

June 20, 1944.

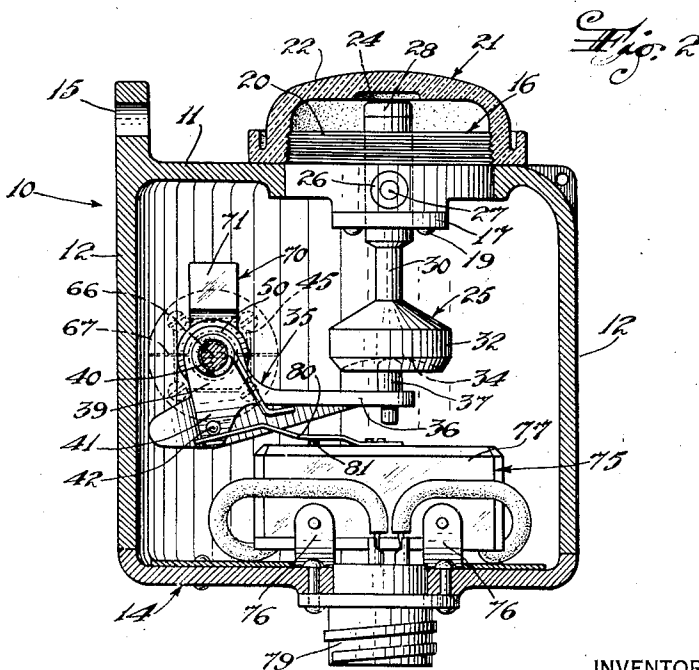
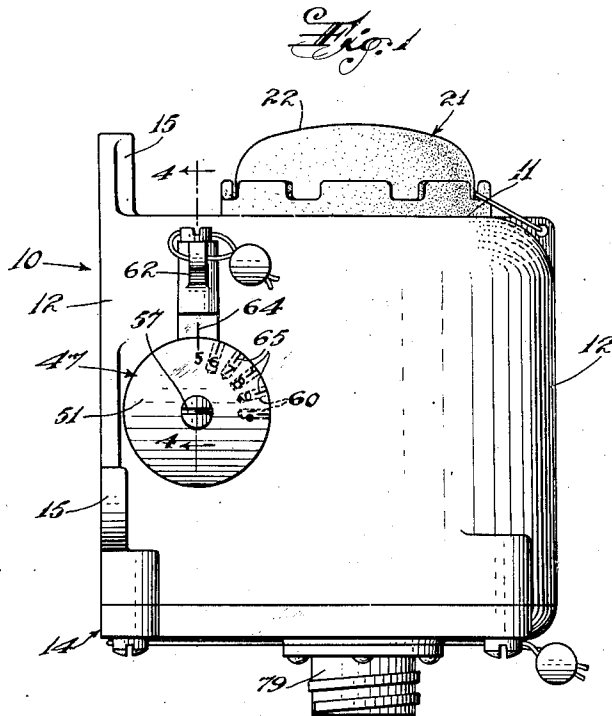
H. C. GRANT, JR., ET AL

