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(54) VEHICLE DOOR HANDLE ASSEMBLY

(57) The invention relates to a coupling device for a vehicle door handle (1), the door handle (1) having a handle lever (3) movable between a flush position in which it is flush with an exterior door panel (100) surface and a ready position in which it is protruding and graspable by a user by an electric motor (7), and an inward clicking position in which a preloaded push-push unit (13) is released so as to bring the handle lever (3) in said ready position without actuation of the electric motor (7), comprising :

• a central shaft (31), connected to the handle lever (3),
• a push-push lever cylinder (29), rotatively coupled with the central shaft (19), interacting via a push-push lever (45) with the push-push unit (13) when the handle lever (3) is pushed inwards in the clicking position so as to release the preloaded push-push unit (13) and push the lever (3) in the ready position,
• a coupling gear (27), rotatively coupled with the central shaft (31), interacting with the electric motor (7) to move the handle lever (3) from the flush position to the ready position on actuation of the electric motor,

wherein the coupling gear and push-push lever cylinder (29) comprise for one an axial protrusion (41) and for the other a circular arc recess (43), the axial protrusion (41) engaging in the circular arc recess (43) so as to allow a free relative rotation of the coupling gear (27) and push-push lever cylinder (29) within an angular range corresponding at least to the angular distance between the ready position and the clicking position of the handle lever (3).

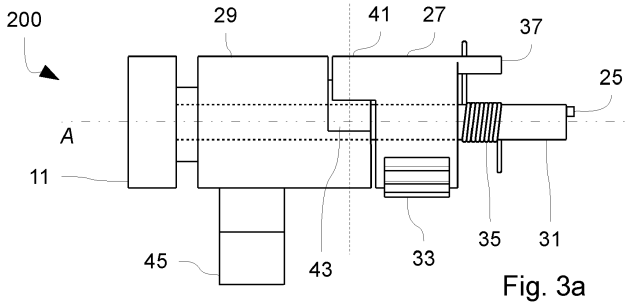

Fig. 3a

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Description

[0001] The present invention concerns a vehicle door assembly, in particular of the type with a flushing door handle lever.

[0002] Such vehicle door handle assemblies comprise an electric motor which, when actuated, moves the handle lever between a flush position and a ready position. In the flush position, the handle lever is flush with the exterior surface of the door body. In the ready position, the handle lever is protruding from said exterior surface, so as to be graspable by a user.

[0003] Once the user grasped the handle lever in its ready position, he can unlatch the door by pulling the lever in a further protruding unlocking position, in which the handle door lever interacts (via a Bowden cable, a rotating pin or a gear mechanism) with a latch mechanism and unlatches the door.

[0004] A handle lever spring brings the handle lever back in its ready position when the user releases the handle lever. The electric motor may also move the handle lever from the ready position to the flush position after opening or closing the door.

[0005] Such door handle assemblies also comprise a back-up mechanism, to enable the opening of the door in case of, for example, electric motor or car battery failure, that is when the electric motor cannot be actuated. This mechanism comprises for example a push-push mechanism, in which the user pushes the handle lever inwards from its flushing position until reaching a clicking position in which a preloaded spring is released. Said preloaded spring, when released, pushes the handle lever from the inward clicking position in the protruding ready position.

[0006] Once the user accesses the vehicle in back-up mode, the battery will generally be recharged, and/or the motor failure will be lifted and normal, electric, actuation can be resumed.

[0007] In normal functioning, the electric motor sets the handle lever in motion via a reduction mechanism, for example a worm drive and gear mechanism, which reduces the rotational speed of the motor actuation while increasing torque value. When the user pushes the lever from the flushing to the clicking position, said reduction mechanism is actuated in reverse.

[0008] The resulting reverse actuation, in case of non-reversibility due to friction increased by temperature, may cause the reduction mechanism to deteriorate or even break, thus potentially compromising the operating of the door handle as a whole, both in manual back-up and when resuming normal, electrical actuation (e.g. after recharging the battery or lifting the motor malfunction).

[0009] In order to overcome the aforementioned drawbacks, the invention proposes a coupling device for a vehicle door handle, the door handle having a handle lever movable between a flush position in which it is flush with an exterior door panel surface and a ready position in which it is protruding and graspable by a user by an electric motor, and an inward clicking position in which a preloaded push-push unit is released so as to bring the handle lever in said ready position without actuation of the electric motor, comprising :

- a central shaft, connected to the handle lever,
- a push-push lever cylinder, rotatively coupled with the central shaft, interacting via a push-push lever with the push-push unit when the handle lever is pushed inwards in the clicking position so as to release the preloaded push-push unit and push the lever in the ready position,
- a coupling gear, rotatively coupled with the central shaft, interacting with the electric motor to move the handle lever from the flush position to the ready position on actuation of the electric motor,

wherein the coupling gear and push-push lever cylinder comprise for one an axial protrusion and for the other a circular arc recess, the axial protrusion engaging in the circular arc recess so as to allow a free relative rotation of the coupling gear and push-push lever cylinder within an angular range corresponding at least to the angular distance between the ready position and the clicking position of the handle lever.

[0010] The relative free rotational movement allows to selectively uncouple the lever and the reduction stages when the user is pushing said lever in clicking position and when the push push unit pushes said lever in ready position.

[0011] The coupling device may present one or more of the following characteristics, taken separately or in combination.

[0012] The axial protrusion and circular arc recess are configured to allow a free relative rotation of the coupling gear and push-push lever cylinder within an angular range corresponding to the angular distance between the open position and the clicking position of the handle lever.

[0013] The axial protrusion is a circular arc protrusion.

[0014] The angular portion of the coupling gear bearing meshing teeth to interact with a reduction mechanism covers an angular portion of the side of the coupling gear greater than the sum of the angular distance between the clicking and ready positions and the angular distance between the clicking and open positions.

[0015] It further comprises a handle spring, and the coupling gear comprises a protruding spring finger cooperating with the handle spring to bring the handle lever from clicking position into flush position.

