

UNMANNED SPRAYING DEVICE FOR CAISSON COATING

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

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This application claims the benefit of Korean Patent Application No. 10-2020-0005262, filed on January 15, 2020, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

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BACKGROUND OF THE INVENTION

1. Field of the Invention

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The present invention relates to an unmanned spraying device for caisson coating, and more particularly, to an unmanned spraying device for caisson coating, in which a process of applying a silane solution used for a caisson can be performed in an unmanned manner.

2. Description of the Related Art

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A caisson is a hollow concrete structure manufactured in the form of a box on the water or land and is used as a structure for a main body such as the foundation of a bridge, breakwater, and a quay wall. The caisson is a foundation filled with sand, gravel or concrete after the caisson is sunken to a support layer by its own weight or a loading load. Types of caissons include an open caisson, an air caisson, a box caisson, and the like.

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Among these caissons, a caisson used for a splash zone has a problem of deteriorating durability due to the penetration of chloride into pores formed in concrete. Thus, before installing the caisson, a work of filling voids formed in the concrete by applying a silane chemical is preceded.

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However, in an existing process of applying a silane chemical, an operator boards in a man cage to manually apply a Silane chemical such that the safety during the work, quality, and the efficiency of the process are deteriorated.

SUMMARY OF THE INVENTION

The present invention provides an unmanned spraying device for caisson coating, in which a process of applying a coating solution used for caisson can be performed in an unmanned manner.

According to an aspect of the present invention, there is provided an unmanned spraying device for caisson coating, including a structure mounted to cross an open top of a box included in a caisson, a supply hose connected to a coating solution tank, installed along the structure and supplying a coating solution to be applied to the box from the coating solution tank, a lift installed at the structure and unwinding and winding a lifting wire, a spray connected to a free end of the lifting wire, being lowered or lifted along an inside of the box by an unwinding and winding operation of the lifting wire and connected to the supply hose to spray the coating solution of the supply hose onto an inner circumferential surface of the box, and a control unit moving or reciprocating the spray along the inside of the box through the lift so that the coating solution is applied along the inner circumferential surface of the box.

According to another aspect of the present invention, there is provided an unmanned spraying device for caisson coating, including a structure mounted to cross an open top of a caisson including a plurality of boxes arranged adjacent to each other and forming rows and columns, the structure mounted along the rows or the columns of the plurality of boxes, a plurality of supply hoses connected to a coating solution tank, installed on a top of each of the boxes along the structure and supplying a coating solution to be applied to the box from the coating solution tank, a plurality of lifts installed at the structure, positioned on the top of each of the boxes and unwinding and winding a lifting wire, a plurality of sprays connected to a free end of the lifting wire, each being lowered or lifted along an inside of each of the boxes by an unwinding and winding operation of the lifting wire and connected to the supply hose to spray the coating solution of the supply hose onto an inner circumferential surface of each of the boxes, and a control unit moving or reciprocating each of the plurality of sprays along the inside of each of the boxes through each of the

plurality of lifts so that the coating solution is applied along the inner circumferential surface of each of the boxes.

According to the present invention, there are the following effects.

First, a device for applying a coating solution used for a caisson can be unmanned so that the safety accident of a process of applying a coating solution can be prevented from occurring, unlike in an existing process in which the coating solution is applied by manpower in a man cage.

Second, the process of applying the coating solution can be automated so that the uniformity of the process of applying the coating solution can be secured without depending on a worker's skill level and thus the further improved durability of the manufactured caisson can be expected.

Third, as the process of applying the coating solution is performed in an unmanned manner and is automated, the coating solution can be applied to several boxes included in the caisson at once so that the efficiency of a caisson manufacturing process can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features and advantages of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

FIG. 1 is a state diagram illustrating an unmanned spraying device for caisson coating installed in a caisson, according to an embodiment of the present invention;

FIG. 2 is a plan view illustrating the full configuration of the unmanned spraying device for caisson coating of FIG. 1;

FIG. 3 is a front view of the detailed configuration of the unmanned spraying device for caisson coating of FIG. 2 taken along line A-A;

FIG. 4 is a partially-enlarged view of the configuration of an equilibrium part and a spray of FIG. 2; and

FIG. 5 is a view for describing a buffer member according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 is a state diagram illustrating an unmanned spraying device 100 for caisson coating installed in a caisson CS, according to an embodiment of the present invention, and FIGS. 2 and 3 are a plan view and a front view illustrating the unmanned spraying device 100 for caisson coating of FIG. 1.

Referring to FIGS. 1 through 3, the unmanned spraying device 100 for caisson CS coating (hereinafter, referred to as an 'unmanned spraying device'), in order to automate an existing process of applying a coating solution that was manually applied to the caisson CS by an operator on board a man cage, is installed on an open top of the caisson CS including a plurality of boxes B arranged adjacent to each other and forming rows and columns, sprays the coating solution by making a spray 140 to enter the inside of the caisson CS and rotating the spray 140. The unmanned spraying device 100 includes a structure 110, a supply hose 120, a lift 130, and the spray 140.

