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(54) **AUTOMATED TROLLEY CONSTRUCTION APPARATUS, AND METHOD**

(57) An automatic trolley construction device and a method thereof are provided. The automatic trolley construction device includes a frame vehicle. The bottom of the trolley is provided with a bottom cross beam and traveling wheels. The top of the frame vehicle is provided with a top arch cross beam. A rack rail is installed on the top arch cross beam. The rack rail is meshed with a gear. The gear is connected with a third motor through a connecting shaft. The third motor is configured to drive the gear to move along the rack rail. A sleeve is provided outside the connecting shaft. The sleeve is connected with a vertical shaft. An upright column is connected with a crossbar. A first motor is installed on the crossbar. The

first motor drives a rotating disk to rotate through a first star gear. The rotating disk is rotatably connected with the upright column. A construction device operating arm component is installed on the rotating disk. An end of the construction device operating arm component is connected with a construction device connecting component. The construction device connecting component is configured to connect a plurality of construction devices. The device solves the problem well that a tunnel construction device is combined with a trolley, and improve the efficiency and the safety of the construction of a groove, a tunnel, a rock mass and the like.

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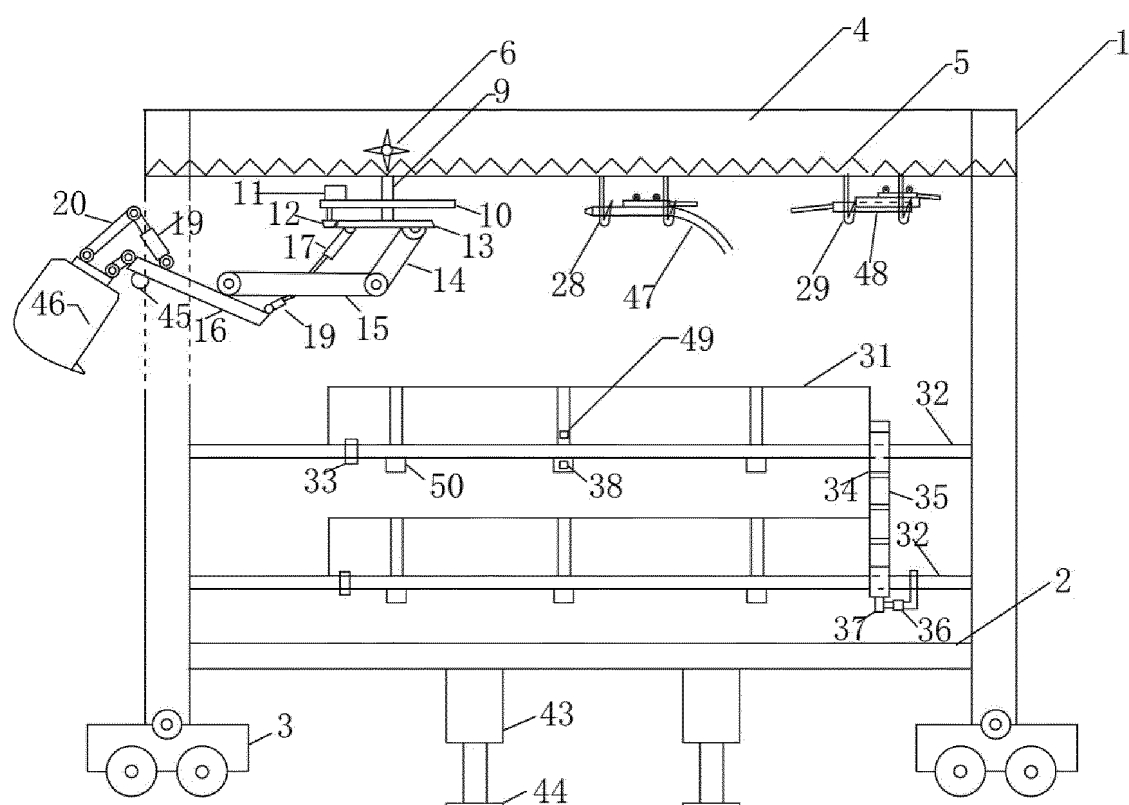


FIG. 1

Description

TECHNICAL FIELD

[0001] The present disclosure belongs to the technical field of tunnel construction, and in particular to an automatic trolley construction device and a method thereof.

BACKGROUND

[0002] A trolley is a common device in tunnel construction. However, a trolley often has a single function and can only be used as a working platform for a task, which is low in degree of automation and intelligence. For example, Chinese Patent Application CN115961973B discloses a tunnel lining trolley and a tunnel construction method. The patent technology solves the problems that the existing tunnel lining trolley cannot be demolded conveniently, it is inconvenient to place the existing tunnel lining trolley after demolding, it is inconvenient to exhaust when pouring, it is easy to leak when pouring and it is easy to deform due to concrete solidification and contraction by providing a side plate, a top shell, a ventilating cylinder, a baffle, a hydraulic elevator, a supporting plate and a supporting rod. The trolley mainly aims at the technical scheme for demolding.

[0003] Therefore, the technical problem to be solved by the present disclosure is how to combine various tunnel construction devices with the trolley to expand the use and function of the trolley.

SUMMARY

[0004] In view of the technical problems existing in the background, an automatic trolley construction device and a method thereof provided by the present disclosure solve the problem well that a tunnel construction device is combined with a trolley, and improve the efficiency and the safety of the construction of a groove, a tunnel, a rock mass and the like.

[0005] In order to solve the above technical problems, the present invention adopts the following technical solution to achieve:

An automatic trolley construction device, comprising a frame vehicle, wherein the bottom of the frame vehicle is provided with a bottom cross beam and traveling wheels, the top of the frame vehicle is provided with a top arch cross beam, a rack rail is installed on the top arch cross beam, the rack rail is meshed with a gear, the gear is connected with a third motor through a connecting shaft, the third motor is configured to drive the gear to move along the rack rail, the connecting shaft is connected with an upright column through an outer sleeve, the upright column is connected with a crossbar, a first motor is installed on the crossbar, the first motor drives a rotating disk to rotate through a first star gear, the rotating disk is rotatably connected with the upright column, a construction device operating arm component is installed on the

rotating disk, an end of the construction device operating arm component is connected with a construction device connecting component, and the construction device connecting component is configured to connect a plurality of construction devices.

[0006] Preferably, the construction device operating arm component comprises a main arm and a first amplitude cylinder installed on the rotating disk, the main arm is hinged with an auxiliary arm, the auxiliary arm is hinged with a forearm, the first amplitude cylinder is configured to drive the auxiliary arm to rotate, a second amplitude cylinder is installed on the auxiliary arm, the second amplitude cylinder is configured to drive the forearm to rotate, a third amplitude cylinder is installed on the forearm, the third amplitude cylinder is hinged with a crank arm, and the crank arm is connected with an outer sleeve of the construction device connecting component.

[0007] Preferably, the construction device connecting component further comprises an assembly groove formed in a side wall of the outer sleeve, a telescopic cylinder is provided at an end of the outer sleeve, the telescopic cylinder is configured to drive a plunger rod to move, the plunger rod is a valve-splitting column, the outer sleeve is configured to accommodate an inner sleeve, the inner sleeve is transversely provided with a locking column at one end, the locking column is a variable-diameter column, the plunger rod is matched with the locking column for locking the inner sleeve and the outer sleeve, the inner sleeve is connected with a connecting plate, and the connecting plate is configured to connect the construction devices.

[0008] Preferably, a supporting cylinder is installed on the bottom cross beam, and a supporting plate is provided at the bottom of the supporting cylinder.

[0009] Preferably, the construction device comprises a bucket, a drilling machine and a grouting machine.

[0010] Preferably, the frame vehicle is provided with a spray gun suspension point, a drill pipe suspension point and a bucket platform.

[0011] Preferably, both sides of the frame vehicle are provided with movable working platforms comprising multiple layers of platforms arranged vertically, the platform is rotatably connected with a platform shaft through a supporting point, the platform shaft is connected with the supporting point, the supporting point is installed on the frame vehicle, the supporting point is rotatably connected with the platform shaft through a bearing, the platform shaft is connected with a shaft wheel through a bearing, the shaft wheel is fixedly connected with the platform, the shaft wheels of the platform on the same side, both upper and lower, are connected through a chain, and the chain is driven to rotate by a platform steering device.

[0012] Preferably, the platform steering device comprises a second motor and a second star gear, the chain is driven to rotate by the second motor and the second star gear, and the second motor drives the platform to rotate by the second star gear, the chain and the shaft

wheels.

[0013] Preferably, a trigger block is installed at the bottom of the platform, a bottom stop block is provided on the trolley frame, a proximity switch is provided on the bottom stop block, after the trigger block is in contact with the proximity switch, the second motor stops operating, and after the platform is leveled, the bottom stop block is configured to support the weight of the platform.

[0014] Preferably, the platform comprises a platform bottom plate, a back plate, a side plate and a side plate stop block, the platform bottom plate is provided with a shaft column, the shaft column is connected with the side plate through a side plate shaft, the platform bottom plate is connected with the back plate through a back plate shaft, the back plate stop block is configured to limit the back plate, and the side plate stop block is configured to limit the side plate.

[0015] Preferably, the back plate is driven to turn over by a turnover cylinder, the back plate is provided with a connecting hinge, the connecting hinge is connected with the side plate, and when the back plate is erected, the back plate slides in hinge slidable way of the side plates at both sides under the driving of the connecting hinge, so that the side plates at both sides are erected synchronously under the driving of the back plate.

[0016] Preferably, each back plate and each side plate are provided with trigger blocks, each back plate stop block and each side plate stop block are provided with proximity switches, and the turnover cylinder stops operating after the trigger block is in contact with the proximity switch.

[0017] Preferably, the bottom of the frame vehicle is provided with a power device and a pulping machine, the power device comprises an air compressor, the air compressor is configured to provide an air power to the first amplitude cylinder, the second amplitude cylinder, the third amplitude cylinder and the turnover cylinder; and the pulping machine is configured to prepare concrete slurry and supply the concrete slurry to a concrete spray gun through a mortar pump for slurry spraying and anchoring construction.

