

[54] **CONTROL CIRCUITS FOR VEHICLE WINDOW LIFT MECHANISM**

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[58] Field of Search.....318/266, 267, 280,
318/466, 467, 283, 285, 286

[56] **References Cited**

UNITED STATES PATENTS

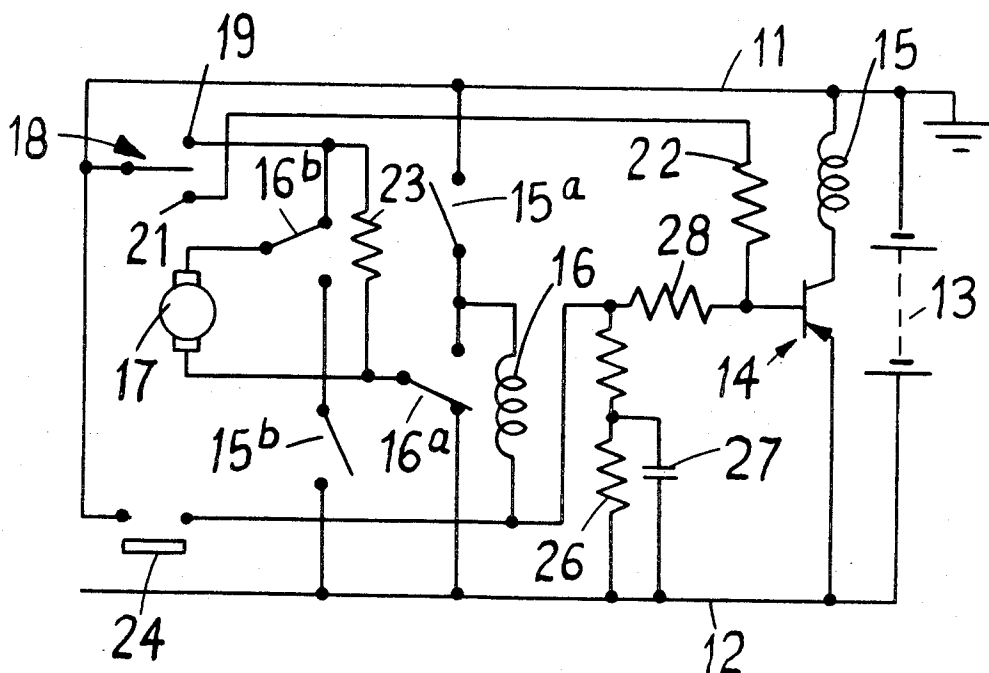
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[57] **ABSTRACT**

A control circuit for a vehicle window lift mechanism incorporating a manually operable switch having an off position and first and second operative positions. A reversible electric motor is connected in the control circuit in such a manner that in the first operative position of the switch the motor is operated in a direction to lift the window, while in the second operative position of the switch the motor is operated in the opposite direction to lower the window. A limit switch is associated with the window, and is operable in the event of an obstruction being placed in the path of movement of the window while the window is being lifted. The circuit further includes means operable upon operation of the limit switch for reversing the direction of operation of the motor even though the manually operable switch remains in its first operative position. Said means incorporates a delay network whereby the motor is only operated to lower the window for a predetermined period of time.