[0016] The invention also relates to the associated door handle, in particular for a vehicle door, having a handle lever movable between a flush position in which it is flush with an exterior door panel surface and a ready position in which it is protruding and graspable by a user by an electric motor, and between an inward clicking po-

sition in which a preloaded push-push unit is released so as to bring the handle lever in ready position without actuation of the electric motor, comprising :

- a central shaft, connected to the handle lever,
- a coupling gear, rotatively coupled with the central shaft, interacting with the electric motor to move the handle lever from the flush position to the ready position on actuation of the electric motor,
- a push-push lever cylinder, rotatively coupled with the central shaft, interacting via a push-push lever with the push-push unit when the handle lever is pushed inwards in the clicking position so as to release the preloaded push-push unit and push the lever in the ready position,
- a push-push unit with at least one preloaded spring configured to bring a handle lever from a clicking position in which the preloaded spring is released in a ready position without actuation of an electric motor,
- an electric motor and a reduction mechanism to transmit rotational movement from the motor to the handle lever,

wherein the coupling gear and push-push lever cylinder comprise for one an axial protrusion and for the other a circular arc recess, the axial protrusion engaging in the circular arc recess so as to allow a free relative rotation of the coupling gear and push-push lever cylinder within an angular range corresponding at least to the angular distance between the ready position and the clicking position of the handle lever.

[0017] The push-push unit may further comprise two preloaded springs pushing, when released, a slider interacting via a push-push finger with a push-push lever protruding radially from the push-push lever cylinder.

[0018] The reduction mechanism may comprise a worm drive interacting with the coupling gear to set the handle lever in motion when the electric motor is actuated.

[0019] The central shaft may carry on its end opposite the handle lever a magnetic index, and the handle comprises a magnetic detector configured to detect movements of the magnetic index and deduce from the movements a position of the handle lever.

[0020] Other characteristics and advantages of the invention will appear at the reading of the following description, given in an illustrative and not limiting fashion, of the following figures, among which :

- figure 1 is a schematic cut away of a vehicle door with a handle comprising a handle lever represented in different positions,
- figure 2 is a schematic view of a vehicle door handle,
- figure 3a is a schematic side view of a coupling device for a door as previously represented,
- figures 3b and 3c represent the main components of the coupling device viewed in perspective,
- figures 4a, 4b and 4c are cross sections of the coupling device of figure 3 during electric actuation of the door,
- figures 5a, 5b and 5c are cross sections of the coupling device during manual back-up actuation of the door,
- figures 6a, 6b and 6c are cross sections of the coupling device during electric rearming of the back-up actuation mechanism,

[0021] In all figures, the same references apply to the same element.

[0022] Though the figures refer to precise embodiments of the invention, other embodiments may be obtained by combining or altering slightly the represented embodiments, said new embodiments are also within the scope of the invention.

[0023] Figure 1 shows a series of schematic cutaways of a vehicle door panel 100 having a built-in door handle 1. The door panel 100 forms an exterior surface of the vehicle, the door handle 1 is essentially represented by its handle lever 3 (the part meant to be grasped and set in motion by a user) and a handle frame 5 (part that remains stationary during actuation).

[0024] The terms like "inwards", "outwards" and equivalents are defined with respect to the vehicle interior and exterior.

[0025] In the first cutaway of figure 1, the handle lever 3 is in a flushing position. In said flushing position, the outer surface of the handle lever 3 is flushing with the door panel 100. Said flushing position is adopted when the vehicle is driving and when it is parked for longer times. In flushing position, the handle lever 3 is less likely, when parked, to be interacted with by passers-by, accidentally or not, and air drag is reduced when driving. In the flushing position, the handle lever 3 also appears integrated in the door panel 100 in a pleasant and discrete way.

[0026] In the second cutaway of figure 1, the handle lever 3 is in a ready position. In said ready position, the handle lever 3 has rotated outwards by a predefined angle (20 to 45° for example) around a handle axis *A*, so as to be graspable by the user. Said ready position is adopted when the user approaches the vehicle or causes unlocking of the doors, for example using a remote control integrated in a key or a RFID security token. In said position the handle lever 3 is available and graspable for the user, but the handle is still latched.

[0027] In the third cutaway of figure 1, the handle lever 3 is in an open position. Compared to the ready position, the handle lever 3 has been rotated further outwards (40° to 60° and more) by the user, and the handle lever interacts with a latch mechanism to unlatch the door, which is consequently unlatched and ready to be opened by pulling further on the handle lever 3.

[0028] In the event of a mechanical or electrical failure of the mechanism that drives the lever 3 from the flushing position to the ready position, the user can push the lever 3 inwards with respect to the door panel 100, as in the fourth cutaway of figure 1, by applying inwards directed pressure P on the handle lever 3. The handle lever 3 is then in a position herein called clicking position, where a mechanical interaction (a "click") releases a spring of a push-push unit that drives the lever 3 in ready position without actuation of a motor.

[0029] Figure 2 is a view of the door handle 1 from inside. In figure 2, the handle lever 3 is rotatively mobile with respect to the handle frame 5, which is to be attached to an interior surface of the vehicle door panel 100. The frame 5 comprises housings for most parts of the door handle 1.

[0030] In a housing of the frame 5 is an electric motor 7 with a reduction mechanism 9. The electric motor 7 is activated by injection of electric current, in particular from a vehicle battery. The reduction mechanism 9 adapts the rotary output motion of the electric motor 7 by reducing rotational speed and increasing the torque values. The reduction mechanism 9 sets the handle lever 3 in motion, in particular from the flushing position to the ready position.

[0031] The reduction mechanism 9 comprises for example one or more reduction stages, with reduction gears and/or worm and gear systems.

[0032] The reduction mechanism 9 sets a coupling device 200 in motion. The coupling device 200 comprises a lever base 11, to which a handle lever body (not represented) is attached upon assembling the handle 1 to obtain the assembled handle lever 3.

[0033] The frame 5 also houses a push-push unit 13, comprising two push-push springs 15, placed around two guiding rods 17. The push-push springs 15 push when released a slider 19 carrying a push-push finger 21 which rests against a push-push lever (see figure 3a) of the coupling device 200. The push-push finger 21 is in particular made of rubber, soft plastic or any shock absorbing material.

[0034] The springs 15 and guiding rods 17 are placed on each side of a release mechanism 23, which, when being compressed (clicking position), releases the slider 19 which is then pushed by the springs 15 along the guiding rods 17, pushing the handle lever 3 in ready position.

