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(54) PORTABLE EMBEDDED DIRECT-CURRENT ELECTRIC HOIST

(57) Provided is a portable embedded direct-current electric hoist, comprising a permanent magnet brushless direct-current motor (7), a controller (8), left and right end plates (2, 6), a rope drum (5), a first reducer (4), and a second differential transmission device (1), wherein the left and right end plates (2, 6) are fixedly connected into a whole through a connecting rod (3), and the rope drum (5) is rotatably arranged on the left and right end plates (2, 6); a built-in motor base (23) fixed to the right end plate (6) is provided in the rope drum (5), the permanent magnet brushless direct-current motor (7) and the first reducer (4) are fixed, in an abutting manner, to the built-in motor base (23), so that the permanent magnet brushless direct-current motor (7) and the first reducer (4) are embedded in the rope drum (5); the second differential transmission device (1) is fixed to the left end plate (2) and is connected to the first reducer (4) through a transmission shaft (16). During operation, the permanent magnet brushless direct-current motor drives, through the first reducer and the transmission shaft, the second differential transmission device to rotate, and the second differential transmission device drives the rope drum to rotate. After the above structure is employed, there are advantages of a simple and reasonable structure, flexible and easy lifting, a small volume, high transmission efficiency, a good braking effect, safe and reliable use, and so on.

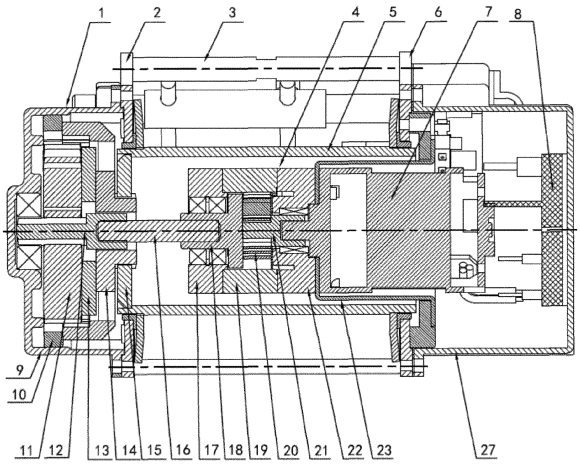

FIG. 1

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to the technical field of electric hoists, and in particular, to a portable embedded direct-current electric hoist with easy installation, a small volume, and good safety performance.

BACKGROUND

[0002] With the development of society and the progress of science and technology, people's economic income has been greatly increased, material living standards have undergone fundamental changes, and people have increasingly higher requirements on purchased hoisting equipment. Many hoisting equipment currently on the market uses an alternate-current motor, which is not convenient and cumbersome for outdoor or family use. At present, foreign countries are developing a small number of direct-current electric hoist products, with a structure that a motor, a reducer, and a steel wire rope drum are connected in series on the same axis, which has disadvantages of a large size in length, a bulky structure, and low mechanical efficiency. Moreover, the motor of the electric hoist products developed by the foreign countries adopts a brushed commutator direct-current motor, and a carbon brush needs to be replaced after a period of use. In use, a commutator frequently contacts the carbon brush to commutate at a high speed in case of a severe environment and high strength, which easily causes damage or even burn-in to the commutator. Besides, since the direct-current electric hoist is not provided with a braking device, there are serious safety risks, and the potential danger is self-evident. It at best can only be called a tractor but cannot be used as an electric hoist. Therefore, it is an urgent problem to develop a direct-current electric hoist with a simple and convenient structure, good safety performance, and practicability. Therefore, lots of manufacturers and people of insight are carrying out development and trial production in view of the above problems, but so far there has not been a more ideal product.

SUMMARY

[0003] In order to overcome the above shortcomings existing in the prior art, an objective of the present disclosure is to provide a portable embedded direct-current electric hoist with a simple and reasonable structure, flexible and easy operation, a small volume, high transmission efficiency, a good braking effect, safe and reliable use.

[0004] The present disclosure adopts the following technical solution to solve the technical problem thereof: the portable embedded direct-current electric hoist includes a permanent magnet brushless direct-current motor, a controller, left and right end plates, a rope drum, a first reducer, and a second differential transmission device, the left and right end plates are fixedly connected into a whole through a connecting rod, the rope drum is rotatably arranged on the left and right end plates, a built-in motor base fixed to the right end plate is provided in the rope drum, the permanent magnet brushless direct-current motor and the first reducer are fixed, in an abutting manner, to the built-in motor base, so that the permanent magnet brushless direct-current motor and the first reducer are embedded in the rope drum, and the second differential transmission device is fixed to the left end plate and is connected to the first reducer through a transmission shaft; and during operation, the permanent magnet brushless direct-current motor drives, through the first reducer and the transmission shaft, the second differential transmission device to rotate, and the second differential transmission device drives the rope drum to rotate.

