March 5, 1940. G. DE BENEDETTI 2,192,542

ELECTRIC DETONATOR

Filed June 3. 1937

Fig. 1

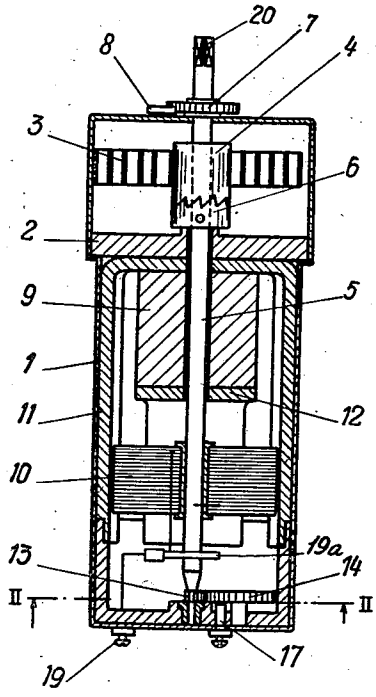


Fig. 3

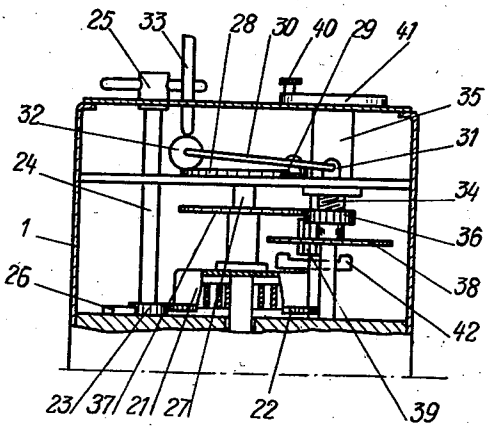


Fig. 4

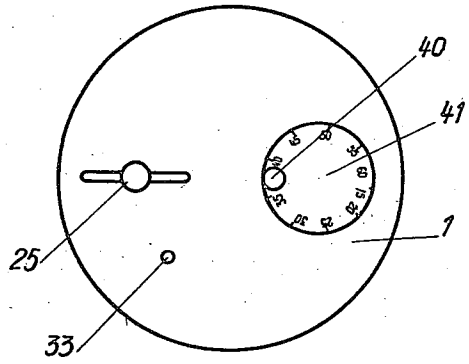
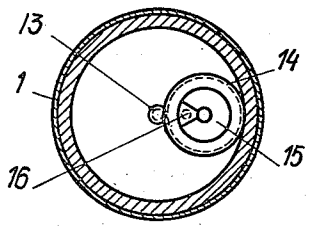


Fig. 2



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UNITED STATES PATENT OFFICE

2,192,542

ELECTRIC DETONATOR

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4 Claims. (Cl. 102—37)

This invention relates to an electric detonator for mines or low speed projectiles provided in the body of the mine or projectile and in which the igniting spark is supplied by an electric current generator driven by a spring motor provided with means for winding it. This spring mechanism is normally kept from unwinding, but a detent device is released upon mechanical shock to drive the generator.

The various objects and features of the invention will be apparent to those skilled in the art upon a consideration of the accompanying drawing and the following description wherein several exemplary embodiments of the invention are disclosed.

In the drawing:

Figure 1 is a longitudinal axial section of the detonator part that is essential to the inventiin.

Figure 2 is a sectional view of the inside of the bottom part taken on line II—II of Fig. 1.

Figure 3 is a sectional view of a delay device and

Figure 4 is a top view thereof.

According to Figures 1 and 2, the spring motor and electric current generator are arranged in the body 1, which is subdivided by the plate 2 into two superposed chambers. The top chamber contains the spring 3, one of the ends whereof is attached to the body 1, while the other end is attached to a bush 4 loosely mounted on the shaft 5. The lower end of the bush 4 is formed with saw teeth meshing with associated teeth on a ring 6 secured on the shaft 5.

The shaft 5 passes through the lower portion of the body 1 and the permanent magnet 9 in the shape of a cylinder. Underneath the permanent magnet 9 the shaft 5 carries the coil 10 forming the rotor of the current generator, while the stator is formed by the U-shaped pole pieces 11, 12 of the permanent magnet 9 merging with the two ends of the latter.

A pinion 13 is fixed to the lower end of the shaft 5 and meshes with the teeth 14 of a metal disc 15 having on one side a sector 16 of insulating material. A contact 17 formed by a terminal for the feed current wipes on this side of the disc. An end of the coil 10 is electrically connected to the disc 15 through the shaft 5 and the pinion 13, and its other end is electrically connected to the second feed terminal 19 by means of a slip ring 19a. In its inoperative position the wiping contact 17 engages the insulating sector 16 and the igniting circuit is open. When the spring motor is released, rotation of the disc 15 brings the conducting portion of the disc on the wiping contact 17 and the igniting circuit is closed. The transmission ratio between the shaft 5 and disc 15 is chosen in such manner that the igniting circuit is closed during unwinding of the spring 3.

The arrangement of this circuit breaking device is more particularly advantageous in submarine mines and the like having a plurality of detonators, the igniting circuits of which act upon one charge. It has been found that on impact of one of these detonators, a portion of the current generated is lost by induction in the lines of the other detonators, if these circuits are closed. This reduces the current available for forming the igniting spark and makes ignition uncertain, unless powerful current generators are employed, which would objectionably increase the size of the unit and cost of the detonator. The use of the breaking device 16, 17 obviates this drawback, as there are no closed circuits of the inoperative detonators.

