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## ACCELERATION RESPONSIVE SWITCH

Charles R. Bonnell, Columbia Heights, Minn., and James S. Fink, El Paso, Tex., assignors to Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., a corporation of Delaware

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This invention pertains to accelerometers and particularly to acceleration responsive switches. It is well known in the art that aircraft are designed to operate within certain stress limits and that aircraft are often stressed beyond these limits due to excessive accelerations or high shock loads. Our invention concerns an acceleration responsive switch that can be used to give a signal or operate a control device before excessive accelerations or high shock loads occur.

Therefore, an object of our invention is to provide a switch that is responsive to acceleration.

Another object of our invention is to provide means for latching the switch upon reaching predetermined accelerations.

Further objects of our invention will become evident upon inspection of the following drawings, specifications and claims.

Figure 1 is a plan view seen from the upper end of an embodiment of our invention with the cover removed.

Figure 2 is an elevation partly in section taken generally on line 2—2 of Figure 1.

Figure 3 is an elevation partly in section taken on line 3—3 of Figure 1.

A casing 10 has end plates 11 and 12 suitably secured thereto. A mass 15 consisting of a center shaft 16 and end portions 17 and 18 is guided in casing 10 for translational movement by a ball bushing 20 which engages the shaft 16. Spring 23 is soldered to casing 10 at bushing 20 and to mass 15 at end portion 18. Spring 23 supports mass 15 when the casing 10 is mounted vertically and biases mass 15 to its normal at rest position.

A lever arm 28 is pivoted at screw 29 on a collar 30 in casing 10. A plurality of small plunger actuated snap switches 33 are mounted in casing 10 and held by screws 34. A leaf spring 37 is held in casing 10 by screws 34 and cooperates with the plungers 38 of switches 33. A cross bar 40 attached to the right end of lever 28 cooperates with leaf spring 37 and is biased in a clockwise direction by leaf spring 37. A follower wheel 44 is mounted on the left end of lever 28 and cooperates with the cylindrical end portion 17 of mass 15. The lever arm 28, cross bar 40 and follower wheel 44 are balanced so that lever arm 28 is substantially insensitive to accelerations in its plane of movement.

Upon a vertical acceleration upward parallel to the translational axis of shaft 16 mass 15 will move downward against spring 23 with follower wheel 44 cooperating with the surface 46 of end portion 17 of mass 15. With sufficient upward acceleration of the case 10, mass 15 will move downward beyond the point of cooperation of follower wheel 44 and surface 46, and leaf spring 37 will bias lever 28 into a clockwise pivotal movement as seen in Figure 1 with follower wheel 44 bearing on the top surface 47 of end portion 17 latching mass 15 against return movement upward. The clockwise rotation of lever 28 releases the plungers 38 of switches 33.

Conversely, upon a vertical acceleration downward of

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casing 10, mass 15 will move upward against spring 23 with follower wheel 44 cooperating with the surface 46 of end portion 17 of mass 15. With sufficient downward acceleration mass 15 will move upward beyond the point of cooperation of follower wheel 44 and surface 46 and leaf spring 37 will again bias lever 28 into a clockwise pivotal movement, this time with follower wheel 44 bearing on the abutment or lower surface 48 of end portion 17 latching mass 15 against return movement downward. The pivotal movement of lever 28 will again actuate switches 33. The cooperation of shaft 16 and ball bushing 20 acts as a restricted passageway for air between the upper and lower chambers. Movement of the mass 15 changes the pressure in the two chambers which tends to equalize through the restricted passageway of the ball bushing thereby damping the movement of the mass 15.

A reset rod 50 is provided to pivot lever arm 28 from either of the latching positions described above and again place follower wheel 44 in the normal position of cooperating with surface 46 of end portion 17 of mass 15. Reset rod 50 is mounted in casing 10 and biased downward by a spring 51 so that cam surface 52 is normally below lever arm 28. Upon pushing reset rod 50 upward at reset button 53, cam surface 52 will engage lever 28 pivoting it counterclockwise bringing follower wheel 44 out of engagement with surfaces 47 or 48 and allowing spring 23 to return mass 15 to its normal at rest position.

The electrical connectors 55 from the switches 33 can be brought outside the casing 10 by a suitable connector (not shown).

Selection of the vertical length of surface 46 or the stiffness of spring 23 will determine the range of the accelerometer between the latching points. End portions 17 and 18 are threadably attached to shaft 16 and their position on shaft 16 is thereby adjustable. The distance between the normal at rest position of follower wheel 44 on surface 46 and the two latching positions can be varied by adjusting either one or both of end portions 17 and 18 on shaft 16. This gives the desirable feature of allowing a selection of predetermined acceleration at which the switching action will occur for both vertical upward and downward acceleration. It is desirable to have both end portions 17 and 18 adjustable on shaft 16 to insure adequate room for movement of mass 15 for any selected at rest position of follower wheel 44 on surface 46. That is, the distance from the top of follower wheel 44 to abutment 48 may not be greater than the distance from the top of end portion 18 to the bottom of ball bushing 20 to allow latching of mass 15 upon downward acceleration of case 15. Conversely the distance from the bottom of follower wheel 44 to surface 47 may not be greater than the distance from the top of ball bushing 20 to surface 48 to allow latching of mass 15 upon upward acceleration of case 15. Further, if the distance from the top of follower wheel 44 to abutment 48 is substantially equal to the distance from the top of end portion 18 to the bottom of ball bushing 20 and the distance from the bottom of follower wheel 44 to surface 47 is substantially equal to the distance from the top of ball bushing 20 to surface 48, it will be obvious that in either of the latched positions translational movement of mass 15 in either direction is impossible.

