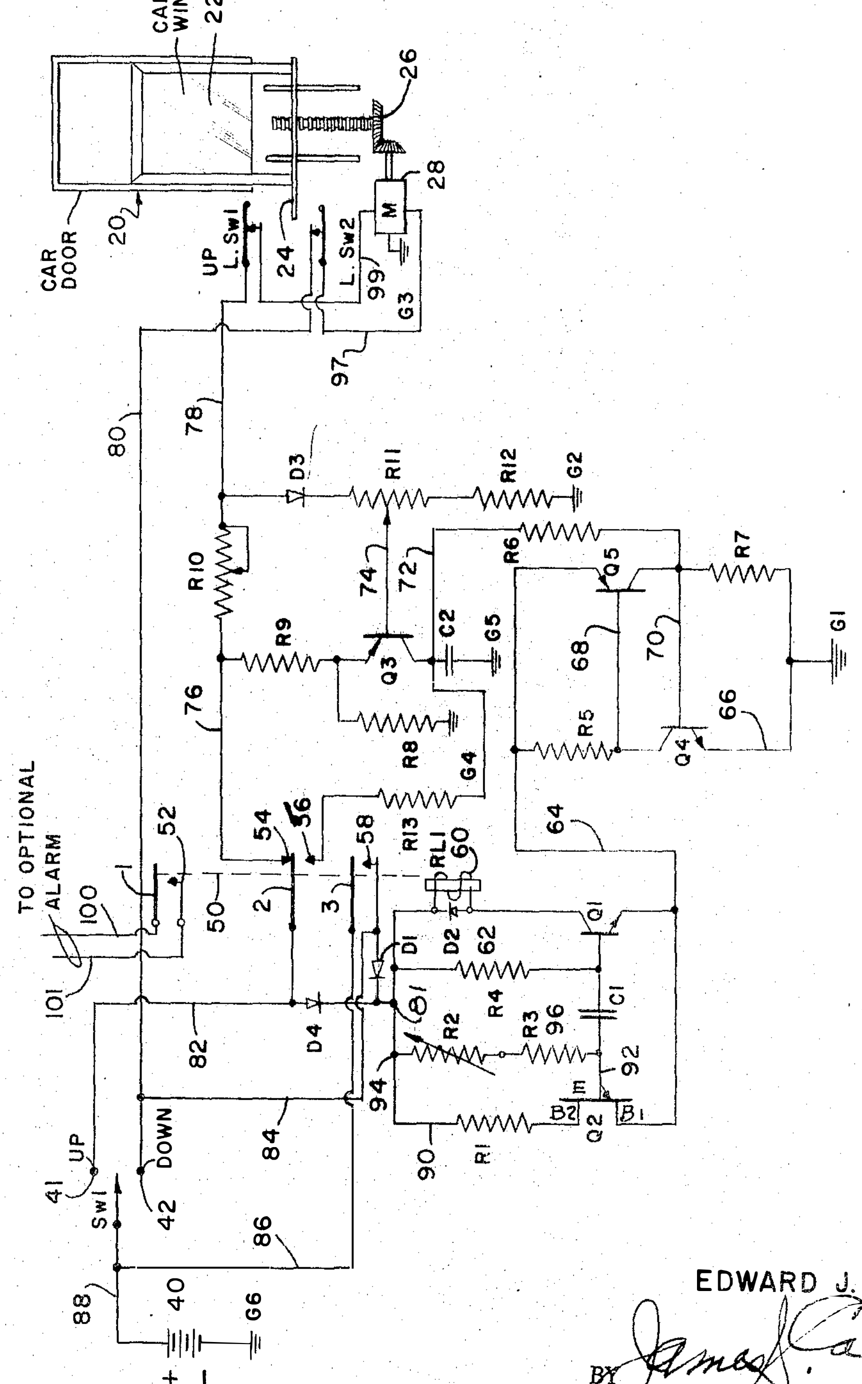

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CAR WINDOW SAFETY CIRCUIT

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ABSTRACT OF THE DISCLOSURE

A circuit of transistor elements interconnected to provide a safety sensing overload circuit which controls a timing and a motor reversing circuit for operating car windows and the like.

