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(54) **SMART LOCK MODULAR CYLINDER**

(57) The disclosed smart lock comprises a lock body and a smart control box, with the lock body containing an interior cylinder core, a thumb turn, and an exterior cylinder core. A transmission clutch assembly is situated at the interior cylinder core's inner end. The smart control box houses a control circuit board, an electric actuator, and a second mechanical unlocking assembly. The control circuit board manages the electric actuator to engage the transmission clutch assembly, facilitating the first mechanical unlocking assembly's connection to the thumb turn while the second mechanical unlocking assembly maintains a connection through the transmission clutch assembly. This setup allows quick assembly and disassembly via a rotatable snap-fitting mechanism between the fitting base on the interior cylinder core and the smart control box.

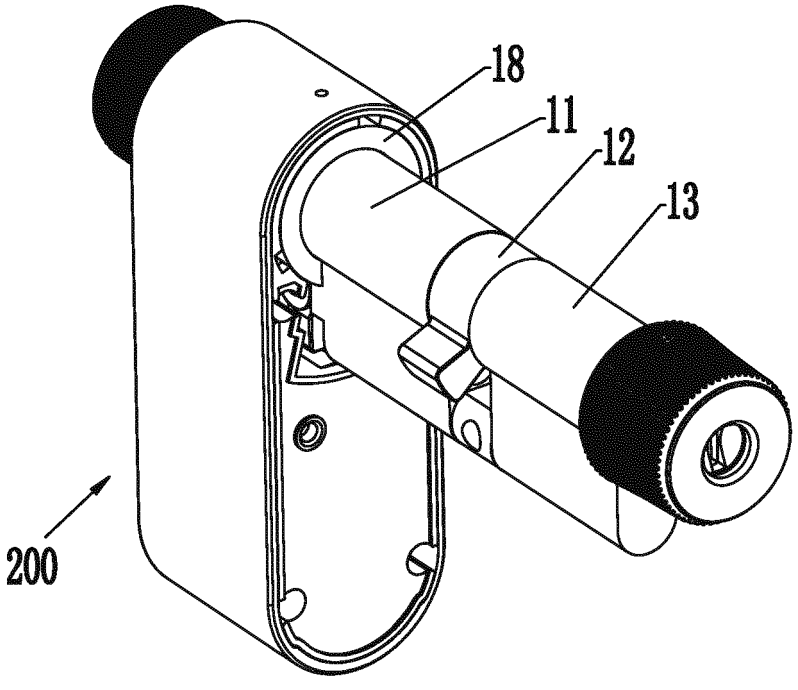

Fig. 1

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Description

FIELD

[0001] The present invention pertains to the field of locks, specifically focusing on the advancements in smart lock technology.

BACKGROUND

[0002] Traditional locks are being progressively replaced by smart locks due to their superior capabilities in user authentication, security, and operational versatility. Unlike their mechanical counterparts, smart locks integrate sophisticated features such as biometric recognition, password authentication, and card swiping mechanisms. However, the transition from mechanical locks to smart locks often necessitates a complete replacement of the lock mechanism and may require additional drilling to accommodate the new system. Moreover, when only the cylinder is replaced, the original mechanical unlocking functionality is compromised, leading to concerns regarding reliability in case of cylinder malfunction. Furthermore, smart locks are susceptible to power outages and prone to component failures, resulting in a high rate of malfunctions and necessitating costly replacements.

[0003] In addressing these challenges, a smart lock system has been developed, comprising a lock body and a rear panel portion. However, existing solutions still lack a user-friendly method for convenient replacement and assembly.

SUMMARY OF THE INVENTION

[0004] The object of the present invention is to provide a smart lock system which overcomes the shortcomings of conventional smart locks, enabling users to swiftly assemble and disassemble the lock body and smart control box.

[0005] According to the present invention, there is provided a smart lock according to claim 1.

[0006] Embodiments of the disclosed smart lock system comprise a lock body and a smart control box. The lock body includes an interior cylinder core, a thumb turn, and an exterior cylinder core. A transmission clutch assembly is positioned at the inner end of the interior cylinder core, with the thumb turn connected to an outer end of the transmission clutch assembly. The smart control box includes a rear panel portion, a smart kit, and a handle. The rear panel portion is situated at the right end of the lock body and houses the smart kit and handle. The smart kit consists of an outer case enclosing an inner case, partitioned into a smart compartment and a battery compartment. The smart compartment accommodates the control mechanism and transmission mechanism.

[0007] Embodiments of the disclosed smart lock system feature an intricate interplay between the lock body and the smart control box to achieve enhanced functionality and user convenience. The interior cylinder core, situated within the lock body, drives the transmission clutch assembly, which, in turn, facilitates the operation of the thumb turn located at the outer end of the assembly. Concurrently, the exterior cylinder core is linked to the interior cylinder core, ensuring seamless coordination between mechanical unlocking mechanisms. Within the smart control box, a control circuit board governs the electric actuator, which, in conjunction with the transmission clutch assembly, enables synchronized operation between the first and second mechanical unlocking assemblies. Notably, the smart control box is meticulously designed with an accommodation groove to accommodate the movement of the transmission clutch assembly, ensuring optimal functionality. At the heart of the detachable connection between the lock body and the smart control box lies the innovative fitting base, strategically positioned at the inner end of the interior cylinder core. Through a sophisticated rotatable snap-fitting mechanism, the lock body and the smart control box are seamlessly interconnected, facilitating swift assembly and disassembly.

[0008] The technical solution outlined above offers a myriad of advantages, revolutionizing the landscape of smart lock technology:

1. Convenient Replacement and Upgrade:
By seamlessly integrating with the original bolt assembly of conventional mechanical locks, the lock body presents a cost-effective and convenient solution for replacement and upgrade, minimizing associated costs and enhancing accessibility.
2. Modular Design for Enhanced Maintenance:
The detachable connection between the lock body and the smart control box enables independent replacement of either component, obviating the need for complete system overhauls in the event of malfunction. This modular design drastically reduces maintenance costs and simplifies upkeep procedures.
3. Enhanced Security Measures:
Leveraging the rotatable snap-fitting mechanism, users can effortlessly dismantle the smart lock, bolstering security by preventing unauthorized access and tampering. Installing the smart control box on the inner side of the door further fortifies security measures, safeguarding against external threats.

[0009] In summation, the disclosed smart lock system not only delivers unparalleled convenience and efficiency but also sets a new standard for security and maintenance in the realm of smart home technology.

[0010] Some further specific advantages are as follows:

Enhanced Connection Mechanism

[0011] Additionally, a connecting convex rib is meticulously positioned on the outer peripheral surface of the fitting base. The opening portion of the accommodation groove is precisely contoured to accommodate the fitting base, while a rotating slot, located at the inner wall of the opening portion, facilitates the mounting of the connecting convex rib. This innovative design ensures that upon connection of the fitting base to the smart control box, a portion of the fitting base securely engages with the opening portion of the accommodation groove, enhancing the structural integrity of the connection. By suspending the smart control box at the inner end of the lock body, this fitting arrangement further fortifies the bond between the smart control box and the fitting base. Moreover, the fitting base serves the additional function of sealing the opening portion of the accommodation groove, effectively shielding the transmission clutch assembly from external contaminants such as dust and insects.

Lockup Mechanism

[0012] Furthermore, a lockup member, designed to secure the smart control box following the successful fitting of the connecting convex rib and rotating slot, is positioned between the fitting base and the smart control box. This lockup member acts as a safeguard against accidental rotation of the smart control box, preventing disengagement from the fitting base.

Reinforced Lockup Mechanism

[0013] Moreover, the fitting base features a mounting hole intended for the lockup member, accompanied by a cover plate to prevent the lockup member from dislodging. The cover plate, seamlessly integrated into the outer peripheral surface of the fitting base, includes a through hole allowing passage for the lockup member. The lockup member, maintaining a protruding position from the through hole, engages with a locking hole within the inner wall of the opening portion of the accommodation groove. This configuration ensures that the fitting between the fitting base and the opening portion of the accommodation groove remains unaffected.

