Dec. 8, 1953 P. L. SCHNEIDER ET AL 2,661,730

ENGINE STARTER CONTROL APPARATUS

Filed Nov. 30, 1950

4 Sheets-Sheet 1

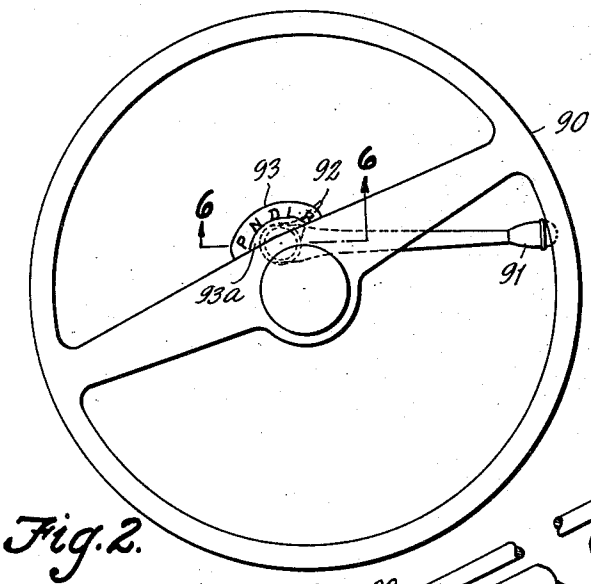
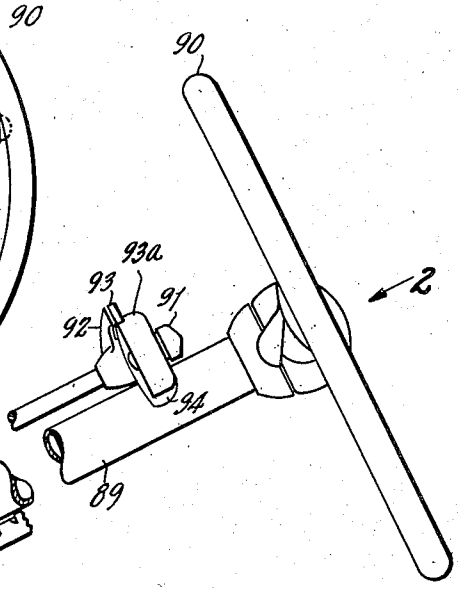


Fig. 2.



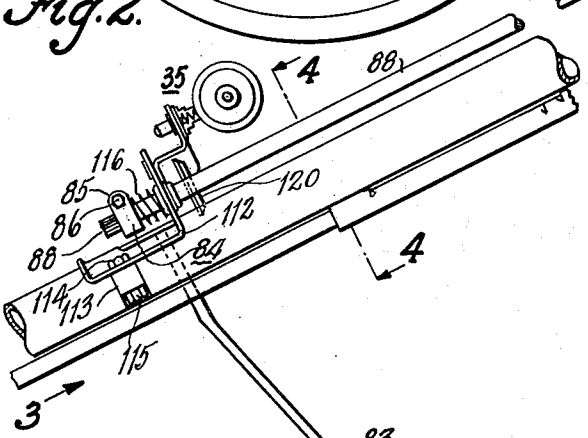


Fig. 1.

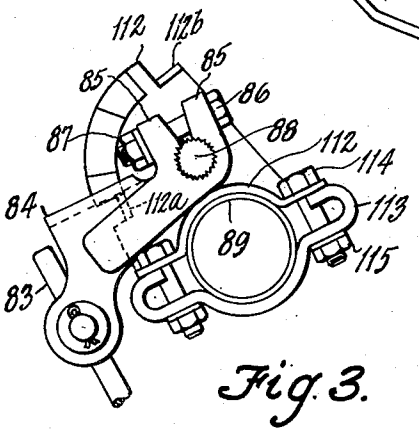
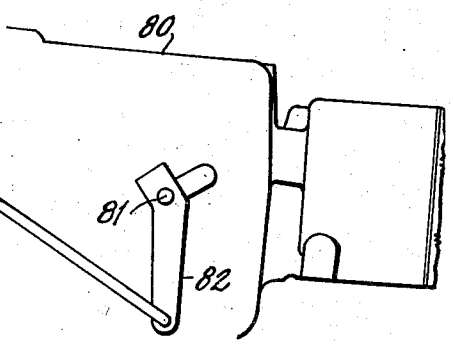


Fig. 3.



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Fig. 8.

Fig. 5.

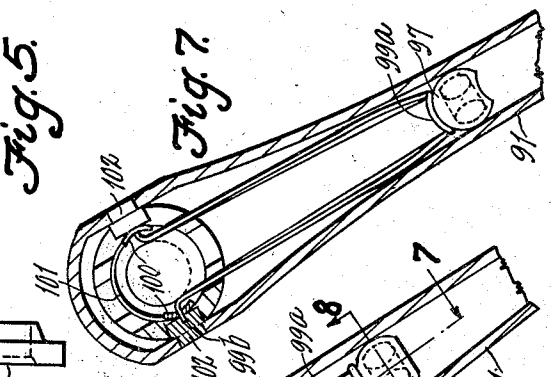


Fig. 7.

