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MOISTURE RESPONSIVE WINDOW CONTROL SYSTEM

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2 Sheets-Sheet 1

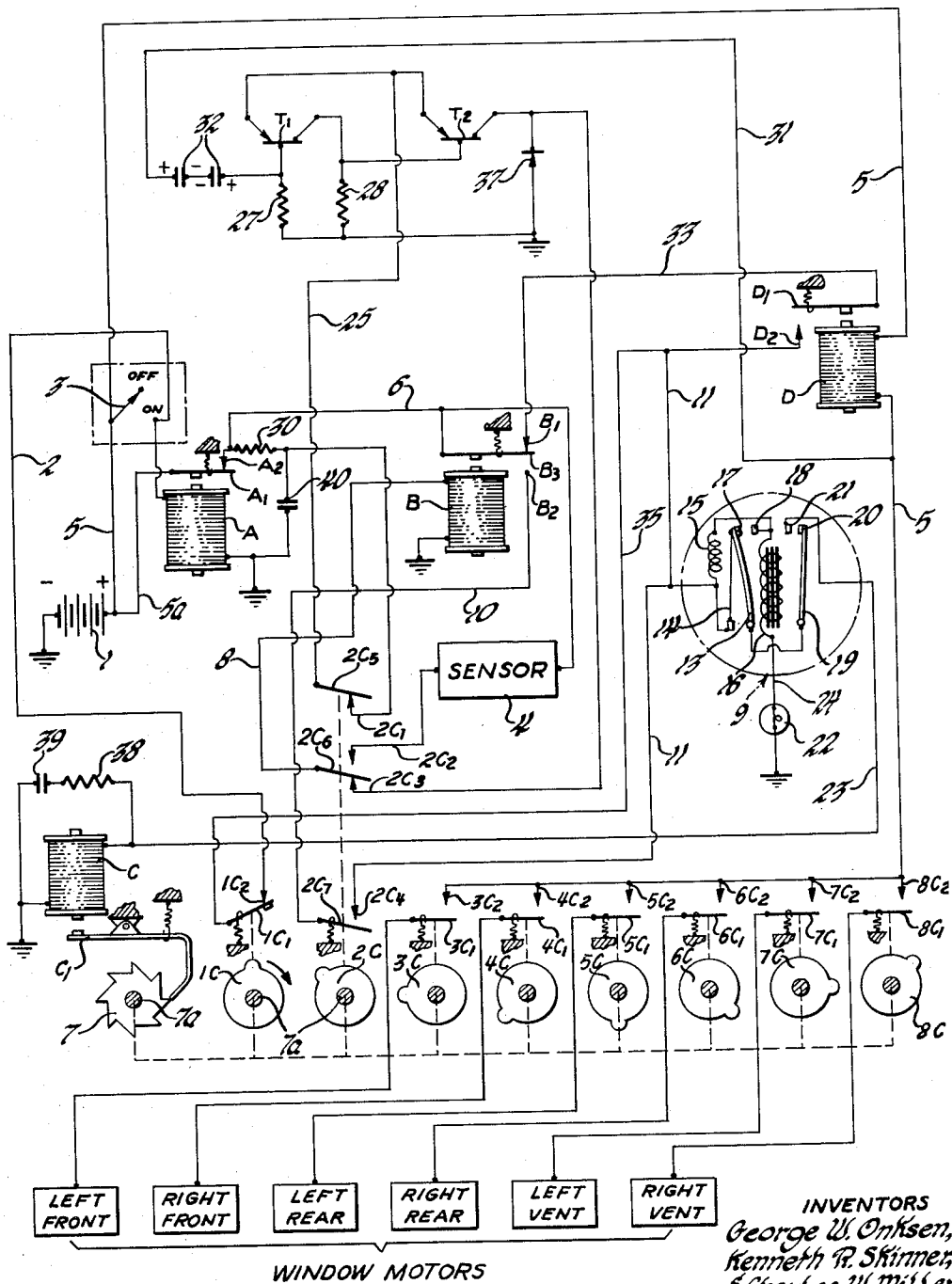


Fig. 1

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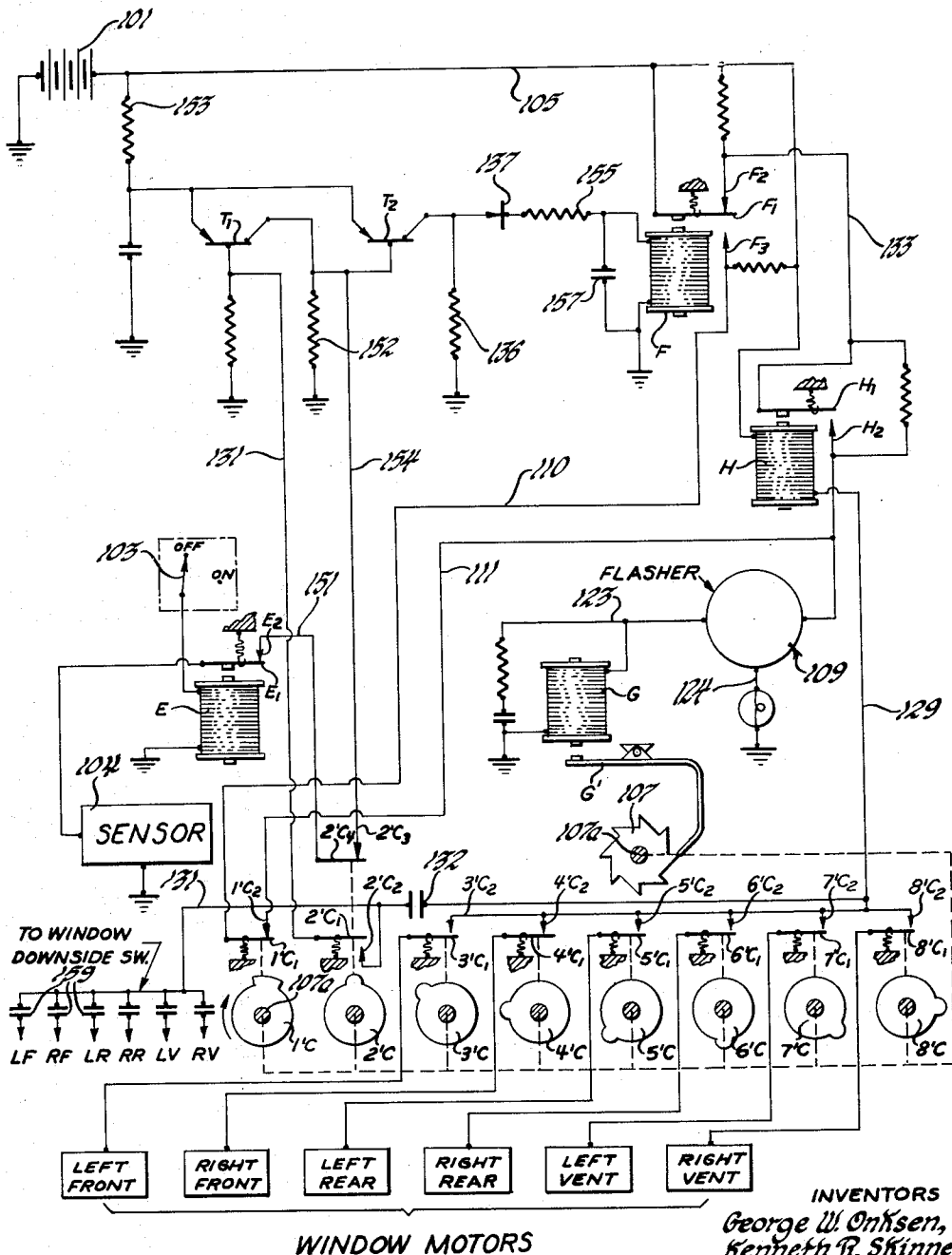


Fig. 2

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MOISTURE RESPONSIVE WINDOW CONTROL SYSTEM

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This invention relates to a moisture controlled automatic window closing system and more particularly to such a system especially applicable to motor vehicles having power operated windows.

Many motor vehicles are presently equipped with power operated windows. There have been proposals whereby such windows are automatically closed in the event of rain allowing the driver to leave the windows open while away from the vehicle. Since electric motors of the type used to operate vehicle windows draw substantial current, it is necessary to limit any automatic window closing to successive operation wherein first one window is closed and then a second window, etc., so that only one window motor operates at a time and hence the vehicle battery is not overloaded. To provide this sequential operation it has been proposed to utilize limit switches, photo electric cells, etc., to turn off one window motor and turn on the next motor. Other proposals have provided special current sensitive relays in each motor circuit to sense when the motor has stalled due to its associated window reaching a closed position. All of the above proposals require special and elaborate installations.

The present invention provides a single package unit that can be mounted remotely from the windows and also easily be adapted to existing power window installations. Each window motor is successively operated and then completely turned off automatically. The invention also provides a safety stoppage of the raising of any window in the event that an obstacle such as a person's arm is in the path of the window. The invention also provides for the automatic by-passing of any window that is already closed when rain or other moisture starts the system in operation.

It is therefore an object of the invention to provide an automatic window closing system for closing windows in the event of rain.

It is a further object of the invention to provide such an automatic system wherein the windows are sequentially closed and where the final closing of one window initiates the closing of the next window.

Still a further object is to provide a relatively simple, compact, and low power consuming automatic window closing system.

Another object is to provide an automatic window closing system having an automatic reset upon the opening of any window in the system. These and other objects and advantages will be readily apparent to those skilled in the art from the following disclosure and accompanying figures.

FIGURE 1 schematically illustrates one form of the invention; and

FIGURE 2 schematically illustrates a different form of the invention.

