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(71) Applicant: **Mitsui Mining and Smelting Co., Ltd.**
Shinagawa-ku,
Tokyo 141-8584 (JP)

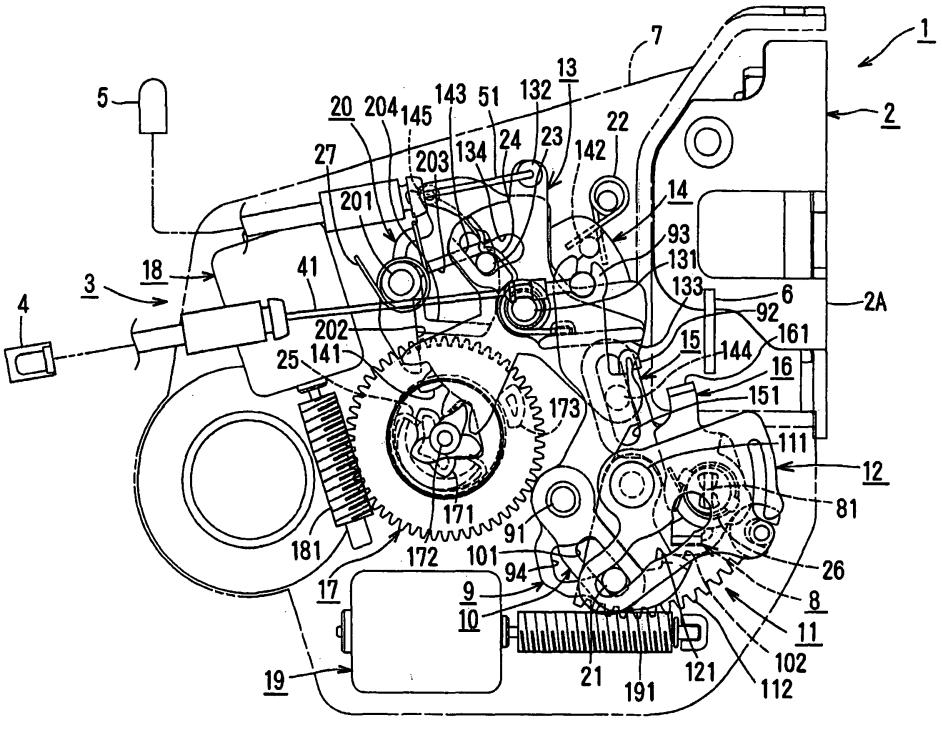
(72) Inventors:
- **Ishiguro, Katsuyuki**
  Yokohama-shi
  Kanagawa-ken (JP)
- **Sakagami, Hiroyuki**
  Yokohama-shi
  Kanagawa-ken (JP)

(74) Representative: **Grünecker, Kinkeldey,**
Stockmair & Schwanhäusser
Anwaltssozietät
Leopoldstrasse 4
80802 München (DE)

(54) **Vehicle door latch apparatus**

(57) When first and second locking lever are in locking positions, a double locking control pin is caused to move to a disconnecting position via a double locking switching lever through rotation of a worm wheel from a neutral position in a locking direction. When the double locking control pin is in the disconnecting position, the double locking control pin is caused to move to a connecting position via the double locking switching lever through rotation of the worm wheel from the neutral position in an unlocking direction and the first and second locking levers are also caused to move to unlocking positions.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a vehicle door latch apparatus which includes a meshing mechanism unit which can be engaged with and disengaged from a striker on a vehicle body side and an operating mechanism unit for controlling the operation of the meshing mechanism unit.

2. Description of the Related Art

[0002] There has been proposed a related art vehicle door latch apparatus including, in addition to a locking and unlocking mechanism which disables the opening of a door through operation of a door opening operation activating handle provided on the door of a motor vehicle, a double locking mechanism for preventing the locking and unlocking mechanism from being switched improperly to an unlocking state by preventing the transmission of an unlocking operation of an unlocking and locking operation activating lock knob provided inside the vehicle to the locking and unlocking mechanism (for example, refer to JP-A-2005-133320, Japanese Patent No. 3974337 and Japanese Patent No. 3029966).

[0003] The related vehicle door latch apparatus as described above enables switching operation of a locking and unlocking mechanism and the switching operation of a double locking mechanism are made possible by a single motor. However, operations and configurations of parts which are involved in locking and unlocking operations and double locking operations become complex, and a size of the apparatus may be increased.

SUMMARY OF THE INVENTION

[0004] The invention has been made in view of the problem and an object thereof is to provide a vehicle door latch apparatus which can ensure locking and unlocking operations and double locking operations with a single motor in a simple configuration.

[0005] According to a first aspect of the invention, there is provided a vehicle door latch apparatus comprising: a meshing mechanism unit that is configured to engage with and disengage from a striker provided on a vehicle body side; a operating mechanism unit that is configured to operate the meshing mechanism unit, the operating mechanism unit comprising: a first locking member that is movable to an unlocking position and a locking position based on operations of a lock knob provided on an inner side of a door; a second locking member that is movable in conjunction with the first locking member so as to move to: an unlocking position where an engagement between the meshing mechanism unit and the striker can be released; and a locking position where the engagement between the meshing mechanism unit and the striker cannot be released; a connecting and disconnecting member that is movable to: a connecting position where the operations of the lock knob can be transmitted to the second locking member via the first locking member; and a disconnecting position where the operations of the lock knob can not be transmitted to the second locking member via the first locking member; an elastic holding member that applies an elastic force to the connecting and disconnecting member so as to hold the connecting and disconnecting member in the connecting position and the disconnecting position; a rotating member, which is rotatable in an unlocking direction and a locking direction opposite to the unlocking direction, and which is configured to: move the first and second locking members to the unlocking positions by being rotated in the unlocking direction from the neutral position; and move the first and second locking members to the locking positions by being rotated in the locking direction from the neutral position; a motor that drives the rotating member to rotate in the unlocking direction and the locking direction from the neutral position; and a double locking switching lever that is configured to: move the connecting and disconnecting member from the connecting position to the disconnecting position in conjunction with a rotation of the rotating member in the locking direction from the neutral position when the first and second locking members stay in the locking positions; and move the connecting and disconnecting member to the connecting position in conjunction with a movement of the second locking member from the locking position to the unlocking position, the second locking member being moved in association with a rotation of the rotating member from the neutral position to the unlocking direction.

[0006] According to a second aspect of the invention, in the vehicle door latch apparatus, wherein the rotating member comprises an operating portion, wherein the double locking switching lever comprises an operated portion that enters a moving locus of the operating portion when the second locking member moves to the locking position, and wherein the operating portion is contactable with the operated portion so as to move the double locking switching member to a double locking position and move the connecting and disconnecting member to the disconnecting position in accordance with the rotation of the rotating member in the locking direction from the neutral position.

[0007] According to the aspects of the invention, when the first and second locking members stay in the locking positions, by the rotating member being rotated in the unlocking direction from the neutral position, the first and second locking members are moved to the unlocking position, so that the door latch apparatus can be switched to the unlocking state. In addition, by the rotating member being rotated in the locking direction from the neutral position, the connecting and disconnecting member is moved to the disconnecting position via the double locking switching lever with the first and second locking mem-

bers held in the locking positions, so that the door latch apparatus can be switched to the double locking state. Additionally, when the first and second locking members stay in the unlocking position, by the rotating member being rotated in the locking direction from the neutral position, the first and second locking members are moved to the locking positions, so that the door latch apparatus can be switched to the locking state. Furthermore, when the connecting and disconnecting member stays in the disconnecting position, that is, in the double locking state, by the rotating member being rotated in the unlocking direction from the neutral position, not only can the connecting and disconnecting member be moved to the connecting position via the double locking switching lever, but also the first and second locking members can simultaneously be moved to the unlocking position. By this configuration, the locking and unlocking operations (operations for enabling a switching from the unlocking state to the locking state and an opposite switching thereto) and the double locking operations can be ensured by the single motor in the simple configuration in which the rotating member is made to move in the predetermined directions from the neutral position.

[0008] Further, by the operating portion of the rotating member being brought into abutment with the operated portion of the double locking switching lever, the double locking switching lever is moved to the double locking position so as to move the connecting and disconnecting member to the disconnecting position.

[0009] According to the vehicle door latch apparatus of the invention, the locking and unlocking operations and the double locking operations can be implemented in an ensured fashion by the single motor in the simple configuration in which the rotating member is made to rotate in the predetermined directions from the neutral position.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1 is a front view of a door latch apparatus according to an embodiment of the invention when the door latch apparatus is in a double locking state;

Fig. 2 is a front view of the door latch apparatus when the door latch apparatus is in an unlocking state;

Fig. 3 is a front view of the door latch apparatus when the door latch apparatus is in a locking state;

Fig. 4 is a front view of the door latch apparatus when the door latch apparatus is in a childproof locking state;

Fig. 5 is a rear view of the door latch apparatus in a state in which a lock knob is operated to unlock a door when in the double locking state;

Fig. 6 is an enlarged front view of first and second inner levers, a childproof locking sector gear and a childproof locking lever;

Fig. 7 is an enlarged front view of first and second locking levers, a worm wheel and a double locking switching lever;

Fig. 8 is a partial enlarged front view of the door latch apparatus when the door latch apparatus is in the double locking state;

Fig. 9 is a partial enlarged front view of the door latch apparatus showing a process of switching from the double locking state to the unlocking state;

Fig. 10 is a partial enlarged front view of the door latch apparatus when the door latch apparatus is in the double locking state;

Fig. 11 is a partial enlarged front view of the door latch apparatus showing a process of switching from the double locking state to the unlocking state;

Fig. 12 is a partial enlarged front view of the door latch apparatus when the unlocking state is being produced;

Fig. 13 is a partial enlarged front view of the door latch apparatus showing an initial process of switching from the unlocking state to the locking state;

Fig. 14 is a partial enlarged front view of the door latch apparatus showing an intermediate process of switching from the unlocking state to the locking state;

Fig. 15 is a partial enlarged front view of the door latch apparatus showing a final process of switching from the unlocking state to the locking state; and

Fig. 16 is a partial enlarged front view of the door latch apparatus showing a process of switching from the locking state to the unlocking state.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] Hereinafter, an embodiment of the invention will be described based on the drawings. Figs. 1 to 5 are front views showing respective states of a door latch apparatus according to the invention, and Figs. 6, 7 are enlarged front views of respective elements. Incidentally, in the following description, a left-hand side of the respective drawings is referred to as a "front," and a right-hand side as a "rear", while a far side of the drawings is referred to as an "outside of the vehicle" and a near side of the drawings as an "inside of the vehicle."

[0012] A door latch apparatus 1 includes a meshing mechanism unit 2 which is provided on an inner side of a rear end portion of a rear side door (hereinafter, referred to as a door) of a motor vehicle for holding the door in a closed state and an operating mechanism unit 3 for controlling the meshing mechanism unit 2.

