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(54) Title: IMPROVED IGNITION SWITCH CUM STEERING LOCK

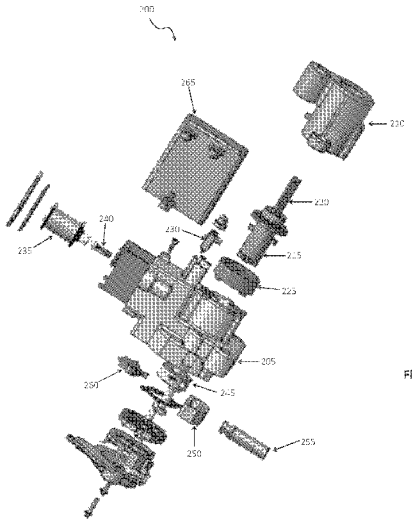


Figure 2

(57) Abstract: A multilevel authentication based electronic lock unit for a vehicle, said lock unit working in conjunction with an electronic control unit, the lock unit comprising: a first switch operatively coupled to the electronic control unit for initiating first level of authentication; a rotor having a top end, a bottom end and at least two sideward protruding arms which are spaced apart; a knob rigidly fixed to the top end of the rotor for facilitating steering LOCK/UNLOCK and ignition ON/OFF of the vehicle; a ring having at least two plates protruding from inner circumference of the ring, the plates being spaced apart so as to form a slot between any two adjacent plates to all the allow the rotor and its protruding arms to pass through; the bottom side of each plate being provided with projections to engage the arms of the rotor within the said projections; a cam unit comprising: a cylindrical body which mates with the bottom end of the rotor; and a cam element rigidly connected to the cylindrical body; a movable stopper positioned between the bottom end of the rotor and the cylindrical body for separating the rotor from the cam unit; and a second switch operatively coupled to the electronic control unit and being actuated by the movement of the cam element for initiating second level of authentication.

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"IMPROVED INGITION SWITCH CUM STEERING LOCK"

FIELD OF THE INVENTION

The present invention generally relates to the field of vehicles. More specifically, the present invention relates to a multilevel authentication based electronic lock unit for vehicles.

BACKGROUND OF THE INVENTION

Conventionally it is known that, steering LOCK/UNLOCK of a vehicle and turning ON/OFF of the ignition of the vehicle requires a mechanical key. More specifically, a user has to insert, push and rotate the mechanical key in the cylindrical lock to UNLOCK the steering and turn ON the ignition. Similarly, the user has to rotate the mechanical key from the lock to turn OFF the ignition and LOCK the steering.

The conventional technique of using a mechanical key has a number of disadvantages. One of disadvantages of using a mechanical key is that it is cumbersome for the user to take out the key and insert the key in the lock every time the vehicle is to be used.

Another disadvantage is that, mechanical keys are prone to wear and tear i.e. continuous and excessive use of such keys leads to damage of the profile on the keys, under which condition the user has to get a new key made again.

Yet another disadvantage is that, many users have a tendency of forgetting the key in the lock which may lead to the theft of the vehicle. Moreover, mechanical keys can be copied easily which again increases the chances of theft of the vehicle. Several attempts have been made to provide an anti-theft/security device/system for vehicles. In the known security systems for vehicles are mostly mechanical systems, such as chains or metal wires used for the moving parts. It is known to secure the vehicles against unauthorized driving away, in that the wheels are connected to a fixed stop. Further, many sophisticated electrical/electronic systems have been developed for preventing the theft of the vehicles. However, the said systems are either costly or have a complex arrangement and their installation is very expensive.

Thus, there always existed a need in the art to provide an alternative technique that overcomes the above mentioned disadvantages.

OBJECTS OF THE INVENTION

The principal object of the present invention is to provide a multilevel authentication based electronic lock unit for a vehicle.

Another object of the present invention is to provide a multilevel authentication based electronic lock unit which provides prevention from theft.

Yet another object of the present invention is to provide a multilevel authentication based electronic lock unit which is user friendly.

STATEMENT OF THE INVENTION

The present invention relates to a multilevel authentication based electronic lock unit for a vehicle, said lock unit working in conjunction with an electronic control unit, the lock unit comprising: a first switch operatively coupled to the electronic control unit for initiating first level of authentication; a rotor having a top end, a bottom end and at least two sideward protruding arms which are spaced apart; a knob rigidly fixed to the top end of the rotor for facilitating steering LOCK/UNLOCK and ignition ON/OFF of the vehicle; a ring having at least two plates protruding from inner circumference of the ring, the plates being spaced apart so as to form a slot between any two adjacent plates to allow the rotor and its protruding arms to pass through; the bottom side of each plate being provided with projections to engage the arms of the rotor within the said projections; a cam unit comprising: a cylindrical body which mates with the bottom end of the rotor; and a cam element rigidly connected to the cylindrical body; a movable stopper positioned between the bottom end of the rotor and the cylindrical body for separating the rotor from the cam unit; and a second switch operatively coupled to the electronic control unit and being actuated by the movement of the cam element for initiating second level of authentication.

SUMMARY OF THE INVENTION

The present invention relates to a multilevel authentication based electronic lock unit for a vehicle, said lock unit working in conjunction with an electronic control unit, the lock unit comprising: a first switch operatively coupled to the electronic control unit for initiating first level of authentication; a rotor having a top end, a bottom end and at least two sideward protruding arms which are spaced apart; a knob rigidly fixed to the top end of the rotor for

facilitating steering LOCK/UNLOCK and ignition ON/OFF of the vehicle; a ring having at least two plates protruding from inner circumference of the ring, the plates being spaced apart so as to form a slot between any two adjacent plates to allow the rotor and its protruding arms to pass through; the bottom side of each plate being provided with projections to engage the arms of the rotor within the said projections; a cam unit comprising: a cylindrical body which mates with the bottom end of the rotor; and a cam element rigidly connected to the cylindrical body; a movable stopper positioned between the bottom end of the rotor and the cylindrical body for separating the rotor from the cam unit; and a second switch operatively coupled to the electronic control unit and being actuated by the movement of the cam element for initiating second level of authentication.

In the above paragraphs the most important features of the invention have been outlined, in order that the detailed description thereof that follows may be better understood and in order that the present contribution to the art may be better understood and in order that the present contribution to the art may be better appreciated. There are, of course, additional features of the invention that will be described hereinafter and which will form the subject of the claims appended hereto. Those skilled in the art will appreciate that the conception upon which this disclosure is based may readily be utilized as a basis for the designing of other structures for carrying out the several purposes of the invention. It is important therefore that the claims be regarded as including such equivalent constructions as do not depart from the spirit and scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Further aspects and advantages of the present invention will be readily understood from the following detailed description with reference to the accompanying drawings. The figures together with the detailed description below, are incorporated in and form part of the specification, and serve to further illustrate the aspects/embodiments and explain various principles and advantages, in accordance with the present invention wherein:

Figure 1 illustrates the perspective view of the electronic lock unit according to an embodiment of the present invention;

Figure 2 illustrates the exploded view of the electronic lock unit according to an embodiment of the present invention;

Figure 3 illustrates the housing of the electronic lock unit according to an embodiment of the present invention;

Figure 4 illustrates the cover of the electronic lock unit according to an embodiment of the present invention;

Figure 5 illustrates the rotor-knob assembly of the electronic lock unit according to an embodiment of the present invention;

Figure 6 illustrates the ring of the electronic lock unit according to an embodiment of the present invention;

Figure 7 illustrates the cam unit of the electronic lock unit according to an embodiment of the present invention;

Figure 8 illustrates the cam follower of the electronic lock unit according to an embodiment of the present invention;

Figures 9, 10, 11 and 12 illustrate the cross-sectional views of the electronic lock unit according to an embodiment of the present invention;

Figure 13 illustrates the block diagram of the electronic system of the electronic lock unit according to an embodiment of the present invention; and

Figure 14 illustrates the electronic key according to an embodiment of the present invention.

Skilled artisans will appreciate that elements in the drawings are illustrated for simplicity and have not necessarily been drawn to scale. For example, the dimensions of some of the elements in the drawings may be exaggerated relative to other elements to help to improve understanding of aspects of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

In order that the invention may be readily understood and put into practical effect, reference will now be made to exemplary embodiments as illustrated with reference to the accompanying drawings. The figures together with a detailed description below, are incorporated in and form part of the specification, and serve to further illustrate the embodiments and explain various principles and advantages.

The terms "comprises", "comprising", or any other variations thereof, are intended to cover a non-exclusive inclusion, such that a process, method that comprises a list of steps does not include only those steps but may include other steps not expressly listed or inherent to such process, method. Similarly, one or more elements in a system or apparatus or device proceeded by "comprises" does not, without more constraints, preclude the existence of other elements or additional elements in the system or apparatus or device.

Accordingly, the present invention relates to a multilevel authentication based electronic lock unit for a vehicle, said lock unit working in conjunction with an electronic control unit, the lock unit comprising: a first switch operatively coupled to the electronic control unit for initiating first level of authentication; a rotor having a top end, a bottom end and at least two sideward protruding arms which are spaced apart; a knob rigidly fixed to the top end of the rotor for facilitating steering LOCK/UNLOCK and ignition ON/OFF of the vehicle; a ring having at least two plates protruding from inner circumference of the ring, the plates being spaced apart so as to form a slot between any two adjacent plates to allow the rotor and its protruding arms to pass through; the bottom side of each plate being provided with projections to engage the arms of the rotor within the said projections; a cam unit comprising: a cylindrical body which mates with the bottom end of the rotor; and a cam element rigidly connected to the cylindrical body; a movable stopper positioned between the bottom end of the rotor and the cylindrical body for separating the rotor from the cam unit; and a second switch operatively coupled to the electronic control unit and being actuated by the movement of the cam element for initiating second level of authentication.

