United States Patent [19]

Quantz

[11] **3,767,242**

[45] **Oct. 23, 1973**

[54] **SOLENOID OPERATED DOOR LOCK**

[75] Inventor: **Norman G. Quantz,** Algonac, Mich.

[73] Assignee: **Lectron Products Inc.,** Troy, Mich.

[22] Filed: **Oct. 29, 1971**

[21] Appl. No.: **193,871**

[52] **U.S. Cl.** **292/216,** 292/336.3, 292/201

[51] **Int. Cl.** **E05c 3/26**

[58] **Field of Search** 70/264; 335/228, 335/259, 268, 279; 292/144, 201, 336.3

[56] **References Cited**

UNITED STATES PATENTS

3,016,968	1/1962	Lenz et al.	292/201 X
3,030,794	4/1962	Dyer et al.	292/201 X
2,752,540	6/1956	Schleicher	335/268 X

FOREIGN PATENTS OR APPLICATIONS

1,568,503	5/1969	France	292/201

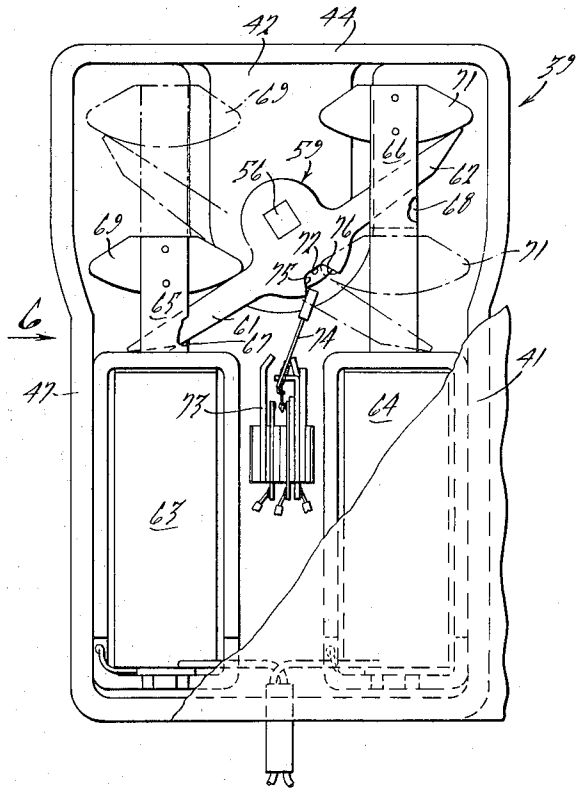
Primary Examiner—Richard E. Moore

Attorney—J. King Harness et al.

[57] **ABSTRACT**

An actuator for the locking mechanism of an automotive door latch, having a housing secured directly to the latch frame. The actuator has a crank linked to the door lock and actuated by a pair of relatively slender solenoids. These slenoids have plungers which are connected to the crank by means having a variable moment arm. As each solenoid is energized, its plunger is connected to the crank during the first portion of its stroke by a relatively long moment arm. As the pull on the plunger becomes greater near the end of its stroke, the moment arm shortens, thus maintaining a substantially constant torque on the lock actuating lever.