[0005] As a further solution of the present disclosure, the first reducer includes an inner fixed mount, a first sun wheel, a first planetary wheel, a first planetary carrier, an inner gear ring, and an outer fixed mount, the outer fixed mount and the inner gear ring are fixedly connected to the inner fixed mount, the first sun wheel is rotatably arranged on the inner fixed mount and abuts an output shaft of the permanent magnet brushless direct-current motor, the first planetary carrier is rotatably arranged on the outer fixed mount and abuts the transmission shaft, the first planetary wheel is rotatably correspondingly arranged on a fixed shaft of the first planetary carrier, and the first planetary wheel engages with the first sun wheel at an inner side and the inner gear ring at an outer side, respectively; and during operation, the permanent magnet brushless direct-current motor drives the first planetary wheel through the first sun wheel, and the first planetary wheel rotates relative to the inner gear ring to drive, through the first planetary carrier, the transmission shaft to rotate, so as to achieve one-stage reduction output.

[0006] As a further solution of the present disclosure, the second differential transmission device includes a second sun wheel, a second planetary wheel, a floating planetary carrier, a fixed gear ring, a moving gear ring, and a second box body, the fixed gear ring is fixed to the second box body, the second sun wheel is rotatably arranged on the second box body and abuts the transmission shaft, the second planetary wheel is rotatably arranged on the floating planetary carrier, the second planetary wheel engages with the second sun wheel at an inner side and the fixed gear ring at an outer side respectively, the moving gear ring sleeves the second sun wheel, with one end simultaneously engaging with the second planetary wheel at an outer side and another end being connected to a fixed end plate on the rope drum, and the moving gear ring and the fixed gear ring are designed into a differential matching structure with different quantities of teeth; during operation, the first reducer drives the second sun wheel through the transmission shaft, the second sun wheel drives the second planetary wheel, the second planetary wheel rotates relative to the

fixed gear ring to drive the moving gear ring and the rope drum to rotate, so as to achieve two-stage reduction and differential output; and in case of shutdown, a heavy object actively drives the moving gear ring through the rope drum, the moving gear ring drives the second planetary wheel to rotate, and in this case, since the quantity of the teeth of the fixed gear ring is different from that of the moving gear ring, the second planetary wheel is incapable of rotating relative to the fixed gear ring, resulting in one-way interlocking and achieving differential reverse mechanical braking.

[0007] As a further solution of the present disclosure, in case of shutdown, the controller uses reverse electromotive force generated by the permanent magnet brushless direct-current motor to achieve electromagnetic braking.

[0008] As a further solution of the present disclosure, the left and right end plates are provided with a suspension mechanism, the suspension mechanism includes a suspension component connected to the left and right end plates and a protective hook rotatably arranged on the connecting rod, a protective hook hanging plate is fixed to the suspension component, the protective hook hanging plate is provided with a hanging hole matching the protective hook, the suspension component is provided with an elastically resettable protective buckle, and the protective buckle is provided with a protective buckle wrench.

[0009] As a further solution of the present disclosure, the controller is fixed to the right end plate through a controller housing, upper and lower limit components are correspondingly arranged between the left and right end plates below the rope drum, and the controller housing is correspondingly provided with upper and lower limit controllers matching the upper and lower limit components and electrically connected to the controller.

[0010] As a further solution of the present disclosure, an aviation socket electrically connected to the controller and an aviation plug matching the aviation socket are fixed to the controller housing, the aviation plug is connected to a control handle through a control line, the control handle is provided with an emergency stop switch and up-down start switch, and a detachable lithium battery pack is arranged at a bottom of the control handle.

[0011] As a further solution of the present disclosure, the rope drum is provided with a rope drum perforated groove, a steel wire rope is introduced from the rope drum perforated groove and is wound on the rope drum, a tail of the steel wire rope is fixed to a fixed groove buckle of a rope drum left end plate through a tenon block, and a head of the steel wire rope is connected to a hook component for hanging a heavy object.