BACKGROUND OF THE INVENTION

In many circuits for operating motors for raising and lowering automobile windows, the operator manually operates a switch to energize a circuit and proper operational windings to operate an electrical mechanism for operational closing and opening the car window for the above closed position and open position of the window, with no safety provision of the circuit for automatically reversing the closing of a car window should a child's head or other object becomes lodged between the top of the car window and door frame.

SUMMARY OF THE INVENTION

The circuit of the invention, in general, comprises a manually operated switch, transistor circuit, means for energizing an electric circuit and motor means for raising and lowering a car window means having upper and lower cut-off switch means for ordinary operation of said car window means, and overload sensing and timing circuit means to reverse the window travel should it strike an object in its upward travel.

BRIEF DESCRIPTION OF THE DRAWING

The drawing is a schematic circuit showing of the invention implemented by interconnected upper and lower manual directional operational switches for open and closed positions of the car window by energized motor means, and transistorized sensing and timing overload circuits to actuate a relay means including contacts for reversing the electric motor to lower the window should it reistively strike an object such as a child's head or the like in its upward travel.

DETAILED DESCRIPTION

Referring to the drawing, the exemplary car window **22** of car door **20** is connected by conventional means **26** to motor **28** which is interconnected by circuit and suitable switch means to battery **40** or other suitable power means, as shown and hereinafter described. Switch interrupter **24** of window **22** contacts upper limit switch ULSW to open same when the window is closed on its upward travel, and contactor means **24** opens the DLSW switch when car window **22** is fully opened. SW**1** of the circuit is manually closed on the up contact **41** to actuate motor **28** and close window **22**. Likewise, SW**1** is manually closed on down contact **42** to close window **22**. One of the novel safety features of this safety sensing and timing circuit is that, should window **22** on its upward travel contact an object like a child's head, the window will go back down to a predetermined level or fully opened as hereinafter explained, even if switch SW**1** is manually held closed in the up position.

Applicant's novel circuit includes an up limit switch

G**5**; capacitors C**1** and C**2**; resistors R**1**, R**2**, R**3**, R**4**, R**5**, R**6**, R**7**, R**8**, R**9**, R**10**, R**11**, R**12** and R**13**; conventional diode-rectifiers D**1**, D**2**, D**3** and D**4** (1N3193); transistors Q**1** and Q**4** of a conventional switching type (2N3904), transistors Q**3** and Q**5** also of a conventional switching type (2N3906), and uni-junction transistor Q**2** used for timing circuits (2N2160), all elements being functionally interconnected in the circuit as shown in the drawing and hereinafter described.

Applicant's new circuit can be built in part or entirely in the form of an integrated circuit to conserve space and to reduce cost of production and labor installation of same. A broad dedfinition of an integrated circuit is defined as a "chip" or "module," with all components of the circuit such as resistors, capacitors, transistors or other electronic components enclosed in such "module," capsule or similar small device or type of packaging of assembled electronic circuits and parts.

The term bias or biasing means, as used in this application, means in general, the voltage applied to a transistor to bring it to a state necessary for proper circuit operation.

Referring more specifically to motor **28**, this motor has conventional field windings (not shown) to operate by gear means **26**, the car window **22** in the closed position or open position of window **22**, as hereinafter described.

Referring more specifically to relay means RL**1**, this relay is comprised of energizing coil **60**, armature **50** interconnected to switches **1**, **2** and **3** and switch contacts **52**, **54**, **56** and **58** as shown in the drawing when relay coil **60** is not energized, and as hereinafter explained when relay RL**1** is energized. Coil **60** is also in parallel with diode D**2** in this circuit to protect Q**1** during the novel operation of this circuit and car window **22**.

Applicant's new circuit is additionally comprised of a timing pulse circuit, a voltage sensing circuit and a current sensing circuit, as hereinafter described.

Applicant's timing pulse circuit is comprised, in general, of diode D**1** connected to connection **81**, lead **90**. resistor R**1**, transistor Q**2**, R**2**, R**3**, capacitor C**1**, R**4**, diode D**2**, coil **60**, Q**1** and lead **64** as shown in the drawing. Transistor Q**2** is a uni-junction transistor and is comprised of bases B**1** and B**2** and emitter E as shown in the above circuit.

