

LOW ALTITUDE HEAD-TYPE EXCAVATION APPARATUS

BACKGROUND

[0001]

5 The present invention relates to a low altitude head-type excavation apparatus that excavates vertical holes for driving long piles or tubes and so on in low altitude head spaces such as insides of buildings and tunnels, and railroad waysides.

[0002]

10 In a pile foundation construction work in a construction site, an excavation work that excavates vertical holes is executed by using an excavation apparatus which combines a base and a turning-type boring machine. Concretely, the excavation work uses an all casing method that drives a casing tube in the ground while rotating the casing tube by the
15 boring machine and removes soil in the casing tube by a hammer grab suspended from the base.

[0003]

 A conventional all casing method is disclosed in, for example, JPH10-205261A and JPH10-205263A. In the all casing method, a clamp
20 device, a turning motor, a drawing cylinder and so on provided in the boring machine are –operated first. Thereby, the casing tube is clamped by the clamp device, rotated by the turning motor, and driven in the ground by the drawing cylinder. Next, the hammer grab suspended from the base excavates soil in the casing tube, and the excavated soil is moved to a place
25 apart from the casing tube.

[0004]

 In the excavation work, the hammer grab suspended from the base

is lowered and dropped in the casing tube by releasing the winch from a height. By dropping the hammer grab, tip ends of the shell pieces which are opened pierce in the ground. When winding up the winch from this state, the shell pieces are closed to contain excavated soil in a space formed
5 by the closed shells, and the hammer grab is then wound up in a state containing the soil.

[0005]

After executing the excavation work such that a plurality of casing tubes are embedded in the ground until reaching a predetermined depth
10 while being connected to each other by lock pins, the hammer grab is released from the base and a reinforcement cage suspended from the base is inserted in the excavated vertical hole. Next, a tremie pipe to place freshly mixed concrete is set. The casing tube is drawn by the boring machine while placing freshly mixed concrete with the tremie pipe and a pile
15 is completed in the ground after the freshly mixed concrete is hardened. The excavation work is finished after the completion of the placement of the freshly mixed concrete and the drawing of the casing tube.

[0006]

In the foregoing excavation apparatus, because excavation or
20 conveyance is executed in a state suspending the hammer grab or the casing tube from the base placed at a high position, a high altitude head space is required to execute this work. Therefore, there is a problem that the foregoing excavation apparatus cannot be used in a place having a roof or tunnel and so on of a limited height. As a method improving this, a
25 suspending conveyance device is known (see, for reference, JPH8-4892A). The suspending conveyance device is configured to be capable of moving excavating tubes, H-steels or the like by sliding the base horizontally. The

conveyance device has a self-run carriage on which casing tubes and so on are placed. The carriage moves to a position close to a work place of a low altitude head space, in other words, in which a height is limited. Then, rails each having a tip end from which the excavating tubes and so on are suspended are slid in a lateral (right and left) direction to execute works such as embedding repeatedly the excavating tubes in a predetermined excavating place.

[0007]

JP2010-106615A discloses a low altitude head-type excavation apparatus including a rail capable of projecting horizontally from an excavation position to a soil removal position and a carriage suspending an excavator such as the hammer grab and so on and capable of reciprocating along the rail.

[0008]

However, in the conventional excavation apparatus disclosed in each of JPH10-205261A and JPH10-205263A, a wide altitude head space is required to execute, for example, a work removing excavated soil, stones, rocks even in works other than the work setting or moving the excavating parts such as the hammer grab or the casing tube. Therefore, there is a problem that the excavating work cannot be executed in a place having a limited upper space as in an inside of a building and a tunnel, and a railroad wayside, even if the excavation apparatus is conveyed in the place, a range of work is limited and an excavation of a sufficient depth cannot be executed.