[0012] After the above structure is employed, there are the following advantages and effects compared with the prior art. Firstly, there is no precedent at home and abroad to apply a permanent magnet brushless direct-current motor technology to the field of hoisting. Mechanical commutation is replaced with electronic commutation. There are advantages of reliable performance, never wear, a low failure rate, a long life, a low no-load current, high efficiency, a small volume, and so on. Secondly, two-stage reduction is achieved through the first reducer and the second differential transmission device, so that less power can output a larger torque, greatly improving the hoisting capability. Thirdly, differential reverse mechanical braking is achieved through the second differential transmission device, electromagnetic braking is achieved through the controller and the permanent magnet brushless direct-current motor, and dual braking functions of mechanical braking and electromagnetic braking are available at the same time, which can avoid accidents of sudden sliding of load, so as to ensure safe and reliable hoisting. Since the permanent magnet brushless direct-current motor and the first reducer are fixed, in an abutting manner, to the built-in motor base, so that the permanent magnet brushless direct-current motor and the first reducer are embedded in the rope drum, which solves the problems of a large size in length, a bulky structure, and low mechanical efficiency, so as to make the present disclosure more safe and reliable and have better safety performance while being fast, time-saving, and portable. Fifthly, there is no need to temporarily pull a power supply, safe disassembly, installation, and use anytime and anywhere are available as required. Sixthly, the structure of the control handle is convenient for hand-held operations, and the lithium battery pack can be changed according to the power.

BRIEF DESCRIPTION OF DRAWINGS

[0013]

FIG. 1 is a schematic diagram of a matching structure according to the present disclosure.

FIG. 2 is a schematic diagram of a three-dimensional structure according to the present disclosure.

FIG. 3 is a schematic diagram of a usage state of a suspension mechanism according to the present disclosure.

[0014] In the drawings, 1: second differential transmission device, 2: left end plate; 3: connecting rod; 4: first reducer; 5: rope drum; 6: right end plate; 7: permanent magnet brushless direct-current motor; 8: controller; 9: second box body; 10: fixed gear ring; 11: second planetary wheel; 12: second sun wheel; 13: floating planetary carrier; 14: moving gear ring; 15: fixed end plate; 16: transmission shaft; 17: outer fixed mount; 18: first planetary carrier; 19: inner gear ring; 20: first planetary wheel; 21: first sun wheel; 22: inner fixed mount; 23: built-in motor base; 24: protective hook hanging plate; 25: suspension component; 26: aviation plug; 27: controller housing; 28: control line; 29: emergency stop switch and up-down start switch; 30: control handle; 31: lithium battery pack; 32: lower limit component; 33: upper limit component; 34: protective hook; 35: protective buckle wrench; 36:

protective buckle; 37: aviation socket; 38: steel wire rope; 39: rope drum left end plate; 40: steel wire rope fixed groove buckle; 41: hook component.

DESCRIPTION OF EMBODIMENTS

[0015] FIG. 1 to FIG. 3 show a specific implementation solution of a portable embedded direct-current electric hoist according to the present disclosure, including a permanent magnet brushless direct-current motor 7, a controller 8, left and right end plates 2 and 6, a rope drum 5, a first reducer 4, and a second differential transmission device 1. The left and right end plates 2 and 6 are fixedly connected into a whole through a connecting rod 3, and the rope drum 5 is rotatably arranged on the left and right end plates 2 and 6. A built-in motor base 23 fixed to the right end plate 6 is provided in the rope drum 5. The permanent magnet brushless direct-current motor 7 and the first reducer 4 are fixed, in an abutting manner, to the built-in motor base 23, so that the permanent magnet brushless direct-current motor 7 and the first reducer 4 are embedded in the rope drum 5. The second differential transmission device 1 is fixed to the left end plate 2 and is connected to the first reducer 4 through a transmission shaft 16. During operation, the permanent magnet brushless direct-current motor 7 drives, through the first reducer 4 and the transmission shaft 16, the second differential transmission device 1 to rotate, and the second differential transmission device 1 drives the rope drum 5 to rotate.

[0016] In order to achieve one-stage reduction, the first reducer 4 includes an inner fixed mount 22, a first sun wheel 21, a first planetary wheel 20, a first planetary carrier 18, an inner gear ring 19, and an outer fixed mount 17. The outer fixed mount 17 and the inner gear ring 19 are fixedly connected to the inner fixed mount 22. The first sun wheel 21 is rotatably arranged on the inner fixed mount 22 and abuts an output shaft of the permanent magnet brushless direct-current motor 7. The first planetary carrier 18 is rotatably arranged on the outer fixed mount 17 and abuts the transmission shaft 16. The first planetary wheel 20 is rotatably correspondingly arranged on a fixed shaft of the first planetary carrier 18. The first planetary wheel 20 engages with the first sun wheel 21 at an inner side and the inner gear ring 19 at an outer side, respectively. During operation, the permanent magnet brushless direct-current motor 7 drives the first planetary wheel 20 through the first sun wheel 21, and the first planetary wheel 20 rotates relative to the inner gear ring 19 to drive, through the first planetary carrier 18, the transmission shaft 16 to rotate, so as to achieve one-stage reduction output.