The spring 3 is wound by means of a key fitted on the end 20 of the shaft 5.

The ratchet wheel 7 is mounted outside the body 1 at the top end of the shaft 5 and a ratchet pawl 8 cooperates with said wheel to keep the spring from unwinding. The pawl 8 may be released by a sudden mechanical shock and the spring 3 unwinds to rotate the rotor of the current generator.

The bushing 4 is coupled to the ring 6 by means of saw teeth so that the rotor may revolve after the spring 3 is fully unwound thus avoiding rupture of the spring as a result of the inertia of the revolving rotor.

In the construction shown in Figure 1, the arrangement of the rotor, stator and spring motor in alignment is more particularly advantageous, for it permits of reducing the detonator in width.

When it is desired to produce ignition only a certain time after impact of the projectile, as is frequent in impact detonators, the detonator is provided with a delay device, for instance of the type shown in Figures 3 and 4. In this case the top portion of the body 1 carries a box 21 for the spring 3 having a toothed rim 22 which meshes with the pinion 23 of a winding-up device mounted on the shaft 24 projecting outwardly and carrying at its outer end the handle 25. The pawl 26 prevents backward rotation of the pinion 23 and box 21 to which the outer end of the spring is attached.

The other spring end is attached to the shaft 27 carrying the ratchet wheel 28 engaging the pawl 29 carried by an arm 30 rockably mounted at 31 and carrying at its free end an inertia mass 32. The latter is held in its inoperative position by the pin 33.

After removal of the pin 33, the inertia of the mass 32 rocks the arm 30, upon mechanical shock and the pawl 29 is released and the spring motor is allowed to unwind.

The mechanism cannot attain at once the speed required for igniting on account of the provision of the delay device. The delay device shown by way of example consists chiefly of a screw 34 on which a bush 35 fixed to the cover of the body 1 is screwed.

The screw 34 carries a pinion 36 having teeth of a substantial length. The pinion 36 meshes with a toothed wheel 37 mounted on the shaft 27 of the spring motor. A toothed wheel 38 is fixed to the screw 34 and meshes with a pinion 39 controlling a damping wing 42.

As the spring motor begins to unwind, the screw 34 is set in rotation by the gears 37 and 36 and is screwed up into the bush 35. As a result of this rotation, the screw 34 is raised and carries with it the pinion 36. This rotational movement is braked by the damping wing as long as the pinion 36 is in engagement with the toothed wheel 37. When the pinion 36 no longer meshes with the toothed wheel 37, the spring motor is released and promptly reaches its operating speed. The duration of damping and, consequently, the ignition delay depend upon the starting position of the pinion 36 with respect to the level of the toothed wheel 37. It is thus possible to adjust the delay by varying the initial position of the pinion 36. For this purpose a milled button 40 is provided on the dial 41, which is fixed to the upper end of the screw 34.

I wish to be understood that I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

What I claim is:

1. A device for use in detonating an explosive charge comprising, an electric generator for producing a spark, a spiral spring connected to said generator for driving the same, hand-operated means for winding the driving spring, detent means to keep said spring from unwinding and automatically operable means for releasing said detent means and a delay device for delaying the formation of the spark during rotation of the generator, this delay device comprising a braking member, a gear transmission between said braking member and the current generator, and a nut and screw mechanism, one of the members of which is fixed and the other is coupled for rotation with one of the gears of said transmission in such manner as to bring it out of engagement after a certain time of rotation.

2. A device for use in detonating an explosive charge comprising, an electric generator for producing a spark, a spiral spring connected to said generator for driving the same, hand-operated means for winding the driving spring, detent means to keep said spring from unwinding and automatically operable means for releasing said detent means and a delay device for delaying the formation of the spark during rotation of the generator, this delay device comprising a braking member, a gear transmission between said braking member and the current generator, and a nut and screw mechanism, one of the members of which is fixed and the other is coupled for rotation with one of the gears of said transmission in such manner as to bring it out of engagement after a certain time of rotation and hand-operated means for adjusting the initial position of the screw and nut mechanism and timing the delay action of said device.

3. A device for use in detonating an explosive charge comprising, an electric generator for producing a spark consisting of a stator constituted by a permanent magnet of cylindrical form, U-shaped pole pieces attached one at each end of said magnet and having their arms arranged at 90° to each other and extending from one end of said magnet, a rotor arranged between said projecting arms and a shaft for said rotor passing through an axial bore of said magnet, a spiral spring coaxially arranged on said magnet for driving said shaft, hand-operated means for winding said driving spring, detent means to keep said spring from unwinding and means operable upon mechanical shock for releasing said detent means.

4. A device for use in detonating an explosive charge comprising, a firing circuit, an electric generator for producing the spark current in said circuit, comprising a stator constituted by a permanent magnet of cylindrical form, U-shaped pole pieces attached at each end of said magnet and having their arms arranged at 90° to each other and extending from the ends of said magnet, a rotor arranged between said projecting arms and a shaft for said rotor passing through an axial bore of said magnet, a spiral spring coaxially arranged on said magnet for driving said shaft, hand-operated means for winding said driving spring, detent means to keep said spring from unwinding, automatically operable means for releasing said detent means and a contact mechanism in said firing circuit and controlled by said shaft so that when the device is in its inoperative position it maintains said circuit open while and when the spring unwinds to operate the generator, said contact mechanism closes said circuit and maintains it closed as long as the driving spring is unwinding.

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