Dynamic Locking Mechanism

[0014] Additionally, a locking hole is strategically incorporated into the outer peripheral surface of the fitting base. The lockup member, situated within the smart control box, securely lodges into the locking hole upon successful fitting. This lockup member, often comprising a ferromagnet or magnet, disengages from the locking hole when subjected to a magnetic force, facilitating automatic lockup under the gravitational force of the lockup member and simplifying the structure.

Optimization of Smart Control Box Design

[0015] Additionally, a battery compartment is strategically positioned at the bottom of the smart control box. The fitting base features a mounting through-hole for the interior cylinder core, with its outer peripheral surface downwardly eccentric relative to the mounting through-hole. A locating step, situated at the inner wall of the accommodation groove, supports and positions the fitting base. The outer edge of the locating step is downwardly eccentric relative to its inner edge. This innovative configuration ensures unimpeded access for battery replacement while lowering the gravitational center of the smart control box. By aligning the gravitational center of the smart control box below that of the fitting base, structural stability is further enhanced. Upon successful fitting of the connecting convex rib and rotating slot, the gravitational force of the smart control box tightly presses the locating step against the fitting base, enhancing stability. Widening the locating step further bolsters the stability of the assembled smart control box, minimizing any potential shaking.

Enhanced Assembly Mechanism

[0016] Furthermore, a mating slot is incorporated into the outer end surface of the fitting base, securely accommodating the inner end of the interior cylinder core. This pre-locating mechanism simplifies assembly and ensures a secure connection between the interior cylinder core and the fitting base. Enhanced Interior Cylinder Core Design The interior cylinder core is comprised of an internal locking lever and an internal locking sleeve. The outer end of the internal locking lever is in transmitting connection with the exterior cylinder core, while the internal locking sleeve is sleeved around the outer periphery of the internal locking lever. The outer end of the internal locking sleeve is connected to the thumb turn and co-rotates with it. The transmission clutch assembly consists of a clutch transmission wheel, a slipping collar, and a shift fork. The clutch transmission wheel is axially located at the inner end of the internal locking lever and co-rotates with it. The slipping collar is in sliding connection with the inner end of the internal locking sleeve and is peripherally limited by it. It maintains transmitting connection with the second mechanical unlocking assembly and, under the action of the second mechanical unlocking assembly, remains separated from the clutch transmission wheel. The shift fork comprises a driven end, a connecting portion, and a fork body. The driven end is connected to the electric actuator, the connecting portion is rotatably connected to the fitting base, and the fork body extends to the outer end side of the slipping collar. Additionally, a notch is formed at the inner wall of the accommodation groove to avoid interference with the driven end during mounting, facilitating the mounting process of the smart control box.

Electric Actuator Design

[0017] Moreover, the electric actuator consists of an electric motor and a transmission member. The electric motor is electrically connected to the control circuit board, and the transmission member is secured on the output shaft of the electric motor. The transmission member projects into the notch to establish transmitting connection with the driven end. This design ensures a stable and reliable transmission mechanism, contributing to a simple and cost-effective structure.

Exterior Cylinder Core Design

[0018] Furthermore, the exterior cylinder core comprises an exterior lock housing and an external locking lever axially located within it. The inner end of the external locking lever projects into the internal locking sleeve to connect and co-rotate with the outer end of the internal locking lever. The outer end of the external locking lever projects out of the exterior lock housing, allowing the user to turn it for locking and unlocking.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Hereinafter, the disclosure will be further elucidated with reference to the accompanying drawings:

Fig. 1 illustrates a schematic diagram of a smart lock according to the disclosure.
Fig. 2 showcases a schematic diagram of a smart lock according to the disclosure, presenting an initial view of the interior of the smart control box.
Fig. 3 depicts a first schematic diagram of a smart control box according to the disclosure.
Fig. 4 displays a second schematic diagram of a smart control box according to the disclosure.
Fig. 5 exhibits a first schematic diagram of a fitting base according to the disclosure.
Fig. 6: A second schematic diagram of the fitting base according to the disclosure.
Fig. 7: A third schematic diagram of the fitting base according to the disclosure.
Fig. 8: A schematic diagram of a smart lock according to the disclosure, showcasing an alternative presentation of the interior of a smart control box.
Fig. 9: A sectional view of a smart lock according to the disclosure, demonstrating the engagement between a clutch transmission wheel and a slipping collar.
Fig. 10: Zoomed-in view of part I of Fig. 9 for a closer examination.
Fig. 11: A third schematic diagram of a smart control box according to the disclosure.
Fig. 12: A schematic diagram illustrating the connection of the lock body to a transmission clutch assembly and a second mechanical unlocking assembly according to the disclosure.
Fig. 13: A schematic diagram viewed from direction B-B in Fig. 12.
Fig. 14: A schematic diagram viewed from direction A-A in Fig. 12.
Fig. 15: A sectional view of a smart lock according to the disclosure, demonstrating the disengagement of the clutch transmission wheel from the slipping collar.

DETAILED DESCRIPTION OF EMBODIMENTS

[0020] In order to elucidate the objectives, technical solutions, and advantages of the embodiments of the disclosure, the technical solutions in the embodiments will be expounded upon in a clear and comprehensive manner with reference to the accompanying drawings. It should be noted that the example embodiments described herein represent only a portion of the embodiments of the disclosure, and not all of them.

[0021] The terms "first," "second," "third," and "fourth" (if applicable) used in the specification and claims of the disclosure are employed for distinguishing similar objects, and do not necessarily denote a specific sequence or priority. Even if a technical feature is denoted as "second," it does not necessarily imply the existence of a preceding "first" feature. It is understood that data labeled with such terms may be interchangeable under appropriate circumstances, allowing the embodiments of the disclosure as described herein to be implemented in sequences other than those explicitly illustrated or described.

[0022] Furthermore, it should be understood that the terms "comprise" and "have," as well as any variations thereof, denote a non-exclusive inclusion. For instance, a process, method, system, product, or apparatus comprising a series of steps or units is not limited to the steps or units listed, but may include other steps or units not explicitly mentioned or inherent to the process, method, product, or apparatus.

[0023] Within the disclosure, the term "plurality" denotes two or more. The term "and/or" signifies an associative relationship between related objects, suggesting the possibility of three scenarios. For instance, "X and/or Y" may indicate three circumstances: X alone, or both X and Y together, or Y alone. The symbol "/" generally denotes an "or" relationship between the preceding and subsequent associated objects. The phrase "comprising X, Y, and Z" or "comprising X, Y, Z" implies the inclusion of all of X, Y, and Z; "comprising X, Y, or Z" suggests the inclusion of one of X, Y, or Z; and "comprising X, Y and/or Z" encompasses any one, or any two, or all three of X, Y, and Z.

[0024] Hereafter, the technical solution of the disclosure will be delineated in detail through specific implementations. The implementations described below may be combined or substituted as needed, and similar concepts or processes may be omitted in certain implementations.

[0025] Figs. 1 to 4 depict a smart lock as described in the disclosure, comprising a lock body 100 and a smart control box 200. The lock body 100 includes an interior cylinder core 11, a thumb turn 12, and an exterior cylinder core 13. Positioned at the inner end of the interior cylinder core 11 is a transmission clutch assembly 101. The thumb turn 12 is affixed to the outer end of the interior cylinder core 11 and is turned by the motion of the interior cylinder core 11. The interior cylinder core 11 is connected to the exterior cylinder core 13 at its inner end, while the outer end of the exterior cylinder core 13 features a first mechanical unlocking assembly 102.

[0026] The smart control box 200 comprises a control circuit board 21, an electric actuator 201, and a second mechanical unlocking assembly 202. The control circuit board 21 regulates the electric actuator 201 to activate the transmission clutch assembly 101. Consequently, the first mechanical unlocking assembly 102 establishes a transmission connection with the thumb turn 12 via the interior cylinder core 11 and the transmission clutch assembly 101, while the second mechanical unlocking assembly 202 maintains a transmission connection with the thumb turn 12 via the transmission clutch assembly 101. Within the smart control box 200, an accommodation groove 29 facilitates the movement of the transmission clutch assembly 101.

