

Oct. 27, 1964

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3,154,302

AUTOMATIC DOOR OPENING AND CLOSING APPARATUS

Filed Jan. 8, 1962

5 Sheets-Sheet 1

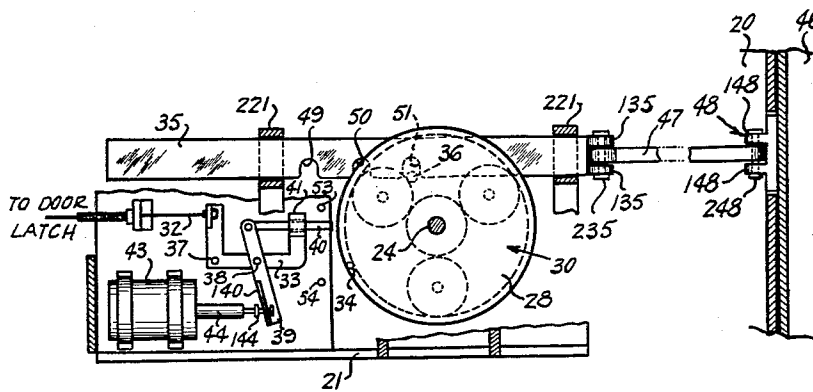


FIG. 1

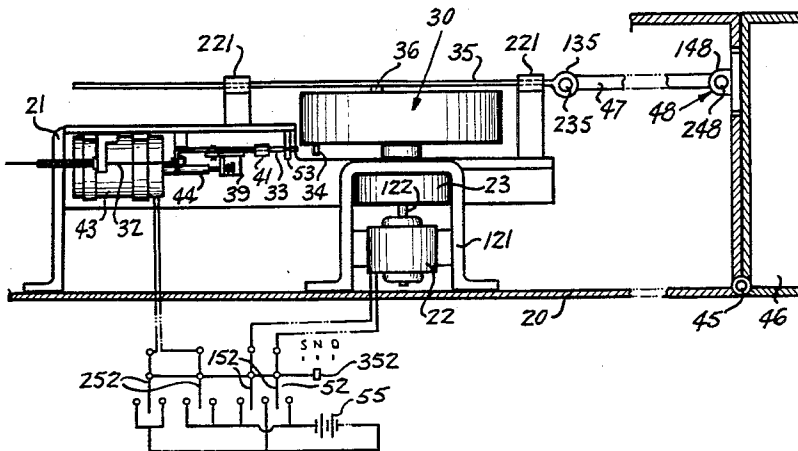


FIG. 2

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5 Sheets-Sheet 2

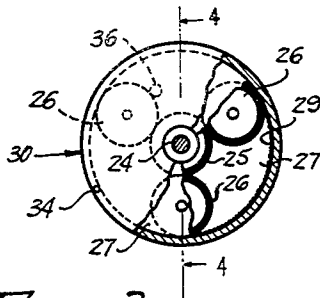