[0018] Preferably, the frame vehicle is provided with an electric control cabinet and a power cabinet, the electric control cabinet is used for overall control of the automatic trolley construction device, the power cabinet is configured to provide an electric power to the automatic trolley construction device, and an external power supply is provided to the automatic trolley construction device through a power supply connector attached to the power cabinet.

[0019] Preferably, an operation method of the automatic trolley construction device, which comprises the following steps:

Step 1, preparing construction: driving a frame vehicle to the site ready for construction, starting a power cabinet and an electric control cabinet, extending a supporting plate on a supporting cylinder,

and after supporting the ground, the traveling wheel being out of contact with the ground;

Step 2: unfolding a platform: starting a second motor and a second star gear, driving a chain to rotate, driving a platform to turn over while driving a shaft wheel to rotate, when a trigger block at the bottom of the platform is in contact with a proximity switch provided on the bottom stop block, a second motor stopping operating, the platform stopping turning over, and then starting a turnover cylinder to drive a back plate to turn over and be erected, driving side plates at both sides to be erected through a connecting hinge, the trigger block provided on the side plate being in contact with the proximity switch and stopping turning over after turning over in place;

Step 3, construction operation: selecting different construction device connecting components for connection according to the type of the operation to be carried out, controlling an operating arm to swivel or an arm rod to carry out a telescopic action, sleeving an outer sleeve at an end of a crank arm into an inner sleeve, driving a telescopic cylinder to connect the inner sleeve with the outer sleeve reliably, that is, connect the operating arm with the construction device connecting component, and then carrying out corresponding drilling, excavation or concrete spray protection operations;

Step 4, construction completion: after the work is completed, controlling an operating arm component to swivel or the arm rod to carry out a telescopic action, placing the construction device connecting component on a bucket platform or a spray gun suspension point and a drill pipe suspension point, driving the telescopic cylinder to disconnect the inner sleeve from the outer sleeve; turning over and retracting the working platform, the back plate and the side plate, and then driving the supporting cylinder to retract the supporting plate, and after the traveling wheel is in contact with the ground, driving the frame vehicle away from the working place.

[0020] The present disclosure can achieve the following beneficial effects.

1. Strong universality: the present disclosure innovatively designs a multi-purpose construction device through an ingenious design, which effectively fills the technical gap in the construction device in confined spaces and has good application scenarios and prospects in narrow spaces such as various tunnels.

2. Powerful functions: in combination with the characteristics of construction in narrow spaces, the present disclosure innovatively achieves the effect of multi-purpose and full-process construction, which not only can be used for drilling operation, spraying and anchoring operation, slag cleaning operation, etc., but also has powerful functions

and strong expansibility. Various functions can be quickly converted and matched with each other, demonstrating excellent functionality and cost-effectiveness.

3. Standardization of manufacturing: the device according to the present disclosure can be categorized into several types for standardized manufacturing, enabling rapid mass production and meeting the requirements of standardized production.

4. Strong innovation: through the ingenious conception, the present disclosure transfers the construction device originally only applicable to a vehicle-mounted platform to a frame vehicle, making it more flexible and convenient than when used on a vehicle-mounted platform. A telescopic platform and a railing are used in the narrow construction space in a cave, so that on the one hand, the function conversion is very convenient, while on the other hand, the function is achieved in a very simple and feasible manner, showing excellent innovation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] In order to explain the detailed description of the present disclosure or the technical scheme in the prior art more clearly, the drawings needed in the description of the detailed description or the prior art will be briefly introduced hereinafter. Obviously, the drawings in the following description are some embodiments of the present disclosure. For those skilled in the art, other drawings can be obtained according to these drawings without paying a creative labor.

FIG. 1 is a front view of the present disclosure.

FIG. 2 is a side view of the present disclosure.

FIG. 3 is a schematic structural diagram of a construction device connecting component according to the present disclosure.

FIG. 4 is a C view in FIG. 3.

FIG. 5 is a schematic diagram of installing a construction device connecting component and a bucket according to the present disclosure.

FIG. 6 is a D view in FIG. 5.

FIG. 7 is a diagram of folding a movable working platform according to the present disclosure.

FIG. 8 is a side view of a movable working platform.

FIG. 9 is a cross-sectional view taken along the line E-E in FIG. 8.

FIG. 10 is a schematic diagram of a working condition of a concrete spray gun according to the present disclosure.

FIG. 11 is a schematic diagram of a working condition of a drill pipe according to the present disclosure.

FIG. 12 is a schematic diagram of unfolding a side plate according to the present disclosure.

FIG. 13 is a schematic diagram of unfolding a bottom plate according to the present disclosure.

FIG. 14 is an overall structural diagram of a movable

working platform according to the present disclosure after the movable working platform is folded.

[0022] In the figures, frame vehicle 1, bottom cross beam 2, traveling wheel 3, top arch cross beam 4, rack rail 5, gear 6, connecting shaft 7, third motor 8, upright column 9, crossbar 10, first motor 11, first star gear 12, rotating disk 13, main arm 14, auxiliary arm 15, forearm 16, first amplitude cylinder 17, second amplitude cylinder 18, third amplitude cylinder 19, crank arm 20, outer sleeve 21, assembly groove 22, telescopic cylinder 23, locking column 24, plunger rod 25, inner sleeve 26, connecting plate 27, spray gun suspension point 28, drill pipe suspension point 29, bucket platform 30, platform 31, platform bottom plate 31.1, back plate 31.2, side plate 31.3, back plate stop block 31.4, side plate stop block 31.5, shaft column 31.6, side plate shaft 31.7, back plate shaft 31.8, turnover cylinder 31.9, connecting hinge 31.10, hinge slideway 31.11, platform shaft 32, supporting point 33, shaft wheel 34, chain 35, second motor 36, second star gear 37, proximity switch 38, air compressor 39, electric control cabinet 40, power cabinet 41, power supply connector 42, supporting cylinder 43, supporting plate 44, camera 45, bucket 46, concrete spray gun 47, drill pipe 48, trigger block 49, bottom stop block 50, stop bar 51, pulping machine 52, mortar pump 53, open groove 54

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0023] The technical scheme of the present disclosure will be further described with reference to the attached drawings.

[0024] It is obvious that the described embodiments are part of, not all, the embodiments of the present invention. Based on the embodiments of the present invention, all other embodiments obtained by a person skilled in the art without creative labor belong to the protection scope of the present invention.

[0025] In the description of the present invention, it is necessary to note that the terms "center", "top", "bottom", "left", "right", "vertical", "horizontal", "inside", "outside" and the like indicate azimuthal or positional relationships based on the azimuthal or positional relationships shown on the accompanying drawings for the convenience of describing the present invention and simplifying the description, not indicating or implying that the device or element referred to must have a particular orientation, be constructed and operated in a particular orientation, and therefore cannot be construed as limiting the present invention. In addition, the terms "first", "second", and "third" are intended for descriptive purposes only and are not to be construed as indicating or implying relative importance.

[0026] In the description of the present invention, it is necessary to note that the terms "install", "connect" and "connect" are to be understood in a broad sense, for example, they may be fixed or detachable, or connected

in one piece, unless otherwise expressly specified and defined; It can be mechanical connection or electrical connection; It can be connected directly or indirectly through intermediate medium, and can be the connection between two elements. For those of ordinary skill in the art, the above terms can be specifically understood in the present invention.

[0027] In addition, the technical features described below in different embodiments of the present invention may be combined as long as they do not constitute a conflict with each other.

Embodiment 1:

[0028] The preferred scheme is shown in FIG. 1 to FIG. 14. An automatic trolley construction device mainly includes a trolley structure, a multifunctional construction device, a movable working platform, a power device, a control device, etc. The structures and the functions of each device are as follows.

1. Trolley structure

[0029] The trolley uses various shapes matched with the excavation surface. Taking the tunnel as an example, a gate-shaped arch structure can be selected. The trolley moves as a whole in the manner of a traveling wheel 3 or a crawler belt. A transverse top arch cross beam 4 is provided at the upper part of the trolley, and a rack rail 5 embedded in the lower opening is provided at the top arch cross beam 4, so that the device can move on the trolley. A bottom cross beam 2 is provided at the lower part of the trolley. A supporting plate 44 is provided on the bottom cross beam 2, which is expanded and retracted by a supporting cylinder 43, so as to support the trolley as a whole in the working state and ensure the working stability.

[0030] The trolley is the transportation carrier of the whole device. Specifically, the trolley includes a frame vehicle 1. The bottom of the frame vehicle 1 is provided with a bottom cross beam 2 and traveling wheels 3. The top of the frame vehicle 1 is provided with a top arch cross beam 4. A rack rail 5 is installed on the top arch cross beam 4. The rack rail 5 is meshed with a gear 6. The frame vehicle 1 is provided with a spray gun suspension point 28, a drill pipe suspension point 29 and a bucket platform 30. A supporting cylinder 43 is installed on the bottom cross beam 2, and a supporting plate 44 is provided at the bottom of the supporting cylinder 43.

2. Multifunctional construction device

[0031] The multifunctional construction device of the present disclosure is a construction device with a replaceable working part under a mechanical arm. Specifically, embedded rack rails 5 are provided at both sides of the open groove in the lower part of the top arch cross beam 4, respectively. The rails are arranged along the

length direction of the top arch cross beam 4. The gears meshed with the rack are connected through a connecting shaft 7, and are driven by a third motor to move in a meshing manner on the rack. The connecting shaft 7 is driven by the motor to rotate together with the gear. The connecting shaft 7 is sleeved with the sleeve through a bearing of the outer sleeve 21. The sleeve is then connected with the upright column 9. The upright column 9 is fixedly connected with the crossbar 10. The gear 6 vertically connected with the third motor 8 at the end of the crossbar 10 is an oblique star gear. The gear 6 is meshed with the gear in the circumferential direction of the rotating disk 13 connected with the vertical shaft through the bearing to drive the rotating disk 13 to rotate. The lower part of the rotating disk 13 is connected with the main arm 14 and the first amplitude cylinder 17 through a hinge point. The other end of the first amplitude cylinder 17 is connected with the auxiliary arm 15. The main arm 14 is connected with the auxiliary arm 15 through a hinge point. The auxiliary arm 15 is connected with the forearm 16 through a hinge point. The second amplitude cylinder 18 is connected between the auxiliary arm 15 and the forearm 16. The front end of the forearm 16 is connected with the outer sleeve 21 through the third amplitude cylinder 19 and the crank arm 20 and then through a hinge point. The construction device of different forms and functions is connected by the outer sleeve 21. The construction device is driven by the construction device operating arm component. The construction device operating arm component includes a main arm 14 and a first amplitude cylinder 17 installed on the rotating disk 13. The main arm 14 is hinged with the auxiliary arm 15. The auxiliary arm 15 is hinged with a forearm 16. The first amplitude cylinder 17 is configured to drive the auxiliary arm 15 to rotate. A second amplitude cylinder 18 is installed on the auxiliary arm 15. The second amplitude cylinder 18 is configured to drive the forearm 16 to rotate. A third amplitude cylinder 19 is installed on the forearm 16. The third amplitude cylinder 19 is hinged with a crank arm 20. The crank arm 20 is connected with an outer sleeve 21 of the construction device connecting component.

