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ELECTROCHEMICALLY ACTUATED FIRING MECHANISM

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Fig. 1.

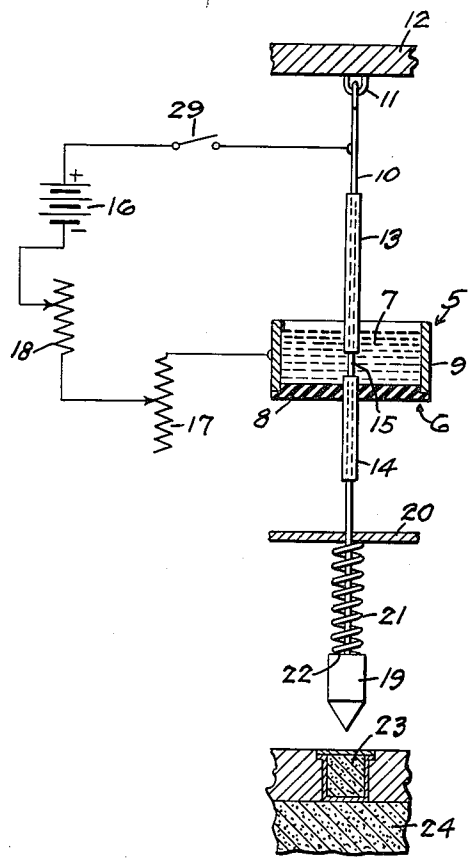


Fig. 2.

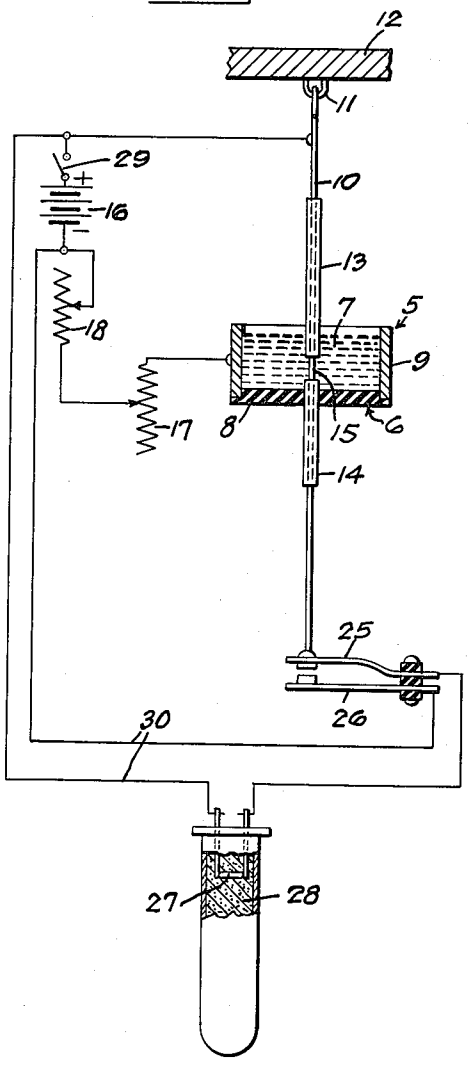
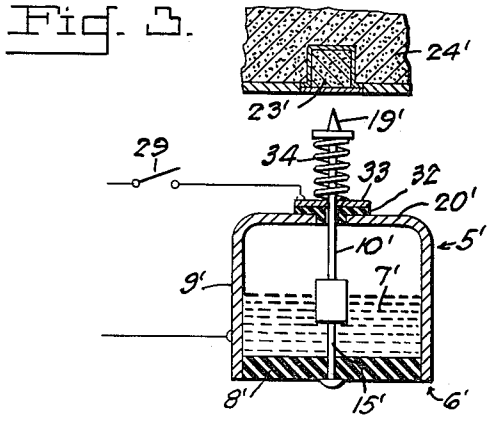


Fig. 3.