3 Claims, 2 Drawing Figures



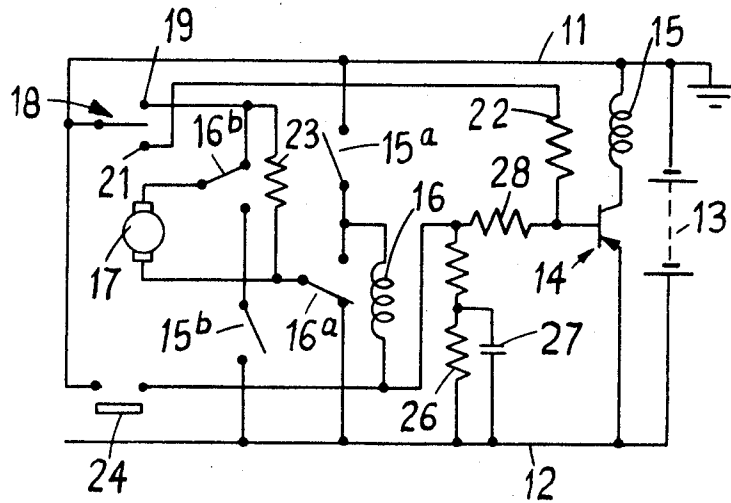


FIG. 1

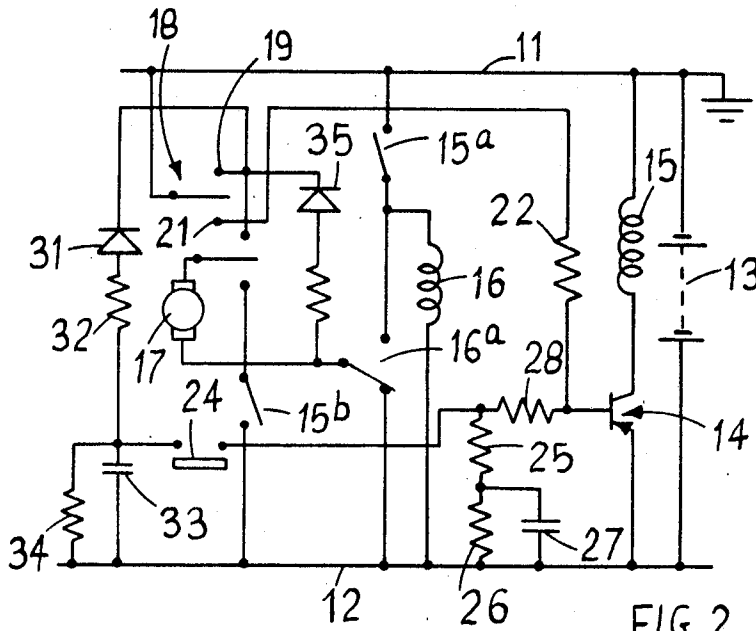


FIG. 2

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CONTROL CIRCUITS FOR VEHICLE WINDOW LIFT MECHANISM

This invention relates to a control circuit for a vehicle window lift mechanism.

A control circuit in accordance with the invention comprises a manually operable switch having an off position and first and second operative positions, a reversible electric motor which then the switch is in its first operative position is operated in a direction to lift the window and which when the switch is in its second operative position is operated in a direction to lower the window, a limit switch which is operable in the event of an obstruction being placed in the path of movement of the window whilst the window is being lifted, means operable upon operation of said limit switch for reversing the direction of operation of the motor, even though the manually operable switch remains in its first operative position, said means incorporating a delay network whereby the motor is only operated to lower the window for a predetermined period of time.

It will be appreciated that using the arrangement specified, if an obstruction is placed in the path of movement of the window while it is being lifted, the window will be lowered for a short distance and then stop.

In the accompanying drawings,

FIG. 1 is a circuit diagram illustrating one example of the invention, and

FIG. 2 is a circuit diagram illustrating a modification of the arrangement shown in FIG. 1.

Referring to the drawing, there are provided negative and positive supply lines 11, 12 connected to a vehicle battery 13, the line 11 being earthed. The circuit incorporates a p-n-p transistor 14 having its emitter connected to the line 12 and its collector connected through a relay winding 15 to the line 11. The winding 15 controls a pair of normally open contacts 15a and 15b, the contact 15a being connected between the lines 11, 12 in series with another relay winding 16, which operates a pair of changeover contacts 16a and 16b.

The circuit further includes a reversible electric motor 17 for lifting and lowering the window, and a manually operable control switch 18 having a movable contact connected to the line 11. The switch 18 has an off position shown in the drawing, a first operative position in which it connects the line 11 to a terminal 19 and a second operative position in which it connects the line 11 to a terminal 21. The terminal 21 is connected through a resistor 22 to the base of the transistor 14, and the terminal 19 is connected through a resistor 23 and the changeover contact 16a in series to the line 12. The terminal 19 is further connected through the changeover contact 16b to one side of the motor 17, the other side of which is connected to the line 12 through the changeover contact 16a. The changeover contact 16a, when in its energized position, breaks the connection to the line 12 from the resistor 23 and motor 17, and completes another connection by way of the contact 15a to the line 11. The changeover contact 16b, when in its energized position, breaks the connection from the motor 17 to the terminal 19 and completes a connection by way of the contact 15b to the line 12.

The circuit further incorporates a limit switch 24 which can be of any convenient form and is so designed that if an obstruction is placed between the window and

the window frame while the window is being lifted, then as soon as any pressure is applied to the limit switch by the obstruction, the limit switch closes. The limit switch is connected in series with a pair of resistors 25, 26 between the lines 11, 12, the resistor 26 being bridged by a capacitor 27, and the junction between the switch 24 and the resistor 25 being connected through a resistor 28 to the base of the transistor 14.

In operation, assuming that the window is lowered but it is desired to lift the window, then the switch 18 is moved to its first operative position, in which current flows by way of the terminal 19, the contact 16b, the motor 17 and the contact 16a to the line 12, energizing the motor 17. The resistor 23 is of course in parallel with the motor 17. The motor continues to operate until the switch 18 is returned to its off position. If it is desired to lower the window, the switch 18 is moved to its second operative position, and a circuit is now completed from the line 11 by way of the contact 21 and the resistor 22 to the base-emitter path of the transistor 14, turning the transistor 14 on and so energizing the winding 15, which closes the contacts 15a, and 15b. Closing of the contact 15a energizes the winding 16, which changes the contacts 16a and 16b over. Current can now flow from the line 11 by way of the contact 15a, the contact 16a the motor, the contact 16b and the contact 15b to the line 12, so that the motor is operated in the reverse direction to lower the window.

