Sept. 27, 1960 J. C. MATHIESEN ET AL 2,953,924

IMPACT SWITCH

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FIG. 1

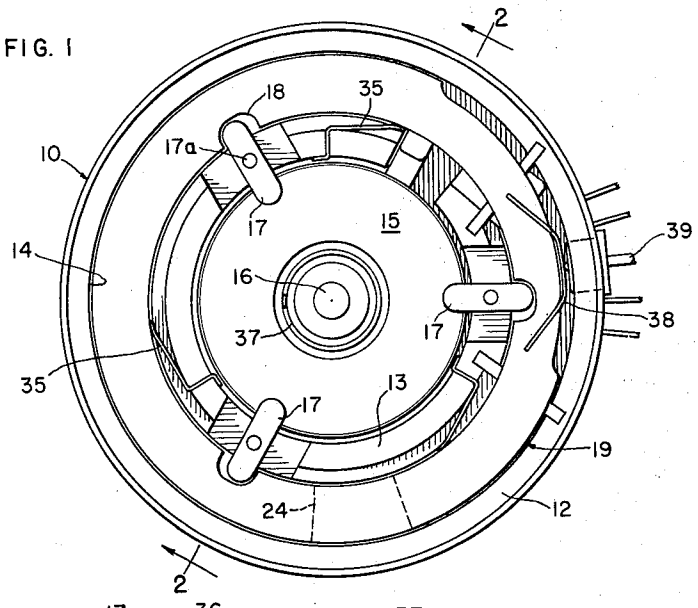


FIG. 2

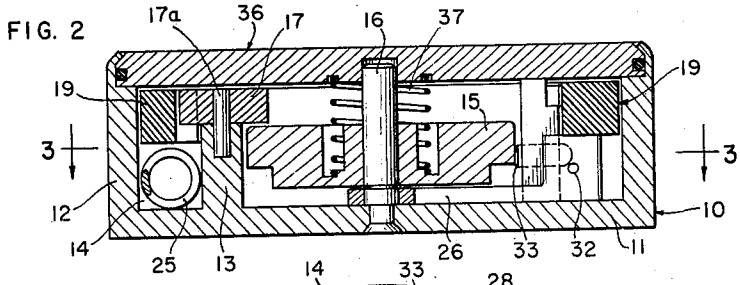
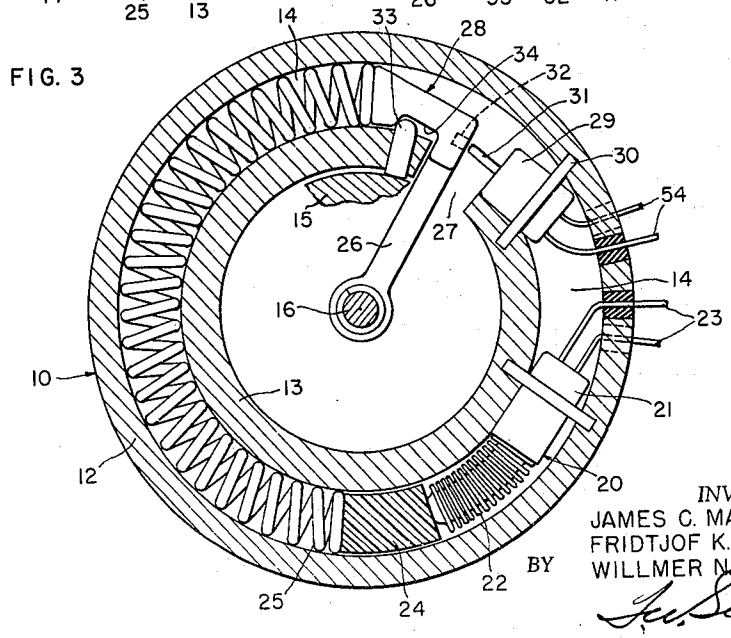


