June 17, 1947. H. C. HEBARD 2,422,548

DETONATING MECHANISM

Filed March 16, 1943 3 Sheets-Sheet 1

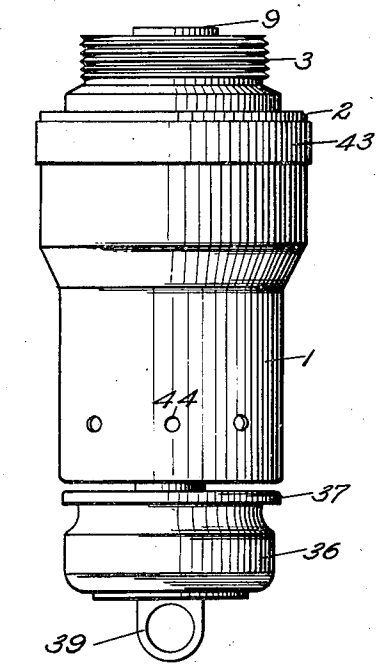


Fig. 1

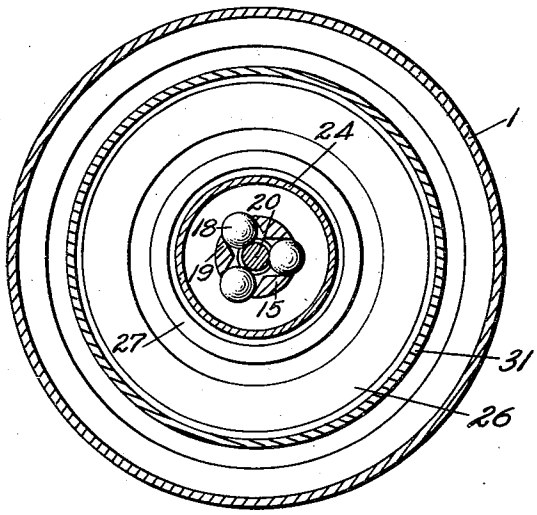


Fig. 4

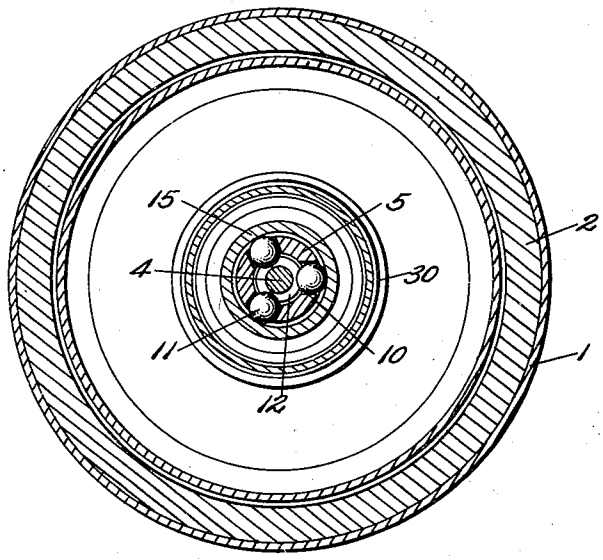


Fig. 3