If at any time while the motor is lifting the window, an obstruction is placed in the path of movement of the window causing the limit switch 24 to close, then current flows by way of the limit switch 24 and the resistor 28 to turn on the transistor 14. At the same time, the capacitor 27 is charged rapidly. Conduction of the transistor 14 energizes the winding 15, which closes the contacts 15a, 15b, so that the winding 16 is energized, and the direction of operation of the motor 17 is reversed, even though the switch 18 has its movable contact in engagement with the terminal 19. As the window is lowered, the obstruction will be released, enabling the limit switch 24 to be opened, so breaking the circuit from line 11 to the base of the transistor 14. However, the transistor 14 will be held on after the switch 24 opens for a predetermined period of time while the capacitor 27 discharges, so that the window will be lowered a predetermined distance, and then will stop. It will be noted that when the capacitor 27 has discharged and the transistor 14 turns off, the window does not start to rise again, even if the switch 18 is held in its first operative position engaging the terminal 19 because the winding 16 remains energized by way of the contact 16a, the resistor 23 and the terminal 19, even though the contact 15a is opened when the transistor 14 turns off. In order to raise the window again, it is necessary to move the switch 18 to its off position, so de-energizing the winding 16. The switch 18 can then be moved to its first operative position again to lift the window.

Whenever the limit switch 24 is closed, the motor will receive a supply current of the correct sense to lower the window. Hence the window may be opened at any time by pressure on the limit switch. Although this may be seen as normally a useful facility, it may be regarded as a potential hazard in that it enables inadvertent or mischievous operation. For example, a child could open the rear window during heavy rain or at high speed, also the motor may be stalled inadvertently for

long periods by resting an obstruction against the limit switch with the window fully lowered. Disabling the system by means of a separate master switch under the control of the driver may be regarded as satisfactory but could conceivably prevent the release of a trapped obstruction if the master switch is turned off near the moment of contact. A more satisfactory solution is simply to take the connection from the limit switch 24 to the terminal 19 rather than to the movable contact of the switch 18 as shown. With such an arrangement it will be clear that the limit switch 24 only becomes effective while the window is being lifted.

Using this modification, it is possible that if an obstruction is placed in the path of movement of the window, then if the switch 18 is moved to its central off position momentarily before the switch 24 opens, the obstruction will not be released. Although such a contingency is unlikely, it can be overcome simply by the arrangement shown in FIG. 2. It will be seen in FIG. 2 that the switch 24 is connected to the terminal 19 through a resistor 32 and a diode 31 in series, with the junction of the resistor 32 and switch 24 connected to the line 12 through a capacitor 33 in parallel with the resistor 34. The operation is the same as in FIG. 1, except of course that the limit switch 24 is only effective when the movable contact of the switch 18 engages the terminal 19, and also for a short period after the switch 18 is returned to its off position. This short period is sufficient to ensure that an obstruction will not become trapped.

FIG. 2 also shows a separate modification, namely a diode 35 which is connected in series with the resistor 23. It has been found that if the window is open and pressure is applied to the limit switch 24 before the manual control switch 18 is released from its up position, the pressure then being maintained indefinitely, then the motor can be stalled with the window open. The diode 35 prevents this difficulty, and it will be appreciated that the diode could be incorporated in the arrangement of FIG. 1, provided the arrangement is

also modified as described above by connecting switch 24 to the contact 19 of switch 18 rather than to the movable contact thereof.

I claim:

1. A control circuit for a vehicle window lift mechanism, comprising a manually operable switch having an off position and first and second operative positions, a reversible electric motor which when the switch is in its first operative position is operated in a direction to lift the window and which when the switch is in its second operative position is operated in a direction to lower the window, a limit switch which is operable in the event of an obstruction being placed in the path of movement of the window whilst the window is being lifted, means operable upon operation of said limit switch for reversing the direction of operation of the motor, even though the manually operable switch remains in its first operative position, said means incorporating a delay network whereby the motor is only operated to lower the window for a predetermined period of time, whereupon said motor stops leaving the window in a partially raised position, and circuit means operable following said predetermined period of time for preventing lifting of the window, said circuit means including the manually operable switch, so that if the manually operable switch is returned to its off position, the circuit means is broken and the window can be lifted by moving the manually operable switch back to its first operative position.
2. A circuit as claimed in claim 1 including means coupling the limit switch to the supply through the manually operable switch so that the limit switch is only effective when the manually operable switch is in said first operative position to lift the window.
3. A circuit as claimed in claim 2 in which the supply to the limit switch incorporates a capacitor which permits the limit switch to be effective for a short period after the manually operable switch is returned from its first operative position to its off position.

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