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E05B 47/00

(52) UK CL (Edition P)
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EP 0262959 A2 WO 84/03909 A1

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INT CL[6] E05B 47/00 47/02
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(54) Abstract Title
Electronically operated lock

(57) An electronically operated lock has a latch mechanism 24 which is operable by a rotatable spindle 18. The spindle 18 can be rotated manually either by an inside turn lever 10 or a key operated outside plug 14 or rotated electronically. A pinion 80 is secured to the spindle 18 and a slider 56 supported for vertical displacement has a vertical rack 82 which cooperates with the pinion 80. The slider 56 has vertically separated upper and lower control surfaces 52, 54 fig 4 and a rotatable wheel gear 39 has an eccentric axially extending finger located intermediate the upper 52 and lower 54 control surfaces. The wheel gear 39 is driven by a single direction motor through gearing. The upper 52 and lower 54 control surfaces are selectively located so that when the finger is rotated in one direction from a 3:00 position to a 9:00 position, the displacement of the slider 56 will displace the bolt 30 to the retracted position and so that when the finger is rotated in that direction from the 9:00 position to the 3:00 position, the displacement of the slider 56 will displace the bolt 30 to the advanced position.

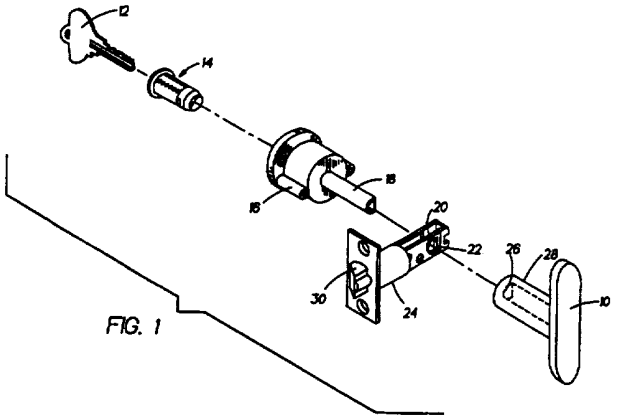
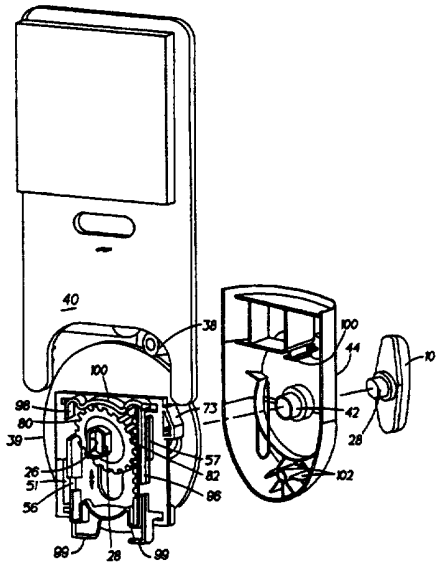


FIG. 1

FIG. 5



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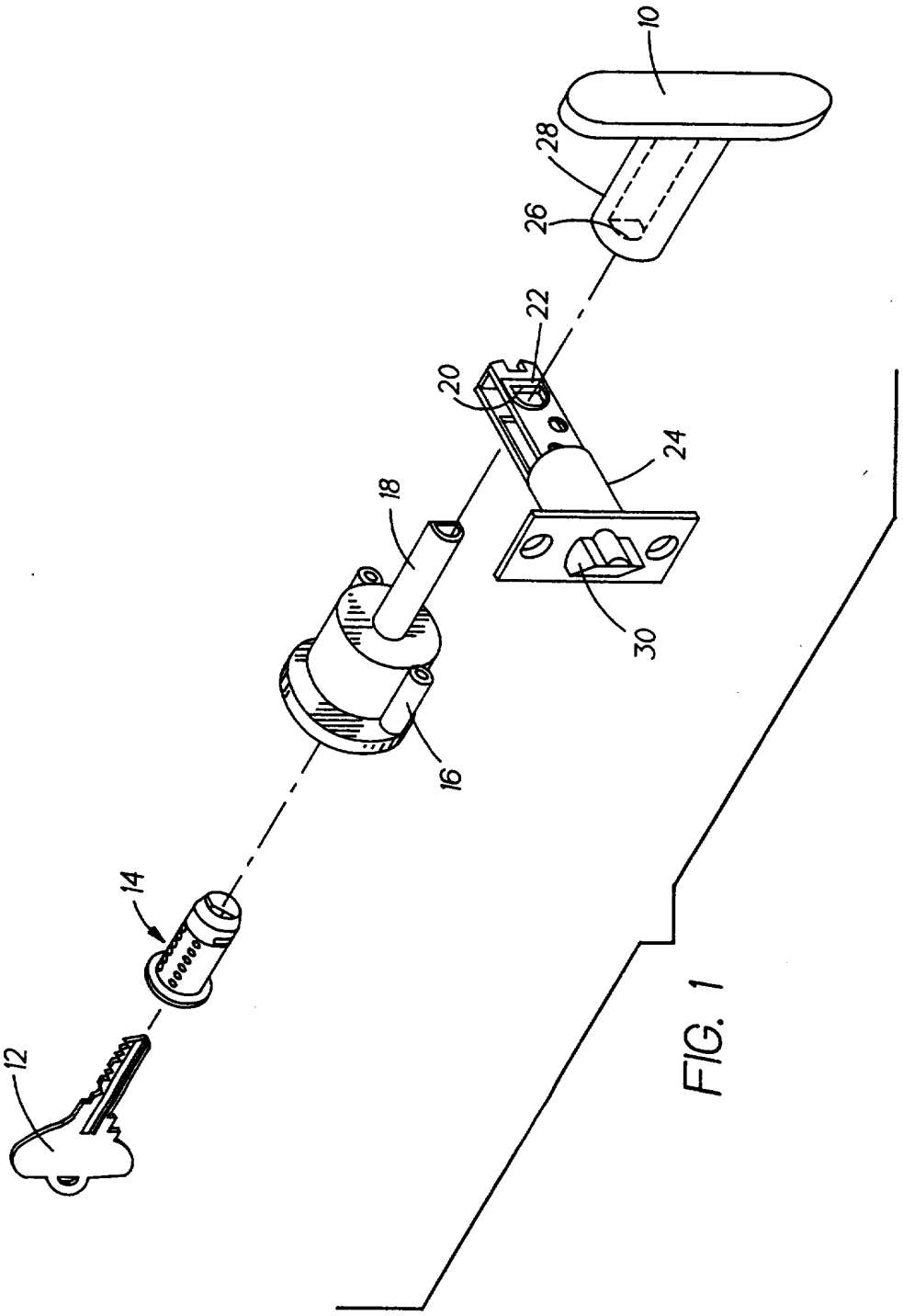


