed to the winch 37. Therefore, the rope 35 is wound or unwound by the winch 37. Specifically, the submersible motor pump 30 is moved upwardly by winding the rope 35 with the winch 37, and is moved downwardly by unwinding the rope 35 with the winch 37.

As shown in FIG. 3, the guide rail 38 for guiding the wheels 34 of the submersible motor pump 30 is disposed adjacent to an entrance 13b of the equipment installation tube 13 so that the submersible motor pump 30 is guided when the submersible motor pump 30 enters the equipment installation tube 13 or goes out of the equipment installation tube 13. The guide rail 38 extends to the location near the guide pulley 36. As shown in FIG. 5, the guide rail 38 comprises a base plate 38a and two guide plates 38b which are provided perpendicularly on the base plate 38a and extend in parallel to each other at a predetermined interval (interval which can accommodate a pair of parallel wheels 34 of the submersible motor pump 30). The wheels 34 of the submersible motor pump 30 are positioned between the two guide plates 38b, and thus the submersible motor pump 30 is guided when the submersible motor pump 30 enters the equipment installation tube 13 or goes out of the equipment installation tube 13. Although the guide plate 38b of the guide rail 38 has an L-shaped cross section, the guide plate 38b may comprise a pipe having a cylindrical cross section or an elongate member

having a triangular cross section.

When maintenance of the submersible motor pump 30 is performed, the winch 37 is driven, and the submersible motor pump 30 is pulled up along the inclined surface (inner wall surface) of the equipment installation tube 13. As shown in FIG. 4, the guide rail 38 having the above structure shown in FIG. 5 is disposed at the maintenance place. Therefore, as the submersible motor pump 30 is guided by the guide rail 38, the submersible motor pump 30 is transferred to the maintenance place.

After maintenance of the submersible motor pump 30 is completed, the submersible motor pump 30 is transferred by unwinding the rope 35 with the winch 37 to the location near the entrance 13b of the equipment installation tube 13, and then the submersible motor pump 30 is introduced into the equipment installation tube 13 through the entrance 13b by the guide rail 38. Thereafter, the rope 35 is further unwound by the winch 37 to move the submersible motor pump 30 downwardly, and the suction port section 31 having the suction port therein of the submersible motor pump 30 is automatically connected to the discharge port section having the discharge port therein of the suction pipe 14 at the lower end of the equipment installation tube 13.

Because the submersible motor pump 30 is installed in the equipment installation tube 13 provided on the inclined surface of the bank 11, the submersible motor pump 30 can be completely protected from sand of the river 10. Specifically, the discharge port section having the discharge port therein of the suction pipe 14 is attached to the lower end of the equipment installation tube 13, and the suction port section 14b having the suction port therein of the suction pipe 14 is supported in a submerged state near the water surface 16 by the floatation apparatus 15. Because sand is not included in the water near the water surface 16, sand of the river hardly enters the equipment installation tube 13. Therefore, sand or the like can hardly enter the pump

section of the submersible motor pump 30, and hence an ordinary submersible motor pump which does not use a material having a high abrasion resistance can be employed.

Further, since the water-intake apparatus can be mainly
5 composed of the equipment installation tube 13 provided on the inclined surface of the bank 11 at the water-intake location of the river 10, the suction pipe 14, the floatation apparatus 15 for floating the suction port section 14b of the suction pipe 14 in the water, the traction mechanism having the winch 37,
10 the pulley 36 and the like, and some attachments, it is not necessary to construct a large-scale civil engineering structure (structures).

Further, since the submersible motor pump 30 can be easily pulled up on the ground by the winch 37 of the traction mechanism
15 when maintenance of the submersible motor pump 30 is performed, maintenance work is extremely facilitated and large-sized equipment such as a crane is not required for the maintenance work. Thus, it is not necessary to secure a large site for installing the water-intake apparatus.

20 Although a facility constituting the water-intake apparatus which is installed on the inclined surface of the bank of the river has been described in the above embodiment, the installation place of the water-intake apparatus is not limited to the river. For example, a facility constituting the
25 water-intake apparatus may be installed on an inclined surface of a bank, a shore, or the like of a channel, a lake, a swamp, or the like. Further, although the embodiment in which the present invention is applied to the water-intake apparatus has been described, the present invention is applicable to a drainage
30 apparatus for draining water from a river, a lake, a swamp, or the like.

According to the present invention, the following advantages can be offered:

According to the present invention, since the submersible motor pump is installed in the equipment installation tube, and water is taken in through the suction pipe whose suction port is supported in the water by the floatation apparatus, sand does not enter the liquid contacting portion (components which contact water) of the pump section or the like of the submersible motor pump. Thus, erosion is not generated at the liquid contacting portion of the water-intake apparatus or the drainage apparatus, and the rotating member such as a pump impeller is not damaged or broken. Further, even if the equipment installation tube is buried in sand due to sedimentation of a large amount of sand, the submersible motor pump can be kept in a safe and stable condition.

Further, since the water-intake apparatus or the drainage apparatus such as a submersible motor pump can be mainly composed of the equipment installation tube installed on the inclined surface, the suction pipe, and the floatation apparatus for supporting the suction port of the suction pipe in the water, it is not necessary to construct a large-scale civil engineering structure (structures). Therefore, the water-intake apparatus or the drainage apparatus becomes inexpensive and can be easily installed.