2,351,607

IMPACT ACTUATOR

Filed July 22, 1941

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

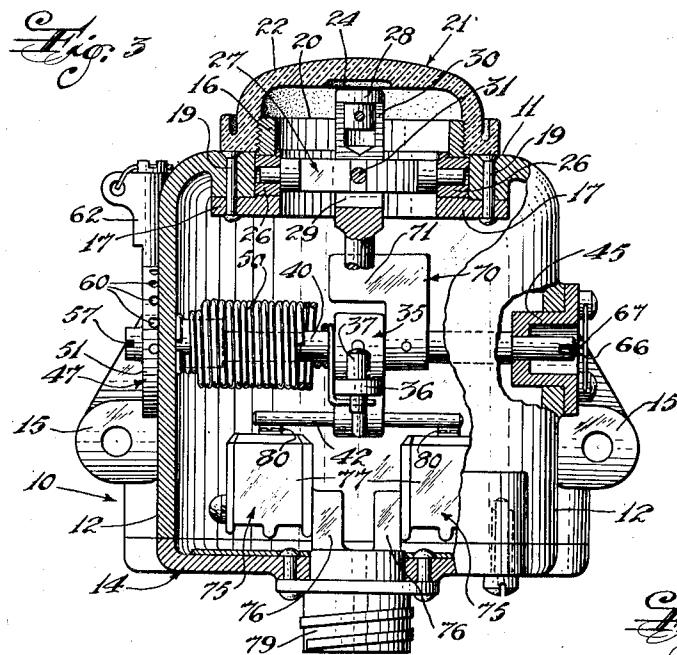
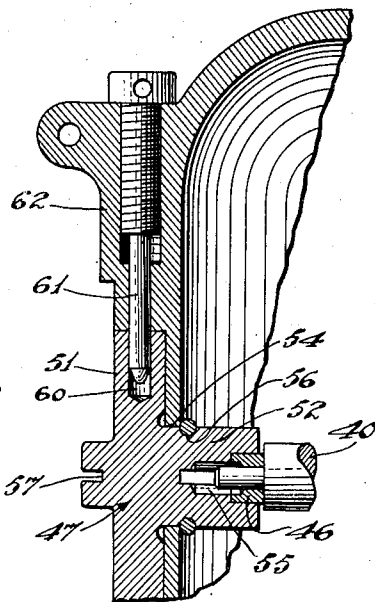
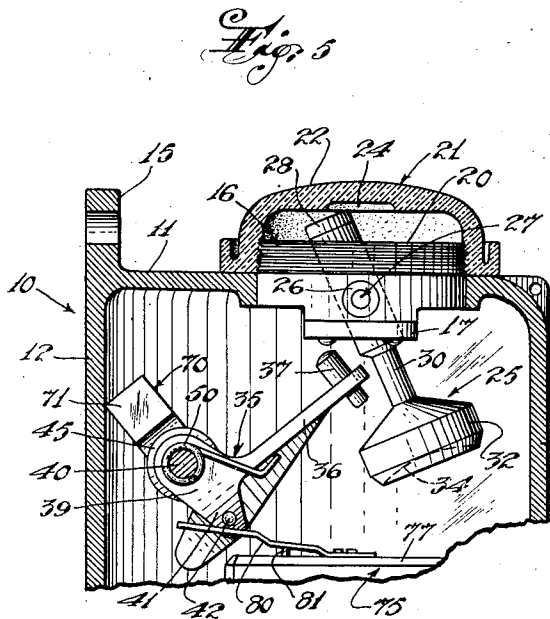


Fig. 4



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UNITED STATES PATENT OFFICE

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IMPACT ACTUATOR

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Application July 22, 1941, Serial No. 403,552

4 Claims. (Cl. 74—2)

The present invention relates to inertia actuated control devices, and more particularly is an improvement upon the device illustrated in British Patent No. 450,862, accepted July 24, 1936.

Inertia actuated devices have been employed on airplanes, motor cars, speed boats or other vehicles or craft designed to travel at a high rate of speed and to be propelled by internal combustion engines, for shutting off the fuel supply or the ignition and for effecting operation of a fire extinguishing system in the event the vehicle or craft is subjected to a sudden violent impact or shock. A popular type of inertia actuated device is illustrated in the above referred to British Patent, and essentially comprises a pivotally mounted, spring urged arm or lever member retained in position by an inertia responsive element such as a pendulum engaging one end of the member which, upon impact or shock, is adapted to release the member and to permit the member to operate suitable switch means which in turn effect emergency operation of other devices.

The present invention aims to provide an inertia actuated device of this type which can be accurately adjusted for operation in response to an impact of a predetermined magnitude, and which is not affected to any extent by the change of its position with respect to the direction of the impact force. The invention further aims to simplify the manufacture and assembly of such devices and reduce the cost thereof to a minimum.

An object of the present invention is to provide an improved inertia or impact actuated device which can be accurately adjusted to operate in response to impacts or shocks of a predetermined force.

Another object is to provide an inertia operated device having dynamically balanced inertia operated means.

Another object is to provide an inertia responsive device which is readily adjusted and the accuracy of which is not affected by variations of its position with respect to the direction of the impact force.

Another object is to provide an inertia actuated device having means for facilitating the setting thereof, and having means for readily determining whether or not the device is properly set.