[0013] The door latch apparatus 1 can be switched to: an unlocking state (a state shown in Fig. 2) where the door can be opened by operating either of an outer handle (not shown) that configures a door opening operation activating handle provided on an outer side of the door and an inner handle 4 (refer to Figs. 1, 2) that configures a door opening operation activating handle provided on an inner side of the door; a locking state (a state shown in

Fig. 3) in which the door cannot be opened by operating the outer handle but can be opened by operating the inner handle 4 in double actions (firstly, the operating mechanism unit 3 is switched from a locking state to an unlocking state by a first operation of the inner handle 4, and then, the meshing engagement of the meshing mechanism unit 2 is released by a second operation of the inner handle 4) ; a childproof locking state (a state shown in Fig. 4) in which the door can be opened by operating the outer handle but cannot be opened by operating the inner handle 4; and a double locking state (a state shown in Fig. 1) in which the double-acting operations of the inner handle 4 and an unlocking operation of an unlocking and locking operation activating lock knob 5 (refer to Figs. 1, 2) provided on the inner side of the door are nullified and the door cannot be opened by operating either of the outer handle and the inner handle 4.

[0014] The meshing mechanism unit 2 includes a body 2, a latch (not shown), a ratchet (not shown) and an opening lever 6. The body 2 is fixed to a rear end portion inside the door with a plurality of bolts (not shown). The latch is pivotally attached within the body 2A and can be brought into engagement with a striker (not shown) which is secured to a vehicle body side. The ratchet is pivotally attached within the body 2A and can be engaged with and disengaged from the latch. The opening lever 6 can rotate together with the ratchet. When the door is closed, the striker is brought into engagement with the latch, and the ratchet is brought into engagement with the latch in such a manner as to prevent the rotation of the latch in an opening direction. Therefore, the door is held in a closed state. In addition, by the opening lever 6 being rotated in a releasing direction (upwards in Figs. 1 to 5) to thereby cause the ratchet to be disengaged from the latch, the door can be opened. Incidentally, a detailed description of the structure of the meshing mechanism unit 2 will be omitted herein.

[0015] A cover 7 (shown by imaginary lines in Figs. 1 to 5), which is made from a synthetic resin, is attached to a front side of the body 2A in such a manner as to cover the front side. The operating mechanism unit 3 is provided within the cover 7.

[0016] The operating mechanism unit 3 includes an outer lever 8, a first inner lever 9, a second inner lever 10, a childproof locking sector gear 11, a childproof locking lever 12, a first lolling lever 13, a second locking lever 14, a first sub-lever 15, a second sub-lever 16, a worm wheel 17, a locking/unlocking and double locking motor 18, a childproof locking motor 19 and a double locking switching lever 20. The outer lever 8 follows or is activated by an operation of the outer handle. The first inner lever 9 is activated by an operation of the inner handle. The second inner lever 10 can operate together with the first inner lever 9 in a childproof unlocking state. The childproof locking sector gear 11 and the childproof locking lever 12 are activated when a childproof locking operation is performed. The fist locking lever 13 configures a first locking member which is activated in association with an operation of the locking and unlocking operation activating lock knob 5 which is provided on an inside of the vehicle. The second locking lever 14 can operate together with the first locking lever 13 in a double unlocking state. The first sub-lever 15 is linked with the second locking lever 14. The second sub-lever 16 is connected to the outer lever 8. The worm wheel 17 configures a rotating member for activating the second locking lever 14. The locking/unlocking and double locking motor 18 rotates the worm wheel 17. The childproof locking motor 19 activates the childproof locking sector gear 11. The double locking switching lever 20 can be activated when a double locking operation is performed.

[0017] Incidentally, in the vehicle door latch apparatus according to the invention, the double-acting operations of the inner handle 4 and the configuration for realizing the childproof locking state are not necessarily required and, hence, can be omitted as required. Specifically, when the double-acting operations of the inner handle 4 are omitted, the configuration is modified in such a manner that the first sub-lever 15 and the second sub-lever 16 operate together. As this occurs, since the second locking lever 14 and the first and second sub-levers 15, 16 are made to operate integrally at all times, the second locking member according to the invention is made up of the second locking lever 14 and the first and second sub-levers 15, 16. In addition, when the childproof locking state is omitted, the configuration is modified in such a manner that the first inner lever 9 and the second inner lever 10 operate together, and the childproof locking sector gear 11, the childproof locking lever 12 and the childproof locking motor 19 are omitted.

[0018] In this embodiment, a locking and unlocking mechanism is made up of the first and second locking levers 13, 14 and the first and second sub-levers 15, 16, and a double locking mechanism is made up of the double locking switching lever 20 and a double locking control pin 23 that configures a connecting and disconnecting member, which will be described later.

[0019] The outer lever 8 is pivotally supported at a lower portion of the cover 7 by a pivot (not shown) which is oriented in a longitudinal direction of the vehicle and moves towards in a releasing direction (upwards in Figs. 1 to 5) against a biasing force of a spring (not shown) based on a door opening operation of the outer handle.

[0020] The first inner lever 9 is pivotally supported at the lower portion of the cover 7 by a pivot 91 which is oriented in a transverse direction of the vehicle and rotates in a releasing direction (in a counterclockwise direction in Figs. 1 to 5) by a connecting portion 93 provided at an upper end portion thereof being connected to the inner handle 4 via an operating effort transmission member 41 which is made up of a cable. An unlocking operating portion 92 which can be brought into abutment with an unlocking operated portion 133, which will be described later, provided on the first locking lever 13 and a substantially L-shaped cam hole 94 with which a control pin 21 can be brought into sliding engagement are pro-

vided on the first inner lever 9.

[0021] As will be described later, the control pin 21 can move based on operations of the childproof locking sector gear 11 and the childproof locking lever 12 to an unlocking position which realizes the childproof unlocking state (a position in which as is shown in Figs. 1 to 5, the control pin 21 engages with a portion of the cam hole 94 which is oriented in a radial direction for engagement relative to the releasing direction of the first inner lever 9) and a locking position which realizes the childproof locking state (a position in which as is shown in Fig. 4, the control pin 21 stays in a corner portion of the cam hole 94 to disable the engagement thereof with the cam hole 94).

[0022] The second inner lever 10 is pivotally supported together with the first inner lever by the pivot 91, and an elongated hole 101 oriented in the radial direction is opened in a rotating surface which is superimposed on the cam hole 94 in the first inner lever 9 in such a manner that the control pin 21 can be brought into sliding engagement therewith. In addition, an abutment portion 102 is provided at a lower portion of the second inner lever 10 in such a manner as to be brought into abutment with the outer lever 8 from therebelow.

[0023] The childproof locking sector gear 11 and the childproof locking lever 12 are pivotally supported at the lower portion of the cover 7 by a pivot 111 which is oriented in the longitudinal direction in such a manner as to rotate integrally. A gear portion 112 provided on the childproof locking sector gear 112 meshes with a worm 191 provided on the childproof locking motor 19 and can rotate by being driven by the childproof locking motor 19 from an unlocking position (Figs. 1 to 3, 5) where the operation of inner hand 4 is effectuated to a locking position (Fig. 4) where the operation of the inner handle 4 is nullified and vice versa. The control pin 21 is brought into sliding engagement with an arc-shaped eccentric cam hole 121 provided in the childproof locking lever 12.

[0024] When the childproof locking sector gear 11 and the childproof locking lever 12 move to the unlocking positions, the control pin 21 moves to the unlocking position, and the first inner lever 9 and the second inner lever 10 are connected to each other in such a manner as to rotate together (refer to Fig. 6). By this action, the first and second inner levers 9, 10 rotate about the pivot 91 from a waiting position (Figs. 1 to 5) in a releasing direction (in a counterclockwise direction in Figs. 1 to 5) based on a door opening operation of the inner handle 4. When the second inner lever 10 rotates in the releasing direction, the abutment portion 102 of the second inner lever 10 is brought into abutment with the outer lever 8 from therebelow, and the outer lever 8 also rotates in the releasing direction. By this action, the door can be opened based on the operation of the inner handle 4. In addition, when the childproof locking sector gear 11 and the childproof locking lever 12 move to the locking positions, the control pin 21 moves to the locking position where the control pin 21 cannot be brought into engagement with the cam hole 94, so as to disconnect the connection between the first inner lever 9 and the second inner lever 10. By this action, the childproof locking state results, and even though the first inner lever 9 moves in the releasing direction based on the door opening operation of the inner handle 4, the second inner lever 10 does not rotate in the releasing direction. Consequently, in the childproof locking state, even though the inner handle 4 is operated, the door cannot be opened.

[0025] The first locking lever 13 is pivotally supported at an upper portion of the cover 7 by a pivot 131 which is oriented in the transverse direction and a connecting portion 132 which is provided at an upper end portion thereof is connected to the lock knob 5 via an operating effort transmission member 51 which is made up of a cable. Thus, the first locking lever 13 moves to a locking position (Figs. 1, 3, 5) and an unlocking position (Figs. 2, 4) based on locking and unlocking operations of the lock knob 5. The unlocking operated portion 133 which can be brought into abutment with the unlocking operating portion 92 of the first inner lever 9 and an L-shaped cam hole 134 with which the double locking control pin 23 which makes up the connecting and disconnecting member is brought into sliding engagement are provided on the first locking lever 13.

[0026] The double locking control pin 23 can move based on operations of the double locking switching lever 20, which will be described later, to a connecting position (Figs. 2, 3, 4) where the double locking control pin 23 is positioned at a portion in of the cam hole 134 which is oriented in a radial direction for connection of the first locking lever 13 with the second locking lever 14 and a disconnecting portion (Figs. 1, 5) where the double locking control pin 23 is positioned at an arc portion in the cam hole 134 for disconnecting the connection of the first locking lever 13 and the second locking member 14. An elastic holding member 24 which is made up of a torsion spring is provided on a circumference of the pivot 131 for elastically holding the double locking control pin 23 in the connecting position and the disconnecting position by virtue of an elastic force thereof.

[0027] The second locking lever 14 is pivotally supported on the cover 7 together with the first locking lever 13 by the pivot 131 and can move to the unlocking position (Figs. 2, 4, 5) and the locking position (Figs. 1, 3) based on rotations of the worm wheel 17 by a gear portion 141 provided on a lower circumferential edge portion being brought into mesh engagement with a small-diameter gear portion 171 provided on the worm wheel 17 and is held in the unlocking position and the locking position with a predetermined elastic holding force by a projecting portion 142 being brought into elastic engagement with an elastic holding member 22 which is made up of a spring supported on the cover 7. In addition, the elastic holding force of the elastic holding member 22 is set larger than a biasing force of a spring 26, which will be described later, which acts between the first sub-lever 15 and the second-sub lever 16.

