

Land mine with safety device against accidental explosion

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The present invention relates to a mine of the type comprising a casing containing an explosive charge, an electrically controlled pyrotechnic firing device, a capsule detonator aligned with the firing device and
5 activatable thereby, a timing mechanism for operating electrical switch means associated with the firing device, and a priming device controllable from the exterior to effect the activation of the timing mechanism.

The object of the present invention is to provide a mine
10 of the type specified above which has a safety device which is practical, simple and functional, and arranged to prevent undesirable detonation of the explosive charge in the event of accidental operation of the pyrotechnic firing device.

15 In order to achieve this object, the present invention provides a land mine of the type defined at the beginning the main characteristic of which lies in the fact that the priming device comprises:

a first rotatable toothed member carried by a shaft which
20 is angularly displaceable by means of an external control from a rest position to a primed position corresponding to the energisation of the timing mechanism, the shaft having cam means for operating the said switch means and a second toothed member meshing with the first toothed
25 member and connected to the said timing mechanism, the second toothed member defining a screen the path of displacement of which is interposed between the firing device and the detonator, the screen being shaped so as to allow interaction between the firing device and the
30 detonator, at the end of the timing period of the timing mechanism, in a single predetermined position corresponding to the condition of activation of the said switch means by the said first toothed member.

By virtue of this characteristic any undesired triggering of the firing device due, for example, to accidental operation of the switch means, would not result in any danger due to the protection of the detonator by the
5 said screen of the second toothed member.

According to the invention the screen of the second toothed member has a through hole with its axis parallel to the firing device and to the detonator and arranged to align itself therewith in the said predetermined
10 position.

Preferably an interposed transmission member is inserted in the hole in the second toothed member and is displaceable by the firing device to the detonator along the axis of the hole.

15 According to a preferred embodiment of the invention, the interposed transmission member is formed by a ball held in the hole by means of deformable or breakable stop formations.

According to a further advantageous characteristic of the
20 invention the condition of activation of the said switch means corresponds to an angular position of the first toothed member which is displaced from the said rest position on the opposite side to the said primed position, and stop means are provided for preventing the
25 angular displacement of the first toothed member from the rest position to the activation position of the switch means. The stop means are disengageable on activation of the timing mechanism.

Further characteristics and advantages of the invention

will become evident in the course of the detailed description which follows, with reference to the appended drawings, provided purely by way of non-limiting example, in which:

- 5 Figure 1 is an exploded partially cut-away view of a land mine according to the invention,

Figure 2 is a schematic plan view from above of part of the mine illustrated in an inoperative rest condition,

- 10 Figure 3 is a sectional view of the mine taken on line III-III of Figure 2,

Figure 4 is a view similar to Figure 3 corresponding to the primed condition of the mine,

- 15 Figure 5 is a perspective view illustrating the external control member of the mine, and

Figure 6 is a perspective view, on an enlarged scale, illustrating a detail of Figures 2 and 4.

- Referring initially to Figure 1, a land mine usable, for example as an anti-tank device, is generally
20 indicated 10.

The mine 10 comprises a substantially cylindrical casing 12 having a circular baseplate 14 and a lid 16.

- To the baseplate 14 is fixed, by means of screws
25 18, a support platform 20 carrying an activation or priming device generally indicated 22 the operation of which is to trigger the explosion of an explosive charge,

not visible in the drawings, contained within the casing 12.

The activation device 22 comprises essentially a pyrotechnic firing device 24 which can be activated
5 electrically through an electrical switch generally indicated 26, a timing mechanism 28 of conventional type and a pair of toothed sectors 48, 78 cooperating with the timing mechanism 28 to control the activation of the electrical switch 26.

10 The pyrotechnic firing device 24 is of conventional type and comprises a capsule 27 having an internal chamber, not shown, containing an explosive material the explosion of which causes a pin 30 constituting the firing pin proper to leave the capsule. The capsule
15 27 is inserted in a hole 32 formed coaxially within the casing 12 in a hollow raised portion 34 of the platform 20 which has internal screw threading in which is engaged corresponding external threading of the capsule 27. The firing pin 30 of the firing device
20 24 is arranged to cooperate with the inner end of a capsule detonator generally indicated 36, the outer end of which carries a screw threaded head 38 arranged to engage a corresponding central screw threaded hole 40 in the lid 16. The detonator 36
25 extends coaxially within the cavity of the casing 12 and is thus aligned with the firing device 24.