FIG. 3



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FIG. 4

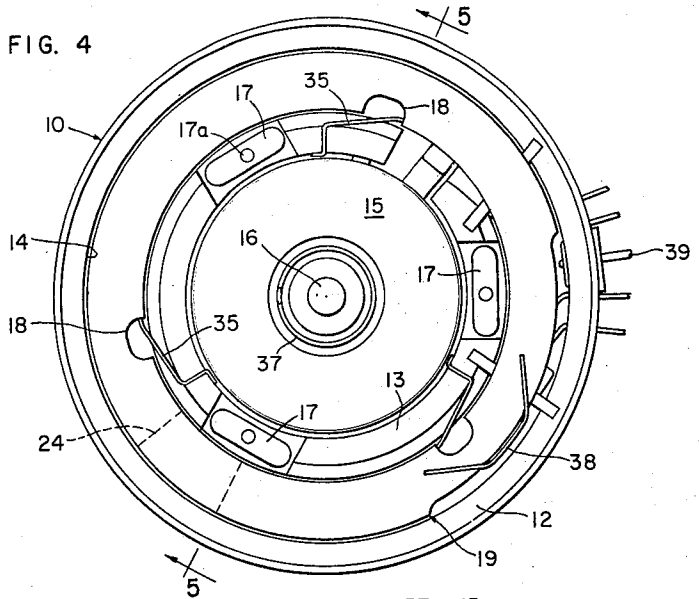


FIG. 5

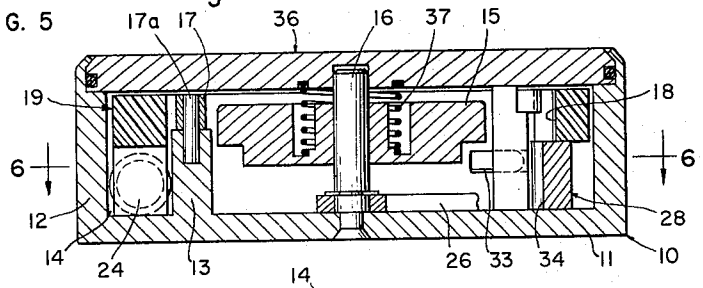
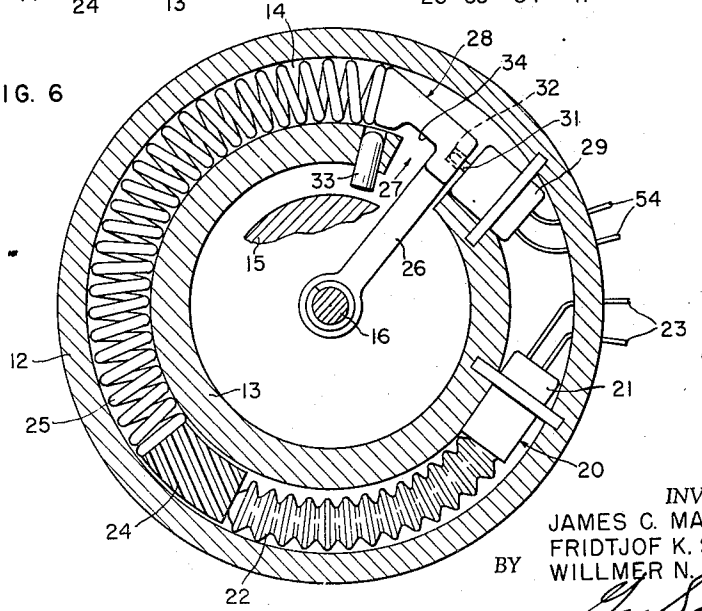