[0009]

In the suspending conveyance device disclosed in JPH8-4892A, first and second rails corresponding to the conventional base are horizontally

arranged. Therefore, it is possible to slide a conveyance object such as the excavating tubes or the H-steels by the rails to convey them in a predetermined work place. However, the suspending conveyance device is configured to convey the conveyance object such as the excavating tubes or the H-steels in a state where the conveyance object is horizontally suspended. Therefore, the conveyance object is suspended to the tip end of the rail capable of extending and contracting. However, the rail does not significantly project in the structure, there is possibility that a range of the work is limited. In addition, there is a problem that the conveyance object, the hammer grab to dig up soil or rock and the casing tube embedded in the ground cannot be easily conveyed only by the rails, because the hammer grab and the casing tube have a heavy weigh.

[0010]

In the low altitude head-type excavation apparatus disclosed in JP2010-106615, there is possibility that the carriage is dragged by the winch that operates the excavator to be positioned out of a stop position, when lifting the excavator in a state where the carriage that suspends the excavator at an excavation position is slid and stopped at a predetermined position. In addition, because the carriage is moved by an oil-pressure cylinder, there is a problem that it takes time to move the carriage at the excavation position and the soil removal position and sufficient braking performance to stop the carriage at a correct position cannot be obtained.

SUMMARY

[0011]

An object of the present invention is to provide a low altitude head-type excavation apparatus capable of rapidly and accurately moving

an excavator such as a hammer grab at a predetermined horizontal position and lifting the excavator in a state where the excavator is securely stopped at a predetermined position.

[0012]

5 To accomplish the above object, a low altitude head-type excavation apparatus according to one embodiment of the present invention includes:

 a conveying rail that is disposed on a base machine including an excavating pedestal, an actuator, and a winch through a frame and is provided to horizontally extend on the excavation pedestal;

10 a first moving body including a front wheel gear and a rear wheel gear and reciprocally disposed along an extending direction of the conveying rail;

 a rotation transmission member that is bridged between the front wheel gear and the rear wheel gear and that has one end fixed to the
15 conveying rail;

 a second moving body that is fixed to another end of the rotation transmission member and that reciprocates between the front wheel gear and the rear wheel gear in accordance with movement of the first moving body; and

20 an excavator that is liftably suspended and supported on the second moving body.

 The second moving body reciprocates between the front wheel gear and the rear wheel gear of the first moving body while the first moving body reciprocates the conveying rail by the actuator. The excavator is liftably
25 moved by the winch in a state where the second moving body is fixed at a predetermined position that stops the drive of the actuator.

BRIEF DESCRIPTION OF DRAWINGS

[0013]

FIG.1 is a side view of a low altitude head-type excavation apparatus according to the present invention.

5 FIG.2 is a plan view of the low altitude head-type excavation apparatus.

FIG.3 is a front view of the low altitude head-type excavation apparatus.

10 FIG.4A is an explanatory view showing a moved state of each of a first moving body and a second moving body in the low altitude head-type excavation apparatus in which the first moving body and the second moving body are moved to one side of a conveying rail.

15 FIG.4B is an explanatory view showing the moved state of each of the first moving body and the second moving body in the low altitude head-type excavation apparatus in which the first moving body and the second moving body are moved to a central portion of the conveying rail.

20 FIG.4C is an explanatory view showing the moved state of each of the first moving body and the second moving body in the low altitude head-type excavation apparatus in which the first moving body and the second moving body are moved to another side of the conveying rail.

FIG.5 is an explanatory view showing a hammer grab suspended from the second moving body.

FIG.6 is an explanatory view showing an operation of a casing tube.

25 FIG.7 is an explanatory view showing an operation of the hammer grab.

DETAILED DESCRIPTION OF EMBODIMENTS

[0014]

Embodiments of a low altitude head-type excavation apparatus according to the present invention will be described hereinafter with reference to the accompanying drawings. As shown in FIGs.1 to 3, the low altitude head-type excavation apparatus (hereinafter referred to as an excavation apparatus) 10 according to the present invention includes a movable base machine 11, an excavating pedestal 12 provided on the base machine 11, a horizontal base 14 mounted on the excavating pedestal 12 through a frame 13, a conveying rail 15 provided on the horizontal base 14, and an actuator 16 and a winch 37 mounted on the conveying rail 15.