Another object is to provide an inertia responsive device which is compact in design, is constructed of a minimum number of parts, and can be readily assembled by unskilled labor.

A further object of the invention consists in the combination and arrangement of the parts of the device, whereby the foregoing objects may be accomplished.

Other and further objects and advantages of the invention, not specifically referred to, will become apparent as the more detailed description of the invention proceeds.

The invention will now be more fully explained with reference to the accompanying drawings, wherein:

Figure 1 is a side elevational view of an inertia actuated device, illustrating an embodiment of the invention.

Figure 2 is a sectional elevational view of the device shown in Figure 1, illustrating the interior thereof.

Figure 3 is an end elevational view, partly in section, of the device.

Figure 4 is an enlarged sectional view, taken along the line 4—4 on Figure 1, illustrating a detail of the device.

Figure 5 is a fragmentary elevational view, illustrating the inertia responsive means after being actuated.

Referring more particularly to the drawings, there is shown an inertia operable device comprising a casing 10 having a top wall 11, side walls 12, and a substantially open bottom adapted to be closed by a suitable closure member such as a lid or cover 14. Suitable ears or lugs 15 are provided on the casing 10 for securing the casing to a supporting structure of a craft or vehicle wherein the inertia responsive device is to be utilized.

The top wall 11 of the casing has an opening therein for receiving an annular collar 16 provided with two or more radially outwardly extending lugs 17 or the like for securing the collar to the casing by suitable rivets 19, bolts or screws or the like (Figure 3). The upper portion 20 of the collar extends upwardly above the top wall of the casing and is threaded on the exterior for receiving a screw cap 21.

The cap preferably is formed of a transparent material, such as a transparent thermo-plastic molding composition, to permit observation of the interior of the casing. The cap is provided with a top portion 22 having a substantially circular centrally located index means 24, such as a recess on the underside of the top portion, for visually determining whether or not certain parts of the inertia responsive means within the casing are in a desired position, as will be described hereinafter.

The collar 16 further serves for mounting an inertia responsive member such as a pendulum 25. To accomplish this, the collar is provided with a pair of diametrically opposite bearing portions 26 at the inner periphery for rotatably mounting the respective ends of a shaft 27 (Figure 3). The portion of the shaft intermediate its ends is substantially flat and extends through a slot 29 in the stem 30 of the pendulum which is suspended for universal swinging movement or circumduction by pivotally attaching the stem 30 to the shaft 27 by a cross pin 31. The upper free end of the stem 30 is provided with a manually engageable portion 28 which, preferably, has a substantially circular top portion adapted to register with the index means in the cap to indicate that the pendulum is in a desired position.

The pendulum is provided with a weighted portion 32 which may be of any desired shape and may be formed integral with or secured to the stem 30. The underside of the weighted portion 32 is provided with a concave depression 34, shown in broken lines in Figure 2, and the surface of the depression is highly polished or mirrored to minimize friction when engaged by the contact portion of a pendulum retaining member about to be described.

To function as an inertia responsive actuating member, the pendulum is maintained in a stationary position and is prevented from swinging unless subjected to a predetermined impact or shock. As indicated herein, this is accomplished by providing a pivoted member which is spring urged against the pendulum with a predetermined force and is adapted to move about its pivot to effect operation of switch means or the like when the pendulum is moved out of disengagement therewith due to an impact or shock of a predetermined magnitude.

As illustrated in the drawings, the pendulum retaining member may be an arm or lever 35 having a substantially horizontally extending portion 36 at one end provided with a pin or finger 37 for engaging the surface of the depression 34. The finger 37 may be secured to the arm, adjacent the end, in any suitable manner. The free end of the finger for engaging the surface of the depression in the pendulum preferably is hemi-spherical and is highly polished or mirrored, whereby engagement between the finger and the depression is effected with a minimum amount of friction resisting relative sliding movement between the finger and the depression.

The other end 39 of the arm 35 is mounted on and secured to a shaft 40 and is provided with a downwardly depending portion 41 carrying a cross arm or rod 42 adapted to operate suitable switch means or other suitable mechanism which will be described hereinafter.