[0035] The rotational position of the handle lever 3 is detected by positioning means 25, on the lower side of the coupling device 200. Said positioning means 25 comprise a magnetic index and a magnetic sensor (e.g. a Hall effect sensor). The magnetic index rotates with the handle lever 3, the magnetic sensor then determinates the rotational position of the magnetic index, and thus the position of the handle lever 3.

[0036] The coupling device 200 is shown in greater detail in the following figures.

[0037] Figure 3a is a side view of the coupling device 200, represented schematically. Figures 3b and 3c are transverse cut away views of two longitudinal parts of said coupling device 200.

[0038] The coupling device 200 has a generally cylindrical shape along the rotation axis *A*, and is divided axially in two independently rotating elements, comprising one coupling gear 27 and one push-push lever cylinder 29 surrounding a central shaft 31.

[0039] The coupling gear 27 and push-push lever cylinder 29 correspond to two axial portions of the cylinder, and surround the axial central shaft 31 which is bound in rotation with the handle lever base 11 and the push-push lever cylinder 29, in particular, they may be solidly linked.

[0040] The coupling gear 27 and push-push lever cylinder 29 comprise on their mutually facing radial sides partial coupling means. Figures 3b and 3c show respectively the coupling gear 27 and push-push lever cylinder 29 viewed in perspective.

[0041] The coupling gear 27 comprises a tubular body, covered on part of its axial side by meshing teeth 33 to cooperate with the electric motor 7, for example via a worm and gear link. The coupling gear 27 also interacts with a handle spring 35 via a spring finger 37 protruding axially in figure 3a, but shown protruding radially in subsequent figures for clarity purpose, and pushing on a free end of the handle spring 35 on a portion of its course during handle 1 actuation.

[0042] The handle spring 35 is a coil spring, surrounding a portion of the central shaft 31. The free ends of the handle spring 35 are constrained between two anchors 39 (see figures 5a, 5b, 5c and following) of the frame 5 in a relative position of the free ends wherein the handle spring 35 is in a preconstrained state.

[0043] The coupling gear 27 comprises on its radial side facing the push-push lever cylinder 29 a circular arc protrusion 41, in particular with a square or rectangular radial cross section. Other possible forms are for example that of one or more fingers, tubular in particular. The circular arc form of the protrusion 41 results in increased stability while still being guidable in rotation.

[0044] The push-push lever cylinder 29 comprises on its axial side facing the coupling gear 27 a circular arc recess 43, in which the circular arc protrusion 41 is engaged when the coupling device 200 is assembled.

[0045] Further embodiments are obtained by forming the circular arc recess 43 on the coupling gear 27, and the circular arc protrusion 41 on the push-push lever cylinder 29.

[0046] The circular arc recess 43 covers in particular an angular opening greater than that covered by the circular arc protrusion 41, so as to allow a free relative rotation of the coupling gear 27 and push-push lever cyl-

inder 29 within an angular range corresponding at least to the angular distance between the ready position and the clicking position of the handle lever 3.

[0047] The push-push lever cylinder 29 comprises a radially protruding push-push lever 45, which interacts with the push-push unit 13 via the push-push finger 21 against which the push-push lever 45 rests in particular in click and flush positions of the handle lever 3.

[0048] As is more visible visible in figure 3a, the central shaft 31 carries a magnetic index of the positioning means 25 on its end opposite the handle lever 3. The magnetic index cooperates with one or more magnetic detectors of the positioning means 25 to determine a rotational position of the handle lever 3.

[0049] In the following figures the counter clockwise rotation of the push-push lever cylinder 29 causes the unlatching of the door (outwards rotation of the handle lever 3, see figure 1), while clockwise rotation moves the handle lever 3 towards the clicking position (inwards rotation, see figure 1).

[0050] The cooperation of the circular arc protrusion 41 and recess 43 is illustrated in figures 4a, 4b, 4c, 5a, 5b, 5c and 6a, 6b, 6c. Said figures are a schematic representation of the coupling gear 27 and push-push lever cylinder 29, represented by their circular arc protrusion 41 and recess 43 carrying cross sections, with the handle spring 35, shown alongside the spring finger 37, push push-push lever 45 and handle spring 35.

[0051] Figures 4a, 4b and 4c illustrate the electrical, normal actuation of the handle 1. The handle 1 is initially in a flush position, taken for example after the user left the vehicle. The actuation depicted in figures 4a, 4b and 4c corresponds for example to the actuation in case of detection of an incoming user carrying an identification token, or when a user actuates a remote to unlock the doors, or manually request a readying of the handle 1.

[0052] In the flush position, depicted in figure 4a, the circular arc protrusion 41 is set apart angularly from the ends of the circular arc recess 43.

[0053] Between figures 4a and 4b, the electric motor 7 has been actuated, and has rotated the coupling gear 27 counter clockwise, so that its counter clockwise end rests against the counter clockwise end of the circular arc compartment 43. In figure 4b, the push-push lever cylinder 29 has not moved, the handle lever 3 is still in flush position.

[0054] Between figures 4b and 4c, the electric motor 7 has rotated the coupling gear 27 further in counter clockwise direction. The coupling gear 27 consequently transmitted the rotation to the push-push lever cylinder 29, which rotated counter clockwise, bringing the handle lever base 11, and consequently the handle lever 3, in ready position.

[0055] From this ready position, the user can easily grasp the handle lever 3 and further rotate it in counter clockwise direction to unlatch and open the door panel 100.

[0056] Figures 5a, 5b and 5c illustrate the mechanical or back up actuation of the handle 1, for example in case of battery or electric motor 7 failure.

[0057] In figure 5a, the coupling device 200 is once again represented in flush position. The horizontal positions of the push-push lever 3 and push-push finger 21 corresponding to the flush and clicking positions are represented by vertical lines, the one of the clicking position being the leftmost one, the right one corresponding to the flush position.

[0058] In the flush position, the far end of the push-push lever 45 rests against the push-push finger 21. The push-push unit 13 is in an armed state : the springs 15 are compressed, and the release mechanism 23 is locked.

[0059] Between figures 5a and 5b, the user pressed the handle lever 3 inwards, to bring said handle lever 3 in clicking position, as represented in figure 5b. In figure 5b, the push-push lever 45 has pushed the push-push finger 21 (and consequently the slider 19) to the left of figure 5b, in clicking position where the release mechanism 23 is actuated.