[0015]

The actuator 16 includes a first moving body 18 movably provided along the conveying rail 15, a second moving body 19 that moves between one end and another end of the first moving body in accordance with the move of the first moving body 18, and an oil-hydraulic cylinder 21 that drives the first moving body 18. An excavator 17 is attached to the second moving body 19 to be liftably suspended and supported. The excavation apparatus 10 can be applied in a building such as a storeroom, a garage, a tunnel and so on in which an overhead work clearance is restricted. A height of the second moving body 19 located at the highest position from an earth surface is set within several meters.

[0016]

For example, a heavy machinery vehicle for construction work is used as the base machine 11. The base machine 11 includes the excavating pedestal 12 on which the frame 13 is mounted and a power mechanism 22 to drive the actuator 16. A tubing section 34 to press-fit a casing tube 33 therein is preset in an excavation execution place, as shown

in FIG.6. The base machine 11 is moved toward the tubing section 34 and the excavating pedestal 12 provided on the base machine 11 is positioned right above the tubing section 34.

[0017]

5 The frame 13 is disposed on the excavating pedestal 12 and is composed of four main supporting legs 23 that horizontally support the conveying rail 15.

[0018]

10 As shown in FIG.1, the conveying rail 15 is composed of a pair of right and left rails arranged parallel on the frame 13. The winch 37 is disposed at one end of the conveying rail 15. The winch 37 includes a wire 30 wound on the winch to pull the excavator 17. The winch is disposed on a placing table 29 which is provided at a position lowered from the one end of the conveying rail 15. This configuration, thereby, does not cause
15 troubles in a work in a low altitude head clearance in which a height moving the second moving body 19 is limited.

[0019]

20 As shown in FIGs.4A to 4C, the first moving body 18 is formed by a first carriage section 24 (see FIG.2) including a pair of right and left front wheel gears 27 and a pair of right and left rear wheel gears 28 which engage with guide lanes (not shown) provided on the conveying rail 15 and a pair of rotation transmission members 31 composed of timing chains or timing belts wound around the right front wheel gear 27 and the right rear wheel gear 28 and the left front wheel gear 27 and the left rear wheel gear
25 28, respectively. In the first carriage section 24, one end of the oil-hydraulic cylinder 21 is connected to one end of each of the rear wheel gears 28. The pair of rotation transmission members 31 is bridged on the

front wheel gears 27 and the rear wheel gears 28 which are arranged at the front and rear of the first carriage section 24 so as to have a certain tension. One end of a lower side of each rotation transmission member 31 is fixed to a first fixed portion 36a provided on the conveying rail 15 and other end of an upper side of each rotation transmission member 31 is fixed to the second moving body 19.

[0020]

The second moving body 19 includes a second carriage section 25 (see FIG.2) fixed to a second fixed portion 36b of each rotation transmission member 31 fixed to a position going about half around from the first fixed portion 36a and a pulley section 26 provided on a central portion of the second carriage section 25.

[0021]

By rotating the rotation transmission members 31 in a traveling direction of the first moving body 18 around the first fixed portion 36a of the conveying rail 15 as a base point, the second moving body 19 fixed to the second fixed portion 36b moves on the first moving body 18 in accordance with the first moving body 18.

[0022]

FIGs.4A to 4C illustrate a relative relationship between the first moving body 18 and the second moving body 19. FIG.4A illustrates an initial position before driving the oil-hydraulic cylinder 21. In the initial position, the oil-hydraulic cylinder 21 is in a contracted state such that the rear wheel gear side of the first moving body 18 is positioned at a basic end portion of the conveying rail 15.

[0023]

FIG.4B illustrates a state where the rotation transmission members

31 are rotated to move the pulley section 26 of the second moving body 19 to a position just above the excavating pedestal 12 by driving the oil-hydraulic cylinder 21 from the initial position and pressing out the first moving body 18 forwardly. The position of the second moving body 19 in the state becomes an excavation position. In the excavation position, the excavation work is executed by dripping the hammer grab 32 in the tubing section 34.