[0027] Additionally, the inner end of the interior cylinder core 11 is equipped with a fitting base 18, situated at the outer end side of the transmission clutch assembly 101. The fitting base 18 is rotatably snap-fitted to the smart control box 200, enabling a detachable connection between the lock body 100 and the smart control box 200. It should be noted that the inner and outer orientations mentioned are determined with respect to the inner and outer sides of the door where the smart lock is installed. For example, the inner end of the interior cylinder core 11 is positioned on the inner side of the door, while the outer end of the interior cylinder core 11 is closer to the outer side of the door. Similarly, the outer end of the exterior cylinder core 13 is located on the outer side of the door. These orientations may also be referenced in Fig. 2, where the left side signifies the inner orientation and the right side signifies the outer orientation.

[0028] The lock body 100 described in the disclosure offers a significant advantage by seamlessly integrating with the original bolt assembly of conventional mechanical locks, leading to a more convenient replacement and upgrade process at a lower cost. The rotatable fitting mechanism between the fitting base 18 and the smart control box 200 enables a detachable connection between the lock body 100 and the smart control box 200, facilitating quick and convenient assembly.

[0029] This design allows users to easily replace the old lock body with the smart lock, enhancing the overall user experience. Furthermore, in case of any malfunction, such as damage to the smart control box 200 or the lock body 100, they can be separately replaced without the need to replace the entire smart lock system. This modular approach significantly reduces maintenance costs.

[0030] Considering that the lock body 100 is fixed in place after installation and is not rotatable, the detachable connection between the lock body 100 and the smart control box 200 is achieved through a rotatable snap-fitting mechanism between the fitting base 18 and the smart control box 200. To dismantle the smart lock, the smart control box 200 needs to be rotated first. Additionally, installing the smart control box 200 on the inner side of the door enhances security by preventing potential tampering from the outside. This configuration prevents unauthorized access by making it difficult to destroy the lock body 100 from the outside and then dismantle it from the smart control box 200. Overall, these features contribute to enhancing the security and convenience of the smart lock system.

[0031] The smart lock system incorporates two mechanical unlocking assemblies, the first mechanical unlocking assembly 102 and the second mechanical unlocking assembly 202, to enable unlocking from both the inner and outer sides of the door.

[0032] The second mechanical unlocking assembly 202 maintains a transmitting connection with the thumb turn 12 through the transmission clutch assembly 101. This ensures that users can unlock the door freely from the inner side of the door.

[0033] On the other hand, the first mechanical unlocking assembly 102, located on the outer side of the door, requires the control circuit board 21 to receive an unlocking signal. Upon receiving this signal, the control circuit board 21 activates the electric actuator 201 to actuate the transmission clutch assembly 101. This action enables the first mechanical unlocking assembly 102 to unlock the door by transmitting motion to the thumb turn 12 via the interior cylinder core 11 and the transmission clutch assembly 101.

[0034] Without the unlocking signal, the transmission clutch assembly 101 disconnects the first mechanical unlocking assembly 102 from the thumb turn 12. Consequently, even if the first mechanical unlocking assembly 102 is turned from the outer side of the door, the thumb turn 12 remains stationary and cannot be rotated, thereby maintaining security. This feature ensures that unauthorized individuals cannot manipulate the lock from the outside without the necessary authorization signal.

[0035] To achieve rotational snap-fitting, a connecting convex rib 181 is integrated into the outer peripheral surface of the fitting base 18, while the opening portion of the accommodation groove 29 is designed to accommodate this rib. The inner wall of the opening portion is equipped with a rotating slot 291 specifically for mounting the connecting convex rib 181. As a result, when the fitting base 18 is connected to the smart control box 200, a portion of the fitting base 18 protrudes into the opening portion of the accommodation groove 29, ensuring a secure fit. This configuration establishes a connection between the lock body 100 and the smart control box 200

solely through the fitting base 18, suspending the smart control box 200 at the inner end of the lock body 100. Consequently, the projection of the fitting base 18 into the accommodation groove 29 enhances the connection's stability, thereby improving the overall security of the system. Moreover, by sealing the opening portion of the accommodation groove 29, the fitting base 18 acts as a protective barrier for the transmission clutch assembly 101, effectively shielding it from dust and insects.

[0036] Maintaining the assembled state of the smart control box 200 with the fitting base 18 is crucial during daily use. Hence, precautions are taken to prevent accidental rotation of the smart control box 200, which could lead to disengagement from the fitting base 18. One approach involves incorporating a check protrusion and a corresponding check recess in the connecting convex rib 181 and the rotating slot 291, respectively. However, this method may increase dismantling difficulty and result in wear and failure after repeated use. Alternatively, a lockup member 112 is introduced between the fitting base 18 and the smart control box 200. This lockup member 112 secures the smart control box 200 in place after the connecting convex rib 181 and the rotating slot 291 are properly fitted, ensuring a stable connection without the drawbacks associated with a check protrusion and recess system.

[0037] In a detailed implementation, a mounting hole 182 is incorporated into the outer peripheral surface of the fitting base 18 to accommodate the lockup member 112. A cover plate 183 is then installed to prevent the lockup member 112 from escaping out of the mounting hole 182. This cover plate 183 is designed to sit flush with the outer surface of the fitting base 18 to ensure it does not interfere with the fitting between the fitting base 18 and the opening portion of the accommodation groove 29. The cover plate 183 features a through hole 184 through which the lockup member 112 can extend. The lockup member 112 is equipped with a compression spring 187, maintaining a tendency to project out of the through hole 184. Meanwhile, a locking hole 292 is formed in the inner wall of the opening portion of the accommodation groove 29. After the connecting convex rib 181 and the rotating slot 291 are properly fitted, the lockup member 112 projects into the locking hole 292, effectively locking up the smart control box 200 in place.

[0038] To dismantle the smart control box 200, the lockup member 112 needs to be ejected out of the locking hole 292. For this purpose, an ejector pin may be employed, inserted into the locking hole 292 from the outer side of the smart control box 200 to eject the lockup member 112. Given that the lockup member 112 is situated on the outer peripheral surface of the fitting base 18, the locking hole 292 can be positioned at various locations around the smart control box 200 for ease of access, such as on the top, left side, or right side surface. To enhance durability, a metallic sleeve 295 may be introduced for the smart control box 200, with the locking hole 202 extending through the metallic sleeve 295. The lockup member 112 is then inserted into the metallic sleeve 295 to securely fit with it, ensuring robust locking functionality.

[0039] Alternatively, in another implementation, the locking mechanism can be reversed. Here, the locking hole 292 is formed on the outer peripheral surface of the fitting base 18, while the lockup member 112 is integrated into the smart control box 200. After the connecting convex rib 181 and the rotating slot 291 are properly engaged, the lockup member 112 naturally falls into the locking hole 292 due to gravity. This lockup member 112 is equipped with a ferromagnet or magnet, enabling it to be released from the locking hole 292 via magnetic force. For instance, a magnetic needle can be positioned to draw the lockup member 112 out of the locking hole 292.

[0040] The lockup member 112 can also be designed to fall into the locking hole 292 with the assistance of an elastic force, such as a spring. In this case, the lockup member 112 can be located at various positions around the outer periphery of the fitting base 18, including the top, left side surface, or right side surface of the smart control box 200. It's essential that the magnetic force exerted by the magnetic needle on the lockup member 112 outweighs the elastic force of the spring to ensure effective release.

[0041] To power both the control circuit board 21 and the electric actuator 201, a battery compartment 22 can be integrated into the smart control box 200. Depending on requirements, this compartment may be positioned at the top, middle, or bottom of the smart control box 200. However, in an implementation where the second mechanical unlocking assembly 202 is typically aligned with the height of the lock body 100, positioning the battery compartment 22 at the bottom of the smart control box 200 is advantageous.

[0042] With this arrangement, interference between the battery compartment 22 and the second mechanical unlocking assembly 202 is minimized, facilitating easier battery replacement. Additionally, placing the battery compartment 22 at the bottom lowers the gravitational center of the smart control box 200, enhancing overall stability. Given that the fitting base 18 is situated at the outer end of the transmission clutch assembly 101, a mounting through-hole 185 is crafted into the fitting base 18 to accommodate the interior cylinder core 11 during assembly.

