Battery Replacement Device Unlocking Apparatus, Battery Replacement Device and Battery Box Quick Battery Replacement System

This application claims the priority of the Chinese patent application CN201711486870.4 filed on December 29, 2017, the content of which are incorporated herein by its entirety.

Field of invention

The present invention relates to the field of battery box replacement equipment, in particular to a battery replacement device unlocking apparatus, a battery box quick battery replacement system and battery replacement robot.

Prior arts

Due to the shortage of oil resources and the increasing awareness of environmental protection, electric vehicles are more and more widely used and have become a trend. In order to cooperate with the use of electric vehicles, the battery replacement station has also emerged. In the battery replacement station, the battery box of the electric vehicle can be quickly replaced by the battery replacement robot.

In the prior art, the unlocking device used for removing and separating the battery box of the electric vehicle from the electric vehicle in the battery replacement robot adopts a structure in which the suction cup and the unlocking mechanism are separated, that is, the suction cup for connecting to the battery box is provided on the surface, which is used for docking with the battery box, of the unlocking device, the unlocking mechanism is located on both sides of the unlocking device. When the suction cup is connected to the battery box, the unlocking mechanism respectively unlocks the locking mechanisms on both sides of the battery box to complete the disassembly of the battery box. However, in the actual use process, the unlocking accuracy of this structure is poor, and the problem of incomplete unlocking will cause the battery replacement robot to be unable to pull out the battery box, which also affects the battery replacement efficiency of the battery replacement robot to a certain extent.

Content of the present invention

The technical problem to be solved by the present invention is to overcome the defects of the poor accuracy and poor efficiency of battery replacement robots during the battery replacement process in the prior art, and to provide a battery replacement device unlocking apparatus, a battery box quick battery replacement system and a battery replacement robot.

The present invention solves the above technical problems through the following technical solutions:

A battery replacement device unlocking apparatus includes: a driving element, a transmission mechanism and an unlocking bar; the driving element is connected with the transmission mechanism, the transmission mechanism is connected with the

unlocking bar; the driving element drives the transmission mechanism to move, and the transmission mechanism drives the unlocking lever to expand and contract.

Preferably, in the battery replacement device unlocking apparatus of the present invention, the transmission mechanism includes a transmission rod, a driving column, a driven column, a connecting element and a guide portion; one end of the transmission rod is connected with the driving element, and the other end of the transmission rod is connected with the driving column, the connecting element is respectively connected to the driving column and the driven column, and the guide portion is provided with a driven column guide hole extending in the axial direction of the unlocking bar, the driven column passes through the driven column guide hole and slides in the driven column guide hole, the guide portion is provided with an unlocking bar guide hole, the unlocking bar passes through the unlocking bar guide hole; the connecting element rotates around the axis of the driving column, the connecting element rotates around the axis of the driven column, and the unlocking bar rotates around the axis of the driven column. According to the preferred embodiment, the linkage of the driving column and the driven column is adopted to convert a lateral torque of the transmission rod into a longitudinal torque of the unlocking bar, which saves the space inside the commentary device of the battery replacement equipment. The guide portion keeps the unlocking bar always on the same straight-line during expansion and contraction, which further improves the unlocking accuracy of the unlocking bar.

Preferably, in the battery replacement device unlocking apparatus of the present invention, a driving column guide hole extending in the axial direction of the transmission rod is further provided on the guide portion, and the driving column passes through the driving column guide hole and slides in the driving column guide hole. According to the preferred embodiment, the transmission rod is always in the same straight line through a driving column guide hole during the process of pulling the driving column, which avoids the force loss in the torque transmission process and improves the energy utilization efficiency.

Preferably, in the battery replacement device unlocking apparatus of the present invention, the guide portion has a first plate body, a second plate body and a third plate body, and the second plate body is connected between the first plate body and the third plate body, the driving column guide hole is formed on the first plate body and/or the third plate body, and the driven column guide hole is formed on the first plate body and/or the third plate body, the unlocking bar guide hole is formed on the second plate body. According to the preferred embodiment, the whole transmission mechanism can be more stable without hindering the movement of the transmission rod and the unlocking bar, the telescopic movement of the unlocking bar can be kept in the horizontal plane, and the accuracy of the point-to-point unlocking of the unlocking bar is further improved.

Preferably, in the battery replacement device unlocking apparatus of the present invention, the transmission rod includes a active element, a force transmission element and a driven element, the active element is connected with the driving element, and the

driven element is connected with the driven column, the force transmission element is movably connected with the active element, and the force transmission element is fixedly connected with the driven element. According to the preferred embodiment, the transmission rod adopts a three-part structure, and the strength of the transmission rod can be improved by the force transmission element in the intermediate section, so that the force of the transmission rod is dispersed in three parts during the torque transmission of the transmission rod, thereby the transmission rod is protected, the service life of the transmission rod during long-term repeated operations is extended.

Preferably, in the battery replacement device unlocking apparatus of the present invention, the force transmission element includes a force transmission piece, a force transmission spring and two fixing pieces, and two ends of the force transmission piece are respectively connected to the active element and the driven element, the two fixing pieces are fixed on the force transmission piece and connected to both ends of the force transmission spring, the force transmission spring extends along the axial direction of the transmission rod, the force transmission piece is provided with a through hole, and the through hole is located between the two fixing pieces; the driving element includes a driving piece and a clamping column, and the driving piece sequentially passes through the two fixing pieces and is disposed in the force transmission spring, the clamping column is connected to the driving piece and is located between the two fixing pieces, one end of the clamping column extends into the through hole, and the other end of the clamping column is clamped between the two spirals of the force transmission spring; the driving piece slides in the axial direction of the transmission rod, and the clamping column slides in the through hole. According to the preferred embodiment, a buffer structure composed of the force transmission spring, the fixing piece, the clamping column and the through hole is used, when the driving element is in operation, the force applied by the driving element on the active element is stored by the force transmission spring and then transmitted to the driven element through a restoring force released from the force spring, resulting in a delay in force transmission and ensuring that the transmission rod can still stably transmit the force when the driving element is turned on or off, or when a frequency mutation happens.