[0032] The construction device connecting component is configured to connect various construction devices. The construction device connecting component includes an outer sleeve 21. The outer sleeve 21 is in a structural form, one end of which is provided with a telescopic cylinder 23 and the bottom of which is provided with an assembly groove 2. The inner sleeve 26 on various construction devices is connected with the outer sleeve in a matching manner. The inner sleeve 26 is in a cylindrical structure with an open groove therein. The inner sleeve 26 is transversely provided with a locking column 24 at one end. The diameter of the locking column 24 gradually decreases from the bottom to the top. The axis of the locking column 24 coincides with the diameter of the inner sleeve 26. The lower part of the inner sleeve 26 is fixedly connected with various construction devices

through a connecting plate 27. When different construction devices need to be installed on the device of the outer sleeve 21, the forearm 16 drives the outer sleeve 21 to axially align an orifice at one end of the outer sleeve far away from the telescopic cylinder 23 with the end of the inner sleeve 26. When the outer sleeve 21 extends into the inner sleeve 26, the plunger rod 25 of the telescopic cylinder 23 is in a retracted state. The assembly groove 22 at the lower part of the outer sleeve 21 is designed to pass through the connecting plate 27 to avoid mutual interference. After the outer sleeve 21 completely penetrates into the inner sleeve 26, the plunger rod 25 of the telescopic cylinder 23 extends. The plunger rod 25 has a valve-splitting shape with an internal hole. The internal hole also has a tapered structure with a large external port and a small internal port. This design is convenient to cooperate with the locking column 24 in the inner sleeve 26, because the locking column 24 has a structure with a large inner end and a small outer end. When the locking column 24 penetrates into the valve-splitting column, the valve-splitting column is gradually expanded. The valve-splitting column abuts against the inner side of the inner sleeve 26 tightly, and even the outer shell of the inner sleeve 26 is slightly expanded, because open grooves are provided between the valve-splitting parts of the inner sleeve 26. In this way, the expansion will not damage the inner sleeve 26, but can allow the inner sleeve and the outer sleeve 21 to be combined more tightly, preventing the construction device from loosening and falling during work. In order to release the inner sleeve and the outer sleeve 21 from contact, the retraction of the telescopic cylinder 23 and the reverse operation of the above operation can be used to know that the inner sleeve and the outer sleeve 21 can be separated from each other and return to the original state.

[0033] Through the same connecting method described above, a construction device such as a bucket, a drilling machine and a grouting machine can be connected to complete different construction operations. During the operation of the construction device, not only the action and the function can be realized by the expansion and contraction of the mechanical arm and the matching amplitude cylinder, but also the possibility of working in different directions can be realized by synchronously rotating the rotating disk 13, moving on the rack rail 5 or traveling the trolley. At the same time, the adjustment range is expanded. For example, a backhoe can play the role of a front shovel by rotating the rotating disk 13.

[0034] The device of the present disclosure can not only realize operations such as drilling, grouting and excavation, but also can be replaced with different quick operating arms as required to realize different functions and carry out rapid function expansion.

3. Movable working platform

[0035] In order to provide more working spaces to the

construction device, the platform of the trolley is set to be movable, rotatable and retractable. When the platform 31 is in a retracted state, the railing on the upper part is also in a retracted state. When the platform 31 is rotated and leveled in a working state, the railing on the upper part can be extended to protect workers. Platforms 31 are provided at both the inner side and the outer side of one side of the trolley, and a plurality of platforms 31 on one side can be rotated, expanded and retracted uniformly. The platforms 31 are all connected with the platform shaft 32 through a plurality of supporting points 33. The supporting point 33 is rotatably connected with the platform shaft 32 through a bearing. A shaft wheel 34 is also fixedly connected with the platform 31 at one end of the platform. The shaft wheel 34 is also fixedly connected with the platform shaft 32 through a built-in bearing. The shaft wheels 34 of the platform on the same side, both upper and lower, are connected in series through a chain 35, and then drive the chain 35 by a set of second motors 36 and second star gears 37 fixed on the platform shaft 32 to further drive the shaft wheel 34 and the platform to rotate, so that the platform 31 is in a horizontal working state or a vertical non-working state. A trigger block 49 is arranged on the bottom cross beam, and a proximity switch 38 is arranged on the corresponding bottom stop block 50. When the platform moves to a position close to the bottom stop block 50, the trigger block 49 is in contact with the proximity switch 38. After the control system obtains this feedback, the second motor 36 stops operating, and the second star gear 37 and the chain 35 stop operating synchronously. Since a plurality of sets of second motors 36, second star gears 37, and chains 35 are used to drive the device at different sides as well as at the left and right sides of the same edge, the purpose of independent operation can be achieved, ensuring the flexibility of operation.

[0036] After the platform is levelled, the bottom stop block 50 supports the weight of the platform. If necessary, the platform railing can be unfolded. In the stacking state, the platform back plates 31.2 are stacked at the bottom, and the side plates 31.3 at both sides are stacked above the back plate 31.2. The turnover and the erection of the railing are completed by the action of the turnover cylinder 31.9. At this time, the turnover cylinder 31.9 starts the action to support the back plate 31.2. The connecting hinges at the back of the back plate 31.2 are connected with the side plates 31.3 at both sides, respectively. The connecting hinge is fixedly connected to the back plate 31.2. The side plates 31.3 slide in the hinge slideways. When the back plate 31.2 is gradually erected, the connecting hinges slide in the hinge slideways of the side plates 31.3 at both sides under the driving of the connecting hinges, so that the side plates 31.3 at both sides are synchronously erected under the driving of the back plate 31.2. After the back plate 31.2 and the side plate 31.3 are erected, the safety of personnel operating on the platform can be guaranteed.

[0037] Specifically, the platform 31 includes a platform

bottom plate 31.1, a back plate 31.2, a side plate 31.3 and a side plate stop block 31.5. The platform bottom plate 31.1 is provided with a shaft column 31.6. The shaft column 31.6 is connected with the side plate 31.3 through a side plate shaft 31.7. The platform bottom plate 31.1 is connected with the back plate 31.2 through a back plate shaft 31.8. The back plate stop block 31.4 is configured to limit the back plate 31.2, and the side plate stop block 31.5 is configured to limit the side plate 31.3. The back plate 31.2 is driven to turn over by a turnover cylinder 31.9. The back plate 31.2 is provided with a connecting hinge 31.10. The connecting hinge 31.10 is connected with the side plate 31.3. When the back plate 31.2 is erected, the back plate slides in hinge slideway 31.11 of the side plates 31.3 at both sides under the driving of the connecting hinge 31.10, so that the side plates 31.3 at both sides are erected synchronously under the driving of the back plate 31.2. One or more of the back plates 31.2 and the side plates 31.3 are provided with trigger blocks. One or more of the back plate stop blocks 31.4 and the side plate stop blocks 31.5 are provided with proximity switches 38. The turnover cylinder 31.9 stops operating after the trigger block is in contact with the proximity switch 38.

4. Power device

[0038] An air compressor 39 is arranged on the platform at the bottom of the frame vehicle. The air compressor 39 provides an air power to each of the amplitude cylinders and a turn-over cylinder. The amplitude cylinder includes a first amplitude cylinder, a second amplitude cylinder and a third amplitude cylinder. The turn-over cylinder includes a turnover cylinder. A pulping machine 52 and a mortar pump 53 are further provided on the platform. The corresponding operations are carried out under the spraying and anchoring condition of using the concrete spray gun 47. Bucket platforms 30 are provided on the frame vehicle, respectively. The bucket platforms 30 are specially designed for placing idle buckets under non-bucket working conditions. In order to place the bucket 46 more stably, several stop bars are welded and fixed on the platforms to prevent the bucket 46 from shaking and falling off the platforms under the working condition of the frame vehicle. Several suspension points, including a spray gun suspension point 28 and a drill pipe suspension point 29, are also provided at appropriate positions on the upper part of the frame vehicle, which are used to suspend the drill pipe 48 and the concrete spray gun 47, thus facilitating the reasonable conversion between various working conditions. When digging, drilling and spraying and anchoring operations are carried out, the outer sleeve 21 and the inner sleeve 26 can be automatically interfaced with and separated from each other in the monitoring process of the camera 45 on the mechanical arm and the comparative analysis of the background control system. However, after the interfacing is completed, the interfacing and

disconnection operations of quick connectors such as hydraulic, air and control pipelines need to be manually carried out.

5. Control device

[0039] The platform of the frame vehicle is also provided with an electric control cabinet 40 and a power cabinet 41. The electric control cabinet 40 is used for overall control of the device according to the present disclosure. The power cabinet 41 is configured to provide a power to the device according to the present disclosure. An external power supply can be provided to the device according to the present disclosure through the power supply connector attached to the power cabinet 41. After the pressure and the power storage are adjusted through the power cabinet 41, the pressure and the power storage are controlled by the control cabinet and distributed to all power users.

[0040] As an alternative embodiment, the construction device connecting component not only can connect the bucket, the drilling machine and the grouting machine, but also can connect various construction devices such as a mechanical tong, a boom and a splitter according to the change and adjustment of the construction.

[0041] Preferably, the operation method of the automatic trolley construction device includes the following steps.

[0042] Step 1, preparing construction: a frame vehicle 1 drives to the site ready for construction, a power cabinet 41 and an electric control cabinet 40 start, a supporting plate 44 on a supporting cylinder 43 extends, and after supporting the ground, the traveling wheel 3 is out of contact with the ground.

