

- [54] SAFETY DEVICE FOR POWER WINDOW
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- [22] Filed: Mar. 26, 1973
- [21] Appl. No.: 344,723

Related U.S. Application Data

- [63] Continuation of Ser. No. 114,878, Feb. 12, 1971.

[30] Foreign Application Priority Data

Feb. 17, 1970 Japan..... 46-13693

- [52] U.S. Cl..... 49/28, 200/61.43
- [51] Int. Cl..... E05f 15/08
- [58] Field of Search..... 49/26-28;
200/61.41-61.44, 61.62, 61.71, 81, 82, 83,
81.9; 338/99, 100, 114; 180/111-113

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[57] ABSTRACT

A safety device for power windows comprising a pres-
sure sensitive tape-like switch including a plurality of
electrode plates each made of a tape-like flexible and
resilient material and juxtaposed to and spaced apart
from each other a distance of 1 or several millimeters,
a flexible insulating protective case containing said
electrode plates therein, and a window operation con-
trol circuit for stopping at least a closing motion of a
window pane when external force is exerted on said
pressure sensitive switch while the window pane is
moving in closing motion. Said tape-like pressure sen-
sitive switch is attached to a fixed part of a motor ve-
hicle.

13 Claims, 14 Drawing Figures

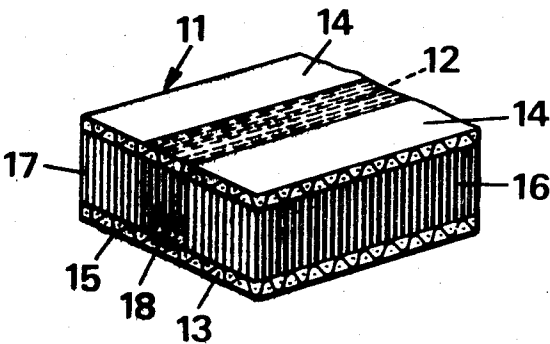


Fig. 1

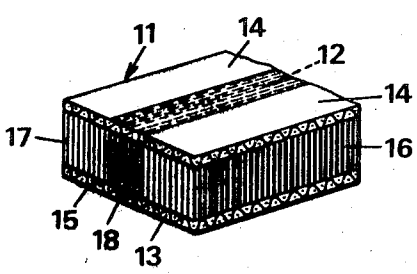


Fig. 2

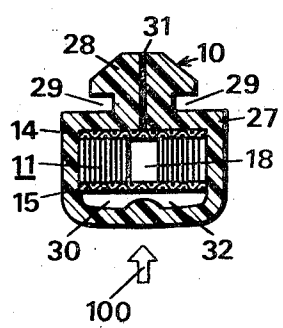


Fig. 3

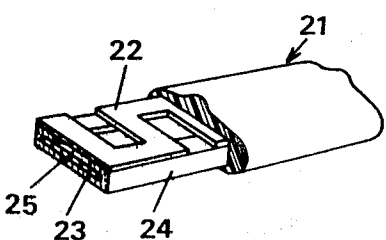
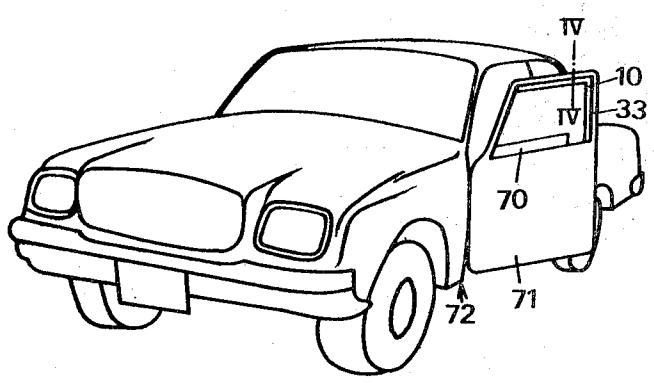