Briefly, the invention takes advantage of the fact that brush type motors, as are commonly utilized for power operated vehicle windows, generate an electrical noise or hash when they are running, but do not create such a noise when they are stalled, even though energized. Thus when a window motor is raising its associated window, there is an electrical noise or hash imposed on the voltage leads to the motor. This noise is in a high frequency static form and while it has a very small current

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value, the average voltage value thereof can amount to as much as one or more volts. When the window reaches its closed position or meets an obstruction in its path, the motor, which has a limited torque output, stalls and the noise or hash on the motor leads ceases.

The present invention is shown applied to two representative embodiments and utilizes the presence or absence of this running noise to control a motor switch stepping relay to sequentially switch the battery voltage from the stalled or closed window motor to another window motor.

Referring to FIGURE 1 which schematically illustrates one form of the invention, 1 represents a battery or other voltage source and 3 a manual switch such as the ignition switch in a motor vehicle. The supply voltage in the examples would be about 12 volts, although obviously other higher or lower voltages can be used.

The system shown in FIGURE 1 is in the condition which would exist after the system had operated to automatically close the windows, but prior to operation of the vehicle. The system includes four relays A, B, C, and D. The relay C is a stepping ratchet relay having a pivoted armature C_1 that acts to rotate a toothed wheel 7 a fixed amount each time the relay C is energized to move the armature. The wheel 7 carries a shaft 7a having secured thereon eight switch operating cams 1C to 8C, inclusive. Cams 3C to 8C control normally open contacts $3C_1-3C_2$ to $8C_1-8C_2$, respectively, which contacts are sequentially closed to connect a battery lead 5 to the left front, right front, left rear, right rear, left vent, and right vent window motors, respectively. The window motors can be located in any suitable location to raise and lower the windows they control.

If a manual or ignition switch 3 is moved to its "on" position, battery voltage is supplied to lead 2 and through contacts $1C_1$ and $1C_2$ to lines 35 and 11 which is connected to the input of a repeating relay unit generally designated 9. The relay unit 9 in the illustrated embodiment is of the type commonly utilized for providing flashing in motor vehicle directional signals and will hereafter be referred to as the flasher unit. The flasher unit shown is of the magnetic type such as a Tung Sol flasher type UP141D, although other types could be utilized. Lead 11 is connected to a pair of armatures 13 and 19. These armatures carry switch contacts 17 and 20, respectively, that cooperate with stationary switch contacts 18 and 21, respectively. The armature 13 is self-spring biased towards its closed position but is normally held open by a normally contracted connected resistance wire 14. Current from lead 11 passes through armature 13 and resistance wire 14, through a surge limiting buffer and load coil 15 and then through the main relay magnet coil 16. A load lamp 22 connected to the system ground is for providing the proper rate of current buildup to give satisfactory operation.

With the contacts 17—18 open as shown in FIGURE 2, the combined resistance of wire 14 and lamp 22 allows a small current to flow to the system ground through lead 24 and load lamp 22. This current is not enough to cause the magnet coil 16 to move the armatures 13 and 19, but which is sufficient to heat the resistance wire 14. As the wire expands due to heating, the self biased armature 13 and contact 17 move toward the stationary contact 18 and the electro magnet. At the instant of closing of contacts 17—18, the resistance wire 14 is short circuited and the full current limited by lamp 22 flows through the magnet coil 16. This increased current creates a strong magnetic field which holds the contacts 17—18 together and at the same time the armature 19 is pulled toward the magnet to close contacts 20—21 and connect lead 11 with lead 23. Lead 23 supplies current to the stepping or ratchet relay C which pulls its arma-

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ture C_1 to cause the ratchet wheel 7 to rotate clockwise, as seen in FIGURE 1, one step. This movement of wheel 7 and its shaft 7a causes the cam members 1C to 8C to also rotate clockwise one step.

When the resistance wire 14 of the flasher unit 9 is short circuited it immediately begins to cool, and after sufficient cooling contracts enough to pull the armature 13 away from magnet coil 16, thereby opening the contacts 17-18. At this moment, the resistance wire 14 and ballast coil 15 are again introduced in the circuit and the strong magnetic field collapses, allowing the armature 19 to move contact 20 away from contact 21 and break the connection between leads 11 and 23, thereby cutting off the current flow to the relay C. This allows pivoted armature C_1 to be returned by its spring to the position shown ready for another stepping cycle of operation.

The first rotation of cam 1C from the position shown in FIGURE 1 allows the normally closed contacts $1C_2$ and $1C_1$ to disengage thereby cutting off the connection between battery lead 2 and the lead 35 and hence lead 11. The flasher unit 9 is then deenergized. The simultaneous initial clockwise rotation of cam 2C from the position shown in FIGURE 1 opens contacts $2C_1-2C_5$, closes contacts $2C_6-2C_2$ and contacts $2C_7-2C_4$. Cams 3C to 8C also rotate one step but do not effect the condition of their respective normally open contacts.