Further, since sand or the like can hardly enter the water-intake apparatus or the drainage apparatus, it is not necessary to use an expensive material having a high abrasion resistance for the liquid contacting portion (components which contact water) of the water-intake apparatus or the drainage apparatus. Thus, an ordinary water-intake apparatus or drainage apparatus such as a submersible motor pump which is inexpensive can be used.

According to the present invention, since the submersible motor pump can be moved up and down along the inclined surface in the equipment installation tube by the traction mechanism,

the submersible motor pump can be easily moved to the maintenance location on the ground when maintenance of the submersible motor pump is performed, and hence maintenance work is extremely facilitated. Therefore, large-sized equipment such as a crane
5 is not required for maintenance work, and it is not necessary to construct the civil engineering structure (structures) and to secure a large site for the civil engineering structure.

According to the present invention, when the submersible motor pump is moved downwardly to the lower end of the equipment
10 installation tube, the suction port of the submersible motor pump is automatically coupled to the discharge port of the suction pipe. Therefore, installation work of the submersible motor pump is extremely facilitated. Particularly, after maintenance of the submersible motor pump is performed, reinstallation work
15 of the submersible motor pump can be easily performed.

According to the present invention, because the submersible motor pump has wheels so that the center of the suction port of the submersible motor pump is aligned with the center of the equipment installation tube, the submersible motor pump is moved
20 downwardly along the inner wall surface of the equipment installation tube so that the center of the suction port of the submersible motor pump is aligned with the center of the equipment installation tube at all times. Therefore, the position of the center of the suction port of the submersible motor pump is always
25 constant, and hence the center of the suction port of the submersible motor pump is aligned with the center of the suction pipe, and the suction port of the submersible motor pump is connected to the discharge port of the suction pipe.

According to the present invention, because the suction
30 pipe is supported in such a manner that the suction port of the suction pipe is open in the water near the water surface, and water near the water surface hardly includes sand or the like (solid substance having a larger specific gravity than water

or a smaller specific gravity than water) or includes a trace amount of sand or the like, the water which is taken in from the suction port hardly includes sand or the like or includes a trace amount of sand or the like, and hence the amount of sand
5 or the like which enters the pump section of the submersible motor pump is minimized.

Industrial Applicability

The present invention is applicable to a water-intake
10 apparatus or a drainage apparatus which is suitable for taking water in from a river or the like in which water level is largely fluctuated and sand or the like tends to be accumulated.

CLAIMS

1. A water-intake apparatus comprising:
an equipment installation tube having a lower end which
5 is submerged in water;
a submersible motor pump provided in said equipment
installation tube;
a suction pipe connected to a suction port of said
submersible motor pump;
10 a delivery pipe connected to a discharge port of said
submersible motor pump and extending through said equipment
installation tube to a predetermined location; and
a floating apparatus for supporting a suction port of said
suction pipe in the water.
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2. A water-intake apparatus according to claim 1, wherein
said equipment installation tube is provided on an inclined
surface.
- 20 3. A water-intake apparatus according to claim 1, wherein
said equipment installation tube has an upper end positioned
above a water surface.
4. A water-intake apparatus according to claim 1, further
25 comprising:
a traction mechanism for moving said submersible motor
pump up and down along an inclined surface of said equipment
installation tube.
- 30 5. A water-intake apparatus according to claim 4, wherein
a discharge port of said suction pipe is fixed to the lower end
of said equipment installation tube, and when said submersible
motor pump is moved to the lower end of said equipment installation

tube along said inclined surface of said equipment installation tube, said suction port of said submersible motor pump is automatically connected to said discharge port of said suction pipe.

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6. A water-intake apparatus according to claim 1, wherein said submersible motor pump has wheels so that the center of said suction port of said submersible motor pump is aligned with the center of said equipment installation tube.

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7. A water-intake apparatus according to any one of claims 1 to 6, wherein said suction port of said suction pipe is open in the water near the water surface.

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8. A drainage apparatus comprising:

an equipment installation tube having a lower end which is submerged in water;

a submersible motor pump provided in said equipment installation tube;

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a suction pipe connected to a suction port of said submersible motor pump;

a delivery pipe connected to a discharge port of said submersible motor pump and extending through said equipment installation tube to a predetermined location; and

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a floating apparatus for supporting a suction port of said suction pipe in the water.

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9. A drainage apparatus according to claim 8, wherein said equipment installation tube is provided on an inclined surface.

10. A drainage apparatus according to claim 8, wherein said equipment installation tube has an upper end positioned above a water surface.

11. A drainage apparatus according to claim 8, further comprising:

5 a traction mechanism for moving said submersible motor pump up and down along an inclined surface of said equipment installation tube.

12. A drainage apparatus according to claim 11, wherein a discharge port of said suction pipe is fixed to the lower end
10 of said equipment installation tube, and when said submersible motor pump is moved to the lower end of said equipment installation tube along said inclined surface of said equipment installation tube, said suction port of said submersible motor pump is automatically connected to said discharge port of said suction
15 pipe.

13. A drainage apparatus according to claim 8, wherein said submersible motor pump has wheels so that the center of said suction port of said submersible motor pump is aligned with
20 the center of said equipment installation tube.

14. A drainage apparatus according to any one of claims 8 to 13, wherein said suction port of said suction pipe is open in the water near the water surface.

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