[0043] Step 2: unfolding a platform: a second motor 36 and a second star gear 37 start, a chain 35 is driven to rotate, a platform 31 is driven to turn over while driving a shaft wheel 34 to rotate, when a trigger block 49 at the bottom of the platform 31 is in contact with a proximity switch 38 provided on the bottom stop block 50, a second motor 36 stops operating, the platform 31 stops turning over, and then a turnover cylinder 31.9 starts to drive a back plate 31.2 to turn over and be erected, side plates 31.3 at both sides are driven to be erected through a connecting hinge 31.10, the trigger block provided on the side plate is in contact with the proximity switch, and turning over stops after turning over in place.

[0044] Step 3, construction operation: different construction device connecting components are selected for connection according to the type of the operation to be carried out. An operating arm is controlled to swivel or an arm rod is controlled to carry out a telescopic action. An outer sleeve 21 at an end of a crank arm 20 is sleeved into an inner sleeve 26. A telescopic cylinder 23 is driven to connect the inner sleeve 26 with the outer sleeve 21 reliably, that is, connect the operating arm with the construction device connecting component, and then corresponding drilling, excavation or concrete spray protec-

tion operations are carried out. In this way, different construction device connecting components can be replaced to carry out construction of different work contents.

[0045] Step 4, construction completion: after the work is completed, an operating arm component is controlled to swivel or the arm rod is controlled to carry out a telescopic action. The construction device connecting component is placed on a bucket platform 30 or a spray gun suspension point 28 and a drill pipe suspension point 29. The telescopic cylinder 23 is driven to disconnect the inner sleeve 26 from the outer sleeve 21. The working platform 31, the back plate 31.2 and the side plate 31.3 are turned over and retracted, and then the supporting cylinder 43 is driven to retract the supporting plate 44. After the traveling wheel 3 is in contact with the ground, the final related work is completed. The frame vehicle 1 may drive away from the working place.

[0046] As an alternative embodiment, the construction device connecting component not only can connect the bucket, the drilling machine and the grouting machine, but also can connect various construction devices such as a mechanical tong, a boom and a splitter according to the change and adjustment of the construction.

[0047] The above embodiment is only the preferred technical scheme of the present disclosure, and should not be regarded as the limitation of the present disclosure. The scope of protection of the present disclosure should take the technical scheme described in the claims, including the equivalent alternatives of technical features in the technical scheme described in the claims, as the scope of protection. For those skilled in the art, other modifications or changes in different forms can be made on the basis of the above description. It is unnecessary and impossible to exhaust all the embodiments here, that is, equivalent substitution and improvement within this scope also fall within the scope of protection of the present disclosure.

Claims

1. An automatic trolley construction device, comprising a frame vehicle (1), wherein the bottom of the frame vehicle (1) is provided with a bottom cross beam (2) and traveling wheels (3), the top of the frame vehicle (1) is provided with a top arch cross beam (4), a rack rail (5) is installed on the top arch cross beam (4), the rack rail (5) is meshed with a gear (6), the gear (6) is connected with a third motor (8) through a connecting shaft (7), the third motor (8) is configured to drive the gear (6) to move along the rack rail (5), the connecting shaft is connected with an upright column (9) through an outer sleeve, the upright column (9) is connected with a crossbar (10), a first motor (11) is installed on the crossbar (10), the first motor (11) drives a rotating disk (13) to rotate through a first star gear (12), the rotating disk (13) is rotatably con-

nected with the upright column (9), a construction device operating arm component is installed on the rotating disk (13), an end of the construction device operating arm component is connected with a construction device connecting component, and the construction device connecting component is configured to connect a plurality of construction devices.

2. The automatic trolley construction device according to claim 1, wherein the construction device operating arm component comprises a main arm (14) and a first amplitude cylinder (17) installed on the rotating disk (13), the main arm (14) is hinged with an auxiliary arm (15), the auxiliary arm (15) is hinged with a forearm (16), the first amplitude cylinder (17) is configured to drive the auxiliary arm (15) to rotate, a second amplitude cylinder (18) is installed on the auxiliary arm (15), the second amplitude cylinder (18) is configured to drive the forearm (16) to rotate, a third amplitude cylinder (19) is installed on the forearm (16), the third amplitude cylinder (19) is hinged with a crank arm (20), and the crank arm (20) is connected with an outer sleeve (21) of the construction device connecting component.

3. The automatic trolley construction device according to claim 2, wherein the construction device connecting component further comprises an assembly groove (22) formed in a side wall of the outer sleeve (21), a telescopic cylinder (23) is provided at an end of the outer sleeve (21), the telescopic cylinder (23) is configured to drive a plunger rod (25) to move, the plunger rod (25) is a valve-splitting column, the outer sleeve (21) is configured to accommodate an inner sleeve (26), the inner sleeve (26) is transversely provided with a locking column (24) at one end, the locking column (24) is a variable-diameter column, the plunger rod (25) is matched with the locking column (24) for locking the inner sleeve (26) and the outer sleeve (21), the inner sleeve (26) is connected with a connecting plate (27), and the connecting plate (27) is configured to connect the construction devices.

4. The automatic trolley construction device according to claim 3, wherein a supporting cylinder (43) is installed on the bottom cross beam (2), and a supporting plate (44) is provided at the bottom of the supporting cylinder (43).

5. The automatic trolley construction device according to claim 4, wherein the construction device comprises a bucket, a drilling machine and a grouting machine.

6. The automatic trolley construction device according to claim 5, wherein the frame vehicle (1) is provided with a spray gun suspension point (28), a drill pipe

suspension point (29) and a bucket platform (30).

7. The automatic trolley construction device according to claim 6, wherein both sides of the frame vehicle (1) are provided with movable working platforms comprising multiple layers of platforms (31) arranged vertically, the platform (31) is rotatably connected with a platform shaft (32) through a supporting point (33), the platform shaft (32) is connected with the supporting point (33), the supporting point (33) is installed on the frame vehicle (1), the supporting point is rotatably connected with the platform shaft (32) through a bearing, the platform shaft (32) is connected with a shaft wheel (34) through a bearing, the shaft wheel (34) is fixedly connected with the platform (31), the shaft wheels (34) of the platform (31) on the same side, both upper and lower, are connected through a chain (35), and the chain (35) is driven to rotate by a platform steering device.
8. The automatic trolley construction device according to claim 7, wherein the platform steering device comprises a second motor (36) and a second star gear (37), the chain (35) is driven to rotate by the second motor (36) and the second star gear (37), and the second motor (36) drives the platform (31) to rotate by the second star gear (37), the chain (35) and the shaft wheels (34).
9. The automatic trolley construction device according to claim 8, wherein a trigger block (49) is installed at the bottom of the platform (31), a bottom stop block (50) is provided on the trolley frame (1), a proximity switch (38) is provided on the bottom stop block (50), after the trigger block (49) is in contact with the proximity switch (38), the second motor (36) stops operating, and after the platform (31) is leveled, the bottom stop block (50) is configured to support the weight of the platform (31).
10. The automatic trolley construction device according to claim 9, wherein the platform (31) comprises a platform bottom plate (31.1), a back plate (31.2), a side plate (31.3) and a side plate stop block (31.5), the platform bottom plate (31.1) is provided with a shaft column (31.6), the shaft column (31.6) is connected with the side plate (31.3) through a side plate shaft (31.7), the platform bottom plate (31.1) is connected with the back plate (31.2) through a back plate shaft (31.8), the back plate stop block (31.4) is configured to limit the back plate (31.2), and the side plate stop block (31.5) is configured to limit the side plate (31.3).
11. The automatic trolley construction device according to claim 10, wherein the back plate (31.2) is driven to turn over by a turnover cylinder (31.9), the back plate (31.2) is provided with a connecting hinge (31.10),

the connecting hinge (31.10) is connected with the side plate (31.3), and when the back plate (31.2) is erected, the back plate slides in hinge slideway (31.11) of the side plates (31.3) at both sides under the driving of the connecting hinge (31.10), so that the side plates (31.3) at both sides are erected synchronously under the driving of the back plate (31.2).

12. The automatic trolley construction device according to claim 11, wherein each back plate (31.2) and each side plate (31.3) are provided with trigger blocks, each back plate stop block (31.4) and each side plate stop block (31.5) are provided with proximity switches, and the turnover cylinder (31.9) stops operating after the trigger block is in contact with the proximity switch.
13. The automatic trolley construction device according to claim 12, wherein the bottom of the frame vehicle (1) is provided with a power device and a pulping machine (52), the power device comprises an air compressor (39), the air compressor (39) is configured to provide an air power to the first amplitude cylinder, the second amplitude cylinder, the third amplitude cylinder and the turnover cylinder; and the pulping machine (52) is configured to prepare concrete slurry and supply the concrete slurry to a concrete spray gun (47) through a mortar pump (53) for slurry spraying and anchoring construction.
14. The automatic trolley construction device according to claim 13, wherein the frame vehicle (1) is provided with an electric control cabinet (40) and a power cabinet (41), the electric control cabinet is used for overall control of the automatic trolley construction device, the power cabinet (41) is configured to provide an electric power to the automatic trolley construction device, and an external power supply is provided to the automatic trolley construction device through a power supply connector (42) attached to the power cabinet.
15. An operation method of the automatic trolley construction device according to claim 14, which comprises the following steps:

Step 1, preparing construction: driving a frame vehicle (1) to the site ready for construction, starting a power cabinet (41) and an electric control cabinet (40), extending a supporting plate (44) on a supporting cylinder (43), and after supporting the ground, the traveling wheel (3) being out of contact with the ground;
Step 2: unfolding a platform: starting a second motor (36) and a second star gear (37), driving a chain (35) to rotate, driving a platform (31) to turn over while driving a shaft wheel (34) to rotate,

when a trigger block (49) at the bottom of the platform (31) is in contact with a proximity switch (38) provided on the bottom stop block (50), a second motor (36) stopping operating, the platform (31) stopping turning over, and then starting a turnover cylinder (31.9) to drive a back plate (31.2) to turn over and be erected, driving side plates (31.3) at both sides to be erected through a connecting hinge (31.10), the trigger block provided on the side plate being in contact with the proximity switch and stopping turning over after turning over in place;

Step 3, construction operation: selecting different construction device connecting components for connection according to the type of the operation to be carried out, controlling an operating arm to swivel or an arm rod to carry out a telescopic action, sleeving an outer sleeve (21) at an end of a crank arm (20) into an inner sleeve (26), driving a telescopic cylinder (23) to connect the inner sleeve (26) with the outer sleeve (21) reliably, that is, connect the operating arm with the construction device connecting component, and then carrying out corresponding drilling, excavation or concrete spray protection operations;

Step 4, construction completion: after the work is completed, controlling an operating arm component to swivel or the arm rod to carry out a telescopic action, placing the construction device connecting component on a bucket platform (30) or a spray gun suspension point (28) and a drill pipe suspension point (29), driving the telescopic cylinder (23) to disconnect the inner sleeve (26) from the outer sleeve (21); turning over and retracting the working platform (31), the back plate (31.2) and the side plate (31.3), and then driving the supporting cylinder (43) to retract the supporting plate (44), and after the traveling wheel (3) is in contact with the ground, driving the frame vehicle (1) away from the working place.