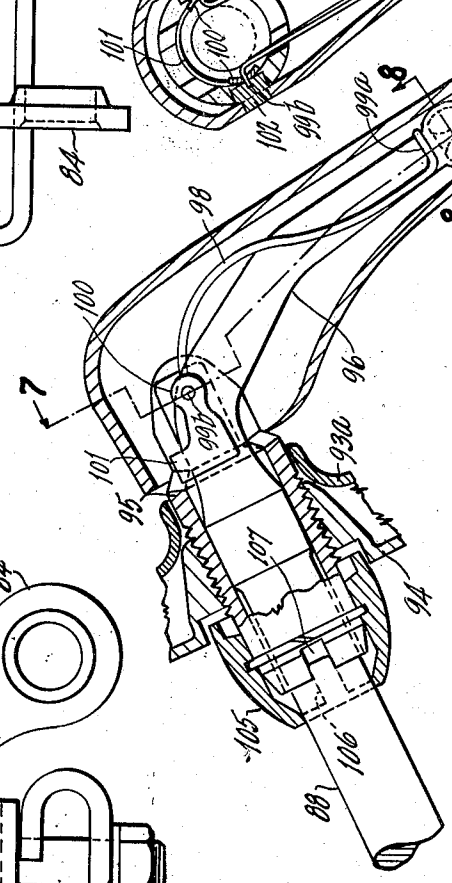


Fig. 6.

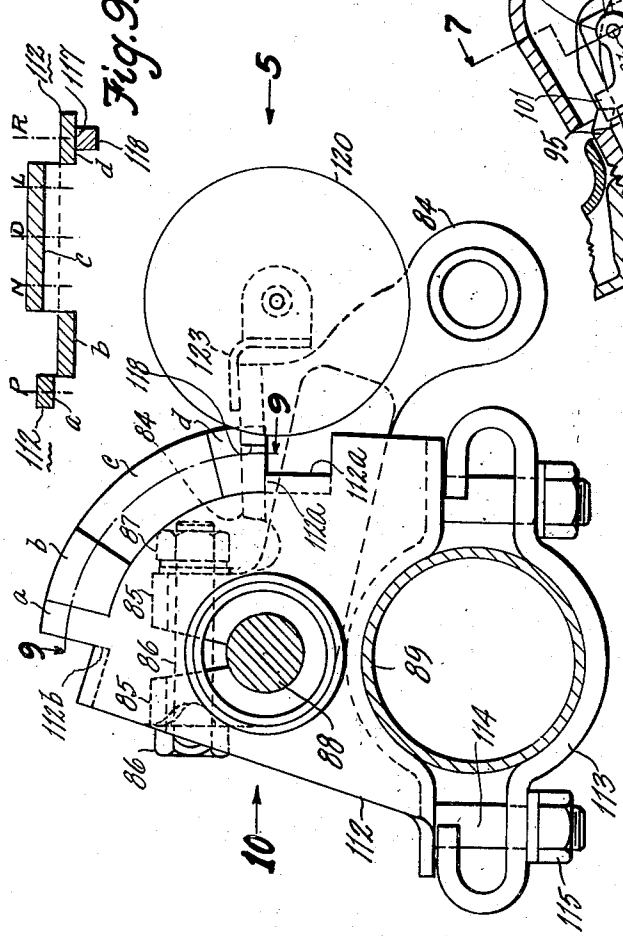


Fig. 9.

Fig. 4.

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ENGINE STARTER CONTROL APPARATUS

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4 Sheets-Sheet 3

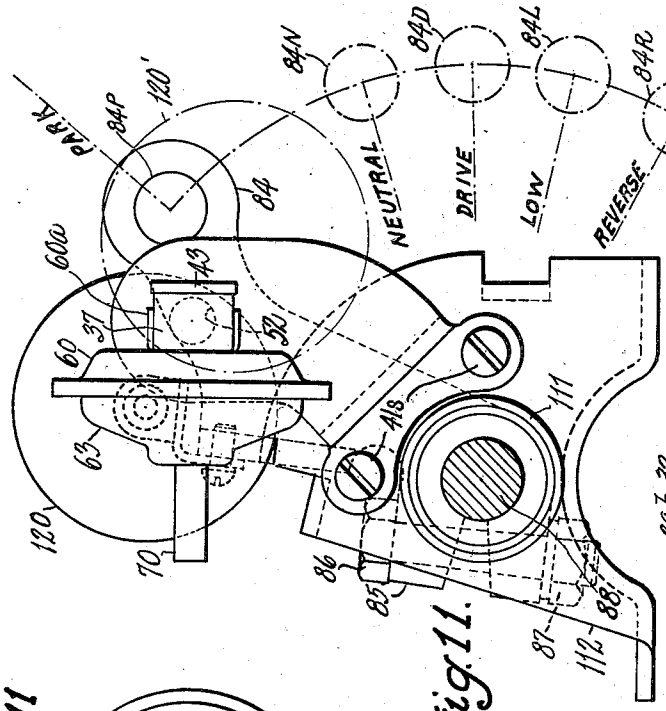


Fig. 11.

