

Dec. 8, 1942.

H. C. GRANT, JR., ET AL

2,304,084

INERTIA ACTUATED DEVICE

Filed Aug. 1, 1941

3 Sheets-Sheet 1

Fig. 1

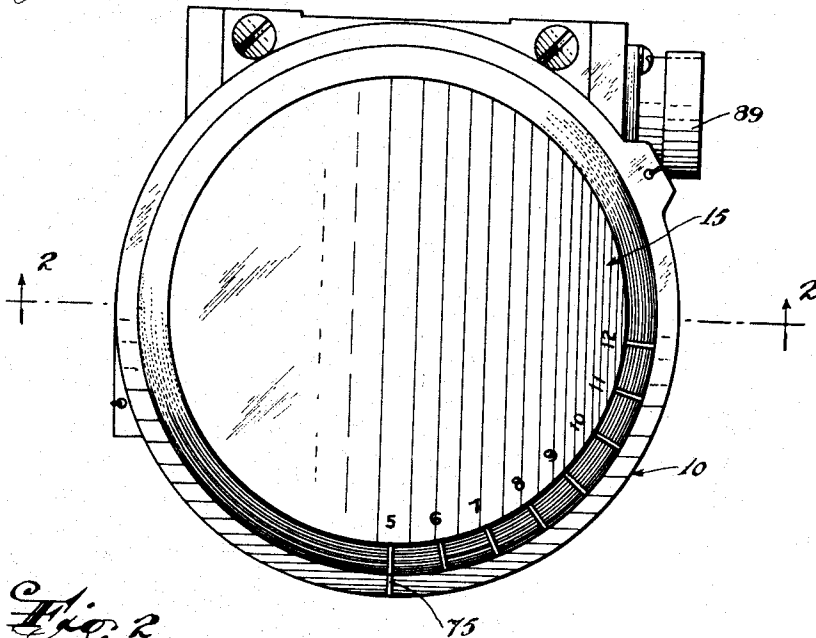
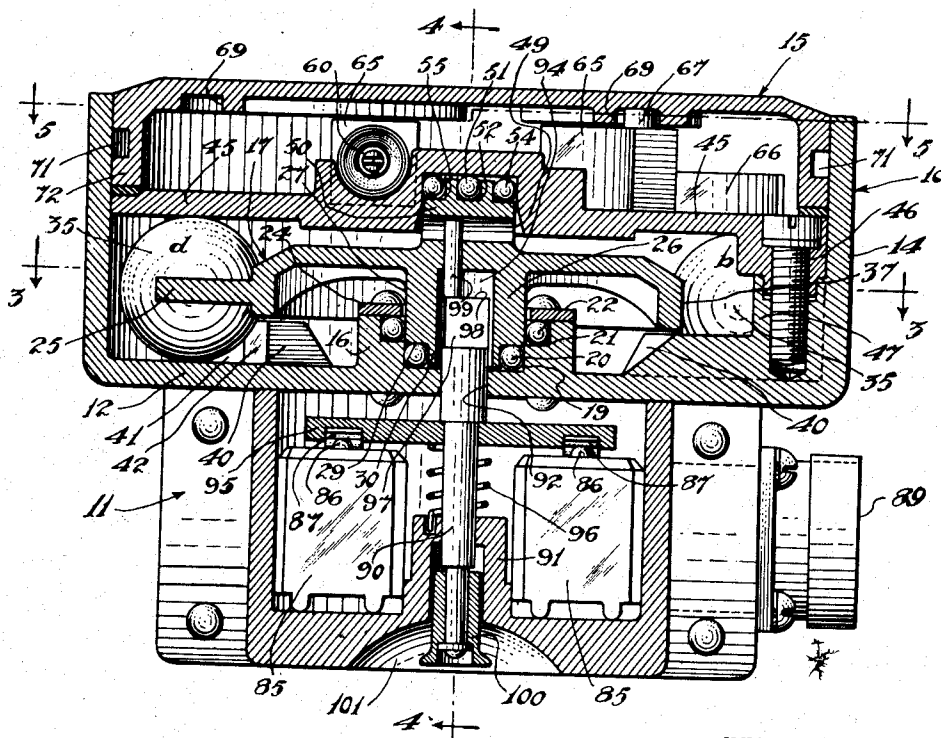