The structure 110 that provides an installation structure or a support structure for placing the lift 130 of the unmanned spraying device 100 and the spray 140 connected to the lift 130 in the center of the top of each of the boxes B of the caisson CS, is installed in the form of a steel structure and is mounted to cross the open top of the caisson CS and to be seated on the plurality of boxes B that form one row or column.

Here, in an embodiment of the present invention, the structure 110 is shown assuming the steel structure. However, this is only one embodiment of a simplified structure that can be easily manufactured and installed at a construction site, and a truss structure that allows the spray 140 and the lift 130 described above to be firmly disposed on the open top of the caisson CS and other such configurations will also be within the scope of the technical idea of the present invention.

The supply hose 120 is connected to a coating solution tank (not shown) and supplies a coating solution from the coating solution tank. A start end of the supply hose 120 is connected to the coating solution tank and is arranged along the structure 110 so that ends (free ends) of the supply hose 120 may be connected to the spray 140 through a plurality of lifts 130 installed on the top of

each of the boxes B of the caisson CS. Here, the coating solution is a solution for preventing the penetration of chloride by filling voids formed on inner and outer peripheral surfaces of each of the boxes B of the caisson CS, and a silane solution is used in an embodiment of the present invention.

5 The lift 130 is coupled to the structure 110 and is installed on the top of each of the boxes B of the caisson CS. A control unit (not shown) moves or reciprocates an end of each supply hose 120 to a lower part of the structure 110, i.e., to the inside of each of the boxes B of the caisson CS through the lift 130 so that the coating solution may be applied onto the inner circumferential surface of
10 each of the boxes B of the caisson CS through each supply hose 120. The lift 130 includes a hose reel 131, a chain hoist 132, and an equilibrium part 133.

 The hose reel 131 is coupled to a hose reel bracket 131a installed at the structure 110 and winds the supply hose 120 arranged along the structure 110 inside using an elastic force to accommodate it.

15 The chain hoist 132 is coupled to a chain hoist bracket 132a installed at the structure 110 and unwinds and winds a lifting wire 132b wound therein to lower or lift a hook 132c coupled to an end (free end) of the lifting wire 132b.

 The equilibrium part 133 is coupled to the end (free end) of the lifting wire 132b and is installed to reduce rolling and pitching flow of the spray 140 flowing
20 by wind or a spray force. The configuration of the equilibrium part 133 for maintaining equilibrium of the spray 140 and functions thereof will be described again in detail with reference to FIG. 4 to be described later.

 The spray 140 is coupled to a lower part of the equilibrium part 133 and is connected to the supply hose 120. The spray 140 includes a plurality of spray
25 arms 141 extending radially symmetrically around the lifting wire 132b and rotatably coupled around the lifting wire 132b, thereby delivering the coating solution of the supply hose 120. In this case, a plurality of nozzles 142 are coupled to free ends of the plurality of the spray arms 141 to spray the coating solution of the supply hose 120 delivered through the spray arms 141. The
30 plurality of nozzles 142 are bent in a rotation direction of the spray arms 141, i.e., in a clockwise or counterclockwise direction around the lifting wire 132b, thereby rotating the spray arms 141 around the lifting wire 132b by using the pressure of

the sprayed coating solution.

Hereinafter, the configuration of the equilibrium part 133 and a buffer member 111 installed to reduce rolling and pitching flow of the unmanned spraying device 100 according to the present invention and the effects thereof will be described in detail with reference to FIGS. 4 and 5. FIG. 4 is an enlarged view of the configuration of the equilibrium part 133 and the spray 140, and FIG. 5 illustrates the configuration of the buffer member 111 additionally installed at the structure 110.

Referring to FIG. 4, the spray 140 according to an embodiment of the present invention is connected to the end that is a free end of the lifting wire 132b and thus may rolling and pitching flow according to ambient air flow or rotation of the spray 140.

Thus, the unmanned spraying device 100 according to the present invention may further install the equilibrium part 133 at the end of the lifting wire 132b to which the spray 140 is connected, thereby adding a separate load to the end of the lifting wire 132b. Thus, the entrance path of each spray 140 entering the inside of each of the boxes B of the caisson CS may be directed toward the center of the inside of each of the boxes B, and the added load may be widely distributed so that rolling and pitching flow of the spray 140 connected to the lifting wire 132b may be reduced.