Fig. 4



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Fig. 5

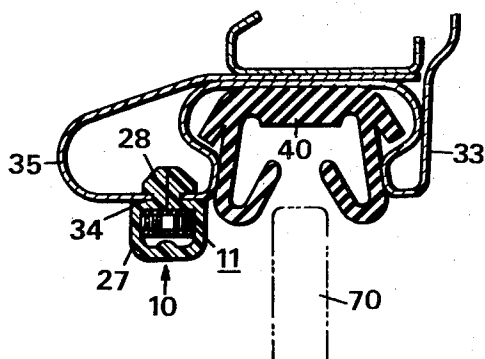


Fig. 6

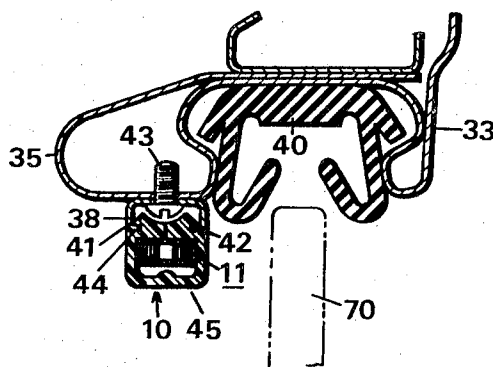


Fig. 7

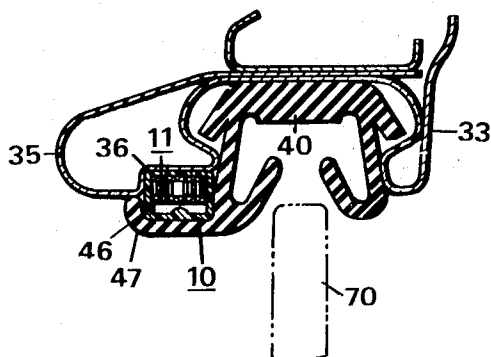
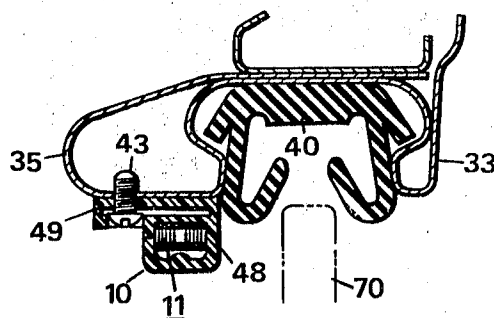


Fig. 8



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Fig. 9

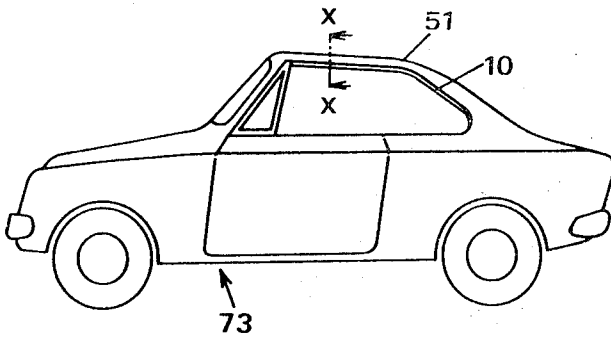


Fig. 10

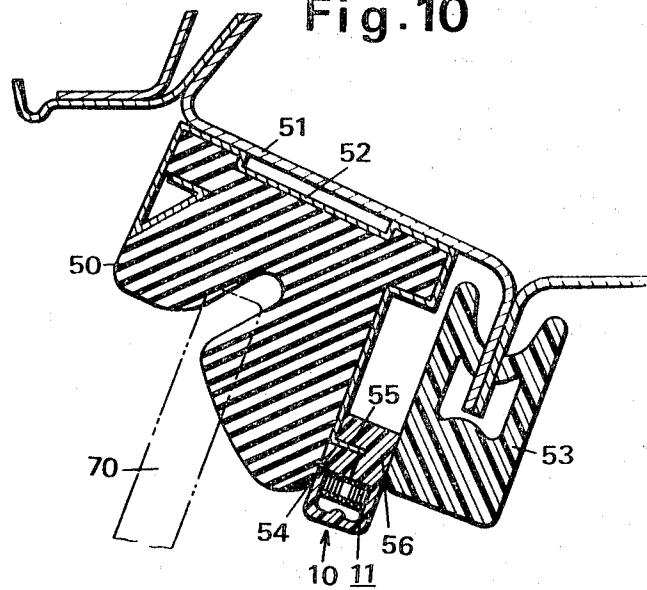
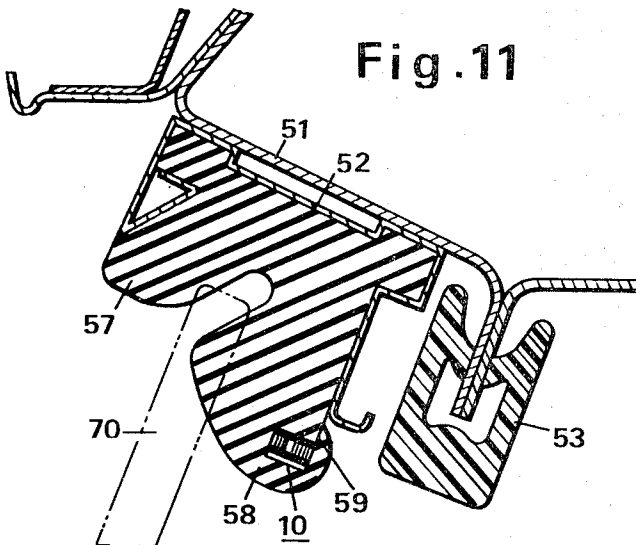