[0017] In order to achieve two-stage reduction, differential output, and reverse braking, the second differential transmission device 1 includes a second sun wheel 12, a second planetary wheel 11, a floating planetary carrier 13, a fixed gear ring 10, a moving gear ring 14, and a second box body 9. The fixed gear ring 10 is fixed to the second box body 9. The second sun wheel 12 is rotatably arranged on the second box body 9 and abuts the transmission shaft 16. The second planetary wheel 11 is rotatably arranged on the floating planetary carrier 13. The second planetary wheel 11 engages with the second sun wheel 12 at an inner side and the fixed gear ring 10 at an outer side respectively. The moving gear ring 14 sleeves the second sun wheel 12, with one end simultaneously engaging with the second planetary wheel 11 at an outer side and another end being connected to a fixed end plate 15 on the rope drum 5. The moving gear ring 14 and the fixed gear ring 10 are designed into a differential matching structure with different quantities of teeth. During operation, the first reducer 4 drives the second sun wheel 12 through the transmission shaft 16, the second sun wheel 12 drives the second planetary wheel 11, and the second planetary wheel 11 rotates relative to the fixed gear ring 10 to drive the moving gear ring 14 and the rope drum 5 to rotate, so as to achieve two-stage reduction and differential output. In case of shutdown, a heavy object actively drives the moving gear ring 14 through the rope drum 5, the moving gear ring 14 drives the second planetary wheel 11 to rotate, and in this case, since the quantity of the teeth of the fixed gear ring 10 is different from that of the moving gear ring 14, the second planetary wheel 11 is incapable of rotating relative to the fixed gear ring 10, resulting in one-way interlocking and achieving differential reverse mechanical braking.

[0018] In order to achieve an electromagnetic braking function, in case of shutdown, the controller 8 uses reverse electromotive force generated by the permanent magnet brushless direct-current motor 7 to achieve electromagnetic braking.

[0019] In order to facilitate installation and suspension and ensure safe use, the left and right end plates 2 and 6 are provided with a suspension mechanism, the suspension mechanism includes a suspension component 25 connected to the left and right end plates 2 and 6 and a protective hook 34 rotatably arranged on the connecting rod 3, a protective hook hanging plate 24 is fixed to the suspension component 25, the protective hook hanging plate 24 is provided with a hanging hole matching the protective hook 34, the suspension component 25 is provided with an elastically resettable protective buckle 36, and the protective buckle 36 is provided with a protective buckle wrench 35. When the present disclosure is used for horizontal, traction, and other functions, the suspension mechanism needs to be removed, and after removal, the functions can be achieved by fixing bolt holes on the left and right end plates 2 and 6 with bolts.

[0020] In order to ensure safe hoisting and easy operation, the controller 8 is fixed to the right end plate 6 through a controller housing 27, upper and lower limit components 33 and 32 are correspondingly arranged between the left and right end plates 2 and 6 below the rope drum 5, and the controller housing 27 is correspondingly provided with upper and lower limit controllers matching the upper and lower limit components 33 and 32 and electrically connected to the controller 8. An aviation

socket 37 electrically connected to the controller 8 and an aviation plug 26 matching the aviation socket 37 are fixed to the controller housing 27, the aviation plug 26 is connected to a control handle 30 through a control line 28, the control handle 30 is provided with an emergency stop switch and up-down start switch 29, and a detachable lithium battery pack 31 is arranged at a bottom of the control handle 30.

[0021] In order to facilitate disassembly, replacement, and fixation of a steel wire rope 38, the rope drum 5 is provided with a rope drum perforated groove, the steel wire rope 38 is introduced from the rope drum perforated groove and is wound on the rope drum 5, a tail of the steel wire rope 38 is fixed to a fixed groove buckle 40 of a rope drum left end plate 39 through a tenon block, and a head of the steel wire rope 38 is connected to a hook component 41 for hanging a heavy object. The hook component 41 consists of a hook, a limit spring assembly, and a limit counter weight.

[0022] In case of normal hoisting according to the present disclosure, the control handle 30 is manipulated, the control handle 30 controls, through the controller 8, the permanent magnet brushless direct-current motor 7 to drive the first sun wheel 21, the first sun wheel 21 drives the first planetary wheel 20, the first planetary wheel 20 rotates relative to the inner gear ring 19 to drive the first planetary carrier 18, and the first planetary carrier 18 drives the transmission shaft 16 to rotate, so as to achieve one-stage reduction output. The transmission shaft 16 drives the second sun wheel 12, the second sun wheel 12 drives the second planetary wheel 11 to rotate relative to the fixed gear ring 10, and the second planetary wheel 11 also simultaneously drives the moving gear ring 14 and the rope drum 5 to rotate to achieve two-stage reduction and differential output.