An advantage of having the track for follower wheel 44 the surface 48 of cylindrical end portion 17 is that upon angular adjustment of end portion 17 the surface 46 is still in position to cooperate with follower wheel 44. However, the track for follower wheel 44 need not

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necessarily be as shown as long as it moves with mass 15.

The specific embodiments of our invention herein shown and described are susceptible of modification without departing from the spirit of the invention, for instance control means other than an electric switch could be used, and we intend therefore to be limited only by the scope of the appended claims.

We claim as our invention:

1. An acceleration responsive switch comprising a casing, a mass disposed in said casing, upper and lower portions of said mass larger in diameter than the center portion of said mass, a ball bushing in said casing for guiding translational movement of said mass, said center portion of said mass riding in said ball bushing, a first spring means connecting said lower portion of said mass to said casing and supporting said mass in said casing, a lever pivotally mounted in said casing, a follower wheel attached to said lever, a second spring means between said actuator and said casing normally biasing said follower wheel against said upper portion of said mass, excessive acceleration along the axis of translational movement causing said upper end portion of said mass to move beyond said follower wheel, pivotal action of said lever due to bias of said second spring means latching said mass by said follower wheel, a shaft positioned by a reset button, a cam surface on said shaft cooperating with said lever, manual operation of said reset button pivoting said lever by said cam surface on said shaft, said lever and said follower wheel returned to the normal position against said upper end portion of said mass by said pivotal movement due to manual operation of said reset button, a switch means actuated by pivotal movement of said lever.

2. An acceleration responsive switch comprising a casing, a mass movable in said casing, said mass comprising two members and a first spring means, a guiding means for guiding movement of said mass in said casing, first member of said mass threadably attached to the second member of said mass, said first spring means biasing said mass to a normal position in said casing, a lever pivoted in said casing, a second spring means biasing said lever into cooperation with said first member of said mass, adjustment of said threadably attached first member of said mass on said second member of said mass determining the normal at rest position of cooperation of said lever and said first member of said mass, a predetermined acceleration in either direction of movement of said mass in said casing causing said first member of said mass to move out of cooperation with said lever, movement of said lever latching said mass upon said predetermined acceleration, and a switching means actuated by said movement of said lever.

3. An acceleration responsive device comprising a casing, a mass disposed in said casing, upper and lower portions of said mass of longer diameter than the center portion of said mass, a ball bushing in said casing for guiding translational movement of said mass, said center portion of said mass riding in said ball bushing, an upper and a lower chamber in said casing, cooperation of said ball bushing and said center portion of said mass providing a restricted passageway between said upper and lower chambers, translational movement of said mass changing the pressures in said upper and lower chambers, the changing pressures tending to equalize through said restricted passage giving damping of the translational movement of said mass, a first spring means biasing said mass to a normal position along the axis of translational movement in said casing, a second spring means normally biasing a member into cooperation with said mass, a predetermined acceleration along said axis of translational movement caus-

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ing said mass to move out of cooperation with said member, said second spring means biasing said member into latching said mass against further translational movement.

4. An acceleration responsive device comprising, in combination: a mass having a longitudinal axis and a limited camming surface extending in the direction of said axis; bearing means supporting said mass for movement in the direction of said axis in response to accelerations having components in either direction along said axis; spring means continuously opposing movement said mass in either direction from a predetermined position relative to the supporting means; a cam follower normally engaging said camming surface; and switch means actuated when said camming surface moves beyond said cam follower.

5. An acceleration responsive device comprising, in combination: a mass having a longitudinal axis and a limited camming surface extending in the direction of said axis; bearing means supporting said mass for movement in the direction of said axis in response to accelerations having components in either direction along said axis; spring means continuously opposing movement of said mass in either direction from a predetermined position relative to the supporting means; a cam follower normally engaging said camming surface; and means for adjusting the position of said camming surface along the axis of said mass.

6. An acceleration responsive device comprising, in combination: a mass having a longitudinal axis and a limited camming surface extending in the direction of said axis; bearing means supporting said mass for movement in the direction of said axis in response to accelerations having components in either direction along said axis; spring means continuously opposing movement of said mass in either direction from a predetermined position relative to the supporting means; a cam follower normally engaging said camming surface; switch means actuated when said camming surface moves beyond said cam follower; and locking means, including said cam follower, for preventing said spring means from restoring said mass to said predetermined position after said camming surface moves beyond said cam follower in either direction.

7. An acceleration responsive device comprising, in combination: a mass having a longitudinal axis and a limited camming surface extending in the direction of said axis; bearing means supporting said mass for movement in the direction of said axis in response to accelerations having components in either direction along said axis; spring means continuously opposing movement of said mass in either direction from a predetermined position relative to the supporting means; a cam follower normally engaging said camming surface; switch means actuated when said camming surface moves beyond said cam follower; locking means, including said cam follower, for preventing said spring means from restoring said mass to said predetermined position after said camming surface moves beyond said cam follower in either direction; and means operable on said cam follower to disable said locking means, so that said spring means may restore said mass to said predetermined position.

8. An acceleration responsive device comprising, in combination: a mass having a longitudinal axis and a limited camming surface extending in the direction of said axis; bearing means supporting said mass for movement in the direction of said axis in response to accelerations having components in either direction along said axis; spring means continuously opposing movement of said mass in either direction from a predetermined position relative to the supporting means; a cam follower normally engaging said camming surface; and locking means including said cam follower for preventing said spring means from restoring said mass to said predeter-

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mined position after said camming surface moves beyond  
said cam follower in either direction.

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