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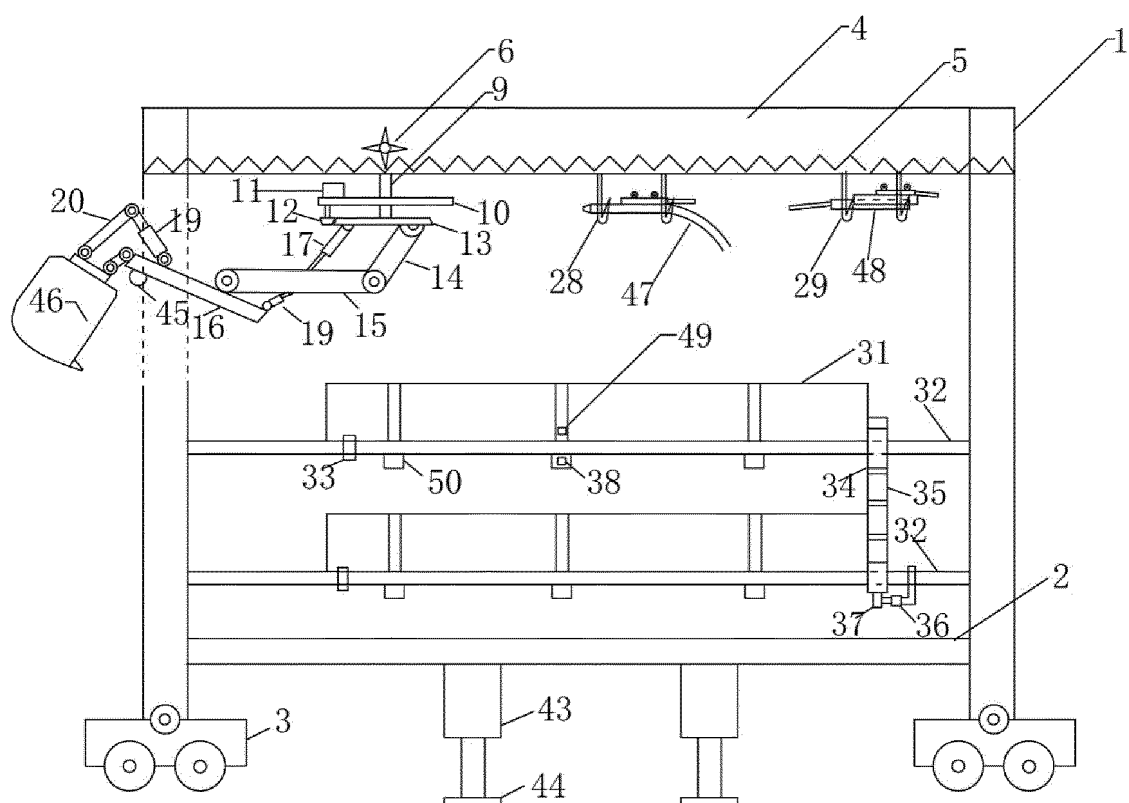