If the switch 3 is then turned to the "off" position, as when the vehicle driver turns off the ignition and leaves the vehicle, the relay A is deenergized allowing contacts A_1 and A_2 to close and connect the moisture sensor 4 to the battery through leads 6 and 5a. The sensor 4, which may be of any suitable form, is of the type that has a relatively high resistance when dry and a relatively low resistance when wet. The sensor 4 is located in any suitable exposed place such as the hood or fender of the motor vehicle and acts to provide a low resistance connection between lead 6 and contact $2C_2$ when wet. At this point in the system operation, the contact $2C_2$ is engaged with contact $2C_6$ and therefore the sensor 4 is connected to ground through the coil of relay B. When dry the high resistance of sensor 4 prevents sufficient current from the battery 1 to pass through the coil of relay B to activate the same.

With the system conditioned as stated above, and it begins to rain or for any other reason the sensor 4 becomes wet it will allow sufficient current to flow from the battery 1 to relay B to activate the same. Closure of contacts B_2-B_3 connects the battery voltage lead 6 to lead 10. Battery voltage is then applied through closed contacts $2C_7-2C_4$ and lead 11 to activate the flasher unit 9 in the manner detailed above. After a predetermined time the contacts 20 and 21 of the flasher unit will close and cause the relay C to rotate the wheel 7 clockwise one more step and advance each of the cams 1C-8C to their next positions.

This last movement of cams 1C and 4C to 8C have no effect on the system since their respective contacts remain in their previous conditions. Movement of cam 2C returns the contacts associated therewith to the positions shown in FIGURE 1. Movement of cam 3C simultaneously causes contacts $3C_1$ and $3C_2$ to close and connect battery voltage lead 5 to the left front window motor labeled left front and thereby energize the same. The motor then starts to close the left front window. With contact $2C_6$ again in the position shown in FIGURE 1, the sensor 4 is cut out of the system and the lead 8 is connected through contacts $2C_3-2C_6$ to the collector of a PNP type transistor T_2 .

Transistor T_2 forms the second amplification stage of a two stage amplifier which also includes a first stage transistor T_1 . Transistors T_1 and T_2 are of any suitable PNP type such as type 2N217 and are connected in a two stage common emitter amplifier arrangement. If the battery connections are reversed, it is obvious that NPN transistors could be utilized. The output collector of T_1 is

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directly coupled to the input base of T_2 as shown. The input base of T_1 is coupled through one side of a pair of back to back capacitors 32 the other side of which is connected to lead 31 in turn connected to the window motor voltage supply lead 5. A resistor 27 provides proper bias for the base of T_1 and resistor 28 provides the proper load for the collector of the same. The emitters of T_1 and T_2 are both connected to line 25 which through contacts $2C_5-2C_1$ is connected through voltage dropping and current limiting resistor 30 to the positive terminal of battery 1.

Current supplied to the left front window motor passes through the relay D and activates the same to close contacts D_1-D_2 . As long as the left front window motor is running and moving its window, an electrical noise or hash is generated and imposed on the motor supply lead 5. The noise signal, which is in the form of a low power high frequency A.C. voltage, is coupled through the capacitors 32 to the base of T_1 and amplified by T_1 and T_2 . The amplified signal is rectified by a diode 37 of any suitable form such as type 1N295, and through contacts $2C_3-2C_6$, energizes relay B to open contacts B_3-B_1 and close B_3-B_2 .

When the first operated window, or left front window in the illustrated example, reaches its closed position or hits an obstacle such as a person's arm, etc., the motor stalls and ceases to produce the hash or noise. Reduction of the amplified noise deenergizes relay B closing B_3-B_1 . Battery voltage from lead 6 is then connected to lead 33 and through closed contacts D_1-D_2 , to lead 11. The flasher unit 9 is then again activated and after a short delay cause the relay C to again step and rotate the cams 1C to 8C to their next positions. This new position of cams 1C and 2C causes no change in the condition of their respective contacts. Movement of cam 3C causes contacts $3C_1-3C_2$ to open cutting off the left front window, while movement of cam 4C closes contacts $4C_1-4C_2$ to connect lead 5 to the right front window motor.

As long as the right front motor runs, it also generates electrical noise that is amplified by T_1 and T_2 to cause relay B to open contacts B_1-B_3 cutting off the battery from the flasher unit 9. When this motor stalls, the generated noise ceases and relay B opens to again connect the battery lead 6 to the flasher unit 9 to again activate the same. This causes the relay C to step again and energize the next motor. This cycle is repeated until all of the windows have been closed.

After the last window controlled, i.e., that controlled by cam 8C stalls, the flasher unit 9 is again activated causing the relay C to again step. Cams 1C to 8C then move to the position shown in FIGURE 1. The system is then inoperative until reset by again closing the switch 3.