[0023] When abnormal conditions occur in the hoisting process, for example, the power suddenly fails, the load exceeds the output torque and rotation stops, and so on, the heavy object actively drives the moving gear ring 14 through the rope drum 5, and the moving gear ring 14 drives the second planetary wheel 11 to rotate. In this case, since the quantity of the teeth of the fixed gear ring 10 is different from that of the moving gear ring 14, the second planetary wheel 11 is incapable of rotating relative to the fixed gear ring 10, resulting in one-way interlocking and achieving differential reverse mechanical braking. Meanwhile, the controller 8 uses reverse electromotive force generated by the permanent magnet brushless direct-current motor 7 to achieve electromagnetic braking for the permanent magnet brushless direct-current motor 7. Thus, dual braking functions of differential reverse mechanical braking and electromagnetic braking are achieved.

[0024] The above are merely specific embodiments of the present disclosure, instead of limiting the present disclosure in any form. Simple alterations, equivalent changes or modifications made without departing from the technical solution of the present disclosure all fall within the protection scope of the present disclosure.

Claims

1. A portable embedded direct-current electric hoist, comprising a permanent magnet brushless direct-current motor (7), a controller (8), left and right end plates (2, 6), a rope drum (5), a first reducer (4), and a second differential transmission device (1), wherein the left and right end plates (2, 6) are fixedly connected into a whole through a connecting rod (3), and the rope drum (5) is rotatably arranged on the left and right end plates (2, 6); a built-in motor base (23) fixed to the right end plate (6) is provided in the rope drum (5), the permanent magnet brushless direct-current motor (7) and the first reducer (4) are fixed, in an abutting manner, to the built-in motor base (23), so that the permanent magnet brushless direct-current motor (7) and the first reducer (4) are embedded in the rope drum (5); the second differential transmission device (1) is fixed to the left end plate (2) and is connected to the first reducer (4) through a transmission shaft (16); and during operation, the permanent magnet brushless direct-current motor (7) drives, through the first reducer (4) and the transmission shaft (16), the second differential transmission device (1) to rotate, and the second differential transmission device (1) drives the rope drum (5) to rotate.

2. The portable embedded direct-current electric hoist according to claim 1, wherein the first reducer (4) comprises an inner fixed mount (22), a first sun wheel (21), a first planetary wheel (20), a first planetary carrier (18), an inner gear ring (19), and an outer fixed mount (17), the outer fixed mount (17) and the inner gear ring (19) are fixedly connected to the inner fixed mount (22), the first sun wheel (21) is rotatably arranged on the inner fixed mount (22) and abuts an output shaft of the permanent magnet brushless direct-current motor (7), the first planetary carrier (18) is rotatably arranged on the outer fixed mount (17) and abuts the transmission shaft (16), the first planetary wheel (20) is rotatably correspondingly arranged on a fixed shaft of the first planetary carrier (18), and the first planetary wheel (20) engages with the first sun wheel (21) at an inner side and the inner gear ring (19) at an outer side, respectively; and during operation, the permanent magnet brushless direct-current motor (7) drives the first planetary wheel (20) through the first sun wheel (21), and the first planetary wheel (20) rotates relative to the inner gear ring (19) to drive, through the first planetary carrier (18), the transmission shaft (16) to rotate, so as to achieve one-stage reduction output.

3. The portable embedded direct-current electric hoist

according to claim 1 or 2, wherein the second differential transmission device (1) comprises a second sun wheel (12), a second planetary wheel (11), a floating planetary carrier (13), a fixed gear ring (10), a moving gear ring (14), and a second box body (9); the fixed gear ring (10) is fixed to the second box body (9), the second sun wheel (12) is rotatably arranged on the second box body (9) and abuts the transmission shaft (16), the second planetary wheel (11) is rotatably arranged on the floating planetary carrier (13), the second planetary wheel (11) engages with the second sun wheel (12) at an inner side and the fixed gear ring (10) at an outer side, respectively; the moving gear ring (14) sleeves the second sun wheel (12), with one end simultaneously engaging with the second planetary wheel (11) at an outer side and another end being connected to a fixed end plate (15) on the rope drum (5); the moving gear ring (14) and the fixed gear ring (10) are designed into a differential matching structure with different quantities of teeth; during operation, the first reducer (4) drives the second sun wheel (12) through the transmission shaft (16), the second sun wheel (12) drives the second planetary wheel (11), the second planetary wheel (11) rotates relative to the fixed gear ring (10) to drive the moving gear ring (14) and the rope drum (5) to rotate, so as to achieve two-stage reduction and differential output; and in case of shutdown, a heavy object actively drives the moving gear ring (14) through the rope drum (5), the moving gear ring (14) drives the second planetary wheel (11) to rotate, since the quantity of the teeth of the fixed gear ring (10) is different from the quantity of the moving gear ring (14), the second planetary wheel (11) is incapable of rotating relative to the fixed gear ring (10), resulting in one-way interlocking and achieving differential reverse mechanical braking.

