United States Patent

Heckendorf

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[54] ACCELERATION RESPONSIVE SWITCH

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[52] **U.S. Cl.** .....**200/61.45 R,** 200/61.45 M, 340/262

[51] **Int. Cl.** **H01h 35/14**

[58] **Field of Search** .....200/61.45, 61.48, 61.49, 61.5, 200/61.52, 61.53, 52 B, 61.45 M; 340/262

[56] **References Cited**

UNITED STATES PATENTS

2,986,614	5/1961	Minch	200/61.51
2,802,204	8/1957	Kennelly et al.	200/61.45
2,254,294	9/1941	Kimmell	200/61.45
3,500,007	3/1970	Koomen et al.	340/262
3,518,385	6/1970	Boudes et al.	200/61.45

FOREIGN PATENTS OR APPLICATIONS

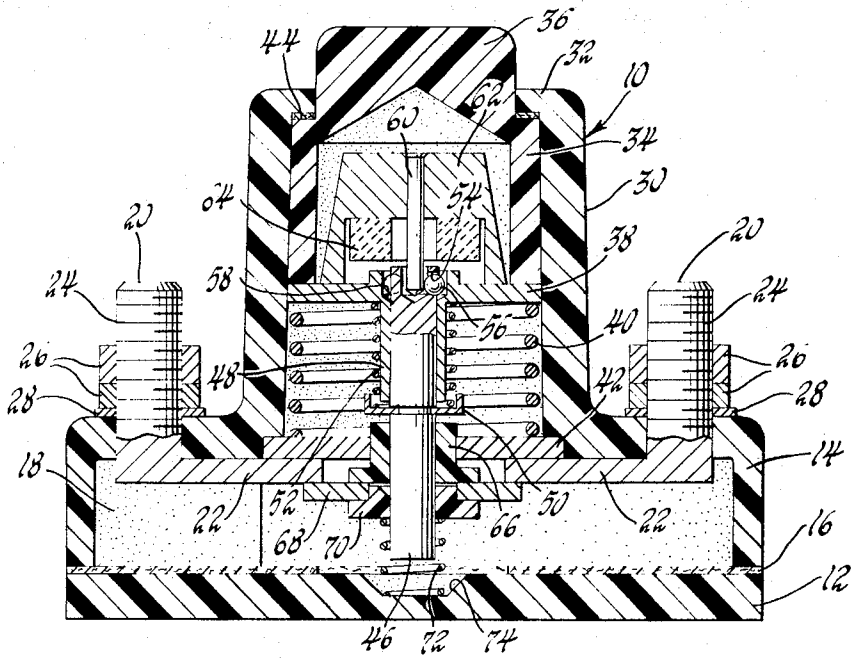
524,687	5/1956	Canada	200/61.45
625,512	9/1961	Italy	200/61.5

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[57] **ABSTRACT**

An acceleration responsive switch includes a housing mounting a pair of spaced fixed contacts connected across a source of power. The housing includes a cylindrical lateral extension which slidably receives a pushbutton and a release plate. A coil compression spring seating on one apertured wall of the housing holds the release plate in engagement with the pushbutton to hold the pushbutton in engagement with the other apertured wall. An operator is slidably mounted within a guide portion of the release plate. A movable contact for bridging the fixed contacts is slidably mounted on the operator and spring biased to a position connecting the fixed contacts. A plurality of balls are slidably mounted within respective radial bores of the operator for movement inwardly of the bores or outwardly thereof. In the latter position, the balls are axially engageable between the walls of the bores and a radial shoulder of the release plate to locate the operator in a first position against a spring bias to a second position. The balls are forced outwardly of the bores by an axial pin which is secured to a generally frustoconically shaped seismic mass seating on the release plate. A magnet on the mass exerts a predetermined flux between the mass and plate to normally locate the mass in seated position unless an acceleration pulse of predetermined amplitude and time is applied to the mass. When such a pulse is received, the control pin is withdrawn from engagement with the balls to permit the balls to move inwardly of the bores and release the operator for movement under its spring bias to its second position. The operator engages the movable contact as the operator moves to its second position to open the switch. The switch can be reset in closed position by manually moving the pushbutton inwardly of the extension. This moves the release plate, the mass and the button toward the operator to locate the radial shoulder of the plate with respect to the radial bores of the operator and simultaneously engage the control pin with the balls to force the balls into engagement with such radial shoulder. This reconnects the release plate and operator, and the spring of the release plate returns the operator to its first position and likewise returns the release plate and pushbutton to their normal position to reset the switch.