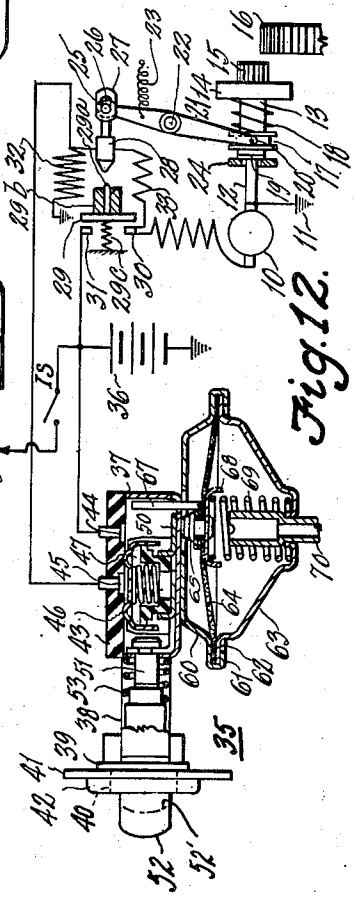


Fig. 12.

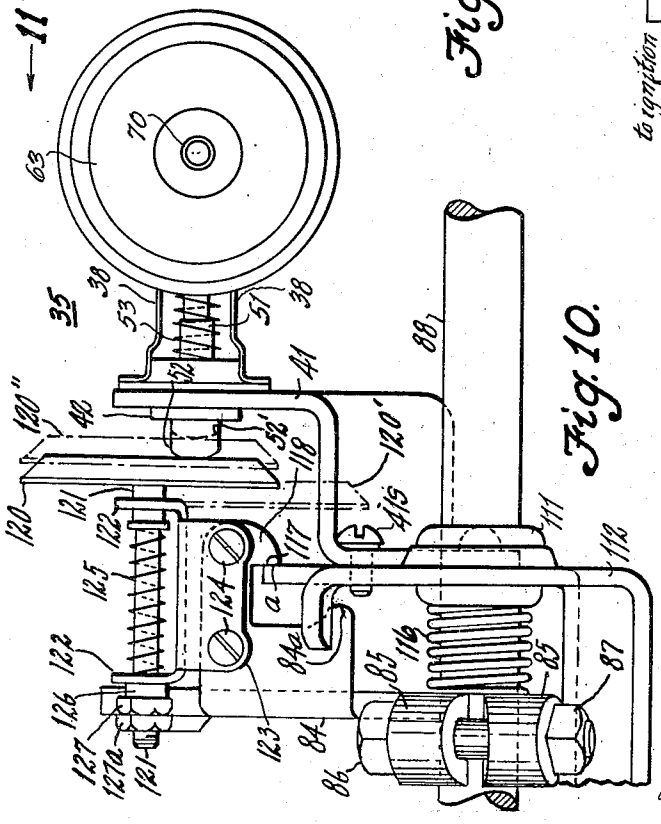


Fig. 10.

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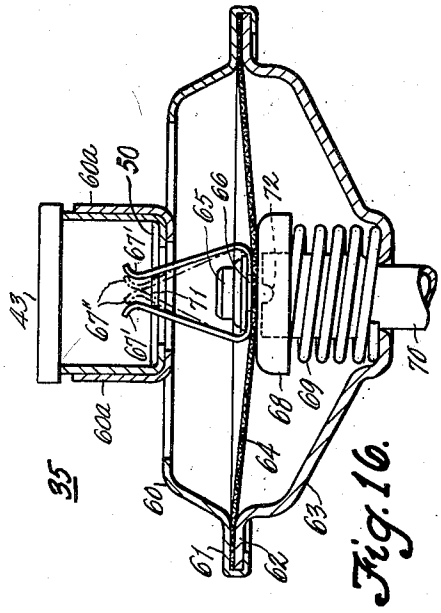


Fig. 16.

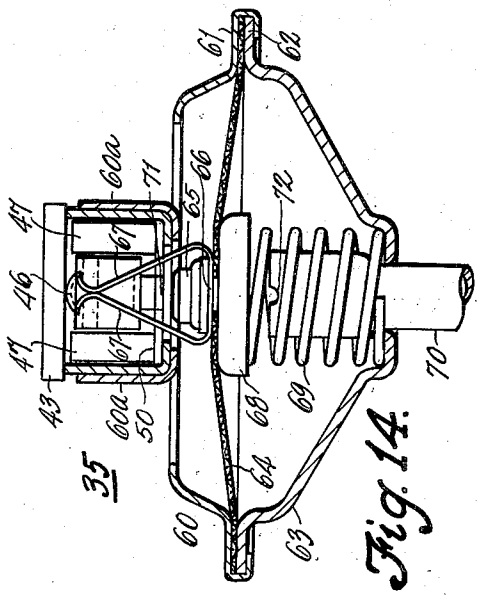


Fig. 14.