Preferably, in the battery replacement device unlocking apparatus of the present invention, the driven element includes a driven piece and two supporting pieces, the driven piece is connected to the force transmission element, and the two supporting pieces are respectively connected to two sides of the driven piece along the axial direction of the driving column, and the two supporting pieces are respectively connected to the driving column. According to the preferred embodiment, the strength of the connection between the transmission rod and the driving column is strengthened.

Preferably, in the battery replacement device unlocking apparatus of the present invention, the battery replacement device unlocking apparatus further includes a box body, and one end of the unlocking bar connected to the transmission mechanism is located in the box body, the other end of the unlocking bar penetrates out of the box body. According to the preferred embodiment, the box body with the strength and the

hardness surrounds the connecting position of the fragile transmission mechanism and the unlocking bar, so that the effect of protecting the transmission mechanism and the unlocking bar is achieved.

Preferably, in the battery replacement device unlocking apparatus of the present invention, the box body includes a movable box, a buffer element and a fixed box, the fixed box is fixed, and the movable box is movably connected inside the box through the buffer element. According to the preferred embodiment, a certain buffer protection effect is achieved for the transmission mechanism and the unlocking bar.

Preferably, in the battery replacement device unlocking apparatus of the present invention, the buffer element is a buffer spring that extends in the axial direction of the unlocking bar. According to the preferred embodiment, the stability of the spring buffer and recovery is used to ensure the smooth expansion and contraction of the movable box.

Preferably, in the battery replacement device unlocking apparatus of the present invention, a slide rail is provided on the fixed box, the slide rail extends along the axial direction of the unlocking bar, and a slide member is provided on the movable box, the slide member slides on the slide rail. According to the preferred embodiment, the direction of buffer movement of the movable box is consistent with the telescopic direction of the unlocking lever, and the accuracy of the point-to-point unlocking of the unlocking bar is further improved.

Preferably, in the battery replacement device unlocking apparatus of the present invention, an end portion of the slide rail has an exit hole, and a diameter of the exit hole is larger than an inner diameter of the slide rail and an outer diameter of the slide member. According to the preferred embodiment, the assembly and disassembly operations between the movable box and the fixed box are facilitated.

Preferably, in the battery replacement device unlocking apparatus of the present invention, an end of the transmission mechanism extending into the movable box is connected to the movable box through a connecting member, and a moving channel is arranged on the fixed box, a limit gap is formed on the movable box, the limit gap is in communication with the moving channel, and the transmission mechanism sequentially passes through the moving channel and the limit gap. According to the preferred embodiment, the pulling movement of the transmission rod driven by the driving element is guided by the limit gap, and the overall displacement of the transmission rod in the telescopic direction of the unlocking bar does not occur, and meanwhile, the transmission rod is not affected by the fixed box when the transmission rod is in buffer motion with the movable box.

A battery replacement device includes: a battery tray; the battery replacement device unlocking apparatus as described above; a housing and a battery replacement device suction cup are provided on the battery tray, and the battery replacement device unlocking apparatus is provided in the housing, the battery replacement device suction cup is connected to the housing through the battery replacement device unlocking

apparatus, the battery replacement device suction cup is sleeved on the unlocking bar, and the unlocking bar expands and retracts in the battery replacement device suction cup.

Preferably, in the battery replacement device of the present invention, a flange is provided on the end portion of the unlocking bar away from the transmission mechanism, and a boss is provided in the battery replacement device suction cup corresponding to the flange, the shape of the flange matches the shape of the boss. According to the preferred embodiment, the unlocking bar is prevented from retracting into the suction cup during the retracting process, which would affect the next unlocking operation.

Preferably, in the battery replacement device of the present invention, an end surface of the unlocking bar is flush with a surface of the battery replacement device suction cup. According to the preferred embodiment, the extended end of the unlocking lever can be protected from damage.

A battery box quick battery replacement system, including: a battery box, a battery box fixing frame and the power replacement device as described above; the battery box includes a locking tongue and an unlocking button, the unlocking button moves correspondingly with the locking tongue, and the unlocking button is correspondingly arranged with the unlocking bar; the battery box fixing frame is provided with a locking portion, and the locking tongue and the locking portion are locked and matched; the extending motion of the unlocking bar is used for pressing the unlocking button to drive the locking tongue to disengage the locking portion and to unlock.

Preferably, in the battery box quick battery replacement system of the present invention, a battery box suction cup is sleeved on the unlocking button and the unlocking button expands and retracts in the battery box suction cup, the battery box suction cup and the battery replacement device suction cup are correspondingly arranged. According to the preferred embodiment, when the battery replacement device and the battery box are attracted and attached to each other through the battery replacement device suction cup and the battery box suction cup, the unlocking bar can accurately unlock the unlocking button point by point, and the accuracy of the unlocking is high, which will not cause the problem that the battery box is not completely unlocked resulting in the entire battery replacement unlocking system being locked, which improves the battery replacement efficiency of the battery replacement system.

On the basis of conforming to the common knowledge in the art, the above-mentioned preferred conditions can be arbitrarily combined to obtain preferred examples of the present invention.