[0024]

FIG.4C illustrates a state where the rotation transmission members are rotated to move the front wheel gears 27 of the second moving body 19 to a leading end portion of the conveying rail 15 by further driving the oil-hydraulic cylinder 21 from the excavation position. The position of the second moving body 19 in the state becomes an earth removing position. In the state, a work moving soil excavated by the hammer grab 32 at a position away from the excavation position is executed.

[0025]

In this way, the second moving body 19 can be reciprocated between the excavation position and the earth removing position along the movement direction of the first moving body 18 and can be accurately stopped at the excavation position and the earth removing position by driving the first moving body 18 by the oil-hydraulic cylinder 21 and in accordance with the drive of the first moving body. In addition, because the second moving body 19 is fixed to the rotation transmission members 31 of the first moving body 18 and integrally moves with the rotation transmission members 31, it is possible to securely stop the second moving body 19 onto the first moving body 18 stopped by the oil-hydraulic cylinder 21 by the front wheel gears 27, the rear wheel gears 28, and the rotation

transmission members 31 even in pulling up the hammer grab 32 suspended on the pulley section by the winch 37. The brake operation of both the first moving body 18 and the second moving body 19 makes it possible to securely fix and hold the excavator 17 at a predetermined position of the excavation position and the soil removal position. The first moving body 18 and the second moving body 19 can execute an excavation work corresponding to a predetermined depth by reciprocating them between the positions shown in FIGs.4A and 4C throughout a plurality of times.

10 [0026]

The wire 30 that directly suspends the hammer grab 32 or the casing tube 33 is wound on the pulley section 26 provided on the second moving body 19. In addition, an oil-pressure cable 38 to open and close a shell portion (described below) of the hammer grab 32 is disposed along the wire 30. The wire 30 is moved up and down by the winch 37 disposed at the one end of the conveying rail 15.

[0027]

The hammer grab 32 includes a body portion 32a and a shell portion 32b attached to the body portion 32a to be capable of opening and closing about a lower end of the body portion 32a as a fulcrum. The shell portion 32b has a pair of openable and closeable shell pieces. The shell portion 32b has at a central portion thereof an accommodation space that contains excavated objects such as soil, sand. Each of the shell pieces has at a tip end portion thereof an excavation blade excavating the earth surface. The shell pieces of the shell portion 32b are opened and closed by an oil-pressure motor (not shown) disposed in the body portion 32a. As shown in FIG.5, an oil-pressure cable 38 that supplies oil for driving and

controlling the oil-pressure motor and so on is inserted in a hole (not shown) provided in a top plate 39 of the body portion 32a. The start, the stop and drive control of speed and direction for the oil-pressure motor is executed by the oil supplied through the oil-pressure cable 38.

5 [0028]

The hammer grab 32 is conveyed in a state the shell portion 32b is opened approximately perpendicularly to the earth surface and suspended to the wire 30, as shown in FIG.7. The wire 30 is hung on a suspension ring 35 provided at central portion of an upper surface of the top plate 39.

10 The hammer grab 32 is dropped in the casing tube 33 to be inserted in the casing tube 33 driven in the earth surface. The casing tube 33 protects an inner wall of a hole as excavated and is formed by a steel plate having a diameter adaptable to a size of a vertical hole to be excavated. The casing tube 33 includes a cylindrical body portion 33a and a plurality of cutting
15 edges 33b of especial steel provided on a tip end portion of the cylindrical body portion 33a. A plurality of casing tubes 33 are embedded sequentially in the ground while connecting one of them to the other one.

