

June 25, 1963

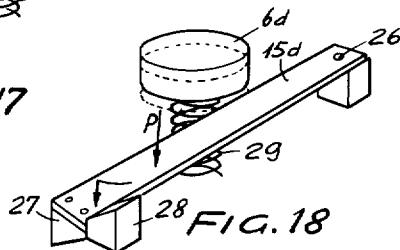
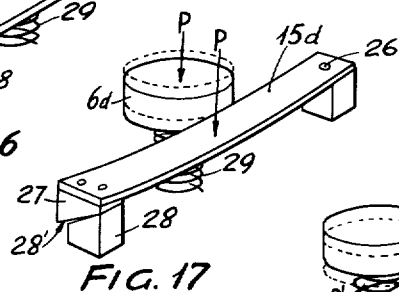
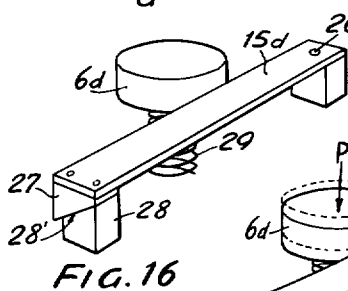
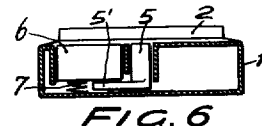
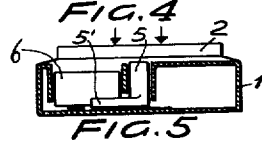
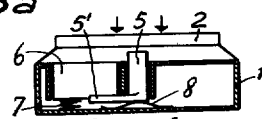
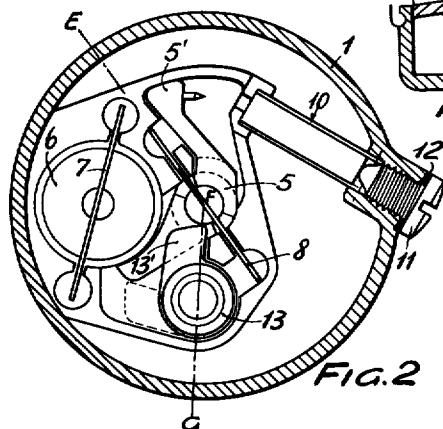
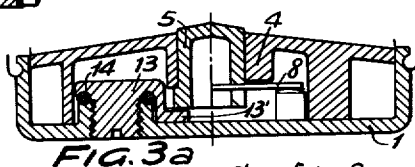
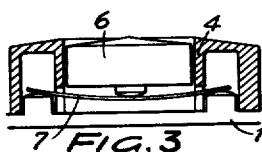
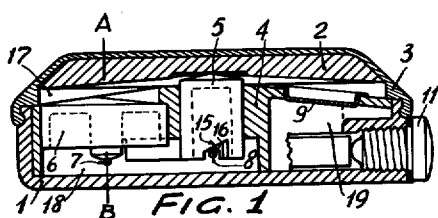
C. METTLER