FIG. 3

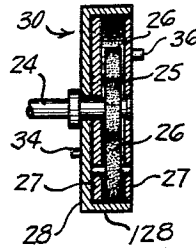


FIG. 4

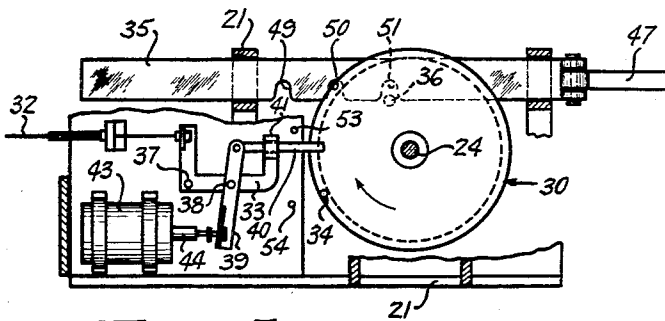


FIG. 5

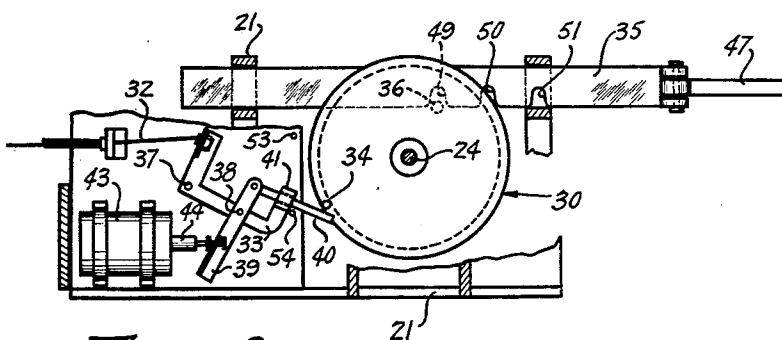


FIG. 6

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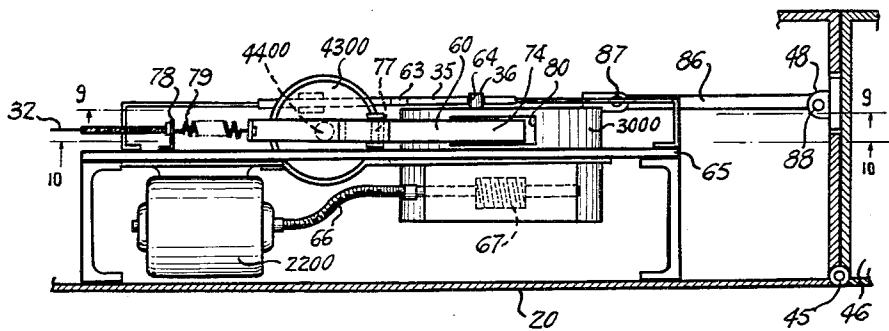
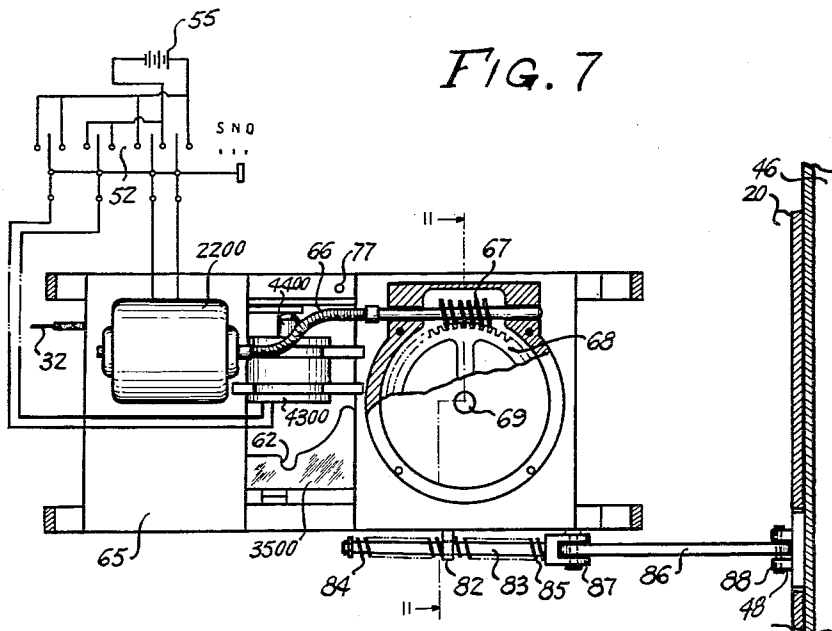
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5 Sheets-Sheet 3