The positive progress effects of the present invention are as follows:

The battery replacement device unlocking apparatus, the battery replacement device and the battery box quick battery replacement system provided by the invention use the transmission mechanism to transmit the torque of the driving element to the unlocking

bar, so that it can achieve precise point-to-point telescopic unlocking and high precision of the unlocking, and the high precision of the unlocking also saves parts of the time for unlocking the battery replacement device, thereby improving the efficiency of battery replacement.

Brief description of the drawings

Fig. 1 is a perspective view of a battery replacement device unlocking apparatus according to an embodiment of the present invention.

Fig. 2 is a side view of a battery replacement device unlocking apparatus according to an embodiment of the present invention.

Fig. 3 is a plan view of a transmission mechanism of an unlocking device of a battery replacement device according to an embodiment of the present invention.

Fig. 4 is a block diagram of a guide portion of a battery replacement device unlocking apparatus according to an embodiment of the present invention.

Fig. 5 is a block diagram of a transmission rod of a battery replacement device unlocking apparatus according to an embodiment of the present invention.

Fig. 6 is a schematic diagram of a three-dimensional structure when a box body and a battery replacement device suction cup are arranged in a battery replacement device unlocking apparatus according to an embodiment of the present invention.

Fig. 7 is a cross-sectional view of Fig. 6.

Fig. 8 is a side view of a box body in a battery replacement device unlocking apparatus according to an embodiment of the present invention.

Fig. 9 is a schematic structural diagram of a battery replacement device according to an embodiment of the present invention.

Fig. 10 is a front view of a battery box in a battery box quick battery replacement system according to an embodiment of the present invention.

Fig. 11 is a schematic diagram of a battery box quick battery replacement system according to an embodiment of the present invention when the battery replacement device approaches the battery box for unlocking.

Description of reference signs:

driving element 1; transmission mechanism 2; transmission rod 21; active element 211; driving piece 2111; clamping column 2112;

force transmission element 212; force transmission piece 2121; force transmission spring 2122; fixing piece 2123; through hole 2124; driven element 213;

driven piece 2131; supporting piece 2132; driving column 22; driven column 23; connecting element 24; guide portion 25; driven column guide hole 251; unlocking bar

guide hole 252; driving column guide hole 253; first plate body 254; second plate body 255; third plate body 256; unlocking bar 3; flange 31; box body 4; movable box 41; slide member 411; connecting member 412; limit gap 413; buffer element 42; fixed box 43; slide rail 431; exit hole 432; moving channel 433; housing 5; battery replacement device suction cup 6; boss 61; insulating plate 62; battery box 7; locking tongue 71; unlocking button 72; battery box suction cup 73

Detailed description of the preferred embodiment

The following is a preferred embodiment, and the present invention will be described more clearly and completely in conjunction with the accompanying drawings.

In the description of the present invention, it should be understood that the orientation or positional relationship indicated by the term "upper", "lower", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inner", "outer" etc., is based on the orientation or positional relationship shown in the figures, but is merely for ease of description of the invention and the simplified description, rather than to indicate or imply that the indicated device or element must have a particular orientation, constructed and operated in a particular orientation, and therefore not to be construed as a limitation of the present invention..

As shown in Figs. 1 and 2, an embodiment of the present invention provides a battery replacement device unlocking apparatus, which includes: a driving element 1, a transmission mechanism 2 and an unlocking bar 3; the driving element 1 is connected to the transmission mechanism 2, and the transmission mechanism 2 is connected with the unlocking bar 3; the driving element 1 drives the transmission mechanism 2 to move, and the transmission mechanism 2 drives the unlocking bar 3 to expand and contract.

Specifically, in a hybrid vehicle battery replacement station, the battery replacement device unlocking apparatuses for unlocking a battery box are usually provided on both sides of the battery replacement device. When the battery replacement device is docked with the battery box, the battery replacement device unlocking apparatuses on both sides press the battery box and the locking tongues locked with the battery box fixing frame from both sides to separate the battery box from the battery box fixing frame. It usually takes about ten minutes to replace the battery, and the time it takes to replace the battery is also long. In the battery replacement device unlocking apparatus of this embodiment, compared with the battery replacement device unlocking apparatus originally used, the overall structure of the apparatus is compact, the volume is not large, and the action is quick and accurate. The most important thing is that the time of replacing the battery is less than six minutes, and the efficiency is improved by nearly one time. In the battery replacement device unlocking apparatus of this embodiment, the unlocking bar 3 manipulates its telescopic movement through the driving element 1 and the transmission mechanism 2 provided behind it, and the structures of the driving element 1 and the transmission mechanism 2 are designed to make the entire battery replacement device unlocking apparatus to meet the demand of

being structurally compact and small. Contrasted to the unlocking apparatuses provided on both sides, it only needs to extend the unlocking bar 3 to complete the unlocking operation, and less steps mean that there is less possibility of error during the unlocking operation. Further, since the unlocking bar 3 is a kind of lever shape like structure, it can achieve the point-to-point unlocking. As long as the unlocking bar 3 is aligned with the position to unlock, the unlocking operation can be completed easily and quickly, and the accuracy is also high.