[0060] In figure 5b, the counter clockwise end of the circular arc recess 43 is close to or rests against the counter clockwise end of the circular arc protrusion 41, without having set the coupling gear 27 in motion.

[0061] To allow this, the angular distance between the counter clockwise ends of the circular arc protrusion 41 and recess 43 is equal to or greater than the angular distance between the flush and clicking positions of the handle lever 3.

[0062] Between figures 5b and 5c, the slider 19 of the push-push unit 13 is consequently released, and the springs 15 push the push-push lever 45 to the right of figure 5b, towards the ready position of the push-push lever cylinder 29 and of the handle lever 3 (arrow of figure 5c).

[0063] Between figures 5b and 5c, the push-push lever cylinder 29 is rotated by an angle corresponding to the angular distance between the clicking and ready positions of the handle lever 3.

[0064] In figure 5c, the handle 1 is in ready position, and the user can grasp the handle lever 3 and further rotate it towards open position of the handle 1. To allow this without setting the coupling gear 27 in motion, the angular distance between the clockwise ends of the circular arc protrusion 41 and recess 43 is at least equal to the angular distance between the ready and open positions of the handle lever 3.

[0065] Therefore, for a mechanical back-up actuation of the handle 1 to bring the handle lever 3 in ready position without setting the coupling gear 27 in motion, the angular range of the free relative rotation between the coupling gear 27 and push-push lever cylinder 29 is at least equal to the sum of the angular distance between the flush and clicking positions and the angular distance between the flush and ready positions. The maximum relative free rotation angle is consequently at least equal to the angular distance between the clicking and ready positions of the

handle lever 3.

[0066] This angular distance is typically comprised between 30° and 120°.

[0067] To further enable opening of the door panel 100 without setting the coupling gear 27 in motion, the angular range of the free relative rotation must be at least equal to the angular distance between the clicking and open positions of the lever 3.

[0068] The range of the free relative rotation is given in the represented embodiments by the difference in angular width of the circular arc recess 43 and the circular arc protrusion 41.

[0069] Figures 6a, 6b and 6c show the electrical rearming of the push-push unit 13. Said electrical rearming is applied when the electrical or motor failure is lifted. For example, the user finds his battery depleted after prolonged parking, and in a first step had to proceed to manual back-up actuation as depicted in figures 5a, 5b and 5c to access his vehicle. After at least partially recharging the battery (using a battery loader, bridging cables or by jump starting the vehicle motor), the electric motor 7 is used to rearm the push-push unit 13 in a process imperceptible for the user.

[0070] The disposition of the coupling gear 27 and push-push lever 29 in figure 6a is identical to that of figure 5c, and corresponds to the ready position of the handle lever 3 while the push-push unit 13 is still in a triggered state (the push push springs 15 are released).

[0071] As visible in figure 6a, in the ready position the spring finger 37 is close to or in contact with a free arm of the handle spring 35, which is located in the clockwise (closing or inwards) direction, therefore, none of the motions illustrated in the preceding pictures cause the handle spring 35 to be actuated.

[0072] Between figures 6a and 6b, the electric motor 35 causes the coupling gear 27 to move clockwise, so that the spring finger 37 pushes the free arm of the handle spring 35 clockwise in its motion. In figure 6b, the clockwise end of the circular arc protrusion 41 is resting against the clockwise end of the circular arc recess 43, but the push-push lever cylinder 29 has not moved; the handle lever 3 is still in ready position.

[0073] Between figures 6b and 6c, the electric motor 35 continues to rotate the coupling gear 27, so that the circular arc protrusion 41 causes a rotation of the push-push lever cylinder 29 in clockwise direction.

[0074] In figure 6c, the push-push lever cylinder 29 and the push-push lever 45 acting on the push-push finger 21 reach the clicking position. In said position, the release mechanism snaps in and locks the slider 19 in a position in which the push-push springs 15 are compressed : the push-push unit 13 is armed again.

[0075] In figure 6c, the handle spring 35 is at its maximum compression.

[0076] Once the electric motor 7 is no longer fed electric current, the push-push unit 13 returns from the position of figure 6c, to the initial position of figure 5a, and thereby pushes the push-push lever cylinder 29, push-push lever 45 and thus the handle lever 3 back to flush position.

[0077] At the same time, the handle spring 35 brings the coupling gear 27 back to its position of figure 4a.

[0078] The handle 1 is then back to its configuration in which the handle lever 3 is flush, and the push-push unit 13 is armed, that is the configuration illustrated in figures 4a and 5a. The handle 1 is at that moment ready for use again, in particular in case of a subsequent electric motor 7 failure, a manual back-up actuating of the handle is possible again.

[0079] The return from the clicking position is in particular done without actuation of the electrical motor 7, which thus needs only to rotate in one direction, the push-push unit 13 and handle spring 35 ensure the motions where reverse actuation of the motor 7 would be required. The handle 1 can therefore be potentially cheaper, as single rotation direction motors can be implemented, without reversing mechanisms that would have to be selectively engaged.

[0080] For the electric motor 7 to be able to bring the push-push lever cylinder 19 in the extremal clicking and ready positions, the angular portion of the coupling gear 27 covered with meshing teeth 33 is greater than the sum of the angular distance between the clicking and ready positions and the angular distance between the clicking and open positions.

[0081] The coupling device 200 reduces the number of reverse actuations of the reduction mechanism 9, which cause important friction and torques, and can potentially damage or deteriorate it. Also, the reverse actuation of the reduction mechanism 9 causes noises, which the user will hear and take as indicator of a reduced quality.

[0082] The coupling device 200 can therefore add to the expected lifetime of the door handle 1 while enhancing the perceived quality of said handle 1.