3,094,935

PNEUMATIC- EFFECTED DELAYED - ACTION TRIPPING DEVICES

Filed July 24, 1961

2 Sheets-Sheet 1



INVENTOR
CARLO METTLER

BY *Greene, Pincus & Durr*
ATTORNEY

June 25, 1963

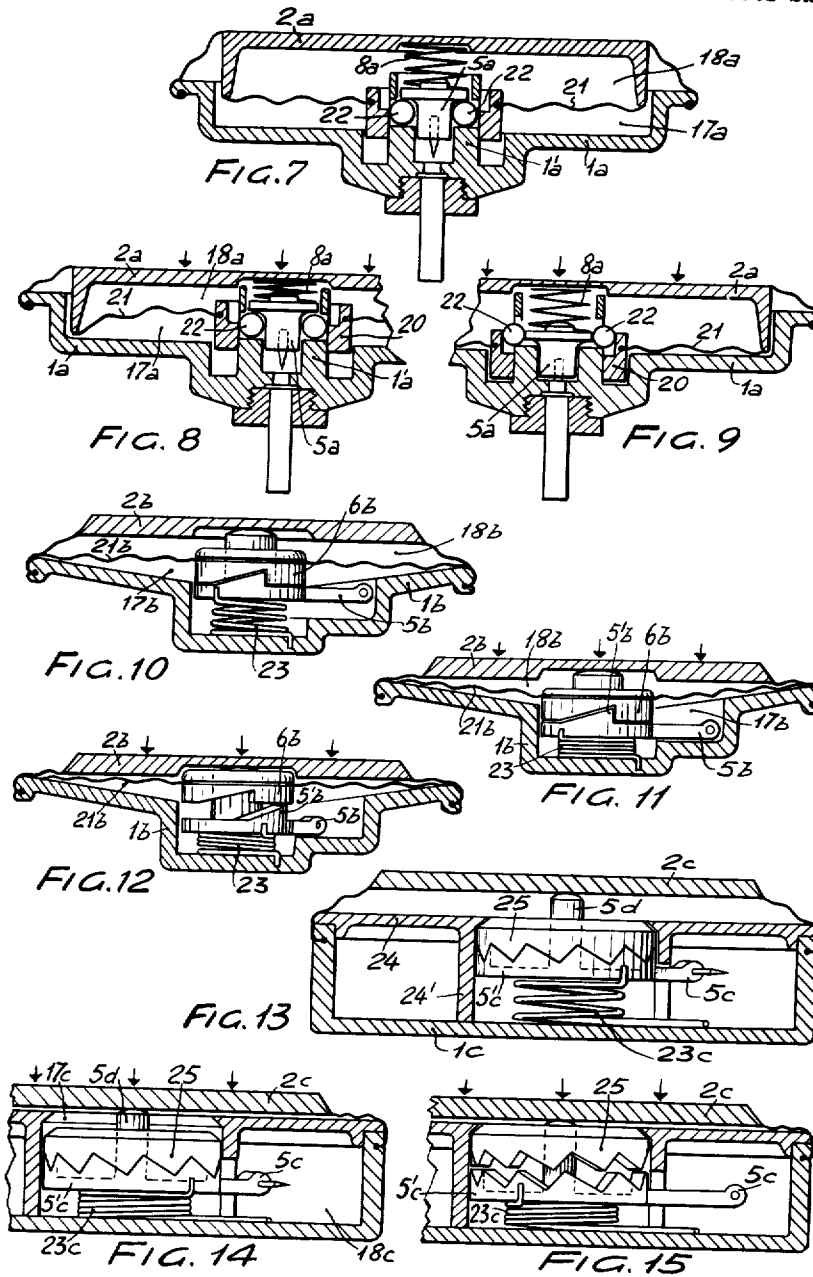
C. METTLER

3,094,935

PNEUMATIC- EFFECTED DELAYED - ACTION TRIPPING DEVICES

Filed July 24, 1961

2 Sheets-Sheet 2



INVENTOR
CARLO METTLER

BY *Greene P. Miller & Sons*

ATTORNEY

1

3,094,935

**PNEUMATIC-EFFECTED DELAYED-ACTION
TRIPPING DEVICES**

Carlo Mettler, Chiasso, Switzerland

Filed July 24, 1961, Ser. No. 126,300

Claims priority, application Switzerland July 26, 1960

4 Claims. (Cl. 102—70)

The present invention relates to a pneumatic delayed-action tripping device which proves particularly suitable for firing explosive charges. In fact, due to the aforementioned delay in the tripping action, said firing devices are rendered insensitive to sudden pressures, such as those created by the blowing up of other explosive charges located in the nearby surroundings.

Naturally the device which is embodied in the invention can also be used for other applications and, in particular, for delayed-action electrical switch or commutator controls, such as are used for lifts, elevators, motor controls, or the like.

