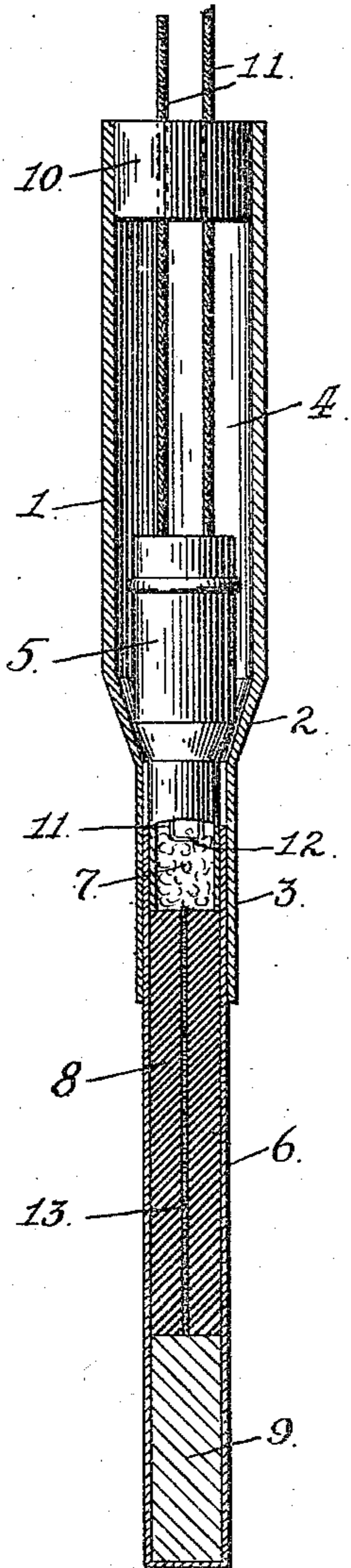


R. L. OLIVER.  
 DELAYED ACTION ELECTRIC EXPLODER.  
 APPLICATION FILED JUNE 22, 1909.

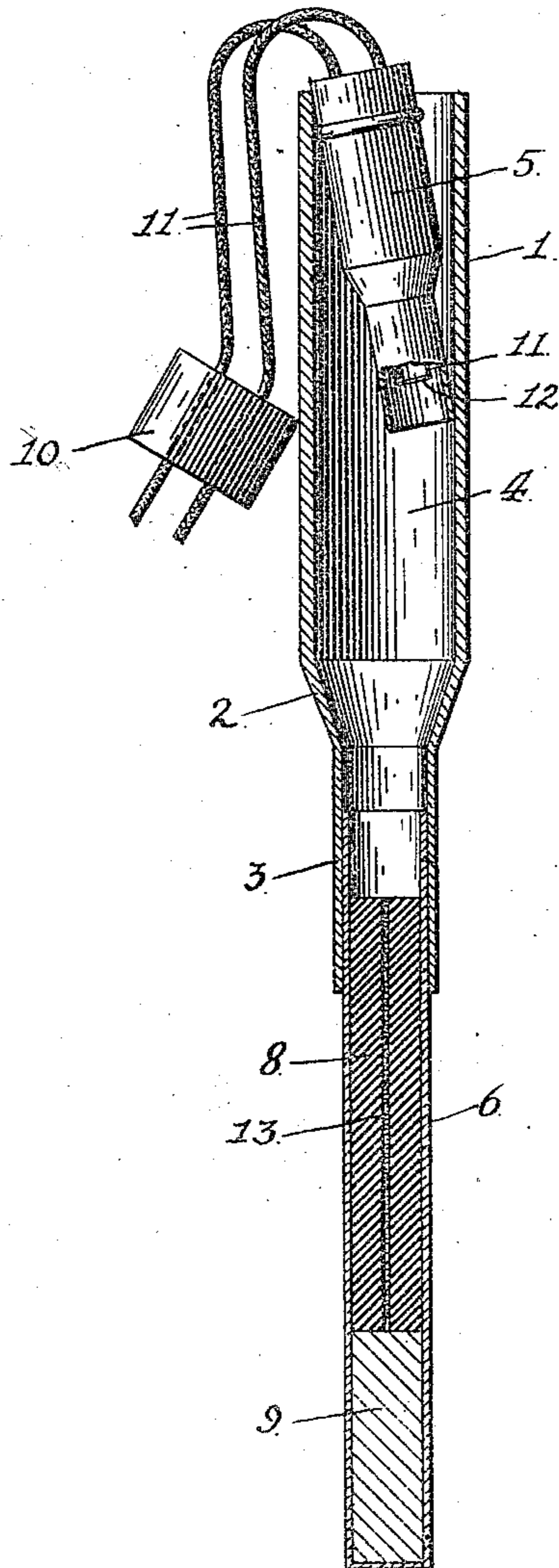
954,689.