17 Claims, 6 Drawing Figures



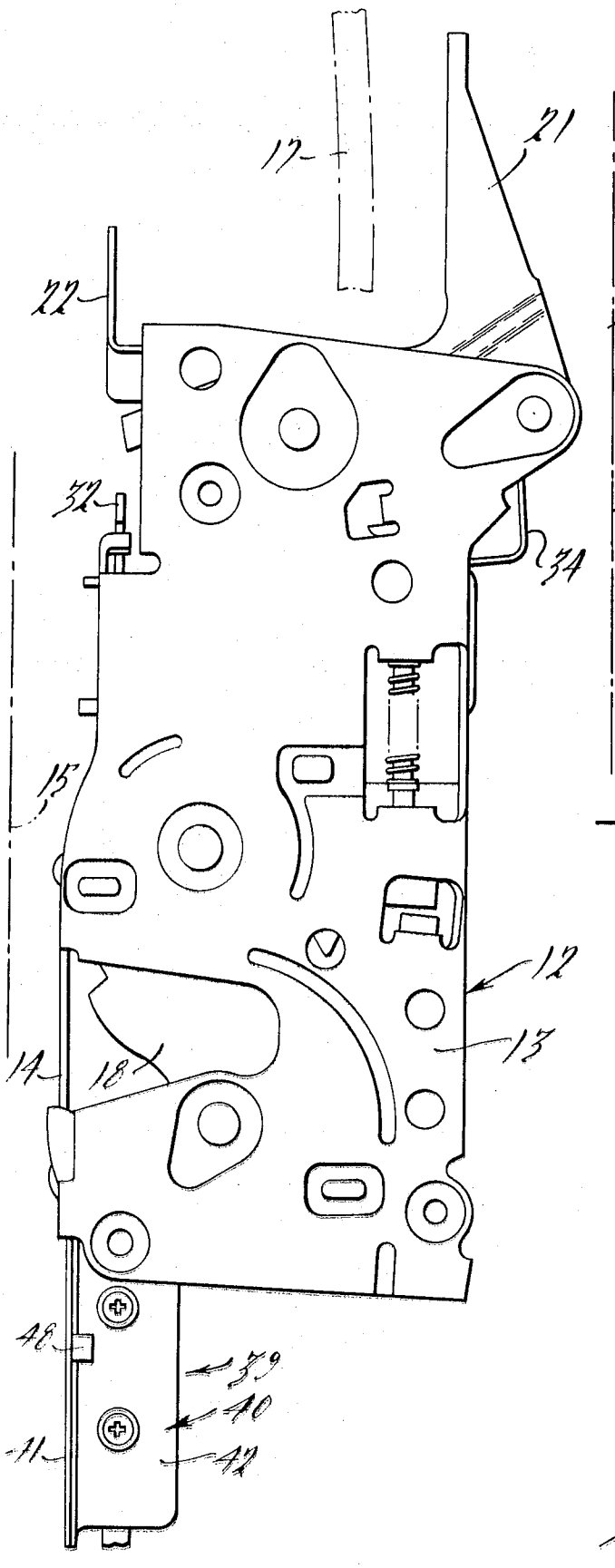


Fig. 1.

