May 5, 1953 S. BLEIER 2,637,791

INERTIA SWITCH

Filed July 7, 1950

FIG. 1

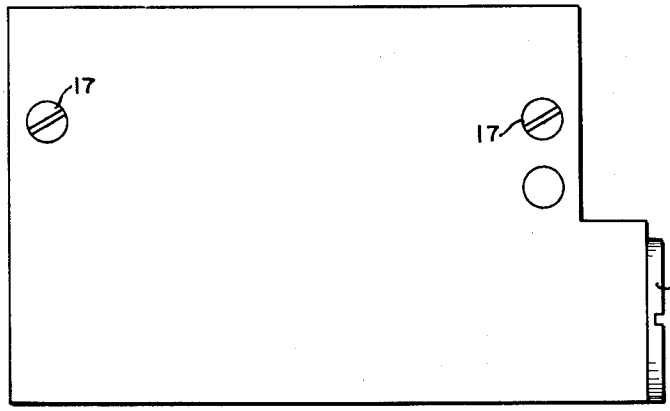


FIG. 2

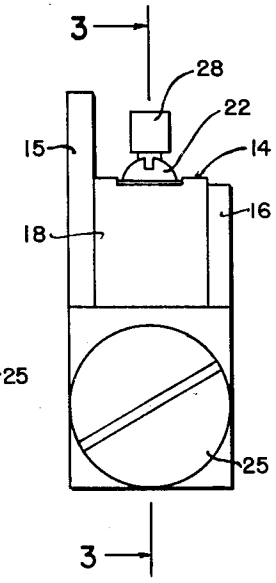
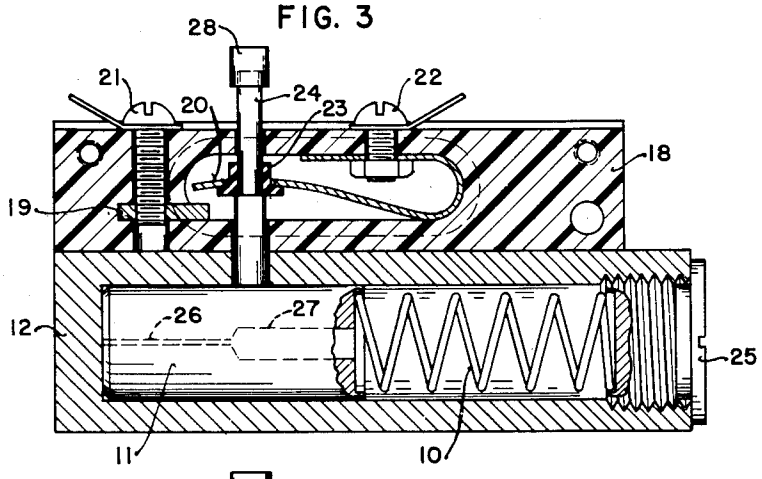


FIG. 3



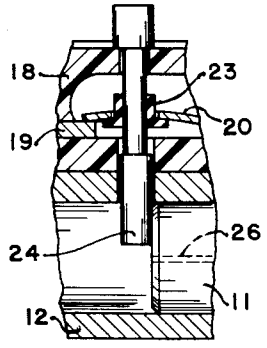


FIG. 4

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INERTIA SWITCH

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6 Claims. (Cl. 200—52)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment of any royalty thereon.

This invention relates to improvements in inertia switches.

Of the various purposes to which my improved inertia switch might be put, a specific and important application resides in its incorporation in a transponder beacon. One form of the latter consists of a small, self-contained, cylindrically-shaped unit including a microwave receiver, a microwave transmitter, and an electronic detonator exciter. Such a beacon is used as a tracking aid in missiles or similar devices. In operation, the electronic detonator exciter is energized only by a received signal having a specific characteristic, and it responds to such signal to effect the firing of an externally-connected electric detonator.

With the beacon installed in a rocket or other missile, there is the danger of premature detonation of the firing circuit, with consequent damage to the missile and possible serious injury to personnel.

With the foregoing in mind, it is one of the objects of my invention to provide an improved inertia switch adapted particularly for use in transponder beacons and which, by virtue of its structural and operating characteristics prevents the firing circuit of the detonator excited unit from functioning until the rocket or missile is far enough away in its flight from the launching site. Accidental discharge, therefore, would not be too dangerous.