6 Claims, 3 Drawing Figures



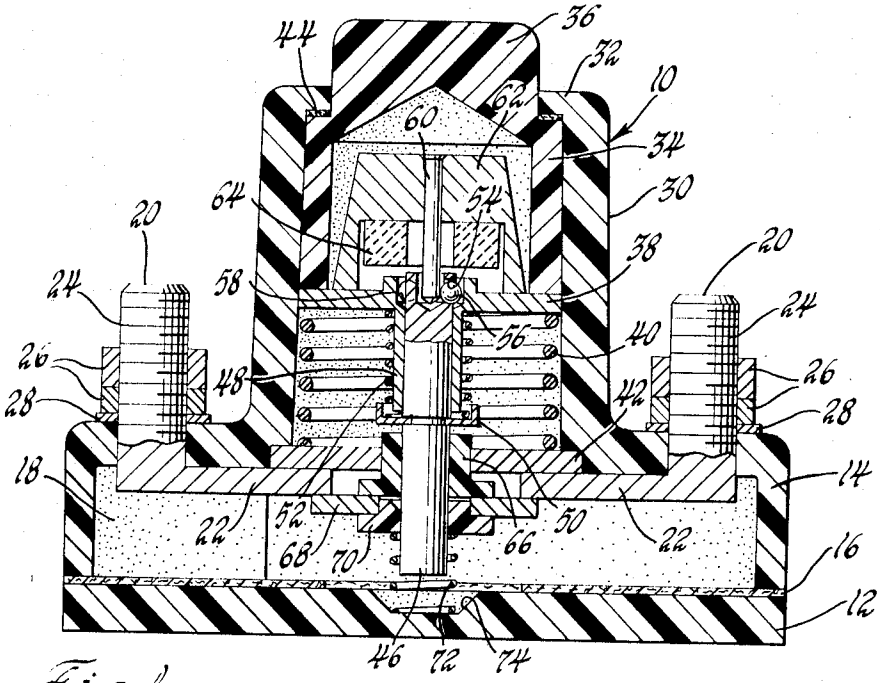


Fig. 1

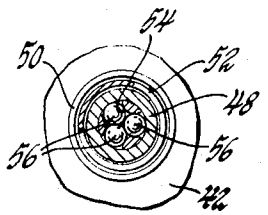


Fig. 3

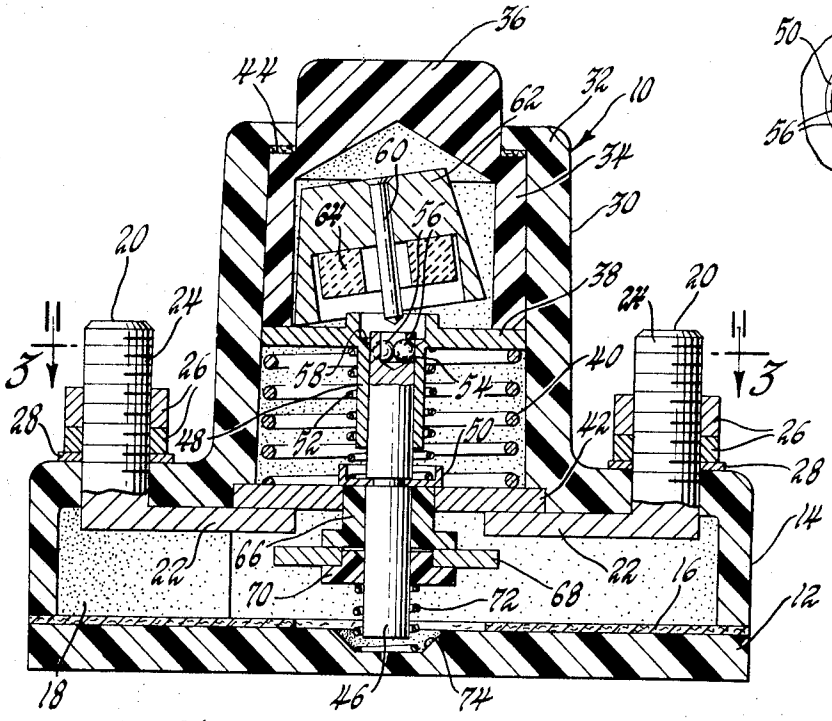


Fig. 2

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ACCELERATION RESPONSIVE SWITCH

This invention relates generally to acceleration responsive switches and more particularly to such switches which automatically open a circuit when an acceleration pulse of predetermined amplitude and time is received and which can be selectively reset without disassembly.