The present invention consists in a delayed-action tripping device constructed to render it insensitive to sudden, instantaneous stresses comprising in combination (1) a movable control member on which the pressure is exerted, arranged inside of a main body which is divided by a diaphragm into two non-hermetic chambers, (2) a tripping device capable of bringing about the desired effect as a result of the aforementioned pressure, and (3) a locking member for the tripping device, said locking member and tripping device maintaining the same relative position in relation to one another during the first instant immediately following the movement of the movable control member on which the pressure is exerted. Due to a difference created between the air pressures inside the two chambers the combination of these various parts and members are such that at a succeeding moment, upon re-establishment of equilibrium between the pressures in the two chambers, the locking member moves with respect to the tripping member, allowing the latter to operate and making possible the subsequent described actions.

The invention will now be described, by way of example only, with reference to the accompanying drawings showing various preferred embodiments of the invention wherein,

FIGURE 1 is a large-scale axial cross-section of an anti-personnel mine equipped with the firing mechanism,

FIGURE 2 is an inverted plan view of the device shown in FIGURE 1,

FIGURE 3 is a cross section taken along the line A—B in FIGURE 1,

FIGURE 3a is a cross section taken along the line E—F—G in FIGURE 2,

FIGURES 4, 5 and 6 show schematic drawings of the relative positions of the various parts of the body of the mine, the pressure cover, firing pin and lock for same, FIGURE 4 when in the rest position, FIGURE 5 at the instant immediately after pressure has been applied and FIGURE 6 several moments later.

FIGURES 7, 8 and 9 show a schematic axial cross-section of another form of embodiment of the firing mechanism for mines, in the three positions shown in FIGURES 4, 5 and 6 respectively.

FIGURES 10, 11 and 12 show, in the same three positions, respectively, another form of embodiment of the firing mechanisms.

FIGURES 13, 14 and 15 show, in the same three positions, a still further form of embodiment of firing mechanisms.

FIGURES 16, 17 and 18 show, respectively, in the three positions corresponding to those of the other figures, a particular or special form which the tripping or

2

firing pin device may take and the stop for same, this unit then being mounted inside the body of a mine or other similar device of the type shown in FIGURES 1, 2 and 3.

5 The mine shown in FIGURES 1, 2 and 3 in the accompanying drawings has, customarily, its firing mechanism built into the mine, itself, thus the above figures show the whole mine, equipped with the new tripping or firing device.

10 The mine comprises a body 1, a pressure plate 2, and an outer plastic cover 3, the inside of the body of the mine being subdivided in two parts by a partition or diaphragm 4 which separates the inside of the firing mechanism into two separate chambers 17 and 18.

15 Said diaphragm 4 has three holes in one of which is inserted the arm 5 of firing pin 5', which arm presses against the pressure plate 2. Another hole houses a plunger 6 which is slidably arranged in said hole and serves as the lock for the firing pin. Said plunger 6 is held at its upper position at the end of its stroke by a spring 7 consisting of a fine steel wire. A plug 9 of a plastic material is applied in the third hole, the use of which will be discussed later on.

20 The arm 5 of firing pin 5' presses against the pressure plate 2 because when in its rest position it is acted upon by a spring 8 which, preferably consists of a simple segment of spring wire on which the firing pin is made to ride as shown in FIGURE 1. The notch providing the seat for the spring 8 in the firing pin 5 has two inclined planes 15 and 16 inclined in opposite directions, which, together with said spring 8 would tend to cause the firing pin to rotate; but this rotation is prevented by the plunger 6.

25 The diaphragm 4 also has the function of defining the chamber 19 holding the explosive, the explosive being fed in through the hole closed by plug 9. To complete the firing mechanism, a small tube 10, preferably of Celluloid, serves as a guide for the percussion cap on which the point of the firing pin will strike at the moment when the mine is made to explode. A plug 11 provided with washer 12 and a safety plug 13 also provided with washer 14 when in the position shown in FIGURE 3a, makes it impossible for the mine to be exploded because it prevents the firing pin 5 from being released except when the threaded plug part 13 is turned, by using a special wrench such that its protruding portion 13' permits the firing pin 5 to be pushed downwardly (see FIG. 3a), the mine is cocked and ready to be fired.