Fig. 11



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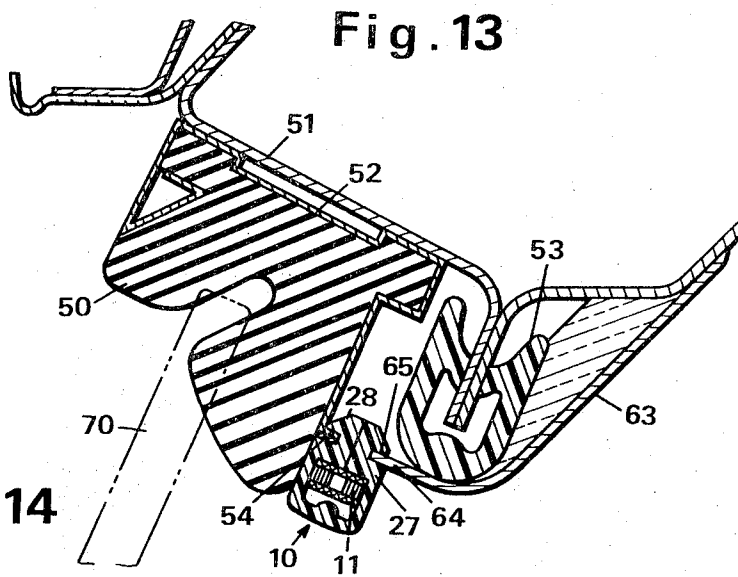
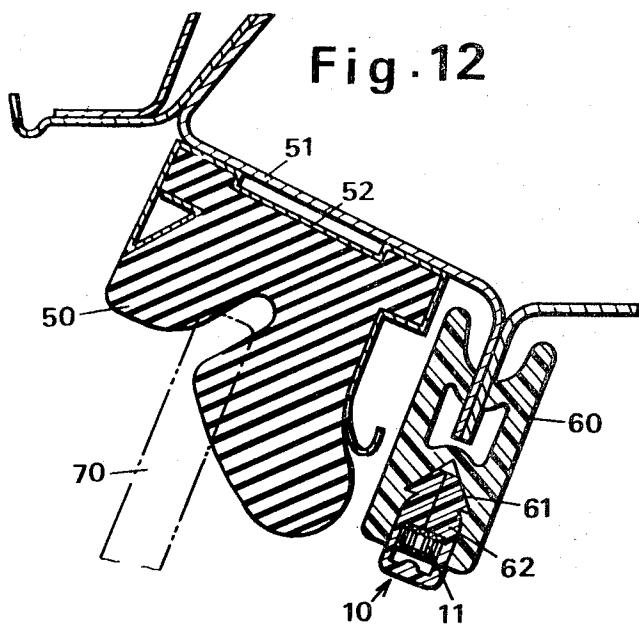
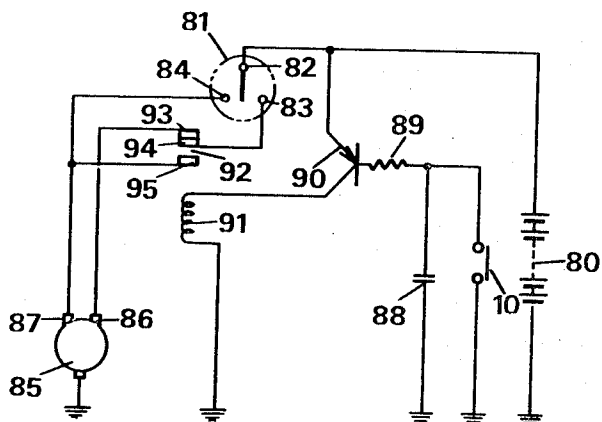


Fig. 14



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SAFETY DEVICE FOR POWER WINDOW

This is a continuation of application Ser. No. 114,878 filed Feb. 12, 1971.