FIG. 1

FIG. 2

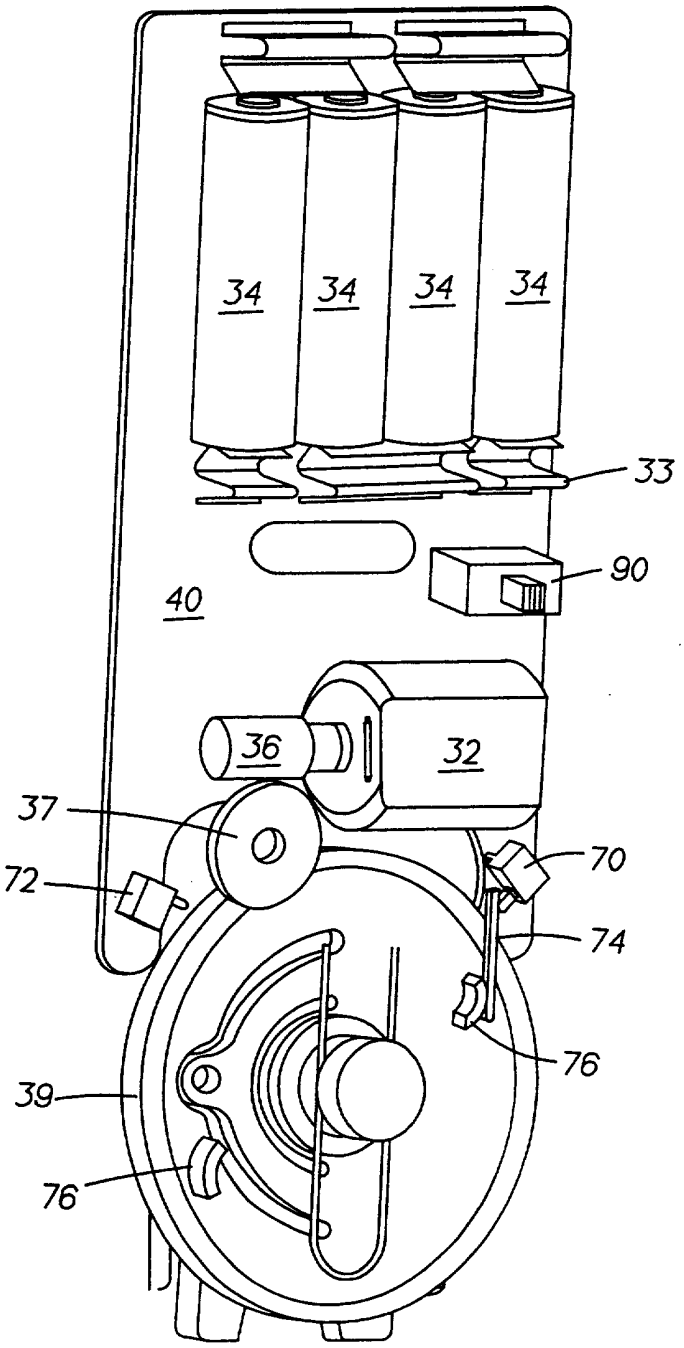


FIG. 3

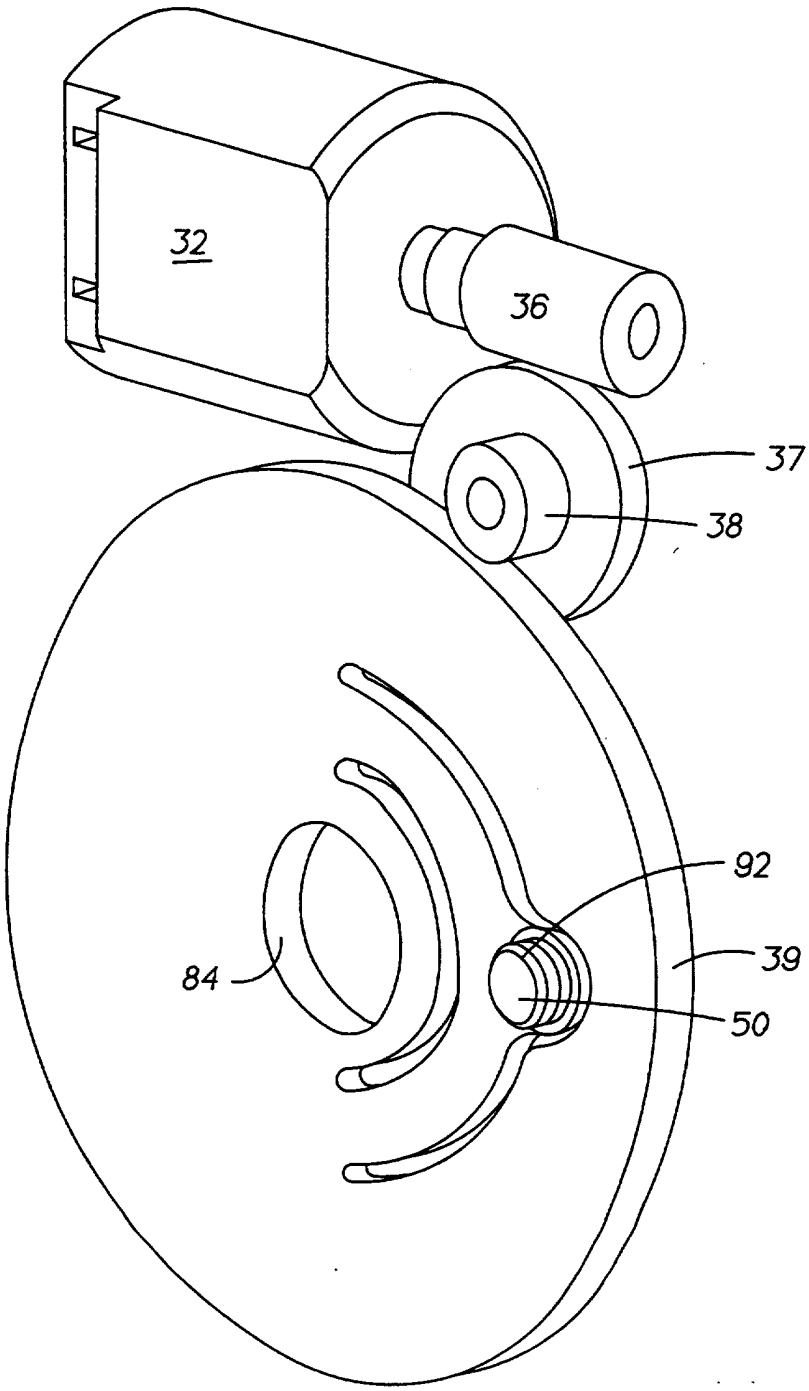


FIG. 4

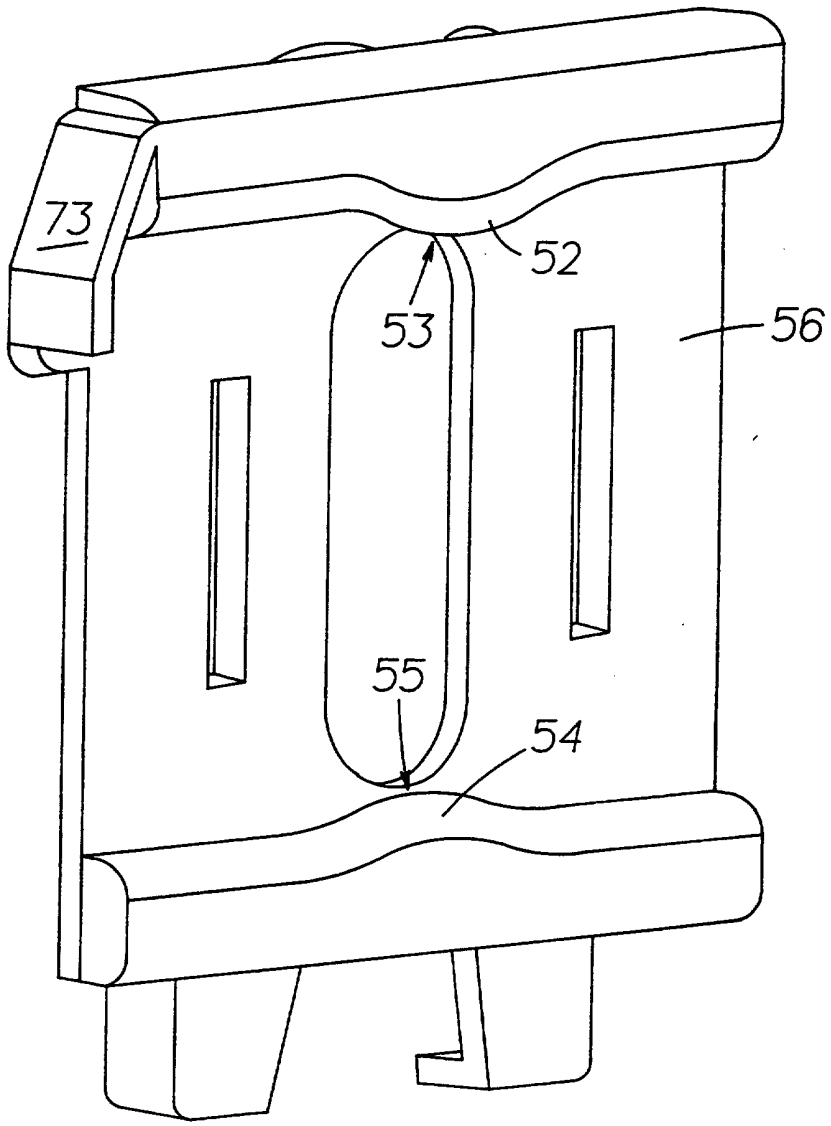


FIG. 5

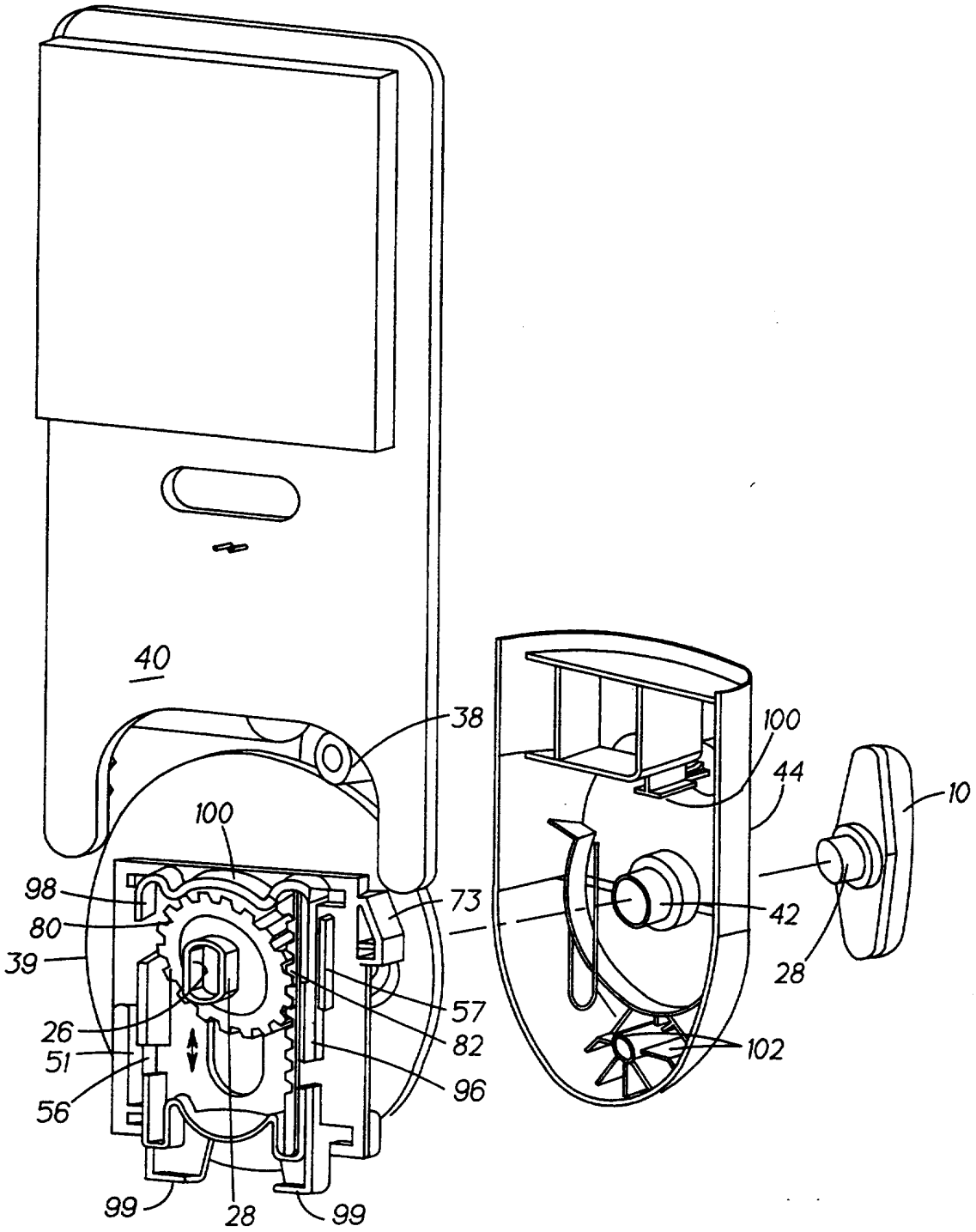


FIG. 6

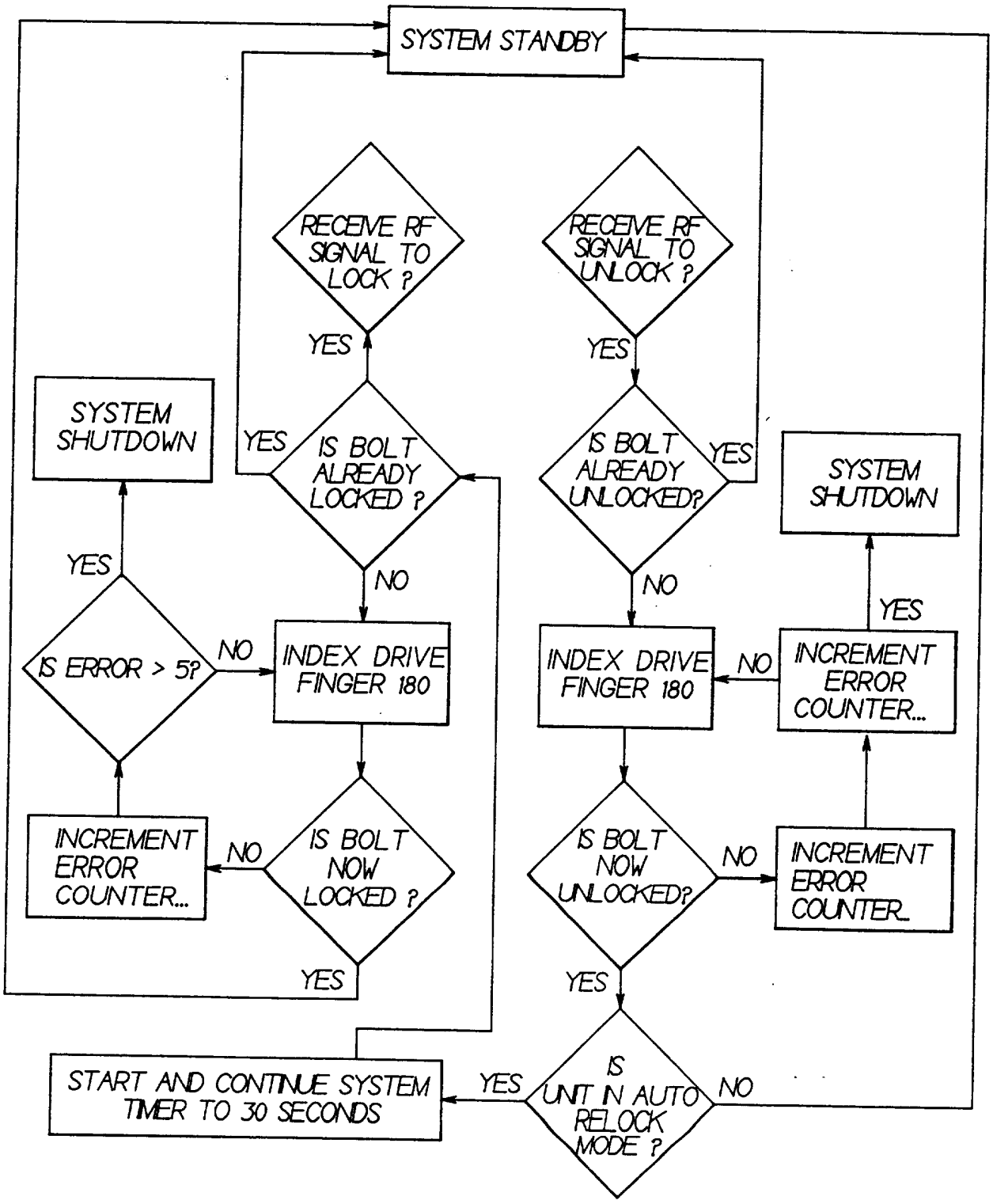

SYSTEM STANDBY
RECEIVE RF SIGNAL TO LOCK ?
RECEIVE RF SIGNAL TO UNLOCK ?
YES
YES
SYSTEM SHUTDOWN
YES
IS BOLT ALREADY LOCKED ?
IS BOLT ALREADY UNLOCKED?
YES
SYSTEM SHUTDOWN
NO
NO
YES
YES
IS ERROR > 5?
NO
INDEX DRIVE FINGER 180
INDEX DRIVE FINGER 180
NO
INCREMENT ERROR COUNTER...
INCREMENT ERROR COUNTER...
IS BOLT NOW LOCKED ?
IS BOLT NOW UNLOCKED?
NO
NO
INCREMENT ERROR COUNTER
YES
YES
IS UNIT IN AUTO RELOCK MODE ?
YES
NO
START AND CONTINUE SYSTEM TIMER TO 30 SECONDS