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AUTOMATIC DOOR OPENING AND CLOSING APPARATUS

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5 Sheets-Sheet 4

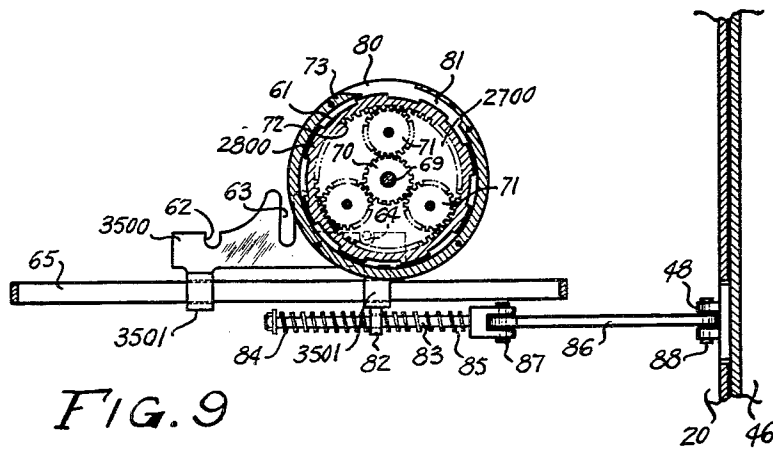


FIG. 9

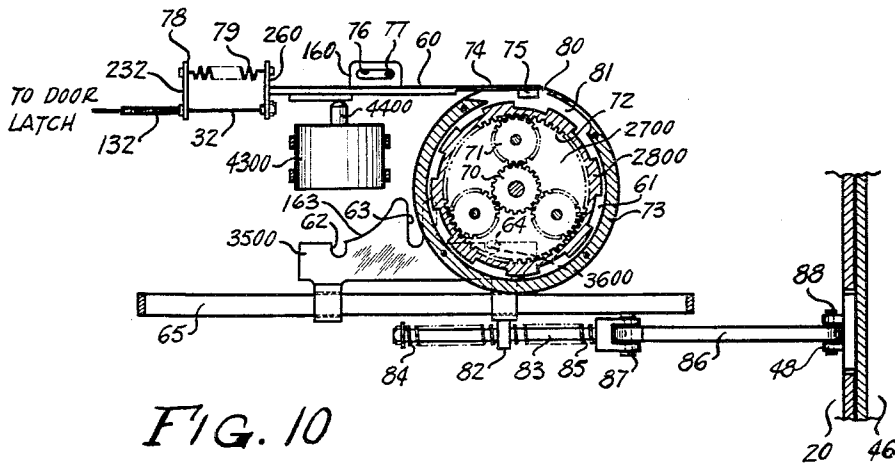


FIG. 10

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3,154,302 AUTOMATIC DOOR OPENING AND CLOSING APPARATUS

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Filed Jan. 8, 1962, Ser. No. 164,805
10 Claims. (Cl. 268—3)

This invention relates to an automatic door opening and closing apparatus, and more particularly to an apparatus for automatically opening and closing a door of a motor vehicle. While the particular mechanism herein described is shown as being designed for operating the door of an automobile, it is applicable to the operation of doors generally.

An object of this invention is the provision of electrically operated means for opening and closing doors.

A further object of this invention is the provision of means controlled by means of a double throw switch for operating in one position to first unlatch the door and then to open same, and operated in another position to close the door and release the latch controlling means.

An additional object of this invention is the provision of a motor driven planetary gearing device which operates in one direction first to release the door latch and then to open the door, and subsequently in the reverse direction to close the door and to release the latch control.

Another object of this invention is the provision of an electromagnet for preconditioning a door latch control means for operation by a planetary gear means to first unlatch the door before operating to open same.

The above and other objects will appear in considering the following specification, which taken with the accompanying drawings constitutes a complete disclosure of my invention.

In the drawings, wherein like characters of reference indicate like parts throughout the several views;

FIG. 1 is a part sectional front elevation showing the invention in position on a door, with the door in closed position, and with parts removed;

FIG. 2 is a plan view of the invention as shown in FIG. 1, parts being in section and including a wiring diagram;

FIG. 3 is a front elevation, partly in section, of a planetary transmission means for operating the door opening and closing means;

FIG. 4 is a section on the line 4—4 of FIG. 3;

FIG. 5 is a fragmentary elevational view showing the position of parts at the start of the door opening operation;

FIG. 6 is a similar view showing the position of the parts at the completion of the door opening operation;

FIG. 7 is a view similar to FIG. 1, showing a modified form of drive, and including a wiring diagram;

FIG. 8 is a plan view of the modified construction shown in FIG. 7;

FIG. 9 is a part sectional view on the line 9—9 of FIG. 8;

FIG. 10 is a part sectional view on the line 10—10 of FIG. 8;

FIG. 11 is a section on the line 11—11 of FIG. 7, and

FIG. 12 is a view similar to FIG. 10 showing the parts in position to open a door.