As shown in Figs. 2 and 3, the transmission mechanism 2 in the present embodiment comprises a transmission rod 21, a driving column 22, a driven column 23, a connecting element 24 and a guide portion 25; one end of the transmission rod 21 is connected with the driving element 1, and the other end of the transmission rod 21 is connected with the driving column 22, the connecting element 24 is respectively connected with the driving column 22 and the driven column 23, and the guide portion 25 is provided with a driven column guide hole 251 extending in the axial direction of the unlocking bar 3, the driven column 23 passes through the driven column guide hole 251 and slides in the driven column guide hole 251, the guide portion 25 is provided with an unlocking bar guide hole 252, and the unlocking bar 3 passes through the unlocking bar guide hole 252; the connecting element 24 rotates around the axis of the driving column 22, the connecting element 24 rotates around the axis of the driven column 23, and the unlocking bar 3 rotates around the axis of the driven column 23. Specifically, the transmission mechanism 2 is a core component, in order to achieve the purpose of the present invention, in the battery replacement device unlocking apparatus of the present embodiment, the structure of the transmission mechanism 2 includes five components, wherein the transmission rod 21 is driven by the driving element 1, which is used for generating the driving force, the driving column 22 moves with the transmission rod 21, the force generated by the transmission rod 21 drives the driving column 22 to move, since the connecting element 24 connects the driving column 22 and the driven column 23 together and can rotate around the axis of both the driving column 22 and the driven column 23, the torque generated by the movement of the driving column 22 drives the connecting element 24 to rotate simultaneously around the driving column 22 and the driven column 23, the connecting element 24 generates a radial pushing force applying on the driven column 23 in the diameter direction of the driven column 23, the driven column 23 is pushed to slide in the driven column guide hole 251 on the guide portion 25, and finally the unlocking bar 3 is pushed to expand and contract in the unlocking bar guiding hole 252. In the present embodiment, the transmission rod 21 is perpendicularly connected to the middle of the driving column 22, the two ends of the driving column 22 and the two ends of the driven column 23 are respectively connected through a connecting element 24, the connecting elements 24 are respectively pivoted with the driving column 22 and the driven column 23, the driven column 23 passes through the driven post guide hole 251 on the guide portion 25, the guide portion 25 is located between the two connecting elements 24, the unlocking bar 3 abuts against the middle of the driven column 23 and passes through the unlocking bar guide hole 252 on the guide portion 25. According to the preferred embodiment, the driving column 22 and the driven column 23 are coordinately linked, the transverse moment of the

transmission rod 21 is converted into the longitudinal moment of the unlocking bar 3, so that the space inside the battery replacement device unlocking apparatus is saved; and the guide portion 25 provided with the driven column guide hole 251 keeps the unlocking bar 3 in the same straight line all the time, so that the unlocking precision of the lock rod 3 is further improved.

As shown in Fig. 4, the guide portion 25 of the present embodiment is further provided with a driving column guide hole 253 extending in the axial direction of the transmission rod 21, and the driving column 22 passes through the driving column guide hole 253 and slides in the driving column guide hole 253. Specifically, the driven column guide hole 251 solves the problem of the movement direction alignment of the driven column 23 and the unlocking bar 3 and the problem of telescopic stability of the locking rod 3, however, in the process of pulling the driving column 22 by the transmission rod 21, the problem that the loss of the force in the transmission process due to the fact that the movement direction of the driving column 22 is not fixed still exists, therefore, the driving column guide hole 253 is provided in the guide portion 25, and the extension direction of the driving column guide hole 253 is the same as the pulling direction of the transmission rod 21, so that the pulling force of the transmission rod 21 is not divided in the process of pulling the driving rod 21 by the transmission rod 21. According to the preferred embodiment, the transmission rod 21 is enable to move in the same straight line through the driving column guide hole 253 in the process of pulling the active column 22, so that the loss of force in the torque transmission process is avoided, and the energy utilization efficiency is improved.

As shown in Fig. 4, the guide portion 25 in the present embodiment has a first plate body 254, a second plate body 255, and a third plate body 256, the second plate body 255 is connected between the first plate body 254 and the third plate body 256, the driving column guide hole 253 is formed on the first plate body 254 and/or the third plate body 256, the driven column guide hole 251 is formed on the first plate body 254 and/or the third plate body 256, and the unlocking bar guide hole 252 is formed on the second plate body 255. Specifically, when the driving element 1 drives the transmission rod 21 to perform expanding and contrasting operation, the stability of the driving column 22, the driven column 23 and the guide portion 25 is particularly important, therefore, the guide portion 25 should be designed to be sufficiently firm and not easily affected by the movement of the driving post 22 and the driven post 23, therefore, in the present embodiment, the guide portion 25 is designed as a semi-enclosed structure, the first plate body 254 and the third plate body 256 support the driving column 22 and the driven column 23 from above and below, the second plate body 255 is supported between the first plate 254 and the third plate 256 in front of the driven column 23, and the second plate body 255 protects the rear transmission mechanism 2 from the front, so that the internal transmission mechanism 2 is prevented from being worn when contacting with external devices, the unlocking bar 3 passes through the second plate body 255, while the unlocking bar 3 is not connected with the second plate body 255 and can freely expand and contrast. In one preferred aspect of the present embodiment, both the first plate body 254 and the third plate body 256 are

provided with a driving column guide hole 253 and a driven column guide hole 251, the two connecting elements 24 are respectively located outside of the first plate body 254 and the third plate body 256, and the unlocking bar guide hole 252 is formed on the second plate body 255. According to the preferred embodiment, the whole transmission mechanism 2 can be more stable without hindering the movement of the transmission rod 2 and the unlocking bar 3, the telescopic movement of the unlocking bar 3 can be kept in the horizontal plane, and the accuracy of the point-to-point unlocking of the unlocking bar 3 is further improved.