Fig. 2



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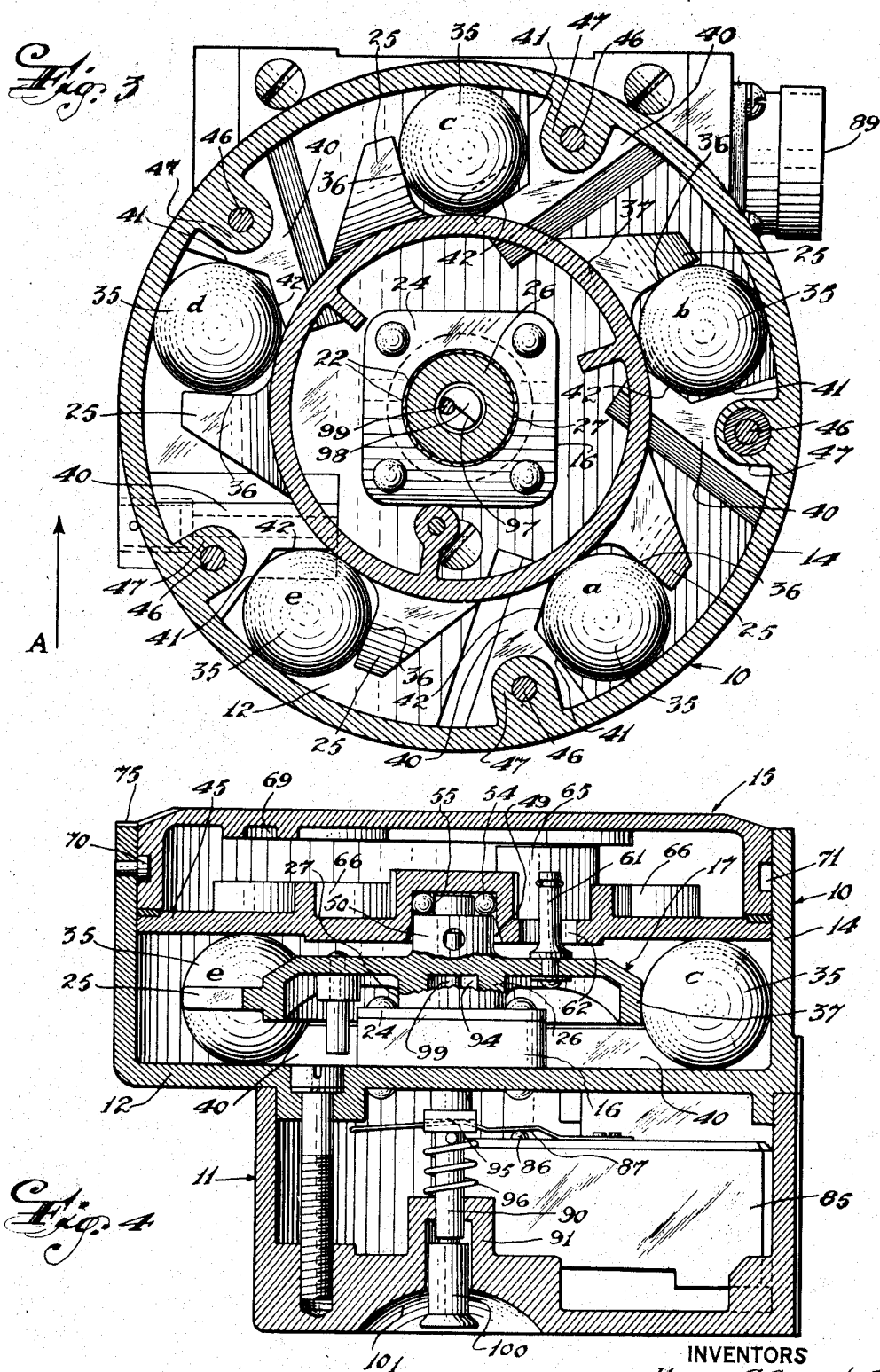
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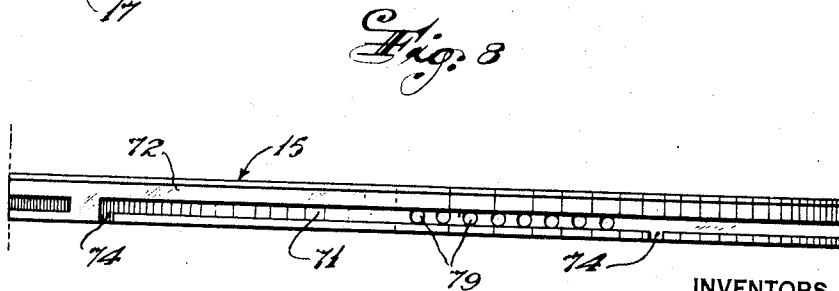