Referring now to FIGS. 1 to 6, I show a door 20 hinged at 48 to a vehicle frame 46. On the door 20, preferably between inner and outer panels thereof, I provide a frame 21. Suitably mounted on the frame 21 in a case 121 is a motor 22 and on its driving shaft 122 there is a speed reducing means 23. On the shaft 24 of the speed reducing means 23 a friction wheel 25

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is fixedly mounted, to operate as a sun gear. Also rotatably mounted on the shaft 24 is a planet carrier 27 having a plurality of friction surfaced planet wheels 26, in frictional engagement with the sun gear or wheel 25. Also rotatably mounted on the shaft 24 there is a transmission wheel 30 being cup shaped and having an end or bottom wall 28 and a rim 128. Said rim 128 is provided with an interior friction surface 29. A pin 34 projects from the end face 28 for a purpose later to appear.

A U-shaped frame 33 is pivoted, off center, at 37 and has a pull wire 32, such as a Bowden wire, attached to one leg thereof. A lever 39 is pivoted at 38 on the bight of the U and has its upper end pivoted to a plunger 40 which is loosely mounted for sliding movement in the other leg of the U. The lever 39 has a flange 140 extending at right angles thereto. The electromagnet 43 is mounted on the frame 21 and has its core 44 projecting toward the lever 39. The end 144 of the core 44 is loosely mounted in an elongated slot, not shown, in the lever flange 140. Stop pins 53 and 54 are placed respectively above and below the plunger 40, as shown in FIG. 1.

In suitable ways 221 on the frame 21 I mount a slide 35, having spaced notches 49, 50 and 51. A pin 36 projects from the planet carrier 27 and is engageable with the notches 49, 50 and 51 as will later appear. A block member 48 having furcations 148 is suitably attached to the frame 46. A pitman 47 is pivoted at one end on the block 48 by means of a pin 248. The other end of the pitman 47 is pivoted in furcations 135 on the slide 35 by means of the pin 235.

A four pole double throw switch 52 is provided at a suitable location easily accessible to the vehicle operator. Duplicate switches may be installed at other locations as is well known in the art.

The switch 52 has one pair of contactors operable to supply E.M.F. from the battery 55 to operate the motor 22 in either of two directions. The contactors 252 supply E.M.F. to the electromagnet or solenoid 43. The handle and indicator 352 of the switch 52 is movable to three positions; "S" for closed, "N" for neutral, and "O" for open.

The device thus far described operates as follows:

With the switch indicator at N, and the door closed, the part will be as shown in FIGS. 1, 2 and 3. When the switch indicator is moved to O, the motor starts to operate and the electromagnet is energized. Rotation of the speed reducer shaft 24 causes the planetary transmission 30 to start to rotate in a clockwise direction (FIG. 5), but the pin 36 engages the notch 51 in the slide 35. As the door is closed, the slide cannot move to the right (FIG. 1) and the drum 28 commences to rotate counter clockwise. In the meantime the energization of the electromagnet 43 has rotated the lever 39 to slide the plunger 40 into the path of the pin 34. Rotation of the drum 28 then causes the pin 34 to engage the plunger 40 and thus rotates the U-shaped lever 33. The lever 33 rotates until it engages the stop pin 54. Pivoting of the U-shaped lever 33 has by this time pulled the wire 32 to disengage the door latch. The door can now be opened and since the outer ring of the planet transmission is locked, the carrier 27 tends to rotate clockwise and the pin 36 will exert thrust on the slide 35 to move the door 20, by virtue of the motor 22 and frame 21 being mounted on the door. The pin 36 successively engages notches 51, 50 and 49 during 3 revolutions of the planet carrier 27. If the switch is not immediately returned to neutral position N, the door will stop and further rotation will cause slip of the planet wheels 26 on the rim and the sun wheel 25. The door

20 may be retained in open position as long as desired by placing the switch indicator 352 in the N position.

To close the door 20 the switch 52 is moved so that the indicator 352 is at the S position. This again energizes the electromagnet 43 and reverses the rotation of the motor 22. The planetary transmission 30 will tend to rotate counter clockwise. However, the plunger 40, which was released from the pin 34 by de-energizing of the electromagnet, now returns to its operative position by re-energization of the electromagnet 43. The pin 36 engages the notch 49 and as the door cannot move (being in maximum open position) the planet carrier 27 stops. The drum 28 rotates clockwise and the pin 34 engages the plunger 40 to move the lever 33 counter clockwise. As soon as the lever 33 reaches a position wherein the plunger engages the stop pin 53, the planet ring stops and the carrier 27 starts to rotate counter clockwise so that the pin 36 successively engages notches 49, 50 and 51 to close the door. The wire 32 is retracted to allow the latch to operate to retain the door in closed position. Moving the switch indicator to the N position will cause all parts to be in the position shown in FIG. 1.