One of the features of this invention is that it provides an improved acceleration responsive normally closed switch which includes an operator movable axially from a normal first position to a second position to open the switch, with the operator being normally held against movement by a plurality of balls engaging axially spaced generally radially extending cooperating surfaces on the operator and a movable release member, and with the movement of the balls into and out of engagement with the cooperating surfaces being controlled by a seismic mass arrangement. Another feature is that the release member can be moved relative to the operator when the latter is in second position to locate the cooperating surfaces in a position to receive the balls therebetween, with the release member and operator being subsequently movable as a unit to return the operator to the first position and permit the switch to close. A further feature of this invention is that the balls are normally forced outwardly of radial bores in the operator and into engagement with a radial shoulder of the release member by an axially movable pin, the movement of which is controlled by a seismic mass seated on the release member under the action of a predetermined strength magnetic flux which is overcome when an acceleration pulse of predetermined amplitude and time is applied to the mass.

These and other features of the switch of this invention will be readily apparent from the following specification and drawings wherein:

FIG. 1 is a view showing the switch in closed position;

FIG. 2 is a view similar to FIG. 1 showing the switch in open position; and

FIG. 3 is a sectional view taken generally along the plane indicated by line 3—3 of FIG. 2.

Referring now particularly to FIGS. 1 and 2 of the drawings, a switch designated generally **10** according to this invention includes a generally rectangularly shaped baseplate **12** of insulating material and a generally rectangularly shaped hollow housing **14** of insulating material, the sidewall of which seats on a gasket **16** on the upper surface of plate **12**. Diagonally opposite corners of the housing **14** are provided with integral lugs **18** which seat on the gasket **16**. Screws, not shown, extend through apertures in the plate **12** and into such lugs to secure the plate **12** and housing **14** to each other. Likewise, aligned apertures in such lugs and in the plate provide for mounting of the switch **10** on any suitable support, such as a vehicle. The switch **10** of this invention could be used in such a vehicle to disconnect the battery from the electrically operated mechanisms and accessories in the event that the vehicle receives an acceleration pulse, due to impact or otherwise, which exceeds a predetermined amplitude and time.

A pair of switch contacts **20** extend through apertures in the upper wall of housing **14** at the other diagonal corners thereof, and each includes an elongated contact portion **22** located along a diagonal through such other corners of the housing, and a threaded portion **24** which is secured to the upper wall of the housing by a pair of nuts **26** and a washer **28**.

An integral cylindrical extension **30** extends generally normal to the upper wall of housing **14** and including an apertured one end wall **32**. A hollow pushbutton **34** of insulating material is slidably mounted within the extension **30** and includes a button portion **36** which extends outwardly of the aperture in wall **32** when the pushbutton is in its position as shown. A circular metal plate or release member **38** is slidably received in extension **30** and seats against the open end of the pushbutton **34**. A coil compression spring **40** seats between plate **38** and an apertured circular plate **42** at the open end of extension **30** and biases the plate **38** upwardly to in turn bias the pushbutton **34** upwardly and locate an annular shoulder **44** thereof in engagement with the wall **32** adjacent the aperture therein. Any suitable resilient washer can be provided on the shoulder **44**. Plate **42** is held within a counterbore of extension **30** by contact portions **22**.

A cylindrical operator **46** is slidably received within a tubular guide or portion **48** of the plate **38**. A split ring spring seat **50** received within an intermediate annular groove of the operator seats one end of a coil compression spring **52**, the other end of which seats on the lower surface of plate **38** to continually bias the operator **46** downwardly as viewed in FIG. **1**. The operator **48** includes three equally spaced radial bores **54**, FIG. **3**, which open to a central axial bore of the operator. A ball **56** is slidably received in each bore. When the balls tangentially engage the walls of the respective boxes and the axially juxtaposed radially and axially extending annular shoulder **58** of the plate **38**, as shown in FIG. **1**, the operator **46** is located in what may be termed its first position and held against movement by spring **52** to its second position shown in FIG. **2**. In order for the operator to move to its second or FIG. **2** position, balls **56** must move radially inwardly of bores **54** and out of tangential engagement with shoulder **58**.