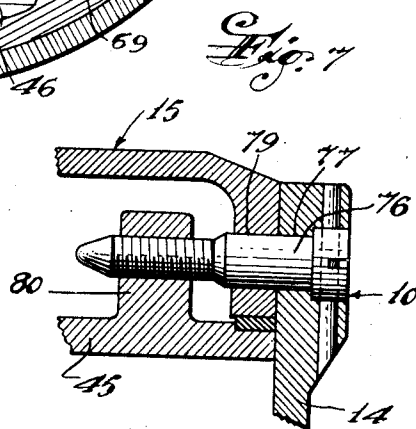
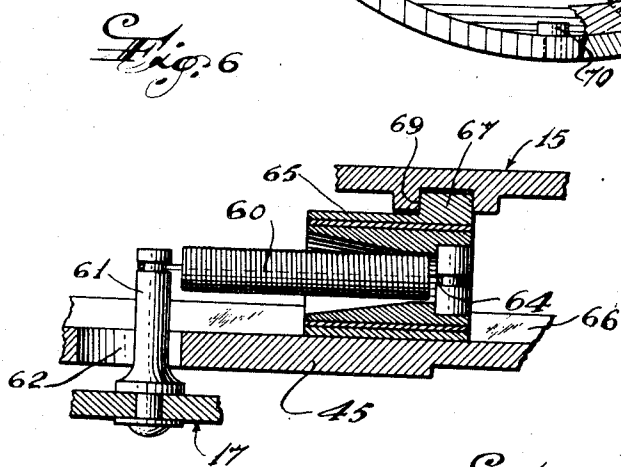
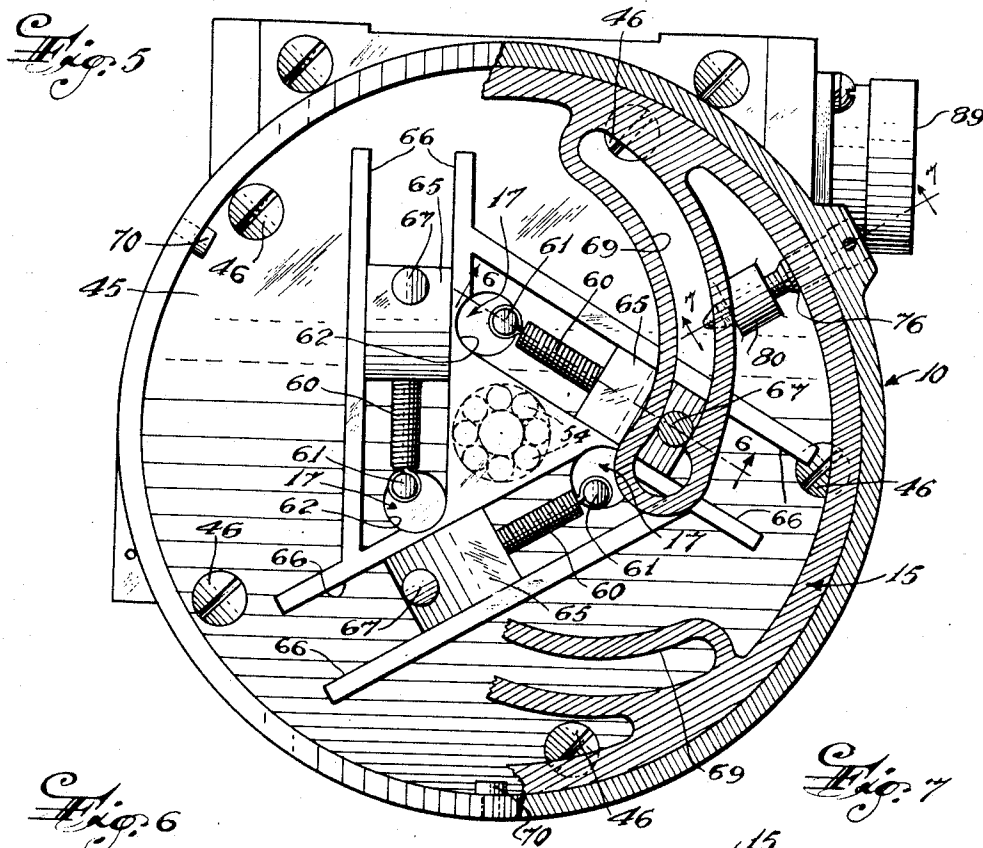
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INERTIA ACTUATED DEVICE