[0029]

As shown in FIG.6, the base machine 11 is moved to the excavation
20 place in the state where the casing tube 33 is set on the excavating pedestal 12. Then, the casing tube 33 is inserted in the earth surface by a predetermined depth while rotating the casing tube 33. As shown in FIG.7, the hammer grab 32 is suspended from the winch 37 through the wire 30 in which the one end is connected to the suspension ring 35 of the hammer
25 grab and the other end is wound around the winch 37 through the pulley section 26 of the first moving body 18 and the second moving body 19 moved along the conveying rail 15. By the drive of the winch 37, the

hammer grab 32 is moved to a position just above the casing tube 33.

[0030]

When the hammer grab 32 is moved to the position just above the casing tube 33, the hammer grab 32 is dropped in the casing tube 33 by releasing the windup of the wire 30 by the winch 37. By dropping the hammer grab 32, a tip end of the shell portion 32b in a state where the shell pieces are opened is driven in the ground. The shell pieces of the shell portion 32b are then closed by driving an oil-pressure type rotation motor (not shown) disposed in the hammer grab 32 to contain soil, sand and so on as excavated in the accommodation space formed by the shell pieces.

[0031]

After the shell portion 32b, concretely, the shell pieces are closed, the hammer grab 32 is pulled up from the casing tube 33 by winding up the winch 37. Then, the second moving body 19 is advanced in accordance with the movement of the first moving body 18 to move to a position close to the tip end portion of the conveying rail 15 apart from the excavating pedestal 12 horizontally. In this position, it is possible to remove the excavated soil or sand etc. by opening the shell pieces by the drive of the rotation motor. The hammer grab 32 can be horizontally reciprocated by the first moving body 18 and the second moving body 19 during the movement from the position of the casing tube 33 to the place to remove the excavated soil and sand. As a result, it is possible to easily and efficiently execute the works to excavate soil and sand and remove the excavated soil and sand in the low altitude head place.

[0032]

As described above, the illustrated embodiment includes the first moving body 18 moved by the rotation transmission members 31 that rotate

while engaging the front wheel gears 27 and the rear wheel gears 28 securely, and the second moving body 19 fixed on the rotation transmission members 31. Thereby, it is possible to move the excavator 17 having a heavy weight suspended from the second moving body 19 to a predetermined position without slipping and securely hold it at the moved position. Note that the drive by the rotation transmission members 31 is performed through the power mechanism 22 of an electrical power system provided on the base machine 11.

[0033]

In the embodiment, although the configuration using the hammer grab 32 or the casing tube 33 has been shown, an excavator having a configuration other than the configuration may be used. In addition, if an object for a work is for conveyance, it is possible to apply even to a general construction equipment other than the equipment used for excavation.

[0034]

The power mechanism 22 drives the actuator 16 or the winch 37. The power mechanism 22 includes an engine unit, an oil-pressure unit, and an electrical power unit. In the power mechanism 22, the slide movement of the first moving body 18, the fastening and the pressing-in of the casing tube 33 and so on through the actuator 16 are executed and the winding operation of the winch 37 necessary to the lifting operation of the excavator 17 is executed. The base machine 11 provided with power mechanism 22 is provided with an operating part that operates the first moving body 18, the second moving body 19, and the winch 37, and a running device capable of moving and turning it to a predetermined excavating execution place.

[0035]

The excavation apparatus 10 in the embodiment is set to the base

machine 11 through the frame 13. Therefore, it is possible to set the excavation apparatus 10 on the excavating pedestal 12 of the base machine 11 in a state where the horizontal base 14 is previously set on the frame 13 and the first moving body 18 and the second moving body 19 or the excavator 17 are set on the frame 13, as needed. It is, also, to set the excavation apparatus 10 by conveying separately the frame 13, the conveying rail 15 constituting the horizontal base 14, the first and second moving bodies 18, 19, the excavator 17, and so on and assembling them on the excavating pedestal 12 of the base machine 11 together with the frame 13 and the horizontal base 14 at the excavation execution place. Alternatively, the excavation apparatus 10 may be configured by integrating it with the base machine 11.