If any of the windows in the system were closed at the time their respective motors were energized no hash or noise would be produced by such motor or motors. In such an event the relay B would continue to remain deenergized and closed contacts B_1-B_3 would keep battery voltage applied to the flasher unit 9. If after the time required for armatures 13 and 19 to be released by contraction of wire 14, voltage is still present in lead 11, the wire 14 will again heat and again expand. This will allow contacts 17-18 to again close, shorting wire 14 and allowing the coil 16 to again pull armature 19 to close contacts 19-20. The flasher unit will thus provide a repeating operation of the stepping relay C. This repeating will be at such a controlled rate or predetermined cycle time period that relay C will be activated and deactivated for a sufficient period of time to cause a full advance of the cams C_1 to C_8 . When the relay C is being energized, a capacitor 39 is charged through resistor 38 and, if for some reason the flasher unit cuts off current to the relay C before it has completed a full step, the capacitor 39 will discharge through the relay C to ensure completion of the step. This condition might occur if the battery

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voltage is below normal causing poor operation of the flasher unit. Capacitor 40 is provided to filter noise from the emitters of T_1 and T_2 .

FIGURE 2 illustrates another embodiment of the invention. In this arrangement the transistor amplifier is also utilized to amplify the sensor signal, enabling a smaller less sensitive sensor to be used. The FIGURE 2 arrangement also features an automatic reset wherein the system is automatically reset if any of the vehicle windows are opened.

The alternative system in FIGURE 2 is shown in the condition which exists after the ignition switch is off and any or all of the windows are open. Most of the components of FIGURE 2 are identical with those in the FIGURE 1 arrangement. A relay E having contacts E_2 and E_1 is controlled by a manual switch 103 which may be the vehicle ignition switch. This system also uses a two stage, direct coupled transistor amplifier using PNP transistors T_1 and T_2 . The transistors are connected in a common emitter circuit arrangement and have their emitters constantly connected to battery voltage through a voltage dropping resistor 153. The amplifier has the collector of T_2 forming an output that controls a sensitive relay F similar to relay B of FIGURE 2. Relay F has a movable contact F_1 that connects battery voltage lead 105 either to contact F_3 and lead 110 or to contact F_2 and lead 133. Resistor 136 provides a load for the output of T_2 .

A stepping relay G identical to the relay C of FIGURE 1, is controlled by a flasher unit 109 also identical to flasher 9 of FIGURE 1. The flasher unit 109 has an input central lead 111, a ground lead 124, and an output controlled lead 123. The stepping relay G operates an armature G' that ratchets a toothed wheel 107 to turn a shaft 107a which in turn rotates cams 1'C to 8'C. As in the previous example, cams 3'C to 8'C control normally open switch contacts 3'C₁-C'C₂ to 8'C₁-8'C₂, respectively, which act to connect battery voltage to the left front, right front, left rear, right rear, left vent, and right vent window motors. These cam operated switches sequentially connect their respective motors to lead 129 which is connected through the coil of a relay H to a battery lead 105 connected to a voltage source such as a battery 101.

Cam 1'C acts as a starting and reset control and has normally open contacts 1'C₁ and 1'C₂ that connect the lead 110 from relay F to 111 leading to the input of the flasher unit 109. Cam 2'C has a pair of movable contacts 2'C₁ and 2'C₄ that serve to connect either the moisture sensor 104 or a noise signal lead 131 to the amplifier. With cam 2'C in the position shown in FIGURE 2, movable contact 2'C₄ connects lead 151 to lead 154 which is connected to the input base element of transistor T_2 . Lead 151 is normally connected through contacts E_1 - E_2 of relay E to one end of variable resistance moisture sensor unit 104, the other end of which is connected, as shown, to the system electrical ground. In the condition shown movable contact 2'C₁, which is connected to lead 131 in turn connected to the input base of transistor T_1 , is disconnected from contact 2'C₂ and the noise signal lead 131.

The operation of the FIGURE 2 system is basically the same as that of FIGURE 1 with certain exceptions. The transistor amplifier is used for amplifying the sensor signal as well as the motor noise signal and an automatic reset is provided.

With the system as shown in FIGURE 2, the sensor 104 is connected through contacts E_1 - E_2 and 2'C₄-2'C₃ to the base of transistor T_2 . As one side of the sensor 104 is grounded upon becoming wet, the sensor's resistance is lowered making the base of T_2 less positive. The normal positive bias of the base of T_2 is furnished by the T_1 collector load resistor 152. Lowering the potential the T_2 's base causes T_2 to conduct and current passes from the collector of T_2 through diode 137 and resistor 155

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to energize the coil of relay F. Contacts F_1 - F_3 close connecting the battery lead 105 to lead 110. Battery voltage is then applied through contacts 1'C₁-1'C₂ of cam 1'C to lead 111 and the flasher unit 109. The flasher unit begins a cycle of operation identical to that of the flasher unit 9 of FIGURE 1 and after a predetermined period of time connects battery voltage to the output lead 123 to actuate the stepping relay G. Armature G_1 then rotates ratchet wheel 107 one step clockwise causing shaft 107a and cams 1'C to 8'C to rotate one step. Contacts 1'C₁ and 1'C₂ open, contacts 2'C₁-2'C₂ close, and contacts 2'C₄ and 2'C₃ open. This switching action disconnects the sensor 104 from the input base of T_2 and thereby cuts off T_2 deenergizing relay F. Lead 131 is simultaneously connected to the base element of T_1 . Leads 110 and 111 are also disconnected by the opening of 1'C₂-1'C₁.