According to an aspect, the present invention relates to a lock unit wherein the first switch is actuated by a user and the first level of authentication comprises: the electronic control unit being configured to: receive ID codes transmitted by an electronic key; and compare the

received ID codes with ID codes stored in it, wherein the first level of authentication is said to be complete if the ID codes received by the electronic control unit matches with the ID codes stored in it.

According to another aspect, the present invention relates to a lock unit wherein: the top end of the rotor having a protrusion; the bottom end of the rotor having a hole at its center and at least two protruding legs spaced apart in radial direction from the hole; and the knob having a circular bottom having a depression for accommodating the protrusion of the rotor.

According to another aspect, the present invention relates to a lock unit wherein: the cylindrical body having a vertical pillar protruding from its center to mate with the central hole of the rotor and at least two slots to accommodate the at least two legs of the rotor.

According to yet another aspect, the present invention relates to a lock unit wherein the cam element comprises: a first pillar rigidly fixed to the bottom of the cylindrical body and being offset from its center; and L shaped member having a horizontal and a vertical portion, wherein the first pillar being rigidly fixed over the horizontal portion such that the horizontal potion is substantially divided into two equal sections.

According to yet another aspect, the present invention relates to a lock unit further comprising: a housing having a top surface, a bottom surface, a chamber on a side and a hole on another side, wherein the top and bottom surfaces are provided with openings.

According to yet another aspect, the present invention relates to a lock unit further comprising: an actuating unit located in the chamber, said actuating unit comprising: a plunger connected to the movable stopper for enabling push-pull movement of the stopper.

According to still another aspect, the present invention relates to a lock unit wherein the ring rests on the top surface of the housing and the rotor is encompassed by the opening in the top surface.

According to still another aspect, the present invention relates to a lock unit further comprising:

a cover for casing the top surface of the housing, said cover being provided with a step on its inner surface, wherein the ring is sandwiched between the top surface of the housing and the step on the inner surface of the cover.

According to further aspect, the present invention relates to a lock unit further comprising: a cam follower having a channel for accommodating the cam element and a T shaped groove located at its circumference, said cam element moving the cam follower to and fro in response to rotation of the knob; and a locking member having an end connected to the T shaped groove for moving to and fro for engaging/disengaging with the steering.

According to a still another aspect, the present invention relates to a lock unit wherein the second switch is placed in one of the corners of the bottom surface of the housing.

According to a still further aspect, the present invention relates to a lock unit wherein one of the sections of the horizontal portion of the L shaped member actuates the second switch and wherein the second level of authentication comprises: the electronic control unit being configured to: receive ID codes transmitted by the electronic key; and compare the received ID codes with ID codes stored in it, wherein the second level of authentication is said to be complete if the ID codes received by the electronic control unit matches with the ID codes stored in it.

According to furthermore aspect, the present invention relates to a lock unit wherein the opening in the top surface comprises at least one spring loaded ball to engage with at least one groove provided on the periphery of the rotor.

According to yet another aspect, the present invention relates to a multilevel authentication based electronic lock unit for a vehicle substantially as herein described with reference to the foregoing specification and accompanying drawings.

The following paragraphs describe the present invention with reference to figures 1-13. In the following description well known functions or constructions are not described in detail since they would obscure the description with unnecessary detail.

Referring now to the drawings, there is shown an illustrative embodiment of the multilevel authentication based electronic lock unit according to the present invention. It should be understood that the invention is susceptible to various modifications and alternative forms; specific embodiments thereof have been shown by way of example in the drawings and will be described in detail below.

Figure 1, illustrates the perspective view of the multilevel authentication based electronic or electro-mechanical lock unit (100) for a vehicle according to an embodiment of the present invention.

As shown in figure 1, the electronic lock unit (100) comprises of a housing (110) for accommodating various elements/components of the lock unit (100), cover (120) for casing/covering the top surface of the housing (110), a knob (130) for operating the lock unit (100) for facilitating steering LOCK/UNLOCK and ignition ON/OFF of the vehicle, a first switch (140) for initiating the multilevel authentication and an electronic control unit (ECU) (150) for facilitating the multilevel authentication.

In other words, the electronic lock unit (100) according to the present invention works in conjunction with the electronic control unit (150) for facilitating multilevel authentication.

It is to be noted that, all components of the lock unit (100) are not illustrated in figure 1 and will be described with reference to figure 2 which illustrates the exploded view of the lock unit (100).

In the embodiment of figure 1, the cover (120) has a circular opening for the allowing the knob (130) to pass through and the first switch (140) is placed in a slot provided in the cover (120) next to the circular opening. It is to be noted that, the first switch (140) can be located at any suitable place on the steering of the vehicle.

Also, in the embodiment of figure 1, the ECU (150) is attached to the housing (110) of the lock unit (100). It is to be noted that, the ECU (150) can be located at any place in the vehicle and coupled with the electronic lock unit (100).

Figure 2, illustrates the exploded view of the multilevel authentication based electronic lock unit according to an embodiment of the present invention.

As shown in figure 2, the electronic lock unit (200) comprises of the following elements/components: housing (205), cover (210), rotor (215), knob (220), ring (225), first switch (230), actuator unit (235), movable stopper (240), cam unit (245), cam follower (250), locking bar (255) and second micro switch (260).

The first switch (230) may be positioned on the housing (205) or at any place on the steering of the vehicle. The first switch (230) is actuated by the user and initiates first level of authentication. The second switch (260) is positioned inside the housing (205) and is actuated by the movement of the cam unit (245). The second switch (260) initiates second level of authentication. The first and second switches (230, 260) are operatively coupled to an electric control unit (ECU) (265) which facilitates the first and second levels of authentication.

The housing (205) is provided with an opening on its top surface for encompassing the rotor (215). The ring (225) rests on the top surface of the housing (205) and allows the rotor (215) to pass through in the opening of the housing (205). The cover (210) provides a casing/covering to the top surface of the housing (205) such that the ring (225) is sandwiched between the top surface of the housing (205) and the cover (210).

The housing (205) is also provided with an opening on its bottom surface for encompassing the cam unit (245), cam follower (250), locking bar (255), second micro switch (260) and movable stopper (240).

The movable stopper (240) is provided between the bottom surface of the rotor (215) and the cam unit (245) for separating the rotor (215) from the cam unit (245). The movable stopper (240) is connected to the actuating unit (235) which enables the push-pull movement of the stopper (240). The pull movement of the movable stopper (240) causes engagement of the rotor (215) with the cam unit (245).

More specifically, the actuator unit (235) comprises of a plunger (270) whose one end is connected to the movable stopper (240) and whose other end is connected to a spring means. In this embodiment, the plunger (270) is surrounded with coils. The coils when energized

enables the plunger (270) to move backwards thereby allowing engagement of the rotor (215) with the cam unit (245). Also, when the coils are dis-energized the plunger (270) is pushed by the spring force.

The cam follower (250) is coupled to the cam unit (245) and follows the movement of the cam unit (245). The cam unit (245) comprises of a cylindrical body and a cam element rigidly fixed to the cylindrical body. The cam follower (250) accommodates the cam element and moves to and fro in response to the movement of the cam element. The second switch (260) is positioned inside the housing (205) and is actuated by the movement of the cam element.

The locking bar/member (255) is coupled to the cam follower (250). More specifically, the locking bar (255) has its one end connected to the cam follower (250) and moves with the movement of the cam follower (250). The locking bar moves to and fro with the movement of the cam follower to engage/disengage with the steering of the vehicle.

Figure 3, shows the housing of the electronic lock unit according to an embodiment of the present invention.

The housing (300) shown in figure 3 comprises of a top surface (310), a bottom surface (320), a chamber (330) on one side and a hole (340) on the other side. It can be noticed from figure 3, each of the top and bottom surfaces of the housing (300) is provided with an opening. The top surface (310) has an opening (350) and the bottom surface (320) has an opening (360).

The chamber (330) accommodates the actuation unit (235) and the hole (340) allows the locking bar (255) to move to and fro for engaging/disengaging with the steering.

Further, the corner (370) of the bottom surface (320) of the housing (300) accommodates the second switch.

Figure 4, shows the cover that cases the top surface of the housing according to an embodiment of the present invention.

The cover (400) shown in figure 4 is used to provide a covering/casing to the top surface of the housing. The cover (400) is provided with a step (410) on its inner surface.

Figure 5, shows the rotor-knob assembly of the electronic lock unit according to the present invention.

As shown in figure 5, the rotor (500) comprises of a top end (505), a bottom end (510) and at least two sideward protruding arms (515) which are spaced apart. The top end (505) of the rotor (500) is provided with a protrusion (520) which is fixed inside a depression/cavity (525) provided in a bottom surface (530) of the knob (550). In other words, the knob (550) is rigidly fixed to the top end (505) of the rotor (500).

Further, as shown in figure 5, the bottom end (510) of the rotor (500) is provided with a hole (535) at its center and at least two protruding legs (540) spaced apart in radial direction from the hole (535).

Furthermore, the rotor (500) is provided with at least one groove (545) on its periphery.