In FIGS. 7 to 12 a modified form of the invention is shown wherein a frame 65 is attached to the door 20 and carries the operating mechanism. A flexible resilient lever 60 is attached to the pull wire 32 and the wire has a casing 132 to which is attached a bracket 232. A tension spring 79 is attached between the bracket 232 and the attaching means 260. A block 160 is mounted on the lever 60 and is provided with an elongated slot 76 which engages over a pivot pin 77 mounted on the frame 65.

An electromagnet 4300 having a core 4400 is mounted on the frame 65 with the core 4400 positioned in contact with the lever 60. The electromagnet 4300 is supplied with energy from the battery 55 through a switch 52 as hereinbefore described in connection with the electromagnet 43. The motor 2200 has a flexible shaft 66 which drives a worm 67 which in turn drives a worm gear 68. The planetary transmission 3000 is mounted in a housing 73 supported on the frame 65 and comprises a shell or drum member 2800, a planet carrier 2700, sun gear 70 on the shaft 69 of the worm gear 68, a plurality of planet gears 71 on the planet carrier 2700 in engagement with the sun gear, and a ring gear 72 on the interior of the drum 2800, in engagement with the planet gears 71. The exterior of the drum 2800 is provided with a plurality of peripherally spaced notches 61. The upper portion of the housing 73 (FIGS. 9-12) is provided with an upwardly facing opening adjacent the end of the lever 60. Further, a space 81 is provided between the casing 73 and the drum 2800 for a portion of the clockwise rotation thereof. A slide 3500 having guides 3501 mounted on the frame 65 has upwardly facing notches 62, 63 and 64, of varying depths. One of the guides 3501 has a bearing 82 thereon which embraces a sliding bar 83. The bar 83 has compression springs 84, 85 surrounding it on either side of the bearing 82. The bar 83 is pivotally attached as at 87 to the pitman 86 which is pivotally connected at 88 to a bifurcated block 48 attached to the frame 46 as hereinbefore described. A pin 3600 projects from the planet carrier 2700 to engage the notches 62, 63 and 64. The flexible elastic portion 74 of the pivoted lever 60 is provided with a hook member 75 in the form of a small block, which is adapted to be engaged by the notches 61 as described hereinafter.

Energization of the electromagnet 4300 by means of the switch 52 being set to the O position causes the core 4400 to push the lever 60 upwardly bringing the block or hook 75 into the path of the lands between the notches 61. The motor 2200 is energized at the same time and the drive tends to rotate the transmission 3000 counter clockwise. This rotation is resisted by engagement of

the pin 3600 with the notch 64, the door being locked. Therefore, the planet carrier is held against rotation and the drum 2800 starts to rotate clockwise. The block 75 will engage in a notch 61 in the drum 2800 and the lever 60 will be pulled into the cavity 81. This operation pulls the wire 32 to unlatch the door. As the block 75 nears the end of the cavity 81, the left end (FIG. 12) of the slot 76 engages the pin 77 stopping rotation of the drum. At this time, the door being unlatched, the carrier 2700, and the pin 3600 engages the notches 64, 63 and 62 to push the slide 3500 to the right and compress the spring 85 (FIG. 12). This pressure is applied to the pitman 86 and after three rotations of the drum 2800, the door 20 is opened. The initial rotation of the drum 2800 has no effect on the pitman 28, as the energy is taken up by the spring 85 until the latch is released by the pull wire 32. The notch 63 is made deeper than either of the notches 62 or 64, so that the pin 3600 operates therein for a longer time than in either of the other notches. The door is now open and the switch 52 is returned to the N position.

The spring 79 retracts the wire 32 which positions the usual latch to latch the door in closed position when the operating mechanism has been operated for that purpose.