Claims

1. Coupling device for a vehicle door handle (1), the door handle (1) having a handle lever (3) movable between a flush position in which it is flush with an exterior door panel (100) surface and a ready position in which it is protruding and graspable by a user by an electric motor (7), and an inward clicking position in which a preloaded push-push unit (13) is released so as to bring the handle lever (3) in said ready position without actuation of the electric motor (7), comprising :

    • a central shaft (31), connected to the handle lever (3),

    • a push-push lever cylinder (29), rotatively coupled with the central shaft (19), interacting via a push-push lever (45) with the push-push unit (13) when the handle lever (3) is pushed inwards

in the clicking position so as to release the preloaded push-push unit (13) and push the lever (3) in the ready position,

• a coupling gear (27), rotatively coupled with the central shaft (31), interacting with the electric motor (7) to move the handle lever (3) from the flush position to the ready position on actuation of the electric motor,

wherein the coupling gear and push-push lever cylinder (29) comprise for one an axial protrusion (41) and for the other a circular arc recess (43), the axial protrusion (41) engaging in the circular arc recess (43) so as to allow a free relative rotation of the coupling gear (27) and push-push lever cylinder (29) within an angular range corresponding at least to the angular distance between the ready position and the clicking position of the handle lever (3).

2. Coupling device according to claim 1, **characterized in that** the axial protrusion (41) and circular arc recess (43) are configured to allow a free relative rotation of the coupling gear (27) and push-push lever cylinder (29) within an angular range corresponding to the angular distance between the open position and the clicking position of the handle lever.

3. Coupling device according to any of the preceding claims, **characterized in that** the axial protrusion (41) is a circular arc protrusion.

4. Coupling device according to any of the preceding claims, **characterized in that** the angular portion of the coupling gear (27) bearing meshing teeth (33) to interact with a reduction mechanism (9) covers an angular portion of the side of the coupling gear (27) greater than the sum of the angular distance between the clicking and ready positions and the angular distance between the clicking and open positions.

5. Coupling device according to the preceding claim, **characterized in that** it further comprises a handle spring (35), and the coupling gear (27) comprises a protruding spring finger (37) cooperating with the handle spring (35) to bring the handle lever (3) from clicking position into flush position.

6. Door handle, in particular for a vehicle door, having a handle lever (3) movable between a flush position in which it is flush with an exterior door panel (100) surface and a ready position in which it is protruding and graspable by a user by an electric motor (7), and between an inward clicking position in which a preloaded push-push unit (13) is released so as to bring the handle lever (3) in ready position without actuation of the electric motor (7),
comprising :

• a central shaft (31), connected to the handle lever (3),

• a coupling gear (27), rotatively coupled with the central shaft (31), interacting with the electric motor (7) to move the handle lever (3) from the flush position to the ready position on actuation of the electric motor (7),

• a push-push lever cylinder (29), rotatively coupled with the central shaft (31), interacting via a push-push lever (45) with the push-push unit (13) when the handle lever (3) is pushed inwards in the clicking position so as to release the preloaded push-push unit (13) and push the lever (3) in the ready position,

• a push-push unit (13) with at least one preloaded spring (15) configured to bring a handle lever (3) from a clicking position in which the preloaded spring is released in a ready position without actuation of an electric motor (7),

• an electric motor (7) and a reduction mechanism (9) to transmit rotational movement from the motor (7) to the handle lever (3),

wherein the coupling gear (27) and push-push lever cylinder (29) comprise for one an axial protrusion (41) and for the other a circular arc recess (43), the axial protrusion (41) engaging in the circular arc recess (43) so as to allow a free relative rotation of the coupling gear (27) and push-push lever cylinder (29) within an angular range corresponding at least to the angular distance between the ready position and the clicking position of the handle lever (3).

7. Door handle according to the preceding claim, **characterized in that** the push-push unit (13) comprises two preloaded springs (15) pushing, when released, a slider (19) interacting via a push-push finger (21) with a push-push lever (45) protruding radially from the push-push lever cylinder (29).

8. Door handle according to claim 6 or 7, **characterized in that** the reduction mechanism (9) comprises a worm drive interacting with the coupling gear (27) to set the handle lever (3) in motion when the electric motor (7) is actuated.

9. Door handle according to claim 6, 7 or 8, **characterized in that** the central shaft (31) carries on its end opposite the handle lever (3) a magnetic index (25), and **in that** the handle comprises a magnetic detector configured to detect movements of the magnetic index (25) and deduce from the movements a position of the handle lever (3).

Amended claims in accordance with Rule 137(2) EPC.

1. Coupling device for a vehicle door handle (1), the door handle (1) having a handle lever (3) movable between a flush position in which it is flush with an exterior door panel (100) surface and a ready position in which it is protruding and graspable by a user by an electric motor (7), and an inward clicking position in which a preloaded push-push unit (13) is released so as to bring the handle lever (3) in said ready position without actuation of the electric motor (7), comprising :

    • a central shaft (31), configured to be connected to the handle lever (3),
    • a push-push lever cylinder (29), rotatively coupled with the central shaft (31), configured to be interacting via a push-push lever (45) with the push-push unit (13) when the handle lever (3) is pushed inwards in the clicking position so as to release the preloaded push-push unit (13) and push the lever (3) in the ready position,
    • a coupling gear (27), rotatively coupled with the central shaft (31), configured to interact with the electric motor (7) to move the handle lever (3) from the flush position to the ready position on actuation of the electric motor,

    wherein the coupling gear and push-push lever cylinder (29) comprise for one an axial protrusion (41) and for the other a circular arc recess (43), the axial protrusion (41) engaging in the circular arc recess (43) so as to allow a free relative rotation of the coupling gear (27) and push-push lever cylinder (29) within an angular range corresponding at least to the angular distance between the ready position and the clicking position of the handle lever (3).

2. Coupling device according to claim 1, **characterized in that** the axial protrusion (41) and circular arc recess (43) are configured to allow a free relative rotation of the coupling gear (27) and push-push lever cylinder (29) within an angular range corresponding to the angular distance between the open position and the clicking position of the handle lever.

3. Coupling device according to any of the preceding claims, **characterized in that** the axial protrusion (41) is a circular arc protrusion.

4. Coupling device according to any of the preceding claims, **characterized in that** the angular portion of the coupling gear (27) bearing meshing teeth (33) to interact with a reduction mechanism (9) covers an angular portion of the side of the coupling gear (27) greater than the sum of the angular distance between the clicking and ready positions and the angular distance between the clicking and open positions.

5. Coupling device according to the preceding claim, **characterized in that** it further comprises a handle spring (35), and the coupling gear (27) comprises a protruding spring finger (37) cooperating with the handle spring (35) to bring the handle lever (3) from clicking position into flush position.