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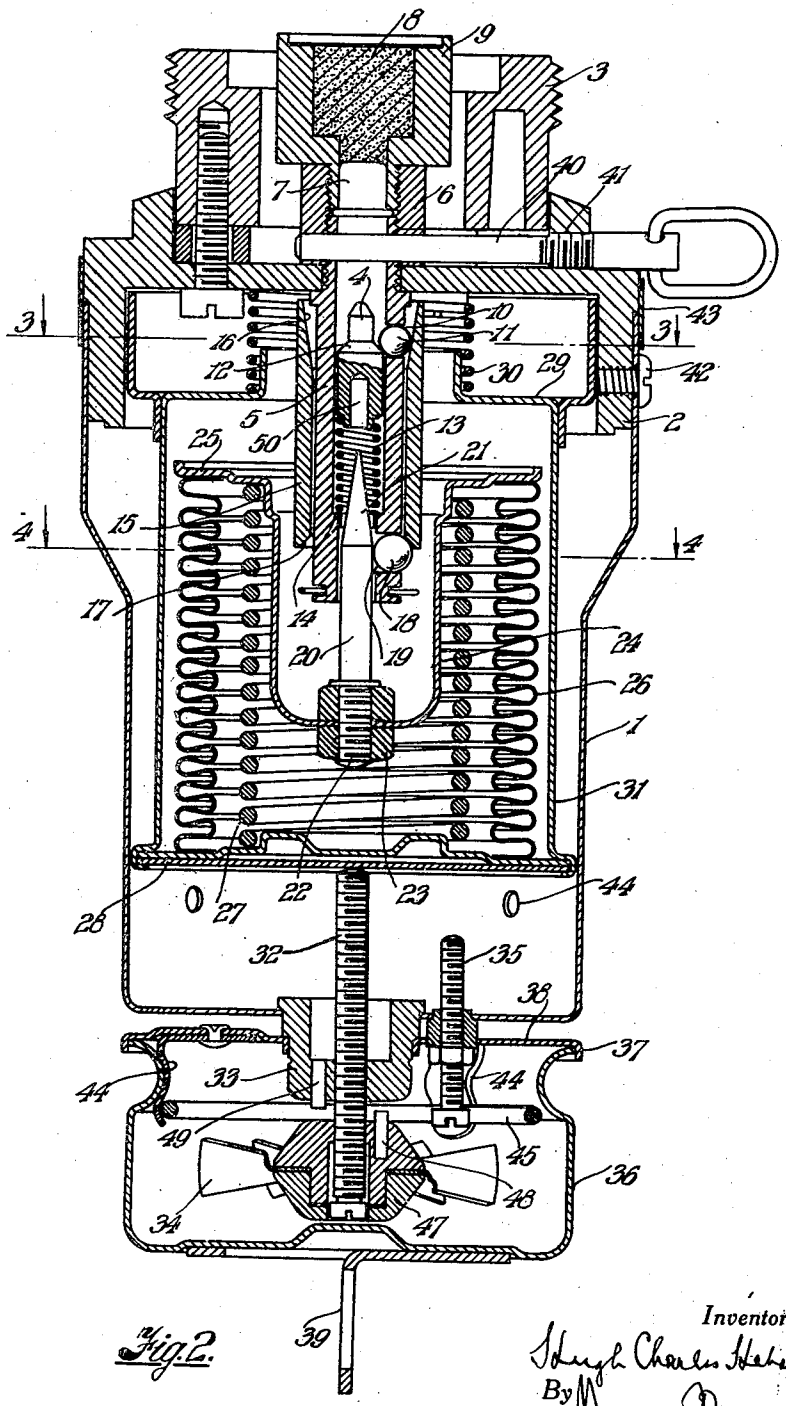


Fig. 2.

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DETONATING MECHANISM

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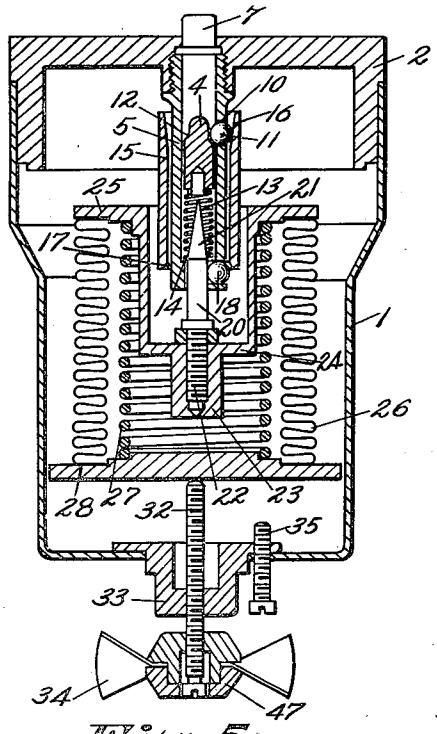


