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(54) **MULTI-POINT LOCKING MECHANISM FOR DOOR SYSTEM**

(57) A multi-point locking mechanism for a door system comprises a driving mechanism, a guide mechanism, a transmission mechanism and a side locking assembly, wherein the driving mechanism and the guide mechanism are located above a door system, and the driving mechanism is movably connected to the guide mechanism and is able to rotate by an angle under the restriction of the guide mechanism when door leaves are about to be closed or opened, so as to partially lock or unlock the door system; at least one side of the door system is provided with the side locking assembly; one end of the transmission mechanism is connected to the side locking assembly, and the other end of the transmission mechanism is located in the vicinity of the driving mechanism; and the driving mechanism drives the transmission mechanism to move when rotating to realize locking or unlocking, and controls the side locking assembly to lock or unlock the door system through the transmission mechanism. Multi-point locking of the top and side face of door leaves is realized through the driving mechanism capable of passing a dead point, the restriction between the driving mechanism and a guide rail, and the restriction of the side locking assembly on the

side face of the door leaves; and the multi-point locking mechanism is good in locking effect, simple and reliable in structure and easy to maintain, and occupies a small space.

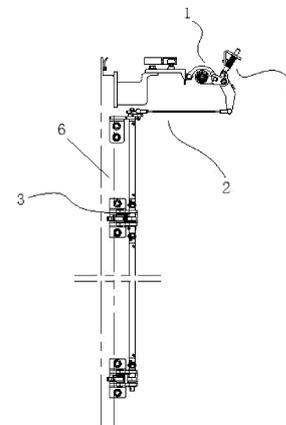


FIG. 1

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Description

BACKGROUND OF THE INVENTION

1. Technical Field

[0001] The invention relates to a multi-point locking mechanism for a door system, and belongs to the technical field of rail transit devices.

2. Description of Related Art

[0002] A locking device is often disposed on a load-bearing and driving mechanism of a vehicle door system to lock a door leaf when the door leaf is closed. For high-speed vehicles that have a high requirement for the locking strength of a door system, an extra locking device will be disposed on the side face of the door system. There are two common types of side locking devices. In one case, an electrical or pneumatic element is used to drive the side locking device to lock or unlock a door leaf; however, in this case, the locking device needs an extra power source, is high in energy consumption, complex in structure and poor in reliability, and occupies a large space.

[0003] In the other case, the side locking device is linked with a mechanism driving device or other moving components, and is driven to lock or unlock a door leaf when the mechanism driving device drives the door leaf to move. In this case, an independent power source is not needed, so energy consumption is reduced.

[0004] However, existing linkage-related structures have the following defects:

[0005] Due to the fact that the movement of the side locking device and the operation of the door leaf are performed synchronously, in order to prevent motion interference between the side locking device and the door leaf, the locking or unlocking operation of the locking device should be faster than the movement of the door leaf, which puts forward high installation and adjustment requirements for the locking device, has the risk of motion interference, and makes maintenance difficult and the locking effect unsatisfactory.

BRIEF SUMMARY OF THE INVENTION

[0006] Objective: To overcome the defects in the prior art, the invention provides multi-point locking mechanism for a door system, which can improve the load bearing capacity of the door system, satisfy the requirement for a higher speed, and solve the problem that multi-point locking mechanisms in existing door systems are complex in structure, poor in locking effect, and difficult to install and adjust, and occupies a large space.

[0007] Technical solution: The technical solution adopted by the invention to solve the abovementioned technical problems is as follows:

[0008] A multi-point locking mechanism for a door sys-

tem comprises a driving mechanism, wherein the driving mechanism is able to rotate by an angle under the restriction of a guide rail when door leaves are about to be closed or opened, to partially lock or unlock a door system; and during rotation, the driving mechanism drives a transmission mechanism to move to drive a side locking assembly to lock or unlock the door system, such that multi-point restriction of the side face of the door system is realized.

[0009] Preferably, the transmission mechanism comprises a transmission shaft, a transmission fork is fixed on the transmission shaft, the transmission shaft is connected to one end of a first rotating arm, the other end of the first rotating arm is connected to one end of a first connecting rod, and the other end of the first connecting rod is connected to one end of a second rotating arm; a mounting block is disposed on the transmission shaft, a limiting pillar is disposed on the mounting block, and the transmission fork contacts the limiting pillar when restored; the side locking assembly comprises a lock body, a rotatable lock fork is disposed in the lock body, a torsion spring is disposed in the lock fork, the lock fork is initially in a restored state under the action of the torsion spring, and a second wheel is disposed at a rear end of the lock fork; a rotating shaft is disposed in the lock body, an inner swing arm is mounted on the rotating shaft and is driven by the rotating shaft to rotate, and when the inner swing arm rotates in position, a front end of the inner swing arm contacts the second wheel; one end of the rotating shaft is connected to one end of a driving shaft through a universal joint, and the other end of the driving shaft is connected to the other end of the second rotating arm; and the driving mechanism is used for driving the transmission fork to rotate.

[0010] Preferably, the driving mechanism comprises a driving motor, the driving motor drives a lead screw to rotate, the lead screw is sleeved with a lead screw nut, one end of the lead screw nut is rotatably connected to one end of a transmission frame through a first hinge pin, the other end of the transmission frame is articulated with one end of a transmission plate, a wheel is disposed on the transmission plate and is movably connected to a guide rail, the guide rail comprises a linear section, a curved section and a grooved section, the linear section, the curved section and the grooved section are connected in sequence, and the lead screw nut is matched with the transmission fork.

[0011] Preferably, multiple side locking assemblies are arranged, a tail end of the rotating shaft of each of the multiple side locking assemblies is connected to the driving shaft of the next side locking assembly through a universal joint, and the driving shaft of the first side locking assembly is connected to the second rotating arm.

[0012] Preferably, the multi-point locking mechanism further comprises an unlocking mechanism, the unlocking mechanism comprises an unlocking handle, the unlocking handle is rotatably connected to the transmission mechanism and is used for driving the transmission

mechanism to move reversely, and an unlocking elastic element is disposed on the transmission mechanism and is used for restoring the unlocking handle.

[0013] Preferably, the multi-point locking mechanism further comprises a transmission fork position holding mechanism, the transmission fork position holding mechanism comprises a mounting plate, stop links are movably connected to the mounting plate and are sleeved with elastic elements, rotating blocks are disposed on the transmission shaft, a free end of each of the rotating blocks is rotatably connected to one end of the corresponding stop link, and the elastic elements are used for maintaining a force of the rotating blocks in the rotation direction.

[0014] Preferably, the driving mechanism comprises a driving motor, the driving motor drives a lead screw to rotate, the lead screw is sleeved with a lead screw nut, one end of the lead screw nut is connected to a first hinge pin, a wheel is disposed at the other end of the lead screw nut and is movably connected to a guide rail, the guide rail comprises a linear section and a grooved section, and the linear section and the grooved section are connected in sequence; and the first hinge pin drives the transmission mechanism to move.

[0015] Preferably, the transmission mechanism comprises a transmission shaft, a transmission fork is fixed on the transmission shaft and is matched with the first hinge pin, the transmission shaft is connected to the middle of a first rotating arm, and one end of the first rotating arm is connected to a first connecting rod through a universal joint; a limiting pillar is disposed on a shaft mounting plate at one end of the transmission shaft, and the first rotating arm contacts the limiting pillar when rotating; and the side locking assembly comprises a driving shaft, one end of the driving shaft is connected to the first connecting rod through a universal joint, and a bolt is disposed on the driving shaft.

[0016] Preferably, multiple bolts are disposed on the driving shaft.

[0017] Preferably, the multi-point locking mechanism further comprises an unlocking mechanism, the unlocking mechanism comprises an unlocking handle, and the unlocking handle is disposed on the driving shaft and drives the bolts on the driving shaft to move upwards or downwards in a vertical direction.

[0018] Preferably, the multi-point locking mechanism further comprises a transmission fork position holding mechanism, the transmission fork position holding mechanism comprises a mounting plate, a stop link is movably connected to the mounting plate and is sleeved with an elastic element, and the stop link is rotatably connected to the other end of the first rotating arm.

[0019] The multi-point locking mechanism for a door system provided by the invention has the following beneficial effects: the top of door leaves can be locked by means of the driving mechanism which can pass a dead point and is restrained by the grooved section of the guide rail; in addition, the side face of the door leaves can be

locked by means of the restriction effect of the side locking assembly on lock pillars or latches; moreover, multiple side locking assemblies can be mounted on the side face of the door leaves to realize multi-point locking of the side face of the door leaves.

[0020] The side locking assembly on the side face of the door system is controlled to lock or unlock the door system by means of the movement of the driving mechanism in the locking or unlocking process, such that multi-point restriction of the door system is realized, the locking effect is good; and the locking or unlocking operation of the side locking assembly is performed after the door leaves are closed or before the door leaves are opened, so motion interference is avoided, and locking is reliable.