The shaft 40 extends crosswise through the casing, and is rotatably mounted by seating one end thereof in a bearing member 45 secured to one side wall of the casing (Figure 3) and by seating the other end thereof in a bearing 46 carried by a member 47 at the opposite side wall of the casing (Figure 4). The member 47 has one end of a cylindrical spiral spring 50 attached thereto which is telescoped over the shaft 40 and has its other end attached to the arm or lever 35. The spring 50 is tensioned to urge the finger 37, carried by the arm 35, upwardly against the depression in the pendulum, whereby the arm prevents the pendulum from

moving unless the effective force of the spring is overcome and the arm is prevented from operating switch means or the like, unless the pendulum is subjected to a shock or impact sufficient to overcome the effective force of the spring.

In order to predetermine the shock or impact required to cause disengagement between the finger 37 and the pendulum, the member 47 is adapted to be rotated into various positions to adjust the tension of the spring 50. To accomplish this, the member 47 comprises a circular disc portion 51 and a cylindrical portion 52 rotatably mounted in and extending into the casing through an aperture 54 in the side wall of the casing. The inner end of the portion 52 is provided with a bore 55 for receiving the shaft bearing 46 and the outer periphery of the cylindrical portion is provided with a notch or groove 56 for securing the end of the spring 50. The spring tension adjusting member 47 may be rotated by manually engaging the disc portion, but, preferably, a centrally located slot 57 is provided on the disc portion for receiving a screw driver, key, or other suitable tool for rotating the member 47 (Figure 1).

In order to retain the spring tension adjusting member in desired positions which predetermine the tension of the spring 50, a series of circumferentially spaced radially extending apertures 60 are formed at the outer periphery of the disc portion 51, adapted to receive a pin 61 or set screw. The pin 61 preferably is retractably mounted in a suitable supporting structure such as a vertical tubular offset 62 located on the side wall of the casing and having its lower end adjacent the periphery of the disc portion 51. The pin preferably is threaded into the offset 62 and has a portion of reduced diameter at its lower end adapted to extend into a selected aperture of the series of apertures. The offset 62 is provided with an index mark 64 at its lower end which is adapted to cooperate with index marks 65 of a dial on the disc portion to indicate the magnitude of the impact required to operate the inertia responsive means for any selected adjustment of the spring. An advantage of the adjusting means constructed in this manner is that adjustments can be readily made from the exterior of the casing without interfering with the devices in the interior of the casing.

The end of the shaft 40 which is mounted in the bearing member 45 extends through the bearing and is engageable from the exterior of the casing. The free end of the shaft at this end, is provided with a slot 66 for receiving a screw driver or other tool adapted to be utilized for rotating the shaft through a fractional turn in opposition to the spring 50. The rotation of the shaft 40 enables the arm 35 to be swung downwardly and away from the pendulum to facilitate setting of the finger 37 in the depression 34. If desired, and as illustrated in Figure 3, the slot 66 may be positioned horizontally or parallel to the base of the casing when the arm and pendulum are in set position, and a horizontal index mark 67 may be provided on the outer face of the bearing member 45 adapted to cooperate with the slot 66 to indicate when the device is in set position.

In order to permit the pendulum to be swung out of engagement with the pin or finger 37 on the arm 35 by a uniform predetermined impact applied from any direction at a given angle with respect to the vertical, the shaft 40 or the arm 35 is provided with a counterbalancing member 70. This member compensates for the weight or mass

of the arm which may increase the resistance to the disengagement of the pendulum and the finger when an impact is applied in a direction causing the inertia of the arm to force the finger against the under surface of the pendulum. Likewise, the resistance of the pendulum to swing out of engagement with the finger may be lessened when an impact is applied in a direction causing the inertia of the arm to swing the finger away from the pendulum. In other words, under certain conditions, the effective force of the spring 50 is either increased or decreased by the mass of the arm, whereby the inertia responsive devices are actuated at impacts of different magnitudes depending upon the direction from which the impact is applied. However, the mass of the counterbalancing member compensates for this effect and dynamically balances the arm.

As illustrated in Figure 3, the counterbalancing member 70 may be substantially L-shaped and is secured to the shaft 40 so that it extends substantially vertically and perpendicularly to the arm 35. The upper arm 71 of the counterbalancing member extends across the shaft 40 at the point where the arm 35 is secured to the shaft whereby the mass of the arm 71 is substantially in the same plane as the mass of the arm 35 and provides an accurate counterbalancing effect. It will be understood that the counterbalancing member could be of a different shape or could be placed in other positions to attain the desired effect, but, with the arrangement illustrated herein, the effect is attained without increasing the size of the casing or complicating the assembly.