As shown in Fig. 5, in the transmission mechanism 2, the transmission rod 21 includes a active element 211, a force transmission element 212 and a driven element 213. the active element 211 is connected to the driving element 1, and the driven element 213 is connected to the driving column 22, the force transmission element 212 is movably connected to the active element 211, and the force transmission element 212 is fixedly connected to the driven element 213. Specifically, in the actual work process, the transmission rod 21, which is single-structured, not only will wear out and cause fracture after repeating hundreds or thousands of pulling movements, but also, due to both the length of the driving column guide hole 253 and the length of the driven column guide hole 251 are usually not very long, therefore, it usually happens to the single-structured transmission rod 21 that the stroke of the driving element 1 is longer than the length of the driving column guide hole 253, resulting in that the driving column 22 has already abuts against the inner wall of the active column guide hole 253 before the driving element 1 completes the stroke, it is easy to cause stress fracture of the transmission rod 21 of a single structure. Therefore, the transmission rod 21 adopts a three-part structure, and the force applied on the driven element 213 is eliminated through the force transmission element 212, thereby protecting the transmission rod 21. According to the preferred embodiment, the transmission rod 21 adopts a three-part structure, and the strength of the transmission rod 21 can be improved by the force transmission element 212 in the intermediate section, so that the force of the transmission rod 21 is dispersed in three parts during the torque transmission of the transmission rod 21, thereby, the transmission rod 21 is protected, and the service life of the transmission rod 21 during long-term repeated operations is extended.

As shown in Fig. 5, in the transmission rod 21, the force transmission element 212 includes a force transmission piece 2121, a force transmission spring 2122 and two fixing pieces 2123, and two ends of the force transmission piece 2121 are connected to the active element 211 and the driven element 213 respectively, the two fixing pieces 2123 are fixed on the force transmission piece 2121 and connected to both ends of the force transmission spring 2122, the force transmission spring 2122 extends along the axial direction of the transmission rod 21, and the force transmission piece 2121 is provided with a through hole 2124, the through hole 2124 is located between the two fixing pieces 2123; the active element 211 includes a driving piece 2111 and a clamping column 2112. The driving piece 2111 passes through the two fixing pieces 2123 sequentially and is disposed in the force transmission spring 2122, and the clamping

column 2112 is connected to the driving piece 2111 and is located between the two fixing pieces 2123, one end of the clamping column 2112 extends into the through hole 2124, and the other end of the clamping column 2112 is clamped between the two spirals of the force transmission spring 2122; the driving piece 2111 slides along the axial direction of the transmission rod 21, and the clamping column 2112 slides in the through hole 2124. Specifically, in order to maximally protect the transmission rod 21 and ensure the smoothness and balancing of pulling motion of the transmission rod 21, the sliding of the driving column 22 and the driven column 23, and the telescopic movement of the unlocking bar 3, the force transmission element 212 is designed to be a structure with functions of both buffering and delaying force transmission. Wherein, the driving piece 2111, the clamping column 2112 and the force transmission spring 2122 form a buffer structure, when the driving element 1 applies a force to the driving piece 2111, or when the driven element 213 applies a force to the force transmission piece 2121, the clamping column 2112 of the driving piece 2111 toggles the force transmission spring 2122, so that the spring between the clamping column 2112 and one of the fixing pieces 2123 is stretched, the spring between the clamping post 2112 and the other one of the fixing pieces 2123 is contracted, and the transmission spring 2122 stores the force, the force will not be applied to the force transmission piece 2121 temporarily. This buffer structure can effectively respond to the force suddenly generated when the driving element 1 turns on and off, so that the force can be slowly, evenly and smoothly transmitted to the next component. At the same time, the two fixing pieces 2123, the force transmission spring 2122, the clamping column 2112, the through hole 2124 and the force transmission piece 2121 form a delayed force transmission structure. When the stretched spring and compressed spring store the force, due to the restoring force of the springs, the stretched spring will pull the fixing piece 2123, the compressed spring will push the fixing piece 2123 away, the two springs have the same direction of force on the two fixing pieces 2123, and finally push the force transmission piece 2121 toward same direction, since the motion of the force transmission piece 2121 is initiated later than the motion of the driving piece 2111 or the motion of the driven element 213, thus, this structure is called a delayed force transmission structure. According to this preferred embodiment, a buffer structure composed of the force transmission spring 2122, the fixing piece 2123, the clamping column 2112 and the through hole 2124 is used, when the driving element 1 is in operation, the force applied by the driving element 1 on the active element 211 is stored by the force spring 2122, then the force is released to the driven element 213 by the restoring force of the force transmission spring 2122, resulting in a delay in force transmission and ensuring that the transmission rod 21 can still stably transmit the force when the driving element 1 is turned on or off, or when a frequency mutation happens.

As shown in Fig. 5, in the transmission rod 21, the driven element 213 includes a driven piece 2131 and two supporting pieces 2132, the driven piece 2131 is connected to the force transmission element 212, and the two supporting pieces 2132 are respectively connected to two sides of the driven piece 2131 along the axial direction of the driving column 22, and the two support pieces 2132 are respectively connected to the driving column 22. Specifically, in the movement of repeatedly pulling the driving column

22, the connection area between the driven element 213 and the driving column 22 is more worn and more fragile, and it is easy to be damaged, in this embodiment, the two supporting pieces 2132 are added on the connection area between the driven element 213 and the driving column 22 for reinforcement, so that the driven element 213 is stronger during pulling the driving column 22, the two supporting pieces 2132 are perpendicular to the axis of the driving column 22, the driven piece 2131 is perpendicular to the two supporting pieces 2132. According to this preferred embodiment, the strength of the connection between the transmission rod 21 and the driving column 22 is strengthened.