[0028] A notched grove 143 oriented in the radial direction is provided on the second locking lever 14, and the double locking control pin 23 is brought into engagement with the notched groove 143 so provided in such a manner as to slide in the radial direction of the second locking lever 14.

[0029] As is shown in Figs. 2, 3, 4, when the double locking control pin 23 is in the connecting position, an unlocking operation and a locking operation of the first locking lever 13 are transmitted to the second locking lever 14. By this action, the first and second locking levers 13, 14 rotate about the pivot 131 together so as to move to the unlocking position and the locking position based on unlocking and locking operations of the lock knob 5. In addition, as is shown in Fig. 1, when the double locking control pin 23 moves to the disconnecting position, the connection between the first locking lever 13 and the second locking lever 14 is disconnected, and the locking and unlocking mechanism is put in the double locking state. By this action, as is shown in Fig. 5, even though the first locking lever 13 moves to the unlocking position based on the unlocking operation of the lock knob 5, the second locking lever 14 moves in no case from the unlocking position to the locking position. Consequently, the locking and unlocking mechanism cannot be switched to the unlocking state.

The first sub-lever 15 is pivotally supported at an end portion 81 of the outer lever 8 in such a manner as to oscillate through a predetermined angle and is activated by the movement of the second locking lever 14 to move to an unlocking position (Figs. 2, 4) and a locking position (Figs. 1, 3, 5) by a vertically elongated hole 151 provided in an upper portion thereof being connected to a connecting projection 144 provided on the second locking lever 14 in such a manner as to slide vertically on the connecting projection 144.

[0030] The second sub-lever 16 is pivotally supported at the end portion 81 of the outer lever 8 in such a manner as to oscillate through a predetermined angle and operates together with the first sub-lever 15 within a range of the biasing force of the spring 26 which acts between the first sub-lever 15 and the second sub-lever 16 so as to move to an unlocking position (Figs. 2, 4) and a locking position (Figs. 1, 3, 5).

[0031] With the first and second sub-levers 15, 16 lying in the unlocking positions, when the first and second sub-levers 15, 16 move upward to perform a releasing operation by being activated by a releasing operation of the outer lever 8, a releasing abutment portion 161 provided on the second sub-lever 16 is brought into abutment with the opening lever 6 from therebelow so as to cause the opening lever 6 to rotate in a releasing direction to thereby release the engagement between the ratchet and the latch. In addition, when the first and second sub-levers 15, 16 lie in the locking position, since the releasing abutment portion 161 of the second sub-lever 16 is made unable to be brought into engagement with the opening lever 6 even though the first and second sub-levers 15, 16 perform the releasing operation, the opening lever 6 cannot be caused to rotate in the releasing direction, and hence, the engagement between the ratchet and the latch cannot be released.

[0032] The worm wheel 17 is pivotally supported on the cover 7 by a pivot 172 which is oriented in the longitudinal direction and meshes with a worm 181 provided on an output shaft of the locking/unlocking and double locking motor 18 so as to rotate from a neutral position (Figs. 1 to 5) in an unlocking direction (in a clockwise direction in Figs. 1 to 5) and a locking direction (in a counterclockwise direction in Figs. 1 to 5) against a biasing force of a neutral restoring spring 25 which is supported between the cover 7 and the worm wheel 17. In addition, the worm wheel 17 meshes with the worm 181 in such a manner as to rotate forwards and backwards.

[0033] A projecting operating portion 173 is provided on a rotating surface of the worm wheel 17 in such a manner as to be brought into abutment with the double locking switching lever 20 when a state, which will be described later, results.

[0034] The small-diameter gear portion 171 of the worm wheel 17 and the gear portion 141 of the second locking lever 14 are mesh with each other via a play corresponding to an operation stroke of the lock knob 5. Specifically, the configuration described in JP-A-2001-173288 which was filed by the same applicant as that of this patent application is adopted. That is, when the worm wheel 17 rotates from the neutral position in the unlocking direction (or in the locking direction) based on the driving of the locking/unlocking and double locking motor 18, the rotation of the worm wheel 17 can be transmitted to the second locking lever 14. However, when the worm wheel 17 rotates back to the neutral position by virtue of the biasing force of the neutral restoring spring 25 after it has rotated from the neutral position in the unlocking direction (or in the locking direction), the returning rotation of the worm wheel 17 is not transmitted to the second locking lever 14. In addition, with the second locking lever 14 lying in the locking position, when the worm wheel 17 rotates from the neutral position in the locking direction, only the worm wheel 17 rotates in the locking direction without meshing engagement between the small diameter gear portion 171 and the gear portion 141. Furthermore, when the worm wheel 17 lies in the neutral position, it is configured in such a manner that even though the second locking lever 14 operates from the unlocking position to the locking position or vice versa, the small diameter gear portion 171 and the gear portion 141 do not mesh with each other and the operation of the second locking lever 14 is not transmitted to the worm wheel 17.

[0035] The double locking switching lever 20 is pivotally supported on the cover 7 by a pivot 201 which is oriented in the longitudinal direction and is biased in the clockwise direction by a spring 27. In addition, the biasing force of the spring 27 which is exerted on the double locking switching lever 20 is set smaller than the holding

force of the elastic holding member 24 which elastically holds the double locking control pin 23 in the respective positions and the holding force of the elastic holding member 22 which elastically holds the second locking lever 14 in the respective positions.

[0036] The double locking switching lever 20 has an operated portion 202 which can advance into and retreat from a moving locus of an operating portion 173 of the worm wheel 17, first and second abutment portions 203, 204 which can be brought into abutment with the double locking control pins 23 and an abutment portion 205 which can be brought into abutment portion with an abutment portion 145 which is provided at the upper end portion of the second locking lever 14 (refer to Fig. 7).

[0037] Next, referring to Figs. 8 to 16, a double locking switching operation implemented by driving the locking/unlocking and double locking motor 18 will described. Figs. 8, 10 and 12 show, respectively, a locking state, a double locking state and an unlocking state, and the remaining drawings show respective states resulting when the states are changed to different ones.

[0038] When the locking states results as is shown in Fig. 8, the worm wheel 17 is held in the neutral position by the biasing force of the neutral restoring spring 25 in which the operating portion 173 is positioned substantially in a 45-degree direction, and the first and second locking levers 13, 14 are held in the locking positions by virtue of the elastic holding force of the elastic holding member 22, the double locking switching lever 20 is held in the locking position where the operated portion 202 enters the moving locus of the operating portion 173 of the worm wheel 17, and the double locking pin 23 is held in the connecting position by virtue of the elastic holding force of the elastic holding member 24. In addition, in this state, although the first abutment portion 203 of the double locking switching lever 20 is in abutment with the double locking control pin 23 by virtue of the biasing force of the spring 27, since the holding force of the elastic holding member 24 is larger than the biasing force of the spring 27, there is caused no such situation that the double locking control pin 23 is caused to move from the connecting position to the disconnecting position.

[0039] When the worm wheel 17 is caused to rotate from the neutral position in the locking direction (in the counterclockwise direction) a predetermined angle by driving the locking/unlocking and double locking motor 18 from the locking state shown in Fig. 8, the operating portion of the worm wheel 17 is brought into abutment with the operated portion 202 of the double locking switching lever 20 from a right-hand side as is shown in Fig. 9. Thus, the double locking switching lever 20 is caused to rotate a predetermined angle in the locking direction from the locking position to lie in a double locking position (a position shown in Figs. 9, 10) where the double locking switching lever 20 is brought into abutment with a stopper portion (not shown), and the double locking switching lever 20 is held in the double locking position by virtue of the biasing force of the spring 27. Incidentally, since the small diameter gear portion 171 of the worm wheel 17 does not mesh with the gear portion 141 of the second locking lever 14 when the worm wheel 17 rotates in the locking direction, the second locking lever 14 is prevented from being moved from the locking position. When the double locking switching lever 20 rotates to the double locking position, the first abutment portion 203 of the double locking switching lever 20 pushes down the double locking control pin 23, whereby the double locking control pin 23 is caused to move to the disconnecting position. When the double locking switching lever 20 moves to the double locking position and the double locking control pin 23 moves to the disconnecting position, the driving of the locking/unlocking and double locking motor 18 is stopped, and as is shown in Fig. 10, the worm wheel 17 is allowed to return to the neutral position by virtue of the biasing force of the neutral restoring spring 25, whereby the double locking operation is completed, and the locking state is switched to the double locking state.

[0040] When in the double locking state shown in Fig. 10, the worm wheel 17 is held in the neutral position by virtue of the biasing force of the neutral restoring spring 25, the first and second locking levers 13, 14 are held in the locking position by virtue of the elastic holding force of the elastic holding member 22, the double locking switching lever 20 is held in the double locking position where the operating portion 202 enters and stays within the moving locus of the operating portion 173 of the worm wheel 17, and the double locking control pin 23 is held in the disconnecting position by virtue of the elastic holding force of the elastic holding member 24. That is, when the locking and unlocking mechanism is switched from the locking state to the double locking state, the first and second locking levers 13, 14 and the first and second sub-levers 15, 16 do not operate at all, while only the double locking switching lever 20 and the double locking control pin 23 operate.

[0041] When the worm wheel 17 is caused to rotate a predetermined angle in the unlocking direction (the clockwise direction) from the neutral position from the double locking state shown in Fig. 10 by driving the locking/unlocking and double locking motor 18, through meshing engagement of the small diameter gear portion 171 of the worm wheel 17 with the gear portion 141 of the second locking lever 14, as is shown in Fig. 11, the second locking lever 14 rotates from the locking position to the unlocking position, and the first locking lever 13 also rotates from the locking position to the unlocking position via the double locking control pin 23. When the second locking lever 14 rotates to the unlocking position, on the way the abutment portion 145 of the second locking lever 14 is brought into abutment with the abutment portion 205 of the double locking switching lever, whereby the double locking switching lever 20 rotates a predetermined angle in the counterclockwise direction from the locking position to the unlocking position shown in Fig. 11 against the biasing force of the spring 27. When the double locking

switching lever 20 moves to the unlocking position, the second abutment portion 204 of the double locking switching lever 20 pushes up the double locking control pin 23 so as move it to the connecting position. when the first and second locking levers 13, 14 and the double locking switching lever 20 move to the unlocking positions and the double locking control pin 23 moves to the connecting position, the driving of the locking/unlocking and double locking motor 18 is stopped, and by the worm wheel 17 being caused to return to the neutral position by virtue of the biasing force of the neutral restoring spring 25 as is shown in Fig. 12, the double unlocking operation is completed, and the unlocking state results. Thus, when the double locking state is changed to the double unlocking state, by the worm wheel 17 being caused to rotate from the neutral position to the unlocking direction by the rotation of the locking/unlocking and double locking motor 18, the locking and unlocking mechanism (the first and second locking levers 13, 14 and the first and second sub-levers 15, 16) is switched to the unlocking state, and the double locking mechanism (the double locking switching lever 20, the double locking control pin 23) can be switched to the double unlocking state.