INVENTOR.
Norman C. Quantz
BY
Harness, Dickey & Pierce
ATTORNEYS

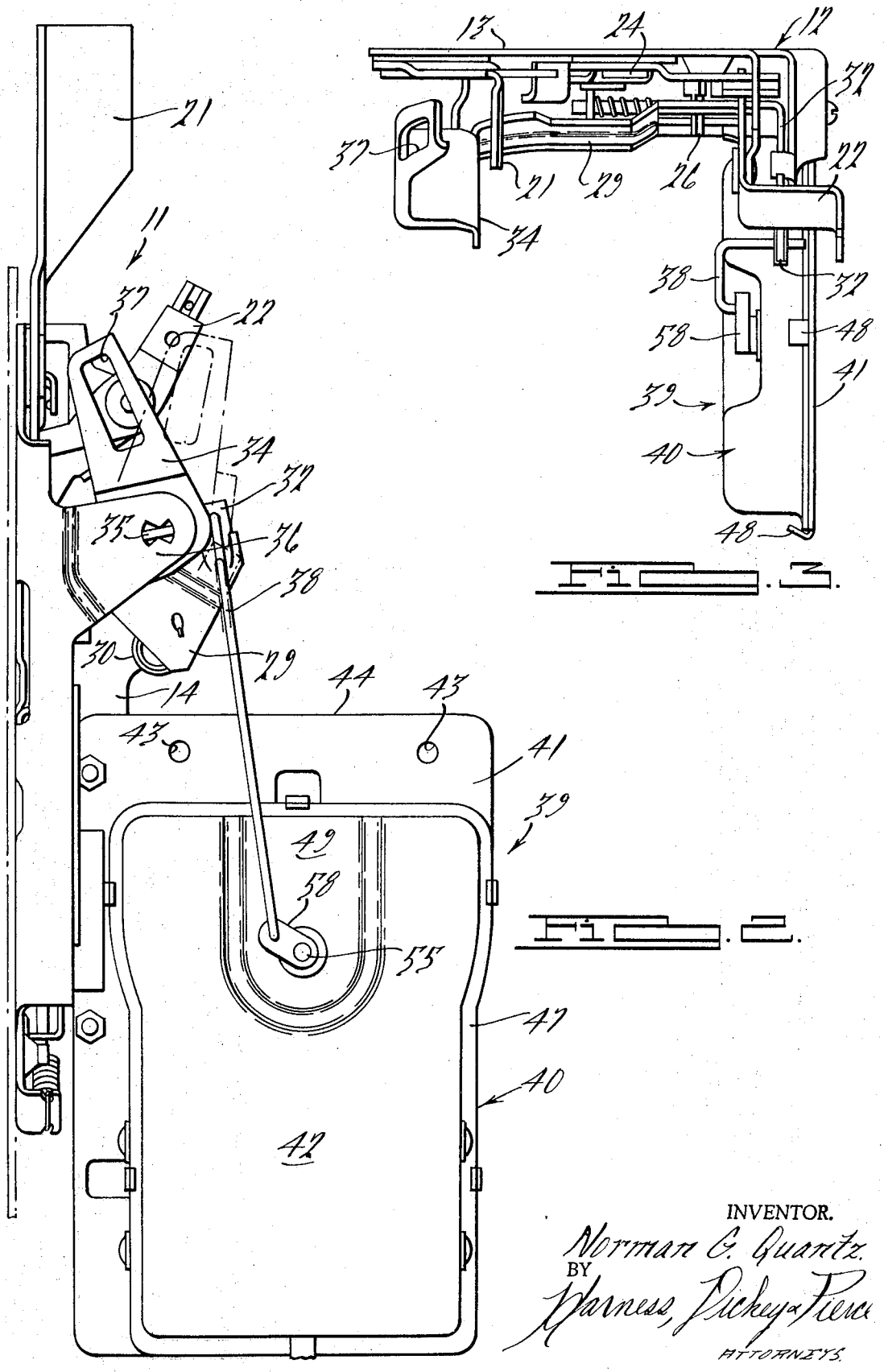
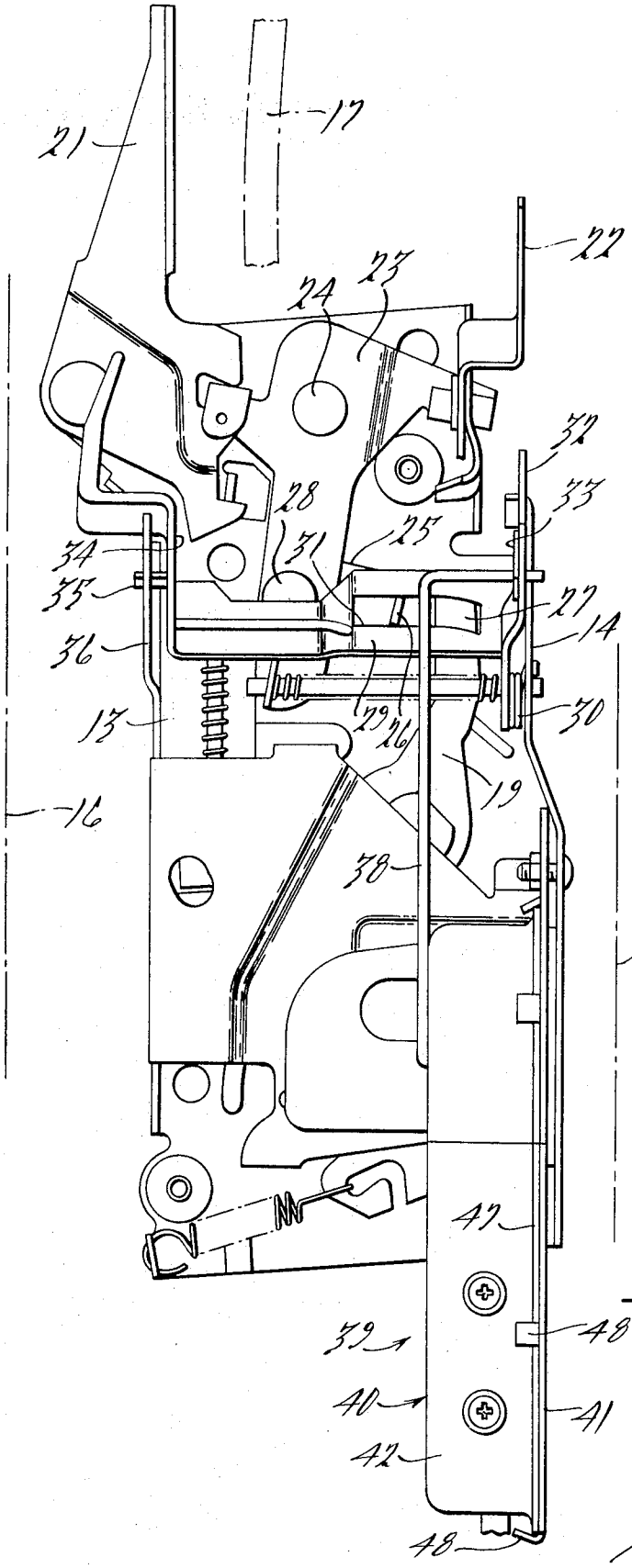
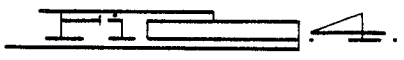


Fig. 3.