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ELECTROCHEMICALLY ACTUATED FIRING MECHANISM

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2 Claims. (Cl. 102—70.2)

This invention relates to a variable delay fuze wherein the rate of erosion or decomposition of the anode of an electrolytic cell is utilized and varied to provide the required predetermined time between arming and initiation of the fuze.

It is the principal object to provide a device of the nature aforesaid which is capable of actuation over a wide range of times, which is positive and reliable in operation and capable of a wide range of conditions of use.

Another object of the invention is to provide a device wherein the firing mechanism is restrained by the tensioned anode of an electrolytic cell and released after the anode has been eroded to the breaking point by electrolytic action in the cell.

A further object of the invention is to provide means to compensate for changes in electrolytic action otherwise caused by variation in temperature of the electrolyte.

Other objects and advantages will be apparent from the following detailed description and the accompanying drawings in which:

Figure 1 is a schematic view showing the invention in use to release a spring pressed firing pin.

Figure 2 is a similar view showing the invention in use to close a circuit to an electric detonating cap, and

Figure 3 is a sectional view of modified type of electrolytic cell and detonator means.

Referring now to the drawings 5 identifies an electrolytic cell. The cell is in the form of a vessel 6 containing an electrolytic solution 7 and is closed at its bottom by an acid resistant dielectric seal 8.

The side wall 9 or a portion thereof, is formed of suitable metal such as copper, to serve as the cathode of the cell. Centrally of the vessel 6 and extending through the seal 8 is an elongated rod 10 which is suspended at its upper end as at 11 from a support 12. The rod serves as the anode of the cell and is formed of a metal such as copper and is shielded by dielectric sleeves 13 and 14 longitudinally spaced thereon to expose a limited portion of its length 15 to the electrolyte 7.

Electrically connected in series with the cell 5 is a source of D. C. voltage 16 whose positive and negative terminals are connected to the anode 10 and the cathode 9, respectively. Electrically connected in series in the circuit are two variable resistors 17 and 18. With an electrolyte composition and proportions, such as the one identified infra, the resistor 17 can be set to cause decomposition of the anode to the breaking point in a predetermined time interval and under a predetermined tension. The resistor 18 will be calibrated in degrees of temperature and is set to the ambient temperature reading to compensate for the known difference in electrolytic decomposition effected by a specified electrolyte and current density at the temperatures for which the resistor is calibrated.

In Figure 1 the rod 10 which serves as the anode of the cell 5, is elongated beyond the cell and has a firing pin 19 secured to its end. An abutment 20 is secured near the firing pin and receives the end thrust of a helical spring

21 which surrounds the rod 10 between the abutment and a shoulder 22 on the firing pin 19. When the rod is weakened by the erosion of anode 10 to the breaking point under the tension of spring 21, the latter drives the firing pin 19 into a percussion cap 23 and detonates an explosive charge 24.

In Figure 2 the rod 10 is secured to a spring contact member 25 which is urged by its tension toward a second contact member 26 to thereby close a firing circuit when the rod 10 is broken. The circuit extends from the battery 16 to an electrically fired squib 27, which in turn detonates an explosive charge 28. A switch 29, Figures 1 and 2, normally holds the circuit in open safe position and is manually closed to start the time delay period.

In Figure 3 a somewhat different assembly of electrolytic cell 5' and firing means is illustrated. The vessel 6' contains an electrolytic solution 7' and is closed at its bottom by an acid resistant dielectric seal 8'. A cover 20' formed with the vessel or as a separate part, serves a purpose similar to the abutment 20 of Figure 1. The side wall 9' of the cell is formed of suitable metal, such as copper, to serve as the cathode of the cell. A rod 10' formed of a metal, such as copper, serves as the anode thereof and extends through the cell from the bottom 8' thereof where it is secured, a portion 15' of the rod being immersed in the electrolyte. The rod 10' extends through cover 20' to carry a firing pin 19'. Mounted upon the cover 20' and insulated therefrom by a washer 32 of dielectric material is a metal washer 33 which is in electrical contact with the rod 10 and included in a circuit, with the side wall 9' of the cell 5', similar to the circuit shown in Figure 1. The rod 10' extends with a sliding fit through apertures in the washers 32 and 33.