FIG. 6



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FIG. 7

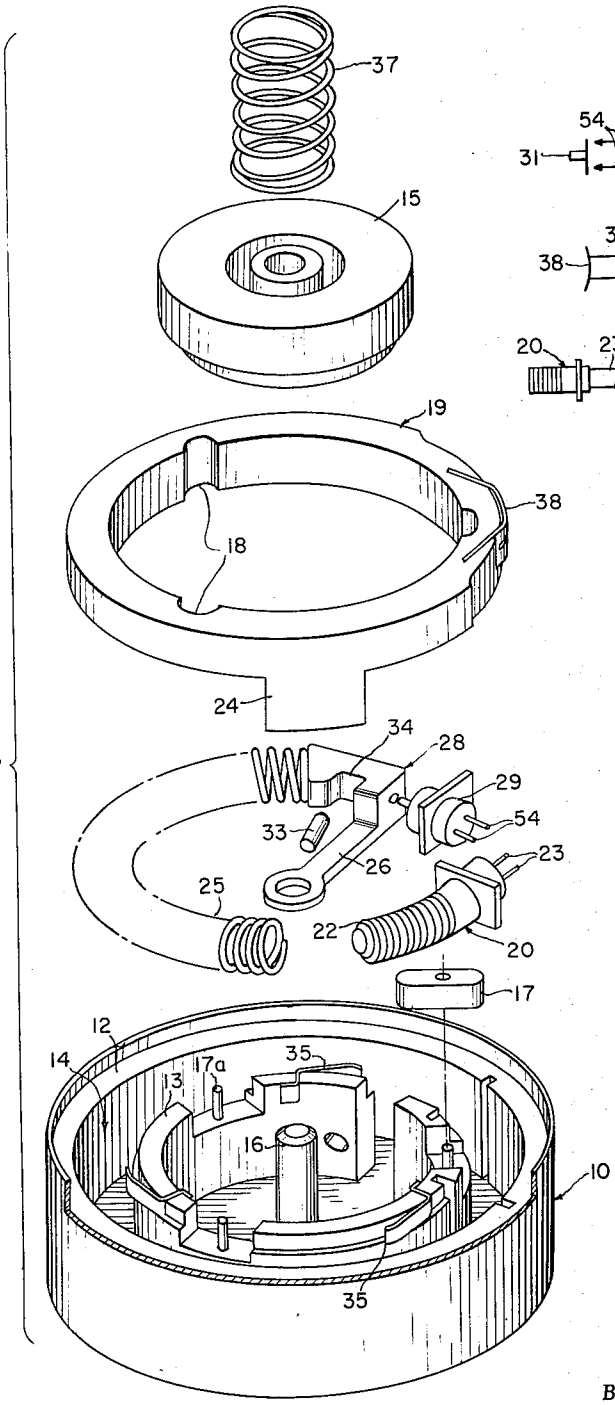


FIG. 8

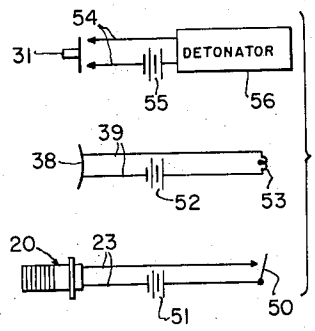
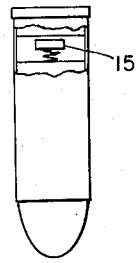


FIG. 9



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United States Patent Office 2,953,924 Patented Sept. 27, 1960

2,953,924

IMPACT SWITCH

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Filed Jan. 2, 1958, Ser. No. 706,873

3 Claims. (Cl. 74—2)

This invention relates to signal-actuated locking devices and more particularly to impact sensitive devices which are insensitive until actuation by an electrical arming signal releases a locking device.

Briefly described, this invention includes a pair of members which are movable with respect to each other and locking means for forming a locking connection between said members. The locking means are engaged by holding means which are in turn released by the operation of signal-actuated means. The signal-actuated means comprise a bellows motor which is an expansible bellows enclosing a combustible charge. When an electrical arming signal is applied to the signal-actuated means, the expansible bellows is forced into an expanded state by the combustion of said charge. This expansion disables said holding means permitting the disengagement of the locking means and allowing relative motion between said pair of members.