Fig. 2.

INVENTOR.
Norman G. Quantz.
BY
Harness, Dickey & Pierce
ATTORNEYS.





INVENTOR.
Norman G. Quartz.
BY
Harness, Dickey & Pierce
ATTORNEYS.

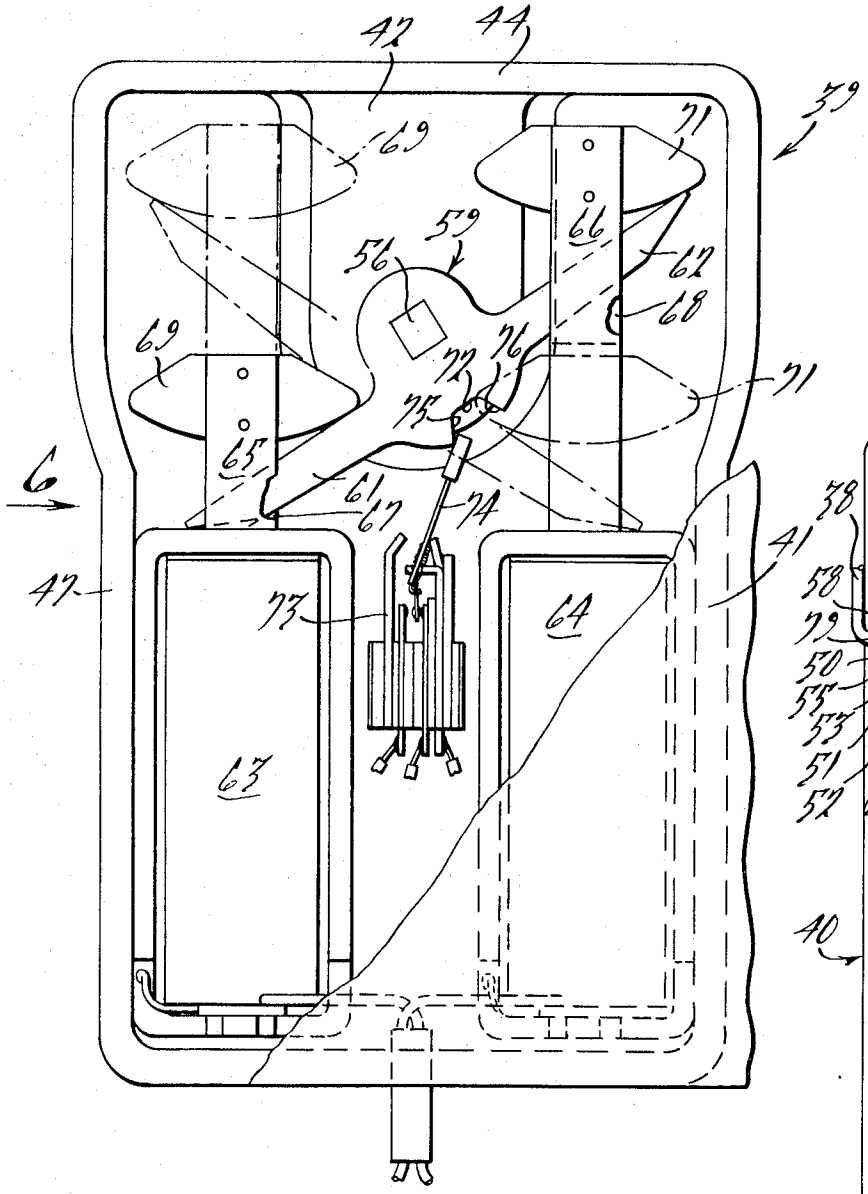


FIG. 5.