In applicant's timing pulse circuit, resistor R**1** is used for temperature stabilization; resistors R**2** and R**3** and capacitor C**1** is used for timing in this circuit; diode D**2** protects transistor Q**1** which controls operation of relay RL**1**; and uni-junction transistor Q**2** is used for pulse timing signal by lead **64** connected to the voltage sensor circuit, as hereinafter described.

Applicant's voltage sensing circuit is comprised, in general, of lead **64**, resistance R**5**, lead **68**, transistor Q**5**, lead **70**, Q**4**, lead **66** connected to ground G**1** and R**7** which is interconnected to R**6** as shown in the drawing.

Applicant's current sensing circuit, in general is comprised of relay operated switch **2** with contacts **54** and **56** interconnected to lead **76** and R**13**, respectively, and R**8** interconnected to R**9** and R**10** and ground G**4**, transistor Q**3**, lead **74** and R**11** which is connected to diode D**3** and R**12** connected to ground G**2**. Transistor Q**3** is connected by C**2** to ground G**5** and lead **72** and resistance R**6** to the above sensing circuit. Lead **78** is connected to car window upper limit switch L.SW**1** as shown in the drawing.

In the above circuits diode D**3** acts as a temperature compensator, resistance R**10** acts as a current sensor for total current flow, resistance R**11** acts as a threshold bias for transistor Q**3**; resistance R**12** acts also as a bias for transistor Q**3**. Resistance R**6** couples the signal

surge at the starting flow from triggering the circuit operation of the current sensor circuit.

Resistances R8 and R9 are used for biasing and stabilizing the current sensor circuit above.

In the current sensing circuit resistance R13 is used as a feed back means to prevent capacitance C2 from being rapidly discharged which keeps relay RL1 operating and the car window 22 going downwardly for a predetermined time after it has contacted an object on its upward travel, even if manual switch SW1 is held closed on up contact 41, thus affecting a novel safety feature of this circuit.

Leads 100 and 101 may be optionally connected to the energized circuit of an alarm such as a buzzer, bell, lamp or the like (not shown) as desired, to switch 1 and contact 52, which is operated by armature 50 of relay RL1 which actuates the alarm after car window 22 has struck an object on its upward travel to give an audible or visual alarm or safety signal to the operator of car window 22.

The above circuit is properly grounded at points G1, G2, G3, G4, G5 and G6 as shown in the drawing and understood by those skilled in the art.

Lead 84 connects contact 42 of manual switch SW1 to diode D1 which is connected to junction 81 of the above timing circuit. Contact 42 is also operatively connected by lead 80 to lower limit switch L.SW2 for downward travel of car window 22. However, down limit switch is not essential, because the down operation of the motor 28 will cease (if the circuit was not automatically operated by excess strain on the windows) by the timing circuit.

OPERATION OF PULSING, VOLTAGE SENSING AND CURRENT SENSING CIRCUITS

Refering to the voltage sensing circuit, when there is no signal from the current circuit on lead 72, the voltage sensing circuit operates like an open switch. When the voltage sensing circuit receives a signal from the current sensor R10 by lead 72 and resistance R6 of the current sensing circuit, transistors Q4 and Q5 turn on. If this signal is removed, Q4 and Q5 remain conducting due to the fact that each of these transistors holds the other forward biased, and on (conducting) they will remain on, until lead 64 has an interruption of power. This interruption of power occurs because of the performance of unijunction transistor Q2. When capacitor C1 of the pulsing circuit charges to the firing voltage of transistor Q2, Q2 fires (shorts) and turns off transistor Q1. Q1 is turned off momentarily which drops out relay RL1 and opens switch 3 from its contact 58. To insure that relay RL1 does become de-energized, transistor Q4 and Q5 also turn off due to the interruption of power.

UPPER OPERATION OF CAR WINDOW AND CIRCUIT

Moving manual switch SW1 to contact 41 will cause current from battery 40 to flow through switch 2, contact 54, lead 76 resistance R10 and lead 78 to window upper limit switch L.SW1 and energize motor 28 to raise by gear means 26 car window 22 until contactor 24 opens the contacts of switch L.SW1 to stop the travel of window 22 upward.