Filed Aug. 1, 1941

3 Sheets-Sheet 3



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2,304,084

INERTIA ACTUATED DEVICE

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Application August 1, 1941, Serial No. 404,954

24 Claims. (Cl. 200—52)

The present invention relates to inertia actuated control devices, and more particularly to inertia actuated devices of a new and improved design.

Inertia actuated devices have been employed on airplanes, motor cars, speed boats or other vehicles or craft adapted to travel at a high rate of speed and propelled by a combustible fluid, for shutting off the fuel supply or the ignition, or for effecting operation of a fire extinguishing system or other safety devices in the event the vehicle or craft is subjected to a sudden impact or shock exceeding a predetermined or permissive magnitude. The inertia responsive devices heretofore utilized generally operated on a pendulum principle, and usually comprised a pendulum or a similar element and a latch or switch adapted to be actuated by movement of the pendulum due to impact or shock.

The present invention aims to provide an inertia operable device which operates on a new and improved principle. More particularly, the invention aims to provide an inertia operable device wherein a series of movable inertia means rotate a member which in turn effects the operation of a switch or the like.

An object of the present invention is to provide an improved inertia or impact actuated device which is compact in design, is economical in construction and can be readily assembled.

Another object is to provide an improved inertia actuated device which can be accurately adjusted to operate in response to a shock or impact exceeding a predetermined magnitude.

Another object is to provide an inertia actuated device adapted to be operated in response to a predetermined force acting substantially in a given plane, regardless of the direction in which the force is applied.

Another object is to provide an inertia actuated device in which the variations in the magnitude of the force required to operate the device are negligible, regardless of the direction of the force when applied in a given plane.

Another object is to provide an inertia actuated device which is positive and more accurate in operation and is not subject to the difficulties and disadvantages of inertia actuated devices heretofore employed.

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, not specifically enumerated above, will be apparent when de-

scribed in greater detail in connection with the accompanying drawings, wherein:

Figure 1 is an elevational view of an inertia operable device, illustrating an embodiment of the invention.

Figure 2 is a slightly enlarged sectional view, taken along the line 2—2 on Figure 1, illustrating the interior of the device.

Figure 3 is a sectional view, taken along the line 3—3 on Figure 2.

Figure 4 is a sectional view, taken along the line 4—4 on Figure 2.

Figure 5 is a sectional view, taken substantially along the line 5—5 on Figure 2.

Figure 6 is a sectional view, taken along the line 6—6 on Figure 5.

Figure 7 is a sectional view, taken along the line 7—7 on Figure 5.

Figure 8 is a developed plan view, illustrating a detail of the device.

Referring to the drawings, there is shown an inertia operable device comprising an upper casing 10 for receiving inertia actuated means, and a lower casing 11 for receiving switch means adapted to be operated by the inertia actuated means. The upper and lower casings may be attached to each other in any suitable manner, and either or both casings may be provided with suitable lugs or the like for attaching the device to a supporting structure of a craft or vehicle on which the device is used.