FIG. 7

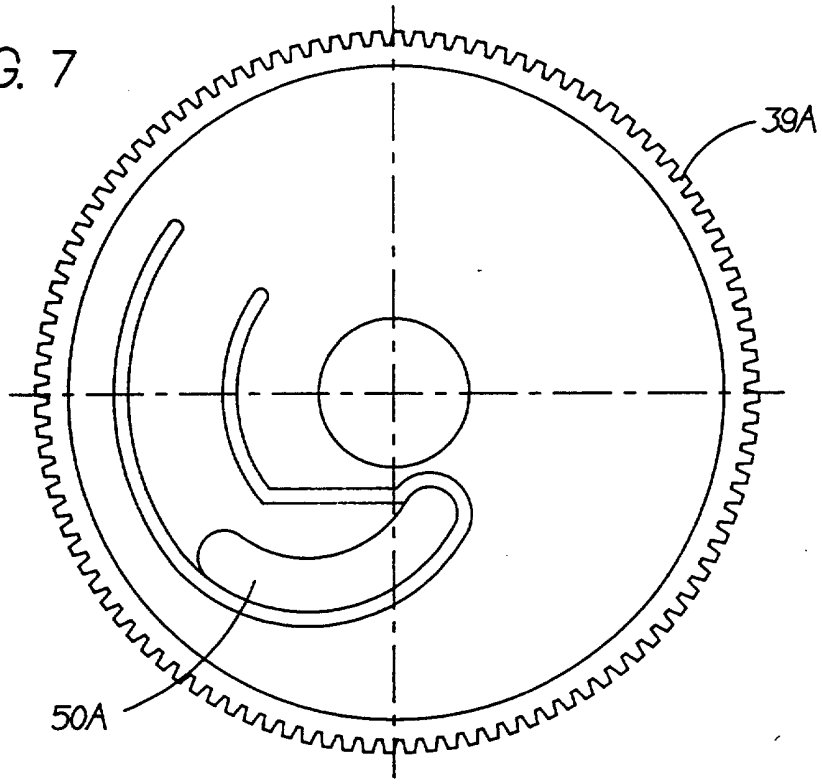


FIG. 8

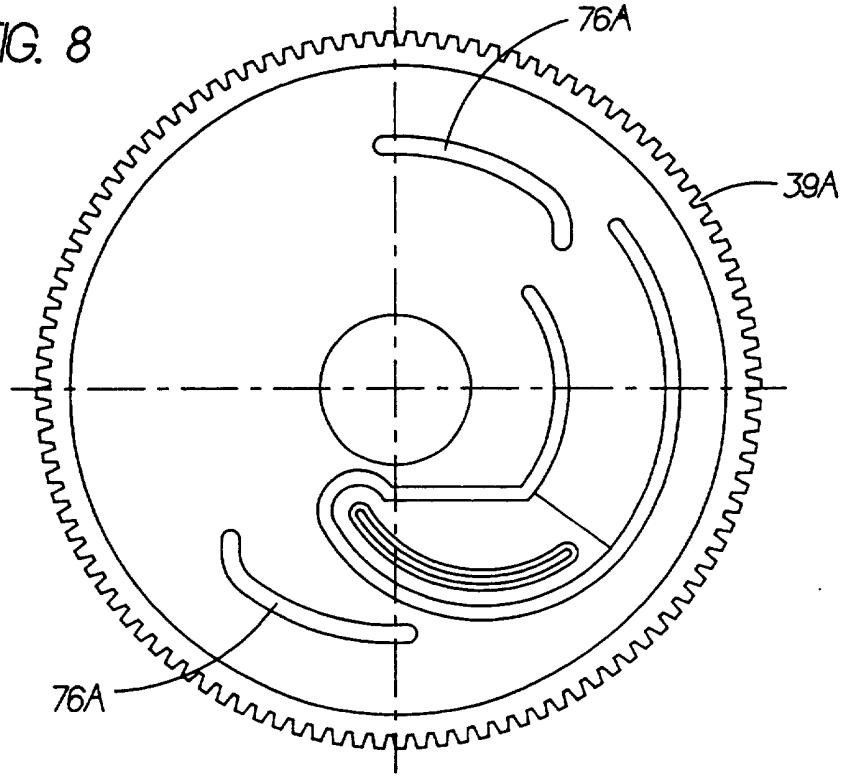
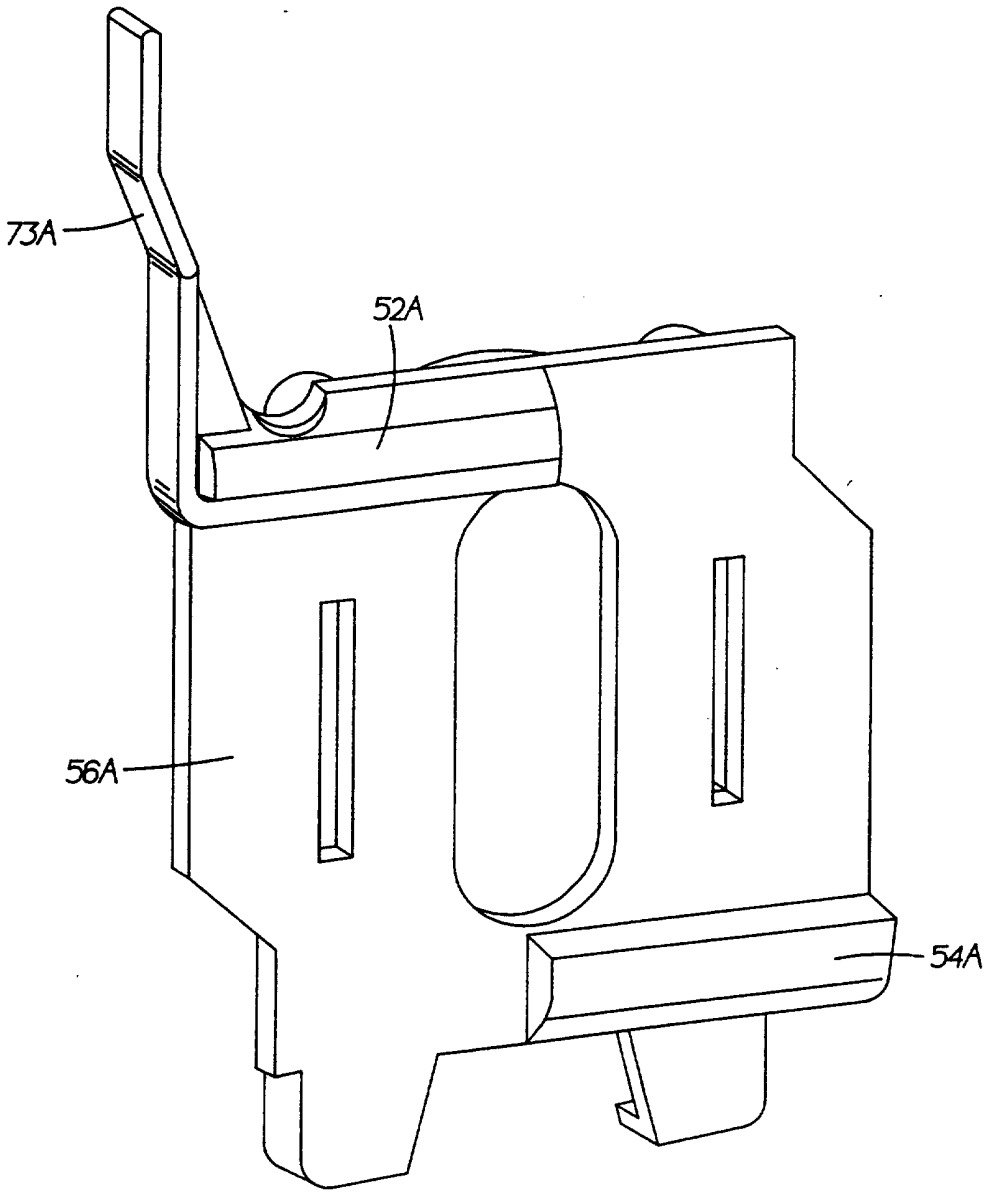


FIG. 9



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ELECTRONICALLY OPERATED LOCK

The present invention relates to a door lock and, more particularly, to a door lock which is electronically operated.

To secure a door, a deadbolt may be extended from the door into a suitable opening in the door jamb. The deadbolt may be separate from other locking elements or it can be interconnected with a conventional lock which is operated with a knob or lever.

Deadbolts are available which have battery powered deadbolt pulling and advancing mechanisms actuated by inputting a code into a finger operated terminal.

The cost of rolling code technology has reduced to the point where it is economically feasible to incorporate this technology into such a lock.

It is accordingly an object of the present invention to provide a lock which has a bolt which can be operated by inputting a code via a transmitter or finger operated terminal.

An embodiment of a door lock will now be described with reference to the accompanying drawings in which:

Figure 1 is an oblique exploded view of a portion of a deadbolt;

Figure 2 is a perspective view, from the front, of the interior turn lever assembly;

Figure 3 is a perspective view of the motor/worm gear/wheel gear shown in Figure 2, seen from the inside;

Figure 4 is an oblique view, from the front of the rack portion of the interior turn lever assembly;

Figure 5 is a perspective view, from the rear, of the interior turn lever assembly;

Figure 6 is an electronic flow chart for the control of the electronic lock;

Figure 7 is a view from the inside of an alternate wheel gear;

Figure 8 is a view from the outside (front) of the alternate wheel gear shown in Figure 7, and

Figure 9 is an oblique view, from the front of a rack portion of the interior turn lever assembly having an alternate embodiment to be used with the wheel gear shown in Figures 7 and 8.

A deadbolt is conventionally operated by either turning a turn lever 10 on the inside of the door or by turning a key 12 on the outside of the door. The key is introduced into a plug 14 which is received by a suitable housing 16. Rotatably secured within the housing is a torque blade 18 which is "D" shaped in cross section and which extends through a similarly shaped opening 20 in the actuator 22 of a dead latch 24 and into a similarly shaped hole 26 in the shaft portion 28 of the interior turn lever 10. The plug is connected to the torque blade and accordingly rotation of the torque blade either by rotating the turn lever 90° or turning the key 90° will either advance (throw) or retract the bolt 30.