In the embodiment of this invention which is herein described, relative motion between said pair of members causes the actuation of an electrical switch. However, in this embodiment no relative motion between the said pair of members will result until an impact is also applied to the mechanism. Before the arming signal is applied to the bellows motor, the electrical switch cannot be actuated by impact or vibration. Thus, we have a device which is used, for example, to provide a detonation mechanism adapted for embodiment in a projectile and which is completely safe until such time as it is desired to arm the projectile.

An object of this invention is to provide a signal-actuated locking device which restrains the relative motion of a pair of members until armed by an electrical signal.

Another object of this invention is to provide an impact sensitive device which can be armed by an electrical arming pulse.

Still another object of this invention is to provide an impact sensitive device which remains insensitive to impact until it is armed at a desired time.

A further object of this invention is to provide actuation means for an electrical switch which will actuate said switch when an impact in a desired direction is applied to said actuation means.

A still further object of this invention is to provide actuation means for an electrical switch which will actuate said switch when an impact in a desired direction is applied to said actuating means, but which will be completely insensitive to all impacts until said actuation means is armed.

Other objects and advantages of this invention will become apparent by reference to the following detailed description of a preferred embodiment of this invention when taken in consideration with the accompanying drawings in which:

Figure 1 shows a plan view with cover removed of the upper section of a form of apparatus embodying this invention before arming;

Figure 2 shows a cross-sectional view of a form of apparatus embodying this invention taken along the line 2—2 in Figure 1;

Figure 3 shows a plan view of the lower section of a form of apparatus embodying this invention taken along the line 3—3 in Figure 2 before arming;

Figure 4 shows a plan view of the upper section of a form of apparatus embodying this invention after arming and impact;

Figure 5 shows a cross-sectional view of a form of apparatus embodying this invention taken through the line 5—5 in Figure 4;

Figure 6 shows a plan view of the lower section of a form of apparatus embodying this invention taken along the line 6—6 in Figure 5 after arming and impact;

Figure 7 shows an exploded view of a form of apparatus embodying this invention;

Figure 8 shows a wiring diagram of a form of apparatus embodying this invention;

Figure 9 shows a form of apparatus embodying this invention mounted in a projectile.

Referring now to the drawings, in which like reference numerals designate like or corresponding parts throughout the several views, there is shown in Figures 1, 2 and 3 a cylindrical housing 10 comprising a circular base 11 provided with concentric circular flanges 12 and 13. The space between the concentric circular flanges 12 and 13 forms a well 14. A disc 15 is slidably fitted to a shaft 16 which is mounted at the center of the circular base 11 such that the disc 15 is free to move axially along the shaft 16. Thus, the disc 15 and the cylindrical housing 10 are adapted to be movable with respect to each other.

Locking means for forming a locking connection between the disc 15 and the cylindrical housing 10 are also provided. Said locking means are shown in Figure 1 as a set of turn buttons 17, each of which is rotatably mounted on a pin 17a fixed in flange 13. The turn buttons 17 lock disc 15 in the position shown in Figure 2 in which disc 15 is restrained from axial movement along shaft 16. Turn buttons 17 are shown in Figure 1 engaged in recesses 18 in rotatable ring 19. Rotatable ring 19 and its recesses 18 serve as holding means preventing rotation of turn buttons 17 and release of disc 15, when in the position shown in Figure 1. Rotatable ring 19 is disposed within well 14 and is rotatable in a clockwise direction by the operation of signal-actuated means.

The signal-actuated means include a bellows motor 20 comprising an explosive charge containing portion 21 and an expansible bellows portion 22; the portion 21 being provided with electrical leads 23 extending through an insulated bushing in the flange 12 to the exterior of the cylindrical housing 10. The passage of an electrical current through leads 23 produces a detonation of the explosive charge in the explosive charge containing portion 21 and causes expansion of the bellows section 22 of the bellows motor 20.