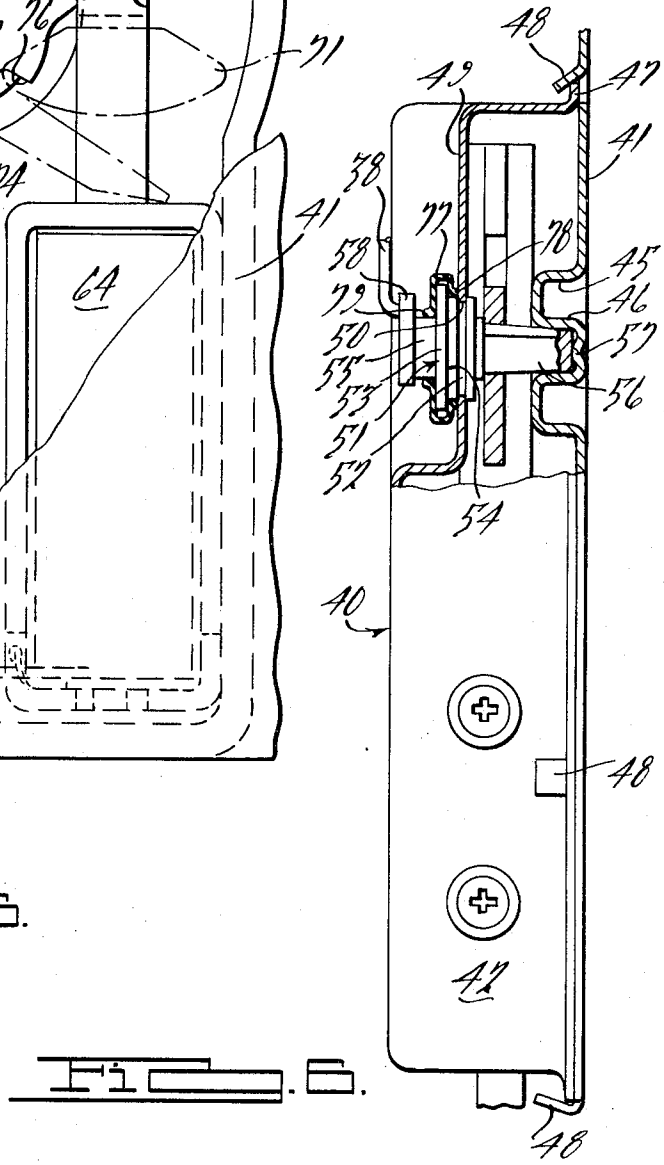


FIG. 6.

INVENTOR.

Norman G. Quantz.

BY Harness, Dickey & Pierce

ATTORNEYS

SOLENOID OPERATED DOOR LOCK

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to electrically operated door locks for automotive vehicles, in which a locking mechanism for each door latch is movable between locking and unlocking positions by means of a pair of solenoids. In order for these mechanisms to perform satisfactorily over an extended period and under varying load conditions, automotive manufacturers require that lock actuators meet certain strength specifications. For example, it might be a requirement that the actuator have a force output of at least 8 pounds over a travel of one-half inch.

2. Description of the Prior Art

The following patents, discovered in a search, show various mechanical structures including door latches which have pairs of solenoids operatively associated with an actuating lever:

U.S. Pat. No. 784,064 J. Nordenberg, U.S. Pat. No. 2,934,930 L. P. Garvey, U.S. Pat. No. 1,150,169 S. C. Bryant, U.S. Pat. No. 3,030,794 J. W. Dyer et al, U.S. Pat. No. 2,299,646 H. A. Muller, U.S. Pat. No. 3,105,162 D. E. Stevenson.

Conventional double solenoid door lock actuators as exemplified by the Garvey and Dyer et al patents have relatively bulky constructions, mainly because of the large solenoids required to achieve the requisite minimum power throughout the length of stroke. The greatest solenoid pull is required in these devices at the beginning of the plunger stroke, since the influence of the coil on the plunger is least at this time. Thus, the large sizes of these solenoids are of no use during most of the plunger stroke, and the extra torque achieved during most of the stroke is wasted. Because of their bulkiness, these conventional actuators must be mounted at some distance from the door latches themselves where there is sufficient room within the door, thus requiring long linkages which further decrease their efficiency because of the tolerance stackups created. Moreover, the conventional actuators must often be located in a space within the door which is relatively unprotected from water.

BRIEF SUMMARY OF THE INVENTION

According to the invention, the door lock is connected to a lock actuating crank rockably mounted on a housing which contains two solenoids of relatively narrow diameter, that is, with thinner gauge wire than has been necessary in previous constructions. The crank is secured to the outside of a rotatable shaft, and a double-armed lever is mounted on this shaft within the housing. The plungers of the two solenoids carry convexly curved cams riding on these arms. The arrangement is such that at the beginning of its stroke, the plunger of each solenoid will be connected by its cam to an outer portion of the arm. As the plunger descends into the coil and is drawn by a greater force, its cam will move inwardly along the arm so that the moment arm decreases. Therefore, the torque on the actuating lever will be substantially constant throughout the plunger's stroke and the wire size of the coil may be smaller than with conventional coils.