Figures 6a and 6b, shows the top surface and bottom surface of the ring of the electronic lock unit according to an embodiment of the present invention respectively.

As shown in figure 6a, the ring (600) is provided with at least two plates (610) protruding from inner circumference of the ring (600), the plates (610) being spaced apart so as to form a slot (620) between any two adjacent plates (610).

Further, as shown in figure 6b, the bottom side of each plate (610) is provided with projections (630) to engage the arms (515) of the rotor (500) within the said projections (630).

As evidenced from figures 2, 9 and 10, the ring rests on the top surface (310) of the housing in such a manner that the ring is sandwiched between the top surface (310) of the housing and the step (410) on the inner surface of the cover (400).

The ring (600) when sandwiched between the top surface (310) of the housing and the step (410) on the inner surface of the cover (400) allows the rotor (500) and its protruding arms (515) to pass through the opening (350) provided in the top surface (310) of the housing.

It is to be noted that, the projections (630) define the movement i.e. rotation of the knob from: steering LOCK to ignition OFF, ignition OFF to ignition ON and vice versa.

Figure 7, shows the cam unit or cam assembly of the electronic lock unit according to an embodiment of the present invention.

As shown in figure 7, the cam unit (700) comprises of a cylindrical body (710) and a cam element (720) rigidly connected to the cylindrical body (710). The cylindrical body (710) is also termed as cam cavity and makes contact with the rotor (500). The cylindrical body (710) is provided with a vertical pillar (730) protruding from its center and at least two slots (740) in the radial direction from the vertical pillar (730). The said vertical pillar (730) is provided with a spring means located on its top surface.

It is to be noted that when the cylindrical body (710) makes contact/engagement with the rotor (500) (i.e. when the movable stopper (240) is pulled back by the plunger), the vertical pillar (730) mates with the central hole (535) of the rotor (500) and the at least two slots (740) mate with the at least two legs (540) of the rotor (500).

The cam element (720) is constituted of a first pillar (750) rigidly fixed to the bottom of the cylindrical body (710) and L shaped member connected to the first pillar (750). The first pillar (750) is offset from the center of the cylindrical body (710).

The L shaped member is divided into a horizontal portion (760) and a vertical portion (770). As shown in figure 7, the first pillar (750) divides the horizontal potion (760) into substantially two equal sections (760a, 760b).

Figure 8, shows the cam follower of the electronic lock unit according to an embodiment of the present invention.

As shown in figure 8, the cam follower (800) comprises of a channel (810) and a T shaped groove (820) located at its circumference. The channel (810) accommodates the cam element (720) and allows rotation of the first pillar (750) of the cam element (720). The T shaped groove (820) accommodates one end of the locking bar/member (255) such that the locking member (255) moves with the movement of the cam follower (800). The said arrangement converts rotation of the cam element (720) into linear to and fro motion of the locking bar/member (255) for engaging/disengaging with the steering of the vehicle.

Furthermore, as shown in figures 3, 9, 10 and 12, the opening (350) in the top surface (310) of the housing (300) is provided with at least one spring loaded ball (275) which engages with the at least one groove (545) provided on the periphery of the rotor (500). The said arrangement enables the user to correctly identify the steering LOCK position i.e. the position where the user has to press the knob (550).

Figures 9-12 illustrate the cross sectional views of the electronic lock unit according to an embodiment of the present invention.

The lock unit of the present invention works in conjunction with the electronic control unit (150, 265) which receives signals from an electronic key or FOB key for facilitating steering LOCK/UNLOCK and ignition ON/OFF of the vehicle. The key may be a battery operated key and is held by the user of the vehicle. The present invention implies that the users need not insert the key in the lock for steering LOCK/UNLOCK and engine ON/OFF of the vehicle.

Further, the lock unit of the present invention allows multilevel authentication process/methodology to run which permit steering UNLOCK and engine ON of the vehicle. The first level of authentication allows steering UNLOCK of the vehicle and the second level of authentication allows ignition ON of the vehicle. The user having the electronic key or FOB key must remain in a predetermined distance of the vehicle for the authentication process to complete successfully.

The electronic key or FOB key is pre-programmed with specific ID codes which are transmitted continuously. Generally, the electronic control unit (150, 265) is in sleep mode

(for instance when the vehicle is not in use) and is not able to detect the ID codes transmitted by the electronic key. The electronic control unit (150, 265) comes in active mode when a trigger signal is provided to the same.

According to an embodiment of the present invention, the trigger signal is provided by the first switch (230). The first switch (230) is provided either on the lock unit or at any place on the steering of the vehicle. The first switch (230) is actuated by the user of the vehicle. The actuation of the first switch (230) provides a trigger signal to the electronic control unit (150, 265) and initiates the multilevel authentication. In other words, the electronic control unit (150, 265) comes in active mode when a trigger signal is provided to it.

After the electronic control unit (150, 265) is in active mode, it receives ID codes transmitted by the electronic key and compares the received ID codes with ID coded stored in it. If the ID codes received by the electronic control unit (150, 265) matches with the ID codes previously stored in it, first level of authentication is said to be complete.

Further, when the first level of authentication is complete, the electronic control unit (150, 265) provides an electric pulse to the actuator unit (235). On receiving the electrical pulse, the plunger (270) of the actuator unit (235) is pulled back. More specifically, the movable stopper (240) provided between the bottom surface of the rotor (500) and the cylindrical body (710) is pulled backward for allowing the rotor (500) to engage with the cam unit (700), as shown in figures 10 and 12.

In other words, the movable stopper (240) prohibiting the engagement between the rotor (500) and the cam unit (700) as shown in figure 9 is pulled backward for allowing the rotor (500) to engage with the cam unit (700).

After the movable stopper (240) is pulled backward, the user is able to push the knob (550). More specifically, the user is able to push the knob-rotor assembly. The knob-rotor assembly is pushed if the arms (515) of the rotor match with the slots (620) of the ring (600) thereby allowing the rotor (500) to pass through the opening (350) in the top surface (310) of the housing (300). The pushing of the knob (550) establishes the engagement between the rotor (500) and the cam unit (700) as shown in figures 10 and 12.

Further, when the rotor (500) is engaged with the cam unit (700), the central hole (535) of the rotor (500) mates with the vertical pillar (730) of the cylindrical body (710) thereby energizing the spring means and the at least two legs (540) of the rotor (500) mate with the at least two slots (740) provided in the cylindrical body (710).

After, engagement of the rotor (500) with the cam unit (700), the user is able to rotate the knob (550) from steering LOCK to engine OFF position. The rotation of the knob (550) from steering LOCK to engine OFF is defined by the projections (630) of the ring (600).

The rotation of the knob (550) from steering LOCK to engine OFF position causes rotation of the cam element (720) due to the engagement of the rotor (500) with the cam unit (700). As defined above with reference to figure 8, the cam follower (800) accommodates the cam element (720) which is divided into first pillar (750) and L shaped member. The first pillar (750) being offset from the center of the cylindrical body (710) converts the rotation of the cam unit (700) into linear to and fro motion of the cam follower (800). Further, as defined above, the cam follower (800) is engaged with the locking bar/member (255). Thus, rotation of cam unit (700) (in response to rotation of the knob (550) from steering LOCK to engine OFF) causes linear motion of the locking bar/member (255) for releasing the steering of the vehicle.

The locking bar/member (255) holds the steering in the LOCK position. In the embodiment of figures 9-12, the locking bar (255) is moved inwards in response to the rotation of the knob (550) from steering LOCK to engine OFF, thereby unlocking or releasing the steering to move freely. The vehicle is now in engine OFF position.

After the vehicle is in engine OFF position, the user can further rotate the knob (550) to start the vehicle, i.e. the user can rotate the knob (550) from engine OFF to engine ON position. The rotation of the knob (550) from engine OFF to engine ON position is defined by the projections (630) of the ring (600).

When the knob (550) is rotated from engine OFF to engine ON position, the horizontal portion (760) of the cam element (720) actuates the second micro switch (260). More specifically, one of the sections of the horizontal portion (760) of the cam element (720)

actuates the second micro switch (260). With reference to figures 6 and 11, section (760b) actuates the second micro switch (260).

The actuation of the second micro switch (260) sends a trigger signal to the electronic control unit (150, 265) which initiates the second level of authentication. During the second level of authentication, the electronic control unit (150, 265) again receives ID codes transmitted by the electronic key and compares the received ID codes with ID coded stored in it. If the ID codes received by the electronic control unit (150, 265) matches with the ID codes previously stored in it, second level of authentication is said to be complete. If the second level of authentication is complete or successful, the engine of the vehicle will start. If the second level of authentication fails the engine will not start.

In view of the above, if an unauthorized user i.e. a user having an incorrect FOB key operates the lock, he/she will not be able to start the vehicle as the first level of authentication will not complete. On the other hand, if an authorized user i.e. a user having a correct FOB key leaves the vehicle at engine OFF position, then also an unauthorized user will not be able to start the vehicle as the second level of authentication will not complete. The knob (550) is an integrated part of the lock unit which is free to rotate with the rotor (500) when an unauthorized user attempts to access the vehicle. The rotation is transferred to the cam unit (700) only in a condition when the authorized users operate the lock i.e. when the authentication process is completed. In this way, unauthorized users can only rotate the knob (550) but cannot operate the lock unit at steering LOCK position.

Figure 14, shows the electronic key. The electronic key may be provided with a spare key to operate other accessories in the vehicle (i.e. seat lock, tool box lock, etc.)