[0042] When the unlocking state shown in Fig. 12 exists, the worm wheel 17 is held in the neutral position by virtue of the biasing force of the neutral restoring spring 25, the first and second locking levers 13, 14 are held in the unlocking positions by virtue of the elastic holding force of the elastic holding member 22, the double locking switching lever 20 is held in the unlocking position where the operated portion 202 retreats to be out of the moving locus of the operating portion 173 of the worm wheel 17, and the double locking pin 23 is held in the connecting position by virtue of the elastic holding force of the elastic holding member 24.

[0043] From the unlocking state shown in Fig. 12, when the worm wheel 17 is caused to rotate a predetermined angle in the locking direction (the counterclockwise direction) from the neutral position by driving the locking/unlocking and double locking motor 18, as is shown in Fig. 13, the second locking lever 14 rotates from the unlocking position towards the locking position through meshing engagement of the small diameter gear portion 171 of the worm wheel 17 with the gear portion 141 of the second locking lever 14, and the first locking lever 13 also rotates from the unlocking position towards the locking position via the double locking control pin 23. In addition, the abutment portion 145 of the second locking lever 14 is displaced in a direction in which the abutment portion 145 is disengaged from the abutment portion 205 of the double locking switching lever 20 in the course of rotation of the second locking lever 14 to the locking position. In addition, the operating portion 173 of the worm wheel 17 passes below the operated portion 202 of the double locking switching lever 20 as is shown in Fig. 13 before the double locking switching lever 20 is displaced to the locking position.

[0044] When the first and second locking levers 13, 14 rotate to the locking positions as is shown in Fig. 14, the abutment portion 145 of the second locking lever 14 is separated from the abutment portion 205 of the double locking switching lever 20, whereby the double locking switching lever 20 is moved to the locking position by virtue of the biasing force of the spring 27, and the operated portion 202 enters the moving locus of the operating portion 173 of the worm wheel 17. When the first and second locking levers 13, 14 and the double locking switching lever 20 move to their locking positions, the driving of the locking/unlocking and double locking motor 18 is stopped, and the worm wheel 17 is caused to return towards the neutral position by virtue of the biasing force of the neutral restoring spring 25. As this occurs, as is shown in Fig. 15, the operating portion 173 of the worm wheel 17 is brought into abutment with the operated portion 202 of the double locking switching lever 20 from an opposite side so as to cause the double locking switching lever 20 to rotate in the counterclockwise direction against the biasing force of the spring 27 and then passes under the operated portion 202 to return to the neutral position, whereby the locking state shown in Fig. 8 results.

[0045] From the locking state shown in Fig. 8, when the worm wheel 17 is caused to rotate a predetermined angle in the unlocking direction (the clockwise direction) from the neutral position by driving the locking/unlocking and double locking motor 18, as is shown in Fig. 16, the second locking lever 14 rotates from the locking position towards the unlocking position through meshing engagement of the small diameter gear portion 171 of the worm wheel 17 with the gear portion 141 of the second locking lever 14, and the first locking lever 13 also rotates from the locking position towards the unlocking position via the double locking control pin 23. In addition, by the second locking lever 14 rotating to the unlocking position, the abutment portion 145 of the second locking lever 14 is brought into abutment with the abutment portion 205 of the double locking switching lever 20 so as to cause the double locking switching lever 20 to move to the unlocking position. When the first and second locking levers 13, 14 and the double locking switching lever 20 move to their unlocking positions, the driving of the locking/unlocking and double locking motor 18 is stopped, and the worm wheel is caused to return to the neutral position by virtue of the biasing force of the neutral restoring spring 25, whereby the unlocking operation is completed, and the unlocking state results.

[0046] As has been described heretofore, in the embodiment, by causing the worm wheel 17 to rotate in the unlocking direction from the neutral position by the single motor 18, whether the double locking state or the locking state is being produced then, the resulting state can be switched to the unlocking state. In addition, by causing the worm wheel 17 to rotate in the locking direction from the neutral position, when the unlocking state is being produced then, the unlocking state can be switched to the locking state, whereas when the locking state is being

produced then, the locking state can be switched to the double locking state. That is, with the single locking/unlocking and double locking motor 18, the locking or unlocking operation and the double locking operation can be implemented in the ensured fashion in the simple configuration in which the worm wheel 17 is only caused to rotate from the neutral position in the predetermined direction.

[0047] Next, operations of respective states of the door latch apparatus according to the embodiment of the invention will be described.

[0048] (A case where the outer handle or the inner handle 4 is operated when the unlocking state is being produced)

[0049] As is shown in Fig. 2, when the door latch apparatus 1 is in the unlocking state, the first and second locking levers 13, 14, the first and second sub-levers 15, 16, the childproof locking sector gear 11, a childproof locking lever 12 and the double locking switching lever 20 are held in the unlocking positions, while the double locking control pin 21 is held in the connecting position. When the outer handle is operated to open the door in this state, the outer lever 8 rotates in the releasing direction (upwards in Fig. 2), whereby the first and second sub-levers 15, 16 move upwards, and the releasing abutment portion 161 of the second sub-lever 16 is brought into abutment with the opening lever 6. By this action, the opening lever 6 rotates in the releasing direction, and the ratchet is disengaged from the latch, whereby the door can be opened. In addition, when inner handle 4 is operated to open the door, both the first and second inner levers 9, 10 rotate in the releasing direction, whereby the abutment portion 102 of the second inner lever 10 is brought into abutment with the outer lever 8, and by this action, the outer lever 8 also rotates in the releasing direction, and as when the outer handle is operated to open the door, the door can be opened.

[0050] (A case where the locking/unlocking and double locking motor 18 is operated to lock the door and the lock knob 5 is operated to lock the door when the unlocking state is being produced)

[0051] When the locking/unlocking and double locking motor 18 is driven in the locking direction from the unlocking state as shown in Fig. 2, the drive of the locking/unlocking and double locking motor 18 is transmitted to the second locking lever 14 via the worm 181, the worm wheel 17 and the small diameter gear portion 171. The second locking lever 14 rotates about the pivot 131 from the unlocking position shown in Fig. 2 to the locking position shown in Fig. 3. The rotation of the second locking lever 14 is transmitted to the first locking lever 13 via the double locking control pin 23, and is also transmitted to the second sub-lever 16 via the first sub-lever 15 and the spring 26. Furthermore, by the abutment portion 145 of the second locking lever 14 being dislocated from the abutment portion 205 of the double locking switching lever 20, the double locking switching lever 20 moves to the locking position by virtue of the biasing force of the spring 27, whereby the first and second sub-levers 15, 16, the first and second locking levers 13, 14 and the lock knob 5 move to the locking positions, respectively, whereby the locking state shown in Fig. 3 results.

[0052] When the lock knob 5 is operated to the lock the door from the unlocking state as shown in Fig. 2, an operation effort exerted on the lock knob 5 is transmitted to the second locking lever 14 via the first locking lever 13 and the double locking control pin 23. The second locking lever 14 rotates about the pivot 131 from the unlocking position to the locking position shown in Fig. 3. The rotation of the second locking lever 14 is transmitted to the first and second sub-levers 15, 16 as when the locking/unlocking and double locking motor 18 is driven, whereby the locking state shown in Fig. 3 results.

(A case where the outer handle or inner handle 4 is operated to open the door in the locking state)

[0053] When the locking state is being produced as is shown in Fig. 3, the lock knob 5, the first and second locking levers 13, 14 and the first and second sub-levers 15, 16 are held in the locking positions, respectively, and the releasing abutment portion 161 of the second sub-lever 16 is in a position where the releasing abutment portion 161 is unable to be brought into abutment with the opening lever 6. In addition, the childproof locking sector gear 11 and the childproof locking lever 12 are held in the unlocking positions, the double locking switching lever 20 is held in the locking position, and the double locking control pin 23 is held in the connecting position.

[0054] When the outer handle is operated to open the door from the locking state as shown in Fig. 3, even though the outer lever 8 rotates in the releasing direction (upwards in Fig. 2) based on the door opening operation of the outer handle and the first and second sub-levers 15, 16 move upwards to thereby move the releasing abutment portion 161 upwards, the releasing abutment portion 161 is not brought into abutment with the opening lever 6. Thus, the opening lever 6 cannot be caused to rotate in the releasing direction (upwards in Fig. 3), whereby the door cannot be opened even though the outer handle is operated to open the door.

[0055] When the inner handle 4 is operated to open the door from the locking state as shown in Fig. 3, through double acting operations, that is, through the first door opening operation of the inner handle 4, the locking state is changed to the unlocking state, and through the second door opening operation of the inner handle 4, the door can be opened.

[0056] Specifically, in the first door opening operation of the inner handle 4, when the first and second inner levers 9, 10 rotate in the releasing direction (in the counterclockwise direction in Fig. 3) based on the door opening operation of the inner handle 4, the abutment portion 102 of the second inner lever 10 is brought into abutment with the outer lever 8, and the unlocking operating portion 92 of the first inner lever 9 is brought into the unlocking

operated portion 133 of the first locking lever 13 while the outer lever 8 is caused to move in the releasing direction (upwards in Fig. 3) and the first and second sub-levers 15, 16 are caused to move upwards, whereby the first and second locking levers 13, 14 are caused to rotate towards the unlocking positions, and a rear edge of the releasing abutment portion161 of the second sub-lever 16 is brought into a front end of the opening lever 6. Because of this, the second sub-lever 16 stops before the unlocking position. In contrast to this, the first sub-lever 15 is activated in association with the movement of the second locking lever 14 towards the unlocking position, moves from the locking position to the unlocking position against the biasing force of the spring 26 with the second sub-lever 16 left staying before the locking position.

[0057] Next, when the inner handle 4 is caused to return temporarily and the first and second inner levers 9, 10 and the outer lever 8 are caused to return to the waiting positions, the first and second sub-levers 15, 16 move downwards, and the rear edge of the releasing abutment portion 161 of the second sub-lever 16 is disengaged from the front end of the opening lever 6. By this action, the second sub-lever 16 moves to the unlocking position by virtue of the biasing force of the spring 26, whereby the unlocking state results. As this occurs, since the unlocking holding force of the elastic holding member 22 which acts on the second locking lever 14 and the first sub-lever 15 is larger than the biasing force of the spring 26 which acts on the first sub-lever 15, the second locking lever 14 and the first sub-lever 15 are held in the unlocking positions.

[0058] Following this, when the inner handle 4 is operated to open the door, the door can be opened in the way that has been described above.