[0036]

As described above, in the excavation apparatus 10 according to the present invention, because the first moving body 18 horizontally moves along the conveying rail 15 extending horizontally at the low altitude head position and the second moving body 19 moves on the first moving body 18 along the rotation transmission members 31 by gear rotation, it is possible to rapidly and accurately move the excavator 17 such as the hammer grab 32 and the casing tube 33 at a predetermined position. In addition, because the first moving body 18 is moved by the oil-hydraulic cylinder 21 and the second moving body 19 is driven by the rotation transmission members 31 braking with the front wheel gears 27 and the rear wheel gears 28 provided on the first moving body 18, it is possible to secularly execute pulling up of the excavator 17 digging up soil, sand and so on at a predetermined stop position.

[0037]

According to the low altitude head-type excavation apparatus, the first moving body including the front wheel gears and the rear wheel gears and the rotation transmission members bridged between the front wheel gears and the rear wheel gears is reciprocated on the conveying rail by the actuator and the second moving body is reciprocated on the first moving body in accordance with the rotation of the rotation transmission members. Therefore, it is possible to rapidly and accurately move the second moving body at a predetermined position on the conveying rail and stop at the moved position with good breaking and hold the stopped state. Thereby, it is possible to rapidly and accurately move the excavator such as the hammer grab suspended from the second moving body toward a predetermined excavating position and pull up soil or sand dug up by the excavator at a predetermined position without a position displacement.

[0038]

Although the several embodiments of the present invention have been described, it should be noted that the present invention is not limited to these embodiments, various modifications and changes can be made to the embodiments by those skilled in the art as long as such modifications and changes are within the scope of the present invention as defined by the Claims.

What is claimed is:

1. A low altitude head-type excavation apparatus, comprising:

a conveying rail that is disposed on a base machine including an excavating pedestal, an actuator, and a winch through a frame;

a first moving body including a front wheel gear and a rear wheel gear and reciprocally disposed on the conveying rail;

a rotation transmission member that is bridged between the front wheel gear and the rear wheel gear and that has one point fixed to the conveying rail;

a second moving body that is fixed to another point of the rotation transmission member and that reciprocates between the front wheel gear and the rear wheel gear in accordance with movement of the first moving body;

and an excavator that is liftably suspended and supported on the second moving body, wherein the second moving body reciprocates between the front wheel gear and the rear wheel gear of the first moving body while the first moving body reciprocates on the conveying rail by the actuator,

and the excavator is liftably moved by the winch in a state where the second moving body is fixed at a predetermined position that stops the drive of the actuator.

2. The low altitude head-type excavation apparatus according to claim 1, wherein, an oil-pressure cylinder is disposed on one end of the conveying rail, and the conveying rail is horizontally disposed from the one end through the excavating pedestal to another end.

3. The low altitude head-type excavation apparatus according to claim 2, wherein, the first moving body has one end connected to the oil-pressure cylinder and reciprocates between one end and another end of the conveying rail by the oil-pressure cylinder.
4. The low altitude head-type excavation apparatus according to claim 1, wherein, the rotation transmission member is a timing chain or timing belt bridged between the front wheel gear and the rear wheel gear of the first moving body and is rotated by engaging with the front wheel gear and the rear wheel gear.
5. The low altitude head-type excavation apparatus according to claim 1, wherein, a pulley section is provided on the second moving body, and the excavator is suspended and supported through the pulley section.
6. The low altitude head-type excavation apparatus according to claim 1, wherein, the excavator is liftably suspended and supported by a wire extending from the winch provided at one end of the conveying rail through a pulley section of the second moving body.
7. The low altitude head-type excavation apparatus according to claim 1, wherein, the excavator is at least one of a hammer grab having an openable and closeable shell portion provided at a tip end of the hammer grab and a casing tube having a cutting blade provided at a tip end portion of the casing tube.
8. The low altitude head-type excavation apparatus according to claim 7, wherein, the hammer grab has an oil-pressure motor therein, and the shell portion is operated to be capable of opening and closing through a link mechanism that converts rotation of the oil-pressure motor in a linear motion.