FIG. 1

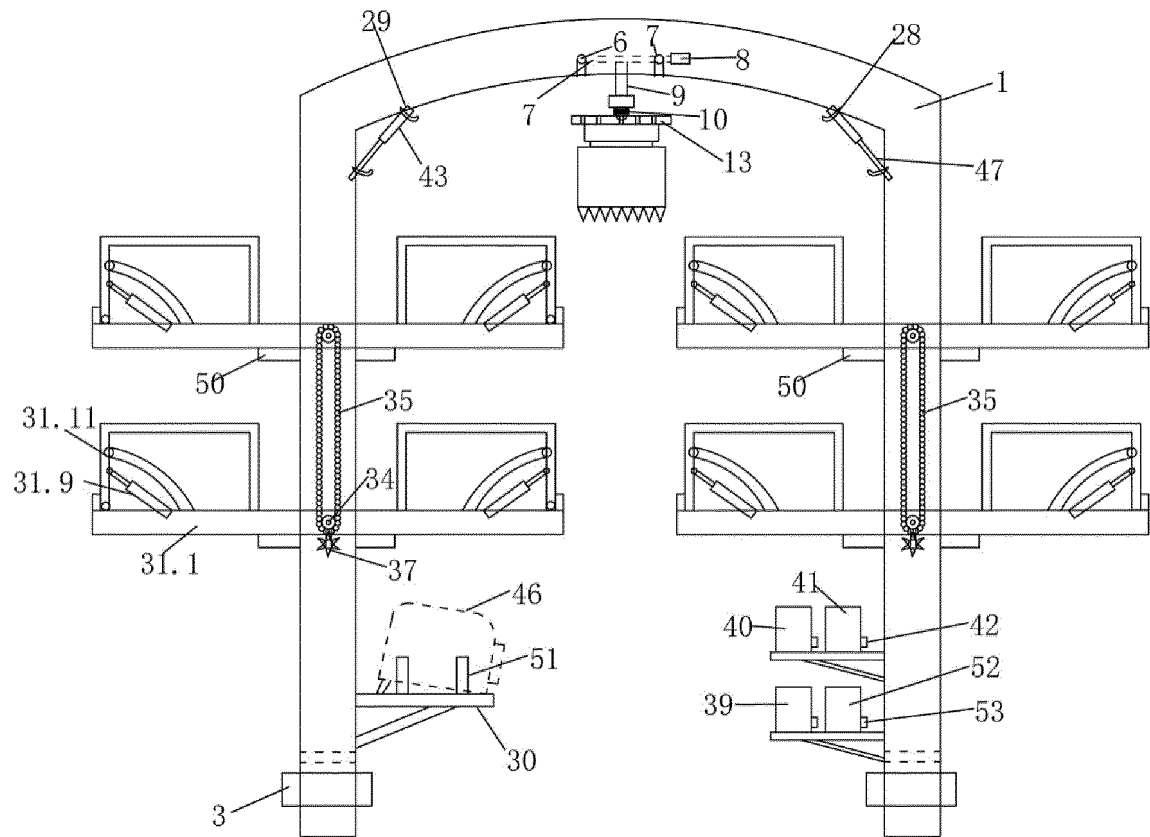


FIG. 2

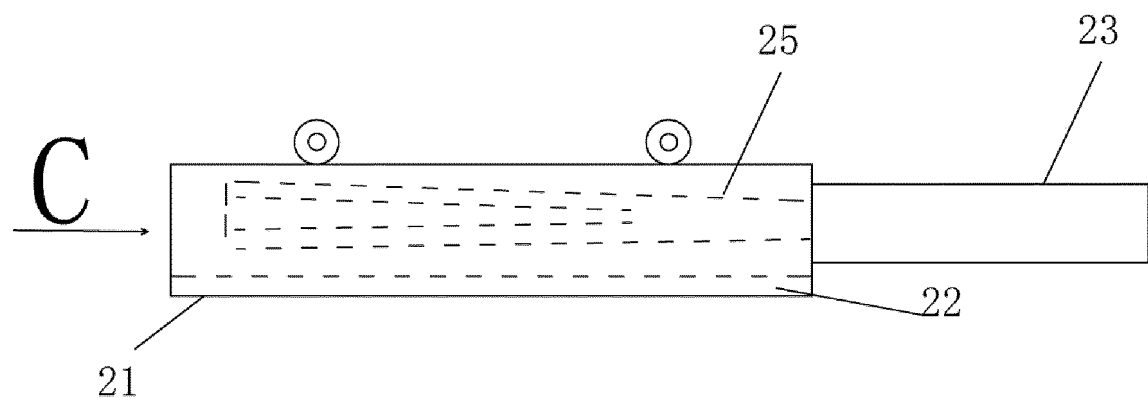


FIG. 3

C view

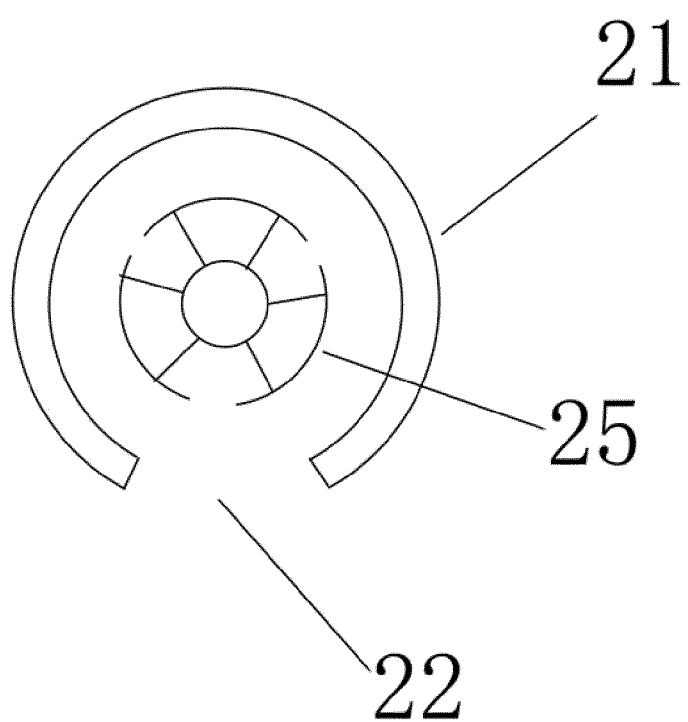


FIG. 4

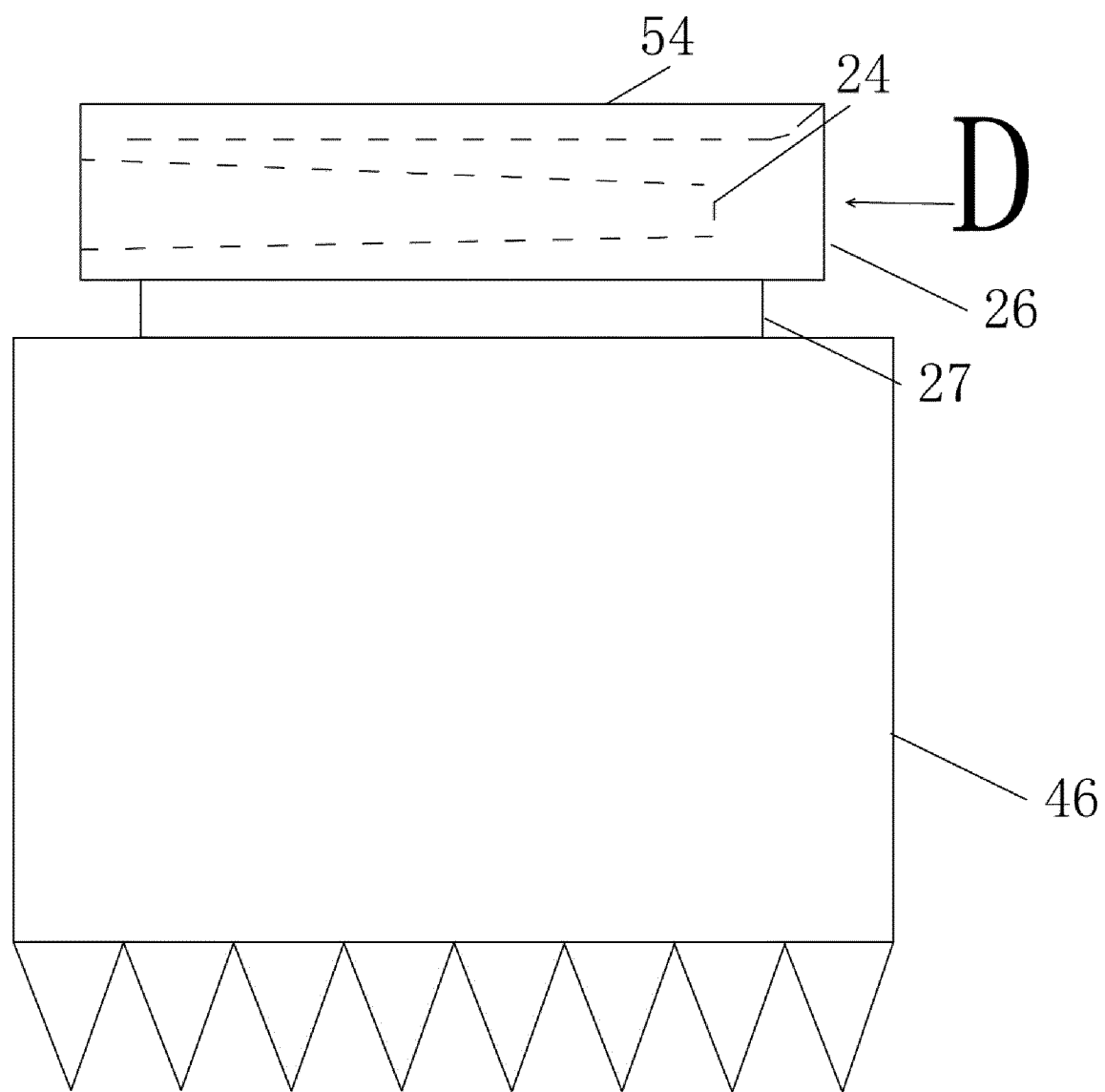


FIG. 5

D view

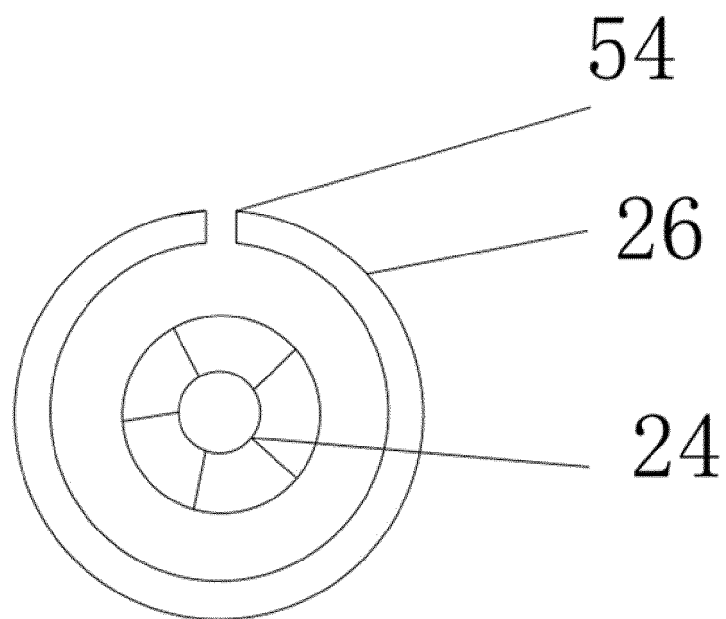


FIG. 6

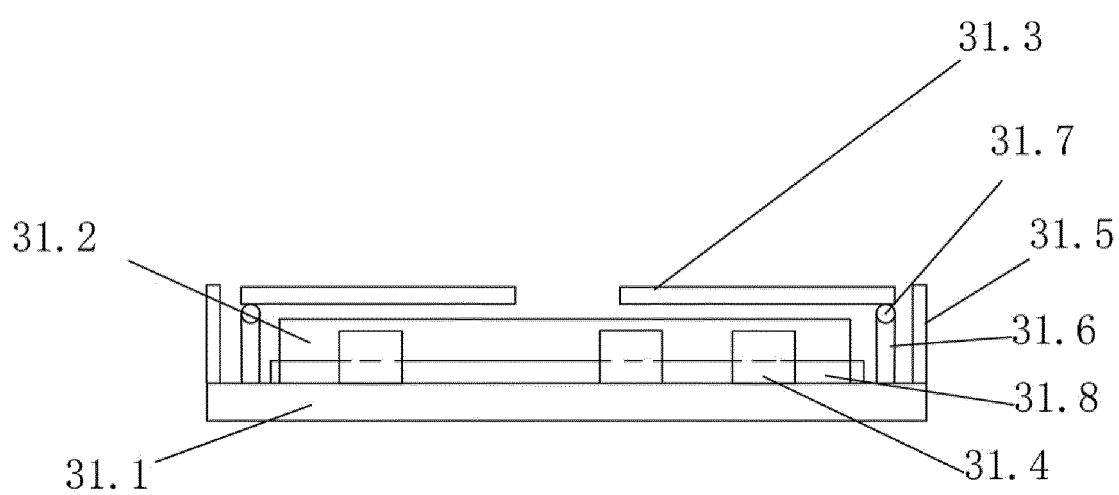


FIG. 7

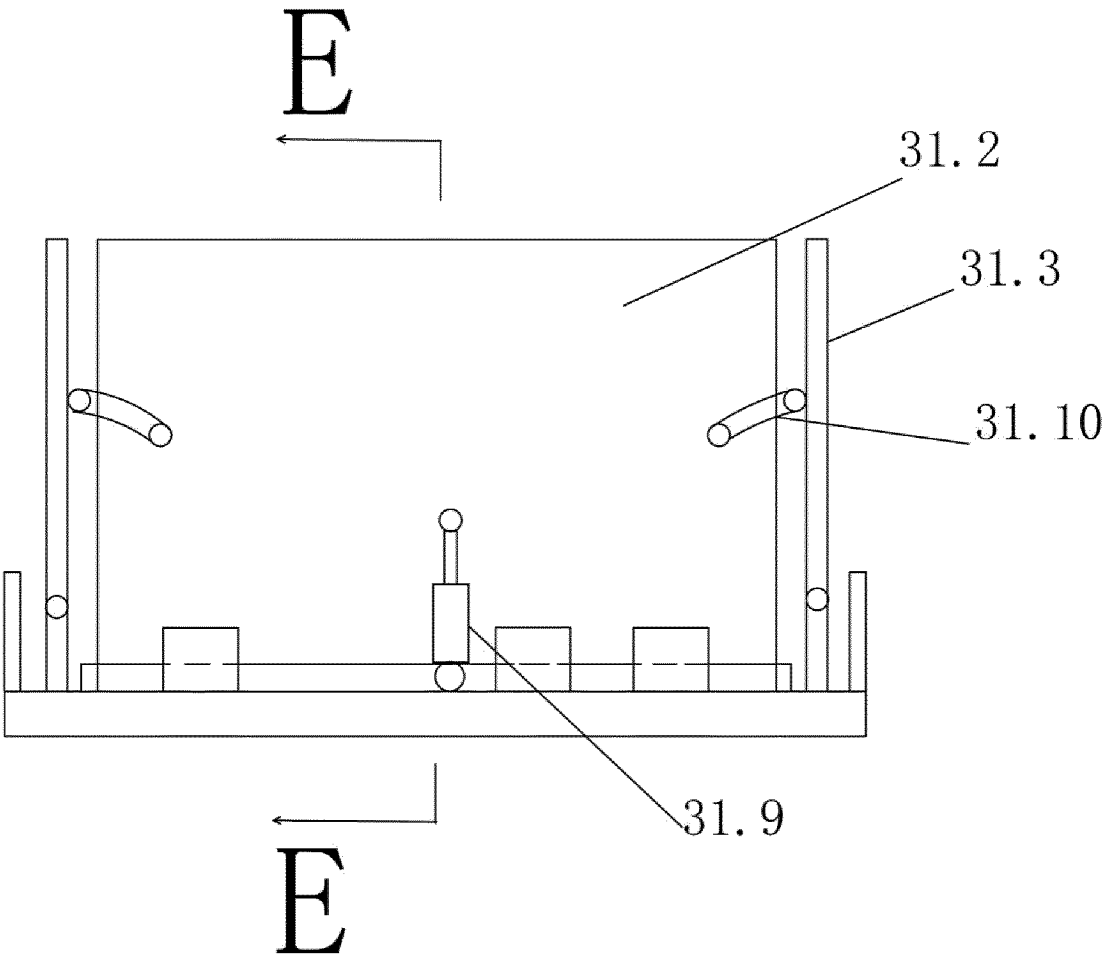


FIG. 8

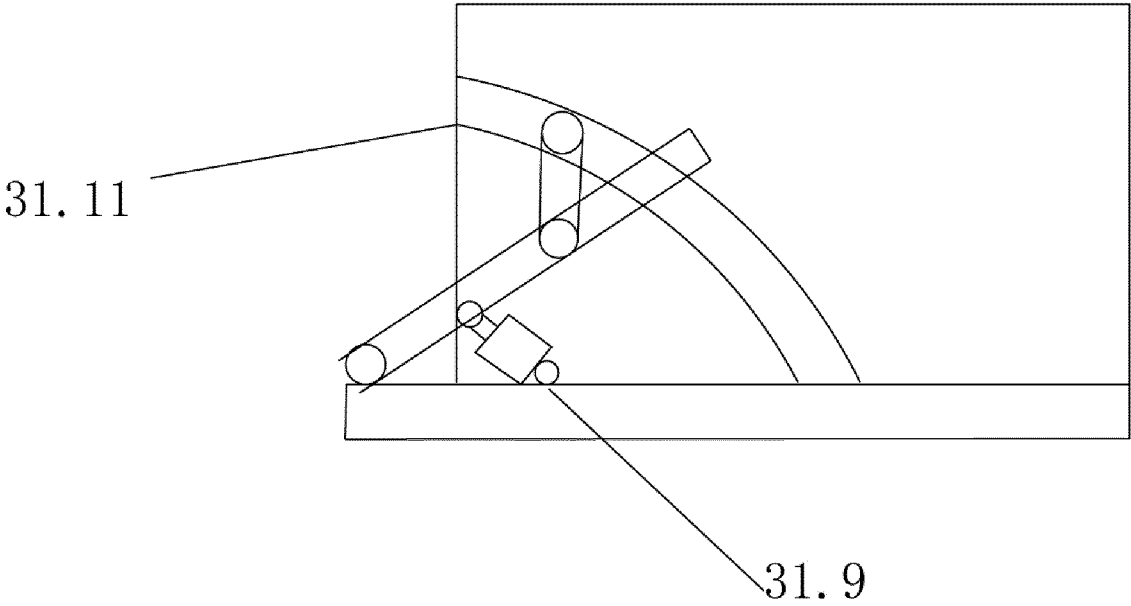


FIG. 9

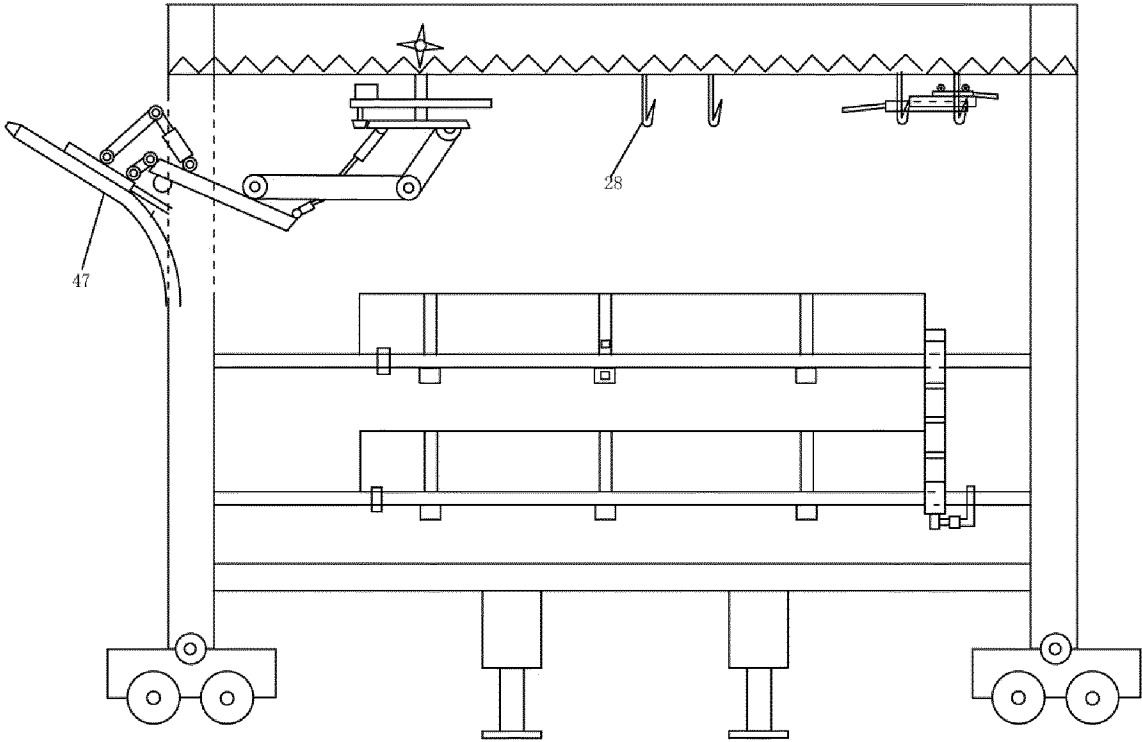


FIG. 10

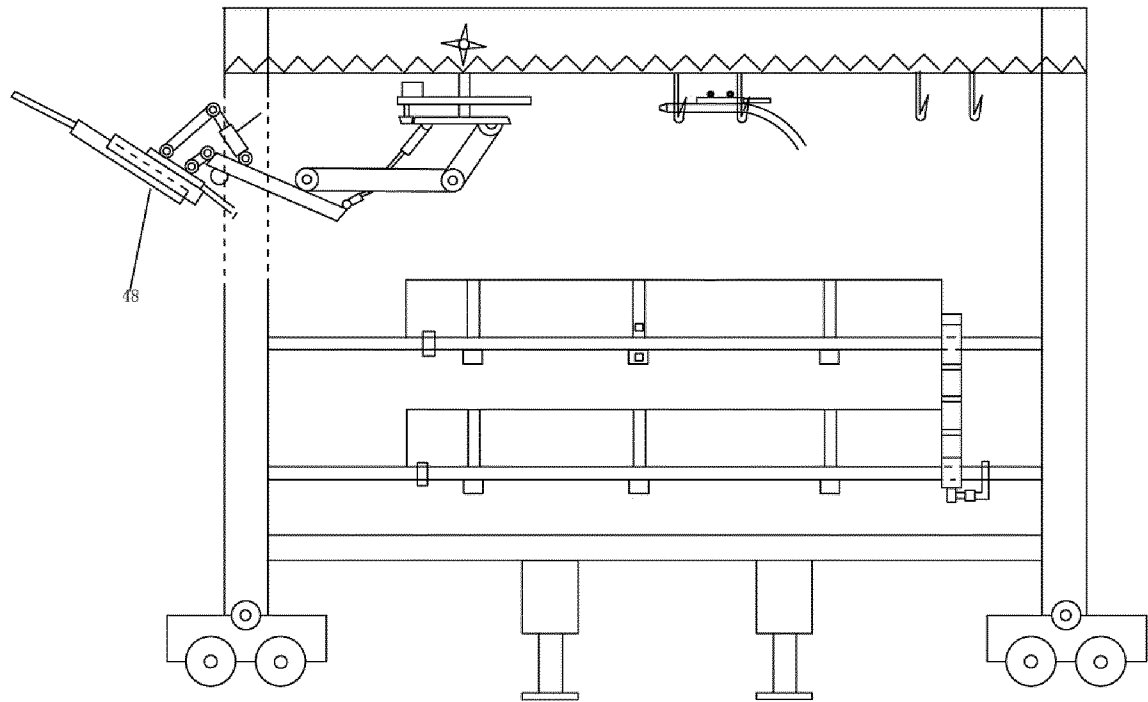


FIG. 11

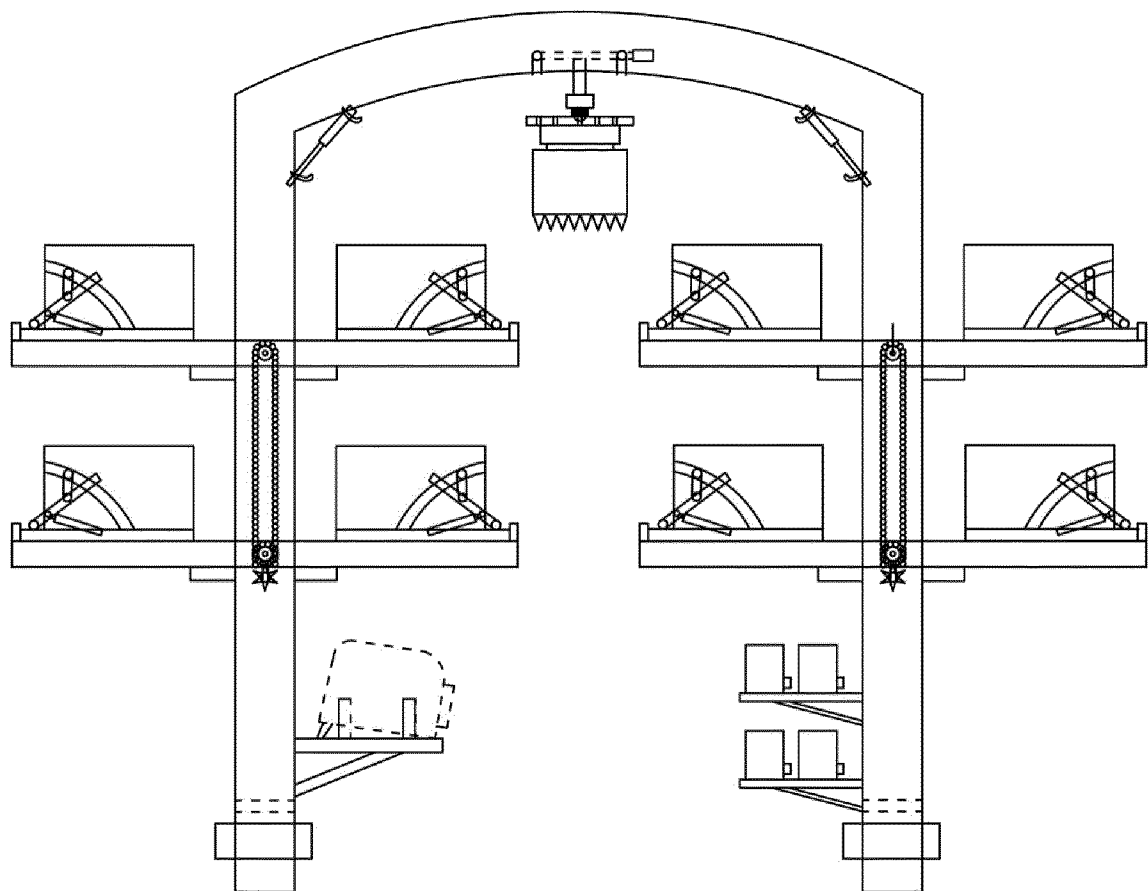


FIG. 12

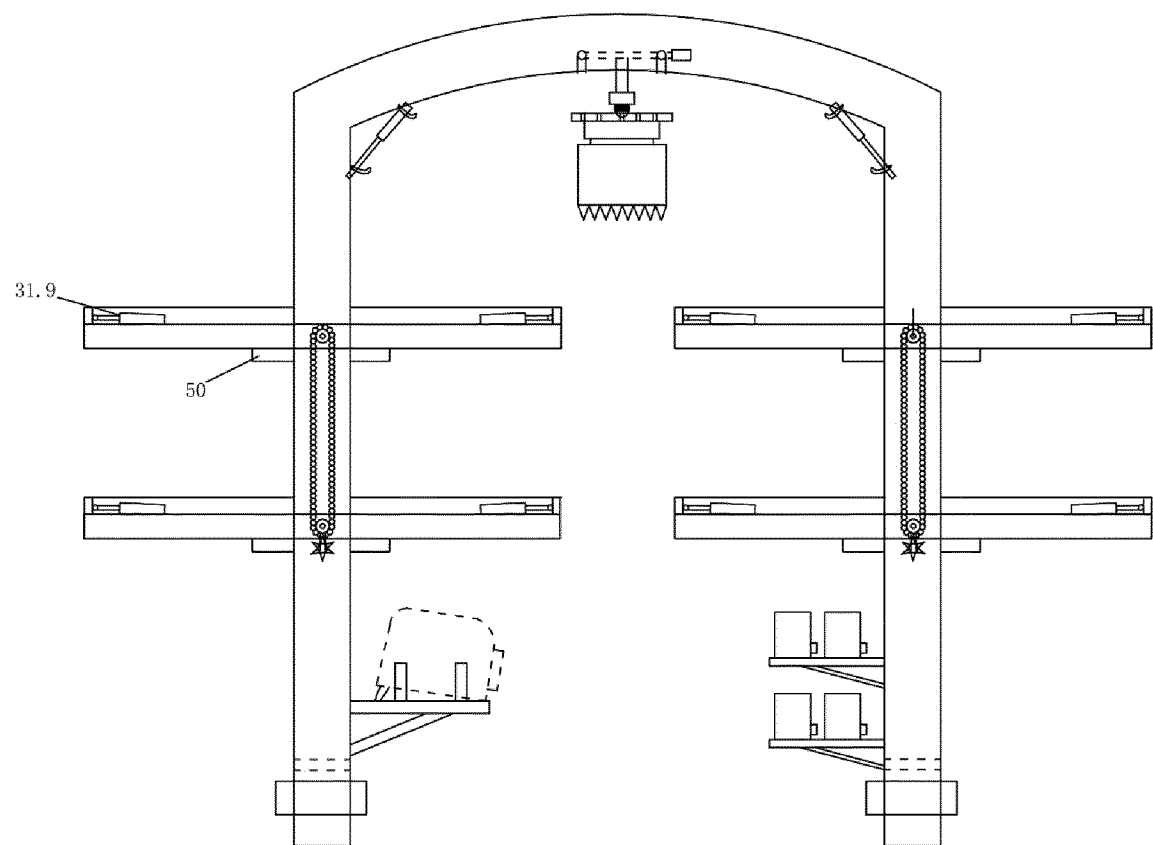


FIG. 13

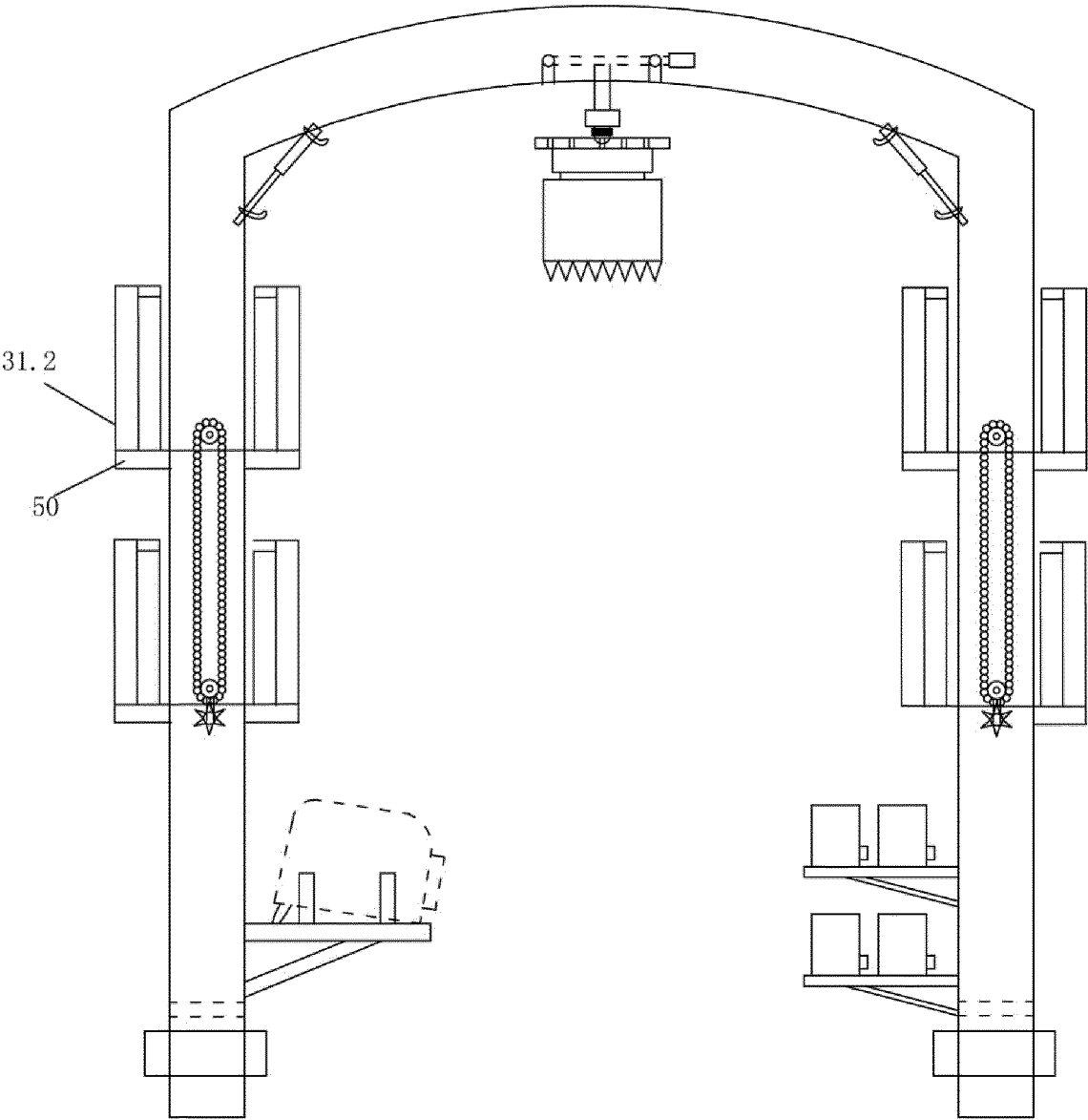


FIG. 14

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2024/115814

A. CLASSIFICATION OF SUBJECT MATTER