Under normal conditions, the window will move to the full up position and stop when the up limit switch is opened by the window mechanism 24. Also under normal conditions, the voltage drop across R10 is very low, less than .5 volt. Should the window meet an obstruction, an excess amount of voltage (.5 v. or more) will develop across resistance R10. When this happens the values of resistances, R11, R12, R9, R10, R8 and diode D3 are so selected as to cause transistor Q3 to conduct, and cause capacitor C2 to develop a voltage across it. Initially

Q4 and Q5. Q4 and Q5 remain turned on (conducting) even when the starting signal is removed, due to the regenerative biasing on the circuit. Essentially then, Q1 emitter is nearly at ground potential. Transistor Q1 is normally in the conducting state, and when the emitter is essentially brought to ground through Q4 and Q5, the relay RL1 will pick up or (energize). The relay contacts will now move by armature 50, and switch 1 will operate an optional alarm if desired, switch 2 will remove power to the up winding of the motor, and if switch SW1 is manually held closed on contact 41 it will apply power to R13 and then to capacitor C2, also switch 3 will close (remembering all contacts of RL1 transfer at once by armature 50) and supply power to RL1 by diode D1 and also apply power to the down winding of the motor to operate car window 22.

If resistance R10 has excess voltage (meaning the motor was stalling) transistor Q3 would energize which would send a signal to transistors Q4 and Q5 which would energize and then RL1 would energize to close contact 58 of switch 3. Also switch 3 would send power to the down winding of motor 28, and switch 1 would energize an optional alarm, also switch 2 would move from 54 to 56 when RL1 is energized.

DOWNWARD OPERATION OF CAR WINDOW AND CIRCUIT

If switch SW1 is manually closed on contact 42, car window 22 will travel downward until contactor 24 reaches and opens the contacts of lower limit switch L.SW2, or if SW1 is removed from 42, or the window will stop after a pre-determined time if the circuit was operated automatically by the current sensor. Assuming operation was automatic capacitor C1 is now charging slowly by resistors R2, R3 and when the firing point of transistor Q2 is reached, the resistance between the emitter of Q2 and the base contacts of Q2 is very low, and causes Q1 to become reverse biased, causing a brief (open) or non-conducting period of time of Q1, which causes RL1 to de-energize, and transistors Q4 and Q5 to return to their original state of non-conducting.

Should switch SW1 be manually closed on up contact 41, the circuit will "cycle," and the window 22 will remain down (or continue going down if the window is not yet fully down) due to the voltage developed across capacitor C2 and due to the resistance value of R13 in the circuit after hitting an object on the way up.

From the foregoing it will now be seen that there is herein provided an improved car window safety operating means and new actuating circuitry therefor which accomplishes all the objects of this invention, and others, including many advantages of great practical utility and commercial importance.

As many embodiments may be made of this inventive concept as obtain within the purview of this invention as desired by those skilled in the art without departing therefrom. Therefore, it is to be understood that all matter herein is to be interpreted merely as illustrative, and not in a limiting sense.

In some types of vehicles there may have to be a slight variation of circuit operation and construction due to electrical and mechanical variations of said vehicles all of whch should come within the scope and spirit of this invention.

What is claimed is:

1. In combination with a direct current motor operated car window or the like, a transistorized safety circuit means comprising a car window, an energized power and motor reversing circuit means including motor and gear means operatively connected to said window, a timing pulse circuit, a voltage sensing circuit operably connected to said timing pulse circuit, a current sensing overload

should the car window strike an object on its upward travel.

2. A transistor safety circuit means as in claim 1, wherein said timing pulse circuit comprises a first uni-junction transistor, a second transistor, said first transistor having one base connected by resistance means to a first diode means of said motor circuit, an emitter of said first transistor connected in series with a resistance connected to said first diode means and connected to a capacitance having its positive terminal connected in series with a resistance connected to said first diode means and connected to the base terminal of said second transistor, said second transistor having an emitter connected to a second base terminal of said unijunction transistor and an output terminal, and a collector terminal of said second transistor being connected in series with a second diode and energizing coil of a relay means interconnected to said first diode means.