Patented Apr. 12, 1910.

*Fig. 1.*



*Fig. 2.*



WITNESSES.

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# UNITED STATES PATENT OFFICE.

ROLAND L. OLIVER, OF OAKLAND, CALIFORNIA, ASSIGNOR TO CALIFORNIA CAP COMPANY, OF SAN FRANCISCO, CALIFORNIA, A CORPORATION OF CALIFORNIA.

## DELAYED-ACTION ELECTRIC EXPLODER.

954,689.

Specification of Letters Patent.

Patented Apr. 12, 1910.

Application filed June 22, 1909. Serial No. 503,718.

*To all whom it may concern:*

Be it known that I, ROLAND L. OLIVER, a citizen of the United States, residing at Oakland, in the county of Alameda and State of California, have invented certain new and useful Improvements in Delayed-Action Electric Exploders, of which the following is a specification.

My invention relates to that class of electric-exploders for blasting charges, in which a delay-action fuse is interposed between the primer and the detonator.

The object of this type of exploders is to enable all the primers of the exploders to be simultaneously fired by one electrical impulse, and yet have different predetermined groups of exploders go off successively according to the prearranged times of their delay-action fuses. This has many advantageous results which are now well recognized and need no discussion here.

Briefly stated the objects of my invention are, to insure the uniform combustion of the delay-action fuse; to prevent undue compression of the gaseous products of combustion which might result in premature explosion; to provide against any spark reaching the detonator except through the combustion of the delay-action fuse; to provide against any disturbance of the position of the later exploders in the blasting charges, due to the possible disarrangement of the electric-wires by debris from blasts immediately preceding; and other objects which will hereinafter appear.

My invention consists, therefore, in certain novel constructions and arrangements of the exploder which I shall now fully describe by reference to the accompanying drawings in which—

Figure 1 is a longitudinal section, partly in elevation, of my delayed-action electric-exploder, showing it before its primer is set off by the igniter. Fig. 2 is a similar section showing the effect on the igniter of the combustion of the primer and prior to the main explosion of the detonator due to the combustion of the delay-action fuse.

1 is a shell which forms part of the inclosing casing of the device. This shell is tapered at 2 to a reduced end 3, a shape which serves the three-fold purpose, first, of providing, in the main body of the shell, a

relatively capacious air-chamber, designated by 4; second, of providing, by the tapering portion, a guide for the entrance of and a seat for the igniter-plug 5; and, third, by its reduced end, serving to receive and hold the tube 6, which forms the other part of the inclosing casing and which contains the primer 7, the delay-action fuse 8, and the detonating composition 9, in the order named.

The inner end of the igniter-plug 5, conforms in general shape to that portion of the shell which surrounds it, but is not seated very tightly, so that it may be readily dislodged as I shall presently point out.

10 is a closure for the shell 1, which may be a cap, or it may be a plug, as here shown, said closure, of whatever form, being not too tightly fitted to the shell, so that it, too, may be readily dislodged.

11 are the leading wires from any suitable source of electric impulse. These wires pass in through the plug 10, and through the igniter-plug 5, from the inner end of which they project and carry the usual bridge which is in contact with the primer 7. The primer 7 is of some material which will serve the double purpose of igniting the delay-action fuse 8 and of sufficiently rapid combustion to effect by its explosion the dislodgment of the igniter-plug 5 and the closure-plug 10. Fibrous gun-cotton is found to well serve for the primer.