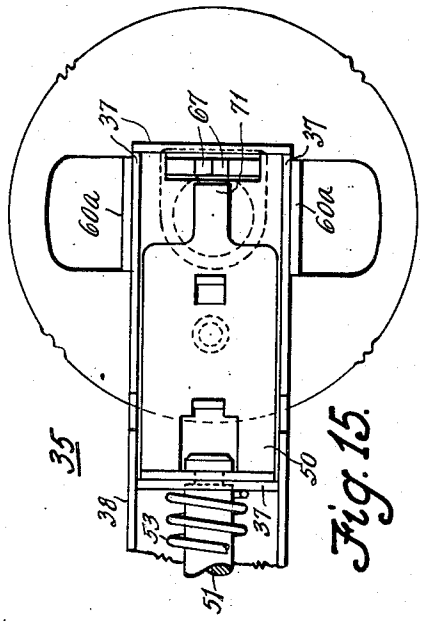


Fig. 15.

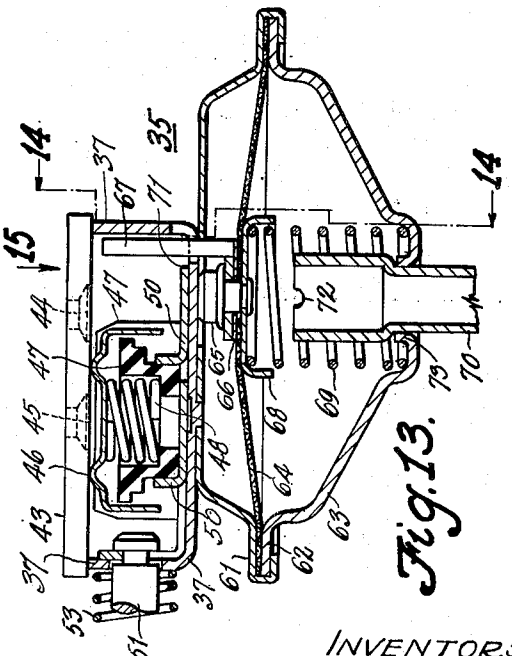


Fig. 13.

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UNITED STATES PATENT OFFICE

2,661,730

ENGINE STARTER CONTROL APPARATUS

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Application November 30, 1950, Serial No. 198,358

9 Claims. (Cl. 123—179)

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This invention relates to the control of the engine starting motor of an engine of an automotive vehicle.

An object of the invention is to provide starting motor control apparatus which eliminates use of a manually operated switch on the instrument panel. In the disclosed embodiment of the invention this object is accomplished by apparatus under control of the transmission selector lever which controls an automatic transmission of the type which is conditioned by movement of the lever into various positions, namely, Park, Neutral, Drive, Low and Reverse. When the selector lever is rotated into either the Park or the Neutral position, lifting the lever upwardly or toward the steering wheel causes closure of a switch which completes a circuit by virtue of which the starting motor is caused to operate. The apparatus provides means responsive to self-operation of the engine for preventing closure of this switch by the selector lever when the engine is running.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a diagram showing a transmission selector lever and mechanism for transmitting movement therefrom to an automatic transmission.

Figs. 2 and 3 are views in the direction of arrows 2 and 3 respectively of Fig. 1.

Fig. 4 is an enlarged scale view on line 4—4 of Fig. 1.

Fig. 5 is a view in the direction of arrow 5 of Fig. 4 of certain parts shown in Fig. 4.

Fig. 6 is an enlarged scale sectional view on line 6—6 of Fig. 2.

Figs. 7 and 8 are sectional views respectively on lines 7—7 and 8—8 of Fig. 6.

Fig. 9 is a sectional view on line 9—9 of Fig. 4.

Fig. 10 is a view in the direction of arrow 10 of Fig. 4.

Fig. 11 is a view in the direction of arrow 11 of Fig. 10.

Fig. 12 is in part a wiring diagram and in part a longitudinal sectional view of the apparatus switch.

Fig. 13 is an enlargement of a portion of the switch shown in Fig. 12.

Fig. 14 is a view on line 14—14 of Fig. 13.

Fig. 15 is a view of certain parts of the switch of Fig. 13 as viewed in the direction of arrow 15 of Fig. 13.

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Fig. 16 is a view similar to Fig. 14 showing certain switch parts in other positions.

Referring to Fig. 12 in which the engine starter is shown diagrammatically, the starting motor 10 has one terminal grounded at 11 and the other connected to a switch contact 30. The motor armature shaft 12 is splinedly connected with a sleeve 13 connected through a one-way or overrunning clutch 14 with a pinion 15 adapted to mesh with the flywheel gear 16 of the engine. A grooved collar 17 which is slidable on sleeve 13 is urged by a spring 18 against a split wire snap ring 19 received by a groove in sleeve 13. Pins 20 received by the groove of collar 17 are attached to a lever 21 which is bifurcated and which is pivoted at 22. A spring 23 urges lever 21 clockwise and sleeve 13 against a stop 24.