Fig. 5

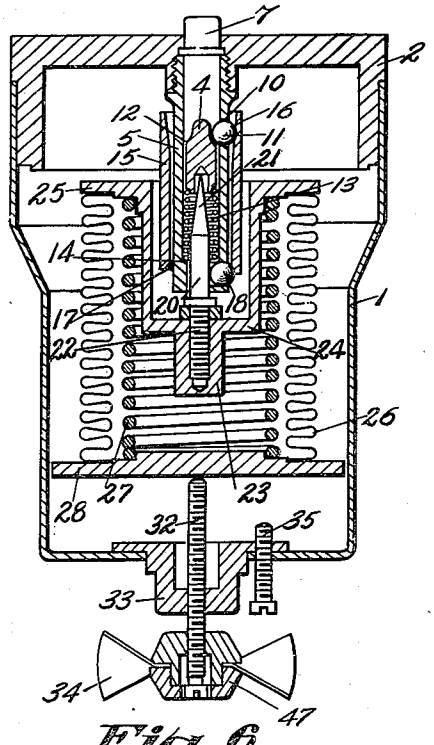


Fig. 6

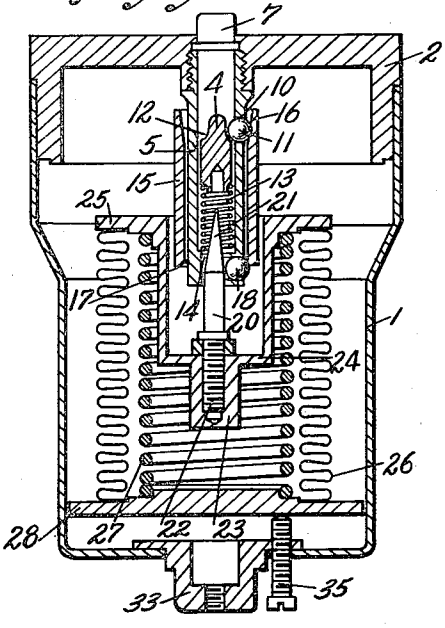


Fig. 7

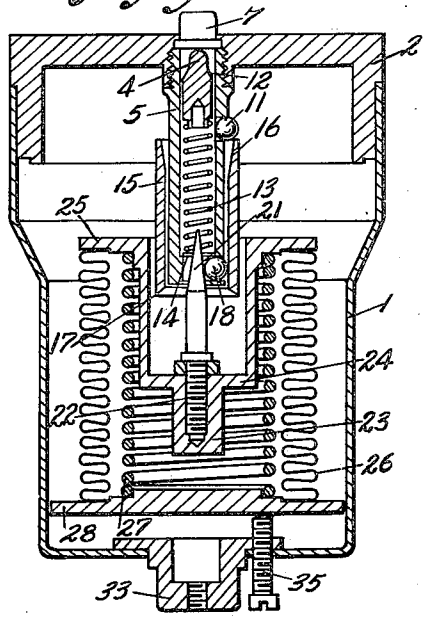


Fig. 8

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UNITED STATES PATENT OFFICE

2,422,548

DETONATING MECHANISM

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In Great Britain October 6, 1941

11 Claims. (Cl. 102—70)

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The invention relates to aerial bombs, pyrotechnic devices and the like and has for its object to provide improvements in connection with the detonating mechanism which enable the said devices to be dropped from any height and, without any special presetting immediately prior to release, explode or ignite at a predetermined height above sea level.

The invention consists in a detonating device for an aerial bomb, pyrotechnic device or the like wherein means normally restraining the striker mechanism from operation are adapted to be released at a predetermined height above sea level by the action of a device responsive to changes in atmospheric pressure.

According to one form of the invention a detonating device for an aerial bomb, pyrotechnic device or the like comprises a casing, a metallic bellows device therein responsive to changes in atmospheric pressure, a striker, and means normally restraining said striker from movement but adapted to be released substantially without effort by movement of said bellows under atmospheric pressure changes to enable the striker to actuate a detonator and ignite a fuze.

The release of the striker without effort by movement of the bellows is preferably effected by the use of a double application of the wedging device described in my earlier application for Letters Patent No. 440,374. This double application consists in the combination of a tapered sleeve whose angle of taper is slightly greater than the critical angle and a tapered pin whose taper is equal to the angle of friction, the pressure due to a striker spring on ball bearings which are restrained from movement by the tapered portion of the sleeve being arranged to force the sleeve down against a second set of ball bearings which in turn bear on the tapered pin. This arrangement possesses the advantage that, since the angle of the tapered pin is equal to the critical angle, the said pin is neither forced out nor held back by the action of the striker spring and can, therefore, be withdrawn without substantial effort from its restraining position.

Reference will now be made to the accompanying drawings which illustrate by way of example a detonating mechanism constructed according to the invention and in which:

Fig. 1 is an elevation,

Fig. 2 is a vertical sectional elevation,

Fig. 3 is a sectional plan taken on the line 3—3 of Fig. 2,

Fig. 4 is a sectional plan taken on the line 4—4 of Fig. 2 and

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Figs. 5, 6, 7 and 8 are diagrams showing the positions of the parts of the mechanism at various stages of operation.