6. Door handle, in particular for a vehicle door, having a handle lever (3) movable between a flush position in which it is flush with an exterior door panel (100) surface and a ready position in which it is protruding and graspable by a user by an electric motor (7), and between an inward clicking position in which a preloaded push-push unit (13) is released so as to bring the handle lever (3) in ready position without actuation of the electric motor (7),
comprising :

    • a central shaft (31), connected to the handle lever (3),
    • a coupling gear (27), rotatively coupled with the central shaft (31), interacting with the electric motor (7) to move the handle lever (3) from the flush position to the ready position on actuation of the electric motor (7),
    • a push-push lever cylinder (29), rotatively coupled with the central shaft (31), interacting via a push-push lever (45) with the push-push unit (13) when the handle lever (3) is pushed inwards in the clicking position so as to release the preloaded push-push unit (13) and push the lever (3) in the ready position,
    • a push-push unit (13) with at least one preloaded spring (15) configured to bring a handle lever (3) from a clicking position in which the preloaded spring is released in a ready position without actuation of an electric motor (7),
    • an electric motor (7) and a reduction mechanism (9) to transmit rotational movement from the motor (7) to the handle lever (3),

    wherein the coupling gear (27) and push-push lever cylinder (29) comprise for one an axial protrusion (41) and for the other a circular arc recess (43), the axial protrusion (41) engaging in the circular arc recess (43) so as to allow a free relative rotation of the coupling gear (27) and push-push lever cylinder (29) within an angular range corresponding at least to the angular distance between the ready position and the clicking position of the handle lever (3).

7. Door handle according to the preceding claim, **characterized in that** the push-push unit (13) comprises two preloaded springs (15) pushing, when released, a slider (19) interacting via a push-push finger (21)

with a push-push lever (45) protruding radially from the push-push lever cylinder (29).

8. Door handle according to claim 6 or 7, **characterized in that** the reduction mechanism (9) comprises a worm drive interacting with the coupling gear (27) to set the handle lever (3) in motion when the electric motor (7) is actuated.

9. Door handle according to claim 6, 7 or 8, **characterized in that** the central shaft (31) carries on its end opposite the handle lever (3) a magnetic index (25), and **in that** the handle comprises a magnetic detector configured to detect movements of the magnetic index (25) and deduce from the movements a position of the handle lever (3).