Figure 13, shows the block diagram of the electronic system of the lock unit according to an embodiment of the present invention.

As shown in figure 13, the electronic control unit (150, 265) receives ID codes from the FOB key for establishing the authentication process. In an embodiment of the present invention, the LF antenna which receives the ID codes may be an integral part of the electronic control

unit (150, 265). In another embodiment, the LF antenna may be external to the electronic control unit (150, 265).

Further, it has been highlighted that the electronic control unit (150, 265) receives the trigger signals from the switches for initiating the multilevel authentication process. Furthermore, the electronic control unit (150, 265) receives input signals from other units of the vehicle.

Also, it has been highlighted that, the electronic control unit (150, 265) provides an output in the form of electrical pulses to the actuator unit (235) for retracting the stopper (240). Moreover, the electronic control unit (150, 265) provides output signals to the vehicle electrical system and electronic circuit of the engine.

The present invention is described with reference to the figures and specific embodiments; this description is not meant to be construed in a limiting sense. Various alternate embodiments of the invention will become apparent to persons skilled in the art upon reference to the description of the invention. It is therefore contemplated that such alternative embodiments form part of the present invention.

The Claims:

1. A multilevel authentication based electronic lock unit for a vehicle, said lock unit working in conjunction with an electronic control unit, the lock unit comprising:

a first switch operatively coupled to the electronic control unit for initiating first level of authentication;

a rotor having a top end, a bottom end and at least two sideward protruding arms which are spaced apart;

a knob rigidly fixed to the top end of the rotor for facilitating steering LOCK/UNLOCK and ignition ON/OFF of the vehicle;

a ring having at least two plates protruding from inner circumference of the ring, the plates being spaced apart so as to form a slot between any two adjacent plates to allow the rotor and its protruding arms to pass through;

the bottom side of each plate being provided with projections to engage the arms of the rotor within the said projections;

a cam unit comprising:

a cylindrical body which mates with the bottom end of the rotor; and

a cam element rigidly connected to the cylindrical body;

a movable stopper positioned between the bottom end of the rotor and the cylindrical body for separating the rotor from the cam unit; and

a second switch operatively coupled to the electronic control unit and being actuated by the movement of the cam element for initiating second level of authentication.

2. The lock unit as claimed in claim 1, wherein the first switch is actuated by a user and the first level of authentication comprises:

the electronic control unit being configured to:

receive ID codes transmitted by an electronic key; and

compare the received ID codes with ID codes stored in it,

wherein the first level of authentication is said to be complete if the ID codes received by the electronic control unit matches with the ID codes stored in it.

3. The lock unit as claimed in claim 1, wherein:

the top end of the rotor having a protrusion;

the bottom end of the rotor having a hole at its center and at least two protruding legs spaced apart in radial direction from the hole; and

the knob having a circular bottom having a depression for accommodating the protrusion of the rotor.

4. The lock unit as claimed in claims 1 and 3, wherein:

the cylindrical body having a vertical pillar protruding from its center to mate with the central hole of the rotor and at least two slots to accommodate the at least two legs of the rotor.

5. The lock unit as claimed in claim 1, wherein the cam element comprises:

a first pillar rigidly fixed to the bottom of the cylindrical body and being offset from its center; and

L shaped member having a horizontal and a vertical portion, wherein the first pillar being rigidly fixed over the horizontal portion such that the horizontal potion is substantially divided into two equal sections.

6. The lock unit as claimed in claim 1, further comprising:

a housing having a top surface, a bottom surface, a chamber on a side and a hole on another side, wherein the top and bottom surfaces are provided with openings.

7. The lock unit as claimed in claim 6, further comprising:

an actuating unit located in the chamber, said actuating unit comprising:

a plunger connected to the movable stopper for enabling push-pull movement of the stopper.

8. The lock unit as claimed in claims 1 and 6, wherein the ring rests on the top surface of the housing and the rotor is encompassed by the opening in the top surface.

9. The lock unit as claimed in claim 8, further comprising:

a cover for casing the top surface of the housing, said cover being provided with a step on its inner surface,

wherein the ring is sandwiched between the top surface of the housing and the step on the inner surface of the cover.

10. The lock unit as claimed in claim 1, further comprising:

a cam follower having a channel for accommodating the cam element and a T shaped groove located at its circumference, said cam element moving the cam follower to and fro in response to rotation of the knob; and

a locking member having an end connected to the T shaped groove for moving to and fro for engaging/disengaging with the steering.

11. The lock unit as claimed in claim 6, wherein the second switch is placed in one of the corners of the bottom surface of the housing.

12. The lock unit as claimed in claims 1 and 5, wherein one of the sections of the horizontal portion of the L shaped member actuates the second switch and wherein the second level of authentication comprises:

the electronic control unit being configured to:

receive ID codes transmitted by the electronic key; and

compare the received ID codes with ID codes stored in it,

wherein the second level of authentication is said to be complete if the ID codes received by the electronic control unit matches with the ID codes stored in it.

13. The lock unit as claimed in claimed 6, wherein the opening in the top surface comprises at least one spring loaded ball to engage with at least one groove provided on the periphery of the rotor.

14. A multilevel authentication based electronic lock unit for a vehicle substantially as herein described with reference to the foregoing specification and accompanying drawings.