The upper casing, preferably, is substantially cylindrical in shape and has a circular bottom portion 12 and a cylindrical side wall 14. The top of the upper casing 10 is open and is adapted to be closed by a circular cover 15, which will be described in detail hereinafter.

The bottom portion 12 is provided with a centrally located boss or sleeve portion 16 (Figure 2) providing a bearing for a rotatable member 17 about to be described. The sleeve portion has a race or annular groove 19 for receiving thrust bearings 20, which may be ball bearings, and has a second race or groove 21 for receiving ball bearings 22 adapted to facilitate rotation of the member 17. The upper end of the bearing boss 16 has an apertured disc or plate 24 secured thereto for retaining the bearings 22 in the race 21 (Figure 3).

As illustrated more particularly in Figures 2, 3 and 4, the rotatable member is in the form of a spider having a series of radially extending arms 25. The under side of the member 17 is provided with a centrally located downwardly depending bearing sleeve or hub 26 having a cy-

lindrical surface 27 in contact with the rotation bearings 22 and having an annular end face 29 adapted to ride on the thrust bearings 20. The inner free end of the hub may be provided with a tubular sleeve 30 projecting downwardly from the face 29 and confining the thrust bearings 20 in the race 19.

While a spider having any suitable number of arms may be used, it has been found that a more accurate inertia responsive device may be provided by utilizing a rotatable member or spider 17 having an odd number of arms 25, for example, three, five, seven, nine, or eleven arms. Each of the arms has a movable inertia operable means adjacent thereto, which may be a weighted spherical member, such as a steel ball 35, adapted to contact a radially extending face 36 on the arm 25 (Figure 3). The balls 35 are confined for rolling movement between the inner side of the cylindrical wall 14 of the casing 10 and a cylindrical flange 37 of the spider intermediate the arms 25.

For purposes of illustration, the spider is shown herein with five arms 25 spaced circumferentially equidistantly (Figure 3) and each having a ball 35 adjacent thereto, which is spaced apart from adjacent balls about 72°. Thus when the device is subjected to a shock or a force resulting from a shock which travels substantially in the plane in which the spider is adapted to rotate, at least some of the inertia responsive balls 35 will bear against the arms adjacent thereto and will exert a force tending to rotate the spider. For example, if the craft or vehicle is traveling in a direction to carry the device in the direction indicated by the arrow A in Figure 3 and the craft or vehicle crashes, the tendency of the balls a and b to continue moving exerts a force against the arms of the spider causing the spider to rotate. The ball c also will tend to continue moving in its direction of movement, but by being substantially in alignment with the center of rotation of the spider, will not exert any force causing rotation of the spider. The ball c will merely bear against the inner side of the wall 14 of the casing 10. Likewise, the balls d and e will tend to continue moving, but their movement will be away from the spider arm adjacent thereto, whereby they do not exert any force on the spider.

In order to limit the circumferential distance the balls may roll away from the spider arms a series of stops 40 are provided on the bottom portion 12 of the casing 10. In the foregoing example, the balls d and e would bear against their stops 40. The stops are circumferentially spaced and a stop is provided adjacent each ball at the surface portion of the ball diametrically opposite the surface portion adapted to engage the arm 25. Preferably, the stops, arms, and balls are of suitable dimensions so that the spider is adapted to rotate between about 15° and about 25°. To prevent the balls forced against the stops from bearing against the flange 37 and tending to resist rotation of the spider, each of the stops 40 has a packet for receiving the balls and directing them away from the flange 37. The packet may be provided by an arcuate groove or, as shown in Figure 3, the stops may comprise a pair of angularly disposed faces 41 and 42.

The balls 35 are confined against upward movement in the casing by a substantially circular member 45 telescoped into the casing 10 and secured by bolts 46 or the like to threaded portions 47 at the stops 40 (Figure 2). The

under side of the circular member 45 is provided with a centrally located bearing recess 49 adapted to receive a stem portion 50 on the upper side of the spider which carries a thrust bearing 51 in a recess 52 and a series of ball bearings 54 in a race 55. The bearings 20, 22, 51 and 54 cooperate to mount the spider for rotation within a minimum of frictional resistance.