[0021] The multi-point locking mechanism is simple in structure and easy to maintain, and occupies a small space, the side locking assembly can be a universal joint, and multiple locking assemblies can be connected in series to one side of the door system to satisfy different locking strength requirements. The multi-point locking mechanism is suitable for flat doors, curved doors, single doors, double doors, sliding-plug doors, sliding doors and other doors, thus being good in universality.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0022]

FIG 1 is a side sectional view of a multi-point locking mechanism for a door system according to a first embodiment;

FIG 2 is a structural view of a driving mechanism according to the first embodiment;

FIG 3 is a structural view 1 of a transmission mechanism according to the first embodiment;

FIG 4 is a structural view 2 of the transmission mechanism according to the first embodiment;

FIG 5 is a structural view of a side locking assembly according to the first embodiment;

FIG 6 is a structural view of a lock body according to the first embodiment;

FIG 7 is a structural view of an unlocking mechanism according to the first embodiment;

FIG 8 is a structural view of a transmission fork position holding mechanism according to the first embodiment;

FIG 9 is a cooperation diagram of the driving mechanism, the transmission mechanism and the transmission fork position holding mechanism in a critical state where a transmission fork contacts/is separated from a first hinge pin when a door leaf is closed/opened according to the first embodiment;

FIG 10 is a cooperation diagram of the driving mechanism, the transmission mechanism and the transmission fork position holding mechanism after the door leaf is closed according to the first embodiment;

FIG 11 is a cooperation diagram in a critical state

where a lock pillar on the side face of the door leaf contacts/is separated from a lock fork of the side locking assembly when the door leaf is opened/closed according to the first embodiment; FIG 12 is a cooperation diagram of the lock pillar on the side face of the door leaf and the lock fork of the side locking assembly when the door leaf is closed according to the first embodiment; FIG 13 is a cooperation diagram of the driving mechanism, the transmission mechanism and the transmission fork position holding mechanism after the transmission fork is separated from the first hinge pin when the door leaf is opened according to the first embodiment; FIG 14 is a side sectional view of a multi-point locking mechanism for a door system according to a second embodiment; FIG 15 is a structural view of a driving mechanism according to the second embodiment; FIG 16 is a cooperation diagram of a driving mechanism, a transmission mechanism and a transmission fork position holding mechanism after a side locking assembly is locked according to the second embodiment; FIG 17 is a cooperation diagram of the driving mechanism, the transmission mechanism and the transmission fork position holding mechanism after the side locking assembly is unlocked according to the second embodiment; FIG 18 is a structural view of the side locking assembly and an unlocking mechanism according to the second embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0023] The invention will be further described in conjunction with specific embodiments.

[0024] A multi-point locking mechanism for a door system comprises a driving mechanism, wherein the driving mechanism is able to rotate by an angle under the restriction of a guide rail when door leaves are about to be closed or opened, to partially lock or unlock a door system; and during rotation, the driving mechanism drives a transmission mechanism to move to drive a side locking assembly to lock or unlock the door system, such that multi-point restriction of the side face of the door system is realized.

First Embodiment:

[0025] As shown in FIG 1-FIG 2 which illustrates a multi-point locking mechanism for a door system according to a first embodiment of the invention, a driving mechanism 1 comprises a driving motor 101, wherein the driving motor 101 is connected to one end of a lead screw 102 through a transmission belt 102, the lead screw 102 is sleeved with a lead screw nut 103, one end of the lead screw nut 103 is rotatably connected to one end of a

transmission frame 104 through a first hinge pin 105, the other end of the transmission frame 104 is articulated with one end of a transmission plate 106, the other end of the transmission plate 106 is connected to a door-linked frame 107, and the door-linked frame 107 is connected to door leaves 6. A wheel 108 is disposed on the transmission plate 106 and is movably connected to a guide rail 109, the guide rail 109 comprises a linear section 1091, a curved section 1092 and a grooved section 1093, and the linear section 1091, the curved section 1092 and the grooved section 1093 are connected in sequence; when the wheel 108 moves to the tail end of the grooved section 1093, the door leaves 6 are closed in position, and the transmission frame 104 rotates to retract; and when the wheel 108 sequentially moves through the curved section 1092 and the linear section 1091 from the tail end of the grooved section 1093, the door leaves are opened gradually, and the transmission frame 104 rotates to stretch out.

[0026] As shown in FIG 3-FIG 4, a transmission mechanism 2 comprises a transmission shaft 201, and a transmission fork 202 is fixed on the transmission shaft 201 and is matched with one end of the first hinge pin 105; when the first hinge pin 105 rotates to retract with the lead screw nut 103, the transmission fork 202 rotates downwards with the first hinge pin 105; and when the first hinge pin 105 rotates to stretch out with the lead screw nut 103, the transmission fork 202 rotates upwards with the first hinge pin 105 until it is separated from the first hinge pin 105. The transmission shaft 202 is connected to one end of a first rotating arm 203, the other end of the first rotating arm 203 is connected to one end of a first connecting rod 204, and the other end of the first connecting rod 204 is connected to one end of a second rotating arm 205. A mounting block 206 is disposed on the transmission shaft 201, a limiting pillar 207 is disposed on the mounting block 206, and the transmission fork 202 contacts the limiting pillar 207 when rotating upwards.

[0027] As shown in FIG 5-FIG 6, a side locking assembly 3 comprises a lock body 301, wherein a rotatable lock fork 302 is disposed in the lock body 301, a torsion spring 303 is disposed in the lock fork 302, the lock fork 302 is initially in a restored state under the action of the torsion spring 303, and a second wheel 304 is disposed at a rear end of the lock fork 302; a rotating shaft 305 is disposed in the lock body 302, an inner swing arm 306 is mounted on the rotating shaft 305 and is driven by the rotating shaft 305 to rotate, and when the inner swing arm 306 rotates in position, a front end of the inner swing arm 306 contacts the second wheel 304; and one end of the rotating shaft 305 is connected to one end of the driving shaft 307 through a universal joint, and the other end of the driving shaft 307 is connected to the other end of the second rotating arm 205.

[0028] As shown in FIG 7, an unlocking mechanism 4 comprises an unlocking handle 401, wherein the unlocking handle 401 is rotatably connected to the transmission

mechanism and is used for driving the transmission mechanism to rotate reversely, and an unlocking elastic element is disposed on the transmission mechanism and is used for restoring the transmission mechanism after the transmission mechanism rotates reversely. The unlocking handle 401 may be mounted on any one part of the transmission mechanism, such as the transmission shaft, the first rotating arm or the first connecting rod, as long as the unlocking handle 401 can drive the part to move reversely to allow the driving shaft to rotate to drive the side unlocking assembly to unlock the door leaves. The unlocking elastic element 402 such as a torsion spring is disposed around the transmission shaft 201, and under the action of the torsion spring, the unlocking handle can be restored after being released.

[0029] As shown in FIG 8, a transmission fork position holding mechanism 5 comprises a mounting plate 501, wherein stop links 502 are movably connected to the mounting plate 501, elastic elements 503 such as pressure springs are disposed around the stop links 502, rotating blocks 504 are disposed around the transmission shaft 201, and a free end of each of the rotating blocks 504 is rotatably connected to one end of the corresponding stop link 502. When the transmission fork 202 rotates upwards, the rotating blocks 504 are driven to rotate to drive the stop links 502 to rotate; and when the transmission fork 202 cannot continue to rotate upwards under the action of the limiting pillar 207, the elastic elements 503 maintain the upward rotation force of the rotating blocks 503 through the stop links 502 to keep the transmission fork 202 static. When the transmission fork 202 rotates downwards, the rotating blocks 504 are driven to rotate to drive the stop links 502 to rotate; when the rotation point of the transmission fork 202 exceeds the maximum rotation position of the transmission plate 106 and the transmission frame 105 which are articulated together, the transmission fork 202 stops rotating downwards, and the elastic elements 503 maintain the downward rotation force of the rotating blocks 504 through the stop links 502 to keep the transmission fork 202 static.

Embodiment 1:

[0030] When the door leaves are to be closed, the motor drives the lead screw nut on the lead screw to move towards the middle, the wheel moves to the curved section from the linear section, under the restriction of the curved section, the lead screw nut drives the transmission frame to move towards the middle and rotate downwards along the lead screw at the same time, as shown in FIG 9, until the first hinge pin contacts the transmission fork and drives the transmission fork to rotate downward synchronously, then the transmission fork drives the transmission shaft to rotate and drives the rotating blocks to rotate, and the rotating blocks drive the stop links to rotate. As shown in FIG 10, when the wheel moves into the grooved section, the lead screw nut stops rotating, the first hinge pin and the transmission fork also stop

rotating; because the transmission shaft and the transmission frame are articulated, the transmission frame and the lead screw nut are articulated through the first hinge pin, the positions of the first hinge pin and the transmission fork are lower than the connecting line between the hinge point of the transmission plate and the transmission frame and the central point of the lead screw (that is, the first hinge pin and the transmission fork have passed the dead point), and the transmission fork is driven by the first hinge pin to the final position, the first hinge pin and the transmission fork will be locked below the dead point under the action of the transmission fork position holding mechanism, such that an outward pulling force and an upward moving force transmitted from the door leaves through the transmission frame can be effectively cut off, and the door leaves are locked. In addition, the wheel stops at the tail end of the grooved section, and the left and right sides of the wheel are restrained by the grooved section, such that the door leaves are locked in the direction of the lead screw.

[0031] As shown in FIG 11, when the door leaves are to be closed, lock pillars 601 on side faces of the door leaves 6 contact the lock fork and drive the lock fork to rotate, and the second wheel rotates at the same time until the door leaves are closed, as shown in FIG 12, such that the lock pillars and the lock fork are locked, and the second wheel rotates in position. The transmission shaft rotates with the transmission fork and sequentially drives the first rotating arm, the first connecting rod and the second rotating arm to rotate, the second rotating arm drives the transmission shaft to rotate, and the driving shaft drives the rotating shaft to rotate through the universal joint, the rotating shaft drives the inner swing arm to rotate until the inner swing arm contacts the second wheel, such that the lock fork and the lock pillars are locked. In addition, multiple side locking assemblies may be connected in series through universal joints to realize multi-point locking of the door leaves.