The first stepping of relay G also causes cam 3'C to close contacts 3'C₁-C'C₂ to connect lead 129 to the left front window motor. Current then passes to this motor through relay H causing it to close contacts H_1 - H_2 . If the left front window is open, its motor begins closing the same, and causes the electrical hash or noise to be generated and imposed on lead 129. Since the base of T_2 is connected through capacitor 132 and contacts 2'C₁-2'C₂ to lead 129, the noise signal is amplified by T_1 and T_2 . The amplified signal output is rectified by diode 137, filtered by capacitor 157, and applied to relay F to maintain it energized. This keeps battery voltage contact F_1 connected to F_3 and lead 110. These later actions all take place instantly upon the closure of 3'C₁-3'C₂ of cam switch 3'C.

When the left front window reaches its closed position or hits an obstruction, the left front motor stalls and the electrical noise is no longer produced. The output from T_2 is then reduced which allows relay F to open to close contacts F_1 - F_2 . Since relay H is energized due to current drawn by the left front window motor, battery voltage is therefore applied through H_1 - H_2 to the input of flasher 109 and it again cycles or flashes to energize relay G and cause the cams 1'C to 8'C to rotate one more step. Rotating of cam switches 1'C, 2'C, and 5'C to 8'C causes no change in their condition. Cam 3'C opens 3'C₁-3'C₂ to deenergize the left front motor and simultaneously 4'C₁-4'C₂ are closed to energize the right front window motor.

If the right front window is open, its motor begins closing the same, thus generating the hash or noise signal, this signal is amplified by T_1 and T_2 to again energize relay F to open contacts F_1 - F_2 and cut off battery voltage from contact H_1 and the flasher unit 109. Upon completion of closing, the right front motor stalls and ceases generating the noise. Relay F is then deenergized by the reduced amplifier output and contacts F_1 - F_2 are closed. Battery voltage is then applied to F_2 and through closed contacts H_1 and H_2 again acts to energize the flasher unit 109. This causes relay G to again step the cams 1'C to 8'C. The right front motor is then disconnected and the next motor, or as shown, the left rear motor is energized. This cycle is repeated until all of the windows are closed.

If any of the windows are closed at the time their respective motor is energized, no noise will be generated in lead 129 and hence the relay F will remain deenergized to keep battery voltage applied to the flasher 109. The inherent repeating characteristics of the flasher will cause the relay G to step after a predetermined period of time and thereby connect the next window motor to the battery.

After all of the windows are closed the relay G steps once more causing cam 8'C to open and contacts 1'C₁ and 1'C₂ to close. Contacts H_1 - H_2 are open since there is no motor current and the flasher unit 109 is deenergized. If any of the conventional manual window down side switches, not shown, are operated to open a window hash generated by the motor controlled by that switch will be coupled through one of the capacitors 159 to noise signal

lead 131. Because the amplifier T_1 - T_2 is continually energized by the battery, the noise signal will be amplified and cause relay F to close contacts F_1 - F_3 to apply battery voltage to the flasher unit 109 through lead 110, contacts $1'C_1$ - $1'C_2$ and lead 111. This causes the flasher unit 109 to energize relay G and step the cams to the position shown in FIGURE 2. The system will then be reset for automatic window closing if the sensor 104 becomes wet. Switch 103 deenergizes relay E when the vehicle ignition is turned on which renders the automatic system inoperative. When the switch 103 is opened the system is again rendered operative.

Both the FIGURE 1 and FIGURE 2 systems can easily be installed in existing vehicle power window systems without modification. The system could also be used in connection with a power operated automatic convertible top, whereby the top is raised if it begins to rain. When the top reaches its closed position and the top motor stalls the system would automatically shut off the motor. For example any of the cam switches 3C-8C or 3'C to 8'C could be used to control a power operated convertible top or an additional cam switch could be added.

Changes in the invention and other applications of the same will be apparent to those skilled in the art and such changes and applications are either the scope of the invention which is to be limited only by the following claims.

We claim:

1. A moisture responsive window closing system including a voltage source, a window operating motor, a control circuit including a switch for connecting said motor to said voltage source, switch operating means for causing said switch to connect said motor to said voltage source, moisture responsive means for controlling said switch operating means to energize said motor, said motor causing electrical noise in said control circuit when running, means connected to said circuit for amplifying said noise, and means connected to said amplifier and responsive to cessation of said noise for causing said switch operating means to open said switch and disconnect said motor from said voltage source.