E21D9/12(2006.01)i; E21D11/10(2006.01)i; E21B7/02(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC:E21D,E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNTXT, ENTXTC, VEN, CJFD: 铲, 撑开, 涨开, 齿, 齿轮, 齿条, 轨, 瓣, 分瓣, 缸, 花瓣, 架, 梁, 扇形, 锁, 挖, 柱塞, 转盘, gear, trolley, +disk, turn+, +table, rotat+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 117231246 A (CHINA THREE GORGES CONSTRUCTION ENGINEERING (GROUP) CO., LTD.) 15 December 2023 (2023-12-15) description, paragraphs 35-53, and figures 1-14	1-15
Y	CN 113530575 A (CHINA RAILWAY 11 BUREAU HANJIANG HEAVY INDUSTRY CO., LTD. et al.) 22 October 2021 (2021-10-22) description, paragraphs 41-49, and figures 1-12	1-2
Y	CN 111764912 A (LIAONING VYUE GROUP MACHINERY MANUFACTURING CO., LTD.) 13 October 2020 (2020-10-13) description, paragraphs 69-79, and figures 1-15	1-2
A	CN 105626082 A (XCMG RAILWAY EQUIPMENT CO., LTD.) 01 June 2016 (2016-06-01) entire document	1-15
A	CN 116181344 A (CHINA RAILWAY 11TH BUREAU GROUP CO., LTD. et al.) 30 May 2023 (2023-05-30) entire document	1-15

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

22 November 2024

Date of mailing of the international search report

22 November 2024

Name and mailing address of the ISA/CN

China National Intellectual Property Administration (ISA/
CN)China No. 6, Xitucheng Road, Jimenqiao, Haidian District,
Beijing 100088

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2024/115814

C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	CN 215332914 U (LUOYANG SHANHAI MACHINERY MANUFACTURING CO., LTD.) 28 December 2021 (2021-12-28) entire document	1-15
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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	CN 105626082 A	01 June 2016	None	
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	CN 102409985 A	11 April 2012	None	
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REFERENCES CITED IN THE DESCRIPTION

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