4. The portable embedded direct-current electric hoist according to claim 3, wherein in case of shutdown, the controller (8) uses reverse electromotive force generated by the permanent magnet brushless direct-current motor (7) to achieve electromagnetic braking.

5. The portable embedded direct-current electric hoist according to claim 1, wherein the left and right end plates (2, 6) are provided with a suspension mechanism, the suspension mechanism comprises a suspension component (25) connected to the left and right end plates (2, 6) and a protective hook (34) rotatably arranged on the connecting rod (3); and a protective hook hanging plate (24) is fixed to the suspension component (25), the protective hook hanging plate (24) is provided with a hanging hole matching the protective hook (34), the suspension component (25) is provided with an elastically resettable protective buckle (36), and the protective buckle (36) is provided with a protective buckle wrench (35).

6. The portable embedded direct-current electric hoist according to claim 1, wherein the controller (8) is fixed to the right end plate (6) through a controller housing (27), upper and lower limit components (33, 32) are correspondingly arranged between the left and right end plates (2, 6) below the rope drum (5), and the controller housing (27) is correspondingly provided with upper and lower limit controllers matching the upper and lower limit components (33, 32) and electrically connected to the controller (8).

7. The portable embedded direct-current electric hoist according to claim 6, wherein an aviation socket (37) electrically connected to the controller (8) and an aviation plug (26) matching the aviation socket (37) are fixed to the controller housing (27), the aviation plug (26) is connected to a control handle (30) through a control line (28), the control handle (30) is provided with an emergency stop switch and up-down start switch (29), and a detachable lithium battery pack (31) is arranged at a bottom of the control handle (30).

8. The portable embedded direct-current electric hoist according to claim 7, wherein the rope drum (5) is provided with a rope drum perforated groove, a steel wire rope (38) is introduced from the rope drum perforated groove and is wound on the rope drum (5), a tail of the steel wire rope (38) is fixed to a fixed groove buckle (40) of a rope drum left end plate (39) through a tenon block, and a head of the steel wire rope (38) is connected to a hook component (41) for hanging a heavy object.