To operate the deadlock electronically, a run signal is supplied to the single direction D.C. 6V motor 32. The control 33, which can be a receiver type control which receives signals from a remote transmitter and the motor are battery 34 powered. The motor has a worm output 36 which drives a worm gear 37 which has a small coaxial gear 38.

(Figure 3) which drives a wheel gear 39 (there is a 250/1 gear reduction from the wheelgear to the worm). The worm gear is rotatably mounted on a support bracket 40 which also supports the motor and the batteries and the wheel gear is rotatably mounted on a suitable bearing member 42 (Figure 5) on the inner surface of the lower shroud 44 of the interior operator assembly.

The inner (facing the door) surface of the wheel gear (Figure 3) has an axially projecting finger 50 which is button shaped and is located between an upper downwardly facing control surface 52 and a lower upwardly facing control surface 54 of a slide 56 (displacement of the slide is restricted to vertical displacement by opposed vertical rails 57 (partially shown) on a slide cover (not shown for clarity). The wheel gear has two "home" positions: one with the finger at 3:00 and the other with the finger at 9:00 and the wheel gear, as shown in Figure 3, rotates counterclockwise. Assuming that the bolt is advanced with the finger at 3:00 and the slide at its fully down position as shown in Figure 5, operation of the motor will rotate the wheel gear counterclockwise to bring the finger into engagement with the upper control surface 52. When the finger is at 12:00 it will engage the peak 53 location of the upper control surface and the slide will be at its fully up position. The motor will stop when the finger reaches 9:00 where the finger is proximate the lower control surface 54. When the motor is again operated, the finger will continue to move counterclockwise engaging the lower control surface 54 and setting the fully down position when it is at the peak 55 of this surface. Counterclockwise rotation will continue until the finger again reaches the 3:00 position proximate the upper control surface. To control the operation of the motor a plunger style micro switch 70 (Figure 2) is secured to the support bracket to monitor the

indexing of the wheel gear 39 and another similar switch 72 is secured to the support bracket to monitor whether the slide is within 1/8" of its fully up (unlocked) position. The first switch 70 is operated by a lever 74 which is mounted on the support bracket and which will be displaced by a pair of lever operators 76 secured to the rear of the wheel gear and displaced to operate the switch. When the motor is operated it will continue until one of the lever operators displaces the switch lever whereupon the motor will stop. The second switch 72 is operated by a ramp 73 (figure 5) at the top of the slide 56 which will displace the plunger of the second switch 72 if the slide is within 1/8" of its fully up position. If the second switch is operated, the control knows that the slide is at the up position.

Referring to Figure 5, a pinion 80 is mounted on the shaft portion 28 of the turn lever 10 and cooperates with a vertical rack 82 secured to the rear side of the slide. In the manual mode, rotation of either the key or the turn lever will rotate the torque blade 18 that is located within the "d" shaped opening 26 of the shaft portion 28 to displace the bolt either to the retracted position or to the advanced position. In this mode whenever the shaft portion is rotated (the shaft portion passes freely through the central hole 84 in the wheel gear), the pinion will rotate and the rack will be displaced vertically with no function. In the electronic unlock mode (Figure 6), a transmitter 100 transmits an RF unlock signal which is received by a receiver (step 102) which will verify that the bolt is in fact extended whereupon (step 104). If the bolt is extended the motor will be operated to index the drive finger 180° (step 106 - the wheel gear will be rotated counterclockwise 180° from its 3:00 slider fully down\deadbolt advanced position to its 9:00 slider fully up/deadbolt retracted

position). This should unlock the bolt and if the control verifies that the bolt is at the unlocked position (step 108) the control determines whether or not the system is in the auto relock mode (step 110). In the event that the location of the bolt at the retracted position is not verified in step 108 an error counter will be incremented (step 112), the count (now 1) will be compared to 2 (step 114) and since the error count is less than 2, a second attempt will be made to retract the bolt (step 106). If the bolt again is not retracted the error counter will be incremented to 2 and since this count is now two, the comparator will send a signal (step 114) which will result in the issuance of an error signal. In the manual relock mode, the deadbolt will be manually relocked (while the manual relocking of the deadbolt lowers the slide to its lowest position, the finger does not move from its 9:00 position). When the control again receives an RF signal to unlock, it will know that the bolt has been advanced (step 104) and as a result the wheel gear will again be indexed 180° returning the finger to the 3:00 position. Since this will occur without retracting the bolt step 108 will result in the error counter being incremented (step 112) and the comparator (step 114) again operating the motor to index the drive finger a second 180° (step 106) back to the 9:00 position retracting the bolt.

In the alternative, the transmitter could also send a signal to lock the door. The receiver would receive the lock deadbolt signal (step 118) and then verify that the bolt was in the unlocked position (step 120) and then operate the motor to index the wheel gear the second 180° (step 122) to return the finger to the 3:00 position thereby advancing the deadbolt. The location of the advanced deadbolt is verified (step 124). If the bolt is not advanced an error counter is incremented (step 126) and a

comparator again operates the motor (step 128) to make a second try at advancing the bolt. If the second try fails the error counter is incremented to 2 (step 126) and the comparator issues a signal (step 128) so that an error signal will be generated.

In the fully automatic mode, once the bolt is retracted and a decision is made that the unit is in the auto relock mode (step 110), a timer is operated (step 132) for a selected period of time and issues a signal to operate the motor to index the drive finger to lock the bolt (step 120).

A three position switch 90 can be switched to define operation in either an automatic relock mode or in a nonautomatic mode or can be switched to a third teach mode so that transmitters can be introduced to the system.