By setting the switch indicator to the S position, as hereinbefore explained, the rotation of the motor 2200 is reversed. The electromagnet 4300 is also energized to rotate the lever 60, but as the mechanism is in the position shown in FIG. 10 with the right end of the slot 76 engaging the pin 77, counter clockwise rotation of the drum 2800 is stopped when the block 75 engages in a notch 61. The planet carrier 2700 then rotates clockwise to move the slide 3500 to the left, by virtue of the pin 3600 successively engaging the slots 62, 63 and 64. Three rotations of the drum 2800 closes the door which is automatically latched by virtue of return of the wire 32. The initial movement in this case is absorbed by the spring 84. Movement of the switch indicator to the N position causes de-energization of the electromagnet 4300 and stops the motor 2200. The block 75 is released from a notch 61 and the parts are in the non-operative position as shown in FIG. 10.

With the switch in the neutral N position the door may be operated manually in the usual manner. The planetary transmission being free, the slide 3500 may be moved by the manual door opening operation without interference with other mechanisms. The pin 3600 slides freely from the recess 64 over the arc shaped portion 163 on either side of the notch 63 and crosses over into notch 62. The door, having been opened automatically, may be closed manually, the operation just described being reversed.

In the above description three notches 49, 50, 51 or 62, 63 and 64 have been described, so that the planetary transmission makes three rotations to open or close the door. It is within the purview of this invention to provide more or less notches allowing the door to be moved either more slowly or faster. Also, only one door has been mentioned. It should be obvious that other doors of a vehicle may be operated in like manner. Further, only one operating or energizing switch has been described, but it should be obvious that any desired number of such switches may be used to operate each door.

Having now described my invention in certain modifications, which are at present preferred, I desire it to be understood that further modifications may be made within the skill of the art and the scope of the appended claims.

I claim:

1. In an automatic door opening and closing device including a door having a latch and a supporting frame, a pitman pivotally connected at one end to the supporting frame, an indented slide movably mounted on the door and pivotally connected at one end to the free end of

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the pitman, a planetary transmission mounted on said door and comprising a cup-shaped ring gear member, and having a planet carrier rotatably mounted therewithin, with planet gears engaging the ring gear member, a sun gear rotatably mounted in said cup-shaped member and engaging the planet gears, means on said planet carrier engageable with indentations in said slide, stop means on said cup-shaped member, means connecting a stop member to said latch with the stop member being engageable with said stop means to first release said door latch and second to stop rotation of said ring gear, causing said planet carrier to move said slide.

2. The structure as defined in claim 1 wherein the stop means includes notches on the periphery of the cup-shaped ring gear member and a slidable and pivoted lever mounted on said door having a flexible hooked end portion engageable with said notches, an electromagnet having a core engageable with said slidable and pivoted lever to move the hooked end of same into notch engaging position.

3. The structure as defined in claim 1 wherein said stop member comprises a plunger, an electromagnet operating said plunger to place same in the path of the stop means on the cup shaped member, means mounting said plunger and adapted for pivotal movement, rotation of said cup shaped drum causing engagement of said stop member with said plunger to move same into engagement with a fixed stop on said door.

4. The structure as defined in claim 3 wherein the means for operating said transmission comprises a reversible electric motor, a speed reducing means between said motor and said transmission, a double throw switch for energizing said electromagnet and for operating said reversible motor in either direction.

5. The structure as defined in claim 4 wherein the

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means releasing a door latch includes a pull wire connected at one end to the door latch, said wire being connected at the other end to the means mounting said plunger for pivotal movement, whereby pivoting movement of said plunger unlatches the door prior to operation of said slide to operate the door.

6. The structure as defined in claim 2 including the means for operating said planetary transmission comprising a reversible electric motor having a flexible shaft and including a worm and gear drive for said transmission, a source of E.M.F. and a double pole switch for energizing said electromagnet and operating said motor in either direction.

7. The structure as defined in claim 6 including a pull wire having one end operable to unlatch the door and the other end connected to said sliding and pivoted lever whereby movement of said lever by engagement of its hook means on the notches of said ring gear drum causes unlatching of the door.

8. The structure as defined in claim 7 including stop means limiting sliding movement of said slideable and pivoted lever.

9. The structure as defined in claim 7 including resilient means between said slide and said pitman to absorb initial movement of said ring drum.

10. The structure as defined in claim 1 including fixed stop members on said door cooperating with the stop means to prevent rotation of the cup-shaped member after a limited predetermined rotation in either direction.

References Cited in the file of this patent

UNITED STATES PATENTS

1,594,706	Berger	Aug. 3, 1926
2,086,030	Hodgson et al.	July 6, 1937