As shown in Fig. 6, the battery replacement device unlocking apparatus in this embodiment further includes a box body 4, one end of the unlocking bar 3 connected to the transmission mechanism 2 is located in the box body 4, and the other end of the unlocking bar 3 passes through the box body 4. Specifically, in this preferred embodiment, the weak connection area of the transmission mechanism 2 is surrounded by the box body 4 with hardness, and most of the structure of the transmission mechanism 2 is accommodated in it, except for the connecting one end of the transmission mechanism 2, which is connected to the drive the element 1, and the extending end of the unlocking bar 3. According to the preferred embodiment, the box body 4 with strength and rigidity is used to surround the weak connection area between the transmission mechanism 2 and the unlocking bar 3 to protect the transmission mechanism 2 and the unlocking bar 3.

As shown in Fig. 7, the box body 4 of this embodiment includes a movable box 41, a buffer element 42 and a fixed box 43, the fixed box 43 is fixed, and the movable box 41 is movably connected to the fixed box 43 through the buffer element 42. Specifically, the box body 4 has two portions, one is the fixed box 43 which is stationary, and the other is a movable box 41 which is movable relative to the fixed box 43, the movable box 41 is connected to the transmission mechanism 2 and is used for offering buffering and protection for the entire unlocking apparatus when the unlocking bar 3 performs point-to-point unlocking operation. According to the preferred embodiment, a certain buffer protection effect is achieved for the transmission mechanism 2 and the unlocking bar 3.

As shown in Fig. 7, in this embodiment, the buffer element 42 is a buffer spring that extends in the axial direction of the unlocking bar 3. Specifically, two buffer springs are connected between the rear end of the movable box 41 and the fixed box 43, the two buffer springs are arranged parallel to each other, and are located on the two sides of the unlocking bar 3, respectively, and play a role of buffering and balancing. According to the preferred embodiment, the stability of the spring buffer and recovery is used to ensure the smooth expansion and contraction of the movable box 41.

As shown in Fig. 8, in the box body 4, a slide rail 431 is provided on the fixed box 43, and the slide rail 431 extends along the axial direction of the unlocking lever 3, and a slide member 411, which slides on the slide rail 431, is provided on the movable box 41. Specifically, in the preferred embodiment, "wheels", which moves back and forth

along the buffer spring, and "rails" are added to the movable box 41, namely the slide member 411 and the slide rail 431, and the sliding direction of the movable box 41 is consistent with the telescopic direction of the unlocking bar 3. According to the preferred embodiment, the direction of buffer movement of the movable box 41 is consistent with the direction of expansion and contraction of the unlocking lever 3, and the accuracy of the point-to-point unlocking of the unlocking bar 3 is further improved.

As shown in Fig. 8, and end portion of the slide rail 431, which is on the fixed box 43, has an exit hole 432, and the diameter of the exit hole 432 is larger than the inner diameter of the slide rail 431 and the outer diameter of the slide member 411. Specifically, in order to facilitate the assembly and disassembly of the movable box 41 and the fixed box 43, the end of the slide rail 431 is designed as the exit hole 432 with a larger hole diameter, which facilitates the slide member 411 to enter and exit the slide rail 431, which facilitates the assembly of the movable box 41 and fixed box 43. According to the preferred embodiment, the assembly and disassembly operations between the movable box 41 and the fixed box 43 are facilitated.

As shown in Fig. 7, an end of the transmission mechanism 2 extending into the movable box 41 is connected to the movable box 41 through a connecting member 412, a moving channel 433 is arranged on the fixed box 43, and a limit gap 413 is formed on the movable box 41, the limit gap 413 is in communication with the moving channel 433, the transmission mechanism 2 sequentially passes through the moving channel 433 and the limit gap 413. Specifically, in this preferred embodiment, the transmission mechanism 2 and the movable box 41 are connected together by providing the connecting member 412 between the second plate body 255 and the inner wall of the movable box 41, and the limit gap 413 guides the pulling movement of the transmission mechanism 2, the moving channel 433 on the one hand plays the role of supporting the gravity of the transmission mechanism 2, on the other hand, the moving channel 433 can slide in the same direction when the transmission mechanism 2 is forced to move backward and compress the spring due to a force applying to the movable box 41. According to the preferred embodiment, the pulling movement of the transmission rod 21 driven by the driving element 1 is guided by the limit gap 413, and the overall displacement in the telescopic direction of the unlocking bar 3 is avoided, and meanwhile, the transmission rod 21 is not affected by the fixing box 43 when the transmission rod 21 is in buffer motion with the movable box 41.

As shown in Fig. 9, the present invention provides a battery replacement device, including: a battery tray and the battery replacement device unlocking apparatus as described above; a housing 5 and a battery replacement device suction cup 6 are provided on the battery tray, and the battery replacement device unlocking apparatus is provided in the housing 5, battery replacement device suction cup 6 is connected to the housing 5 through the battery replacement device unlocking apparatus, the battery replacement device suction cup 6 is sleeved on the unlocking bar 3 and the unlocking bar 3 expands and retracts in the battery replacement device suction cup 6.

Specifically, the battery replacement device of this embodiment integrates the

unlocking bar 3 into the battery replacement device suction cup 6, so that the battery replacement device can use the unlocking bar 3 to complete the unlocking action of the battery box 7 while using the battery replacement device suction cup 6 to dock with the battery box 7, and meanwhile, the battery replacement device suction cup 6 can protect the unlocking bar 3 from being broken during the expansion and contraction of the unlocking bar 3 due to its thick structure, and can also guide the expansion and contraction of the unlocking bar 3 in one direction to further improve the accuracy.

As shown in Figs. 7 and 9, in the battery replacement device of this embodiment, a flange 31 is provided on the end portion of the unlocking bar 3 away from the transmission mechanism 2, and a boss 61 is provided in the battery replacement device suction cup 6 corresponding to the flange 31, the shape of the flange 31 matches the shape of the boss 61. Specifically, the engagement of the boss 61 and the flange 31 acts as a stop for the unlocking bar 3, so that the unlocking bar 3 will not excessively retract resulting in that the next unlocking operation cannot be completely completed, which causes the problem of the battery replacement efficiency being affected. According to the preferred embodiment, the unlocking bar 3 is prevented from retracting into the suction cup during the retracting process, which would affect the next unlocking operation.