30 The above described device operates as follows: When the mine is positioned and after having taken off the safety device all the parts of the mechanism are in their rest positions, the two springs 7 and 8 are not subjected to any external tensions. The plate 2, firing pin 5 and plunger 6 are located in their upper positions, shown in FIGURE 1.

35 When a force equal to or greater than a predetermined amounts acts on the plate 2, it is lowered and, as a result, presses the firing pin 5 downwards, overcoming the opposing action of spring 8 and plunger 6 which is pressed by the air located in chamber 17 which has been compressed by the lowering of plate 2, and the plate itself, comes to rest against the upper face of diaphragm 4, that is the main parts of the mechanism change from the position shown in FIGURE 4 to that shown in FIGURE 5. From these figures and from the above description, it will be seen how firing pin 5 even when in this position is still unable to rotate and cause the mine to be exploded, since its relative position with respect to plunger 6 has not changed during the shift in position taking place between FIGURE 4 and FIGURE 5.

40 As a result, if the action of the force exerted on the plate 2 lasts only for an instant, then, as soon as it ceases,

3

firing pin 5 and plunger 6 will return to their original position, at the upper end of their travel, the position shown in FIGURE 4.

If, instead, the action of the force persists, then the air under pressure which is in the chamber 17 due to the lowering of the plate 2 will be more or less rapidly vented off through the clearances between diaphragm 4 and plunger 6, as well as between the diaphragm and the firing pin and equilibrium will be re-established between the pressure existing inside two chambers 17 and 18. The plunger 6, then, subjected to the pressure exerted by spring 7 will return to its upward position, thereupon assuming the position shown in FIGURE 6, whereupon firing pin 5' will no longer remain locked in its previous position but will be free to trip, exploding the mine.

The form of embodiment shown in FIGURES 7, 8 and 9 is particularly useful as a firing mechanism for mines.

This embodiment of the mine comprises a body 1a having an upper pressure plate 2a the inside of the firing mechanism being divided up into two chambers by a diaphragm, partially constituted by a rigid member 20 and by flexible membrane 21. The body of the firing mechanism 1a has a cylindrical 21. The body of the firing mechanism 1a has a cylindrical projection 1'a at the centre of its upper side, around the outside of which the rigid, ring-shaped member 20 of the diaphragm is free to slide, while, on the inside, a mine firing pin 5a is arranged to slide up and down, said pin in its rest position being held away from a percussion cap 10a by two balls 22 seated in holes and resting on cylindrical projections 1'a, the shoulder of the firing pin 5a being supported by said balls, when the firing pin is forced downwards by a spring 8a.

When a constant pressure having the appropriate value is exerted on the plate 2a of the mine, the various parts of the mine take up the positions shown in FIGURE 8 i.e. the cap 2a is moved down, the flexible membrane 21 taking the position shown in FIGURE 8, but the air which is located inside a chamber 17a has been compressed and prevents the member 20 from moving down together with flexible membrane 21.

When this effect is achieved the reciprocal positions of the firing pin 5 and its locking mechanism, comprising the balls 22 remains unchanged. But, after a short period of time, due to the effect caused by the clearances existing between diaphragm member 20 and the cylindrical projection 1'a of the mine body, the pressure in the two chambers 17a and 18a will balance out, whereupon the diaphragm member 20 will move down, taking up the position shown in FIGURE 9 and the balls 22 will be able to run towards the outside in the seat provided in the member 20, thereby freeing the firing pin 5a which will trip, causing the percussion cap 10a to explode.

The embodiment shown in FIGURES 10, 11 and 12 differs in some of its parts from those shown in the previously described drawings.