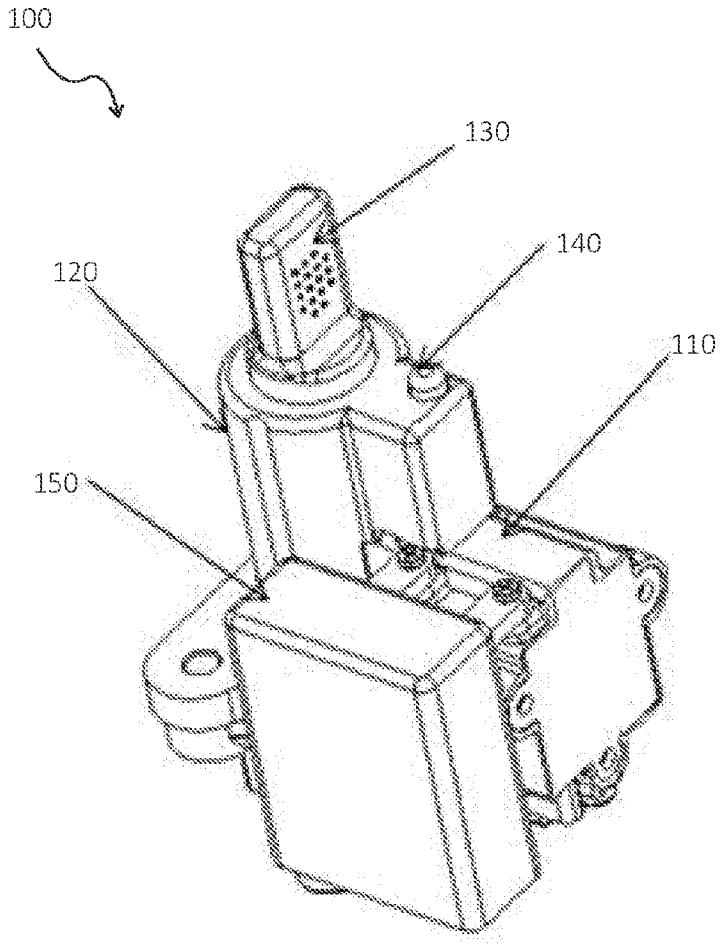


Figure 1

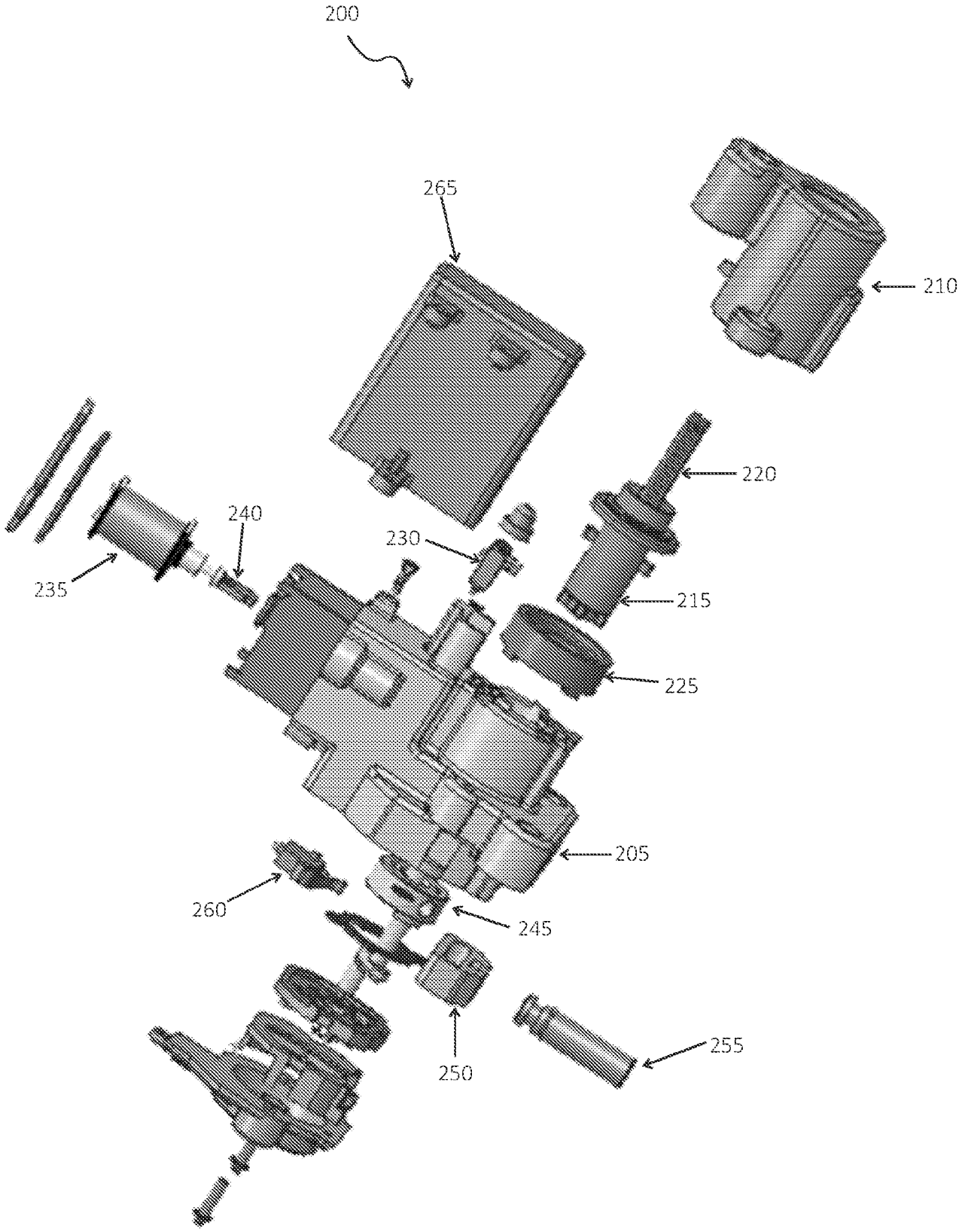


Figure 2

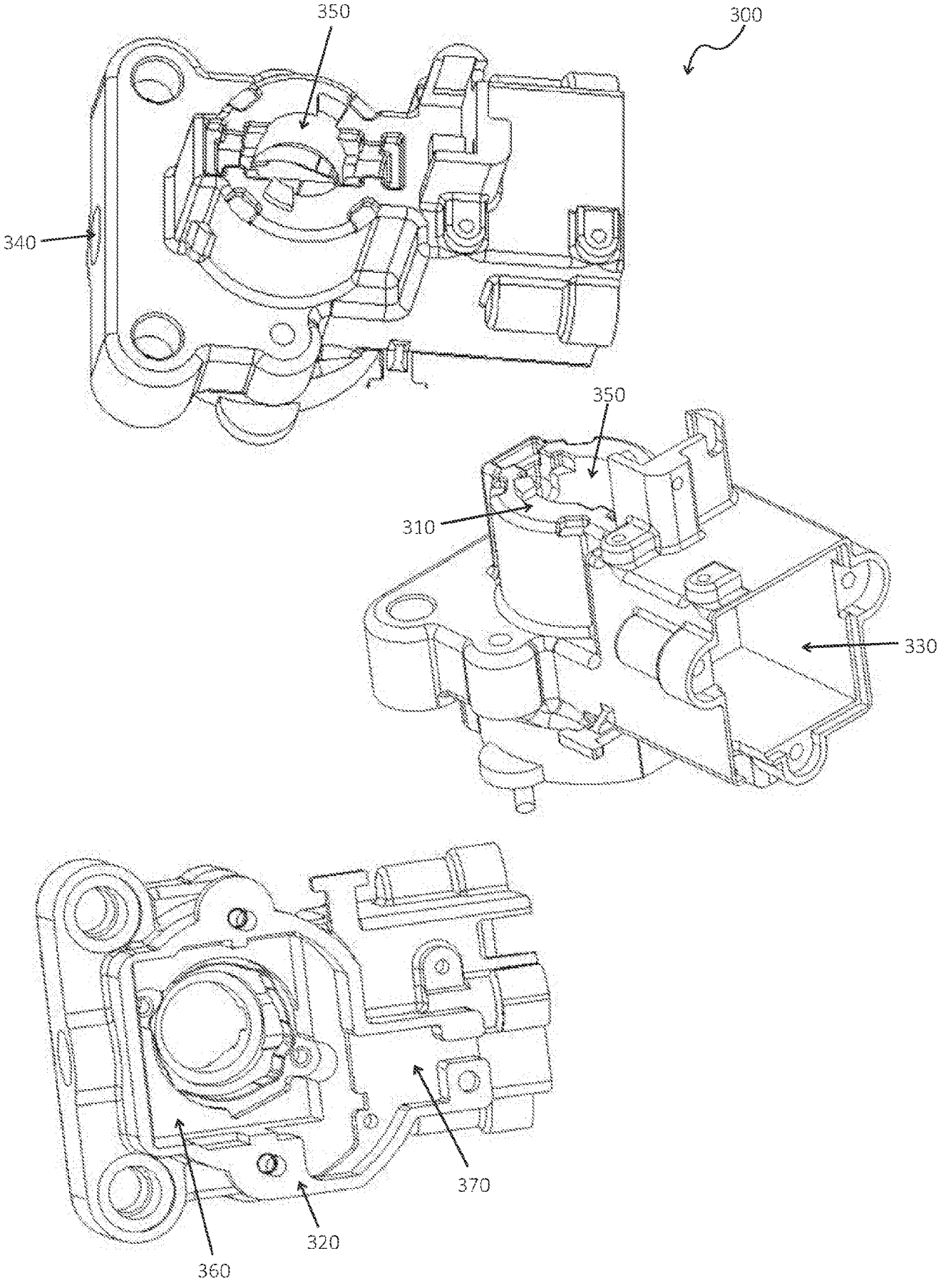


Figure 3

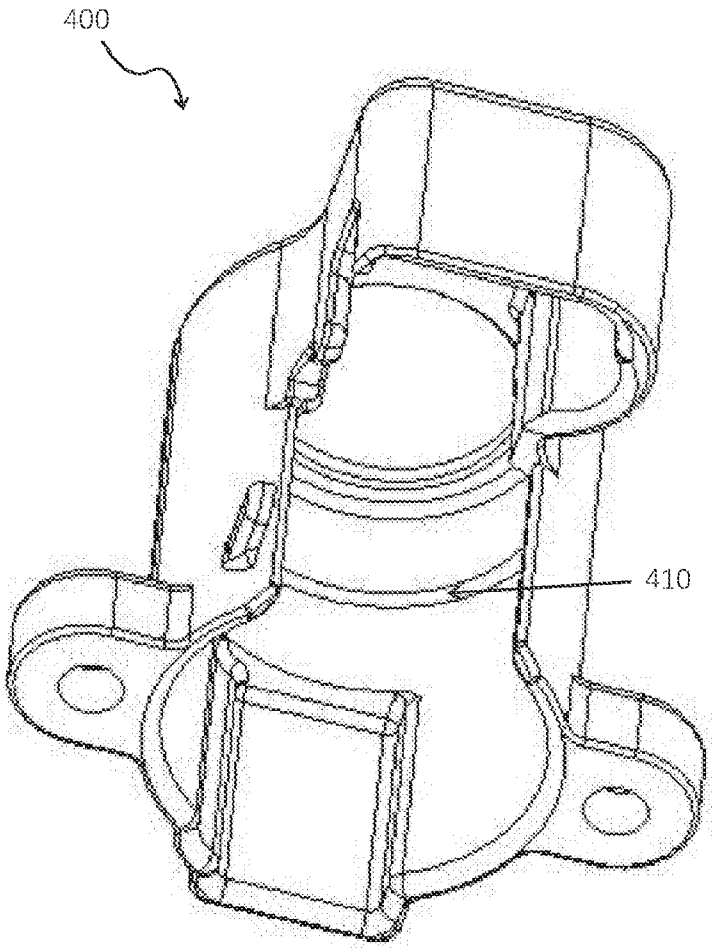