40 Embodiment 2:

[0032] When the door leaves are to be opened, the driving motor drives the lead screw nut on the lead screw to move, under the restriction of the grooved section, the lead screw nut drives the transmission frame to rotate upwards and also drives the first hinge pin and the transmission fork to rotate upwards, such that the door leaves are unlocked for the first time; because the transmission plate and the transmission frame are articulated, the transmission plate can be kept static, as shown in FIG 9, until the transmission fork stops at the position of the limiting pillar, and the first hinge pin is separated from the transmission fork, such that the door leaves are unlocked for the second time. When rotating upwards, the transmission fork drives the transmission shaft to rotate, and the second wheel, restrained by the inner swing arm, at the rear end of the lock fork is released through parts such as the first rotating arm, such that the side locking

assembly is unlocked. At this moment, the transmission fork is kept static under the action of the transmission fork position holding mechanism.

[0033] As shown in FIG 13, after the first hinge pin is separated from the transmission fork, the lead screw nut continues to rotate upwards; on the curved section, the transmission frame rotates and drives the door leaves to be opened towards two sides through the transmission plate and the door-linked frame until the wheel moves out of the curved section, and the lead screw nut stops rotating; and when the wheel moves on the linear section, the lead screw nut moves horizontally until the door leaves are completely opened.

[0034] As shown in FIG 11, when the door leaves are to be opened, the inner swing arm is separated from the second wheel at the rear end of the lock fork, the lock pillars 601 on the side faces of the door leaves 6 disengage from the lock fork 302, and the lock fork is restored under the action of the torsion spring.

Embodiment 3:

[0035] When a side door needs to be unlocked manually, the unlocking handle is rotated manually to drive the transmission shaft to rotate, the transmission shaft sequentially drives the first rotating arm, the first connecting rod and the second rotating arm to rotate, the second rotating arm drives the driving shaft to rotate, the driving shaft drives the rotating shaft to rotate, the rotating shaft drives the inner swing arm to rotate to be separated from the second wheel, such that the lock fork is released. At the same time, the transmission shaft drives the transmission fork to enable the transmission frame to rotate upwards to remove the locking state on the dead point, and because the transmission fork which rotates synchronously on the transmission shaft can only cause the lead screw nut and the transmission frame to rotate and will not cause the transmission plate to move, the door leaves can move without being affected. After being manually unlocked, the door leaves can be manually opened outwards, and the unlocking handle is restored under the action of the torsion spring.

Second Embodiment:

[0036] As shown in FIG 14-FIG 15 which illustrates a multi-point locking mechanism for a door system according to a second embodiment, a driving mechanism 1 comprises a driving motor 101, wherein the driving motor 101 is connected to one end of a lead screw 102, the lead screw 102 is sleeved with a lead screw nut 103, one end of the lead screw nut 103 is connected to a first hinge pin 105, a front end of a transmission frame 104 is rotatably clamped on the lead screw nut 103, a rear end of the transmission frame 104 is articulated with one end of a transmission plate 106, and the other end of the transmission plate 106 is connected to a door-linked frame 106, the door-linked frame 107 is connected to door

leaves 6. A wheel 108 is disposed at the other end of the lead screw nut and is movably connected to a guide rail 109, the guide rail comprises a linear section 1091 and a grooved section 1093, and the linear section 1091 and the grooved section 1093 are connected in sequence. When the wheel 108 moves to the grooved section 1093, one end of the wheel 108 of the lead screw nut 103 rotates downwards until the wheel 108 is clamped at a tail end of the grooved section 1093. When the wheel 108 starts to move from the tail end of the grooved section 1093, one end of the wheel 108 of the lead screw nut 103 rotates upwards, the lead screw nut 103 stops rotating when the wheel 108 reaches the top end of the grooved section 1093, and then the lead screw nut 103 moves horizontally along the linear section 1091.

[0037] As shown in FIG 16-FIG 17, a transmission mechanism 2 comprises a transmission shaft 201, wherein a transmission fork 202 is fixed on the transmission shaft 201; before the lead screw nut 103 enters the grooved section 1093, the first hinge pin 105 contacts the transmission fork 202; when the first hinge pin 105 moves from the top end of the grooved section 1093 to the bottom end of the grooved section 1093 with the lead screw nut 103, the transmission fork 202 rotates upwards with the first hinge pin 105; when the first hinge pin 105 moves from the bottom end of the grooved section 1093 to the top end of the grooved section 1093 with the lead screw nut 103, the transmission fork 202 rotates downwards with the first hinge pin 105, then the lead screw nut 103 moves out of the grooved section 1093 and enters the linear section 1091, and at this moment, the first hinge pin 105 is separated from the transmission fork 202. The transmission shaft 201 is connected to the middle of a first rotating arm 203, and one end of the first rotating arm 203 is connected to a first connecting rod 204 through a universal joint; and a limiting pillar 207 is disposed on a mounting plate at one end of the transmission shaft 201, and the first rotating arm 203 contacts the limiting pillar 207 when rotating towards one side.

[0038] As shown in FIG 18, a side locking assembly 3 comprises a driving shaft 307, wherein one end of the driving shaft 307 is connected to the first connecting rod 204 through a universal joint, bolts 308 are disposed on the driving shaft 307, and the first rotating arm 203 drives the bolts 308 on the driving shaft 307 to move upwards or downwards in the vertical direction through the first connecting rod 204.

[0039] An unlocking mechanism 4 comprises an unlocking handle 401, wherein the unlocking handle 401 is disposed on the driving shaft 307 and drives the bolts 308 on the driving shaft 307 to move upwards or downwards in the vertical direction.

[0040] A transmission fork position holding mechanism 5 comprises a mounting plate 501, wherein a stop link 502 is movably connected to the mounting plate 501, an elastic element 503 such as a pressure spring is disposed around the stop link 502, and the stop link 502 is rotatably connected to the other end of the first rotating arm 203.

When the transmission fork 202 rotates upwards, the transmission shaft 201 drives the first rotating arm 203 to rotate, the first rotating arm 203 drives the stop link 502 to rotate; at this moment, the first rotating arm 203 is limited by the limiting pillar 207 and the transmission fork 202 is limited by the wheel, restrained by the grooved section 1093, on the lead screw nut 103, so the first rotating arm 203 cannot continue to rotate in this direction; meanwhile, the elastic element 503 maintains the rotation force of the first rotating arm 203 in this direction through the stop link 502 to keep the transmission fork 202 static, and the bolts 308 on the driving shaft 307 will not move downwards. When the transmission fork 202 rotates downwards, the transmission shaft 201 drives the first rotating arm 203 to rotate, the first rotating arm 203 drives the stop link 502 to rotate, at this moment, the first rotating arm 203 is limited by the limiting pillar 207 and cannot continue to rotate in this direction, the elastic element 503 maintains the rotation force of the first rotating arm 203 in this direction through the stop link 502 to keep the transmission fork 202 static, and the bolts 308 on the driving shaft 307 will not move upwards.

Embodiment 4:

[0041] When the door leaves are to be closed, the driving motor drives the lead screw nut on the lead screw to move towards the tail end of the guide rail, the wheel moves into the grooved section from the linear section, the lead screw nut drives the transmission frame, the transmission plate, the door-linked frame and the door leaves to move, and the door leaves are closed under the restriction of the door-sliding guide rail. As shown in FIG 16, when the wheel reaches the top of the grooved section, the first hinge pin contacts the transmission fork; then, the wheel starts to rotate downwards under the restriction of the grooved section and drives the transmission fork to rotate upwards, the transmission fork drives the transmission shaft to rotate, the transmission shaft drives the first rotating arm to rotate until the wheel rotates to the bottom of the grooved section, and at this moment, the left and right sides of the wheel are restrained by the grooved section, such that the door leaves are locked in the direction of the lead screw.

[0042] In addition, during rotation, the first rotating arm drives the first connecting rod to move downwards in the vertical direction, and the first connecting rod drives the bolts on the driving shaft to move downwards; at this moment, because the door leaves have closed, latches disposed on side faces of the door leaves are completely matched with bolt guide plates 602 mounted on a vehicle, and the bolts are inserted into lock holes of the latches through the bolt guide plates, such that the side faces of the door leaves are locked. To improve the locking strength and accuracy of the side faces of the door leaves, multiple bolts are connected in series to the first connecting rod, and connecting rod guide plates are mounted on the vehicle, such that the first connecting

rod can move upwards or downwards more stably, and multi-point locking of the side faces of the door leaves is realized. Moreover, because the other end of the first rotating arm drives the stop link to rotate and the transmission fork is limited by the wheel, restrained in the grooved section, on the lead screw nut, the first rotating arm cannot continue to rotate in this direction anymore, the elastic element maintains the rotation force of the first rotating arm in this direction through the stop link to keep the transmission fork static, and the bolts on the driving shafts will not move downwards.

Embodiment 5:

[0043] When the door leaves are to be opened, the driving motor drives the lead screw nut on the lead screw to move, under the restriction of the grooved section, the wheel on the lead screw nut rotates upwards, as shown in FIG 17, to drive the first hinge pin and the transmission fork to rotate downwards, and when the wheel moves from the bottom of the grooved section to the top of the grooved section, the door leaves are unlocked for the first time. Meanwhile, when rotating downwards, the transmission fork drives the transmission shaft to rotate, the transmission shaft drives the first rotating arm to rotate, the first rotating arm drives the first connecting rod to move upwards in the vertical direction, the first connecting rod drives the bolts to move upwards to be separated from the latches on the side face of the door leaves and the bolt guide plates on the vehicle, such that the side faces of the door leaves are unlocked. Under the action of the motor, the lead screw nut moves horizontally along the linear section to be separated from the transmission fork, and drives the door leaves to be opened under the restriction of the door-sliding guide rail.

[0044] In addition, the other end of the first rotating arm drives the stop link to rotate, and when the first rotating arm cannot continue to rotate in this direction under the action of the limiting pillar, the elastic element maintains the rotation force of the first rotating arm in this direction through the stop link to keep the transmission fork static, and the bolts on the driving shaft will not move upwards.