The shaft on which the crank and double-armed lever are mounted is so constructed as to permit sealing to the housing by a snap-on rubber boot, and at one end is rotatably supported by a blind socket pressed from the flat housing. A portion of the shaft is square so that the lever may be mounted thereon in any four positions, thus permitting the housing to be secured in various positions on the door latch frame. In this manner, the unit is usable with different door latch designs. The flat sealed nature of the unit is advantageous, permitting mounting inside the path of the window for additional protection. Mounting of the unit directly on the door latch frame also permits a shorter linkage to the lock, increasing the efficiency of the device because of the decreased travel requirements. The lever may also actuate a switch to be used in sequencing door locking or indicating the lock position.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view of the door latch on which the lock actuator of this invention is mounted;

FIG. 2 is a side elevational view of the door latch from outside the door;

FIG. 3 is a top plan view of the door latch and locking actuator;

FIG. 4 is an elevational view of the door latch and actuator from the inside of the door edge looking towards the rear of the vehicle;

FIG. 5 is an enlarged elevational view of the locking actuator, portions of the housing being removed; and

FIG. 6 is an elevational view of the actuator taken in the direction of arrow 6 of FIG. 5, parts being sectioned for clarity.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

An automobile door latch is generally indicated at 11 and comprises a frame generally indicated at 12 having a base 13 and a flange 14 extending at right angles thereto. In the present instance door latch 11 is for a right front door, the inside of the door being indicated partially in dot-dash lines at 15 and the outside of the door at 16. A portion of the window glass is also indicated in dot-dash lines at 17, it being noted that the glass will pass between the outside 16 of the door and flange 14, which is adjacent the inside of the door.

The basic components of door latch 11 include a latching member 18 engageable with a keeper (not shown) on the door frame and a detent 19 spring-urged into engagement with latch 18. To unlatch the door the detent is moved out of engagement with the latch either by an outside door operator 21 or an inside operator 22. These operators are connected to an intermediate level 23 pivoted at 24 to base 13 and carrying a slide 25 which engages detent 19, swinging the detent clockwise from its FIG. 4 position to retract it from latch 18.

The locking mechanism with which the present invention is associated comprises means for moving slide 25 between locking and unlocking positions with respect to detent 19. Slide 25 is shown in its unlocking position in FIG. 4, with tab 26 thereof aligned with the upwardly extending arm 27 of detent 19. In the locking position slide 25, which is pivoted at 28 to lever 23, is swung counterclockwise from its FIG. 4 position so that tab 26 is out of alignment with arm 27. Rocking of lever 23 will therefore merely reciprocate slide 25 without engagement of the detent.

The means for moving slide 25 between the locking and unlocking positions comprises a guide 29 for tab 26, held in its shifted position by an overcenter spring

30. This guide is of U-shaped construction, its central portion having an elongated slot 31 within which tab 26 is slidably disposed. One arm 32 of guide 29 is pivoted at 33 to flange 14, the other arm 34 being pivoted at 35 to an extension 36 on base 13 which is substantially parallel to flange 14. Guide 29 is thus capable of being rocked between its solid and dot-dash line positions in FIG. 2 to move slide 25 between unlocking and locking positions.

Guide 29 is adapted to be moved either by a key (not shown) from the outside of the door or by the electrical actuator of this invention on the inside. The means for moving guide 29 from the outside comprises a slotted portion 37 in arm 34 connectable to the key tumbler which is mounted on the outside of the door. The means for operating guide 29 from the inside comprises a rod 38 which is connected to arm 32. It should be noted at this point that the particular means for operating the locking mechanism will vary for different door latch models and door positions, and that the invention about to be described is adaptable to these various types of mechanisms.

The actuating mechanism of this invention is generally indicated at 39 and comprises a housing 40 having a mounting plate 41 and a cover 42 secured thereto. The mounting plate is of generally rectangular shape having a plurality of fastener openings 43 at spaced points along its edges. Two of these fastening holes are used to secure actuator 39 to flange 14 with the long axis of the housing extending vertically. It will be understood that for other door latch models the mounting plate could be secured along edge 44.

Mounting plate 41 is generally flat but, as seen in FIG. 6, has an indented portion 45 in the center of which is a pressed-out blind socket 46 with a circular wall. Cover 42 is somewhat smaller than the mounting plate and is provided with a surrounding flange 47 secured to the mounting plate by tabs 48. Cover 42 has a depressed upper portion 49 with an aperture 50 aligned with socket 46. A bushing generally indicated at 51 has a reduced portion 52 extending through and staked to aperture 50 and an enlarged portion 53 outside the housing and having a shoulder 54.