3. A transistorized safety circuit means as in claim 1, wherein said voltage sensing circuit comprises a third transistor having a collector terminal connected by resistance means to the output of said timing pulse circuit and the base terminal of a fourth transistor, said third transistor having an emitter terminal connected to a ground and by resistance means to the collector terminal of said fourth transistor and connected to an output terminal connected to said current sensing circuit, said emitter of said fourth transistor being interconnected to said output of said timing pulse circuit and connected by resistance means to the collector terminal of said third transistor.

4. A transistorized safety circuit means as in claim 1 wherein said current sensing circuit comprises an input from said motor circuit selectively operated by switch means connected to the armature of said relay means, said switch means having a first contact and a second contact, said first contact being connected to a variable resistance sensor means connected in series to the up winding of said motor circuit, a fifth transistor having its base terminal connected in series by resistive means to said motor up winding and connected to ground, said fifth transistor also having an emitter terminal connected by resistance to ground, said fifth transistor having a collector terminal connected in series to said second contact of said switch, connected by a feedback resistance to said voltage sensing circuit and connected by capacitance to ground.

5. A transistorized safety circuit means as in claim 1, wherein said motor circuit comprises a direct current source of energy connected by manual operated switch means to the up winding of the motor and down winding of the motor and inter-connected by switch means operated by the armature of said relay in said safety circuits for selective operation of a car window or the like and having upper and lower limit switch means for selectively obtaining a closed or open position of said window.

6. A combination as in claim 5, wherein said safety circuit includes a command circuit and means for operating an energized alarm circuit should said car window strike an object on its upward travel after a manual closing of a command circuit switch.

7. In combination with a direct current motor operated car window or the like, a car door and window means, a motor and gear means connected to said window, a transistorized safety circuit means comprising an energized power and motor reversing circuit means, a timing pulse circuit having an output, a voltage sensing circuit operably connected to the output of said timing pulse circuit, a current sensing circuit operably connected to said voltage sensing circuit, and relay circuit means selectively cooperating with said circuits and motor to automatically reverse said motor should the car window strike motor circuit comprising a direct current source of energy connected by manual operated switch to the up winding of the motor and down winding of the motor and interconnected by switch means operated by the armature of said relay in said safety circuits for selective operation of a car window or the like and having upper and lower limit switch means for selectively obtaining a closed or open position of said window during free travel thereof.

8. A safety circuit means as in claim 7, wherein said timing pulse circuit comprises a first uni-junction transistor, a second transistor, said uni-junction transistor having one base connected by resistance means to a first diode means of said motor circuit, an emitter of said first transistor connected in series with a resistance connected to said first diode means and connected to a capacitance having its positive terminal connected in series with a resistance connected to said first diode means and connected to the base terminal of a said second transistor, said second transistor having an emitter connected to a second base terminal of said uni-junction transistor and an output terminal, and a collector terminal of said second transistor being connected in series with a second diode and energizing coil of a relay means interconnected to said first diode means.

9. A safety circuit means as in claim 8 wherein, said voltage sensing circuit comprises a third transistor having a collector terminal connected by resistance means to the output of said timing pulse circuit and the base terminal of a fourth transistor, said third transistor having an emitter terminal connected in series to a ground and by resistance means to the collector terminal of said fourth transistor and connected to an output terminal connected to said current censing circuit, said emitter of said fourth transistor being interconnected to said output of said timing pulse circuit and connected by resistance means to the collector terminal of said third transistor.

10. A safety circuit means as in claim 9, wherein said current sensing circuit comprises an input from said motor circuit selectively operated by switch means connected to the armature of said relay means, said switch means having a first contact and a second contact, said first contact being connected to a variable resistance sensor means connected in series to the up winding of said motor circuit, a fifth transistor having its base terminal connected in series by resistive means to said motor up winding and connected to ground, said fifth transistor also having an emitter terminal connected by resistance to ground, said fifth transistor having a collector terminal connected in series to said second contact of said switch, connected by a feedback resistance to said voltage sensing circuit and connected by capacitance to ground.

11. A combination as in claim 7, wherein said safety circuit includes selective operating means to operate an energized auxiliary alarm circuit should said safety circuit overload due to said window contacting an object on its upward travel.

12. A combination of claim 1, wherein said safety circuit may be constructed as an integrated circuit, or as a micro-circuit and encapsulated.

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