This invention relates to a safety device for a window of motor vehicle operated by power or a so-called power window, which is adapted to be mounted on the vehicle body or the sash of the window, and which is effective to interrupt the upward movement of the window in response to pressure applied thereto.

The invention has as its object the provision of a safety device of the type described, simple in construction and positive and quick in performance, which operates such that, when the hand or other object happens to be held between the upper edge of window pane and the sash of the window while the window pane is moving upwardly in closing motion, the upward movement of the window pane is interrupted by pressure applied to the sash or a fixed part of the vehicle, such as roof side rail, no matter how small the pressure may be, and the window pane is instantly switched to opening motion from closing motion, such safety device being capable of provided in the vehicle with almost no alternation in the structure of window sash or roof side rail.

Heretofore, the so-called power window takes very little time in moving from fully open position to fully closed position. To this end, the window pane is moved by a force of considerably great magnitude. The operation of power window has hitherto involved the danger of the hand, face, neck and the like of the driver or passenger being held between the upper edge of window pane and the window sash or roof side rail.

The present invention obviates the aforementioned disadvantage of power window by providing a safety device comprising a tape-like pressure sensitive switch which may be either of the fabric type or plate spring type, such pressure sensitive switch being mounted on the window sash or the inner surface of a fixed part of the motor vehicle, such as roof side rail, and inserted in a window operation control circuit, such as window regulator, so that, when external force is exerted on an insulating protective layer of the pressure sensitive switch during the upward movement of the window pane in closing motion, the pressure sensitive switch opens at least a closing motion circuit in the window operation control circuit, no matter how small the external force may be, thereby switching the window from upward movement to downward movement.

Additional objects as well as features and advantages of this invention will become evident from the description set forth hereinafter when considered in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view of the pressure sensitive switch according to this invention embodied as a tape-like switch of the fabric type, showing the basic construction thereof by using a model;

FIG. 2 is a longitudinal sectional view of the tape-like pressure sensitive switch of FIG. 1 placed in a protective case;

FIG. 3 is a perspective view of the pressure sensitive switch according to this invention embodied as a tape-like switch of the plate spring type;

FIG. 4 is a side view of a motor vehicle having the pressure sensitive switch according to this invention mounted on the window sash of a window of the vehicle;

FIGS. 5 to 8 are sectional views, on an enlarged scale, of various embodiments of the pressure sensitive switch of different cross-sectional shapes according to this invention taken along the line IV—IV of FIG. 4 for showing essential portions of the switch and the different manners in which the switch is attached to the sash of a window;

FIG. 9 is a side view of a motor vehicle having the pressure sensitive switch according to this invention mounted on a roof side rail thereof;

FIGS. 10 to 13 are sectional views, on an enlarged scale, of various embodiments of the pressure sensitive switch according to this invention taken along the line X—X of FIG. 9 for showing essential portions of the switch and the different manners in which the switch is attached to the vehicle body; and

FIG. 14 is a circuit diagram showing an operation control circuit for the safety device according to this invention.

In FIG. 1, which shows the construction of one embodiment of the pressure sensitive switch according to this invention by using a model, the tape-like switch 11 comprises electrode plates 14 and 15 which are in the form of soft and resilient upper and lower tapes having conductors 12 and 13, such as copper wires, woven therein, fabric structures 16 and 17 disposed on both sides of the switch which permit said plates 14 and 15 into which the conductors 12 and 13 are woven to be separated from each other by a clearance 18 of about 1 to several millimeters while being juxtaposed to each other. The switch 11 is formed by weaving as a unit. The tape-like switch 11 constructed as aforementioned is such that, when pressure is applied thereto, it readily yields thereto and is resiliently deformed, so that the portions of the switch into which the conductors are woven are brought into contact with each other. Upon removal of the force which is exerted on the switch, it will readily be restored to its original shape.

FIG. 2 shows the pressure sensitive switch 10 wherein the tape-like switch 11 is enclosed by an insulating protective case 27 of a soft and pliable synthetic resinous material or the like. The protective case 27 is formed in its upper portion with a projection 28 of arrow-shaped cross-section which is formed at opposite side surfaces of the base portion with narrow grooves 29. The projection 28 is shaped such that the pressure sensitive switch 11 can readily be mounted on the inner surface of the sash of a window or a fixed part of the vehicle body, such as roof side rail, as subsequently to be described by utilizing the projection 28.