As about to be described in connection with Figures 4, 5 and 6, the circular member 45 also provides for mounting suitable resilient means for resisting rotation of the spider up to a predetermined magnitude of force exerted by the balls 35. The resilient means may comprise two or more springs 60, for example, three, each having one end attached to a post, pin or stud 61 which is secured to the spider at circumferentially spaced points and extending upwardly through slots or apertures 62 in the member 45. The other end 64 of the springs may be attached to a portion of the member 45.

In order to vary and adjust the tension of the springs, so that rotation of the spider is resisted unless the impact force exceeds a predetermined magnitude, the end 64 of each spring is attached to a movable member, such as a block 65, adapted to be moved in a guideway 66 on the upper surface of the member 45 and thereby increase or decrease the tension of the spring. The blocks 65 are adapted to be moved, preferably simultaneously to tension the springs uniformly, by providing a cam following stud 67 on each block 65 which fits into a cam channel or groove 69 on the under side of the cover 15 (Figure 5).

The cover 15 is rotatably mounted in the upper end of the casing 10 by a pair of studs or pins 70 extending inwardly from the wall 14 of the casings and into a circumferentially extending groove 71, formed in a depending skirt portion 72 of the cover 15. Thus by rotating the cover 15, the cam grooves move the blocks 65 to adjust the tension of the springs. To facilitate assembly of the cover 15 and to retain it on the casing, the skirt portion 72 is provided with a pair of recesses 74 extending from the groove 72 to the lower edge of the skirt. The recesses 74 are circumferentially positioned with respect to the pins 70, so that both pins 70 and both recesses 74 are aligned simultaneously when the cover is rotated into a predetermined position, whereby the cover may be telescoped into or out of the casing. The pins 70, the groove 72 and the recesses 74, provide in effect a bayonet joint (Figure 8).

As illustrated in Figure 1, the cover 15 may be provided with suitable indicia serving to indicate the magnitude of the impact force for which the springs are tensioned. The indicia may be in the form of a dial scale having circumferentially spaced marks or graduations adapted to register with an index mark 75 on the upper edge of the casing 10. The cover is adapted to be secured in any desired adjusted position by a pin 76 (Figure 7) extending through an aperture 77 in the side wall of the casing 10 and through an aperture of a series of apertures 79 (Figure 8) extending radially through the groove 71 of the skirt of the cover and circumferentially spaced in a predetermined position with respect to the dial marks. The free end of the pin is adapted to be threaded into a lug or ear 80 on the upper side of the member 45.

Referring more particularly to Figures 2 and 4, the lower casing 11 is shown as being in the form of a box-like receptacle for housing a pair of

switches 85. These switches, preferably, are of the type known as micro switches, and each has a projecting member 86 adapted to operate the switch means within the switch casings. Suitable spring arms 87 normally bear against the projecting members 86 to normally hold the switch means in open circuit position. The switch means are electrically connected to a socket 89, or the like, at the exterior of the lower casing 11 (Figures 1 and 2).

The switches and the spider are operatively connected, by means about to be described, so that upon rotative movement of the spider the spring arms 87 are released and the switch means move into circuit closing position to effect operation of suitable safety devices. To accomplish this, a shaft or spindle 90 has its lower end mounted in a bearing portion 91 at the bottom of the casing 11 for upward and downward movement, and its upper end extends through an aperture 92 in the bottom 12 of the casing 10 and into a central bore 94 of the hub 26 of the spider 17. A cross arm 95 is secured to the intermediate portion of the spindle and is adapted to bear downwardly on the spring arms 87. A cylindrical helical spring 96 is telescoped about the spindle between the cross arm 95 and the bearing portion 91 for normally urging the spider upwardly.