Embodiment 6

[0045] When the door leaves need to be unlocked manually, the unlocking handle can be lifted manually and drive the transmission shaft to move upwards, the first connecting rod drives the bolts to move upwards to be separated from the latches on the side faces of the door leaves and the bolt guide plates on the vehicle, such that the side faces of the door leaves are unlocked; and because the rotation of the first rotating arm can only cause the lead screw nut to rotate and will not cause the lead screw nut to move horizontally, the door leaves can move without being affected. After being manually unlocked, the door leaves can be manually opened outwards.

[0046] The above embodiments are merely preferred ones of the invention. It should be pointed out that those ordinarily skilled in the art can make some improvements and modifications without deviating from the principle of the invention, and all these improvements and modifications should fall within the protection scope of the invention.

Claims

1. A multi-point locking mechanism for a door system, comprising a driving mechanism, a transmission mechanism, a guide mechanism and a side locking assembly, wherein the driving mechanism and the guide mechanism are located above a door system, and the driving mechanism is movably connected to the guide mechanism and is able to rotate by an angle under the restriction of the guide mechanism when door leaves are about to be closed or opened, so as to partially lock or unlock the door system; at least one side of the door system is provided with the side locking assembly; and the driving mechanism drives the transmission mechanism to move when rotating to realize locking or unlocking, and controls the side locking assembly to lock or unlock the door system through the transmission mechanism.
2. The multi-point locking mechanism for a door system according to Claim 1, wherein the driving mechanism comprises a driving motor, the driving motor drives a lead screw to rotate, the lead screw is sleeved with a lead screw nut, an end of the lead screw nut is rotatably connected to one end of a transmission frame through a first hinge pin, the other end of the transmission frame is articulated with an end of a transmission plate, a wheel is disposed on the transmission plate and is movably connected to a guide rail, the guide rail comprises a linear section, a curved section and a grooved section, and the linear section, the curved section and the grooved section are connected in sequence; and/or, the side locking assembly comprises a lock body, a rotatable lock fork is disposed in the lock body, a torsion spring is disposed in the lock fork, the lock fork is initially in a restored state under the action of the torsion spring, and a second wheel is disposed at a rear end of the lock fork; a rotating shaft is disposed in the lock body, an inner swing arm is mounted on the rotating shaft and is driven by the rotating shaft to rotate, a front end of the inner swing arm contacts the second wheel when the inner swing arm rotates in position, and an end of the rotating shaft is connected to an end of a driving shaft through a universal joint.
3. The multi-point locking mechanism for a door system according to Claim 1, wherein the transmission mechanism comprises a transmission shaft, a first rotating arm and a transmission fork, the first rotating arm and the transmission fork are fixed on the transmission shaft and are able to rotate with the transmission shaft, an end of the first rotating arm is connected to one end of a first connecting rod, the other end of the first connecting rod is connected to one end of a second rotating arm, and the other end of the second rotating arm is connected to a driving shaft of the side locking assembly.
4. The multi-point locking mechanism for a door system according to Claim 3, wherein the transmission mechanism further comprises a limiting pillar mounted on a mounting block of the transmission shaft, and the transmission fork contacts the limiting pillar when restored.
5. The multi-point locking mechanism for a door system according to Claim 2 or 3, wherein the door system is provided with multiple side locking assemblies, a tail end of the rotating shaft of each of the multiple side locking assemblies is connected to the driving shaft of the next side locking assembly through a universal joint, and the driving shaft of the first side locking assembly is connected to the second rotating arm; and/or, the multi-point locking mechanism further comprises an unlocking mechanism, the unlocking mechanism comprises an unlocking handle, the unlocking handle is rotatably connected to the transmission mechanism and is used for driving the transmission mechanism to move reversely, and an unlocking elastic element is disposed on the transmission mechanism and is used for restoring the unlocking handle; and/or, the multi-point locking mechanism further comprises a transmission fork position holding mechanism, the transmission fork position holding mechanism comprises a mounting plate, stop links are movably connected to the mounting plate and are sleeved with elastic elements, rotating blocks are disposed on the transmission shaft, a free end of each of the rotating blocks is rotatably connected to an end of the corresponding stop link, and the elastic elements are used for maintaining a force of the rotating blocks in the rotation direction.
6. The multi-point locking mechanism for a door system according to Claim 1, wherein the driving mechanism comprises a driving motor, the driving motor drives a lead screw to rotate, the lead screw is sleeved with a lead screw nut, one end of the lead screw nut is connected to a first hinge pin, a wheel is disposed

at the other end of the lead screw nut and is movably connected to a guide rail, the guide rail comprises a linear section and a grooved section, and the linear section and the grooved section are connected in sequence; and the first hinge pin drives the transmission mechanism to move. 5

7. The multi-point locking mechanism for a door system according to Claim 6, wherein the transmission mechanism comprises a transmission shaft, a transmission fork is fixed on the transmission shaft and is matched with the first hinge pin, the transmission shaft is connected to a middle of a first rotating arm, and one end of the first rotating arm is connected to a first connecting rod through a universal joint. 10 15
8. The multi-point locking mechanism for a door system according to Claim 7, wherein a limiting pillar is disposed on a shaft mounting plate at an end of the transmission shaft, and the first rotating arm contacts the limiting pillar in an unlocked state; 20
and/or, the multi-point locking mechanism further comprises a transmission fork position holding mechanism, the transmission fork position holding mechanism comprises a mounting plate, a stop link is movably connected to the mounting plate and is sleeved with an elastic element, and the stop link is rotatably connected to the other end of the first rotating arm. 25 30
9. The multi-point locking mechanism for a door system according to Claim 6, wherein the side locking assembly comprises a driving shaft, an end of the driving shaft is connected to the first connecting rod through a universal joint, and a bolt is disposed on the driving shaft. 35
10. The multi-point locking mechanism for a door system according to Claim 9, wherein multiple bolts are disposed on the driving shaft; 40
and/or, the multi-point locking mechanism further comprises an unlocking mechanism, the unlocking mechanism comprises an unlocking handle, and the unlocking handle is disposed on the driving shaft and drives the bolts on the driving shaft to move upwards or downwards in a vertical direction. 45 50 55