The inner end of the detonator 36 is slightly spaced from the firing device 24 for reasons which will be clarified below.

30 In the hollow portion 34 of the support platform 20 there is formed a second axial hole 42 adjacent the hole 32 and extending

through the baseplate 14. Within this hole 42 there is rotatably mounted a shaft 44 which is locked against axial movement by means of a clip 46 and carries at its upper end the toothed sector 48 of moulded plastics material. As is clearly seen in Figure 2, the toothed sector 48 has, in its zone without toothing, an arcuate concentric projection 50 which extends angularly between a frontal stop surface 52 and a peripheral recessed portion 54.

Reference 56 indicates a cylindrical stop pin mounted for axial sliding movement in a third axial hole 58 in the raised portion 34 and having at its lower end a ferrule 60 projecting into a recess 62 formed on the outer face of the baseplate 14. In the recess 62 there is rotatably mounted a control member 64 torsionally coupled to the lower end of the shaft 44, indicated 44a, so as to be disengageable, and provided with a manually operable control lever 66 arranged to be inserted in a suitable seat 68 also formed on the outer face of the baseplate 14. The rotatable control member 64, the function of which will be clarified in the description below, cooperates with the ferrule 60 and maintains the stop pin 56 in the operative position illustrated in Figures 2 and 3 against the action of a helical biasing spring 70. Disengagement of the control member 64 from the end 44a of the shaft 44 and its removal from the recess 62 allows the pin 56 to move into the retracted rest position illustrated in Figures 1 and 4 under the action of the spring 70.

As is clearly visible in Figure 3, the stop pin 56, close to its upper end, has a lateral notch 72 which is slidably engaged by the projection 50 of the toothed sector 48 when the pin 56 is in the operative position.

It should also be noted that the shaft 44 has a lateral recess 74 bounded by a surface comprising a cam surface for cooperating with a push rod 76 which controls the opening and closing of the electrical switch 26. When the toothed sector 48 is
5 in the position illustrated in Figures 2 and 3, which will from now on be called the "rest position" for brevity, the push rod 76 engages the recess 74 and the switch 26 is in the open condition.

The second toothed sector indicated 78 is keyed onto a shaft
10 80 connected to the timing mechanism 28. The toothed sector 78 meshes with the toothed sector 48 and is arranged in such a position that the path of movement of its peripheral part is interposed between the firing device 24 and the inner end of the detonator 36.

15 The toothed sector 78, which is preferably of metal, has at one end a through hole 82, illustrated in detail in Figure 6, in which is housed a metal ball 84. This ball 84 is held in the hole 82 by virtue of the presence of sheerable projections 86 and is arranged to be located,
20 as a result of the angular displacement of the sector 78 in the manner described below, in alignment with the firing device 24 and the detonator 36.

The operation of the activation device 22 will now be described, starting from the rest position illustrated
25 in Figures 2 and 3. In this position the control member 64 is inserted in the recess 62 and the stop pin 56 is pressed axially inwardly of the casing 12. The notch 72 of the pin 56 engages the arcuate projection 50 of the toothed sector 48 and the pin 56 bears frontally
30 against the stop surface 52 of this toothed sector 48,

preventing this from rotating in a clockwise sense as seen in Figure 2. The toothed sector 78 meshes with the toothed sector 48 which is in the angular rest position illustrated in Figure 3, the ball 84 being
5 angularly offset relative to the axis of the casing 12, that is relative to the firing device 24 and the detonator 36. In this condition, any undesired or accidental activation of the firing device 24 would not be able to cause activation of the detonator 36 by
10 virtue of the screening of the latter by the toothed sector 78. The presence of the stop pin 56 also prevents accidental angular displacement of the sector 78 in an anticlockwise sense as seen in Figure 2, which could bring the ball 82 into alignment with the firing
15 device 24 and the detonator 36.

In order to prime the mine 10 it is necessary to rotate and remove the control member 64 by operating the lever 66 manually so as to rotate the toothed sector 48 in an anticlockwise sense as seen in Figure 2. As a result of this rotation the recessed portion
20 54 of the toothed sector 48 is disposed in correspondence with the stop pin 56 whereby, upon removal of the control member 64 from the recess 62 at the end of the rotation, the stop pin 56 is displaced towards the baseplate 14 so as to free the toothed sector 48
25 completely. Furthermore the rotation imparted to the latter allows the timing mechanism 28 to be wound up or energised as a result of the rotation of the toothed sector 78 and its shaft 80 in a clockwise sense with respect to Figure 2. At this point the mine is
30 primed and the timing mechanism 28 slowly brings the toothed sector 78 and hence the toothed sector 48

towards the initial rest position as illustrated in Figure 1.