Upon rotation of the spider a latch is released and upward movement of the spindle is effected. This latch may comprise a semi-cylindrical extension 97 at the upper end of the spindle having a semicircular face 98 adapted to be engaged by a pin 99 eccentrically positioned on the spider and extending downwardly into the bore 94. The pin 99 preferably is positioned adjacent the edge of the diametric chord portion of the semicircular face 98 of the extension, so that, upon slight rotation of the spider, the pin 99 slips off the face 98 and the spindle is released for upward movement, whereby the cross arm is raised to effect actuation of the switches. When the spindle is moved upward it cooperates with the pin to lock the spider against rotation.

In order to reset the spider, the switches and connecting latch means, the lower end of the spindle projects through the bottom of the lower casing 11 and is provided with a manually engageable portion 100, access to which may be facilitated by a recess 101 in the bottom of the casing 11. By pulling the portion 100 downwardly and outwardly, the extension 97 at the upper end of the spindle releases the pin 99, and the springs 60 rotate the spindle in the opposite direction as rotated by the balls 35 to position the pin over the face 98. Upon releasing the portion 100 the device is reset.

From the foregoing description it will be seen that the present invention provides a simple, practical and inexpensive impact operable device. The device is accurate in responding to impacts exceeding a predetermined magnitude and can be accurately adjusted by employing several circumferentially arranged springs for resisting impacts of a force less than the force desired to effect actuation of the device. The parts of the device are readily made and assembled, and provide a device of minimum size and maximum efficiency. The device is rugged in construction and can readily withstand any rough usage to which it 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 a device of the class described the combination of a casing, a rotatable member in said casing having a series of arms, a movable inertia operable means adjacent each of said arms for rotating said member, and switch means adapted to be operated by the rotation of said member.

2. In a device of the class described the combination of a casing, a rotatable member having a series of arms comprising an odd number of arms, a movable inertia operable means adjacent each of said arms for rotating said member, and switch means adapted to be operated by the rotation of said member.

3. In a device of the class described the combination of a casing, a rotatable member in said casing having a series of arms comprising an odd number of arms of at least five in number, a movable inertia operable means adjacent each of said arms for rotating said member, and switch means adapted to be operated by the rotation of said member.

4. In a device of the class described the combination of a casing, a rotatable spider in said casing having five substantially outwardly extending arms, a movable inertia operable means adjacent each of said arms for rotating said spider, and switch means adapted to be operated by the rotation of said spider.

5. In a device of the class described the combination of a casing, a rotatable member in said casing having a series of arms, a movable inertia operable means adjacent each of said arms for rotating said member, a series of stops, each of said stops being adjacent one of said inertia means, and switch means adapted to be operated by the rotation of said member.

6. In a device of the class described the combination of a casing, a rotatable member in said casing having a series of arms comprising an odd number of arms of at least five in number, a movable inertia operable means adjacent each of said arms for rotating said member, a series of stops, each of said stops being adjacent one of said inertia means, and switch means adapted to be operated by the rotation of said member.

7. In a device of the class described the combination of a casing, a rotatable member in said casing having a series of arms, a ball member adjacent each of said arms for rotating said rotatable member, and switch means adapted to be operated by the rotation of said rotatable member.

8. In a device of the class described the combination of a casing, a rotatable member in said casing having a series of arms, a ball member adjacent each of said arms, a stop adjacent each of said ball members, and switch means adapted to be operated by said rotatable member.

9. In a device of the class described the combination of a casing, a rotatable member in said casing having a series of arms comprising an odd number of arms of at least five in number, a ball member adjacent each of said arms, a stop adjacent each of said ball members, and switch means adapted to be operated by said rotatable member.

10. In a device of the class described the combination of a casing, a rotatable member in said

casing having a series of arms, a movable inertia operable means adjacent each of said arms for rotating said member, resilient means for resisting rotation of said member in one direction, and switch means adapted to be operated by the rotation of said member.

11. In a device of the class described the combination of a casing, a rotatable member in said casing having a series of arms, a movable inertia operable means adjacent each of said arms for rotating said member, resilient means for resisting rotation of said member in one direction, and a stop adjacent each of said inertia means.