This embodiment also comprises a mine body 1b with a pressure cap 2b on top, the chamber inside the mine being divided into two parts by means of a diaphragm or partition consisting of a rigid part 6b and a flexible diaphragm or membrane 21b; the firing pin has a shape slightly different from the previous embodiments and has a tooth 5b' capable of engaging in a corresponding recess provided in the part 6b. A spring 23 is provided underneath the firing pin 5b, said spring exerting both pressure and a torsional force against the firing pin. When a pressure which is not instantaneous or transient and which is of sufficient magnitude is applied to cap 2b of the mine shown in FIGURES 10, 11 and 12 for reasons already previously stated, the various parts will move their positions from those shown in FIGURE 10 to those in FIGURE 11 and, more specifically, the firing pin 5b, through its tooth 5' will remain locked to the part 6b while the air pressure in the two chambers 18b and 17b will take on appreciably different magnitudes.

4

After a few moments, due to the effect of the non-hermetic separation between the two chambers, a balance in the pressure between the two chambers will be restored and, consequently diaphragm 21b will take up the position shown in FIGURE 12, drawing along with it the rigid portion 6b, whereupon the firing pin 5b, acted upon by spring 23 will remain free to turn and, upon turning will strike against the percussion cap of the mine, causing it to explode.

The mine shown in FIGURES 13, 14 and 15, comprises a somewhat different structure than the embodiments previously described herein.

This embodiment comprises a mine body 1c, enclosed by a pressure cap 2c, the chamber inside the mine being subdivided by a diaphragm 24, said diaphragm having at its centre a cylindrical portion 24' inside of which is engaged a cylinder, freely slidable therein with a certain clearance. This cylinder comprises a lower saw-toothed member 5'c, having at its side a firing pin 5c and at its centre a shank or stem 5d which acts against the descent of the mine cap 2c. A locking mechanism 25, having the form of a cylinder with its surface toothed in such a way as to fit perfectly with the lower saw-toothed member 5'c is also located on said stem 5d.

When in the rest position FIGURE 13, a spring 23c loaded both torsionally and axially maintains the firing pin the raised position and exerts a force in such a way as to cause the firing pin to rotate, which rotation is prevented by the teeth of the lock mechanism 25. When, as in the preceding embodiments a pressure such as would cause the mine to become operative is applied to the mine cap 2c, said cap 2c moves downwardly, carrying along with it the firing pin 5c and compressing the spring 23c. The locking mechanism 25 follows along perfectly with the action of the firing pin 5c during this downwards motion due to the increased pressure produced by the air enclosed in the chamber 17c. Subsequently, if the pressure on the mine cap 2c persists, due to the effect of the play or clearance between cylindrical part 24' of the diaphragm and the moving cylindrical unit 5c and 25, the pressure inside the chambers 17c and 18c will balance out and the oblique shape of the teeth of the parts 25 and 5'c will, together with the action of spring 23c cause the lock mechanism 25 to move away from the firing pin which will thus remain free to rotate and cause the mine to explode.

In FIGURES 16, 17 and 18 are shown the basic parts of a gripping device in three different positions, i.e. the rest position, the position taken by these parts during the first moment following application of pressure and, lastly, the tripping position which occurs automatically after a few moments of continuous pressure against the actuating part. These figures, however, do not show the other parts, in particular the housing and the dividing diaphragm of partition, but the application of such parts as shown and described in the preceding figures will be apparent from the previously described embodiments.