A shaft 55 extends through and is rotatably supported by bushing 52. Portion 56 of this shaft within cover 42 is of tapered square cross-sectional shape and is rotatably supported by socket 46. For this purpose the socket may have a central dimple 57 engaging the end of the shaft, the sides of the shaft being engageable with the socket wall at their corners so as to minimize frictional resistance. The outer end of shaft 55 has a crank 58 extending therefrom, the crank being connected to rod 38 which actuates the locking mechanism. As illustrated, clockwise rotation of crank 58 in FIG. 2 will move the locking mechanism to its unlocking position and counterclockwise rotation will shift it to its locking position.

A lever generally indicated at 59 is mounted on square portion 56 of shaft 55 within housing 40. Lever 59 has a square hole fitting over the shaft and a pair of arms 61 and 62 extending from opposite sides thereof. These arms have straight upper edges which are aligned but are below the shaft axis. A pair of solenoids 63 and 64 are mounted within housing 40 on parallel axes below lever 59. The solenoids have plungers 65 and 66 respectively extending upwardly therefrom and the upper portions of the plungers having slots 67 and 68 into which arms 61 and 62 extend. A pair of cams 69 and 71 are secured in the upper portions of slots 67 and 68. These cams are of convex arcuate shape and so arranged that they engage the upper edges of arms 61 and 62 at varying points along their length during the plunger stroke. More particularly, when a plunger is at the upper end of its stroke its cam will engage the outer end of the arm, but as the plunger descends the engagement point will travel closer to the pivot axis until, at the bottom of the plunger stroke, the cam will engage the arm much closer to the pivot axis than at the beginning. It is well known that the force with which a solenoid coil attracts a plunger increases as the plunger enters the coil. Since this increased force will be accompanied by a shortening of the moment arm on lever 59, the output torque at crank 58 will be substantially constant throughout the entire length of stroke of each plunger.

A notched portion 72 is provided in lever 59 between arms 61 and 62, and a switch 73 such as a flip-flop reed switch is mounted in housing 40, the reed 74 thereof being disposed between shoulders 75 and 76 of notch 72. During rocking of lever 59 switch 73 will thus be actuated between two positions. The switch could be used to indicate the position of the door locking mechanism or as an element in a sequence locking system.

A rubber-like boot 77 is mounted on bushing portion 53, the seal having a first bead 78 engaging the bushing and a second seal 79 engaging shaft 55. Boot 77 could be installed by snapping it into position.

As stated previously, housing 40 could be mounted in any of a variety of positions on the door latching mechanism, depending on the mechanism construction and the clearances provided within the door. This flexibility in mounting is enhanced by the fact that lever 59 may be mounted in any of four positions 90° apart on shaft portion 56. Thus, the rotational position of crank 58 with respect to housing 40 is similarly adjustable. It should be observed, particularly in FIGS. 1 and 4, that the direct mounting of the relatively flat housing 40 on door latch frame 12 enables the location of the unit to be inside glass 17, thus affording additional protection against water deterioration.

In operation, assuming an initial condition in which guide 29 is in its unlocking position, as shown in solid lines in FIG. 2, lever 59 will be in the position shown in FIG. 5. Upon energization of solenoid 64, cam 71 will be drawn downwardly against arm 62. Since the outer end of cam 71 engages arm 62 at this time, the moment arm will be relatively great even though the magnetic force on plunger 66 is relatively weak. As lever 59 begins to rotate (plunger 65 rising at the same time) cam 71 will engage arm 62 closer and closer to the rotational axis of the lever. This decrease in the moment arm will be accompanied by an increased magnetic force on plunger 66 so that the torque exerted by arm 58 will be substantially constant throughout the stroke. The parts will come to rest with plunger 66 in its lower position and plunger 65 in its upper position, guide 29 being then held in its locking position by spring 30. To return the parts to their unlocking position, plunger 65 will be retracted downwardly, and again the torque exerted by arm 58 will be substantially constant throughout the stroke.

It should be noted that during the first portion of the stroke of each plunger, any sliding action that takes place between its corresponding cam and the arm

which the cam engages will produce a frictional force tending to aid the rotation of lever **59**. This is because of the fact that the positions of arms **61** and **62** are below the rotational axis of lever **59**.

Because of the novel construction, it is possible to use substantially thinner gauge wire in constructing coil **63** and **64**, and the result is that the entire unit can be with much smaller dimensions than has heretofore been the case for locking mechanisms.