The upper end of lever 21 carries a pin 25 received by a slot 26 in a member 27 attached to a solenoid armature 28 engageable with a rod 29a connected with a movable switch contact 29 for connecting contacts 30 and 31. A spring 29c urges contact 29 away from contacts 30 and 31 and into engagement with a rod bearing 29b which provides a magnetizable pole piece toward which the armature 28 is attracted when solenoid windings 32 and 33 are energized by closing a motor control switch 35 which connects these windings with a battery 36.

The switch 35 comprises a case 37 which a yoke 38 attaches to a mounting plate 39 having a threaded portion 40 which extends through a hole in a bracket 41 and receives a nut 42, the tightening of which secures the plate 39 to the bracket 41. Case 37 is closed by a nonconducting cover 43 supporting contacts 44 and 45 engageable by a sliding contact 46 mechanically connected to a nonconducting carrier 47 enclosing a spring 48 which urges the contact 46 toward the cover 43. Carrier 47 is mechanically connected to a carrier slide 50 connected to a rod 51 extending through the plate 39 and attached to a push button 52. A spring 53 urges the rod 51 toward the left and slide 50 against the left wall of case 37.

Case 37 supports a shell 60 having its flange 61 crimped around the flange 62 of a shell 63. Shell 60 has ears 60a (Fig. 14) punched out and bent down and attached by welding to case 37. The peripheral portion of a diaphragm 64 is pinched between shells 60 and 63 and its central portion is connected by a rivet 65 with a plate 66 integral with two spring fingers 67 (Figs. 13–16) and with a cupped washer 68 which receives one end of a spring 69 which surrounds a tube 70 attached to a

flange 73 (Fig. 13) of the shell 63. The spring 69 urges the diaphragm 64 up until the rivet 65 touches the case 37. The fingers 67 are then disposed as shown in Fig. 13 to receive between them a part 71 of the carrier slide 50. Downward movement of the diaphragm 64 is stopped by engagement of washer 68 with the tube 70 which is notched at 72 so that suction on the diaphragm 64 continues after said engagement. Tube 70 is connected with the engine intake so that the diaphragm 64 is under control by engine suction.

To start the engine, the button 52 (Fig. 12) is pushed right by means to be described to cause the contact 46 to connect contacts 44 and 45 and current flows from the battery 36 through solenoid coils 32 and 33. Armature 28 moves left to cause lever 21 to move counterclockwise to move the collar 17 right and, through the spring 18, to move the sleeve 13, clutch 14 and pinion 15. If no tooth abutment occurs, pinion 15 meshes with gear 16 and then the contact 29 engages contacts 30 and 31 and the battery 36 is directly connected with the motor 10 and the engine gear 16 is rotated. Though coil 33 is shorted, coil 32 remains effective to hold the armature 28 in fully attracted position. If tooth abutment occurs, left movement of armature 28 continues to close the contacts 29, 30 and 31 while spring 18 is compressed. The motor 10 operates to turn the pinion 15 to relieve the abutment, whereupon spring 18 is released to move the pinion 15 quickly into mesh with the gear.

When the engine starts, pinion 15 overruns the motor shaft by virtue of the one-way clutch 14. The button 52 is released to permit spring 53 to open the contacts 44, 45 and 46. Coil 32 is deenergized and the armature 28 moves right and the pinion 15 moves left under the action of spring 23. Spring 29c separates contact 29 from contacts 30 and 31. In case of a back fire and the pinion 15 remains in mesh with gear 16, the button 52 is released to permit spring 29c to separate contact 29 from contacts 30 and 31, said movement being possible by virtue of the pin-and-slot lost motion connection between the armature 28 and the lever 21.

When the engine becomes self operative, engine suction applied to the lower side of diaphragm 64 causes it and the fingers 67 to lower so that the upper ends of fingers 67 are in the path of movement of part 71 of the carrier slide 50. If the button 52 had not been released when the engine became self-operative, the part 71 of the carrier slide 50 would remain between the fingers 67 and downward movement of the diaphragm 64 would cause the fingers 67 to engage part 71 and be spread apart to the positions 67′ in Fig. 16. When the button 52 is released spring 53 is still able to move the contact 46 to switch opening position because the functional resistance between the fingers 67 and the part 71 is slight. When the part 71 has been retracted by spring 53, the fingers 67 move into position 67″ (Fig. 16) to block movement of the contact 46 into switch closing position while the engine is running. Therefore, the engine starter cannot be operated while the engine is running.