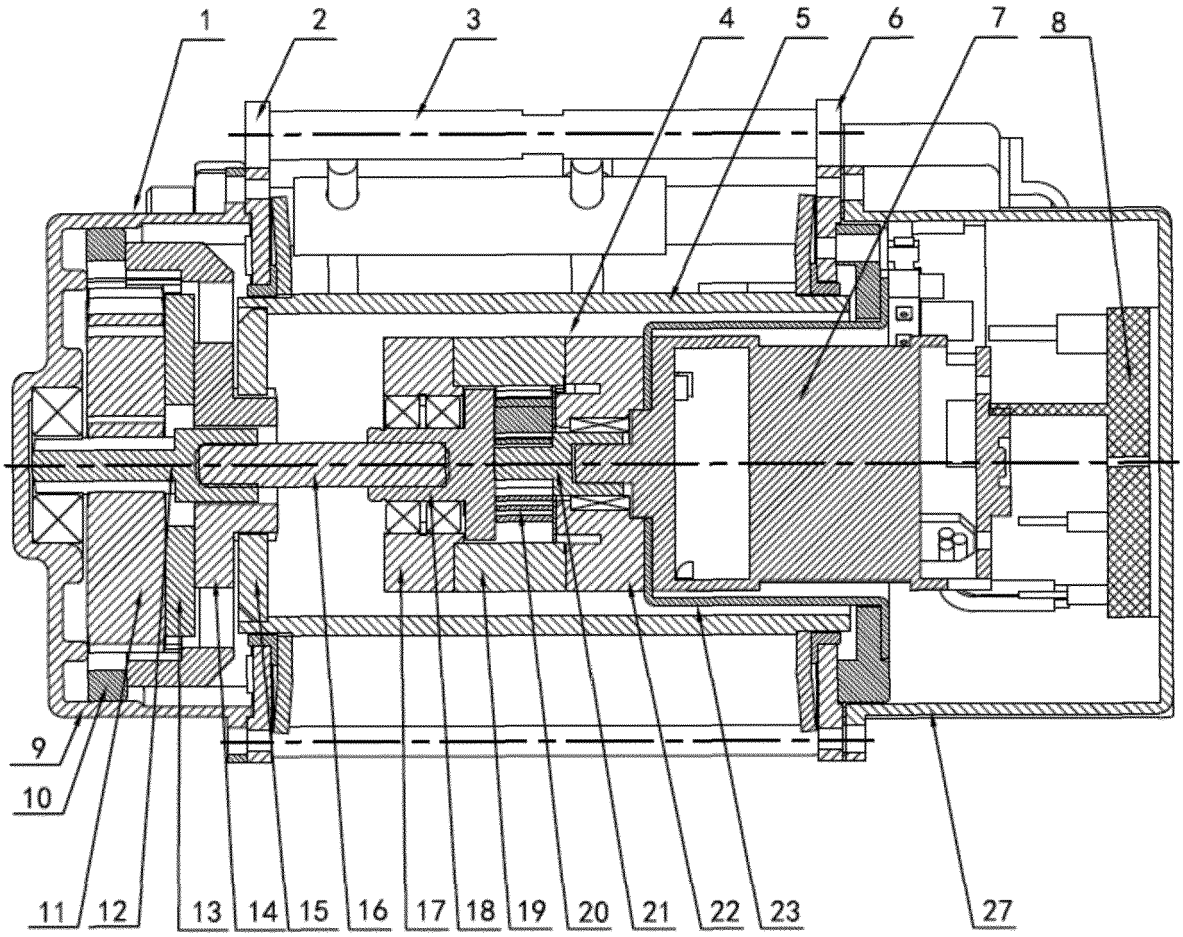

FIG. 1

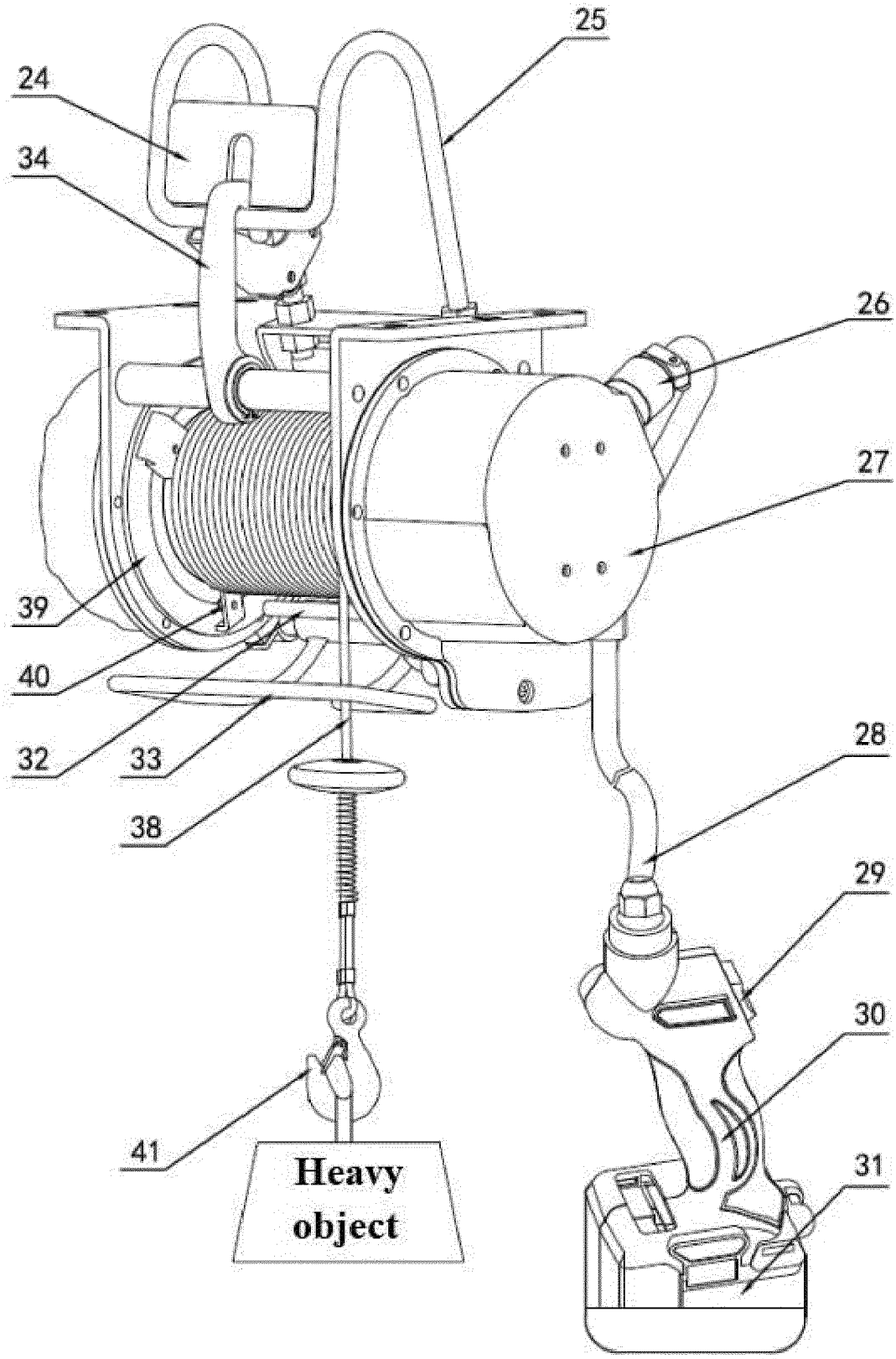

FIG. 2

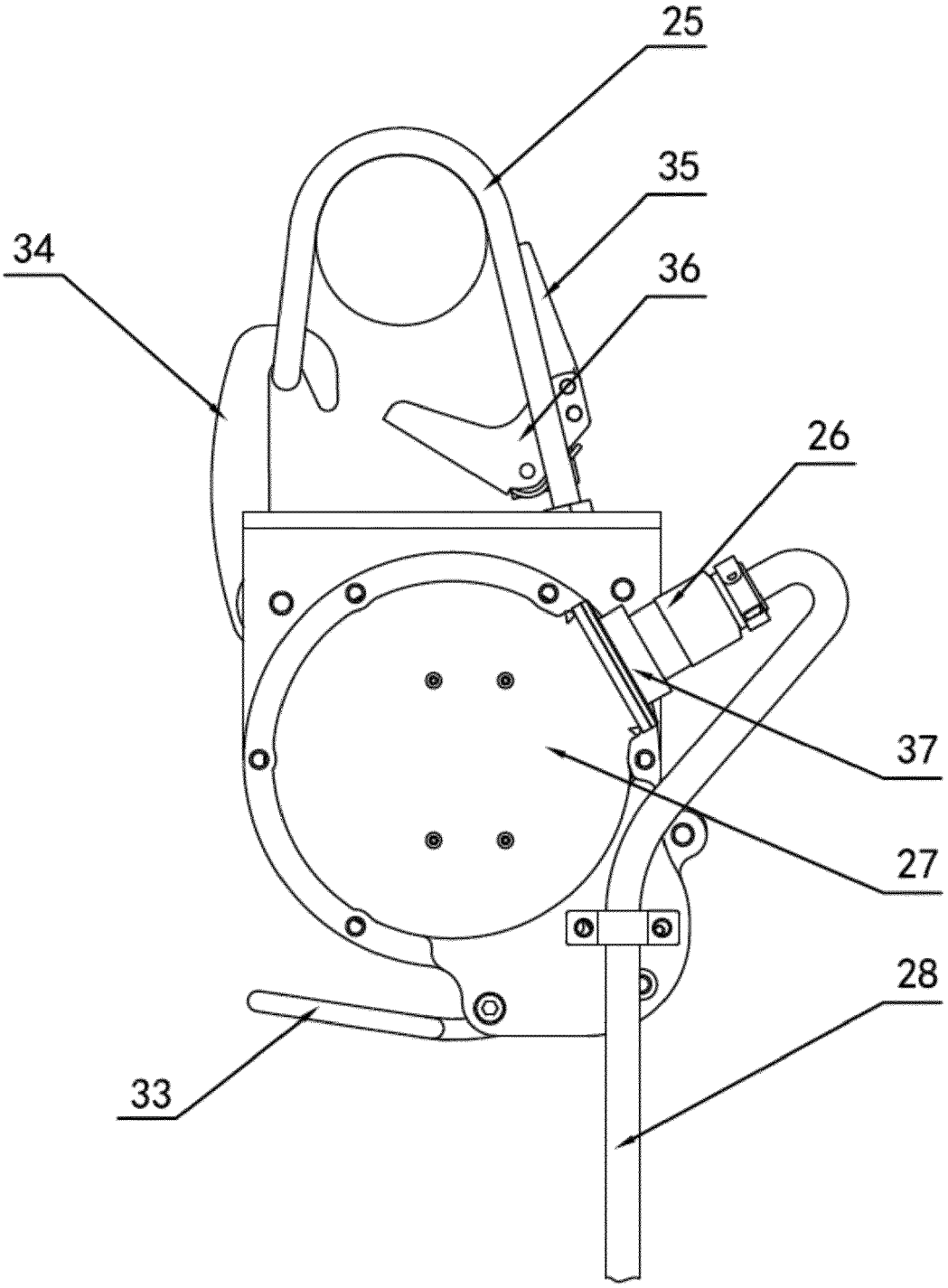

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 21 17 3137

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	27 October 2021	Özsoy, Sevda

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