- Since the stop pin 56 is no longer able to obstruct the rotation of the toothed sector 48 in a clockwise sense this latter reaches the initial position illustrated in Figures 2 and 3, and continues to rotate, allowing the ball 82 to move into alignment with the firing device 24 and the detonator 36, in a manner illustrated in Figure 4. In this position the switch 26 is closed and the firing device 24 simultaneously triggered, causing the firing pin 30 to move towards the detonator 36. This pin 30 is able to interact with the inner end of the detonator 36 through the ball 84, which is displaced from the hole 30 by virtue of the shearing of the stop formations 86 as a result of the force exerted thereon by the firing pin 30. The impingement of the ball 84 on the inner end of the detonator 36 causes the detonation of the latter and the consequent explosion of the mine.
- In the description above it is supposed for simplicity that the triggering of the firing device 24 is initiated directly as a result of the closure of the switch 25. In effect this operation may be achieved in various ways through a "firing" circuit, not illustrated in the drawings, which can be activated by the switch 26 and including, for example, a target presence sensor, for example of the contact, pressure or electromagnetic field variation type, inserted in the lid 16.



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CLAIMS

1. A land mine of the type comprising a casing containing an explosive charge, an electrically controlled pyrotechnic firing device, a capsule detonator aligned with the firing device and activatable thereby, a timing mechanism for operating electrical switch means associated with the firing device, and an activation or priming device controllable from the exterior to effect the activation of the timing mechanism, characterised in that the activation or priming device comprises:

- a first rotatable toothed member carried by a shaft which is angularly displaceable by means of an external control from a rest position to a primed position corresponding to the energisation of the timing mechanism, the shaft having cam means for operating the said switch means and
- a second toothed member meshing with the first toothed member and connected to the said timing mechanism, the second toothed member defining a screen the path of displacement of which is interposed between the firing device and the detonator, the screen being shaped so as to allow interaction between the firing device and the detonator, at the end of the timing period of the timing mechanism, in a single predetermined position corresponding to the condition of activation of the said switch means by the said first toothed member.

2. Mine according to Claim 1, in which the said screen of the second toothed member has a through hole with its axis parallel to the firing device and the detonator and arranged to be aligned therewith in the said predetermined position of the second toothed member.

3. Mine according to Claim 2, in which within the said hole there is inserted an interposed transmission member movable by the firing device along the axis of the hole to the detonator.



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4. Mine according to Claim 3, in which the interposed transmission member is constituted by a ball retained in the hole by means of deformable or breakable stop formations.

5. Mine according to Claim 1, in which the condition of activation of the said switch means corresponds to an angular position of the first toothed member which is displaced from the said rest position on the opposite side to the said primed position, and in which stop means are provided for preventing the angular displacement of the first toothed member from the said rest position to the activation position of the switch means, the stop means being disengageable on activation of the timing mechanism.

6. Mine according to Claim 5, in which the stop means comprise a stop pin movable between an operative position and a rest position, and a stop surface carried by the first toothed member and arranged to cooperate with the stop pin when this is in the operative position, and in which the said external control member is releasably connected to the shaft of the first toothed member in order to effect the energisation of the timing mechanism, and maintains the movable stop member in the said operative position against the action of resilient biasing means;
the removal of the control member at the end of the energisation of the said timing mechanism causing the return of the stop pin to the rest position under the action of the said resilient biasing.

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7. Mine according to Claim 6, in which the first toothed member comprising a toothed sector having, in the zone without tothing, a concentric arcuate projection extending angularly between the said stop surface and a peripheral recessed portion of the toothed sector and in that the said movable stop pin has a lateral notch arranged to engage slidably the arcuate projection and to disengage therefrom as soon as the peripheral recessed portion is located in angular correspondence with the stop pin.

8. Mine according to one or more of the preceding claims, in which the second toothed member is constituted by a toothed sector.

9. Mine according to one or more of the preceding claims, in which the said switch means include an electrical switch which controls the electrical supply to the pyrotechnic firing device directly.

10. Mine according to one or more of Claims 1 to 8, in which the said switch means control the activation of the pyrotechnic firing device indirectly, for example through a firing circuit including target sensor means.

11. A land mine substantially as herein described with reference to and as shown in the appended drawings.