The insulating protective case 27 is formed with a space 30 therein, and a slit 31 is formed in the upper central portion of the protective case 27 to extend from the top of the projection 28 to the space 30 so as to divide the projection 28 of arrow-shaped cross-section into two portions. The slit 31 is provided to permit the operator to have access therethrough to the space 30 of the protective case 27 so as to place the tape-like switch 11 in the space 30. After the tape-like switch 11 is placed in the space 30, the slit 31 is closed by adhesively bonding the opposite edges thereof.

The insulating protective case 27 is formed on its inner bottom surface with a pressure sensitive portion 32 projecting upwardly in semi-circular form. The pressure sensitive switch 10 is inserted in the operation control circuit shown in FIG. 14 as subsequently to be described. If a pressing force is exerted in the direction of

an arrow 100 on the switch 10, the pressure sensitive portion 32 moves the lower electrode plate 15 upwardly, by resiliently deforming the same, into contact with the upper electrode plate 14, thereby closing the circuit. If the pressing force is removed, then the tape-like switch 11 is restored to its original shape.

FIG. 3 shows another embodiment of the tape-like pressure sensitive switch according to this invention which is a tape-like switch 21 of the plate spring type. The switch 21 comprises an electrode plate 23 made of a thin, resilient and flexible electrically conducting material, and a serpentine electrode 22 formed by stamping of the same electrically conducting material, such two electrodes 22 and 23 being juxtaposed to each other with one electrode disposed above the other electrode and a flexible insulating member 24 disposed on opposite sides of said electrodes being interposed therebetween, so that the two electrodes 22 and 23 are spaced apart from each other by a clearance 25 of about 1 to 3 millimeters. Thus, the two electrodes 22 and 23 are normally maintained out of contact with each other but brought into contact with each other when pressure is applied to the switch. The electrodes 22 and 23 and insulating member 24 are placed in a soft protective case 26 as shown.

FIGS. 4 to 13 show the embodiments of the pressure sensitive switch wherein the tape-like switch of the fabric type is employed. It is to be understood that the embodiments employing the tape-like switch of the plate spring type can be mounted in the same manner.

FIG. 4 shows the pressure sensitive switch 10 employing the tape-like switch of the fabric type as being mounted on the inner surface of a sash 33 attached to a door 71 of a motor vehicle by securing the switch 10 to the sash 33 through the projection 28 of the protective case 27. The numeral 70 designates a window pane.

FIGS. 5 to 8 show the embodiments of the pressure sensitive switch 10 in sectional views taken along the line IV—IV of FIG. 4 wherein the switch is mounted in different manners on the inner surface of the sash 33 of the window 70.

In FIG. 5, an opening 34 is formed in annular form in the underside of a curved projection 35 of the sash 33 for receiving therein the projection 28 of arrow-shaped cross-section of the pressure sensitive switch 10 shown in FIG. 2 by force fitting, so as to attach the pressure sensitive switch 10 to the inner surface of the sash 33.

The embodiments of the pressure sensitive switch 10 shown in FIGS. 6 to 8 are of cross-sectional shapes which differ from that of the pressure sensitive switch shown in FIG. 2. They are also attached to the sash 33 as the embodiment of FIG. 5. In FIG. 6, a retainer 41 is connected to the underside of the curved projection 35 by a screw 43. The retainer 41 which is of the inverted U-shape in cross-section is either formed with a circular or rectangular opening 44 in its lower side 42 or of channel shape of the same configuration throughout its length so as to hold a protective case 45 of the pressure sensitive switch 10.

The pressure sensitive switch 10 is mounted on the sash 33 by inserting the projection 38 thereof in the opening 44 or channel shape of the same configuration throughout its length.

In FIG. 7, a recess 36 is formed on the underside of the curved projection 35 of the sash 33 for receiving

therein the pressure sensitive switch 10 contained in the protective case 46 of rectangular cross-section. The top surface of the pressure sensitive switch 10 and the bottom of the recess 36 are adhesively bonded to each other. The lower end edge 47 of a glass run extends toward the underside of the switch 10 to support the switch 10 in embracing relation, so as to prevent the pressure sensitive switch 10 from being exposed to view.