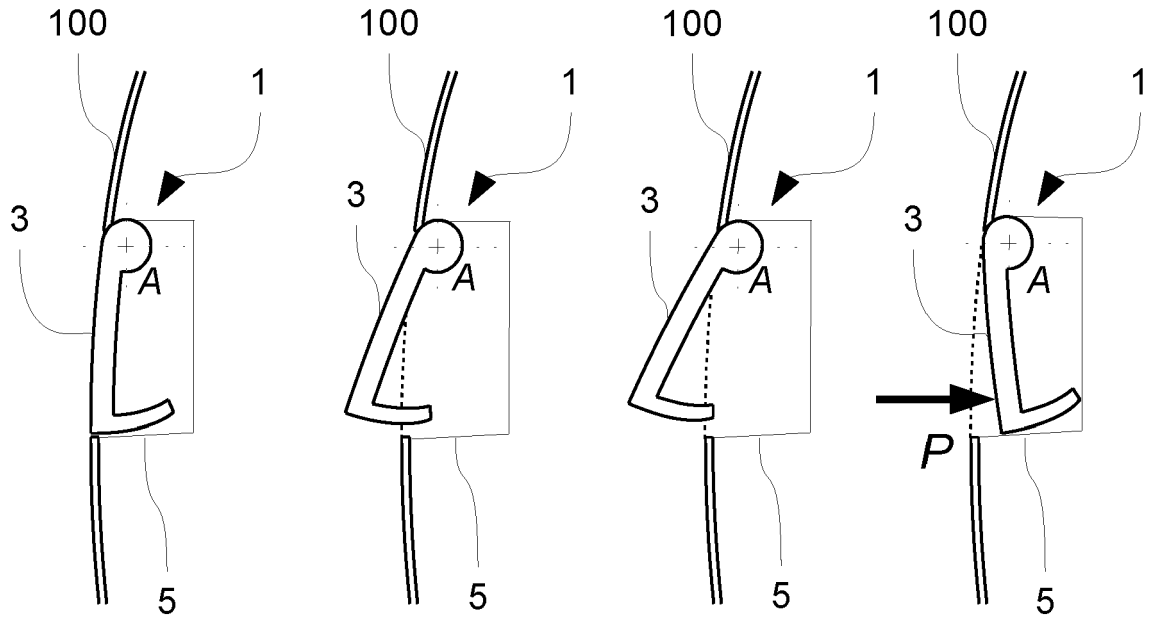

Fig. 1

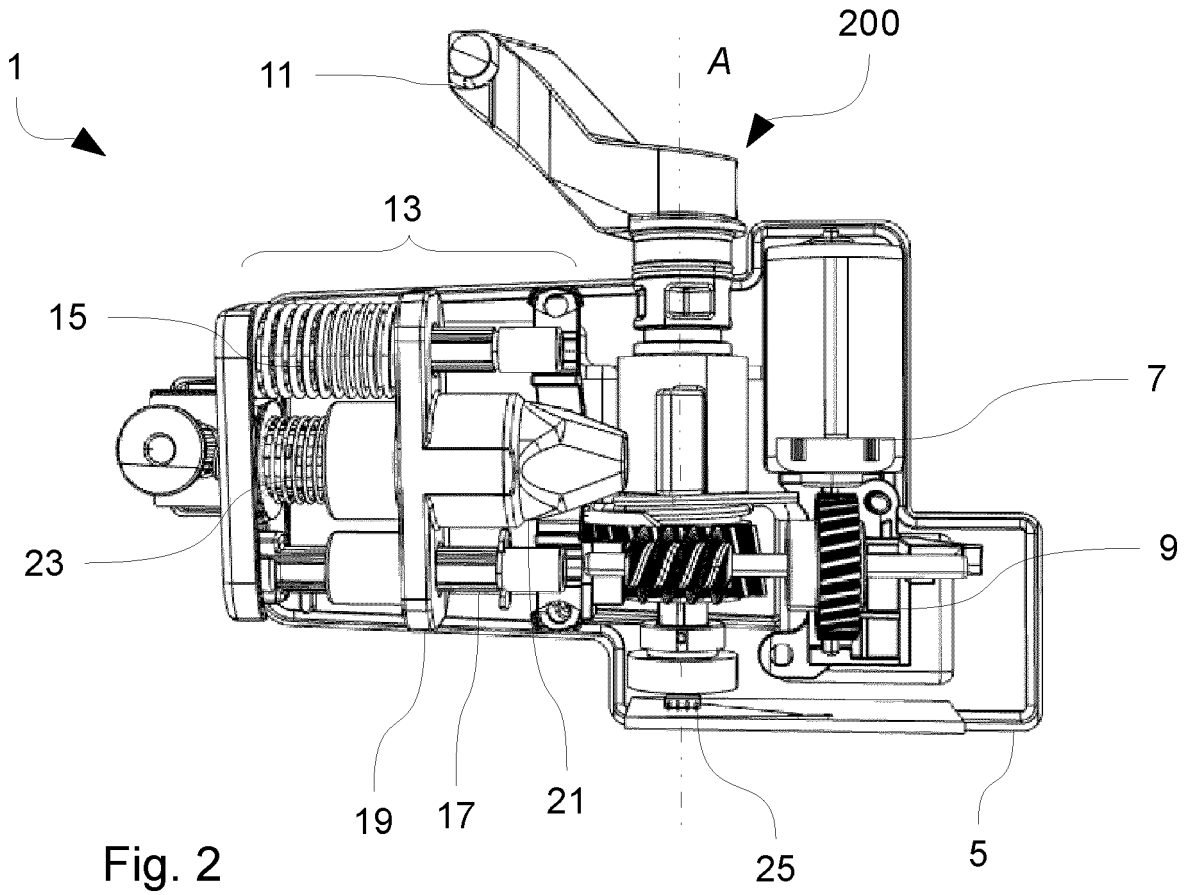

Fig. 2

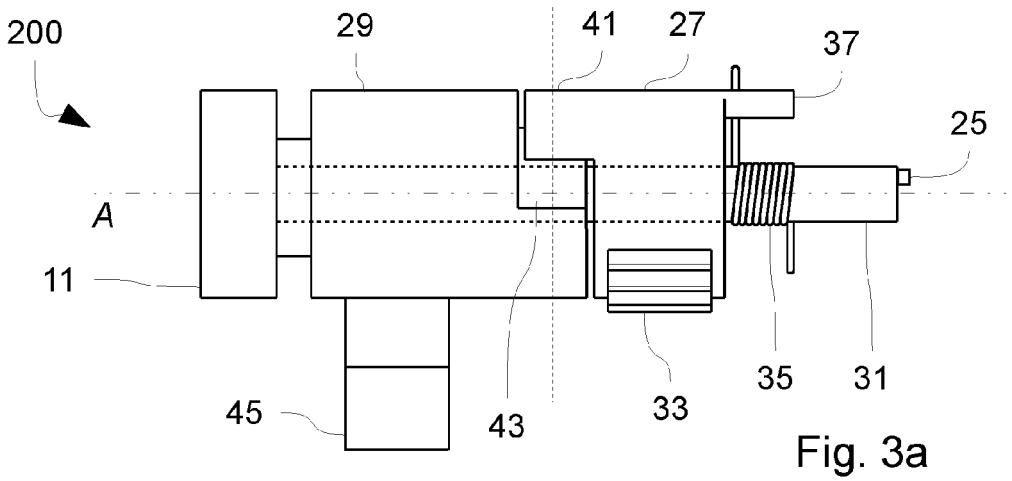

Fig. 3a

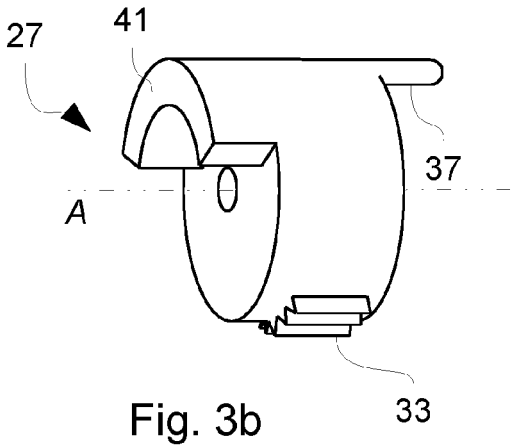

Fig. 3b

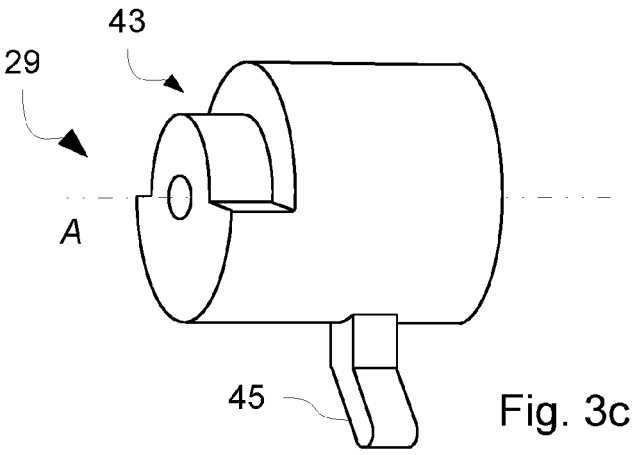

Fig. 3c

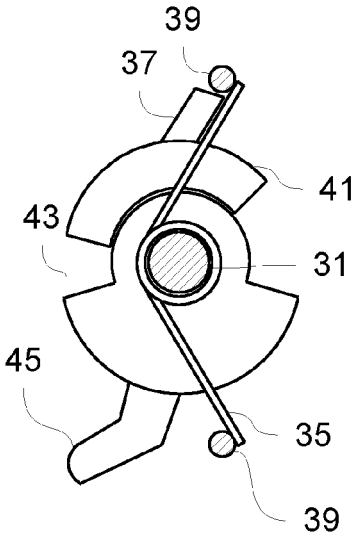

Fig. 4a

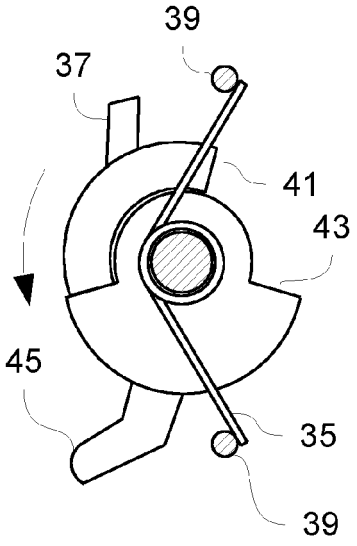

Fig. 4b

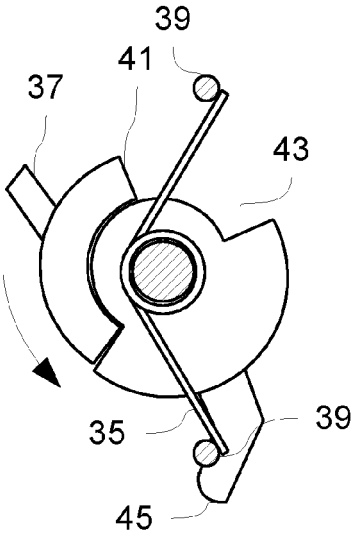

Fig. 4c

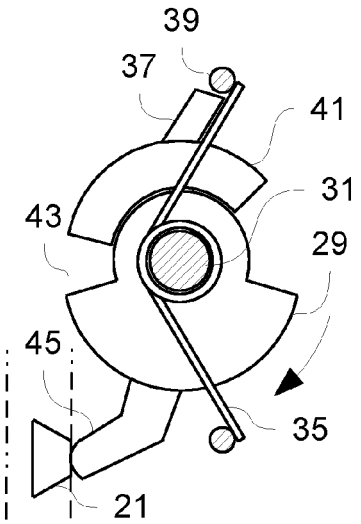

Fig. 5a

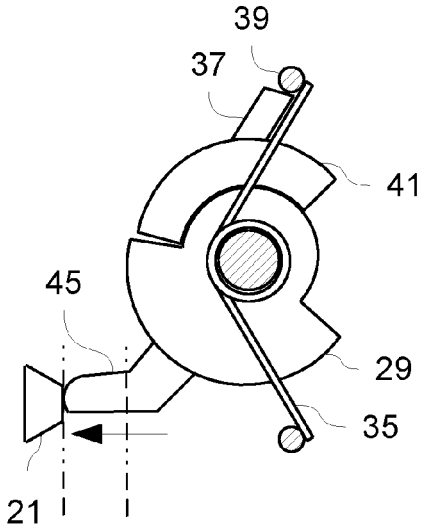

Fig. 5b

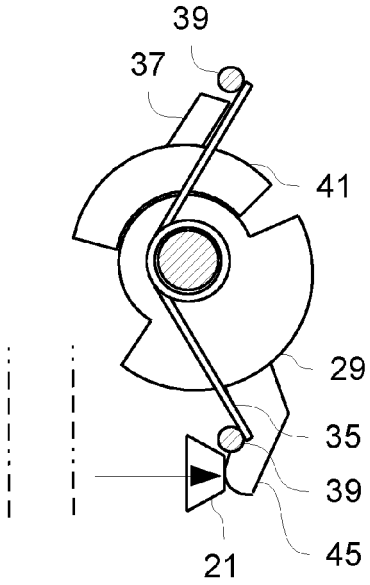

Fig. 5c

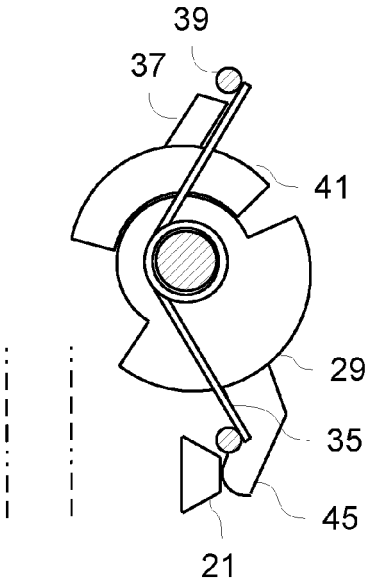