The switch plunger 52 is actuated by a mechanism under control by a selector lever 91 (Fig. 1) which controls the status of an automatic transmission contained in housing 80 through which there extends a control shaft 81 connected with a lever 82, connected by a link 83 with a lever 84 having a clamping hub 85 which receives a screw 86 (Fig. 4) cooperating with a nut 87 to clamp the lever in the desired position of angular adjustment to a shaft 88 which extends parallel to a fixed tubular mast 89 enclosing a steering shaft (not shown) connected with a steering wheel 90. The upper end of shaft 88 is connected with the selector lever 91 which moves a pointer 92 which, by its proximity to marks on a transparent dial plate 93, indicates the status of the transmission in case 80. Plate 93 carries the marks P, N, D, L, R, indicating, respectively, Park, Neutral, Drive, Low, Reverse. Dial 93 is secured by a dial cover 93a to a bracket 94 attached to the column 89.

As shown in Fig. 6, bracket 94 threadedly receives a sleeve 95 providing a bearing for the shaft 88 which has an integral arm 96 received by the lever 91. Arm 96 provides a spherical end 97 through which the lever 91 is mechanically connected with the shaft 88 for rotation thereof. Before the lever 91 can be turned into certain positions it is necessary to move the shaft 88 axially upwardly. This axial movement of shaft 88 is effected by lifting the lever 91 toward the steering wheel as viewed in Fig. 2 against the action of spring 116 (Fig. 1) which opposes upward axial movement of the shaft. An anti-rattle spring 98 provides a yoke 99a engaging the arm 96 and ends 99b passing through holes in ears 100 of a member 101 received by sleeve 95 and extending into pins 102 supported by sleeve 95 and providing pivots for lever 91. Spring 98 is biased to push the pins 102 downwardly and apart. Lever 91 carries an anti-rattle plunger 103 (Fig. 3) which a spring 103a urges against the inside wall of lever 91.

Counter-clockwise movement of lever 91 about pins 102 (Figs. 6 and 7) causes upward axial movement of shaft 88. As shaft 88 is rotated by lever 91, rotary motion is transmitted by lever 91 to sleeve 95 and to a sleeve 105 which carries pointer 92 (Fig. 1), said sleeve 105 having lugs 106 received by notches 107 in sleeve 95.

The lower end of shaft 88 is journaled in a bearing 111 (Fig. 10) carried by a bracket 112 which cooperates with a clamp 113 (Fig. 4) through the use of screws 114 and nuts 115 to secure the bracket 112 in the desired position on the mast 89. Between bracket 112 and hub 85 of lever 84 there is located a compression spring 116 which urges shaft 88 downwardly or to the left in Fig. 10 so that the surface 117 of lug 118 of lever 84 is urged against the bracket 112. The portion of bracket 112 which is engaged by the surface 117 of lug 118 when the lever 91 occupies the various positions indicated in Fig. 2, includes portions *a*, *b*, *c* and *d* (Fig. 9). When lever 91 is in Park position, lug 118 is in position P against portion *a*. When lever 91 is in Neutral Drive and Low positions, lug 118 engages portion *c* at positions N, D and L respectively. When lever 91 is in Reverse position, lug 118 engages portion *d* as shown in Fig. 9. In order to move the lever 91 from Neutral to Park, it is necessary to lift it to move shaft 88 axially upwardly in order that the lug 118 can clear the portion *b* before lug 118 can be moved adjacent portion *a*. Before the lever 91 is moved from Low to Reverse, it is necessary to lift said lever in order that the lug 118 will be retracted from the portion *c* to the plane of the portion *d*. Stops 112*a* and 112*b* of bracket 112 are in the path of movement of lever 84 in order to limit rotation thereof. In the disclosed embodiment of the present invention, advantage is taken of this transmission control to effect

movement of switch contact 46 (Fig. 12) to circuit closing position by lifting lever 91 when in Neutral or Park, provided the engine is not running.

In order to use said movement of lever 91, the present starting motor control apparatus includes the bracket 41 (Fig. 12), attached by screws 41s (Figs. 10 and 11) to bracket 112, which locates the switch plunger 52 for engagement by a disc 120 in certain positions thereof. Disc 120 is supported by a rod 121 which extends through ears 122 of a bracket 123 which screws 124 attach to lever 84. Rod 121 is surrounded by a spring 125 which urges the disc 120 toward the right (Fig. 10), movement of the disc being stopped by engagement of a washer 126 with a bracket ear 122, said washer being retained by a nut 127 threaded on rod 121 and secured in the desired position of adjustment by a lock nut 127a. As shown in Figs. 10 and 11, lever 84 is in Park position and disc 120 is normally in the position shown in full lines. When the lever 91 is in Neutral, lever 84 will be in a position represented by dot-dash circle 84N (Fig. 11) and disc 120 will be in the position indicated by the dot-dash circle 120' corresponding to the position of disc 120 shown at 120' in Fig. 10. When lever 91 is in Neutral position and is not lifted, lever 84 engages surface *c* (Fig. 9). Before rotating lever 91 from Neutral to Park, it is necessary to lift it in order that lever 84 will clear surface *b* so that lever 84 can be moved into position for contact with surface *c* which lever 84 engages by virtue of the action of spring 116 (Fig. 10) when lever 91 is released. Similarly, before lever 91 can be rotated from Park to Neutral, it is necessary to lift it in order that lever 84 will clear surface *b* (Fig. 9). The extent to which lever 91 is lifted, in any event, in order that lever 84 will clear surface *b* is sufficient to cause disc 120 to move to position 120'' (Fig. 10) if it had been in position 120 and just as far to the right as position 120'' if it had been in position 120'. Therefore the lifting of lever 91 in order to permit movement from Neutral to Park or vice versa causes disc 120, if either in Park or in Neutral position, to move the switch button 52 to 52' to effect closure of the switch 35; and the engine starter operates if the engine is not running.