[0043] Considering the suspended nature of the smart control box 200 within the lock body 100, further structural stability is achieved by positioning the battery compartment 22 at its bottom. This setup ensures that the gravitational center of the smart control box 200 lies below the fitting base 18. Notably, the outer peripheral surface of the fitting base 18 can be eccentrically configured relative to the mounting through-hole 185. Moreover, a locating step 293 is incorporated into the inner wall of the accommodation groove 29, with its outer edge also eccentrically positioned downward relative to the inner edge.

[0044] Upon engagement of the connecting convex rib 181 and the rotating slot 291, the gravitational force of the smart control box 200 causes the locating step 293 and the fitting base 18 to tightly press against each other. This arrangement, depicted in Figs. 3, 4, and 11, provides additional stability by employing a broader locating step 293 at the bottom of the inner wall of the accommodation groove 29 to support the smart control box 200 securely, thus minimizing any potential shaking.

[0045] For streamlined assembly and connection between the fitting base 18 and the interior cylinder core 11, a mating slot 186 can be incorporated into the outer end surface of the fitting base 18, as depicted in Figs. 6 and 7. This slot serves as a receptacle for securely inserting the inner end of the interior cylinder core 11. By positioning the inner end into the mating slot 186, prelocating is achieved, simplifying the subsequent secure connection between the interior cylinder core 11 and the fitting base 18 using a screw 188. This method ensures a robust and reliable attachment between the components, enhancing the overall stability and functionality of the smart lock.

[0046] Figs. 9 and 11 illustrate an example structure of the lock body 100. The interior cylinder core 11 comprises an internal locking lever 113 and an internal locking sleeve 114. An outer end of the internal locking lever 113 is in transmitting connection with the exterior cylinder core 13, the internal locking sleeve 114 is sleeved at the outer periphery of the internal locking lever 113, and an outer end of the internal locking sleeve 114 is connected to the thumb turn 12 and co-rotate with the latter. The transmission clutch assembly 101 comprises a clutch transmission wheel 14, a slipping collar 15, and a shift fork 16. The clutch transmission wheel 14 is axially located at the inner end of the internal locking lever 113 and co-rotates with the latter. The slipping collar 15 is in sliding connection with the inner end of the internal locking sleeve 114 and is peripherally limited by the latter, i.e., the slipping collar 15 is axially slidable along the internal locking sleeve 114 and maintains synchronous rotation with the internal locking sleeve 114. The slipping collar 15 maintains transmitting connection with the second mechanical unlocking assembly 202 and under the action of the second mechanical unlocking assembly 202, maintains separated from the clutch transmission wheel 14. The shift fork 16 comprises a driven end 161, a connecting portion 162, and a fork body 163, the driven end 161 being connected to the electric actuator 201, the connecting portion 162 being rotatably connected to the fitting base 18, the fork body 163 extending till the outer end side of the slipping collar 15. The inner wall of the accommodation groove 29 is provided with a notch 294 for avoiding the driven end 161. The electric actuator 201 drives the driven end 161 so that the fork body 163 abuts against the slipping collar 15, allowing for fitting between the slipping collar 15 and the clutch transmission wheel 14 for transmission purpose, whereby the internal locking lever 113 may drive, sequentially via the clutch transmission wheel 14, the slipping collar 15, and the internal locking sleeve 114, the thumb turn 12 to enable unlocking. To enable engagement and disengagement between the slipping collar 15 and the clutch transmission wheel 14, a plug pin 151 is provided for the slipping collar 15, and a socket 141 is provided on an end surface of the clutch transmission wheel 14, so that when the slipping collar 15 is engaged with the clutch transmission wheel 14, the plug pin 151 is insert-fitted in the socket 141, as illustrated in Fig. 9. As the clutch transmission wheel 14 rotates, the slipping collar 15 is driven to rotate; the first mechanical unlocking assembly 102 may drive, sequentially via the exterior cylinder core 13, the internal locking lever 113, the clutch transmission wheel 14, the slipping collar 15, and the internal locking sleeve 114, the thumb turn 12 to enable unlocking. When the slipping collar 15 is disengaged from the clutch transmission wheel 14, as illustrated in Fig. 15, the plug pin 151 departs from the socket 141, in which case the clutch transmission wheel 14 cannot transmit a torque to the slipping collar 15, so that the internal locking lever 113 cannot drive the internal locking sleeve 114 to move; hence, unlocking is disabled, and the first mechanical unlocking assembly 102 only rotates idly. Since the user cannot spot the condition of the interior cylinder core 11 when installing the smart control box 200, design of the notch 294 may ease installation of the smart control box 200. The interior cylinder core 11 generally further comprises an interior lock housing 115, the interior lock housing 115 housing the internal locking lever 113 and the internal locking sleeve 114, the internal locking sleeve 114 being axially located in the interior lock housing 115, the internal locking lever 113 being axially located in the internal locking sleeve 114.

[0047] After completing the unlocking process, locking can be achieved through various methods such as delayed electric locking, elastic reset locking, or manual mechanical locking. To implement locking, the clutch transmission wheel 14 may utilize a ratchet mechanism. Additionally, an elastic ejector pin 152 is situated on the slipping collar 15.

[0048] The elastic ejector pin 152 consistently engages with the teeth 142 of the ratchet, regardless of whether the slipping collar 15 and the clutch transmission wheel 14 are engaged or disengaged. For instance, when viewing inwardly from the outer side of the door, counterclockwise rotation of the thumb turn 12 facilitates unlocking, while clockwise rotation initiates locking.

[0049] If the teeth 142 of the ratchet extend and protrude in a clockwise direction, clockwise rotation of the clutch transmission wheel 14 prompts the elastic ejector pin 152 to make contact with the teeth 142. This action causes the slipping collar 15 to rotate clockwise, thereby driving the thumb turn 12 to rotate clockwise and enabling locking.

[0050] Conversely, when the clutch transmission wheel 14 rotates counterclockwise, the elastic ejector pin 152 intermittently misses the teeth 142 of the ratchet,

preventing the slipping collar 15 from rotating. Consequently, the first mechanical unlocking assembly 102 remains idle, and the thumb turn 12 remains stationary. Furthermore, since doors may open to the left or right, the ratchet can be flipped accordingly for adaptation. For example, the ratchet may be adjusted so that its teeth 142 extend and protrude in a counterclockwise direction. The adjustment of the ratchet depends on the specific installation environment.

[0051] To initiate the swinging motion of the shift fork 16, the electric actuator 201 includes an electric motor 23 and a transmission member 24. In the arrangement depicted in Fig. 9, the electric motor 23 is connected electrically to the control circuit board 21, while the transmission member 24 is affixed to the output shaft of the electric motor 23. This transmission member 24 extends into the notch 294, establishing a transmitting connection with the driven end 161.

[0052] In one implementation, the transmission member 24 is configured as a cam featuring a transmitting recessed groove 241. The driven end 161 fits into this recessed groove 241, and when the cam is driven to rotate by the electric motor 23, it moves the driven end 161. Consequently, the fork body 163 shifts, further prompting the slipping collar 15 to move relative to the internal locking sleeve 114, thereby engaging with the clutch transmission wheel 14 for transmission purposes. This transmission member 24 setup can be based on the rotating cam design disclosed in CN218759296U.

[0053] In an implementation demonstrated in Figs. 9 and 12, the second mechanical unlocking assembly 202 comprises three main components: the interior handle 25, the inner coupling shaft 26, and the inner drive wheel 27. The interior handle 25 is affixed to the inner end of the inner coupling shaft 26. The outer end of the inner coupling shaft 26 extends into the accommodation groove 29, while the inner drive wheel 27 is situated within this groove and mounted onto the outer end of the inner coupling shaft 26. The inner drive wheel 27 is in transmitting connection with the slipping collar 15, typically achieved through a cogging structure for effective transmission.