Other objects and advantages will hereinafter appear.

For the purpose of illustrating my invention, an embodiment thereof is shown in the drawing, wherein

Figure 1 is a front, elevational view of an inertia switch embodying and operating in accordance with my invention;

Fig. 2 is an elevational view, looking toward the left in Fig. 1;

Fig. 3 is a section taken on the line 3—3 in Fig. 2; and

Fig. 4 is a view similar to Fig. 3, and illustrative of the operating action.

In my improved inertia switch, a compressed spring 10 is effective to hold a piston 11 yieldingly in the extreme lefthand position in a cylinder 12, as shown in Fig. 3. A switch unit 14 is disposed between two plates 15 and 16 with which the cylinder structure is provided, and is fixed to the latter by studs 17 which pass

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through plate 15 and are screwed into the insulating base 18 of the switch unit.

A fixed contact 19 and a movable, spring-contact 20 are disposed in the base 18 in the relative positions shown, and are held in place by the terminal studs 21 and 22, respectively. Extending through spring-contact 20 and insulated therefrom by a bushing 23, is a pin 24 which is held or locked in a raised position, as shown in Fig. 3, when engaged with the outer cylindrical surface of piston 11. In this position, pin 24 holds or locks spring-contact 20 out of engagement with contact 19.

When installed, for example, in a transponder beacon, the cylinder 12 of my improved inertia switch is fixed with respect to the beacon casing, and the arrangement or orientation is such that the direction of travel from the launching site is toward the left as viewed in Figs. 3 and 4, and in line with piston 11 and cylinder 12. Due to the acceleration of cylinder 12 when the rocket and the beacon contained therein are launched, and because of the inertia of piston 11, the latter will lag behind cylinder 12 and the tension of spring 10 will increase in proportion to occurring movement of the cylinder relatively with respect to the piston. In a specific design, the action was such that piston 11 would assume the relative position shown in Fig. 4 only at an impact of about 5 G's acceleration, and then only if such acceleration were maintained for approximately ten seconds. There were two factors which entered into this characteristic action. One of these was the adjustment of screw 25 to vary the initial tension of loading spring 10. The other factor was the damping or dash-pot action provided by the continuous passage 26, 27 from one end of piston 11 to the other end thereof. By choosing the right, respective diameters for the passages 26 and 27, the permissible rate of air-flow through piston 11 is obtained to give the correct amount of damping or dash-pot action for the operating characteristics desired.

When the impact is sufficient as the rocket is launched, and when the rate of acceleration persists for the predetermined number of seconds, piston 11 will reach the position shown in Fig. 4, relatively with respect to cylinder 12. Pin 24 will then be free to slip off the end of cylinder 12 under the spring-action of contact 20, and the latter will engage contact 19, as shown, to effect completion of the firing circuit of the detonator exciter unit referred to.

To reset my improved inertia switch, an upward pull is exerted on the knob 28 fixed on the end of pin 24, until the latter clears piston 11

which is then free to snap back to its initial position shown in Fig. 3, under the loading force exerted by spring 10.

In the specific design referred to, the length of piston 11 was one inch, and the diameter of the bore or passage 26 was approximately .016 inch. The respective dimensions of the other parts were in proportion, as shown in the drawing, all the figures of which are drawn to the same scale.

Examples of other specific uses to which my improved inertia switch might be put are shown in Patent No. 915,246, issued March 16, 1909, to Harry F. Stratton, in Patent No. 2,188,144, issued January 23, 1940, to Frank A. Eytman, and in Patent No. 2,431,027, issued November 18, 1947, to John W. Busacker et al.

One of the broader aspects of my invention resides in the provision of an inertia switch wherein some suitable means, such as the compressed spring 10, operates to hold two members such as cylinder 12 and piston 11 yieldingly in an initial relative position as shown in Fig. 3, and wherein there is incorporated some form of switch means such as the unit 14 arranged to be opened when the two members are in the initial relative position and to be closed when these members are in a second relative position as shown in Fig. 4.