A helical spring 34 surrounds the rod and is confined between the metal washer 33 and the firing pin 19'. When the rod 10' is weakened to the breaking point by electrolytic erosion at the point 15' the tension of spring 34 causes breakage thereof and drives the firing pin 19' into a percussion cap 23' to detonate an explosive charge 24'.

In one form of the invention successfully operated an electrolyte made up the proportions of 150 grams per liter of $CuSO_45H_2O$ plus 50 grams per liter of H_2SO_4 of specific gravity 1.84 was used. Wires or rods 10 of copper of initial diameter of 0.0355 to .0370 inch were used. When a current of .006 amp. was used at about 80° F. a time delay of approximately 3 hours was obtained. Since, without temperature compensation, the time delay will decrease with increase in ambient temperatures, the resistor 18 will be graduated so as to result in decreased current with increase in ambient temperature. By various combinations of electrolyte, wire diameter current density and spring tension, the range of time delays possible with the invention may be widely varied to suit any desired or required conditions of use. In the example given, the final diameter of the wire 10, at breakage, was about 0.025".

The operation of the invention is as follows:

When it is desired to fire an explosive charge of a type shown in Figure 1 of the drawings, variable resistor 17 is set in accordance with a predetermined time delay. The variable resistor 18 is set to register with calibrations thereon (not shown) corresponding to ambient temperature. The fuze is armed by closure of switch 29. Current then flows from the portion 15 of the rod 10 through the electrolyte 7 to the side wall 9 to thereby effect anodic dissolution of the rod and finally weakening it to the breaking point under tension of springs 21, 25 or 34. The firing pin 19 on the end of rod 10 is then driven by its spring 21 into the percussion cap 23 to explode the charge 24, Figure 1.

The operation of the form of the invention shown in Figure 2 is identical excepting the addition of a parallel

ircuit, through contacts **25** and **26**, connecting the battery **6** with the electrically fired squib **27**. When the rod **10** ı Figure 2 breaks the spring contact member **25** moves ɔ close the circuit **30** through the fixed contact member **6** to the battery **16** and squib **27** to detonate the explosive charge **28**.

The operation of the form of the invention shown in 'igure 3 is similar to the operation of Figure 1. The elements of the cell **5'** and the firing means are rearranged ɔ illustrate another form of the invention but in this form, he spring **34** is not required to overcome any frictional esistance between the rod and bottom of the cell.

While we have disclosed three forms of the invention ıresently preferred by us, various changes and modifications will occur to those skilled in the art after a study ıf the present disclosure. Hence the disclosure is to be aken in an illustrative rather than a limiting sense; and t is our desire and intention to reserve all modifications alling within the scope of the subjoined claims.

Having now fully disclosed the invention what we laim and desire to secure by Letters Patent is:

1. A time delay mechanism comprising a vessel having ı metallic wall, an electrolyte therein, a metallic rod subect to decomposition in said electrolyte, a source of elecric energy in a circuit connecting the metallic wall and ·od to effect electrolytic decomposition of the metallic ·od within the vessel, a first variable resistor means in he circuit to control the time of decomposition of the metallic rod, and a second variable resistor means in said circuit to compensate for activity changes in the electrolyte due to ambient temperature changes.

2. In a time delay fuze, an electrolytic cell including a container for an electrolyte, an anode comprising a metallic wire fixed at one end and extending through said container, spring means connected with the other end of said wire to tension the same, circuit means including said cell and anode to dissolve the latter to the breaking point under urge of said spring means, a primer, means movable to position initiating said primer, said means being restrained in safe position by said anode until broken, said circuit means including a first variable resistor settable to determine the delay period of said fuze, and a second variable resistor settable to correct for variations in time delay otherwise caused by variations in ambient temperature.

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