(Double locking operation)

[0059] When the locking/unlocking and double locking motor 18 is driven in the locking direction by a locking operation through a remote control switch or the like in the locking state shown in Fig. 3, the worm wheel 17 rotates from the neutral position in the locking direction (in the counterclockwise direction in Fig. 3) against the biasing force of the neutral restoring spring 25. By this action, as has been described before, with the first and second locking levers 13, 14 left staying in the locking positions, the double locking switching lever 20 moves from the locking position to the double locking position, so as to cause the double locking control pin 23 to move from the connecting position to the disconnecting position, whereby the locking state is changed to the double locking state shown in Fig. 1.

[0060] In the double locking state as shown in Fig. 1, since the double locking control pin 23 is in the disconnecting position to thereby be left unable to be brought into engagement with the cam hole 134 in the first locking lever 13, even though the lock knob 5 is operated to unlock the door, only the first locking lever 13 is allowed to move to the unlocking position as is shown in Fig. 5, and the second locking lever 14 and the first and second sub-levers 15, 16 cannot be caused to move to the unlocking positions. Consequently, the double locking state cannot be switched to the unlocking state.

[0061] While the embodiment of the invention has been described, the following modification can be made within the scope of the invention.

(i) The rotating member is made up of a spur gear in place of the worm wheel 17.
(ii) The linking structure of the rotating member and the second locking lever 14 is made up of a combination of a projecting portion provided on either of the rotating member and the second locking lever and an elongated hole which is provided on the other of the rotating member and the second locking lever and is adapted to be brought into sliding engagement with the projecting portion so as to be connected thereto via a play corresponding to the operation stroke of the lock knob 5 in place of the meshing engagement between the gears.

Claims

1. A vehicle door latch apparatus comprising:

a meshing mechanism unit that is configured to engage with and disengage from a striker provided on a vehicle body side;
a operating mechanism unit that is configured to operate the meshing mechanism unit, the operating mechanism unit comprising:

a first locking member that is movable to an unlocking position and a locking position based on operations of a lock knob provided on an inner side of a door;
a second locking member that is movable in conjunction with the first locking member so as to move to:

an unlocking position where an engagement between the meshing mechanism unit and the striker can be released; and
a locking position where the engagement between the meshing mechanism unit and the striker cannot be released;

a connecting and disconnecting member that is movable to:

a connecting position where the operations of the lock knob can be transmitted to the second locking member via the first locking member; and

a disconnecting position where the operations of the lock knob can not be transmitted to the second locking member via the first locking member;

an elastic holding member that applies an elastic force to the connecting and disconnecting member so as to hold the connecting and disconnecting member in the connecting position and the disconnecting position;

a rotating member, which is rotatable in an unlocking direction and a locking direction opposite to the unlocking direction, and which is configured to:

move the first and second locking members to the unlocking positions by being rotated in the unlocking direction from the neutral position; and

move the first and second locking members to the locking positions by being rotated in the locking direction from the neutral position;

a motor that drives the rotating member to rotate in the unlocking direction and the locking direction from the neutral position; and

a double locking switching lever that is configured to:

move the connecting and disconnecting member from the connecting position to the disconnecting position in conjunction with a rotation of the rotating member in the locking direction from the neutral position when the first and second locking members stay in the locking positions; and

move the connecting and disconnecting member to the connecting position in conjunction with a movement of the second locking member from the locking position to the unlocking position, the second locking member being moved in association with a rotation of the rotating member from the neutral position to the unlocking direction.

2. The vehicle door latch apparatus according to claim 1,

wherein the rotating member comprises an operating portion,

wherein the double locking switching lever comprises an operated portion that enters a moving locus of the operating portion when the second locking member moves to the locking position, and

wherein the operating portion is contactable with the operated portion so as to move the double locking switching member to a double locking position and move the connecting and disconnecting member to the disconnecting position in accordance with the rotation of the rotating member in the locking direction from the neutral position.

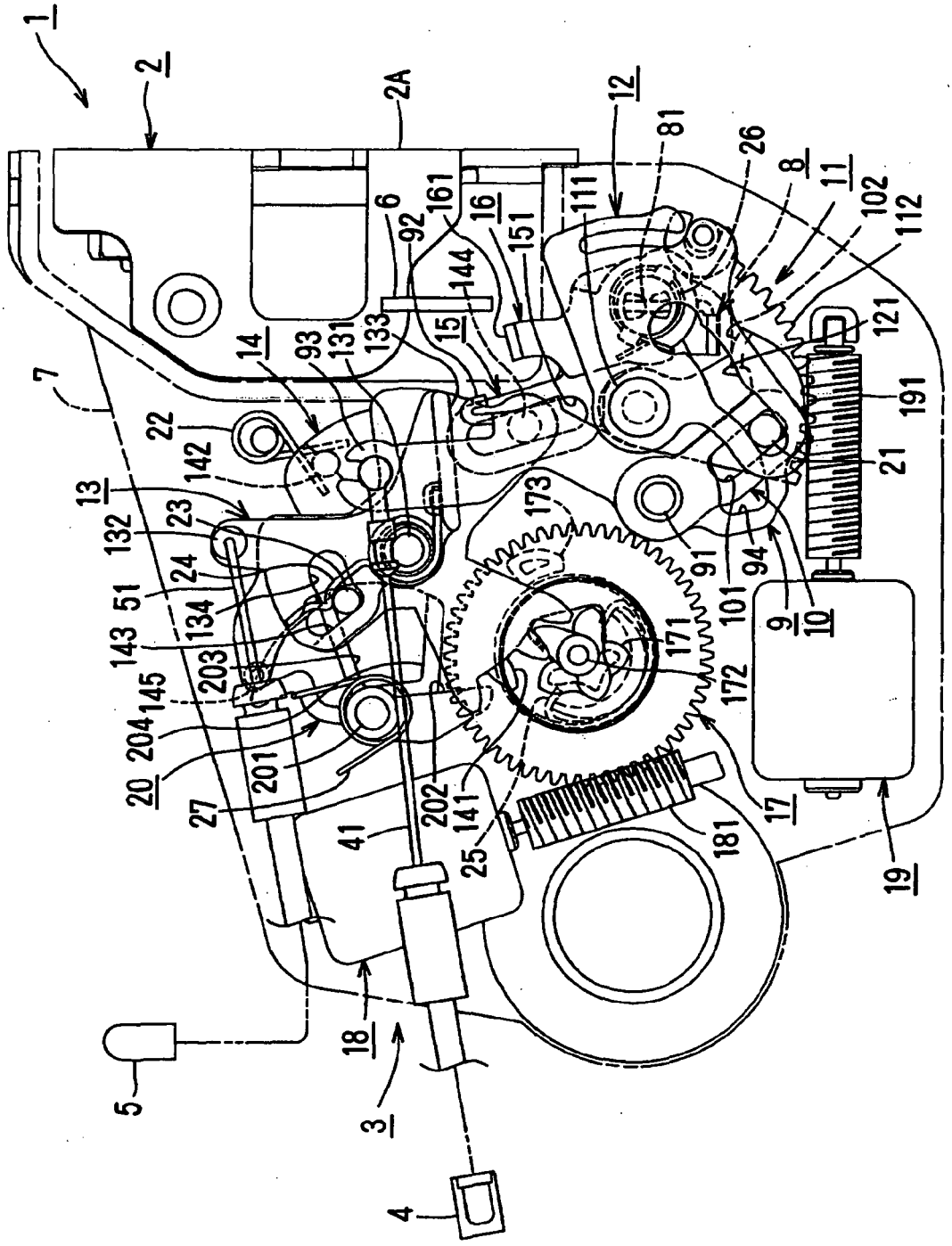
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FIG. 1

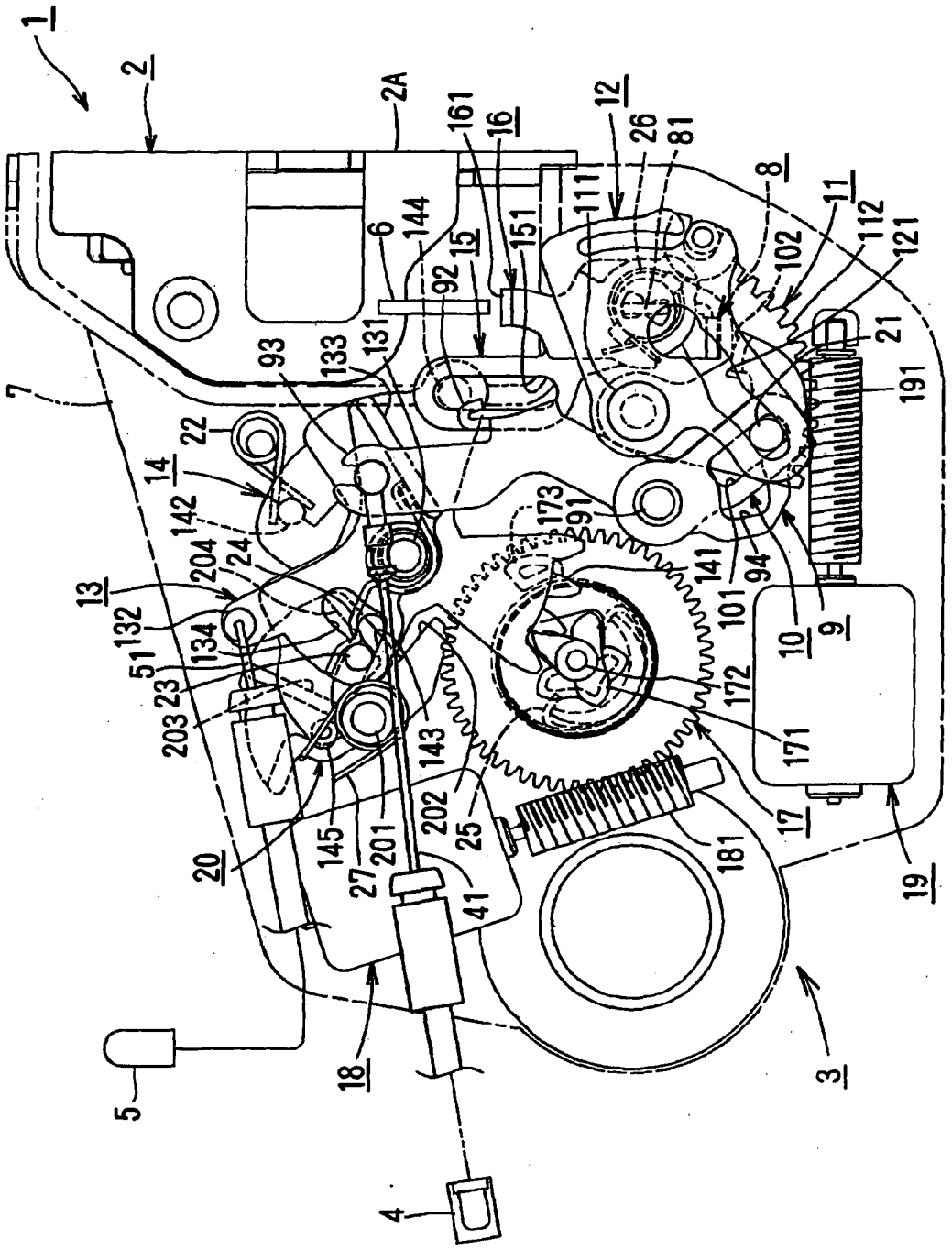
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FIG. 2