As can be seen from Figure 3, the finger has curved surfaces 92 and is supported on a deflectable element 94 so that if the finger ever is located at the 6:00 position with the door locked, manual turning of the turn lever will cam the finger out of the way so that the rack can elevate thereby permitting the pinion to rotate to open the door.

The lock may be installed for either left hand or right operation. Assuming that left hand operation is illustrated, right hand operation would result in movement by the finger in the clockwise direction. In this situation the other half of the upper and lower control surfaces would be engaged by the finger and the rack would be removed from the right side rack support 96 on the slide 56 and flipped over and placed in the left side rack support 98 on the slide. The slider has a pair of feet 99 and a head portion 100 which are contained within an upper rib 100 and two lower ribs 102 in the lower shroud.

The axially projecting finger 50 can be modified from a button as shown in Figure 3 to a curved form similar to the configuration of a banana 50A as shown in Figure 7 so that the moment arm of the finger engaging either the upwardly facing control surface 54A or the downwardly facing control surface 52A will be uniform throughout its engagement. In this embodiment the 3:00 position is the position where the curved finger is located in the 6:00 to 3:00 quadrant and the 9:00 position is the position where the curved finger is located in the 12:00 to 9:00 quadrant. The upwardly and downwardly facing control surfaces 52A,54A need only extend from the center of the slide 56A to the edge thereof. A pair of lever operators 76A will operate the switch 70 which monitors the indexing of the wheel gear 39A. In this alternate embodiment, the ramp 73A is designed to operate the second switch when the slide is within 1/8" of its fully down position (bolt advanced position).

CLAIMS

1 An electronically operated lock comprising

a latch mechanism (24) including a bolt (30) and bolt actuation means having a rotatable actuator (22) for displacing the bolt (30) between advanced and retracted positions,

rotatable spindle means (18) for rotating the rotatable actuator (22),

turn lever means (10) for rotating the spindle means (18) from the interior of a door to displace the bolt (30) between the advanced and retracted positions,

key operated plug means (14) for rotating the spindle means (18) from the exterior of the door to displace the bolt (30) between the advanced and retracted positions,

electronically operated means for rotating the spindle means (18) to displace the bolt (30) from the advanced position to the retracted position including

a pinion (80) secured to the spindle means (18),

a slider (56) supported for vertical displacement and having a vertical rack (82) cooperating with the pinion (80),

the slider (56) having vertically separated upper (52) and lower (54) horizontally extending control surfaces,

a rotatable wheel gear (39) having an eccentric, axially projecting finger (50) located intermediate said upper (52) and lower (54) horizontally extending control surfaces,

a motor (32),

gear means (38) for connecting the output of said motor (32) to said wheel gear (39),

said upper (52) and lower (54) control surfaces being selectively located so that when the finger (50) is

rotated in one direction from a 3:00 position to a 9:00 position, the finger (50) will displace the slider (56) to displace the bolt (30) to the retracted position and so that when the finger (50) is rotated in the one direction from the 9:00 position to the 3:00 position, the finger (50) will displace the slider (56) to displace the bolt (30) to the advanced position.

2 An electronically operated lock according to claim 1, characterised in that the wheel gear (39) includes means for supporting the finger (50) for axial deflection.

3 An electronically operated lock according to claim 2, characterised in that the finger (50) is a button and has a rounded configuration to facilitate the deflection of the finger.

4 An electronically operated lock according to claim 2, characterised in that the finger (50) is arcuate.

5 An electronically operated lock according to claim 1, characterised in that it further comprises first switch means (70) for signaling that the finger (50) is at either the 3:00 position or the 9:00 position.

6 An electronically operated lock according to claim 5, characterised in that it further comprises second switch means (72) for signaling that the slide (56) is substantially at either the bolt retracted or the bolt advanced position.

7 An electronically operated lock according to claim 1, characterised in that it further comprises

a housing (16) for the plug (14), and

a torque blade (18) rotatably supported by the housing (16), and

the turn lever means (10) includes a turn lever portion and a shaft portion interconnected with the torque blade (18),

wherein the spindle means (18) includes the torque blade (18) and the interconnected shaft portion.

8 An electronically operated lock comprising

a latch mechanism (24) including a bolt (30) and bolt actuation means having a rotatable actuator (22) for displacing the bolt (30) between advanced and retracted positions,

rotatable spindle means (18) for rotating the rotatable actuator (22),

electronically operated means for rotating the spindle means (18) to displace the bolt (30) from the advanced position to the retracted position including

a pinion (80) secured to the spindle means (18),

a slider (56) supported for vertical displacement and having a vertical rack (32) cooperating with the pinion (80),

the slider (56) having vertically separated upper (52) and lower (54) horizontally extending control surfaces,

a rotatable wheel gear (39) having an eccentric, axially projecting finger (50) located intermediate the upper (52) and lower (54) horizontally extending control surfaces,

a motor (32),

gear means (38) for connecting the output of the motor (32) to the wheel gear (39),

said upper (52) and lower (54) control surfaces being selectively located so that when the finger (50) is

rotated in one direction from a 3:00 position to a 9:00 position, the finger (50) will displace the slider (56) to displace the bolt (30) to the retracted position and so that when the finger (50) is rotated in the one direction from the 9:00 position to the 3:00 position, the finger (50) will displace the slider (56) to displace the bolt (30) to the advanced position,

first switch means (70) for signaling that the finger (50) is at the 3:00 or 9:00 position, and

second switch means (72) for signaling that the bolt (30) is at the advanced position.

The Patent Office

12

Application No: GB 9809019.4 **Examiner:** Mr A Angele
Claims searched: All **Date of search:** 14 September 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): E2A(AMX)

Int Cl (Ed.6): E05B-047/00, -047/02

Other: EDOC

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 2294087 A	B S SEDLEY	
A	GB 0578563 A	J C & H B BROWN	
A	GB 0482542 A	A L E MAIGRET	
A	EP 0262959 A2	R BUSHNELL	
A	WO 84/03909 A1	TERSAEUS	
	See whole document in each case		

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.