Also disposed within the well 14 is a depending portion 24 of the rotatable ring 19 which lies adjacent to the end of the bellows portion 22 of bellows motor 20 (Figures 3 and 6). A spring 25 is contained in well 14 adjacent to the opposite side of the depending portion 24 of the rotatable ring 19. Pivotally attached to the shaft 16 mounted in the center of the circular base 11 is a radial lever arm 26 extending through a gap 27 in flange 13; said arm having a head 28 disposed in the well 14 adjacent to the opposite side of spring 25.

An electrical switch 29 is supported in well 14 by a

flange 30 which fits into suitable slots cut in flanges 12 and 13; said switch being provided with an actuating pin 31 adapted to be engaged by a recess 32 in head 28. When the actuating pin 31 is depressed by a clockwise movement of head 28, the contacts contained in switch 29 are closed.

Figures 1, 2 and 3 show the apparatus embodying this invention in its unarmed position. In the unarmed position, a cylindrical pin 33 is shown slidably fitting a radial bore in flange 13 to engage a recess 34 in head 28. Pin 33 thus restrains lever arm 26 from moving clockwise under the urging of spring 25. The cylindrical pin 33 is held in position by disc 15 (Figures 2 and 3) which engages the end of pin 33 holding the latter in position to restrain lever arm 26 from clockwise movement. When disc 15 is held in position by turn buttons 17 and turn buttons 17 are in the position shown in Figure 1, disc 15 cannot move axially along shaft 16 to free pin 33 and head 28 of lever arm 26. Thus actuating pin 31 cannot be depressed and the contacts of switch 29 cannot be closed. Figure 1 also shows springs 35 which are attached to circular flange 13. The springs 35 rest against the rotatable ring 19 in the unarmed position.

Figures 4, 5 and 6 show the apparatus embodying this invention after switch 29 has been actuated.

The occurrence of two events in the proper order is necessary for actuation of the switch 29. First, the apparatus must be armed by passing an electric current through leads 23 of bellows motor 20. Second, an impact on side 36 of cylindrical housing 10 must force disc 15 to move axially along shaft 16. The order of the events set out above is critical; that is, an impact on side 36 of cylindrical housing 10 occurring before the arming of the apparatus will have no effect.

The introduction of an electrical signal across leads 23 detonates the explosive charge contained in explosive charge containing portion 21 and causes the expansion of bellows portion 22. This expansion transmits a clockwise movement to spring 25 through the depending portion 24 of the rotatable ring 19. The rotatable ring 19 rotates along with its depending portion 24 until it reaches the position shown in Figure 4 in which the springs 35, acting as pawling means, have entered recesses 18, latching rotatable ring 19 and its extended portion 24 and retaining spring 25 in compression since springs 35 resist movement in a counterclockwise direction. The rotation of rotatable ring 19 also causes a rotation of turn buttons 17 to the position shown in Figure 4, permitting axial movement of disc 15 along shaft 16. However, head 28 is not free to move due to the restraining action of pin 33. Thus, the introduction of an electrical signal across leads 23 changes spring 25 from its substantially uncompressed state as shown in Figures 1, 2 and 3 to a compressed state, while preventing actuation of switch 29 until a subsequent impact is received.

An impact on side 36 causes the disc 15 to assume the position shown in Figure 5, releasing pin 33. When pin 33 is released, spring 25 forces head 28 to move in a clockwise direction, engaging actuating pin 31 in recess 32 and depressing pin 31 until the electrical contacts contained in switch 29 are closed.

A spring 37 (Figures 2 and 5) is provided to resist the response of disc 15 to slight impacts; however, the spring 37 is selected such that it allows the disc 15 to move axially along shaft 16 in response to a desired strong impact.

A shorting bar 38 (Figure 1) is inserted into the rotatable ring 19. The shorting bar 38 maintains electrical continuity across a pair of contacts 39 when the rotatable ring 19 is in the unarmed position (Figures 1, 2 and 3). However, rotation of the rotatable ring 19 (Figures 4, 5 and 6) removes the shorting bar from the contacts 39 and opens the circuit through contacts 39.