Referring first to Figs. 1–4, the detonating mechanism is mounted within a casing 1 of sheet metal mounted around the exterior of a casting 2 which is provided with a screw threaded component 3 for attachment to the bomb or pyrotechnic device to be actuated by the means provided by the invention.

The detonating device includes a striker 4 which is mounted axially within the casing 1, being disposed within a fixed sleeve 5 having screw threaded connection with a sleeve 6 fixed in the component 3 and to which is also connected a third sleeve 9 within which is housed a detonator cap 7 and fuze 8. The upper end of the sleeve 6 projects beyond the component 3 into the housing of the bomb or pyrotechnic device whereby the fuze 8 is brought into communication with the flare charge or bursting charge. The sleeve 5 is formed with apertures 10 to receive a series of balls 11 which normally engage a conical shoulder 12 on the striker 4 and restrain it from being projected into operative position by a spring 13 which is normally held in a state of compression between the base of the striker 4 and the lower end of the sleeve 5 which is formed with an inturned annular shoulder 14 against which one end of the spring abuts. The balls 11 are normally prevented from being displaced by an outer movable sleeve 15 which surrounds the lower end of sleeve 5 and is internally tapered as shown at 16, the angle of taper being greater than the angle of friction between the sleeve 15 and the balls 11. The end of sleeve 15 remote from the internal taper 16 is chamfered as shown at 17 and engages a further series of balls 18 housed in apertures 19 at the lower end of sleeve 5 so that the sleeve 15 is normally held by the balls 11 and 18 against axial movement in either direction.

The balls 18 are held in the operative position, shown in Fig. 2 by a release pin 20 projecting axially into the end of the fixed sleeve 5, the said release pin comprising a cylindrical portion and a tapered end 21, the angle of taper being substantially equal to the angle of friction between the balls 18 and the release pin. The lower end of the said release pin is formed with a screw-threaded portion 22 and engages a socket 23 at the base of a larger socket 24 forming the central portion of the cover plate 25 closing one end of a flexible metallic bellows 26 which is almost completely evacuated but is normally prevented from collapsing by means of a spring 27, one end

of which bears against the inner surface of the plate 25 and the other end of which bears against the inner surface of a plate 28 which closes the other end of the said bellows. Fixed to the rim of the plate 28 is a bellows casing 31 whose opposite end terminates within the casting 2 where it is formed with an annular shoulder 29 on which bears a coiled spring 30 whose other end abuts against the head of the casting.

To prevent the arrangement above described from being operated accidentally, a safety device is employed consisting of a screw threaded spindle 32 which bears at its inner end upon the bellows plate 28, the said spindle passing through a screw threaded socket 33 fixed in the lower end of the housing 1 and carrying externally a rotary wind vane 34. To limit the inward movement of spindle 32 when being operatively positioned, the boss 47 of the wind vane carries a pin 48 adapted to engage a fixed stop 49 carried in the lower end of the socket 33. The extent of downward movement of the bellows plate 28 is limited by an adjustable screw 35 passing through the base of casing 1. Both the wind vane 34 and the head of screw 35 are ordinarily enclosed by a housing 36 whose outer edge engages the rim 37 of a disc 38 carried by the socket 33, the underside of the disc carrying spring clips 44 over which the said housing 36 is sprung into position the said clips being maintained in operative positions by a spring ring 45. The housing 36 is provided with a lug or ring 39 to which any suitable means can be attached for rapidly removing the housing 36 either manually or automatically from the position shown in Fig. 2 when the bomb or pyrotechnic device is released from an aircraft. Until the device is to be used it is locked against operation by means of a safety pin 40 which passes across the casting 2 as shown in Fig. 2, so that should the striker 4 be accidentally released, it will only make contact with the pin 40. The pin is screw threaded at 41 to engage the casting 2 so that it cannot be accidentally detached but must be purposely rotated to remove it.

The casing 1 is fixed to the casting 2 by means of screws 42 and the joint between these two components is sealed by adhesive tape 43. The casing 1 is provided with air inlet apertures 44.

In the operation of the device above described, so long as the bomb or pyrotechnic device is attached to the aircraft the wind vane 34 and its associated spindle 32 are in position and the cylindrical portion of the release pin 20 is engaged between the members of the series of balls 18, this initial position being indicated in the diagram (Fig. 5) in which all the parts occupy the positions shown in Fig. 2.