The delay-action fuse 8 is one which has a body or covering of some sufficiently compressible water-proof material or composition, to make a tight fit in the tube 6 which contains it, said body having a relatively small core of powder, designated by 12, whereby there will be the minimum amount of gaseous products of combustion. What is known as "tape-fuse" well answers the purpose.

Before describing the operation of my exploder, with respect to its several improvements, it may be well to state that, as usual with devices of this general class, some exploders will have a delay-action fuse of one time; others will have fuses of another time; others of still another time, and so on. Those of one time will be set in blasting charges of one group of holes; those of another time in a second group of holes; and

so forth, according to accepted practice. All the exploders will be, as usual, connected by their wires with a single source of electric energy, so that a single impulse will simultaneously ignite the primers of all. But those with fuses of shortest time will explode first, and those with fuses of longest time will explode last.

Now returning to my improved exploder, its operation is as follows:—The electric circuit being closed, the bridge 12 of the igniter becomes heated and fires the primer 7. This instantly sets fire to the powder core 13 of the delay-action fuse 8, and also by its explosion, drives back the igniter-plug 5 from its seat in the shell and also drives out the closure 10 from the end of the shell. By this action the whole igniting device is so disconnected from the exploder that any pull on its wires will not affect the position of the exploder in the blasting charge. Now as this breaking of said connection takes place simultaneously in all the exploders of all the groups, it follows that the flying rocks and debris of the earlier blasts can have no effect, by interfering with the wires of the delayed exploders, of pulling them from their places. While this result is one much to be desired and is approached in some degree by the use of groups of differently timed exploders, the primers of which are set off by one electrical impulse, as compared with the practice of separately setting off ordinary exploders by successive impulses, it, obviously, is not fully reached, for, though all the primers of delay action exploders are set off simultaneously, the blasts themselves are still, necessarily, successive, and the early ones will, by their debris acting on the wires, disturb the positions of the later exploders and pull them out of their places. This is entirely obviated by my exploder, as I have described.

The relatively large air-chamber 4, which is afforded by the main body of the shell, insures the perfect and uniform combustion of the delay-action fuse so that there is no liability of its smoldering or going out. It also provides for the expansion of the gases of combustion, thus avoiding the danger of prematurely exploding the detonator. Usually in exploders, the shell is tightly filled with the igniter and other parts, so that the fire is liable to be smothered, or the confined gases will explode the detonator.

Resort is sometimes had to making vent holes in the shell walls, filled with meltable material. In my construction the air-chamber in the shell is ample for the purpose of preventing smothering and supporting combustion and permitting the gases to expand; and, particularly so, in view of the use of the "tape-fuse" with its small core which gives

the minimum amount of gaseous products. The employment of the "tape-fuse" with its compressible body or covering is of further advantage in affording a tight, close filling of the tube 6, so that no spark from the primer can reach the detonator except through the core of the fuse.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:—

1. In an electric-exploder of the delayed-action type, an inclosing casing; a primer, delay-action fuse, and detonator in said casing; electric-circuit wires with igniter, leading into said casing to the primer; and a breakable connection between the circuit wires of the igniter and the casing, the parts being constructed and arranged to permit the connection to yield to the explosion of the primer to disconnect the wires from the casing.

2. In an electric-exploder of the delayed-action type, electric-circuit wires leading to and having a separable connection with said exploder to initiate its action; and means dependent upon said initial action to simultaneously therewith disconnect said wires from the exploder.

3. In an electric-exploder of the delayed-action type, an inclosing casing; a delay-action fuse and a detonator in said casing; a primer therein of gun-cotton; electric-circuit wires with igniter, leading into said casing to the primer; and a detachable connection between the circuit wires of the igniter and the casing, adapted to yield to the explosion of the primer to disconnect the wires from the casing.