A control pin or member **60** controls the radial movement of the balls **56** and is movable relative to the balls within the central axial bore of the operator **46**. Pin **60** is secured to a hollow seismic mass **62** of predetermined weight and of generally frustoconical shape which seats on the plate **38** and is held thereagainst by an annular permanent magnet **64** which is secured to the mass and exerts a predetermined strength flux between the mass and the plate. The seismic mass **62** normally maintains the control pin **60** in its position as shown in FIG. **1**. In this position, the pin **60** tangentially engages the three balls **56** and forces the balls radially outward of bores **54** into tangential engagement with shoulder **58** to retain the operator **46** in its first position. When the mass is subjected to an acceleration pulse of predetermined amplitude and time, the mass will tilt relative to the plate **38** to its position shown in FIG. **2**. This movement of the mass partially withdraws the pin **60** from the axial bore of the operator and permits the balls **56** to move radially inwardly of the bores **54** and out of engagement with shoulder **58** to release the operator **46** for movement to its second position shown in FIG. **2**. The tapering of the shoulder **58** axially of the operator **46** aids the spring **52** in camming the balls **56** radially inwardly of bores **54** to permit movement of the operator to its second position. The guide **48** retains the balls within their respective bores as the operator moves to its second position.

A flanged bushing **66** of insulating material is slidably mounted on the operator **46** and received within a central aperture of the plate **42**. A circular contact **68** seats against the flange of bushing **66** and is held thereagainst by being piloted on a flanged washer **70** of insulating material which is slidably mounted on the operator **46** and biases the contact **68** upwardly under the action of a coil compression spring **72** which seats on the base of a bore **74** in the plate **12** and also against the washer **70**.

When the operator **46** is in its position shown in FIG. **1**, the contact **68** bridges the contact portions **22** so that the switch is closed and the circuit across the switch is complete.

As previously described, when the seismic mass **62** receives an acceleration pulse of predetermined amplitude and time the balls **56** will move inwardly of the operator, and the operator thereupon will immediately move downwardly to its second position, shown in FIG. **2**, under the action of the spring **52**. As the operator moves to this position, the split ring **50** first engages the bushing **66** and then the plate **42**. When the ring **50** engages the bushing **66**, it moves the bushing, contact **68** and washer **70** slightly downwardly as shown in FIG. **2**. This moves the contact **68** out of electrical connection with the contact portions **22** so that the switch is open and the circuit across the switch is open. Upon cessation or reduction of the acceleration pulse, the mass **62** will return from its FIG. **2** position to a position in engagement with plate **38**, not shown. However, the length of the pin **60** is such that the pin will not engage the balls **56** when the operator is in its second position and the mass returns to its normal position.

If it is desired to manually reset the switch, the operator engages the button portion **36** and depresses the button **34**. This moves the mass **62** and the plate **38** downwardly of their position shown in FIG. **2** so that the bores **54** now open to the radial shoulder **58** of the plate **38**. Likewise, this moves the control pin **60** into engagement with the balls **56** to again force the balls radially outwardly of the bores **54** and into engagement with the shoulder **58**. Thus, the plate **38** and the operator **46** are again connected. When the button portion **36** is released, the spring **40** immediately returns the plate **38** and mass **62** to their position shown in FIG. **1**. The operator **46** moves with the plate **38** to this position to permit spring **72** to locate contact **68** in electrical contact with the contact portions **22** and close the switch.

Thus, this invention provides an improved acceleration responsive switch.

I claim:

1. An acceleration responsive switch, comprising, a support including a pair of spaced electrical contacts, a release member movably mounted on the support, means locating the release member in a predetermined first position, an operator mounted on the release member for axial movement relative thereto between first and second positions, means biasing the operator to the second position, detent means acting between the operator and release member movable between detented and undetented positions and engageable in detented position with the operator to hold the operator in the first position, a seismic mass movably mounted on the support, means operatively connecting the mass to the detent means for movement of the detent means to undetented position to release the operator for movement to the second position upon movement of the seismic mass relative to the support, magnetic means exerting a magnetic flux of predetermined strength between the mass and support to retain the seismic mass against movement relative to the support, an acceleration pulse of predetermined amplitude and time moving the seismic mass relative to the support against the flux of the magnetic means to release the operator, contact means normally electrically connecting the spaced contacts, means disconnecting the contact means and spaced contacts upon movement of the operator to second position, and means for moving the detent means to detented position in engagement with the operator upon movement of the release member from the predetermined first position when the operator is in the second position.