FIG. 3

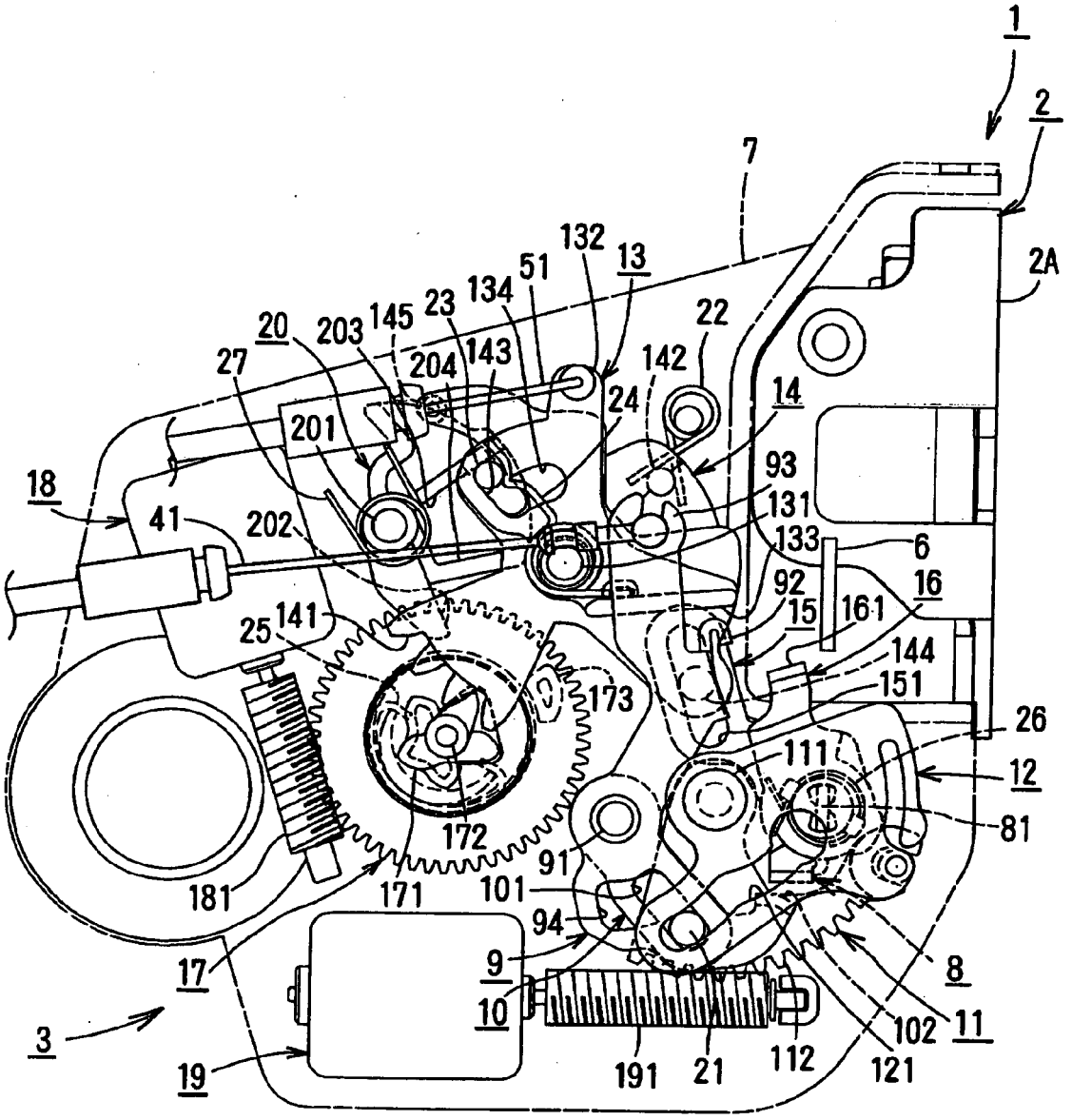
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FIG. 4

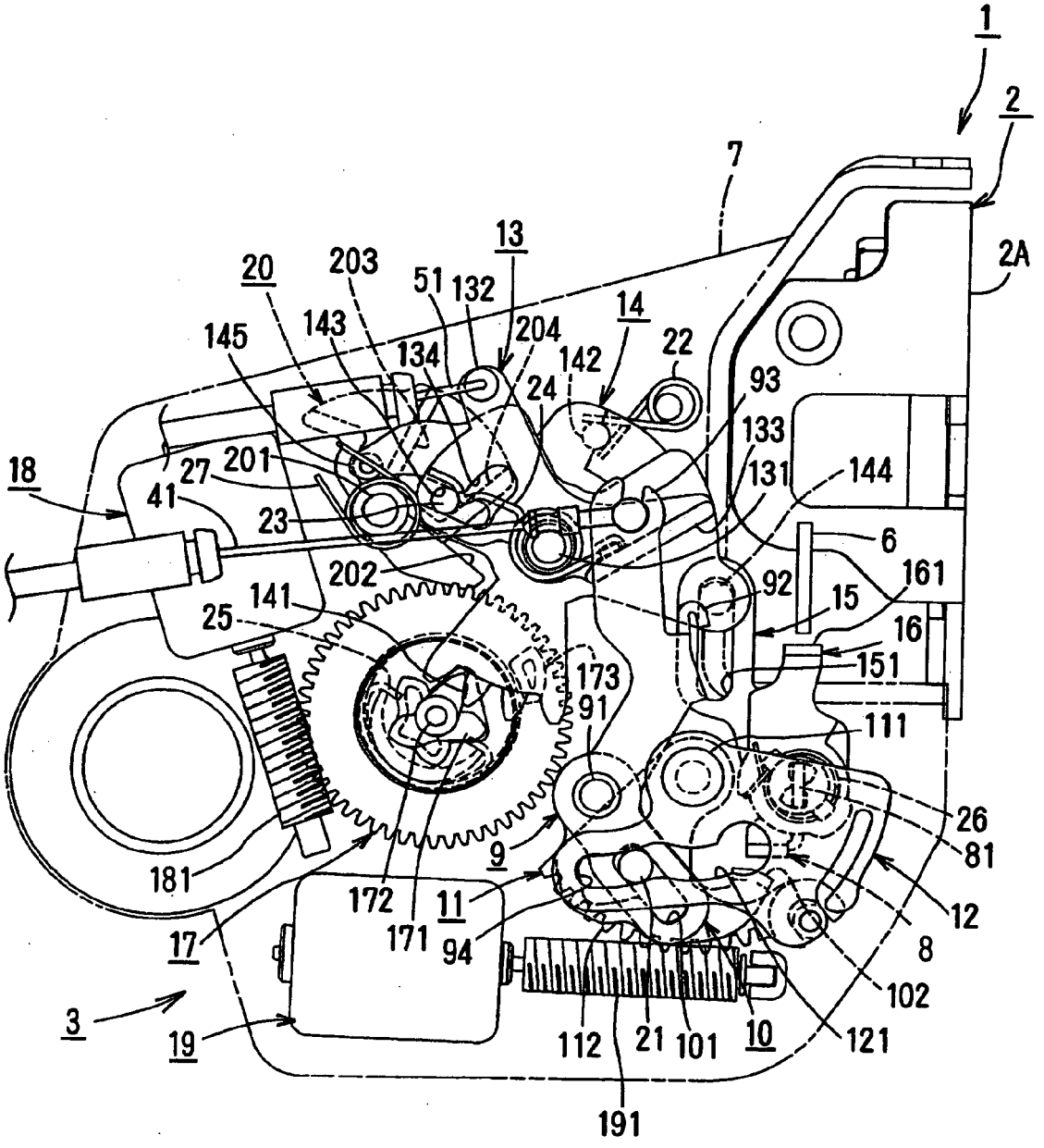
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FIG. 5

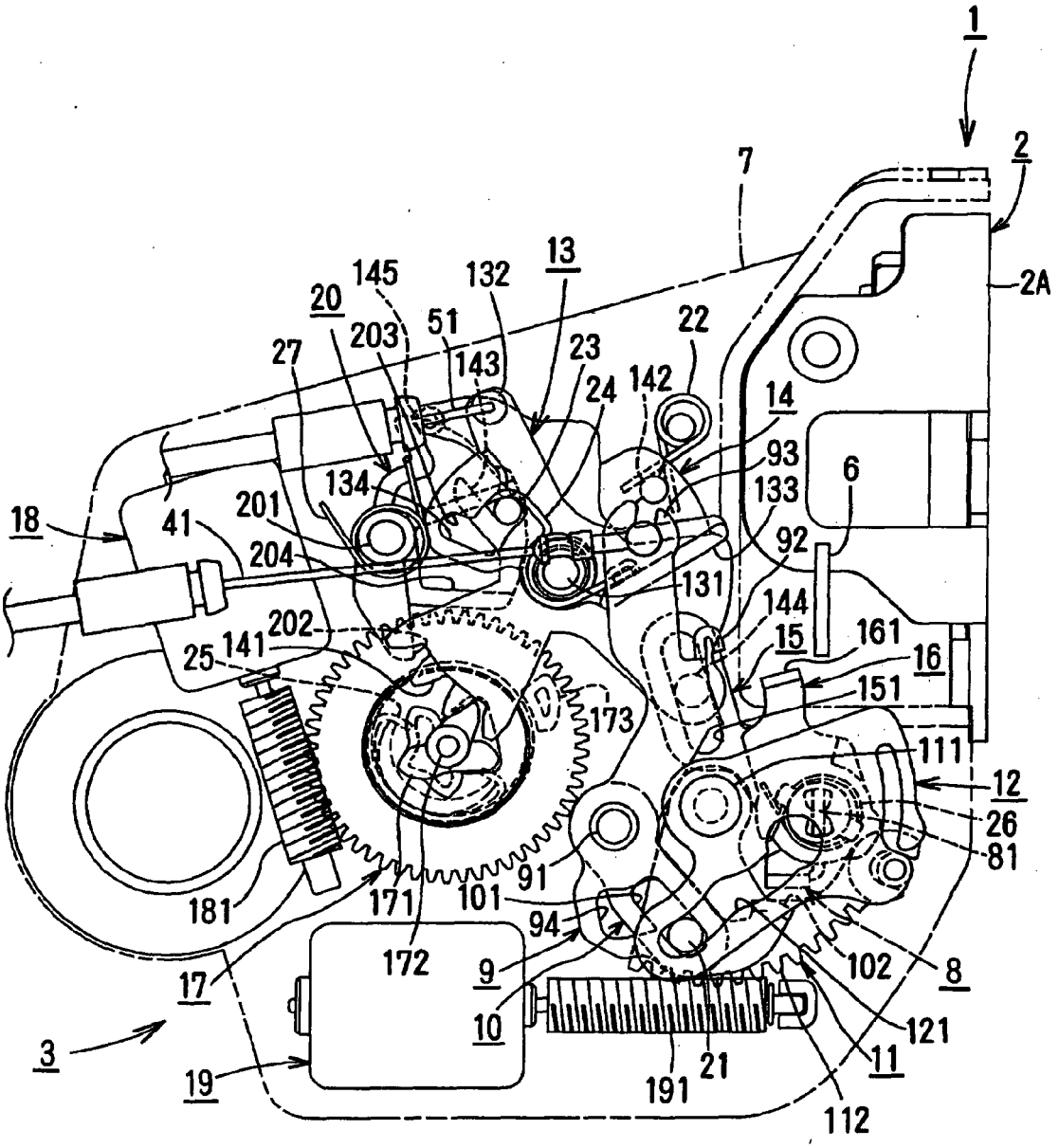
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FIG. 6