4. In an electric-exploder of the delayed-action type, an inclosing casing; a primer, delay-action fuse, and detonator in said casing; electric-circuit wires with igniter, leading into said casing to the primer; and a carrier for said wires removably fitted to the casing whereby it is adapted to yield to the explosion of the primer to disconnect itself and the wires from the casing.

5. In an electric-exploder of the delayed-action type, an inclosing casing; a delay-action fuse, and a detonator in said casing; a primer therein of gun-cotton; electric-circuit wires with igniter, leading into said casing to the primer; and a carrier for said wires loosely fitted to the casing whereby it is adapted to yield to the explosion of the primer to disconnect itself and the wires from the casing.

6. In an electric-exploder of the delayed-action type, an inclosing casing; a primer, delay-action fuse, and detonator in said casing; electric-circuit wires with igniter, leading into said casing to the primer; an igniter plug carrying the inner ends of the

wires and a closure plug carrying said wires into the casing, said plugs being detachably fitted to the casing in a manner to yield to the explosion of the primer to disconnect themselves and their wires from said casing.

7. In an electric-exploder of the delayed-action type, an inclosing casing having an enlarged end; a primer, delay-action fuse and detonator filling the reduced end of the casing; and an electric-igniting device in the enlarged end of the casing, said casing forming an enlarged air-chamber at said enlarged end.

8. In an electric-exploder of the delayed-action type, a tapered inclosing casing formed at one end with an enlarged air-chamber; a primer, delay-action fuse and detonator in its other end; and an electric igniter in the air chamber of the casing.

9. In an electric-exploder of the delayed-action type, an inclosing casing formed at one end with an air chamber, and its other end reduced; a primer, delay-action fuse, and detonator in the reduced end; electric circuit wires with igniter, leading into said air chamber to the primer; an igniter-plug in the inner end of the air-chamber carrying the wires and igniter, and a closure plug in its outer end leading said wires into the air chamber, said plugs being detachably fitted in said chamber and adapted to yield to the explosion of the primer to open the air chamber to the gases of combustion and disconnect the circuit wires from the casing.

10. In an electric-exploder of the delayed-action type, a casing; a detonator in one end; a tape-fuse in said end in advance of the detonator said fuse comprising a compressible covering tightly fitting the casing and a relatively small powder-core; a primer in the casing in advance of the tape fuse; and an electric igniter in the other end of the casing.

11. In an electric-exploder of the delayed-action type, an inclosing casing formed at one end with an air-chamber; a detonator in its other end; a tape-fuse in said other end in advance of the detonator, said fuse comprising a compressible covering tightly fit-

ting the casing and a relatively small powder-core; a primer in the casing in advance of the time-fuse; and an electric-igniter in the air chamber of the casing.

12. In an electric-exploder of the delayed-action type, an inclosing casing formed at one end with an air-chamber; a detonator in its other end; a tape-fuse in the said other end in advance of the detonator, said fuse comprising a compressible covering tightly fitting the casing and a relatively small powder-core; a primer in the casing in advance of the time-fuse; and an electric-igniter in the casing; electric-circuit wires leading to said igniter; and a connection between said wires and the casing adapted to yield to the explosion of the primer to disconnect the wires from the casing.

13. In an electro exploder of the delayed-action type, an inclosing casing having a seat therein for loosely receiving a removable plug, a primer and detonator below the plug, electric circuit wires with igniter connected to said removable plug and leading to the primer and means whereby the plug with the parts carried thereby will be released from said seat upon the explosion of the primer.

14. In an electro exploder of the delayed-action type, an inclosing casing comprising an enlarged end portion, a reduced end portion and a connecting portion constituting a guide and seat for a plug, a detonator in the reduced end of the casing, a tape fuse in said end in advance of the detonator, said fuse comprising a compressible covering tightly fitting the reduced end of the casing and a relatively small powder core; a primer in the casing in advance of the tape fuse and behind the said plug, the space in advance of the plug constituting an enlarged air chamber.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ROLAND L. OLIVER.

Witnesses:

WM. F. BOOTH,  
D. B. RICHARDS.