2. The system of claim 1 wherein said amplifying means is capacitively coupled to said circuit.

3. In a moisture responsive window closing system, a plurality of window motors, direct current voltage source, control means for sequentially connecting said motors to said source including moisture responsive means to energize one of said motors, said motors being of the type that generate an electrical noise in said system amplifier means capacitively connected to receive said noise and amplify the same, rectifier means connected to the output of said amplifier to provide a direct current signal in response to said noise, relay means responsive to said signal to maintain energization of said one motor, said relay means responsive to absence of said signal to cause said control means to deenergize said one motor and energize another of said motors.

4. A moisture responsive window closing system including a direct current voltage source, a window operating motor for closing a window, a control circuit including a switch for connecting said motor to said voltage source, switch operating means for causing said switch to connect said motor to said voltage source, moisture responsive means for controlling said switch operating means to energize said motor, said motor producing electrical noise in said control circuit when running, means connected to said circuit for amplifying said noise, and means connected to said amplifier and responsive to said noise for causing said switch operating means to maintain said switch closed during running of said motor and to disconnect said motor from said voltage source when said motor stops running and thereby stops producing said electrical noise in said control circuit.

5. A moisture responsive window closing system including a direct current voltage source, a plurality of

window operating motors for closing a plurality of windows, a control circuit including a plurality of switches for connecting said motors to said voltage source, switch operating means for sequentially causing said switches to connect said motors to said voltage source, moisture responsive means for controlling said switch operating means to sequentially energize said motors, said motors producing an electrical noise in said control circuit when running, means connected to said circuit for amplifying said noise, and means connected to said amplifier and responsive to cessation of said noise for causing said switch operating means to open the switch controlling one of said motors to disconnect said one motor from said voltage source and simultaneously close another switch controlling another of said motors to energize the same.

6. In a moisture responsive window closing system, a plurality of window operating motors for individually controlling a plurality of windows, a direct current voltage source, a plurality of switches connected to said voltage source and said motors to energize said motors to close said windows, switch operating means, moisture responsive means located in an exposed area, amplifying and switching means, first circuit means for connecting said moisture responsive means to said amplifying and switching means to control the same in accordance with the moisture in said exposed area, second circuit means connected to said amplifier means and said switch operating means and responsive to a change in the output of said amplifying and switching means to cause the switch actuating means to close one of said switches to energize one of said motors, third circuit means capacitively connected to said voltage source and responsive to motor electrical noise imposed on said direct current caused by running of said one motor, and means responsive to said on motor energization to simultaneously open said first circuit and to connect said third circuit to said amplifying and switching means to cause noise in said second circuit means to control the output of said amplifying and switching means to cause said second circuit to maintain said switch operating means in its one motor energizing condition until said one motor stalls and ceases to impose said noise on said voltage source, said second circuit responsive to a reduced output from said amplifying and switching means to cause said switch operating means to open said one motor switch and close another of said motor switches.

7. In a moisture responsive window closing system, a window operating motor, a direct current voltage source, a switch for connecting to said voltage source and said motor to energize said motor and close a window, switch operating means, moisture responsive means located in an exposed area, amplifying and switching means including a two stage transistor amplifier, first circuit means for connecting said moisture responsive means to the second stage of said amplifying and switching means to control the output of same in accordance with the moisture in said exposed area, second circuit means connected to the output of the second stage of said amplifier means and to said switch operating means and responsive to a predetermined change in the output of said amplifying and switching means to cause the switch actuating means to close said switch and energize said motor, third circuit means connected to said voltage source and responsive to motor electrical noise imposed on said direct current voltage caused by running of said motor, and means responsive to said motor energization to simultaneously open said first circuit and to connect said third circuit to the first stage of said amplifying and switching means to amplify said noise, said second circuit means to control the amplified noise output of said amplifying and switching means to maintain said switch operating means in its motor energizing condition until said motor stalls and ceases to impose said noise on said direct current voltage, whereby reduced output from said amplifying and switching means into said second circuit will cause

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said switch operating means to deenergize said window motor.

8. A moisture responsive window closing system including a direct current voltage source, a plurality of window operating motors, a motor control circuit including a plurality of motor switches for connecting said motors to said voltage source, a stepping relay for sequentially operating said motor switches, a repeating time delay relay for energizing said stepping relay, moisture responsive means, switching and amplifying means, sensitive relay means controlled by the output of said switching and amplifying means, a first switch controlled by said stepping relay for connecting the output of said sensitive relay to said repeating relay, a second switch controlled by said stepping relay for connecting said moisture responsive means to said switching and amplifying means, a motor relay switch closed by energization of any of said motors and connected to said repeating relay, said sensitive relay connecting said voltage source to said motor relay switch when deenergized and connecting said voltage source to said first switch when energized, said motors imposing an electrical noise on said voltage source when running, a third switch controlled by said stepping relay, said third switch capacitively coupled to said voltage source and operable to connect the same to said switching and amplifying means, said moisture responsive means operable upon being exposed to a predetermined moisture to change the output of said switching and amplifying means to energize said sensitive relay and thereby connect said voltage source to said repeating relay through said first switch to effect initial operation of said repeating relay and thereby effect initial operation of said stepping relay, initial operation of said stepping relay causing one of said motor switches to close and energize one of said motors, simultaneously causing said second switch to open and disconnect said moisture responsive means from said switching and amplifying means, and simultaneously closing said third switch to connect said noise to said switching and amplifying means, whereby the output of said switching and amplifying means will maintain said sensitive relay energized; said stepping relay simultaneously opening said first switch to disconnect said repeating relay from said sensitive relay switch, said switching and amplifying means being responsive to absence of said noise from said one motor to deenergize said sensitive relay and thereby connect said voltage source through said motor relay switch to said repeating relay to effect a second operation thereof to thereby effect a second operation of said stepping relay, said second stepping relay operation causing said one motor switch to open and another of said motor switches to close.