In FIG. 8, an upper portion 49 formed by causing the upper side of the insulating protective case 48 of the switch 10 to project is secured by screw 43 to the inner surface of the curved projection 35 of the sash 33.

FIG. 9 shows in a side view the safety device according to this invention as it is attached to the inner surface of a fixed part, such as roof side rail, of a motor vehicle of the so-called hard top model having no window sash 33. Different manners of attaching the safety device to the fixed part of the motor vehicle are shown in FIGS. 10 to 13 in sectional views taken along the line X—X of FIG. 9.

In FIG. 10, the retainer 52 having on its underside a weather strip or elastomer 50 for the window pane 70 is secured to the inner surface of a roof side rail 51 of a motor vehicle, and an L-shaped locking member 54 is formed at the lower end portion or the portion nearer to the interior of the vehicle throughout its length. The shorter leg of the L-shaped locking member 54 is received in a groove 55 formed on one side of the pressure sensitive switch 10 comprising the tape-like switch 11 contained in the protective case 56 of substantially rectangular cross-section, and the other side of the switch 10 is pressed against a door opening trim 53, so as to securely attach the pressure sensitive switch 10 to the retainer 52.

In FIG. 11, a cavity 58 of substantially rectangular cross-section is formed in the lower portion of the weather strip 50 supported by the retainer 52 secured to the underside of the roof side rail 51, such cavity 58 being provided in a position which is nearer to the interior of the vehicle. A slit 59 is formed between the cavity 58 and a suitable position in the periphery of the weather strip 50, so as to permit the operator to have access to the cavity 58 through the slit 59 for placing the pressure sensitive switch 10 in the cavity 58. After the switch 10 is placed in the cavity 58, the slit 59 is closed by adhesively bonding its edges together, so that the pressure sensitive switch 10 can be made integral with the strip 50.

In FIG. 12, the pressure sensitive switch 10 is not disposed in the weather strip 50 but embedded in the door opening trim 60. More specifically, a V-shaped groove 61 is formed in the lower portion of the opening trim 60 mounted on the lower end of the roof side rail 51. The pressure sensitive switch 10 comprising the tape-like switch 11 contained in the protective case 62 formed with a projection 28 of V-shaped cross-section is received in the groove 61, so that the projection 28 is fitted in the groove 61 but the lower portion of the switch 10 is partly exposed to view.

In FIG. 13, a silencer pad 63 is provided on the side nearer to the interior of the vehicle of the weather strip retainer 52 secured to the underside of the roof side rail 51, said silencer pad 63 being formed at its lower end portion with an annular or rectangular opening 65 which receives therein the projection 28 of the pressure

sensitive switch 10 of the cross-sectional shape shown in FIG. 2.

FIG. 14 is a circuit diagram of the operation control circuit in which the safety device according to this invention is inserted. In the figure, 80 is a battery or other direct current power source, 81 a manually operated change-over switch comprising a movable contact 82 and fixed contacts 83 and 84, 85 an electric motor having a terminal 86 of the window pane closing movement side and a terminal 87 of the window pane opening movement side for moving the window panes in closing and opening motion, 88 a capacitor in a delay circuit, 89 a resistor for adjusting the time lag of the delay circuit, 90 a transistor, 91 an electromagnetic coil excited when the transistor 90 is fired, and 92 an electromagnetic contact means comprising contacts 93, 94 and 95, the contacts 93 and 94 being normally closed and contacts 94 and 95 being closed only when the electromagnetic coil 91 is excited. The numeral 10 designates the pressure sensitive switch 10 according to this invention.

If the pressure sensitive switches 10 disposed in the positions as described previously are inserted in the operation control circuit shown in FIG. 14 and the movable contacts 82 of the manually operated change-over switch 81 is brought into engagement with the fixed contact 84 thereof, then a current is passed from the power source 80 to the terminal 87 of the window pane opening movement side of the electric motor 85, so that the window panes are opened. If the movable contact of the manually operated switch 81 is brought into contact with the fixed switch 83 thereof, then a current is passed from the power source to the terminal 86 of the window pane closing movement side of the electric motor 85 through the contacts 93 and 94 of the electromagnetic switch means 92, so that the window pane is closed.