When the inertia responsive devices are actuated, they are adapted to operate switch means or the like which in turn may operate any suitable safety devices. The switch means may comprise one or more, for example two, switches 75, which are mounted by a bracket 76 to the inner surface of the lid or cover 14 and are positioned in the lower part of the casing. Preferably, these switches are of the type known as "micro-switches" which comprise a casing or housing 77 for the electrical control parts thereof, whereby no parts carrying electrical energy are exposed in the casing 10. Suitable electrical leads from the switches are connected to a socket 79, of the "Cannon" type, or of any other standard design which is located at the exterior of the lid or cover 14. This type of socket is adapted to be electrically connected by a suitable plug which facilitates the installation and removal of the inertia device from the system. Also, the electrical connections are reduced to a minimum.

The switches utilized are of the type which normally are adapted to close an electrical circuit, but are held in an open position by spring arms 80 (Figure 2) normally bearing against an operating portion 81 projecting outwardly from the switch casing 77. The spring arms 80 are held downwardly by the cross-bar 42 on the arm 35 when the inertia devices are in set position and are adapted to flex upwardly when the inertia devices are operated to relieve the pressure on the portions 81 and permit the switches to close the circuit (Figure 5). A further advantage of the switches utilized is that only a slight movement is necessary to open or close the electrical circuit.

By mounting the switches on the removable lid or cover 14, the mechanical and electrical parts may be separately assembled or taken apart for repair. Also, the assembly of the device is greatly

simplified by this arrangement and more accurate operation can be obtained.

In the operation of the device, the tension of the spring 50 is adjusted so that the inertia responsive means are adapted to be actuated when the craft or vehicle is subjected to an impact which exceeds a predetermined magnitude. This may be done by withdrawing the pin 61 from its support or unscrewing it to an extent where the lower portion thereof is out of engagement with the outer periphery of the disc 51. The disc 51 is then rotated to a position so that the index mark 65, corresponding to a selected impact, registers with the index mark 64 on the pin support 62. The pin is then inserted into the aperture 60 selected and corresponding to the index mark 65 in registry with the index mark 64.

To determine whether or not the inertia devices are in set position (Figure 2), the cap 21 is observed to determine whether or not the upper portion 28 of the stem 30 is in registry with the index means 24 in the cap, or the slot 66 in the exposed end of the shaft 40 is observed to determine whether or not the slot 66 registers with the index mark 67. In the event it is found that the inertia devices are not set (Figure 5), the reset shaft 40 must be turned to move the arm 35 and finger 37 thereon downwardly and away from the pendulum. The shaft 40 then may be released to permit the finger to engage the depression 34. If the device is in a level position, that is, when the base thereof is in a horizontal plane, the inertia means may be set by merely moving the finger 37 on the arm 35 away from the pendulum, which will level itself and place the depression in a position to be engaged by the finger. However, if the device is not in a level position, the cap 21 is removed and the portion 28 of the pendulum stem is manually engaged and tilted into a position where the finger 37 may engage the depression 34. When the device is in set position, the cross-bar 42 bears downwardly on the spring arms 80 which in turn hold the switch portions 81 downwardly to open the electrical circuit.

If, during the travel of the craft or vehicle, the device is subjected to a shock or impact exceeding the shock or impact for which the spring 50 is adjusted, the inertia of the pendulum will cause the surface of the depression to slide out of engagement with the pin. The arm 35 then is released and swings upwardly to the position shown in Figure 5, whereby the cross-bar 42 is raised and the spring arms 80 flex upwardly to release the switch portions 81. The switches now close and effect actuation of the safety system.

From the foregoing description it will be seen that the present invention provides an improved impact actuated device which is simple in construction and effective in operation. The device is constructed of a minimum number of parts, is economical to manufacture, and can be readily assembled. The device can be accurately adjusted to respond to a desired impact which may be applied in any direction without failure of the inertia means to be actuated. Furthermore, the device can be readily tested and reset, and does not utilize parts which require frequent inspection and repair or dismantling of the device. The parts of the device are rugged in construction and can readily withstand any rough usage to which they may be subjected.