9. A moisture responsive window closing system including a voltage source, a plurality of window motors, said motors being of the type that cause electrical noise in said system when running, a plurality of motor switches, a stepping relay for sequentially closing and opening said motor switches, a repeating time delay relay connected to said stepping relay, said repeating time delay relay having a predetermined cycle time, first means including moisture responsive means for initiating operation of said repeating relay to cause said stepping relay to connect a first of said motors to said voltage source, second means connected to said voltage source for initiating operation of said repeating relay including means responsive to absence of electrical noise caused by running of any of said motor for initiating operation of said repeating relay to cause said stepping relay to deenergize said first motor and energize a second of said motors, said second means operable on absence of said electrical noise in said system caused by non-running energization of said second motor to maintain said repeating relay energized, said repeating relay causing said stepping relay to deenergize said second motor and energize a third motor after said predetermined cycle time, means operable upon de-

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energization of the last of said motors to disconnect said second means from said repeating relay.

10. A moisture responsive window closing system including a voltage source, a plurality of window motors, said motors being of the type that cause electrical noise in said system when running, a plurality of motor switches, a stepping relay for sequentially closing and opening said motor switches, repeater time delay means including a control circuit having a thermal operated switch, a magnetic coil energized by said thermal operated switch and a controlled switch operated by said magnetic coil, said thermal switch and coil cooperating to provide a predetermined time cycle operation of said controlled switch, said controlled switch connected to said stepping relay to connect and disconnect the same with said voltage source at a rate determined by said predetermined time, first means including moisture responsive means for initiating operation of said repeater control circuit to cause said stepping relay to connect a first of said motors to said voltage source, second means connected to said voltage source for initiating operation of said repeater control circuit including means responsive to absence of electrical noise in said system caused by running of any of said motor for initiating operation of said repeating relay to cause said stepping relay to deenergize said first motor and energize a second of said motors, said second means operable on absence of said electrical noise caused by non-running energization of said second motor to maintain said repeater control circuit energized, said repeater means causing said stepping relay to deenergize said second motor and energize a third motor after said predetermined cycle time, means operable upon deenergization of the last of said motors to disconnect said second means from said repeater means.

11. A moisture responsive window closing system including a voltage source, a plurality of window motors, said motors causing electrical noise in said system, a plurality of motor switches, a stepping relay for sequentially closing said motor switches, switching means for controlling said stepping relay, first means including moisture responsive means operably connected to said switching means for initiating operation of the same to cause said stepping relay to connect a first of said motors to said voltage source and simultaneously disconnect said first means from said switching means, second means connected to said voltage source and said switching means for initiating operation of the same, said second means including circuit means responsive to absence of electrical noise caused by running of any of said motor for initiating operation of said switching means to cause said stepping relay to deenergize said first motor and energize a second of said motors, said second means operable on absence of said electrical noise caused by non-running energization of said second motor to maintain said switching means energized, said switching means causing said stepping relay to deenergize said second motor and energize a third motor after said predetermined cycle time, means operable upon deenergization of the last of said motors to disconnect said second means from said repeating relay, and means responsive to actuation any of said motors by means other than said system for reconnecting said first means to said switching means.

12. A moisture responsive window closing system including a voltage source, a plurality of window motors, said motors causing electrical noise in said system, a first set of motor switches, a stepping relay for sequentially closing said motor switches, switching means for controlling said stepping relay, first means including moisture responsive means operably connected to said switching means for initiating operation of the same to cause said stepping relay to connect a first of said motors to said voltage source and simultaneously disconnect said first means from said switching means, second means connected to said voltage source and said switching means for initiating operation of the same, said second means

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including circuit means responsive to absence of electrical noise caused by running of any of said motor for initiating operation of said switching means to cause said stepping relay to deenergize said first motor and energize a second of said motors, said second means operable on absence of said electrical noise caused by non-running energization of said second motor to maintain said switching means energized, said switching means causing said stepping relay to deenergize said second motor and energize a third motor after said predetermined cycle time, means operable upon deenergization of the last of said motors to

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disconnect said second means from said repeating relay, a second set of motor switches for manually controlling said window motors, and means responsive to actuation any of said motors by said second set of switches for reconnecting said first means to said switching means.

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