I claim:

1. In an actuator for the locking mechanism of an automotive door latch, a housing, a shaft supported by said housing, a pair of solenoids within said housing, a pair of plungers movable into and out of said solenoids, a crank on said shaft connected to said locking mechanism, and means for rocking said crank between locking and unlocking positions comprising connections between each of said plungers and said crank, each connection having a variable moment arm with respect to said crank which decreases as the plunger descends into its solenoid.

2. The combination according to claim **1**, said connections comprising a lever mounted on said shaft, said lever having a pair of oppositely extending arms, said solenoid plungers having convex arcuate cams engaging said arms in such manner that each cam engages the outer end of its arm at the beginning of the plunger stroke and the inner end at the end of the stroke.

3. The combination according to claim **2**, said arms extending into slots formed in said plungers, said cams being carried within said slots.

4. The combination according to claim **2**, the surfaces on said oppositely extending arms engaged by said cams being spaced from the rotational axis of said lever whereby frictional forces exerted by said cams on said lever during the beginning of each plunger stroke will assist lever rotation.

5. The combination according to claim **2**, further provided with a switch mounted in said housing, and spaced shoulders on said lever engageable with said switch whereby the switch will be operated in response to rocking of said lever.

6. The combination according to claim **1**, said housing being of flat shape, and a plurality of mounting holes formed around the edges of said housing whereby the housing may be mounted in a variety of positions on the door latch.

7. The combination according to claim **1**, said shaft having a portion of circular cross section, a bushing in said housing supporting said last-mentioned shaft portion, said crank being outside said housing, and an annular seal having a first portion engaging said bushing and a second portion engaging said circular shaft portion outside the bushing.

8. The combination according to claim **7**, said seal comprising an annular rubber-like boot having a first seal portion which may be snapped over a shoulder on said bushing and a second seal portion engaging said circular shaft portion.

9. The combination according to claim **1**, said shaft having a portion of square cross-sectional shape within said housing, said connections between the crank and plungers comprising a double-armed lever mounted on said last-mentioned shaft portion, whereby the angular orientation between said lever and crank may be varied in order to mount the housing in different positions with respect to door latches.

10. The combination according to claim **9**, said housing being provided with a blind socket into which said square shaft portion extends and is rotatably supported.

11. The combination according to claim **10**, the end of said blind socket having an indented portion engaging the end of said shaft to reduce said axial play.

12. The combination according to claim **9**, said shaft further having a portion of circular cross section, a bushing carried by said housing and supporting said last-mentioned shaft portion, and a rubber-like snap-on boot seal engaging said bushing and circular shaft portion.

13. The combination according to claim **12**, said plungers carrying convex cams engaging said double-armed lever, each cam engaging the outer end of its lever at the beginning of the plunger stroke and the inner end at the end of the stroke, whereby the moment arm of the solenoid force on the lever decreases as the plunger descends into the solenoid coil.

14. The combination according to claim **1**, said shaft being rotatably supported by said housing, said connections being between said plungers and said shaft.

15. The combination according to claim **2**, said door latch being mounted at the edge of an automobile door having inner and outer panels and a sliding window descending therebetween, said door latch having a frame, said actuator housing being substantially flat, secured directly to said door latch frame, and disposed between the sliding glass and the inside door panel.

16. In combination, an automobile door having inner and outer panels and a sliding window descending therebetween, a door latch having a frame mounted at the edge of said door, a locking mechanism on said door latch shiftable between locking and unlocking positions, and an electric actuator for said locking mechanism comprising a substantially flat housing mounted within said door between the sliding glass and the inside panel thereof, said actuator having a pair of alternately energizable solenoids within said housing, a shaft rotatably mounted in said housing and extending outwardly therefrom, a crank on said shaft linked to said locking mechanism, plungers for said solenoids, and connections within said housing between said plungers and shaft, said last-mentioned connections comprising a double-armed lever mounted on said shaft and convex cams carried by said plungers, whereby each plunger will be connected to the outer end of its lever arm at the beginning of the plunger stroke and to the inner end at the end of the stroke so as to decrease the moment arm of the solenoid forces on the lever as each plunger descends into its solenoid coil.

17. The combination according to claim **16**, said housing being mounted directly to said door latch frame, mounting holes on said housing whereby the housing can be mounted on frame in any of a variety of positions, said double-armed lever being mounted on a portion of said shaft having a square cross-sectional shape, whereby the angular orientation of said lever with respect to said crank may be varied.

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