The tripping mechanism which, in the case of its application to a mine will carry the firing pin, comprises in this case a part consisting of a flexible trip spring 15d preferably consisting of suitable plastic material and which rotates about a fixed point 26 to which it is pinned or hinged, while the other end carries an inclined tooth 27 which, in the rest position rests above a corresponding fixed inclined surface 28' offered by a rigid, immobile part 28. Combined with said stripping device 15d there is also the locking device for same 6d which also in this case has the shape of a plunger, the two faces of which on the upper and lower sides are exposed to the pressures existing in the two chambers into which the housing for the device has been divided by means of the usual partition or diaphragm (not shown in these figures). Said locking device 6d in the unlocked position is subjected to pressure by a spring 29 of suitable resilience. Said parts, as already mentioned, have in their rest position, the reciprocal positions shown in FIGURE 16. When, for example by means of suitable extensions, the pressure plate or control device is

5

subjected to a persistent pressure P, this pressure is transmitted to the flexible trip spring 15d which becomes slightly curved as shown in FIGURE 17. Locking plunger 6d, however, due to the fact that a greater pressure is being exerted on its upper face than on its lower face, descends together with spring 15d, due to which the relative position between these two parts will not change for all practical purposes and springs 15d will be still prevented from tripping.

After a few moments the equilibrium between the two pressures which act on the two faces of plunger 6d will be reached and then the plunger 6d, under the pressure exerted by spring 29 will return to its upwards position with respect to the spring 15d leaving the latter free to slide with its tooth 27 along the inclined surface 28, and as soon as the end of this tooth 27 has passed beyond the end of inclined plane 28, the spring 15d will trip downwards, bringing about the desired action, which in the case of a mine will be the usual action of the firing pin carried by the flexible trip spring 15d against the percussion cap of the mine.

The advantages offered by the delayed-action tripping system described hereinabove in various forms of its embodiment are both important and widely varied and, among the most important advantages are the following: simplicity of construction; low cost; absence of metal springs under constant load which, in time are subject to set or lose their tension; greater resistance to shock caused by pressure waves originating in blasts from explosions, because the cap does not rigidly resist the thrust but, instead, recedes to the end of its stroke where it is fully supported by a sturdy base; easy calibration and substantially complete insensitivity to temperature changes; anti-magnetic characteristics of the mine for which it is used because the metal parts comprising it, are reduced to a minimum; safe to use, impermeable; indefinite life as all working parts are of thermosetting or thermoplastic material.

What I claim is:

1. In a delayed action tripping device particularly adapted for the ignition of explosive substances for controlling electrical units, etc., and of the type that is insensitive to sudden pressures but adapted to trip when subjected to prolonged pressures, said device comprising

- a body member providing a casing,
- a firing arm rotatably mounted in said casing for pivotal movement and for axial movement with respect to the pivotal axis,

6

means adapted to rotate said firing arm to fire said device,

a pressure plate extending over a side of said body member which is substantially perpendicular to the pivotal axis of said firing arm,

diaphragm means extending between said casing and said pressure plate,

flexible means connecting the pressure plate to said body member to provide an imperfect pneumatic chamber between said pressure plate and said diaphragm,

means on said firing arm extending through said diaphragm means and adapted to contact said pressure plate to determine the axial position of said firing arm,

safety means adapted to contact said firing arm and prevent rotation thereof when said firing arm is not depressed by said pressure plate,

said safety means being mounted for axial movement in the same direction as said firing arm to prevent pivotal movement of said firing arm when in contact therewith,

means urging said safety means away from said firing arm when both are in depressed position,

said safety means comprising a head portion acted on by said pneumatic chamber to temporarily depress the same together with the firing arm when the pressure plate is depressed whereby said pressure plate must be held in depressed position for a predetermined length of time for the device to fire.

2. The device as claimed in claim 1 in which said diaphragm means is relatively rigid and said safety means is mounted for axial movement with respect to said diaphragm.

3. The device as claimed in claim 2 wherein said safety means is mounted coaxially with respect to the firing arm.

4. The device as claimed in claim 2 wherein said safety means is mounted in spaced relation to the axis of said firing arm.

References Cited in the file of this patent

UNITED STATES PATENTS

45	2,555,318 2,678,604	Christensen ----- June 5, 1951 Walker ----- May 18, 1954
----	------------------------	---