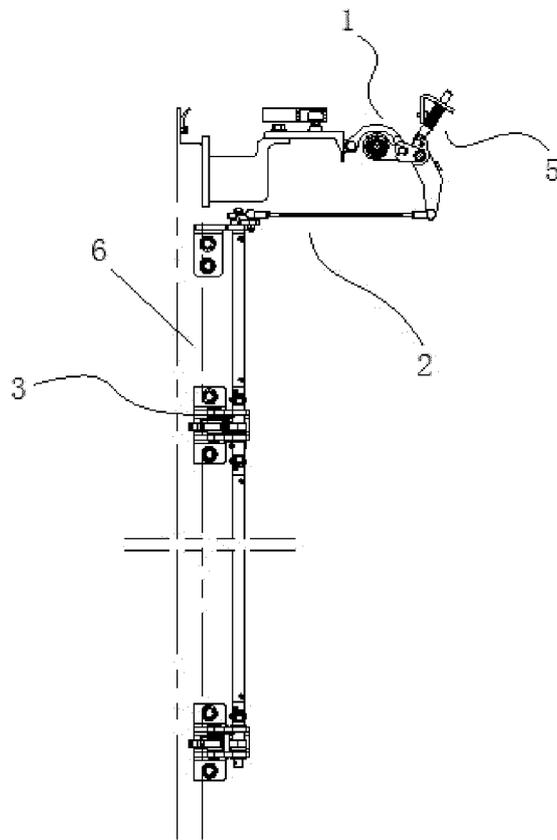


FIG 1

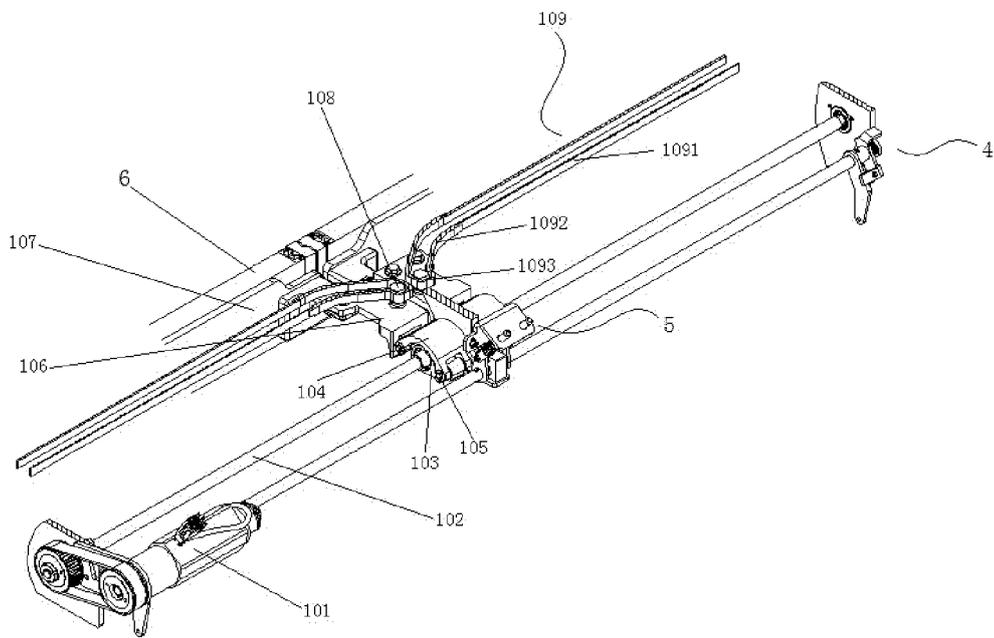


FIG 2

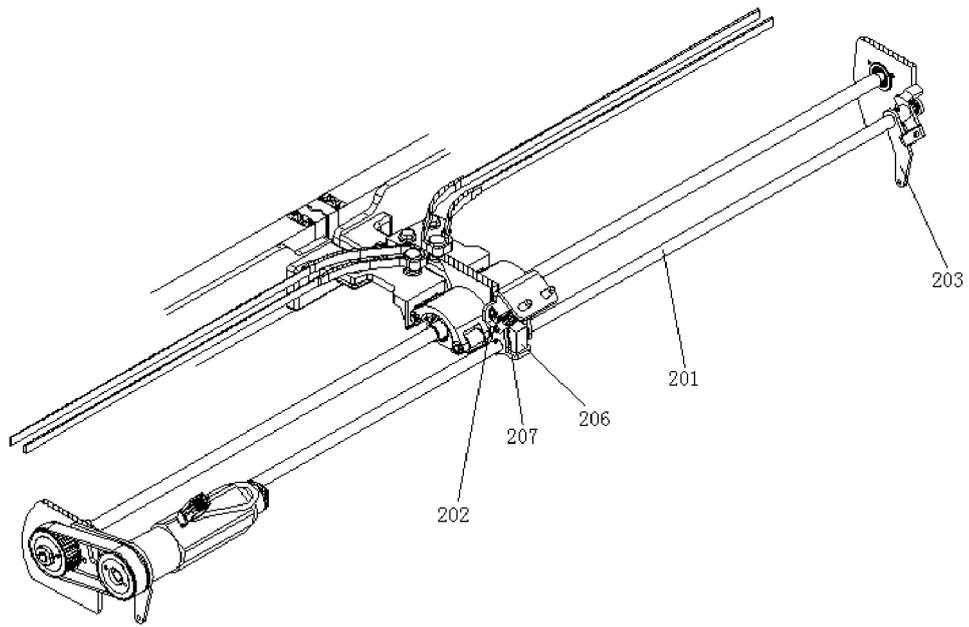


FIG. 3

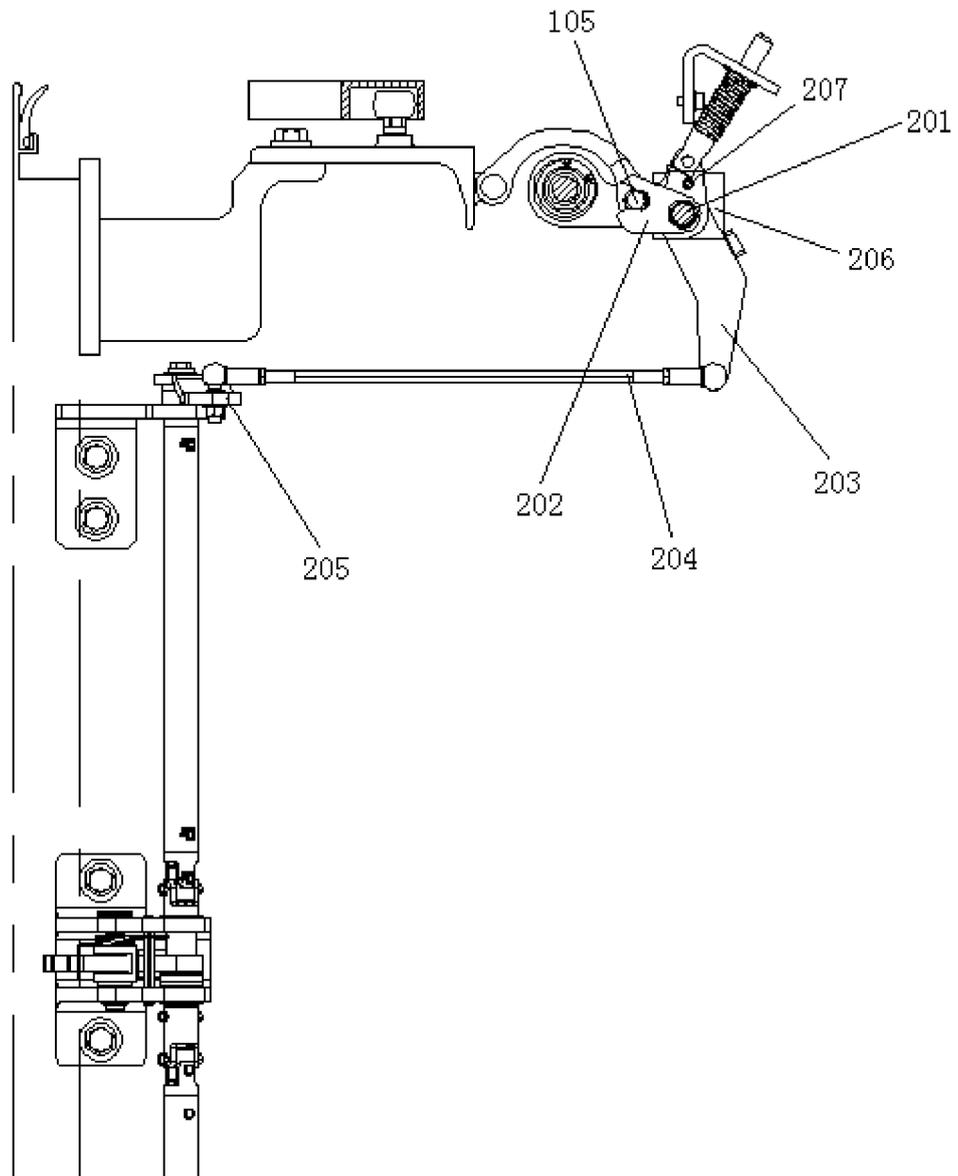


FIG. 4

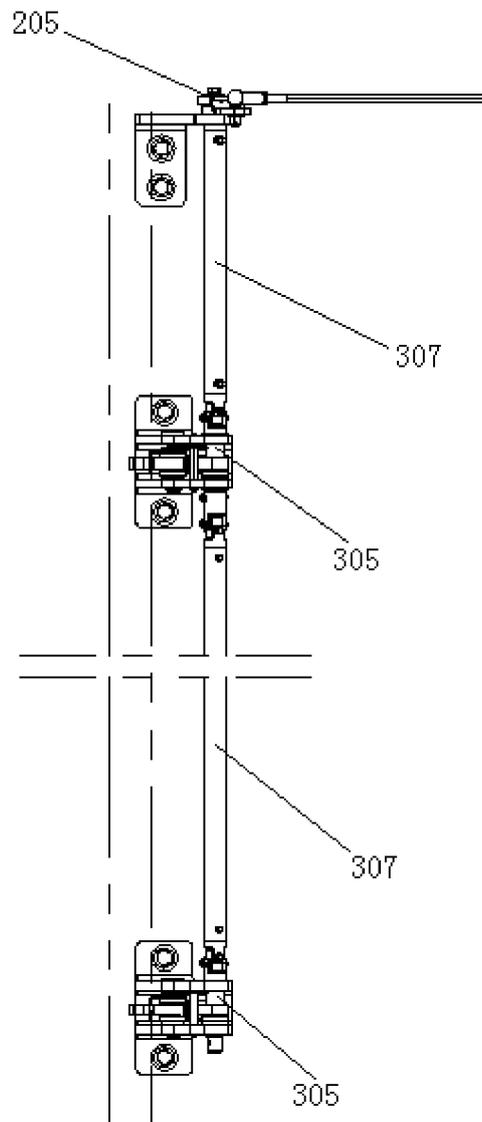


FIG. 5

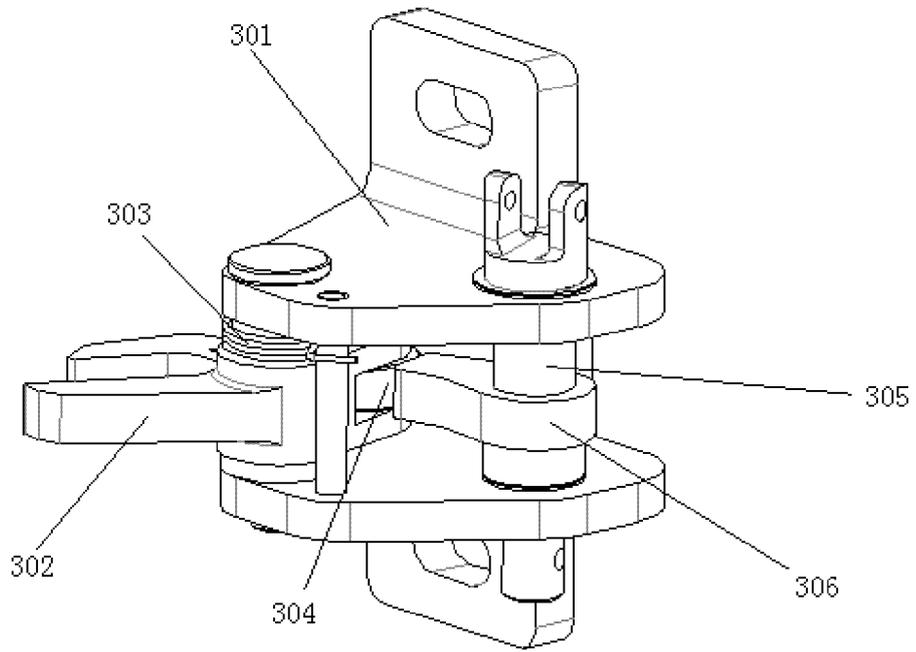


FIG. 6

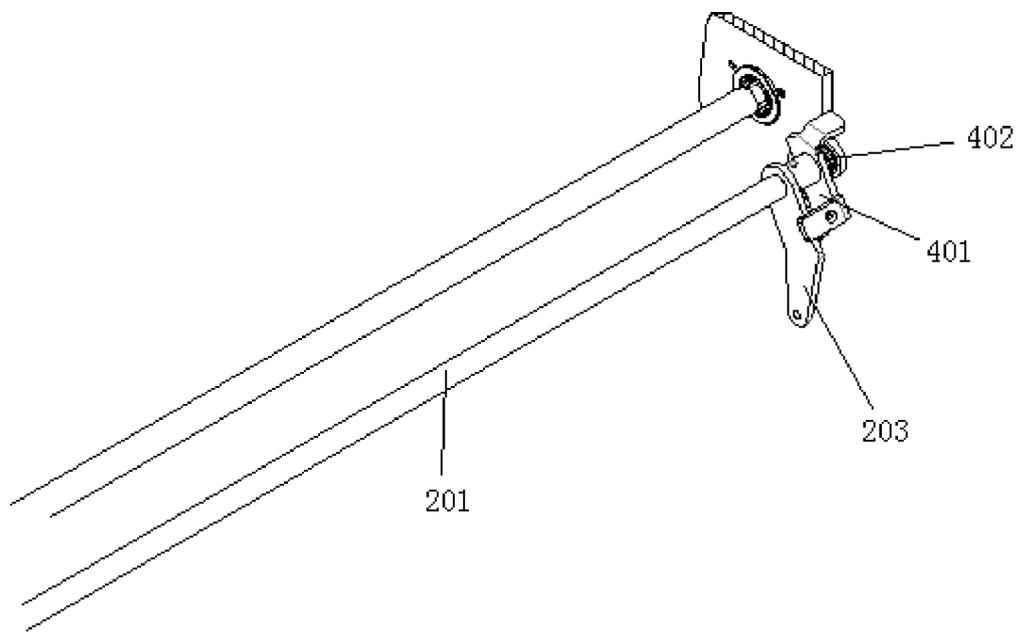


FIG. 7

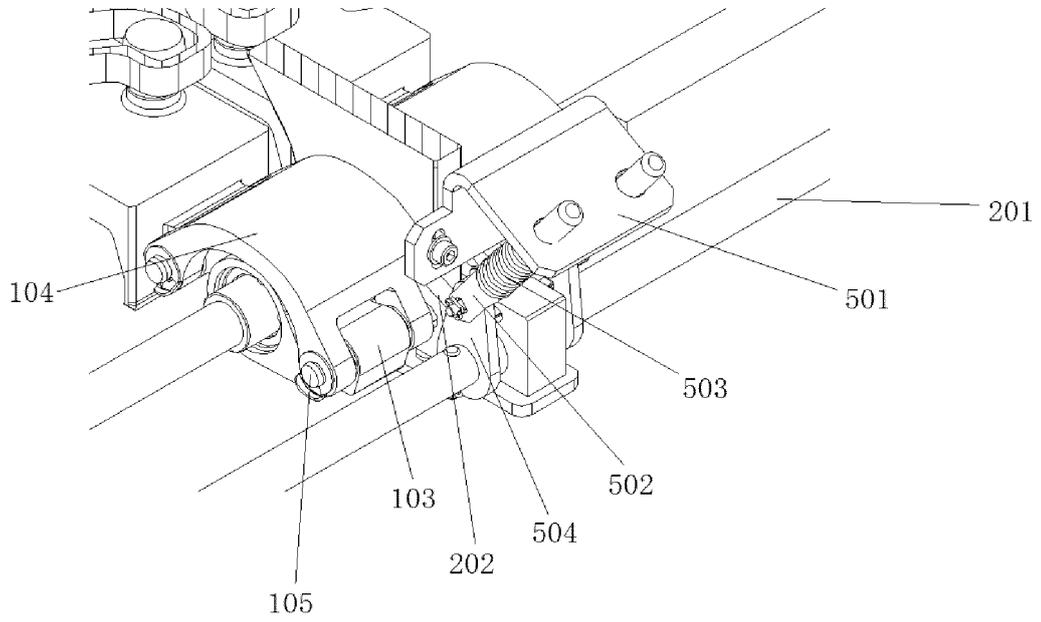


FIG 8

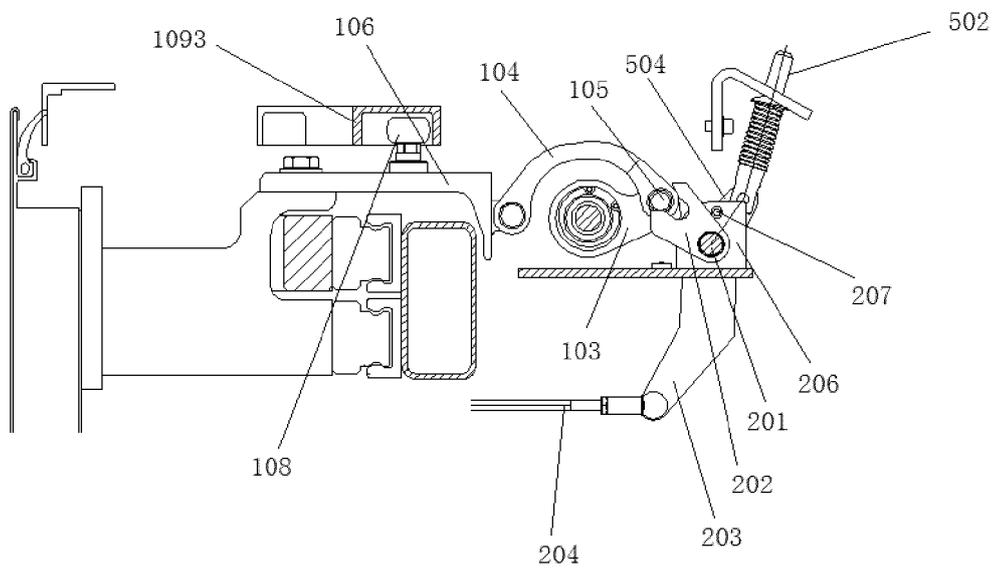


FIG 9

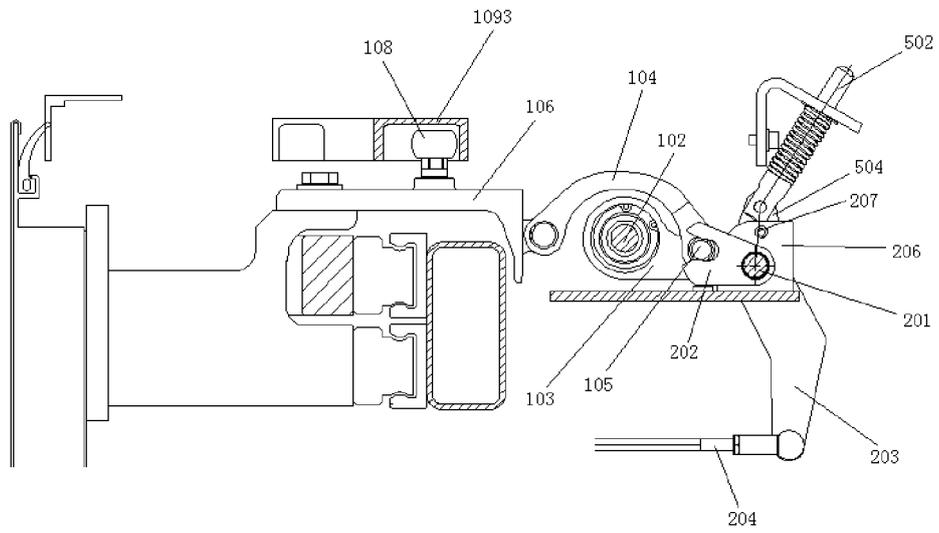


FIG. 10

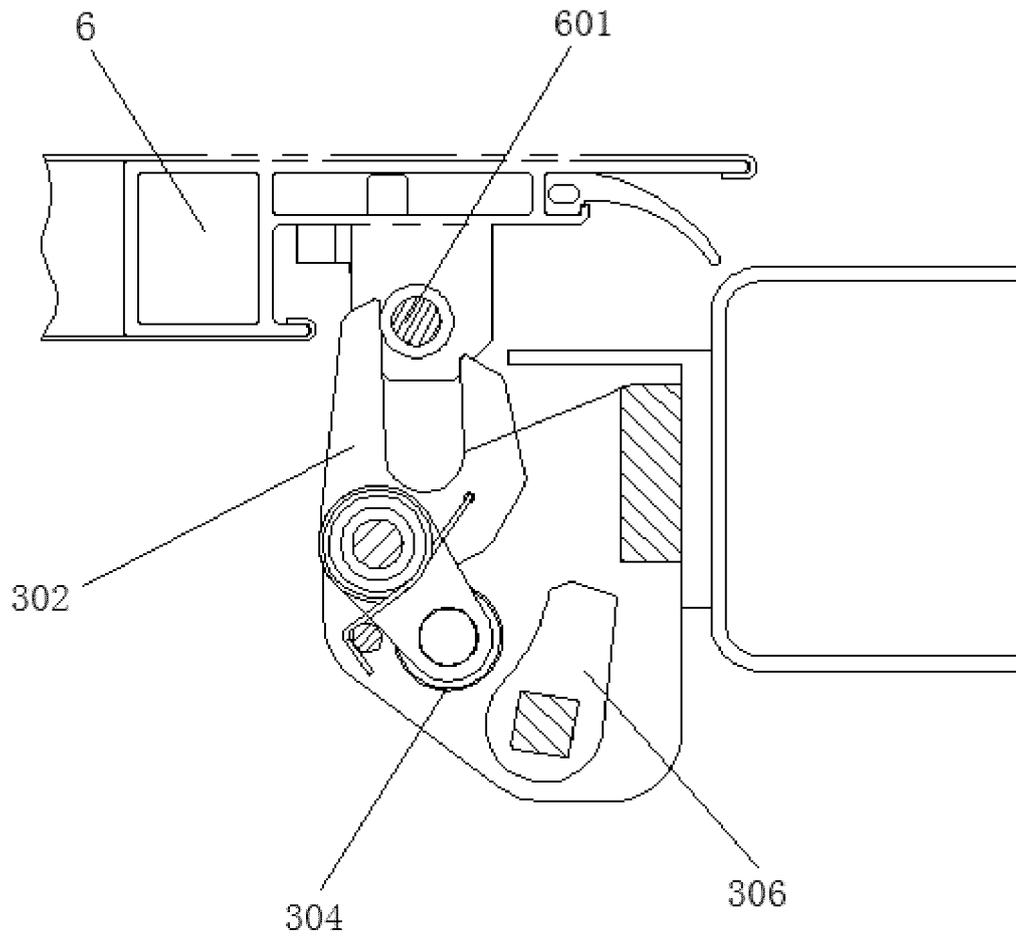


FIG. 11

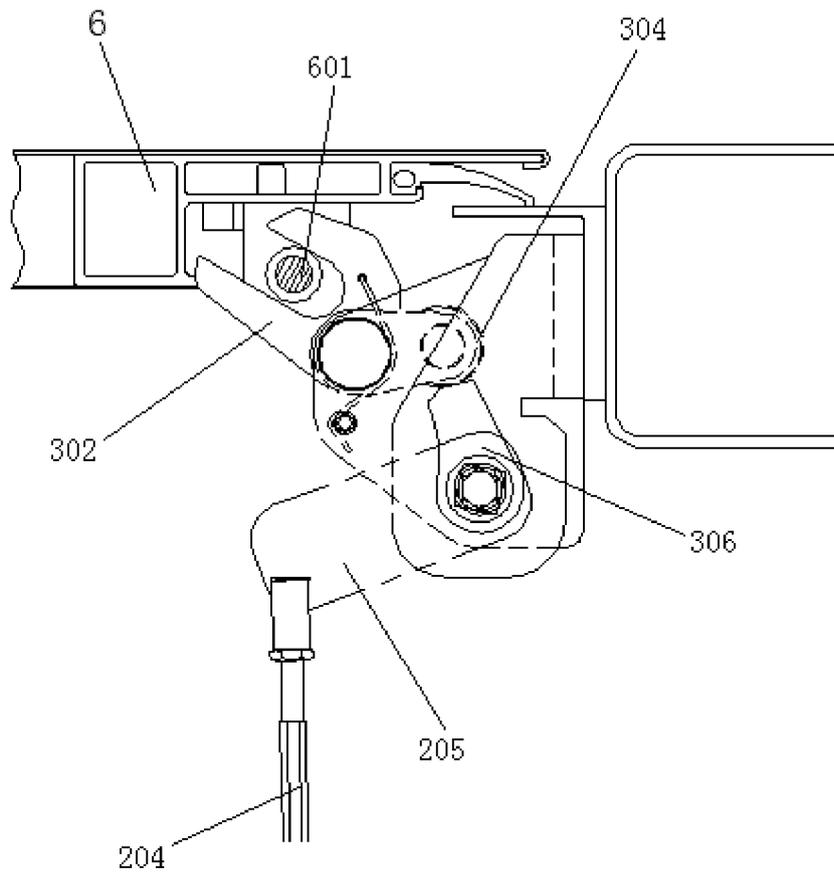


FIG 12

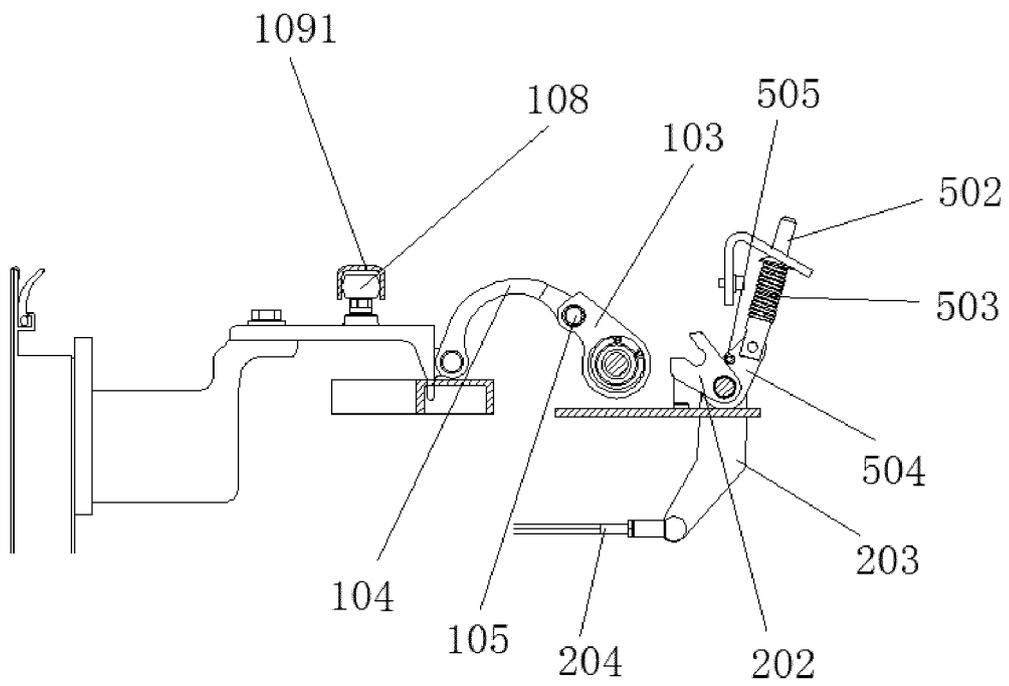


FIG 13

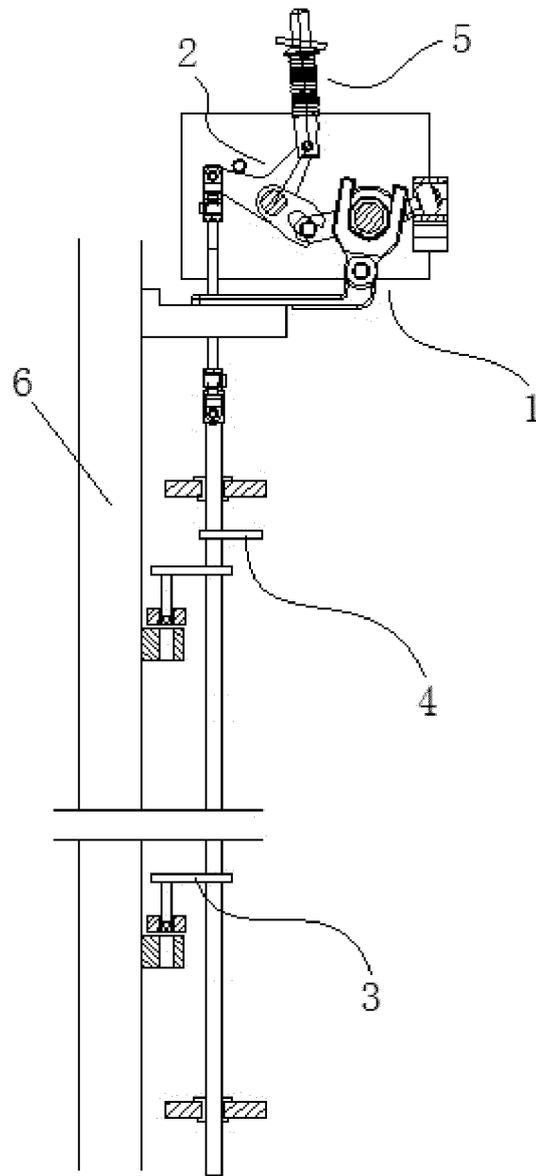


FIG 14

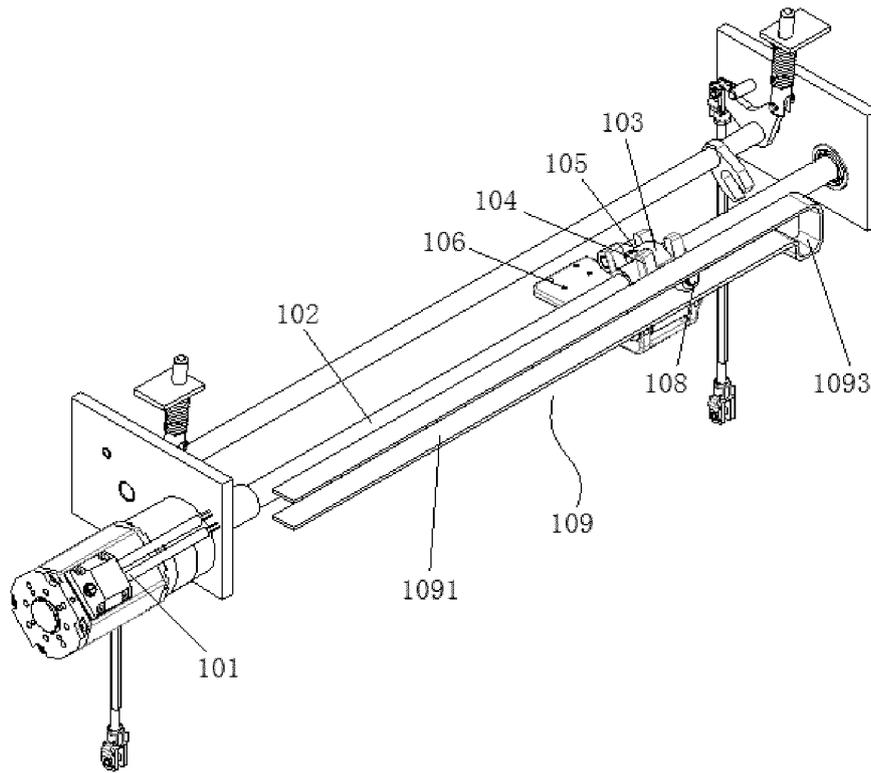


FIG 15

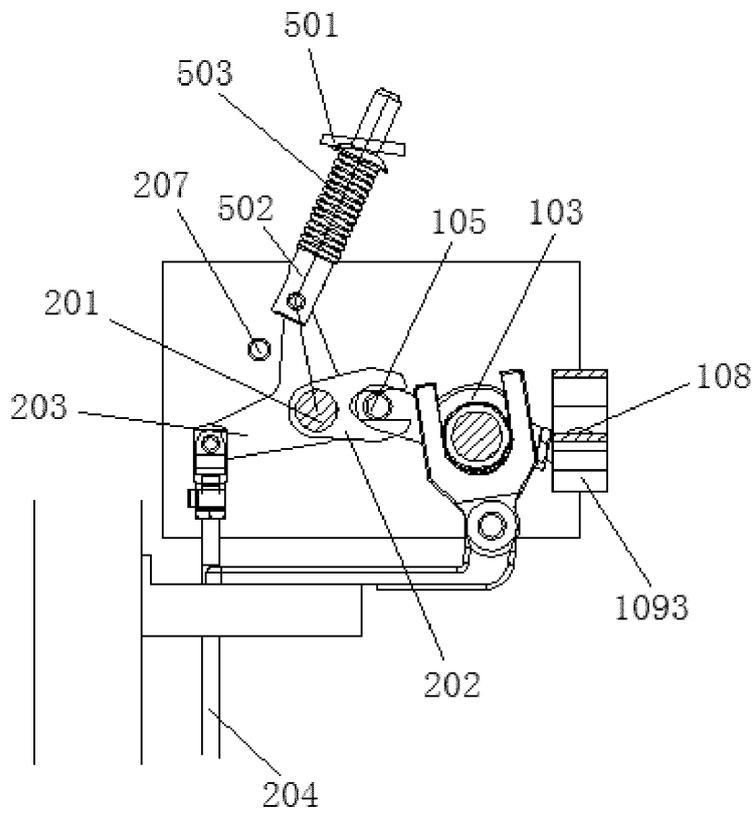


FIG 16

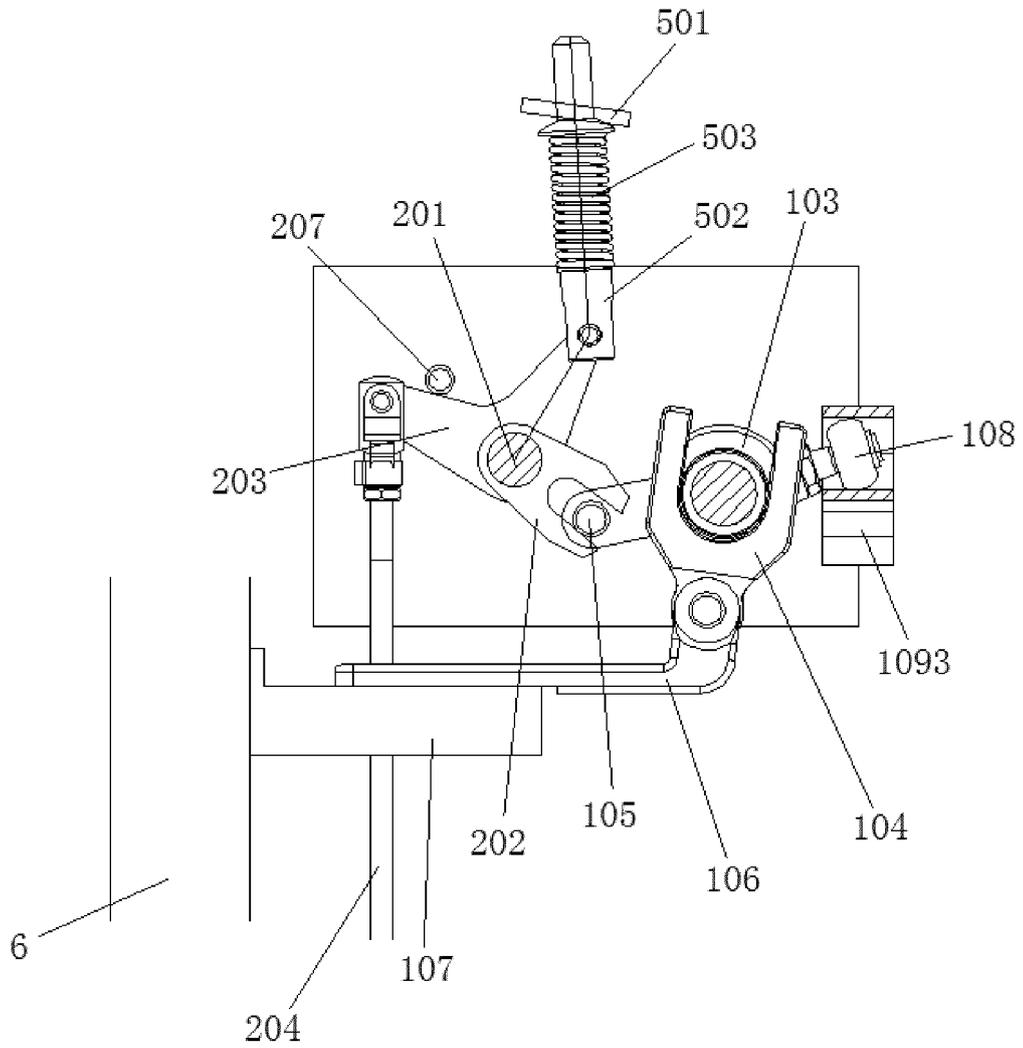


FIG. 17

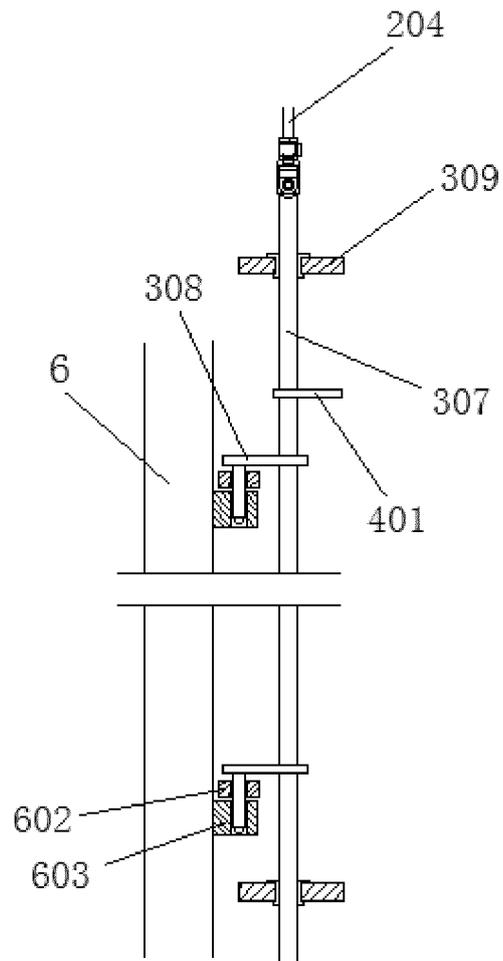


FIG. 18

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2021/095713

5	A. CLASSIFICATION OF SUBJECT MATTER	