12. In a device of the class described the combination of a casing, a rotatable member in said casing having a series of arms comprising an odd number of arms of at least five in number, a movable inertia operable means adjacent each of said arms for rotating said member, a stop adjacent each of said inertia means, resilient means for resisting rotation of said rotatable member in one direction, and switch means adapted to be operated by said rotatable member.

13. In a device of the class described the combination of a casing, a rotatable member in said casing having a series of arms, a ball member adjacent each of said arms, resilient means for resisting rotation of said rotatable member in one direction, and switch means adapted to be operated by said rotatable member.

14. In a device of the class described the combination of a casing, a rotatable member in said casing having a series of arms comprising an odd number of arms of at least five in number, a ball member adjacent each of said arms, a stop adjacent each of said ball members, and resilient means for resisting rotation of said rotatable member in one direction.

15. In a device of the class described the combination of a casing, a rotatable member in said casing having a series of arms, a movable inertia operable means adjacent each of said arms for rotating said member, resilient means for resisting rotation of said member in one direction, and means for adjusting the tension of said resilient means.

16. In a device of the class described the combination of a casing, a rotatable member in said casing having a series of arms comprising an odd number of arms of at least five in number, a ball member adjacent each of said arms, a stop adjacent each of said ball members, resilient means for resisting rotation of said rotatable member in one direction, and means for adjusting the tension of said resilient means.

17. In a device of the class described the combination of a casing, a rotatable member in said casing having a series of arms comprising an odd number of arms of at least five in number, a movable inertia operable means adjacent each of said arms for rotating said member, a stop adjacent each of said inertia means, resilient means for resisting rotation of said rotatable member in one direction, switch means adapted to be operated by said rotatable member, and means for adjusting the tension of said resilient means.

18. In a device of the class described the combination of a casing, a rotatable spider in said casing having a series of arms, a ball member adjacent each of said arms adapted to be moved by an impact to rotate said spider in one direction, stop means in said casing for preventing movement of the ball members in the other direc-

tion, resilient means for resisting rotation of said spider in one direction, means for adjusting the tension of said resilient means, and a rotatable cover for said casing having means for operating said means for adjusting the tension of said resilient means.

19. In a device of the class described the combination of a casing, a rotatable spider in said casing having a series of arms, a ball member adjacent each of said arms adapted to be moved by an impact to rotate said spider in one direction, stop means in said casing for preventing movement of the ball members in the other direction, resilient means for resisting rotation of said spider in one direction, means for adjusting the tension of said resilient means, a rotatable cover for said casing having means for operating said means for adjusting the tension of said resilient means, and switch means associated with said spider adapted to be operated upon rotation of said spider.

20. In a device of the class described the combination of a casing, a rotatable spider in said casing having a series of arms, a ball member adjacent each of said arms adapted to be moved by an impact to rotate said spider in one direction, stop means in said casing for preventing movement of the ball members in the other direction, resilient means for resisting rotation of said spider in one direction, means for adjusting the tension of said resilient means, a rotatable cover for said casing having means for operating said means for adjusting the tension of said resilient means, and switch means and means for operating said switch means including a latch operatively associated with said spider adapted to be released on rotation of said spider.

21. In a device of the class described the combination of a rotatable member having a series of arms, and a movable inertia operable means adjacent each of said arms for rotating said member.

22. In a device of the class described the combination of a normally stationary rotatable member, a series of substantially equidistantly circumferentially spaced means associated with said rotatable member, and a series of inertia operable means independently movable with respect to said rotatable member for effecting rotation thereof in response to an impact, each of said inertia operable means being associated with one of said means associated with said rotatable member.

23. In a device of the class described the combination of a rotatable member having a series of arms, a movable inertia operable means adjacent each of said arms for rotating said member, and a series of stops, each of said stops being adjacent one of said inertia means.

24. In a device of the class described the combination of a normally stationary rotatable member, a series of substantially equidistantly circumferentially spaced means associated with said rotatable member, and a series of inertia operable means independently movable with respect to said rotatable member for effecting rotation thereof in response to an impact, each of said inertia operable means being associated with one of said means associated with said rotatable member, and a series of stops, each stop being adjacent one of said inertia operable means.

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