If the hand, neck or the like is held between the upper edge of the window pane 70 and the sash 33 or weather strip 50 attached to the roof side rail during the closing movement of the window pane 70, the pressure sensitive switch 10 will be pressed from below and the electrode plates 14 and 15 therein will be brought into contact with each other, so that the pressure sensitive switch 10 is closed. Upon closure of the pressure sensitive switch 10, the normally charged capacitor 88 instantly discharges and fires the transistor 90, with a result that the electromagnetic coil 91 is excited through the emitter and collector of the transistor. Excitation of the electromagnetic coil 91 opens the contacts 93 and 94 of the electromagnetic contact means 92 and closes the contacts 94 and 95 thereof. While the electromagnetic switch means is in this state, a current is passed from the power source 80 to the terminal 87 of the window pane opening movement side of the electric motor 85 through the movable contact 82 and fixed contact 83 of the manually operated change-over switch 81 and the contacts 94 and 95 of the electromagnetic switch means 92, so that the window pane is switched from the closing motion to the opening motion. When the window pane begins to open again, if the pressure sensitive switch 10 is opened, the transistor 90 remains fired and the window pane continues its opening movement until the capacitor 88 is charged up by a charge current flowing through the capacitor 88 for a predetermined time interval which is

determined by the value set for the resistor 89 for adjusting the time lag.

When the predetermined time interval has elapsed, the charged current ceases to flow to the capacitor 88 and the transistor 90 is rendered inoperative, so that the contacts 94 and 95 of the electromagnetic switch means 92 is opened and the contacts 93 and 94 thereof are closed as shown in FIG. 14. Thus, the window pane begins to close again.

The safety device according to this invention is constructed and operates as aforementioned. The safety device comprises the pressure sensitive switch 10 contained in the insulating protective case made of a resilient synthetic resinous material and provided in the window sash 33 or a fixed part of the vehicle body, such as roof side rail 51, by fitting or embedding, so that the safety device is actuated when a pressing force is exerted on the underside of the switch 10, no matter how small the force may be. If the hand or neck of the driver or passenger is caught by the power window, the safety device will instantly actuates the window operation control circuit and switches the window pane from closing operation to opening operation, thereby eliminating the accident of hand or neck being damaged by the power window.

The present invention has many other advantages. The safety device is simple in construction and can be readily attached to a window sash or fixed part of the vehicle body with very little alteration of the structure of the window sash and vehicle body without spoiling the appearance of the vehicle body.

It is to be understood that the form of the invention herewith shown and described is to be taken as a preferred embodiment. Various changes may be made in the shape, size and arrangement of parts. For example, equivalent elements may be substituted for those illustrated and described herein, parts may be reversed, and certain features of the invention may be utilized independently of the use of other features, all without departing from the spirit or scope of the invention as defined in the subjoined claims. In this invention, of course, a plurality of pressure sensitive switch may be used in place of a single pressure sensitive switch.

What we claim is:

1. A safety device for power windows having a movable pane and a sash with a sash surface in and near the path of movement of the pane, a portion of the surface being exposed to pressure from objects whose dimensions in the direction of the thickness of the pane are larger than the thickness of the pane, said device comprising a pressure sensitive tape-like switch including a plurality of elongated electrode plates each made of a tape-like flexible and resilient material and juxtaposed to and spaced apart from each other a distance of 1 or several millimeters, a flexible insulating protective case containing said electrode plates therein, said tape-like pressure sensitive switch being attached to a portion of the surface exposed to the objects when the objects are placed in the path of the pane, and a window operation control circuit for stopping at least a closing motion of a window pane when external force is exerted on said pressure sensitive switch while the window pane is moving in closing motion, said plates having elongated edges, and resilient spacing means extending between the plates along the elongated edges for spacing the plates, said pressure sensitive tape-like switch being provided on the upper side in a space formed by said

protective case, and a pressure sensitive portion projecting upwardly in semi-circular form in a space provided between said protective case and said pressure sensitive tape-like switch, said case having a slit for receiving said switch.

2. A safety device as defined in claim 1, wherein a pressure sensitive switch comprising tape-like members of a flexible and resilient material is embedded in a door opening trim.

3. A safety device as defined in claim 1, wherein the window is on a vehicle, and said pressure sensitive switch comprising tape-like members of a flexible and resilient material is provided on the side of a window sash nearer to the interior of the vehicle in a position which corresponds to the upper edge of the window pane.

4. A safety device as defined in claim 1, wherein said pressure sensitive switch comprising tape-like members of a flexible and resilient material is provided in a weather strip mounted on the exposed portion of the sash surface in a position corresponding to the upper edge of the window pane.