[0054] To ensure that the inner drive wheel 27 maintains its transmitting connection with the slipping collar 15 without impeding the clutching operation of the transmission clutch assembly 101, a specific arrangement is implemented. The inner drive wheel 27 is set in a sliding connection to the outer end of the inner coupling shaft 26, being peripherally limited by it. This configuration allows the inner drive wheel 27 to slide axially along the inner coupling shaft 26 while remaining in co- rotation with it. Additionally, a keeper spring 28 is positioned between the inner drive wheel 27 and the smart control box 200. The elastic force exerted by the keeper spring 28 ensures that the inner drive wheel 27 maintains its transmitting connection with the slipping collar 15. When engagement of the slipping collar 15 is required, the electric actuator 201 can overcome the elastic force of the keeper spring 28 to push the slipping collar 15 into motion. Furthermore, the inner coupling shaft 26 can serve to axially limit the clutch transmission wheel 14.

[0055] In one implementation, the lock body 100 is designed with a keyless structure, meaning that the user can solely unlock the first mechanical unlocking assembly 102 from outside the door using a smart control unit to operate the electric actuator 201. As depicted in Fig. 9, the exterior cylinder core 13 comprises two main components: an exterior lock housing 131 and an external locking lever 132. The external locking lever 132 is axially situated within the exterior lock housing 131. Its inner end extends into the internal locking sleeve 114 to connect and co-rotate with the outer end of the internal locking lever 113. Meanwhile, the outer end of the external locking lever 132 protrudes from the exterior lock housing 131, allowing the user to turn it. This lever is also axially located within the exterior lock housing 131.

[0056] Alternatively, in another implementation, the lock body 100 may feature a keyhole structure. For example, the exterior cylinder core 13 may incorporate a key cylinder-locking lever structure as disclosed in CN210622523. In this arrangement, the inner end of the external locking lever 132 and the outer end of the internal locking lever 113 can be connected via a flat-side shaft structure to transmit torque, as illustrated in Fig. 14. Both the exterior lock housing 131 and the interior lock housing 115 are securely connected and serve to axially locate the thumb turn 12 simultaneously.

[0057] In one implementation, the first mechanical unlocking assembly 102 consists of an exterior handle 17, which is sleeved onto the outer end of the external locking lever 132. The exterior handle 17 can be detachably secured to the external locking lever 132, allowing the user to easily turn the external locking lever 132. The method of securing the exterior handle 17 to the external locking lever 132 may follow the structure of the lockup member 112 as described earlier, which can be unlocked using an ejector pin or a magnetic needle. Alternatively, it's also possible to directly integrate the exterior handle 17 into the outer end of the external locking lever 132 for user operation. In another implementation, if the exterior cylinder core 13 adopts the key cylinder-locking lever structure as disclosed in CN210622523U, the first mechanical unlocking assembly 102 may also employ an exterior handle with a keyhole, as disclosed in CN210622523U.

[0058] The control circuit board 21 may receive an unlocking signal from a smart terminal via a wireless communication module, and also may receive an unlocking signal via a conventional manner such as a fingerprint recognition module, a password entry module, or an NFC module, whereby unlocking by a phone, unlocking by a fingerprint, unlocking by a password, or unlocking by card swiping may be realized.

[0059] The unlocking and locking referred to herein are all implemented by the thumb turn 12 driving the bolt assembly. What have been described above are only

example embodiments of the disclosure; however, the protection scope of the disclosure is not limited thereto. A person skilled in the art should understand that the disclosure includes, but is not limited to, the contents described in the drawings and the embodiments. Any modifications without departing from the functions and structural principles of the disclosure will be included within the scope of the claims.

Claims

1. A smart lock, comprising:

a. a lock body comprising:

i. an interior cylinder core,
ii. a thumb turn,
iii. an exterior cylinder core,
iv. a transmission clutch assembly provided at an inner end of the interior cylinder core,
v. the thumb turn connected to an outer end of the interior cylinder core and driven to turn by the interior cylinder core,
vi. an inner end of the exterior cylinder core connected to the interior cylinder core, and
vii. an outer end of the exterior cylinder core provided with a first mechanical unlocking assembly; and

b. a smart control box comprising:

i. a control circuit board,
ii. an electric actuator, and
iii. a second mechanical unlocking assembly;

wherein the control circuit board controls the electric actuator to actuate the transmission clutch assembly so that the first mechanical unlocking assembly is in transmitting connection with the thumb turn via the interior cylinder core and the transmission clutch assembly and the second mechanical unlocking assembly maintains transmitting connection with the thumb turn via the transmission clutch assembly, and wherein the smart control box is formed with an accommodation groove in which the transmission clutch assembly moves, and a fitting base is further provided at the inner end of the interior cylinder core, the fitting base being disposed at an outer end side of the transmission clutch assembly, and the lock body and the smart control box are detachably connected via rotatable snap-fitting between the fitting base and the smart control box.

2. The smart lock of claim 1, wherein a connecting convex rib is provided on an outer peripheral surface of the fitting base, an opening portion of the accommodation groove is adapted to the outer peripheral surface of the fitting base, and a rotating slot for mounting the connecting convex rib is provided at an inner wall of the opening portion of the accommodation groove, the rotating slot opening towards the fitting base.

3. The smart lock of claim 2, wherein a lockup member, which is operable to lock up the smart control box after the connecting convex rib and the rotating slot are fitted in place, is provided between the fitting base and the smart control box.

4. The smart lock of claim 3, wherein a mounting hole for mounting the lockup member and a cover plate for preventing the lockup member from escaping out of the mounting hole are provided on the outer peripheral surface of the fitting base, an outer surface of the cover plate being in flush with the outer peripheral surface of the fitting base; the cover plate is provided with a through hole for the lockup member to pass through; the lockup member maintains a tendency of projecting out of the through hole; and a locking hole for the lockup member to project into for fitting purpose is formed at the inner wall of the opening portion of the accommodation groove.

5. The smart lock of claim 3, wherein a locking hole is formed on an outer peripheral surface of the fitting base, the lockup member is provided at the smart control box and falls into the locking hole after the connecting convex rib and the rotating slot are fitted in place, and the lockup member comprises a ferromagnet or magnet and is operable to move out of the locking hole when being subjected to a magnetic force.

6. The smart lock of claim 1, wherein a battery compartment is provided at a bottom of the smart control box, a mounting through-hole for the interior cylinder core to pass through is formed at the fitting base, the outer peripheral surface of the fitting base being downwardly eccentric relative to the mounting through-hole; and a locating step for supporting and locating the fitting base is provided at an inner wall of the accommodation groove, an outer edge of the locating step being downwardly eccentric relative to an inner edge thereof.

7. The smart lock of claim 1, wherein a mating slot is formed on an outer end surface of the fitting base, the inner end of the interior cylinder core being securely insertion-fitted into the mating slot.

8. The smart lock of claim 1, wherein the interior cylinder core comprises an internal locking lever and an

internal locking sleeve, an outer end of the internal locking lever being in transmitting connection with the exterior cylinder core, the internal locking sleeve being sleeved at an outer periphery of the internal locking lever, an outer end of the internal locking sleeve being connected to the thumb turn and co-rotating with the latter; the transmission clutch assembly comprises a clutch transmission wheel, a slipping collar, and a shift fork, the clutch transmission wheel being axially located at an inner end of the internal locking lever and co-rotating with the latter, the slipping collar being in sliding connection with an inner end of the internal locking sleeve and being peripherally limited by the latter, the slipping collar maintaining transmitting connection with the second mechanical unlocking assembly and under action of the second mechanical unlocking assembly, maintaining separated from the clutch transmission wheel; the shift fork comprises a driven end, a connecting portion, and a fork body, the driven end being connected to the electric actuator, the connecting portion being rotatably connected to the fitting base, and the fork body extending till an outer end side of the slipping collar; and a notch for avoiding the driven end is formed at the inner wall of the accommodation groove.

9. The smart lock of claim 8, wherein the electric actuator comprises an electric motor and a transmission member, the electric motor being electrically connected to the control circuit board, the transmission member being secured on an output shaft of the electric motor, the transmission member projecting into the notch so as to be in transmitting connection with the driven end.

10. The smart lock of claim 8, wherein the exterior cylinder core comprises an exterior lock housing and an external locking lever axially located in the exterior lock housing, an inner end of the external locking lever projecting into the internal locking sleeve so as to be connected to and co-rotate with the outer end of the internal locking lever, an outer end of the external locking lever projecting out of the exterior lock housing for a user to turn.