If, while the engine is running, lever 91 is moved into Neutral position and then lifted, switch 35 is not closed since its closing movement is blocked; but lever 84 will move right in Fig. 10 while disc 120 is blocked by switch button 52. Therefore bracket 123 moves right relative to disc 120 and spring 125 is further compressed. Therefore the lifting of lever 91 to permit its rotation from Neutral to Park and vice versa while the engine is running can be effected without interference by the blocked switch 35. In the Drive, Low and Reverse positions of lever 91, there is no contact between disc 120 and switch button 52 even when lever 91 is lifted.

The lifting of lever 91 to cause lever 84 to clear surfaces *b* and *d* (Fig. 9) is limited in amount by engagement of surface 84a of lever 84 with bracket 112 (Fig. 10). Therefore when lever 91 is lifted while the engine is not running and it is in either Neutral or Park positions, the switch button 52 is moved sufficiently to close switch 35 but not a distance such as to cause damage to this switch. The limit of travel of button 52 toward switch closing position is slightly to the right of the switch closing position 52' into which the button is moved by lifting lever 91. Therefore lever 91, when lifted, does not force the

contact carrier of switch 35 against the switch case.

The starting operation obviously requires closure of ignition switch IS (Fig. 12). The closure of switch 35 is resisted by spring 53 which is much weaker than spring 125 through which lever 84 acts when lever 91 is lifted. The starting operation ceases when lever 91 is released since spring 116 (Fig. 10) retracts lever 84 to the left and spring 53 opens switch 35.

When lever 91 is raised to allow lug 118 of lever to clear the barrier between surfaces *c* and *b* (Fig. 9), if lever 91 were moved from Drive to Park, disc 120 will strike the switch button 52 edgewise. Therefore the edge of disc 120 is bevelled to provide a camming action which forces button 52 to the right in Fig. 10 as disc 120 approaches position 120''.

The present invention is applicable also to the type of engine starter which comprises a starting motor driving a screw shaft on which the starter pinion is threaded, the operation of the motor under control by a push button switch causing the pinion to move axially into mesh with the engine flywheel gear and then to rotate it.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. Engine starter control apparatus comprising a rotatable and axially movable shaft, manually operable means for rotating the shaft into a plurality of positions and for moving the shaft axially, stop means for blocking rotary movement of the shaft from one of its positions to an adjacent position and vice versa and avoided by axial movement of the shaft, a switch for controlling engine starting apparatus, and having an operating member which moves parallel to the axis of the shaft, and a plate carried by the shaft and presenting a surface for engagement with the switch operating member whenever the shaft is in either of its said positions of rotation, said plate being moved laterally in response to axial movement of the shaft, when in either of its said positions of rotation, to effect movement of the switch operating member to close the switch.

2. Engine starter control apparatus comprising a rotatable and axially movable shaft, manually operable means for rotating the shaft into a plurality of positions and for moving the shaft axially, stop means for blocking rotary movement of the shaft from one of its positions to an adjacent position and vice versa and avoided by axial movement of the shaft, a switch for controlling engine starting apparatus, said switch having an operating member and having means rendered effective in response to self-operation of the engine for blocking movement of the switch operating member into switch closing position, a lever attached to the shaft, a plate carried by the lever into location adjacent to the switch operating member in response to rotation of the shaft into either of said two positions, and means including a spring for transmitting from the shaft, when axially moved, a movement of the plate to cause movement of the switch operating member into switch closing position, said spring yielding in the event of axial movement of the shaft when either one of said two positions of rotation while the engine is running.

3. Engine starter control apparatus comprising a rotatable and axially movable shaft, manually operable means for rotating the shaft into a

plurality of positions and for moving the shaft axially, stop means for blocking rotary movement of the shaft from one of its positions to an adjacent position and vice versa and avoided by axial movement of the shaft, a switch for controlling engine starting apparatus, said switch having an operating button which moves axially parallel to the shaft and having means rendered effective in response to self-operation of the engine for blocking movement of the button into a switch closing position, a lever attached to the shaft, a rod supported by the lever in parallel relation to the shaft, a plate attached to the rod and having a surface at right angles to the rod and of such area as to be located adjacent to the button in response to movement of the shaft into one of said two positions of rotation, and a helical coil spring surrounding the rod for transmitting from the shaft, when axially moved, movement to the rod and plate such as to cause the plate to move the button into switch closing position, said spring yielding in the event of axial movement of the shaft when in either one of said two positions of rotation while the engine is running.