5. A safety device as defined in claim 1, wherein the window is on a vehicle having structural members with connecting edges, a pressure sensitive switch comprising tape-like members of a flexible and resilient material being provided between a weather strip and a door opening trim for covering the connecting edge of a structural member of the vehicle.

6. A safety device as defined in claim 3 wherein said pressure sensitive switch is provided in an opening formed on said window sash.

7. A safety device as defined in claim 3 wherein said pressure sensitive switch is fixed on said window sash by bolts.

8. A safety device as defined in claim 3, wherein said pressure sensitive switch is provided between said window sash and a weather strip.

9. A vehicle, comprising a vehicle body, a power window mounted in the body, said window having a movable pane and a sash with a sash surface in and near the path of movement of the pane, a portion of the surface being exposed to pressure from objects whose dimensions in the direction of the thickness of the pane are larger than the thickness of the pane, switch means in the shape of an elongated tape capable of being actuated by pressure transverse to the elongated direction, said switch means including a surrounding flexible insulating protective case, said switch means being mounted on the portion of the surface exposed to the objects when the objects are placed in the path of the pane, window operation control means for moving the pane in response to control by an operator and for stopping at least the closing motion of the window pane in response to a force operating said switch means while the window pane is being closed, said switch means including a pair of elongated flexible conductive plates, said plates having edges, spacer means extending between the plates along the edges, said surrounding flexible insulating protective case forming a space between one of the plates and the case, an elongated projection extending along the interior of the case toward said one of said plates, said projection being rounded and located opposite the elongated center of the one of said plates, said case being flexible so that pressure applied to the portion of the case having said projection causes

said projection to push the one of said plates against the other.

10. A vehicle as in claim 9, wherein said switch means is mounted on the portion of the surface on the interior of the body relative to the pane.

11. A safety device for power windows having a movable pane and a sash with a sash surface in and near the path of movement of the pane, a portion of the surface being exposed to pressure from objects whose dimensions in the direction of the thickness of the pane are larger than the thickness of the pane, said device comprising pressure sensitive switch means having an elongated shape and closeable by pressure applied transverse to the tape, said switch means being mounted to a portion of the surface exposed to the objects when the objects are placed in the path of the pane, and window operation control means for stopping at least the closing motion of the window pane when an external force is exerted on said switch means while the window pane is closing, said switch means including a pair of elongated flexible conductive plates having elongated edges, elongated spacer means spacing the plates from each other and extending between said plates along the longitudinal edges, said spacer means being resilient, said switch means having a case surrounding said plates and said spacer means, said case being flexible and forming a space between one of the plates and the case, an interior projection extending in the space along the case toward the one of said plates, said case being squeezable so that said projection contacts said one of said plates and causes said one of said plates to contact the other of said plates.

12. A pressure sensitive switch for a power window safety device of a vehicle for mounting on the vehicle's strengthening member adjacent the advancing edge of the vehicle's open window pane in parallel with the edge, comprising a tape-like switch assembly, said switch assembly comprising a pair of elongated elastic electrode plates, and resilient spacer means extending between said plates from end to end and in the direction of the width of said electrode plates so that said electrode plates are arranged in spaced relation of up to several millimeters, said plates being electrically closeable by pressing of the opposing surfaces of the electrode plates, and a flexible insulating protective case for surrounding said tape-like switch assembly, said protective case including a chamber for surrounding said tape-like switch assembly and defining a space so that when said assembly is surrounded and encased therein a clearance is formed between the lower surface of the switch and the inner surface of the case, a semi-circular pressure sensitive portion projecting upwardly from the bottom surface of the case in the central portion of said clearance so that both electrode plates may be contacted to each other by pressing said projecting portion upwardly with external application of pressure, and a slit formed in the upper central portion of the tape-like switch surrounding said chamber of said protective case for providing an opening for receiving said assembly.

13. A safety device as defined in claim 12, wherein said flexible insulating protective case comprises projections of arrow-shaped cross sections each positioned with a predetermined interval on the upper portion of said protective case, a slit formed in the upper central portion of said protective case to extend from the top of the projection to the upper portion of a space formed by said protective case, and a pressure sensitive portion projecting upwardly in semi-circular form in a space provided between said protective case and said pressure sensitive tape-like switch, said pressure sensitive tape-like switch assembly being positioned in the upper portion in said space.

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