As the aircraft rises to regions of lower pressure the bellows 26 expands with the assistance of spring 27 and pushes the release pin 20 further into the fixed sleeve 5 until the position shown in Fig. 6 is reached, the striker pin 4 being formed with a socket 50 to permit this movement. In this figure, it will be noted that the bellows 26 has expanded but that the sleeve 15 is still in the position in which it holds the balls 11 in locking engagement with the striker 4.

When the bomb or the like is released from the aircraft, the wind vane 34 is caused to rotate and withdraw the spindle 32 from contact with the bellows plate 28 until the continued rotation removes the spindle 32 altogether from the socket 33 and the wind vane falls away. The removal of the spindle 32 allows the spring 30 acting on

the casing 31 to move the bellows as a whole downwards until the plate 28 makes contact with the inner end of the screw 35. This movement also carries with it the release pin until the tapered portion 21 is brought into engagement with the series of balls 18, the positions of the parts being now as shown in Fig. 7 with the sleeve 15 still holding the balls 11 in position to lock the striker 4 against movement.

The device is now in the armed condition and as the bomb or pyrotechnic device descends to regions of higher pressure the bellows 26 contracts and withdraws the release pin 20 without effort, freeing the balls 18 which move inwards relatively to the sleeve 5 (see Fig. 8) thereby releasing the movable sleeve 15 for downward movement. Owing to the pressure of the spring 13 on the striker 4, the balls 11 are pushed outwards at the same time pushing the sleeve 15 downwards owing to the pressure of the balls on the tapered surface 16 until the balls 11, being unrestrained, move out of the path of the striker 4 which, thereafter, moves into operative position under the continued expansion of its spring 13. As the angle of the tapered pin 20 is equal to the critical angle, the pin is neither forced in nor held back by the action of the striker spring 13 acting through the striker 4, shoulder 12, balls 11, sleeve 15 and balls 18 but can be withdrawn without effort by the bellows to the position shown in Fig. 8. The firing point at which the striker 4 makes impact against the detonator 7 is shown in Fig. 8 in which it will be seen that the sleeve 15 has moved downwards and thereby released the balls 11 from their locking position.

The arrangement above described possesses the advantage that the bomb or the like can be dropped from any height and owing to the fact that the bellows 26 will only be compressed to release position by a predetermined pressure, detonation will always occur at one predetermined height above sea level. The invention thus obviates the need for operating any setting devices immediately prior to release of the bomb or the like.

I claim:

1. A detonating device for an aerial bomb, pyrotechnic device or the like, comprising a casing, a metallic bellows device responsive to changes in atmospheric pressure with altitude disposed in said casing, a striker, movably mounted tapered sleeve means normally restraining said striker from movement, wind vane actuated means for rendering said bellows device operative by flight of the bomb or the like after it has been discharged, mechanical means actuated by said bellows device under atmospheric pressure changes to release the restraining means from said striker, and a spring for operating said striker after its release.

2. A detonating device for an aerial bomb, pyrotechnic device or the like, comprising a casing, a metallic bellows responsive to changes in atmospheric pressure with altitude disposed in said casing, a spring loaded striker mounted movably in said casing, means normally restraining the striker, said means including a movably mounted tapered sleeve whose angle of taper is slightly greater than the critical angle and a tapered pin mounted movably in the casing and whose taper is equal to the angle of friction, and elements interposed respectively between the tapered portion of said sleeve and the striker to restrain the striker and between said pin and sleeve to restrain said sleeve, means for placing said bel-

lows in condition for operation after the bomb or the like has been discharged, means actuated by said bellows under atmospheric pressure changes to move said pin to bring its tapered portion into cooperation with the restraining elements between said pin and sleeve and thereby free said sleeve and release said striker for automatic operation.

3. A detonating device for an aerial bomb, pyrotechnic device or the like, comprising a casing, a metallic bellows responsive to changes in atmospheric pressure with altitude and movable in said casing from a safety to an arming position, a spring actuated striker, means including a series of balls and cooperating wedging devices for restraining said striker from operation, said wedging devices normally maintaining said balls in the restraining positions, a wind vane controlled means operative by flight of the bomb or the like to release the bellows and allow it to move to its arming position, and mechanical means actuated by said bellows under atmospheric pressure changes for operating one of the wedging devices to free said balls and thereby release the striker for actuation by its spring.