As shown in Fig. 7, in the battery replacement device of this embodiment, the end surface of the unlocking bar 3 is flush with the surface of the battery replacement device suction cup 6. According to the preferred embodiment, the extended end of the unlocking bar 3 can be protected from damage.

As shown in Figs. 10 and 11, the present invention provides a battery box 7 quick battery replacement system, which includes: a battery box 7, a battery box fixing frame (not shown), and a battery replacement device as described above; the battery box 7 includes a locking tongue 71 and an unlocking button 72, the unlocking button 72 moves correspondingly with the locking tongue 71, and the unlocking button 72 is arranged corresponding to the unlocking bar 3; the battery box fixing frame has a locking portion (not shown), the locking tongue 71 and the locking portion are locked and matched; the extension movement of the unlocking lever 3 is used to press the unlocking button 72 to drive the locking tongue 71 to disengage the locking portion and to unlock.

Specifically, in the battery box 7 quick power exchange system of this embodiment, corresponding to the unlocking bar 3, the unlocking button 72, which moves correspondingly with the locking tongue 71, is provided on the battery box 7, in actual applications, the unlocking bar 3 extends out to press the unlocking button 72, and the locking tongue 71 retracts into the battery box 7, the battery box 7 and the battery box fixing frame are unlocked, after the battery box 7 is separated from the battery box fixing frame, the locking tongue 71 is reset, and the unlock bar 3 is pushed back into the battery replacement device by the unlocking button 72, the entire operation process is very convenient, and accuracy of the unlocking is also very high.

As shown in Fig. 11, in the battery box 7 quick battery exchange system of this embodiment, a battery box suction cup 73 is sleeved on the unlocking button 72 and the unlocking button 72 expands and retracts in the battery box suction cup 73, the battery box suction cup 73 and the battery replacement device suction cup 6 is correspondingly set. Specifically, in the present embodiment, the battery box suction cup 73 and the battery replacement device suction cup 6 are both electromagnet suction cups. Using the battery box 7 quick battery replacement system of the preferred embodiment, the battery replacement device and the battery box 7 are attracted and connected to each other by the magnetic force generated by the battery replacement device suction cup 6 and the battery box suction cup 73, both of which are energized. At this time, the driving element 1 in the battery replacement device is turned on, and the transmission mechanism 2 is pulled back to drive the unlocking bar 3 to extend out of the battery replacement device suction cup 6. The unlocking bar 3 press down the unlocking button 72 in the battery box suction cup 73. The unlocking button 72 drives the lock tongue 71 to retract into the lock box. The battery box 7 is then unlocked from the battery box fixing frame, and then the battery replacement device uses the suction, which is generated by the two suction cups that are still stuck together to pull the battery box 7 out of the battery box fixing frame, thereby completing the separation operation of the battery box 7 and the battery box fixing frame. Then the driving element 1 pushes the transmission mechanism 2 out, leaving a gap between the driven column 23 and the unlocking bar 3, due to the restoring force of the lock tongue 71, the unlock button 72 pushes the unlocking bar 3 back to the battery replacement device suction cup 6. Finally, the battery box suction cup 73 and the battery replacement device suction cup 6 are powered off, and the battery box 7 is separated from the power exchange device and the disassembly work of the battery box 7 is completed. By operating the above steps in reverse, the battery box 7 can be installed in the car from the battery replacement station. The combination of the two set of steps is the battery replacement process of the battery box 7 quick battery replacement system. The battery box 7 quick battery replacement system of the present embodiment adopts single box battery replacement. The overall structure of the device is compact and the action is quick. The battery replacement time is less than 6 minutes, and a fully automated control is realized. In one preferred aspect of this embodiment, the battery replacement device suction cup 6 and the movable box 41 are connected together through an insulating plate 62 to shield the current when the battery replacement device suction cup 6 is energized. According to this preferred embodiment, when the battery replacement device and the battery box 7 are attracted and attached to each other through the battery replacement device suction cup 6 and the battery box suction cup 73, the unlocking bar 3 can accurately unlock the unlock button 72 point by point, and the unlock accuracy thereof is high, it will not cause the problem that the battery box 7 is incompletely unlocked and the entire battery replacement unlocking system is stuck, and the battery replacement efficiency of the battery replacement system is improved.

The unlocking device for battery replacement equipment, the battery replacement equipment and the battery box 7 quick battery replacement system provided by the present invention utilize the transmission mechanism 2 to transmit the torque of the

driving element 1 to the unlocking bar 3, so that it can achieve precise point-to-point telescopic unlocking, and unlock accuracy is high, and high unlocking accuracy will also save a part of the time for unlocking the battery replacement equipment, thereby improving the efficiency of battery replacement.

While specific embodiments of the invention have been described above, it will be understood by those skilled in the art that this is by way of illustration only and the scope of the invention is defined by the appended claims. Various changes or modifications may be made by those skilled in the art without departing from the principles and spirit of the invention, but such alterations and modifications fall within the scope of the invention.