4. Engine starter control apparatus comprising a mounting bracket, a shaft supported thereby for rotary and axial movements, means for rotating the shaft and moving it axially, a spring resisting axial movement of the shaft from normal position, a lever attached to the shaft and having a lug which the spring urges against the bracket, said bracket providing lug blocking means overcome by axial movement of the shaft prerequisite to rotation of the shaft between certain adjacent positions of rotation thereof, an engine starter control switch supported by the bracket and having an operating member movable in a direction parallel to the axis of the shaft and a plate carried by the lever and having a surface of such area that it is presented for engagement with the switch operating member when the shaft is in either of said positions of rotation, said plate being moved in response to said axial movement of the shaft, when in either of said positions of rotation, to effect movement of the switch operating member to close the switch.

5. Engine starter control apparatus comprising a rotatable and axially movable shaft, manually operable means for rotating the shaft into a plurality of positions and for moving it axially, a switch for controlling engine starting apparatus and having an operating member movable in a direction parallel to the shaft, and having means for preventing switch closing movement of the switch operating member while the engine is running, an actuator located by rotary movement of the shaft in a certain range of its rotary movement into positions such as to present a surface for engagement with the switch operating member, and a spring for transmitting to the actuator a movement in response to axial movement of the shaft such as to cause the actuator to move the switch operating member into circuit closing position, said spring yielding in the event of said axial movement of the shaft while the engine is running.

6. In a starting apparatus for internal combustion engines having an electric starting motor, a current source adapted to supply current to said motor, a control circuit for controlling the operation of the starting motor and effective when closed to cause the starting motor to be energized, a single control switch in said control circuit and effective whenever closed to close the control circuit, means for operating said control switch comprising a rotatably and axially movable shaft, manually operable means for rotating said shaft into a plurality of different positions to effect a control function independent of engine starting and for moving said shaft axially to effect operation of said control switch, stop means for preventing rotary movement of said rod, said stop means being rendered ineffective by the axial movement of said rod so as to release the rod for rotary movement, and means operable upon axial movement of the rod when the engine is not running for closing said control switch to cause the starting motor to become operative.

7. In a starting apparatus for internal combustion engines having an electric starting motor, a current source adapted to supply current to said motor, a control circuit for controlling the operation of the starting motor and effective when closed to cause the starting motor to be energized, a single control switch in said control circuit and effective whenever closed to close the control circuit, means for operating said control switch comprising a rotatably and axially movable shaft, manually operable means for rotating said shaft into a plurality of different positions to effect a control function independent of engine starting and for moving said shaft axially to effect operation of said control switch, stop means for preventing rotary movement of said rod, said stop means being rendered ineffective by the axial movement of said rod so as to release the rod for rotary movement, means operable upon axial movement of the rod when the engine is not running for closing said control switch to cause the starting motor to become operative, and means operable when the engine is self-operative to prevent closing of said control switch upon axial movement of said rod.

8. In a starting apparatus for internal combustion engines having an electric starting motor, a current source adapted to supply current to said motor, a control circuit for controlling the operation of the starting motor and effective when closed to cause the starting motor to be energized, a single control switch in said control circuit and effective whenever closed to close the control circuit, means for operating said control switch comprising a rotatably and axially movable shaft, manually operable means for rotating said shaft into a plurality of different positions to effect a control function independent of engine starting and for moving said shaft axially to effect operation of said control switch, stop means for preventing rotary movement of said rod, said stop means being rendered ineffective by the axial movement of said rod so as to release the rod for rotary movement, and means operable upon axial movement of said rod when the engine is not running and when said rod is in a predetermined rotative position for closing said control switch to cause the starting motor to become operative.

9. In a starting apparatus for internal combustion engines having an electric starting motor, a current source adapted to supply current to said motor, a control circuit for controlling the operation of the starting motor and effective when closed to cause the starting motor to be energized, a single control switch in said control circuit and effective whenever closed to close the control circuit, means for operating said control switch comprising a rotatably and axially movable shaft, manually operable means for rotating said shaft

into a plurality of different positions to effect a control function independent of engine starting and for moving said shaft axially to effect operation of said control switch, stop means for preventing rotary movement of said rod, said stop means being rendered ineffective by the axial movement of said rod so as to release the rod for rotary movement, means operable upon axial movement of the rod when the engine is not running for closing said control switch to cause the starting motor to become operative, and means operable by engine suction when the engine is

self-operative to prevent closing of said control switch upon axial movement of said rod.

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HAROLD J. CROMWELL.
WILLIAM H. TAYLOR.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,324,819	Butzbach	July 20, 1943
2,365,732	Snow	Dec. 26, 1944
2,374,303	Osborne	Apr. 24, 1945