While but one embodiment of my invention has been shown and described, it will be understood by those skilled in the art that various modifications, such as in the size, shape and arrangement of the parts, might be made without departing from the spirit of my invention, or the scope of the claims.

The invention claimed is:

1. In an inertia switch of the character described, a cylinder, a piston disposed in said cylinder and movable relatively with respect thereto from an initial position at one end of said cylinder to a second position toward the other end of said cylinder, a coil spring compressed between said piston and said other end of said cylinder, and a switch unit disposed at one side of said cylinder; said unit comprising a base of insulating material fixed to said cylinder, a switch contact fixed in said base, and a spring contact supported by said base and movable into and out of engagement with said fixed contact, said spring-contact being provided with a pin one end of which extends loosely through said base and through the adjacent cylinder wall for engagement with the cylindrical surface of said piston to hold said spring-contact disengaged from said fixed contact, the disposition of said pin longitudinally of said cylinder being such that with said piston in said second position thereof said pin is released by said piston to permit engagement of said spring-contact with said fixed contact, said piston being provided with a passage of relatively small cross-sectional area and extending from one end to the other end of said piston to effect a dash-pot action against a relatively rapid movement of said piston from said initial position to said second position thereof, the other end of said pin protruding from said base to permit withdrawal of said pin out of said cylinder.

2. In an inertia switch of the character described, a cylinder provided on one side thereof with two plates spaced and parallel with respect to each other, a piston disposed in said cylinder and movable relatively with respect thereto from an initial position at one end of said cylinder to a second position toward the other end of said cylinder, a coil spring compressed between said piston and said other end of said cylinder, and a switch unit disposed between and fixed to said plates; said unit comprising a base of insulating material, a switch contact fixed in said base, and a U-shape spring-contact disposed within said base and fixed to the latter at one end, the other end of said spring-contact being disposed for movement into and out of engagement with said fixed contact, said spring-contact being provided at said other end thereof with a pin one end of which extends loosely through said base and through the adjacent cylinder wall for engagement with the cylindrical surface of said piston to hold said other end of said spring-contact disengaged from said fixed contact, the disposition of said pin longitudinally of said cylinder being such that with said piston in said second position thereof said pin is released by said piston to permit engagement of said other end of said spring-contact with said fixed contact.

3. In an inertia switch of the character described, a cylinder, a piston disposed in said cylinder and movable relatively with respect thereto from an initial position at one end of said cylinder to a second position toward the other end of said cylinder, a spring compressed between said piston and said other end of said cylinder, and a switch unit disposed at one side of said cylinder; said unit comprising a base of insulating material fixed to said cylinder, a switch contact fixed in said base, and a spring-contact supported by said base and movable into and out of engagement with said fixed contact, said spring-contact being provided with a pin one end of which extends loosely through said base and through the adjacent cylinder wall for engagement with the cylindrical surface of said piston to hold said spring-contact disengaged from said fixed contact, the disposition of said pin longitudinally of said cylinder being such that with said piston in said second position thereof said pin is released by said piston to permit engagement of said spring-contact with said fixed contact, and said piston being provided with a passage extending from one end to the other end of said piston.

4. In an inertia switch of the character described, a cylinder, a piston disposed in said cylinder and movable relatively with respect thereto from an initial position at one end of said cylinder to a second position toward the other end of said cylinder, a spring compressed between said piston and said other end of said cylinder, and switch means spring-biased to one position and having at least one part thereof engageable with said piston and disposed to be locked in another position by virtue of such engagement, said piston being provided with a passage extending from one end to the other end of said piston to regulate the movement of said piston.

5. In an inertia switch of the character described, a cylinder, a piston disposed in said cylinder, a spring compressed between said piston and one end of said cylinder, and switch means spring-biased to one position and having at least one part thereof engageable with the cylindrical surface of said piston, and disposed to be locked in another position by virtue of said engagement, said piston being movable axially along said cylinder to a given position toward said one end of the latter to disengage said part from said cylindrical surface thereby to effect movement of said switch means to another posi-

tion, said piston being provided with a passage extending from one end to the other of said piston to regulate said axial movement of said piston.

6. In an inertia switch as claimed in claim 4, means for adjusting the tension of said spring compressed between said piston and said other end of said cylinder.

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