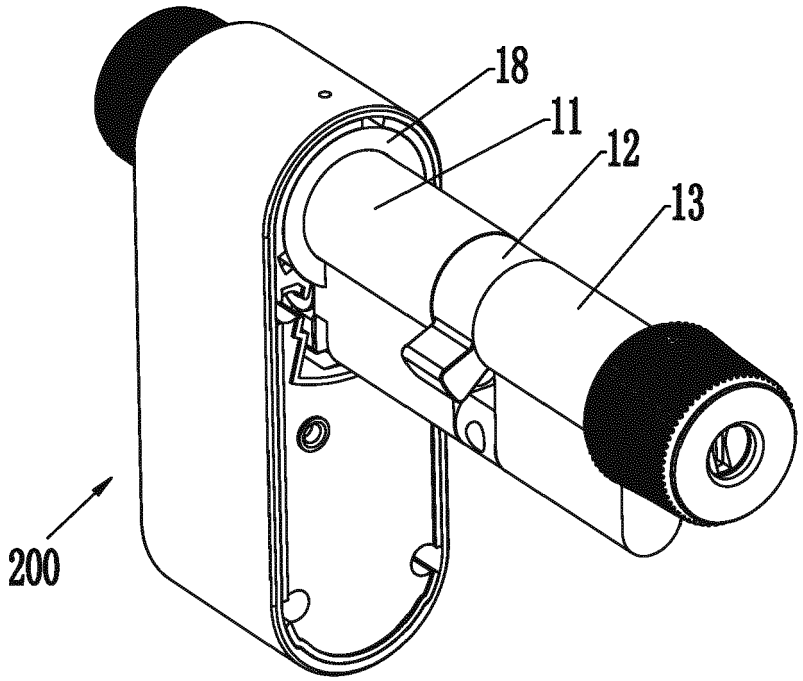

Fig. 1

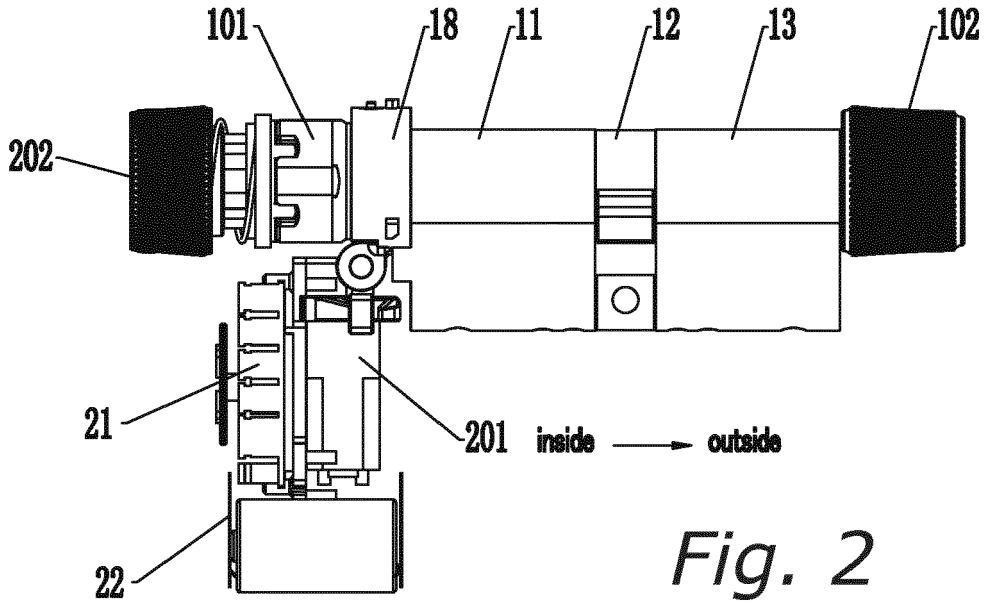

Fig. 2

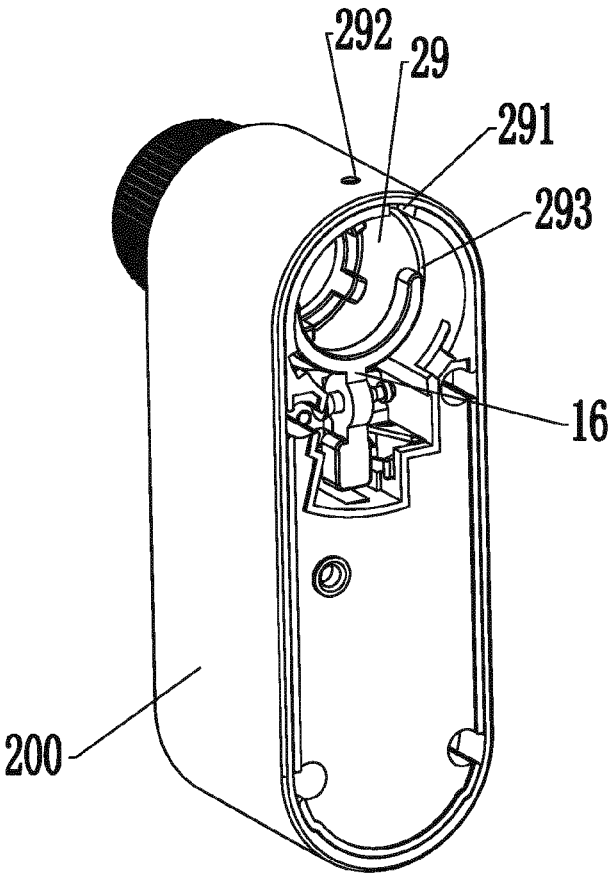

Fig. 3

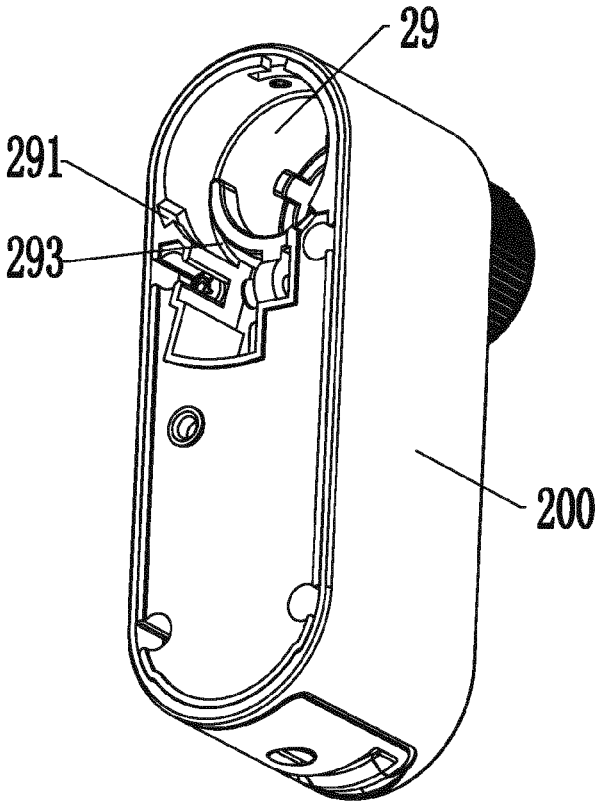

Fig. 4

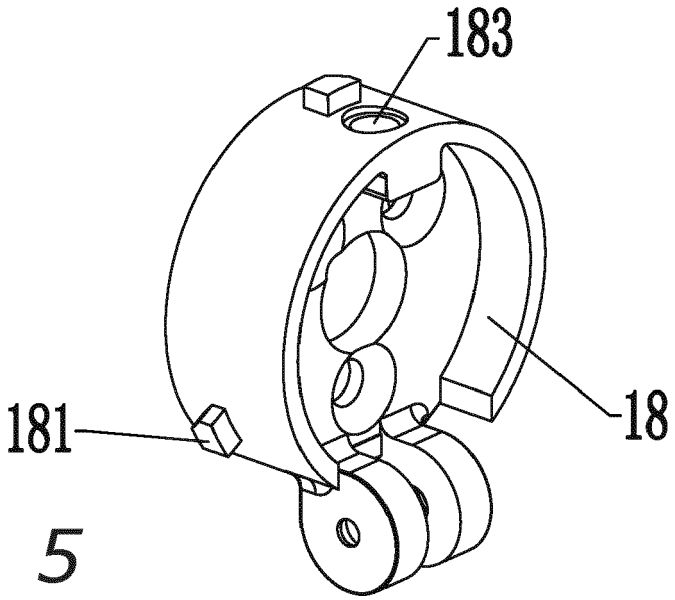

Fig. 5

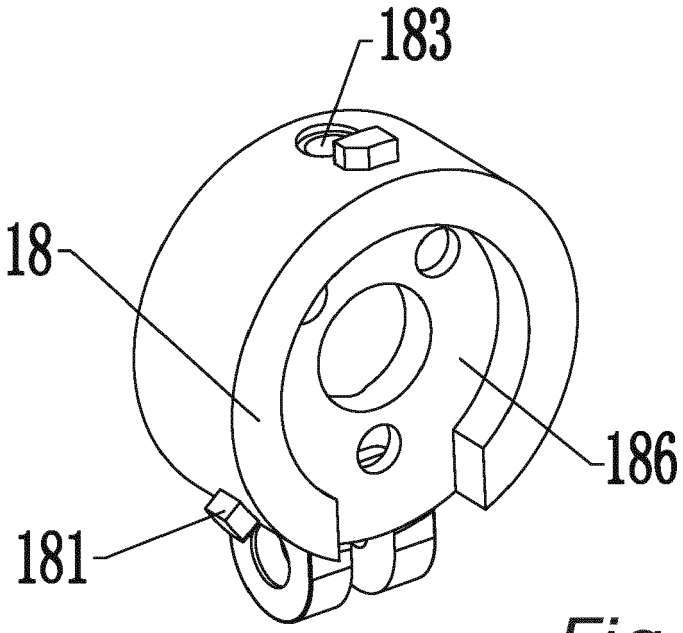

Fig. 6