Figure 4

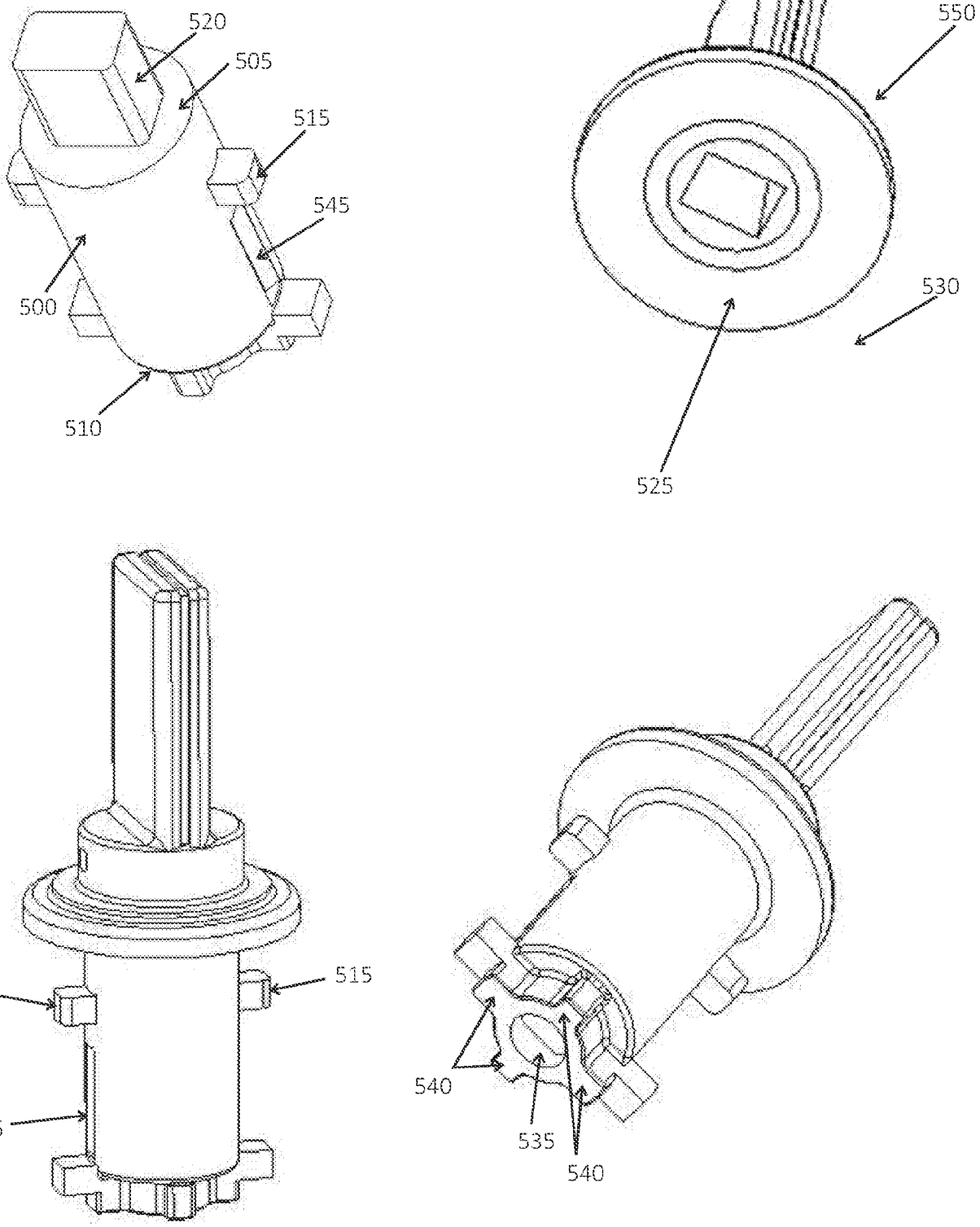


Figure 5

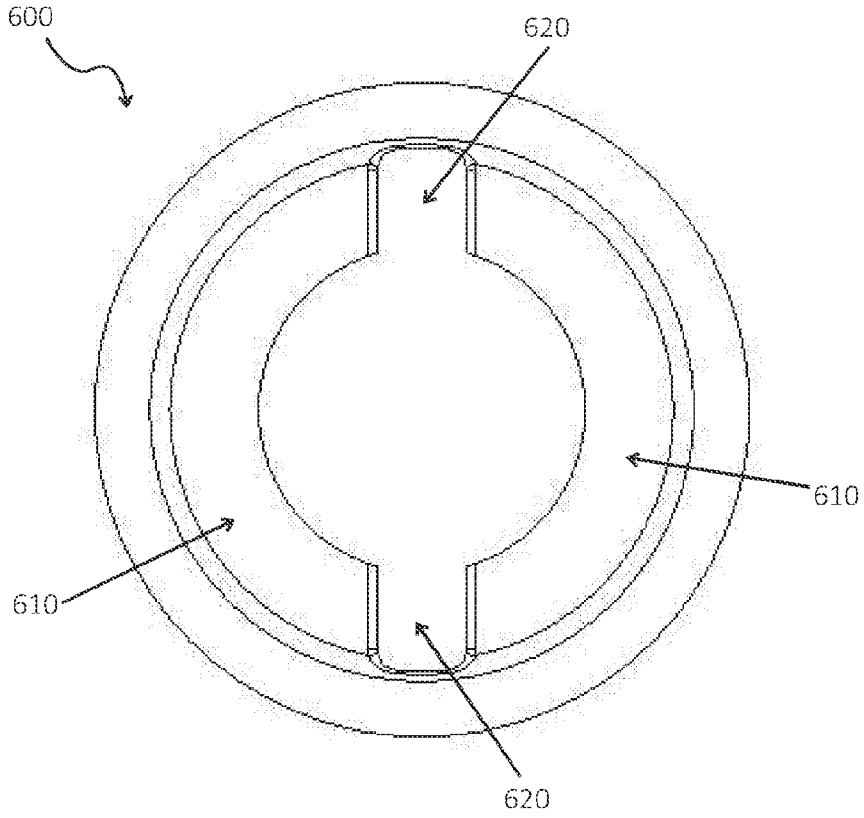


Figure 6(a)

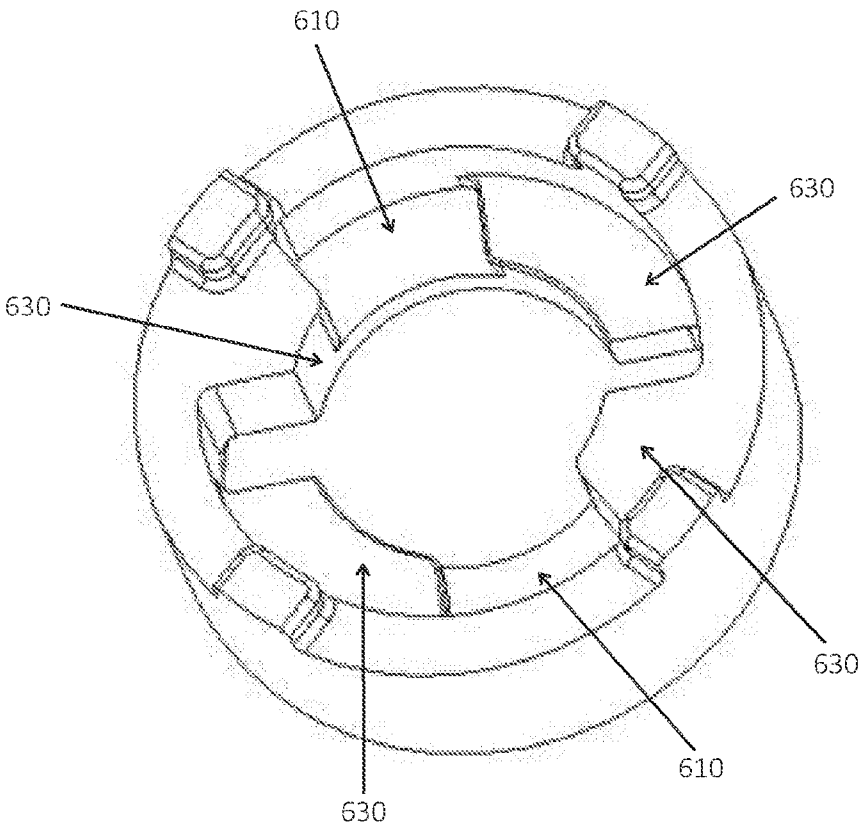


Figure 6(b)