4. A detonating device for an aerial bomb, pyrotechnic device or the like, comprising a casing, a detonator and fuse carried thereby, a striker mounted in the casing for operation upon the detonator, means for restraining the striker from operation, a release member for the restraining means, and a flexible bellows responsive to atmospheric pressure changes and operative to actuate the release member, the bellows being mounted movably in the casing to alter the position of the release member relatively to the restraining means, and wind vane operated means normally acting on the bellows to hold the release member in non-releasing relation with the restraining means and removable from the device during flight thereof to permit movement of the bellows and release member into releasing relation with the restraining means.

5. A detonating device according to claim 4, wherein said wind vane operated means comprises a spindle threaded in an end of the casing and bearing against an end of the bellows and carrying a wind vane, and removable from the casing by the operation of the wind vane.

6. A detonator device according to claim 4, including a spring urging the bellows and release member toward a position for release of the restraining means.

7. A detonator device according to claim 4, wherein said bellows is mounted in the casing between end plates one of which is movable in response to atmospheric pressure changes and is connected to the release member, and including a spring interfused between the other end plate and the casing and acting to move the bellows toward a position for release of the restraining means by the release member.

8. A detonator device for aerial bombs, pyrotechnic devices and the like, comprising a body, a detonator and fuse carried thereby, a spring-operated striker having means for guiding it for operation upon the detonator, means including a set of balls cooperative with the striker for preventing operation thereof, a restraining member movable relatively to the striker guiding means and cooperating with said balls for sustaining the action of the striker thereon, and thereby holding the balls in locking relation with the striker, means including a second set of balls cooperative with the restraining member for holding the latter in holding relation with the first-mentioned set of balls, a release member normally locking the second set of balls in holding relation with the restraining member, and a device responsive to atmospheric pressure changes and operative upon the release member to move it into releasing position relatively to the second set of balls.

9. A detonating device for aerial bombs, pyrotechnic devices and the like, comprising a body, a sleeve fixed on the body and having sets of peripheral apertures spaced longitudinally thereof, a spring-operated striker movable longitudinally in said sleeve and having a tapered portion, a second sleeve movable longitudinally of the first sleeve, a set of balls in one of the sets of apertures and interposed between the tapered portion of the striker and the movable sleeve and acting to move the latter in a direction to release the striker, a releasing pin having a tapered portion movable longitudinally in the fixed sleeve, a second set of balls in another of the sets of apertures and interposed between the releasing pin and the movable sleeve to restrain the latter from striker releasing movement, and a device responsive to atmospheric pressure changes and operative upon the releasing pin to bring its tapered portion into cooperation with the second set of balls and thereby permit them to release the movable sleeve for striker releasing movement.

10. A detonating device for aerial bombs, pyrotechnic devices and the like, comprising a body having a relatively fixed sleeve provided with apertures spaced axially thereof, a striker having a tapered portion thereon, a spring acting to move the striker axially in said sleeve, a flexible bellows responsive to changes of atmospheric pressure, a release pin having a tapered portion extending into said sleeve and movable axially therein by operation of the bellows, balls in the apertures in said sleeve and cooperative respectively with the tapered portions of the striker and pin, a controlling member movable longitudinally of said sleeve and having tapered portions thereon cooperative respectively with said balls, the ball cooperating with the tapered portion of the striker and the respective tapered portion of the controlling member being under the influence of the striker operating spring and the angle of taper of said tapered portion of the controlling member being slightly greater than the angle of friction of said ball, and the angle of taper of the tapered portion of said pin being substantially equal to the angle of friction of the ball cooperating therewith.

11. A detonating device for an aerial bomb, pyrotechnic device or the like, comprising a casing, a bellows device responsive to changes in atmospheric pressure movably mounted in said casing, a sleeve fixedly mounted in said casing and having sets of peripheral apertures therein, a detonator and fuse fixed at one end of said sleeve, a striker pin movably mounted in said sleeve, a spring for operating the striker pin mounted in said sleeve, a series of balls mounted in one of the sets of apertures in said sleeve and normally restraining the striker from movement, a second sleeve movable longitudinally of said fixed sleeve and normally holding said balls in locking position, a second set of balls mounted in another set of the apertures in said fixed sleeve and holding the movable sleeve against movement, a release pin carried by the bellows and movable longitudinally in said fixed sleeve,

and engaging and normally holding the second set of balls in locking position, a casing carrying said bellows, a spring interposed between said casings and adapted to move the bellows casing to a position wherein the bellows withdraws the release pin from its locking position, a safety device normally holding said bellows casing in an inoperative position, and a wind vane operative to withdraw the safety device from the bellows casing after the bomb has been released from an aircraft.

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