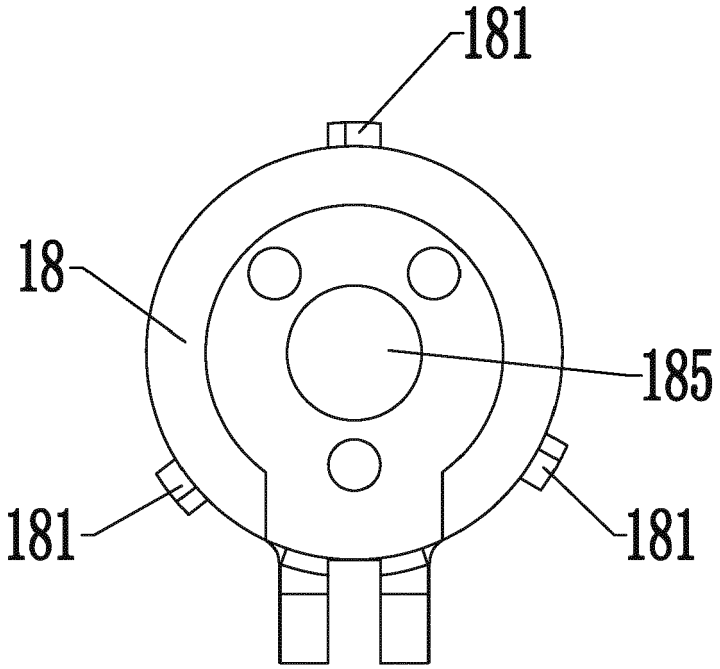

Fig. 7

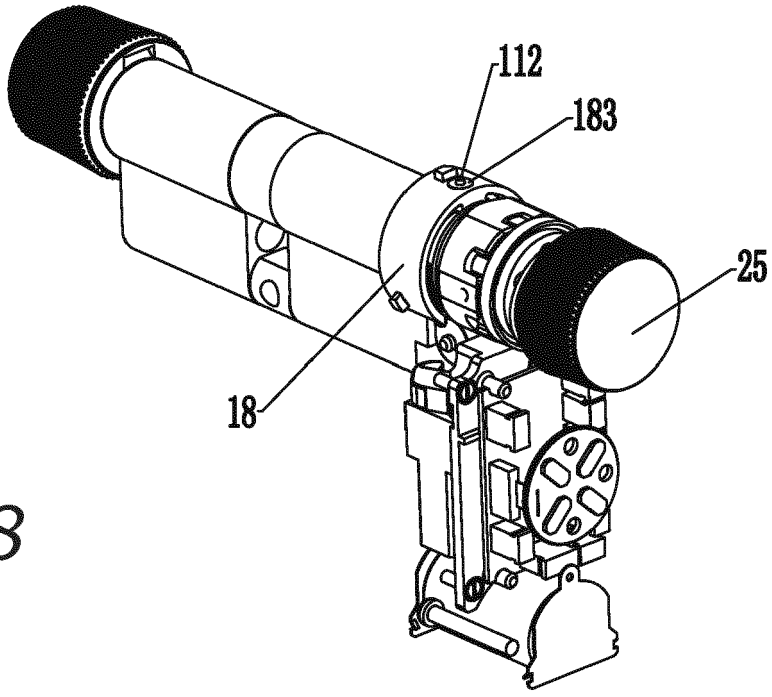

Fig. 8

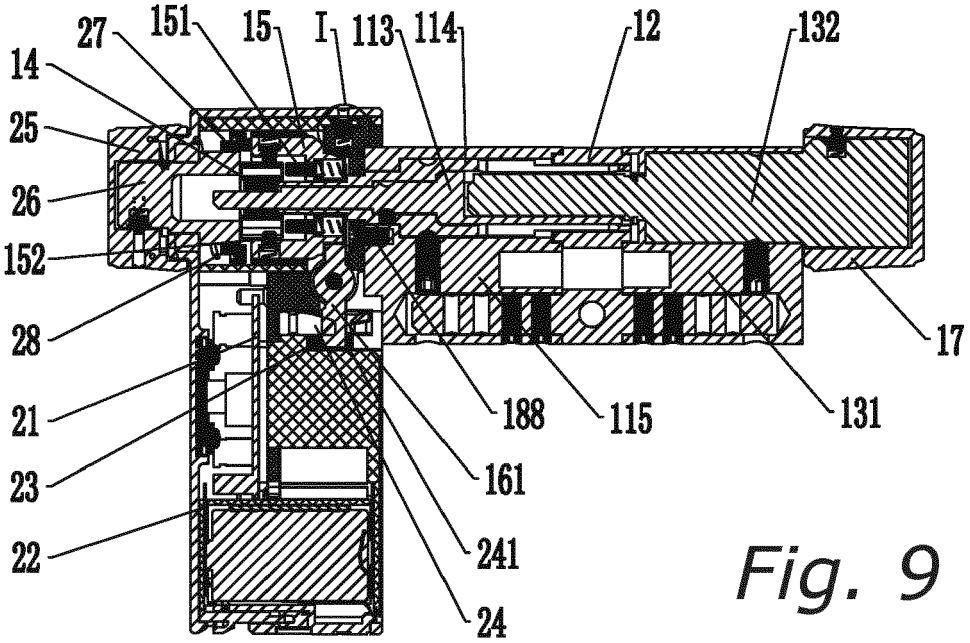
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Fig. 9

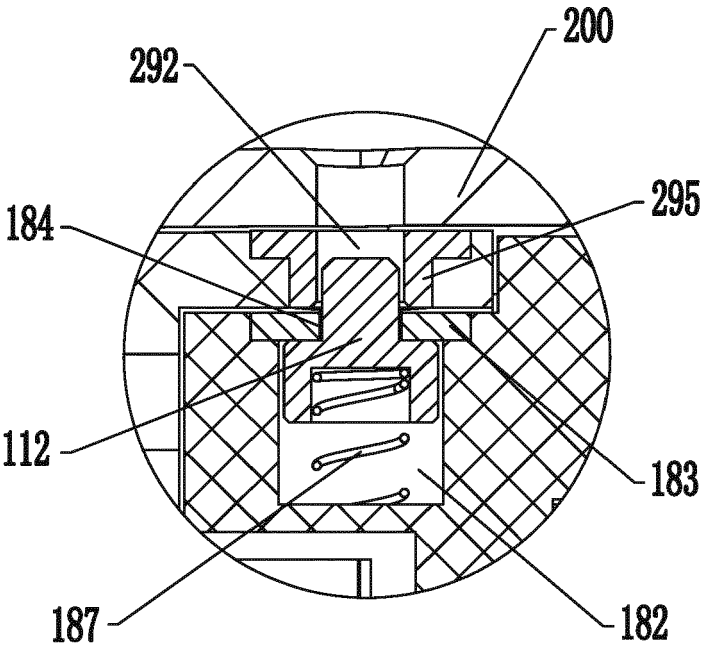
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Fig. 10