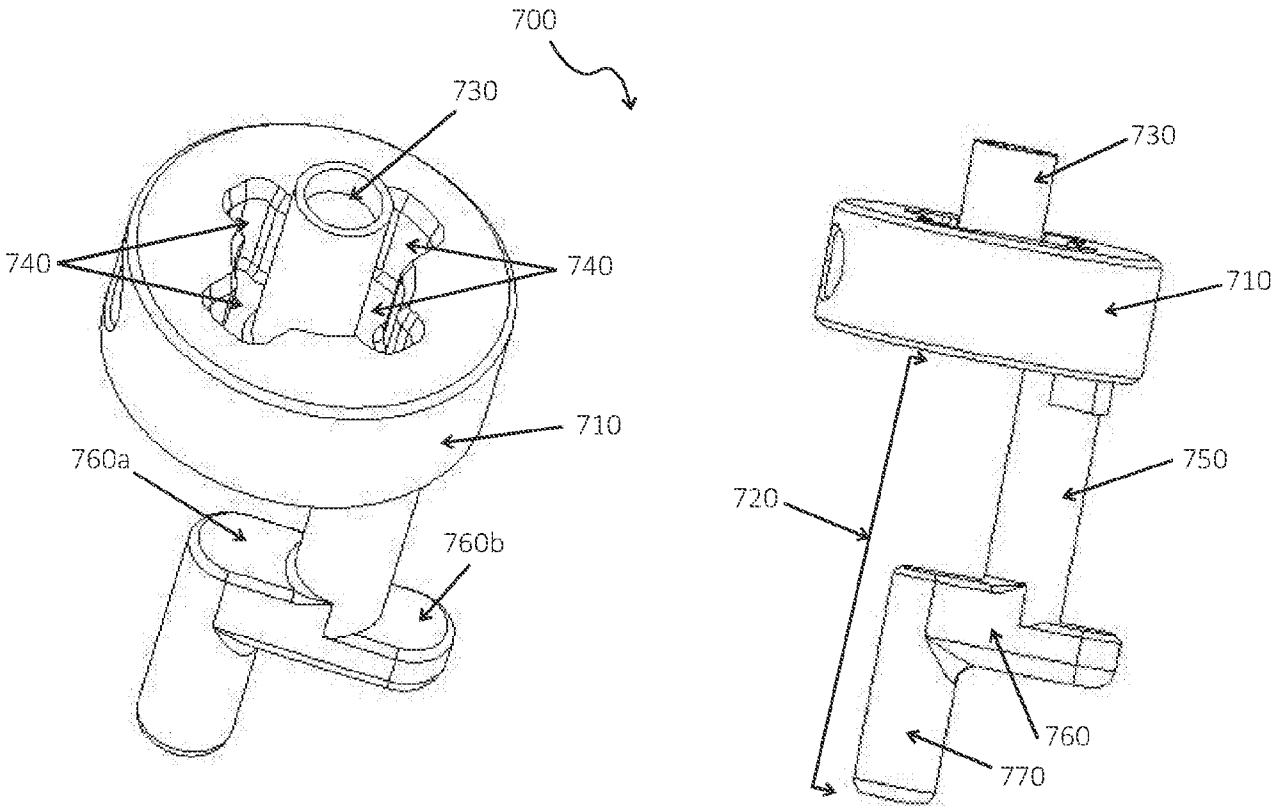


Figure 7

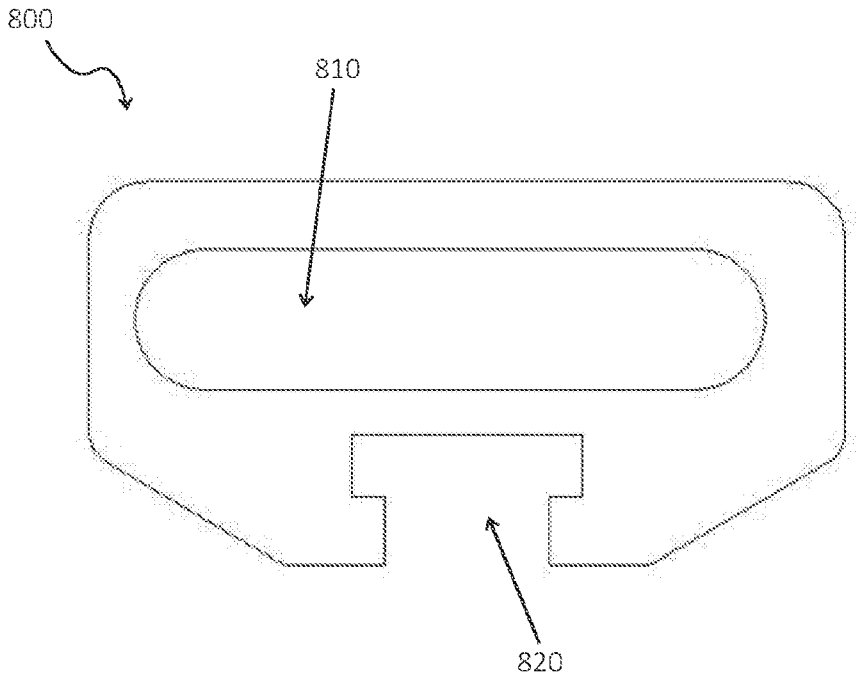


Figure 8

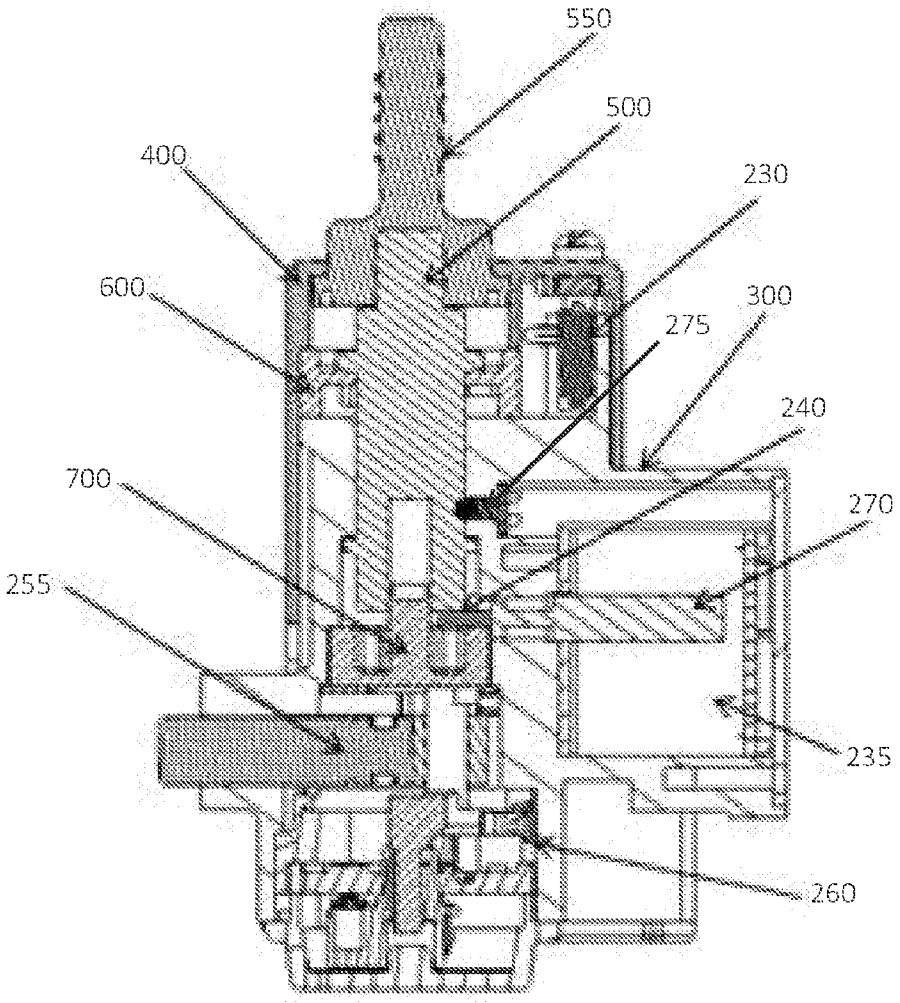


Figure 9

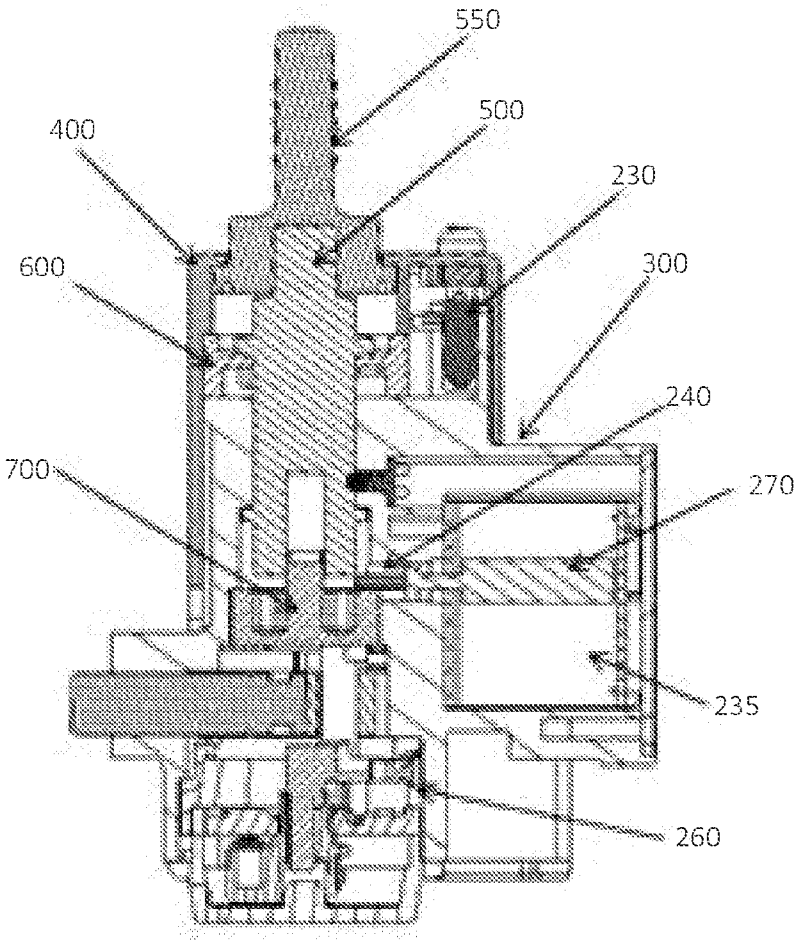


Figure 10

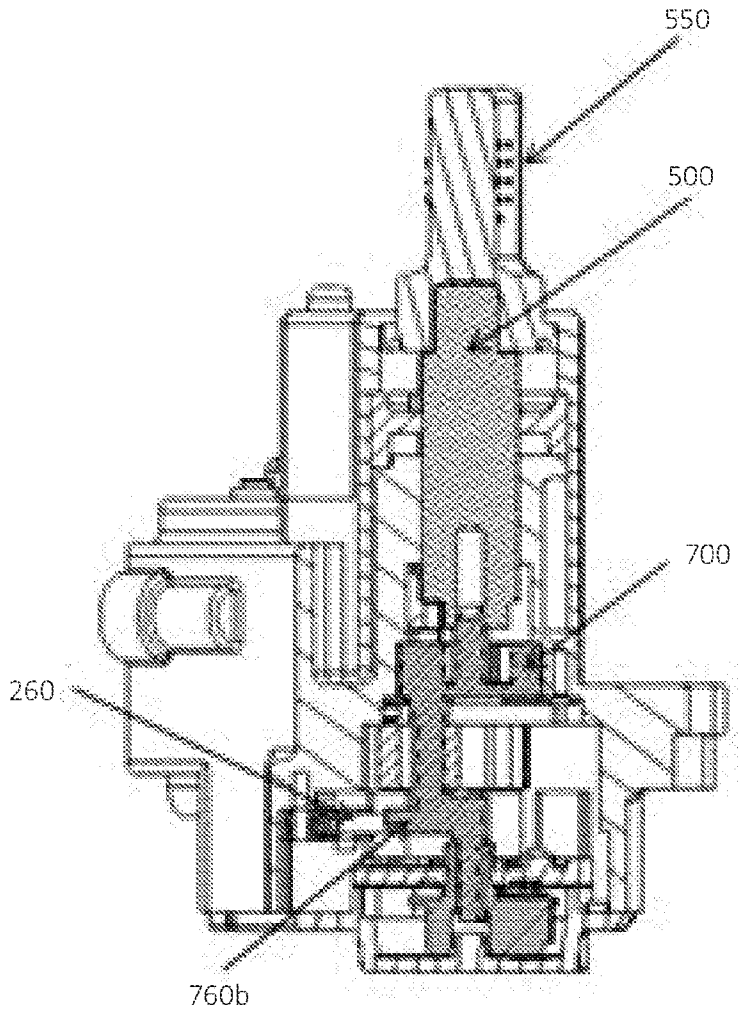


Figure 11

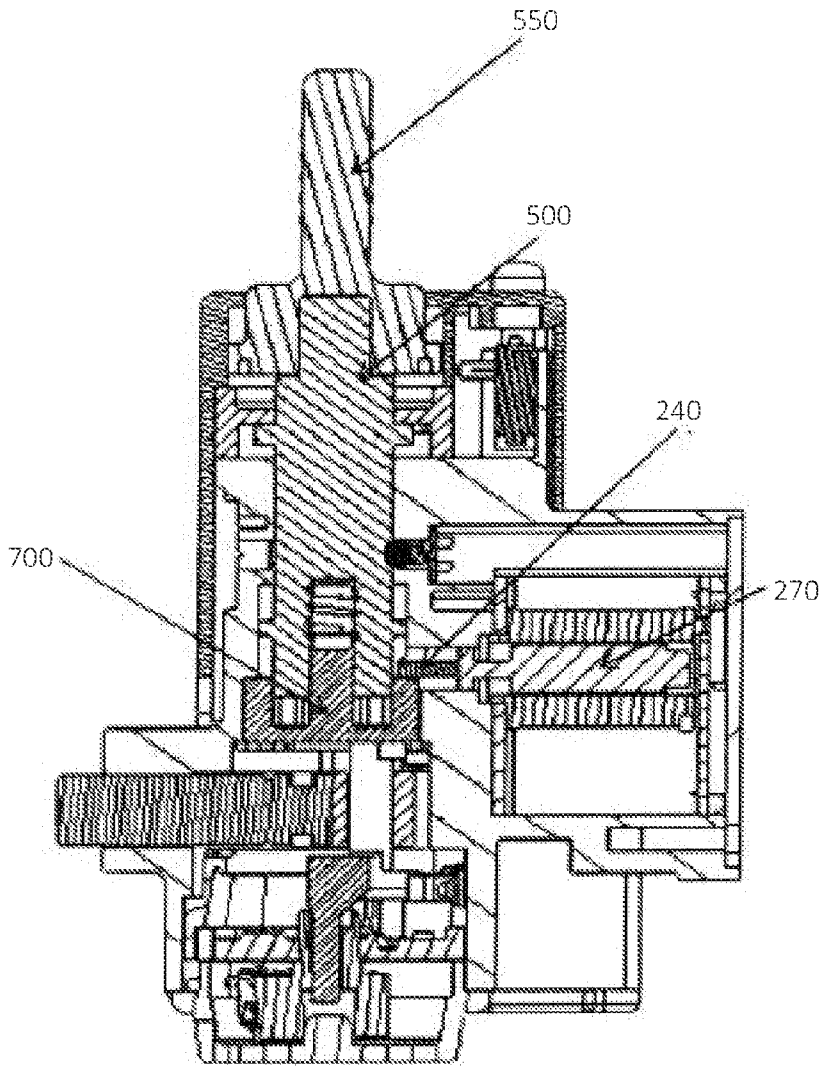


Figure 12

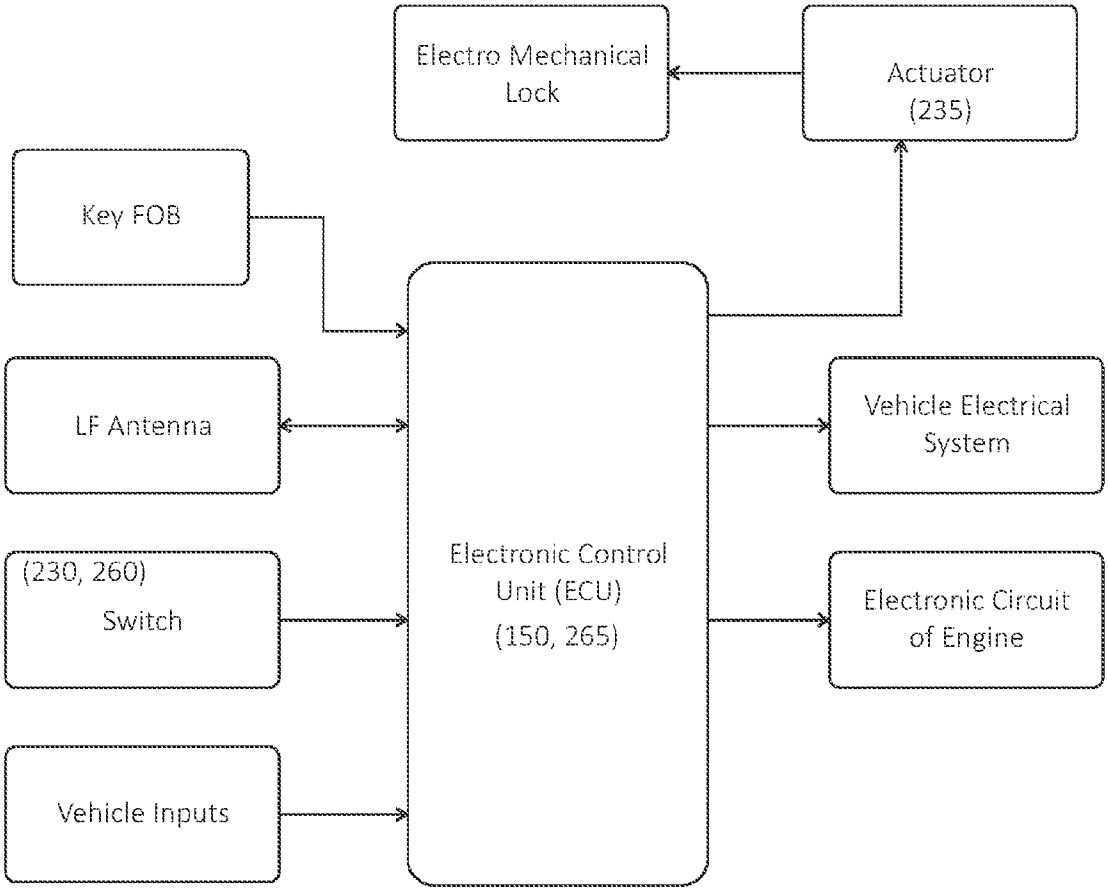


Figure 13

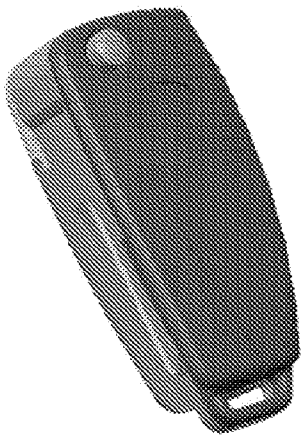


Figure 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2014/067115

A. CLASSIFICATION OF SUBJECT MATTER

B60R 25/021(2013.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B60R

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

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

EPODOC,WPI,CNPAT,CNKI:B60R25, rotor?, ring?, knob, cam, stopper, switch+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 2713381 A1 (TOKAI RIKA CO LTD) 29 September 1977 (1977-09-29) see description, pages 8-15 and figures 1-7	1-13
A	US 5442943 A (DAIMLER BENZ AG) 22 August 1995 (1995-08-22) see the whole document	1-13
A	JP S62231853 A (NISSAN MOTOR ET AL.) 12 October 1987 (1987-10-12) see the whole document	1-13

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"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)

"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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 June 2015	**05 June 2015**

Name and mailing address of the ISA/CN	Authorized officer
STATE INTELLECTUAL PROPERTY OFFICE OF THE P.R.CHINA **6, Xitucheng Rd., Jimen Bridge, Haidian District, Beijing 100088, China**	**WU,Fei**
Facsimile No. **(86-10)62019451**	Telephone No. **(86-10)62085294**

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2014/067115

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☑ Claims Nos.: **14**
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2014/067115

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
DE	2713381	A1	29 September 1977	JP	S52130350	U	04 October 1977
				JP	S5436424	Y2	02 November 1979
US	5442943	A	22 August 1995	GB	2273127	A	08 June 1994
				DE	4240283	C1	25 November 1993
				IT	RM930770	A1	02 June 1994
				IT	1262451	B	19 June 1996
				FR	2698597	A1	03 June 1994
JP	S62231853	A	12 October 1987	JP	H0574500	B2	18 October 1993