Figure 8 shows an embodiment of electrical circuitry

which can be used with this invention. An electrical arming pulse is applied to electrical leads 23 of bellows motor 20 by a switch 50 and a battery 51. Closing switch 50 supplies the electrcal signal necessary to actuate the bellows motor 20.

A circuit for providing an indication when the apparatus is armed is also shown in Figure 8. When the apparatus is in the unarmed position, a circuit is completed through contacts 39 by the shorting bar 38, battery 52 and indicator lamp 53. Arming the apparatus will break the circuit through contacts 39 and extinguish indicator lamp 53.

The firing circuit is also shown in Figure 8. When the actuator pin 31 is depressed, electrical switch 29 closes a circuit through leads 54, a battery 55 and a detonator 56.

Figure 9 shows this invention positioned in a projectile. If the apparatus is armed when an impact is received along the axis of the projectile, disc 15 will advance and allow firing of the projectile.

One possibility of arming this invention without detonation of the bellows motor should be considered. If the projectile is fired from a rifled barrel such that the rifling of the barrel produces sufficient spin in the projectile to force rotatable ring 19 into a position in which springs 35 were engaged in recesses 18, the apparatus would be completely armed. It is for this reason that the rotatable ring 19 is made of a light material, such as plastic, which has an inertia so low that no possibly achieved rotational forces could cause movement of the rotatable ring 19. Further, this invention, if used in a rifled barrel, would be aligned such that the rotation imparted to the projectile would tend to rotate the rotatable ring 19 in the counterclockwise direction (referring to Figure 1) and would thus tend to counteract any forces tending to rotate rotatable ring 19. Thus, it is evident that this invention is insensitive to any impact forces from whatever direction before arming, and cannot supply a signal before the arming signal is received.

It should be understood, of course, that the foregoing disclosure relates to only a preferred embodiment of the invention and that numerous modifications and alterations may be made therein without departing from the spirit and the scope of the invention as set forth in the appended claims.

What is claimed and desired to be protected by Letters Patent of the United States is:

1. In a signal-actuated locking device, an annular housing, a disc adapted to be moved axially of said housing, locking buttons rotatable into and out of a position forming a locking connection between said housing and said disc, an annular ring rotatably mounted within said housing and having recesses therein for retaining said locking buttons in the position forming a locking connection against said disk; said annular ring being effective upon rotation thereof to move said locking buttons out of the position forming said locking connection, signal-actuated means for rotating said rotatable ring, and springs mounted on a portion of said housing for engaging said annular ring and retaining the same in its rotated position and for preventing the return of said locking means to the locking position.

2. In a signal-actuated locking device a pair of members adapted to be moved with respect to each other, locking means movable into and out of a position forming a locking connection between said members, a rotatable ring having recesses therein for retaining said locking means in the position forming a locking connection, said rotatable ring being effective upon rotation thereof to move said locking means out of the position forming said locking connection, and signal-actuated means for rotating said rotatable ring whereby relative movement between said members may take place.

3. A signal actuated locking device comprising an annular housing having an annular fixed ring within said

housing and in spaced relation to an outer circular wall forming the outside of said housing, locking buttons rotatably mounted on said fixed ring, a rotatable ring mounted in said housing and disposed between said outer walls of said housing and said fixed ring, said rotatable ring having recesses disposed about the inner periphery thereof co-acting with said locking buttons, a disk in said housing positioned within said fixed ring and adapted to be moved axially within said housing, said disk being positioned adjacent said locking buttons and retained in an inactive position by said buttons, signal actuated means for imparting radial movement to said rotatable ring whereby said rotatable buttons are disposed to move away from said disk, thereby permitting said disk to freely move axially of said housing, a rockable arm pivotally

mounted in said housing, a pin slidably mounted in said fixed ring and normally in engagement with said rockable arm and said disk when said disk is retained in an inactive position and out of engagement with said arm when said disk is moved axially of said housing, whereby said arm is free to rotate and signal means actuated by said rockable arm.

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