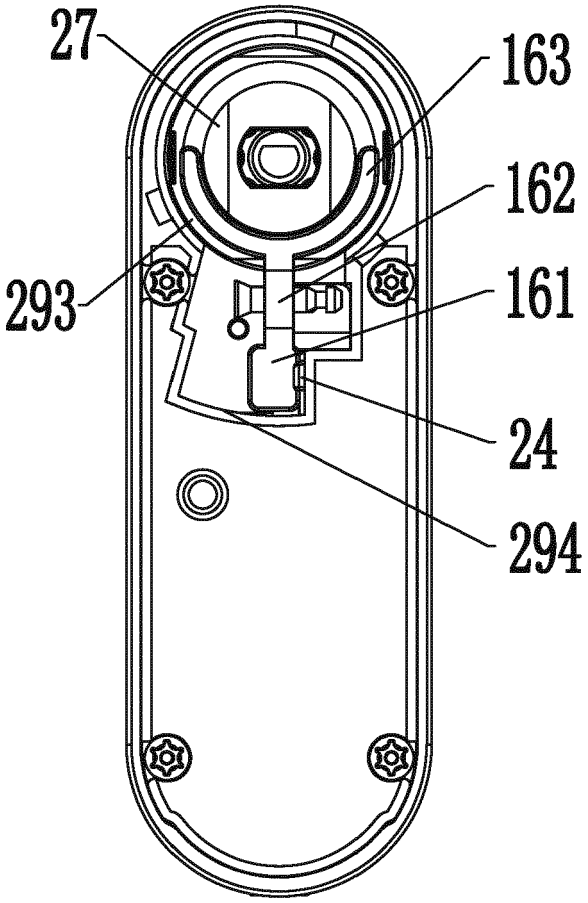

Fig. 11

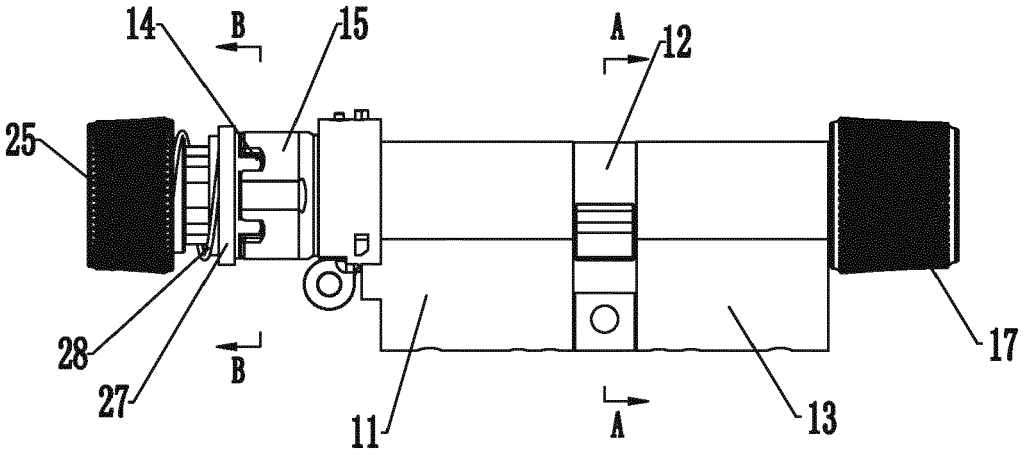

Fig. 12

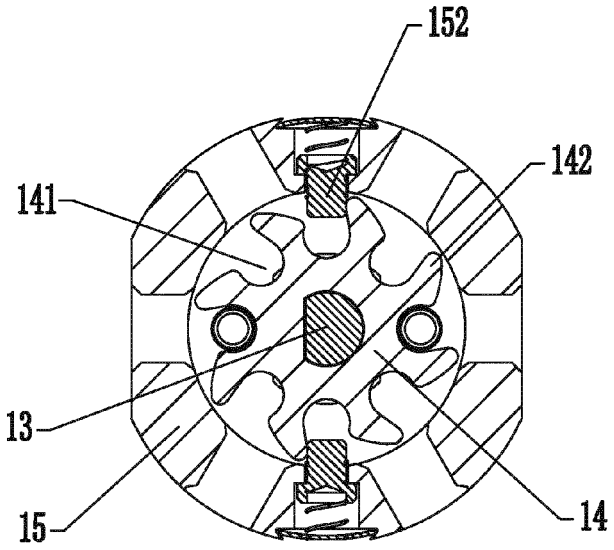

Fig. 13

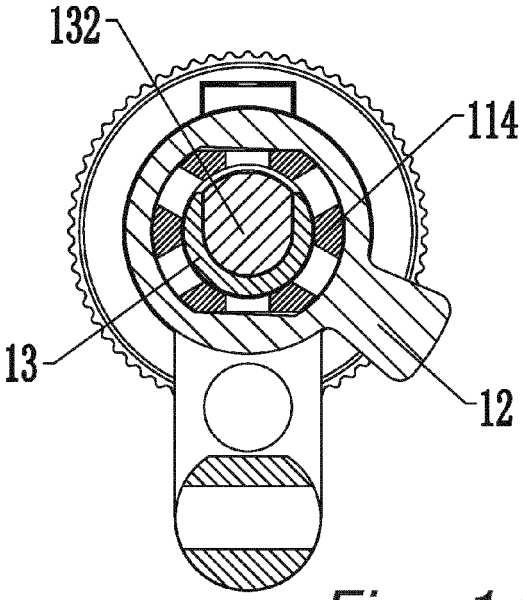

Fig. 14

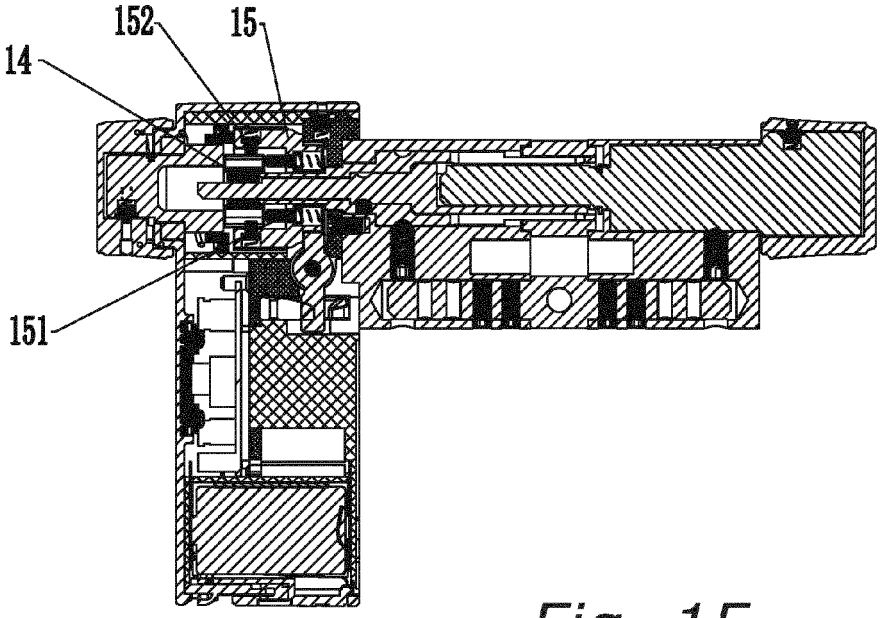

Fig. 15

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EUROPEAN SEARCH REPORT

Application Number
EP 24 17 2302

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

Place of search	Date of completion of the search	Examiner
The Hague	19 September 2024	Cruyplant, Lieve

CATEGORY OF CITED DOCUMENTS

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