While our invention resides in certain principles of construction and operation which have been illustrated and described in connection with the accompanying drawings, it will be apparent

to those skilled in the art that the invention may be embodied in other forms of construction without departing in any manner from the spirit and scope of the invention, and we therefore do not wish to be strictly limited to the disclosure, but rather to the scope of the appended claims.

We claim:

1. In an inertia operated device of the class described, the combination of a pendulum mounted for universal movement and having a weighted portion provided with a depression at the underside thereof; an arm having one end thereof pivotally supported, the other end of said arm being free and having an upwardly projecting finger provided with a surface for engaging the depression of said pendulum; resilient means effective to move said arm in a direction to urge said finger into engagement with the depression; and counterbalancing means at the pivotally supported end of said arm connected for movement with said arm, said counterbalancing means being constructed to compensate for the weight of the portion of said arm extending from its pivotally supported end to its free end having said finger thereon, whereby the weight of said arm and its moment about its pivotal support will not materially increase or decrease the magnitude of the pressure with which said finger bears against the depression when the device is subjected to impact and whereby said pendulum will swing out of engagement with said finger in response to impacts of a predetermined magnitude applied from any direction at a given angle with respect to the vertical.

2. In an inertia operated device of the class described, the combination of a pendulum mounted for universal movement and having a weighted portion provided with a depression at the underside thereof; an arm having one end thereof pivotally supported, the other end of said arm being free and having an upwardly projecting finger provided with a surface for engaging the depression of said pendulum; resilient means effective to move said arm in a direction to urge said finger into engagement with the depression; and a counterbalancing element at the pivotally supported end of said arm connected for movement with said arm, said counterbalancing element being constructed to compensate for the weight of the portion of said arm extending from its pivotally supported end to its free end having said finger thereon and having its center of mass substantially in line with the longitudinal axis of said arm, whereby the weight of said arm and its moment about its pivotal support will not materially increase or decrease the magnitude of the pressure with which said finger bears against the depression when the device is subjected to impact and whereby said pendulum will swing out of engagement with said finger in response to impacts of a prede-

termined magnitude applied from any direction at a given angle with respect to the vertical.

3. In an inertia operated device of the class described, the combination of a pendulum mounted for universal movement and having a weighted portion provided with a depression at the underside thereof; a rotatable shaft; an arm having one end thereof mounted on and secured to said shaft and having an upwardly projecting finger at the other end thereof provided with a surface for engaging the depression of said pendulum; resilient means effective to move said arm in a direction to urge said finger into engagement with the depression; and a counterbalancing element mounted on and secured to said shaft adjacent said arm for movement with said arm, said counterbalancing element being constructed to compensate for the weight of the portion of said arm extending from said shaft to its end having said finger thereon, whereby the weight of said arm and its moment about said shaft will not materially increase or decrease the magnitude of the pressure with which said finger bears against the depression when the device is subjected to impact and whereby said pendulum will swing out of engagement with said finger in response to impacts of a predetermined magnitude applied from any direction at a given angle with respect to the vertical.

4. In an inertia operated device of the class described, the combination of a pendulum mounted for universal movement and having a weighted portion provided with a depression at the underside thereof; a rotatable shaft; an arm having one end thereof mounted on and secured to said shaft and having an upwardly projecting finger at the other end thereof provided with a surface for engaging the depression of said pendulum; resilient means effective to move said arm in a direction to urge said finger into engagement with the depression; and a substantially L-shaped counterbalancing member having an arm portion mounted on and secured to said shaft adjacent said arm and having a weighted portion positioned with its center of mass substantially in line with the longitudinal axis of said arm, said counterbalancing member being constructed to compensate for the weight of the portion of said arm extending away from said shaft to its end having said finger thereon, whereby the weight of said arm and its moment about said shaft will not materially increase or decrease the magnitude of the pressure with which said finger bears against the depression when the device is subjected to impact and whereby said pendulum will swing out of engagement with said finger in response to impacts of a predetermined magnitude applied from any direction at a given angle with respect to the vertical.

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