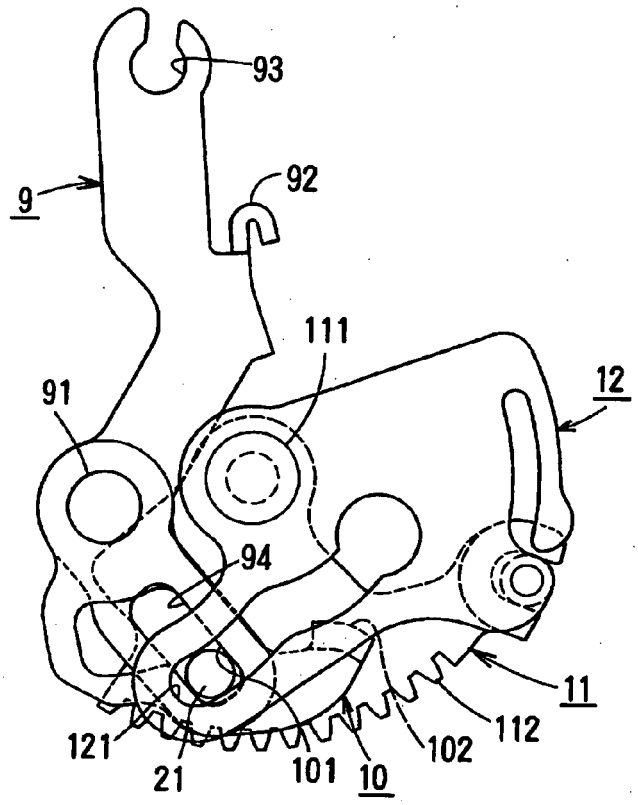
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FIG. 7

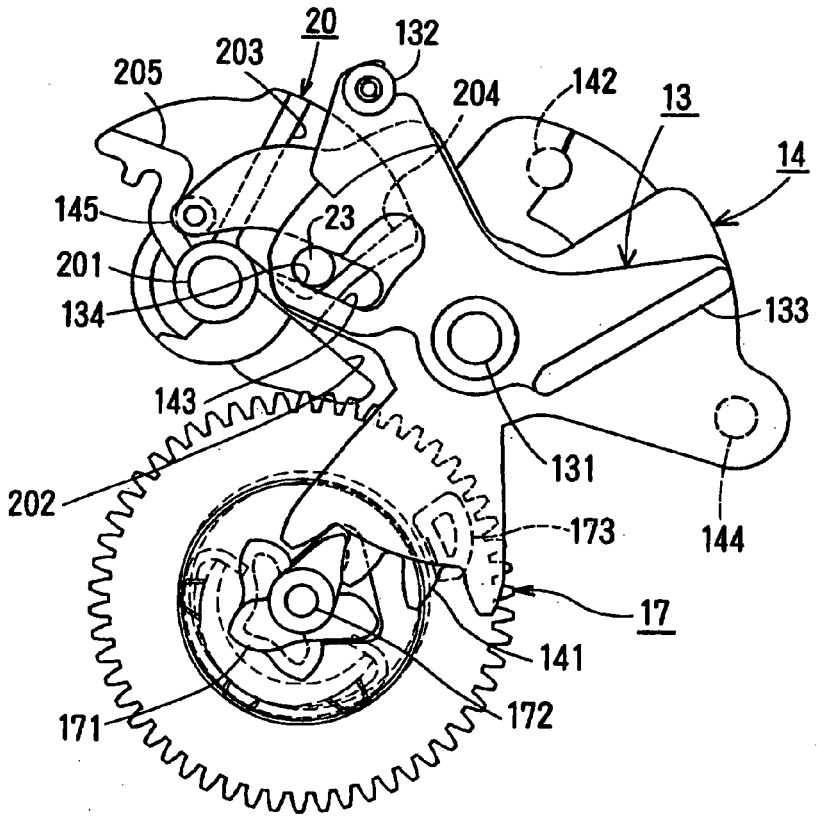
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FIG. 8

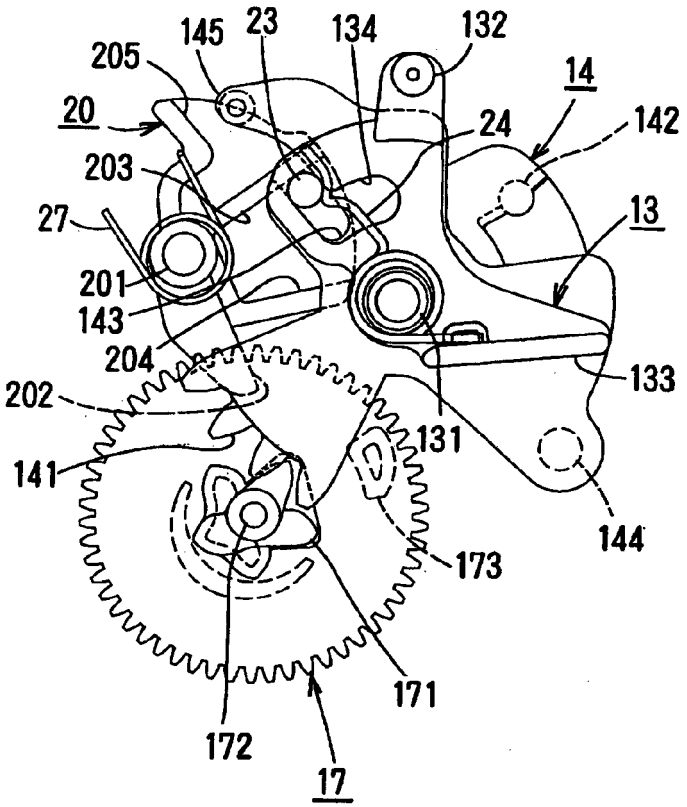
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FIG. 9

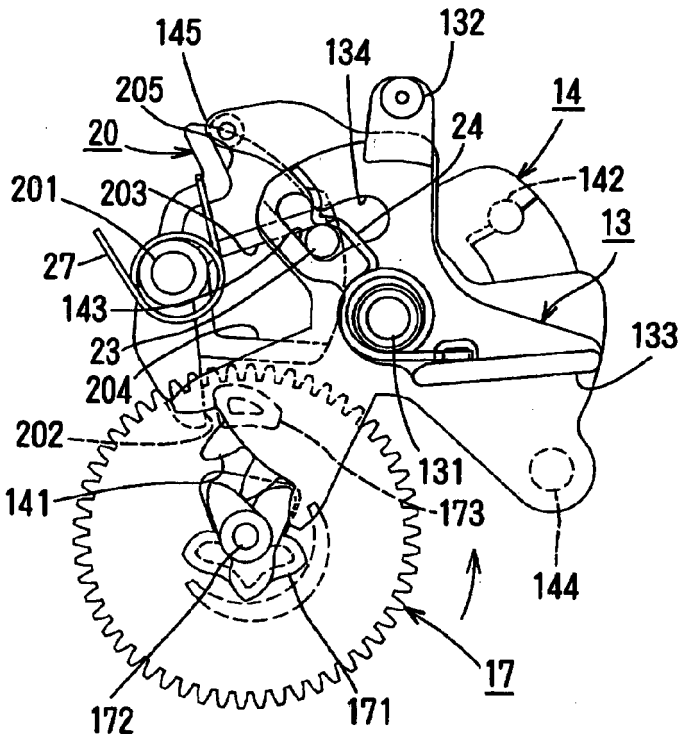
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FIG. 10

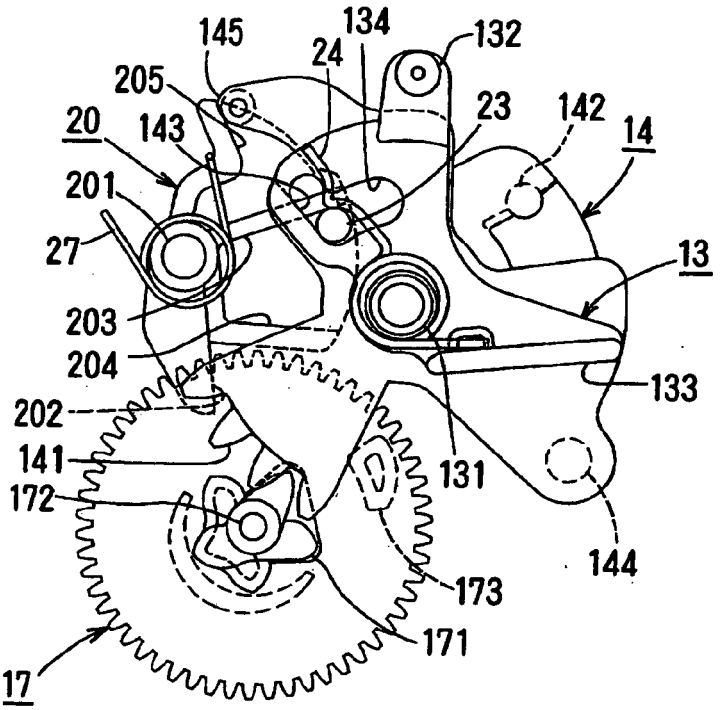
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FIG. 11