Specifically, an upper part of a connection ring 133a of the equilibrium part 133 is formed in a triangle shape, and the connection ring 133a of the equilibrium part 133 is hooked to the hook 132c of the chain hoist 132, and a lower part of the connection ring 133a is formed in a rectangular parallelepiped shape to serve as a base for supporting equilibrium frames 133b. Four equilibrium frames 133b are installed at the lower part of the connection ring 133a radially symmetrically around the lifting wire 132b to add a separate load to the lifting wire 132b and may be installed radially so that the added load may be widely distributed around the lifting wire 132b and rolling and pitching flow of the spray 140 connected to the lifting wire 132b may be reduced.

Furthermore, the spray 140 connected to the supply hose 120 and receiving the coating solution from the supply hose 120 is axis-coupled to the

lower part of the equilibrium part 133, i.e., under the rectangular parallelepiped-shaped lower part of the connection ring 133a rotatably around the lifting wire 132b, as described above. In this case, the spray 140 is installed in a radial structure in which two spray arms 141 are symmetrical with each other based on the lifting wire 132b or the lower part of the connection ring 133a so that the coating solution may be close to the inner circumferential surface of each of the boxes B of the caisson CS and applied thereto, and the nozzles 142 for spraying the coating solution are installed at the ends (free ends) of the spray arms 141. The installed nozzles 142 are bent in a clockwise or counterclockwise direction symmetrically around the lifting wire 132b so that the spray arms 141 may be rotated around the lifting wire 132b or the lower part of the connection ring 133a by using the spray force of the coating solution.

Since these spray arms 141 may flow inside each of the boxes B of the caisson CS according to the spray force of the coating solution or air flow and the nozzles 142 may collide with the inside of each of the boxes B, the above-described equilibrium frames 133b are formed longer than the extension length of the spray arms 141 so that damage of the nozzles 142 may be reduced. Furthermore, as described above, rolling members 133c are installed at ends of the equilibrium frames 133b so that damage of the ends of the equilibrium frames 133b may be reduced.

In this case, a start end of each of four equilibrium frames 133b is not fixed in a radial shape in which they are coupled to the lower part of the connection ring 133a and symmetrically with each other, but is slidably fitted to the lower part of the connection ring 133a so that the length of the four equilibrium frames 133b may be adjusted and thus the four equilibrium frames 133b may respond to changes in the width of each of the boxes B of the caisson CS. Furthermore, if the middle or third point of the start end of each of the equilibrium frames 133b is fixed to the lower part of the connection ring 133a by adjusting the protruding length of the four equilibrium frames 133b from the lower part of the connection ring 133a, one protruding equilibrium frame 133b overlaps or intersects with an adjacent or opposite equilibrium frame 133b so that the distributed load formed around the lifting wire 132b may be further

concentrated in a closer distance rather than a longer distance. The above-described rolling and pitching phenomenon may be further reduced using the distributed load, and a concentrated load is formed close to the lifting wire 132b so that the spray 140 connected to the lifting wire 132b may be lowered or lifted toward the center of the inside of each of the boxes B of the caisson CS.

In addition, in preparation of the case where the protruding length of the equilibrium frames 133b increases, a fixing ring 133e is formed at the middle or end of the equilibrium frames 133b, and the hook 132c of the chain hoist 132 and the fixing ring 133e formed at the middle or end of the equilibrium frames 133b are connected to each other via an equilibrium wire 133d so that a support structure in a diagonal shape may be provided to the equilibrium frames 133b extending in one direction. By using the structure, the equilibrium frames 133b having a bar structure may be reinforced, and rolling and pitching flow of the equilibrium part 133 may be reduced.

Referring to FIG. 5, the buffer member 111 having an elastic band shape is installed at the structure 110 having a steel structure to cross the width direction or longitudinal direction of the structure 110 so that the pitching and rolling flow radius of the equilibrium part 133 may be limited. In this case, the buffer member 111 is installed to cross the structure 110 and preferably, within the pitching and rolling flow radius of the equilibrium part 133. The buffer member 111 limits the pitching and rolling flow radius of the equilibrium part 133 and the spray 140 during the process of applying the coating solution of the unmanned spraying device 100 to reduce the damage of the equilibrium part 133 and the spray 140 and limits the flow radius when the structure 110 is mounted on each of the boxes B of the caisson CS or transported to another place so that damage of the structure 110 may be reduced.

While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims.

What is claimed is:

1. An unmanned spraying device for caisson coating, comprising:
a structure mounted to cross an open top of a box included in a caisson;
a supply hose connected to a coating solution tank, installed along the
5 structure and supplying a coating solution to be applied to the box from the
coating solution tank;

a lift installed at the structure and unwinding and winding a lifting wire;
a spray connected to a free end of the lifting wire, being lowered or lifted
along an inside of the box by an unwinding and winding operation of the lifting
10 wire and connected to the supply hose to spray the coating solution of the
supply hose onto an inner circumferential surface of the box; and

a control unit moving or reciprocating the spray along the inside of the
box through the lift so that the coating solution is applied along the inner
circumferential surface of the box.