	E05F 15/652(2015.01)i; E05F 15/655(2015.01)i; E05D 15/10(2006.01)i; E05B 83/36(2014.01)i	
	According to International Patent Classification (IPC) or to both national classification and IPC	
10	B. FIELDS SEARCHED	
	Minimum documentation searched (classification system followed by classification symbols) E05F; E05D; E05B	
	Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched	
15	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) CNABS; CNKI; CNTXT; VEN; EPTXT; WOTXT; USTXT: 曲, 凹, 塞拉, 丝杠, 导, 轨, 螺纹杆, 螺杆, 丝杆, 螺母, screw, nut, plug, door, spring, motor	
20	C. DOCUMENTS CONSIDERED TO BE RELEVANT	
	Category*	Citation of document, with indication, where appropriate, of the relevant passages
		Relevant to claim No.
	E	CN 112901002 A (NANJING KANGNI MECHANICAL & ELECTRICAL CO., LTD.) 04 June 2021 (2021-06-04) description, paragraphs [0022]-[0043], and figures 1-20
25	Y	CN 111810004 A (NANJING KANGNI MECHANICAL & ELECTRICAL CO., LTD.) 23 October 2020 (2020-10-23) description, paragraphs [0017]-[0026], and figures 1-3
	Y	CN 201344253 Y (NANJING KANGNI NEW TECHNOLOGY OF MECHANTRONIC CO., LTD.) 11 November 2009 (2009-11-11) description, page 2, line 2 to last line, and figure 1
30	A	CN 211166377 U (SAIC MOTOR CORPORATION LIMITED et al.) 04 August 2020 (2020-08-04) entire document
	A	CN 204081737 U (NANJING KANGNI MECHANICAL & ELECTRICAL CO., LTD.) 07 January 2015 (2015-01-07) entire document
35		
	<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.	
40	* Special categories of cited documents:	"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
	"A" document defining the general state of the art which is not considered to be of particular relevance	"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
	"E" earlier application or patent but published on or after the international filing date	"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
45	"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
	"O" document referring to an oral disclosure, use, exhibition or other means	
	"P" document published prior to the international filing date but later than the priority date claimed	
50	Date of the actual completion of the international search 15 September 2021	Date of mailing of the international search report 28 September 2021
	Name and mailing address of the ISA/CN China National Intellectual Property Administration (ISA/ CN) No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China	Authorized officer
55	Facsimile No. (86-10)62019451	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/095713

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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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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2021/095713

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Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
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CN	211166377	U	04 August 2020	None			
CN	204081737	U	07 January 2015	None			
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				CA	2414152	A1	28 February 2004
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				US	2004160065	A1	19 August 2004