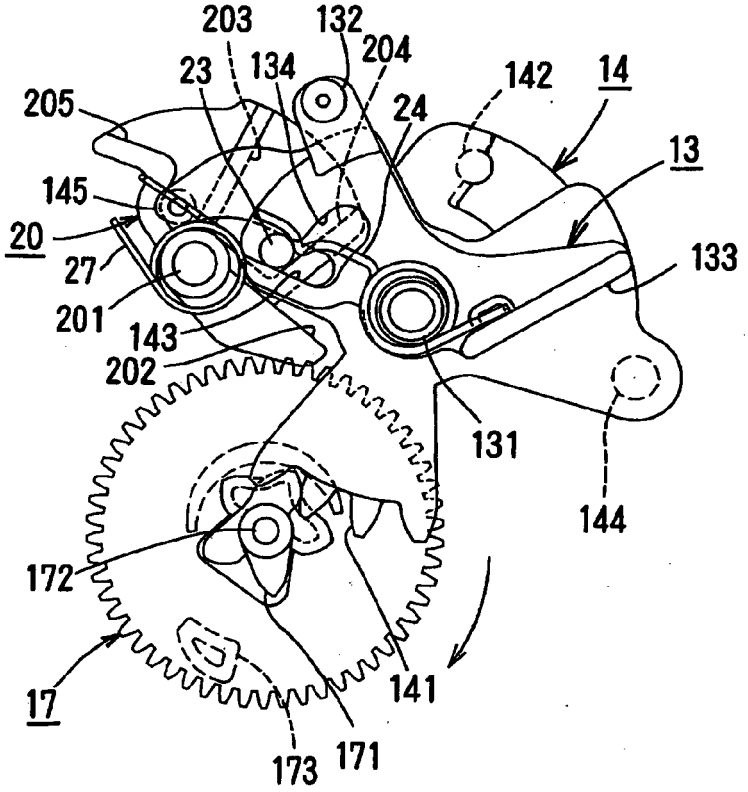
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FIG. 12

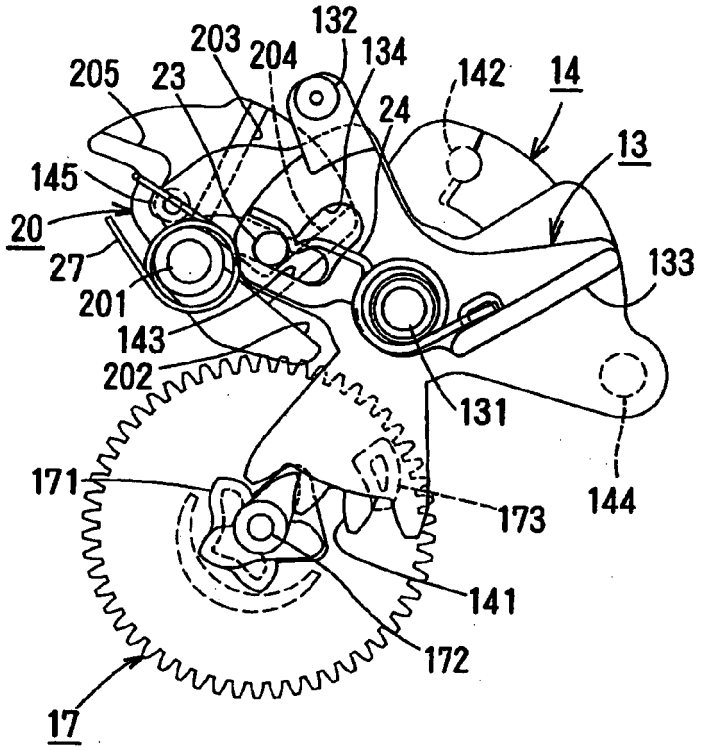
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FIG. 13

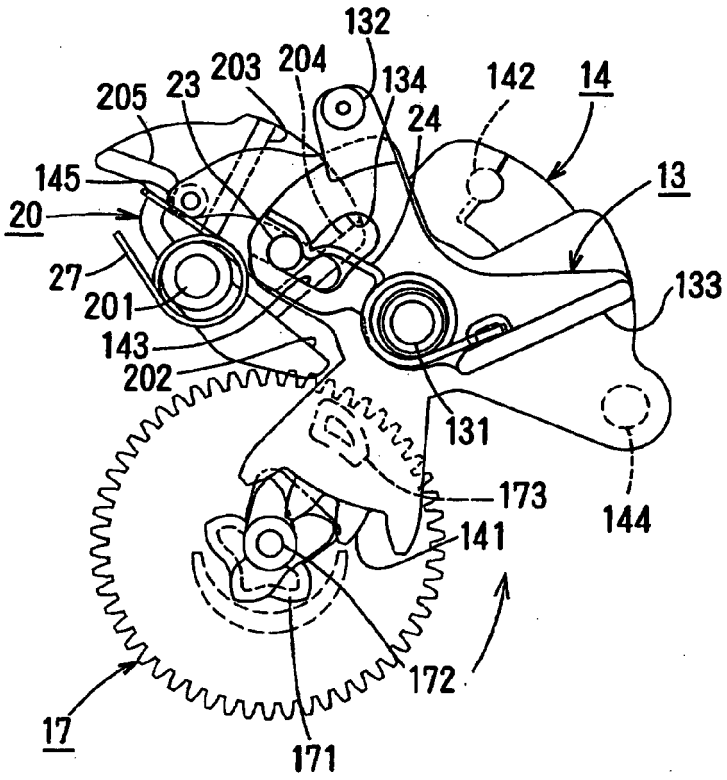
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FIG. 14

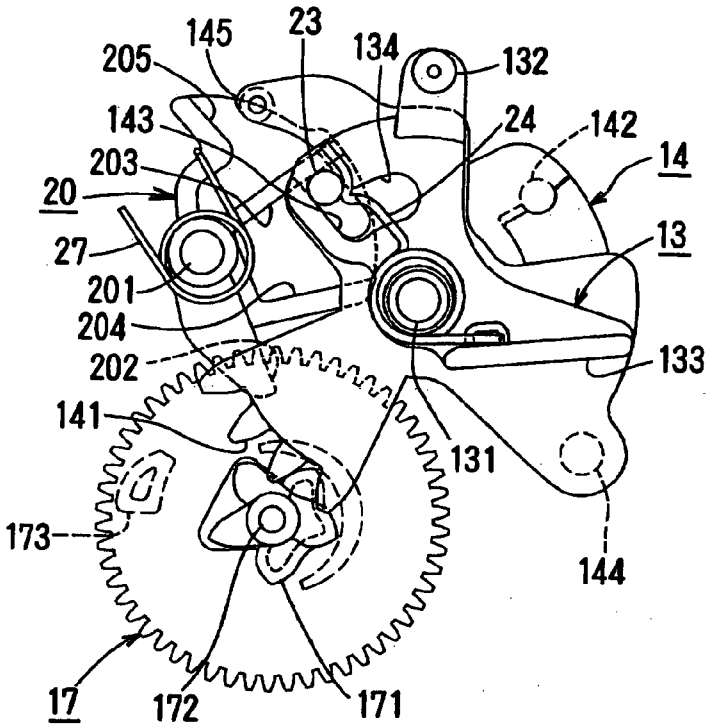
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FIG. 15

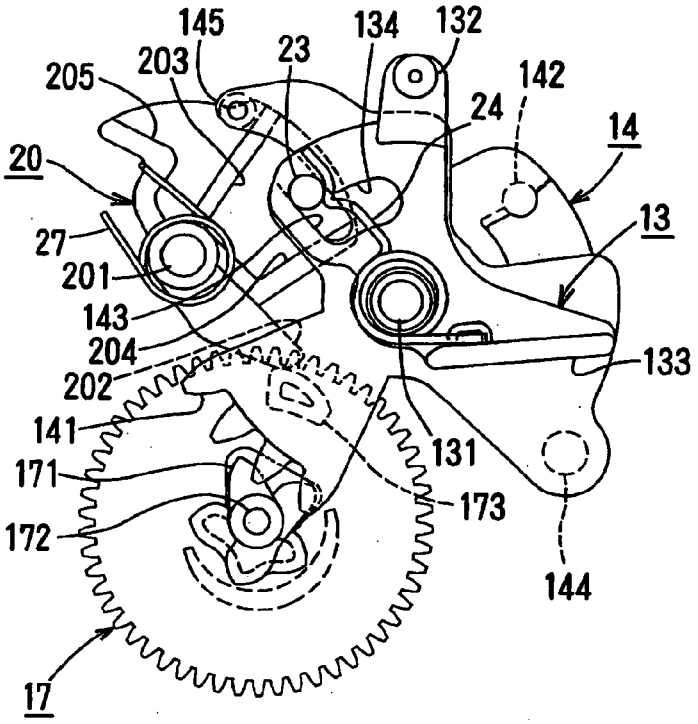
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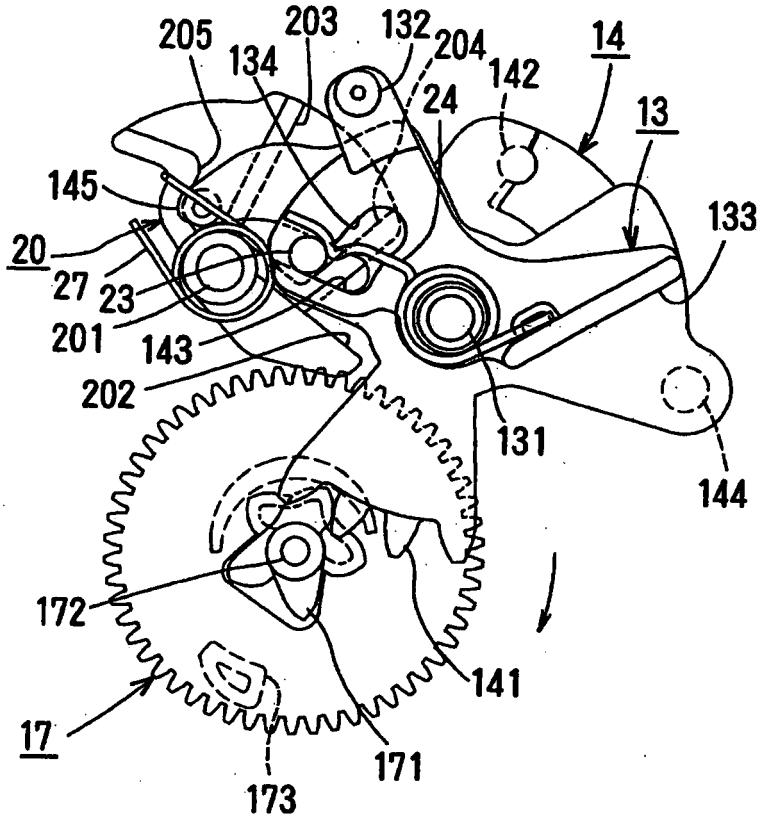
FIG. 16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REFERENCES CITED IN THE DESCRIPTION

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