2. The unmanned spraying device for caisson coating of claim 1,
wherein the structure is installed and seated on the open top of the box so as to
be separated from the open top of the box and moved to an open top of another
adjacent box.

3. An unmanned spraying device for caisson coating, comprising:
a structure mounted to cross an open top of a caisson including a
plurality of boxes arranged adjacent to each other and forming rows and
columns, the structure mounted along the rows or the columns of the plurality of
25 boxes;

a plurality of supply hoses connected to a coating solution tank, installed
on a top of each of the boxes along the structure and supplying a coating
solution to be applied to the box from the coating solution tank;

a plurality of lifts installed at the structure, positioned on the top of each of
30 the boxes and unwinding and winding a lifting wire;

a plurality of sprays connected to a free end of the lifting wire, each being
lowered or lifted along an inside of each of the boxes by an unwinding and

winding operation of the lifting wire and connected to the supply hose to spray the coating solution of the supply hose onto an inner circumferential surface of each of the boxes; and

a control unit moving or reciprocating each of the plurality of sprays along the inside of each of the boxes through each of the plurality of lifts so that the coating solution is applied along the inner circumferential surface of each of the boxes.

4. The unmanned spraying device for caisson coating of claim 3, wherein

the structure is installed and seated on open tops of the boxes so as to be separated from the open tops of the boxes forming the rows and columns and moved to open tops of other adjacent boxes forming other rows and columns.

5. The unmanned spraying device for caisson coating of claim 1 or 3,

wherein the structure is formed in a steel structure.

6. The unmanned spraying device for caisson coating of claim 1 or 3,

wherein each of the lifts comprises:

a hose reel winding the supply hose inside and accommodating the supply

hose;

a chain hoist unwinding or winding the lifting wire; and

an equilibrium part connected to a free end of the lifting wire and adding a load to the free end of the lifting wire so that the free end of the lifting wire is lowered or lifted along a center of the inside of each of the boxes by the load.

7. The unmanned spraying device for caisson coating of claim 6, wherein

the hose reel winds the supply hose inside and accommodates the supply hose using an elastic force, and when the chain hoist unwinds the lifting wire to lower the equilibrium part, the supply hose is unwound from the hose reel along a lowering operation of the spray by the weight of the equilibrium part, and when
5 the chain hoist winds the lifting wire to lift the equilibrium part, the supply hose is wound on the hose reel by the elastic force of the hose reel together with a lifting operation of the spray.

8. The unmanned spraying device of caisson coating of claim 6,
10 wherein
the equilibrium part comprises:
a connection ring coupled to the free end of the lifting wire; and
a plurality of equilibrium frames coupled to the connection ring and
extending radially symmetrically around the lifting wire.

15 9. The unmanned spraying device for caisson coating of claim 8,
wherein
the equilibrium frames are radially, symmetrically and slidably fitted to the
connection ring so that a protruding length of the equilibrium frames is adjusted
20 around the lifting wire.

10. The unmanned spraying device for caisson coating of claim 8,
wherein
the equilibrium part further comprises rolling members each installed at free
25 ends of the equilibrium frames.

11. The unmanned spraying device for caisson coating of claim 8,
wherein
the equilibrium part further comprises equilibrium wires connecting the free end
30 of the lifting wire to middle or free ends of the equilibrium frames in a diagonal
shape.

12. The unmanned spraying device for caisson coating of claim 8,
wherein

the structure is formed in a steel structure and further comprises a buffer
member having an elastic band shape installed to cross a width direction or
longitudinal direction of the steel structure within a pitching or rolling radius of
the equilibrium frames to limit the pitching or rolling radius of the equilibrium
frames.

13. The unmanned spraying device for caisson coating of claim 6,
wherein

each of the sprays comprises:

a plurality of spray arms coupled to a lower part of the equilibrium part,
extending radially symmetrically around the lifting wire, rotatably coupled around
the lifting wire and connected to the supply hose to deliver the coating solution;
and

a plurality of nozzle each coupled to a free end of each of the plurality of
spray arms to spray the coating solution delivered through the spray arms.

14. The unmanned spraying device for caisson coating of claim 13,
wherein

the nozzles are bent in a clockwise or counterclockwise direction around the
lifting wire to rotate the spray arms around the lifting wire by using pressure of
the sprayed coating solution.

15. The unmanned spraying device for caisson coating of claim 13,
wherein

the lift comprises:

a chain hoist unwinding or winding the lifting wire; and

an equilibrium part connected to the free end of the lifting wire and having
a plurality of equilibrium frames extending radially symmetrically around the
lifting wire, and

the spray arms are formed shorter than a length of the equilibrium frames.