Fig. 6a

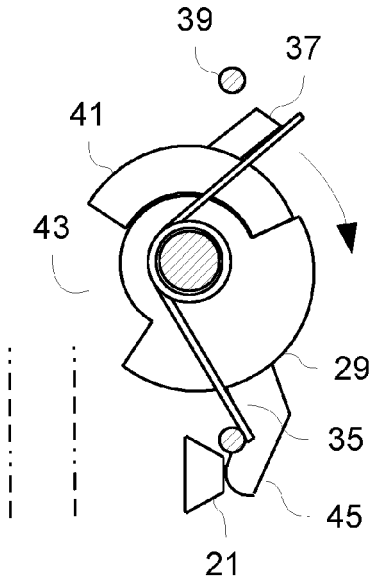

Fig. 6b

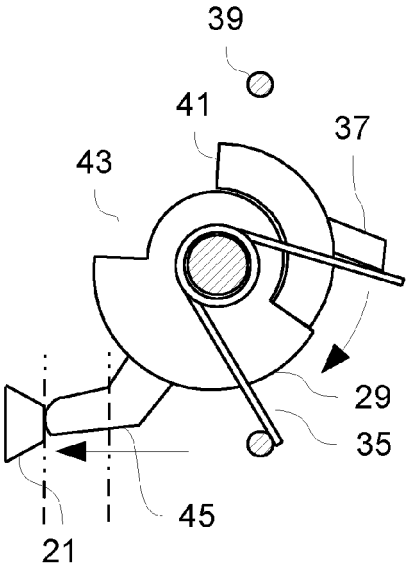

Fig. 6c

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EUROPEAN SEARCH REPORT

Application Number
EP 17 17 8801

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A	WO 2015/074020 A1 (ILLINOIS TOOL WORKS [US]) 21 May 2015 (2015-05-21) * page 2 - page 12; figures 1-12 *	1-9	
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E05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	13 September 2017	Boufidou, Maria

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