2. The switch recited in claim **1** wherein the locating means for the release member includes resilient means holding the release member against stop means on the support, the resilient means returning the release member to the predetermined first position thereof as a unit with the release member upon movement of the detent means to detented position in engagement with the operator when the operator is in the second position.

3. The switch recited in claim **1** wherein the means for moving the detent means to detented position include externally operated manual means for moving the release member relative to the support when the operator is in the second position.

4. The switch recited in claim **1** wherein the locating means includes stop means on the support and resilient means biasing the release member into engagement with the stop means for locating the release member in a predetermined first position, the detent means including means carried by the operator and engageable with the release member in the first positions of the operator and release member, the means for moving the detent means to detented position including externally operated means for moving the release member relative to the support and against the resilient biasing means to a second position wherein the means carried by the operator is engageable with the release member, the resilient biasing means returning the release member and operator as a unit to the first position thereof.

5. An acceleration responsive switch comprising, in combination, a support including a pair of spaced electrical contacts, a pair of members mounted on the support for axial movement relative one another and the support between respective first and second positions, contact means mounted on one member and electrically connecting the spaced contacts in the first position of the one member and disconnecting such contacts in the second position thereof, means biasing the one member to the second position thereof, means normally locating the other member in the first position thereof, the members each including generally radially extending shoulder means located in axially spaced juxtaposed relationship when the members are located in the same number position and located out of juxtaposed relationship when the members are located in a different number position, ball means mounted on the one member for movement radially thereof between a first position in engagement with the juxtaposed shoulder means to connect the one member to the other member and locate the one member in the first position thereof against the action of the biasing means, and a second position out of engagement with the shoulder means of the other member to permit movement of the one member to the second position thereof under the action of the biasing means, a seismic mass, means mounting the mass on the support for movement relative thereto when subjected to an acceleration pulse of predetermined amplitude and time, means on the mass engageable with the ball means to normally hold the ball means in the first position thereof and being movable out of engagement with the ball means upon movement of the mass relative to the support to permit movement thereof to the second position, and means for moving the other member to the second position thereof when the one member is in the second position thereof to move the shoulder means of the other member into axially spaced juxtaposed relationship and move the engageable means into engagement with the ball means to move the ball means to the first position thereof, the locating means returning the other member and the one member as a unit therewith to the respective first positions thereof.

6. An acceleration responsive switch comprising, in combination, a support including a pair of spaced electrical contacts, an operator member mounted on the support for axial movement between first and second positions relative thereto, contact means mounted on the operator member and electrically connecting the spaced contacts in the first position of the operator member and disconnecting such contacts in the second position thereof, means biasing the operator member to the second position thereof, a release member mounted on the support for axial movement relative to the operator member, means locating release member in a first position thereof and resisting movement thereof to a second position thereof, the operator and release members each including generally radially extending shoulder means located in axially spaced juxtaposed relationship when the operator member is in the first position thereof and located out of juxtaposed relationship when the operator member is in the second position thereof, ball means mounted on the operator member for movement radially thereof between a first position in engagement with the juxtaposed shoulder means to locate the operator member in the first position thereof against the action of the biasing means and a second position out of engagement with the shoulder means of the release member to permit movement of the operator member to the second position thereof, seismic mass means mounted on the support and moving when subjected to an acceleration pulse of predetermined amplitude and time, means mounted on the seismic mass and engageable with the ball means to normally hold the ball means in the first position thereof and moving out of engagement with the ball means upon movement of the seismic mass to permit movement of the ball means to the second position, and means for moving the release member to the second position thereof when the operator member is in the second position thereof to move the shoulder means into axially spaced juxtaposed relationship and move the means mounted on the seismic mass into engagement with the ball means to move the ball means to the first position thereof, the

locating means for the release member returning the release member and the operator member as a unit therewith to the respective first positions thereof.

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