Claims

1. A battery replacement device, characterized in that the battery replacement device includes:

a battery tray;

a battery replacement device unlocking apparatus;

the battery replacement device unlocking apparatus includes: an driving element, a transmission mechanism and an unlocking bar;

the driving element is connected with the transmission mechanism, the transmission mechanism is connected with the unlocking bar;

the driving element drives the transmission mechanism to move, and the transmission mechanism drives the unlocking bar to expand and retract;

a housing and a battery replacement device suction cup are provided on the battery tray, and the battery replacement device unlocking apparatus is provided in the housing, the battery replacement device suction cup is connected to the housing through the battery replacement device unlocking apparatus, the battery replacement device suction cup is sleeved on the unlocking bar, and the unlocking bar expands and retracts in the battery replacement device suction cup.

2. The battery replacement device according to claim 1, characterized in that the transmission mechanism includes a transmission rod, a driving column, a driven column, a connecting element and a guide portion;

one end of the transmission rod is connected with the driving element, and the other end of the transmission rod is connected with the driving column, the connecting element is respectively connected to the driving column and the driven column, and the guide portion is provided with a driven column guide hole extending in the axial direction of the unlocking bar, the driven column passes through the driven column guide hole and slides in the guide column guide hole, the guide portion is provided with an unlocking bar guide hole, the unlocking bar passes through the unlocking bar guide hole;

the connecting element rotates around the axis of the driving column, the connecting element rotates around the axis of the driven column, and the unlocking bar rotates around the axis of the driven column.

3. The battery replacement device according to claim 2, characterized in that a driving column guide hole extending in the axial direction of the transmission rod is further provided on the guide portion, and the driving column passes through the driving column guide hole and slides in the driving column guide hole.

4. The battery replacement device according to claim 3, characterized in that the guide portion has a first plate body, a second plate body and a third plate body, and the second

plate body is connected between the first plate body and the third plate body, the driving column guide hole is formed on the first plate body and/or the third plate body, and the driven column guide hole is formed on the first plate body and/or the third plate body, the unlocking bar guide hole is formed on the second plate body.

5. The battery replacement device according to at least one of claims 2-4, characterized in that the transmission rod includes an active element, a force transmission element and a driven element, the active element is connected with the driving element, and the driven element is connected with the driving column, the force transmission element is movably connected with the active element, and the force transmission element is fixedly connected with the driven element.

6. The battery replacement device according to claim 5, characterized in that

the force transmission element includes a force transmission piece, a force transmission spring and two fixing pieces, and two ends of the force transmission piece are respectively connected to the active element and the driven element, the two fixing pieces are fixed on the force transmission piece and connected to both ends of the force transmission spring, the force transmission spring extends in the axial direction of the transmission rod, the force transmission piece is provided with a through hole, and the through hole is located between the two fixing pieces;

the active element includes a driving piece and a clamping column, and the driving piece sequentially penetrates through the two fixing pieces and is disposed in the force transmission spring, the clamping column is connected to the driving piece and is located between the two fixing pieces, one end of the clamping column extends into the through hole, and the other end of the clamping column is clamped between the two spirals of the force transmission spring; the driving piece slides in the axial direction of the transmission rod, and the clamping column slides in the through hole.

7. The battery replacement device according to claim 5 or 6, characterized in that the driven element includes a driven piece and two supporting pieces, the driven piece is connected to the force transmission element, and the two supporting pieces are respectively connected to two sides of the driven piece along the axial direction of the driving column, and the two supporting pieces are respectively connected to the driving column.

8. The battery replacement device according to any one of claims 1-7, characterized in that the battery replacement device unlocking apparatus further includes a box body, and one end of the unlocking bar connected to the transmission mechanism is located in the box body, the other end of the unlocking bar penetrates out of the box body.

9. The battery replacement device according to claim 8, characterized in that the box body includes a movable box, a buffer element and a fixed box, the fixed box is fixed, and the movable box is movably connected inside the box through the buffer element.

10. The battery replacement device according to claim 9, characterized in that the buffer element is a buffer spring that extends in the axial direction of the unlocking bar.

11. The battery replacement device according to claim 9 or 10, characterized in that a slide rail is provided on the fixed box, the slide rail extends along the axial direction of the unlocking bar, and a slide member is provided on the movable box, the slide member slides on the slide rail.

12. The battery replacement device according to claim 11, characterized in that an end portion of the slide rail has an exit hole, and a diameter of the exit hole is larger than an inner diameter of the slide rail and an outer diameter of the slide member.

13. The battery replacement device according to any one of claims 9-12, characterized in that an end of the transmission mechanism extending into the movable box is connected to the movable box through a connecting member, and a moving channel is arranged on the fixed box, a limit gap is formed on the movable box, the limit gap is in communication with the moving channel, and the transmission mechanism sequentially penetrates through the moving channel and the limit gap.

14. A battery replacement device according to claim 1, characterized in that a flange is provided on the end portion of the unlocking bar away from the transmission mechanism, and a boss is provided in the battery replacement device suction cup corresponding to the flange, the shape of the flange matches the shape of the boss.

15. A battery replacement device according to claim 1, characterized in that an end surface of the unlocking bar is flush with a surface of the battery replacement device suction cup.

16. A battery box quick battery replacement system, characterized in that the battery box quick battery replacement system includes:

a battery box, a battery box fixing frame and the power replacement device according to any one of claims 1-15;

the battery box includes a locking tongue and an unlocking button, the unlocking button moves correspondingly with the locking tongue, and the unlocking button is correspondingly arranged with the unlocking bar;

the battery box fixing frame is provided with a locking portion, and the locking tongue and the locking portion are locked and matched;

the extending motion of the unlocking bar is used for pressing the unlocking button to drive the locking tongue to disengage the locking portion and to unlock.

17. A battery box quick battery replacement system according to claim 16, characterized in that a battery box suction cup is sleeved on the unlocking button and the unlocking button expands and retracts in the battery box suction cup, the battery box suction cup and the battery replacement device suction cup are correspondingly arranged.