Jan. 19, 1960 L. M. MOTT-SMITH 2,921,974

DEFERRED ACTION TYPE BATTERY

Filed Oct. 21, 1943

FIG. 1.

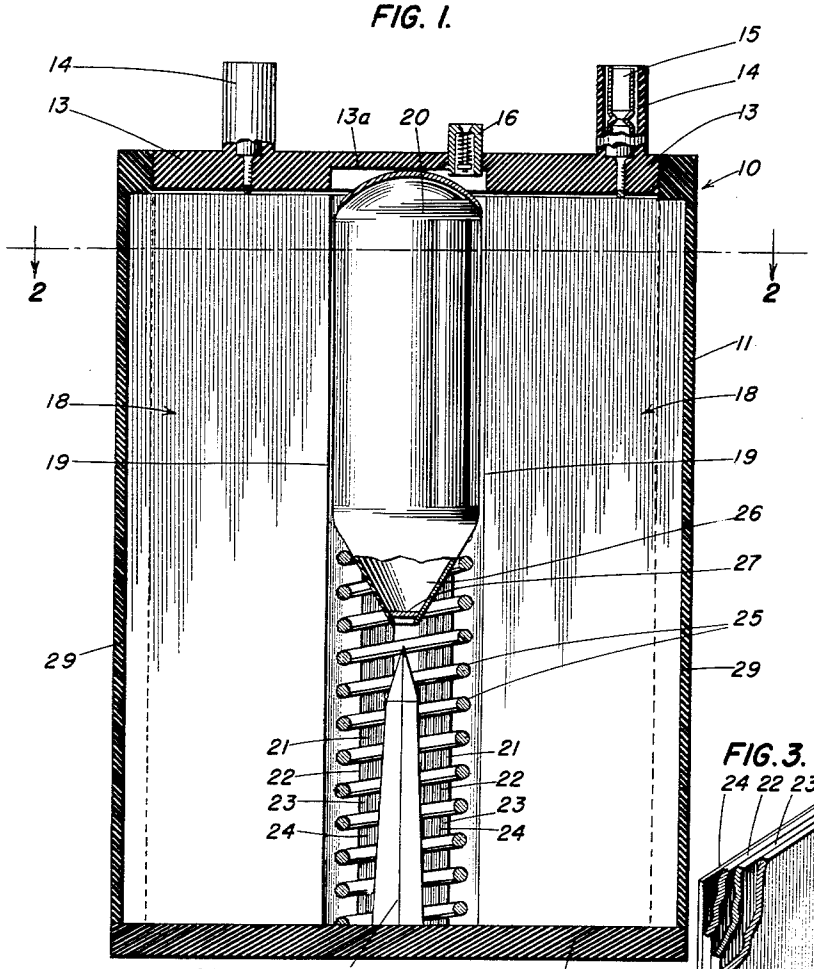


FIG. 3.

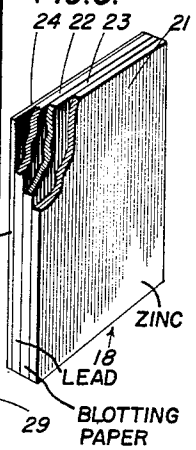
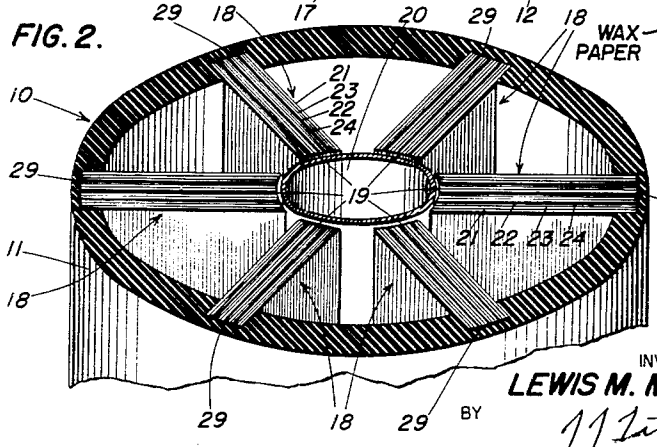


FIG. 2.



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United States Patent Office 2,921,974 Patented Jan. 19, 1960

2,921,974

DEFERRED ACTION TYPE BATTERY

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Application October 21, 1943, Serial No. 507,168

9 Claims. (Cl. 136—90)

This invention relates to batteries and has particular relation to primary cell, deferred action type batteries adapted for use in electrically detonated projectiles and other ordnance missiles.

Projectiles containing electrically operable detonating fuses must be equipped with a source of electric current which will not deteriorate and which will be ready at all times to deliver full voltage in an activation time which is practically instantaneous. Batteries providing the source of current for projectiles of this type must be operable at all climatic conditions of temperature and humidity present on the surface of the earth and at high altitudes to which projectiles and other ordnance missiles are exposed. It is also desirable that the electric current be initiated by the setback resulting from forward acceleration of the projectile when it is fired from a gun or other projector. This is of particular importance when a projectile is fired from a smooth bore gun or similar projector which does not impart substantial rotation to the projectile, since in this instance centrifugal force does not act upon the projectile to any appreciable extent and cannot be utilized to initiate the battery action.

An object of the invention is to provide a primary cell, deferred action type battery which will not deteriorate and remains unactivated until the projectile in which it is mounted is fired, at which time the battery is capable of delivering its full voltage practically instantaneously.

Another object of the invention is to provide a battery which is not adversely affected by rapidly varying conditions of temperature and humidity and which is operable at high and low temperatures.

A further object of the invention is to provide a battery which is activated under the pressure of a suitable electrolytic gas so that complete activation will be assured instantaneously, regardless of whether or not centrifugal force is present to disperse the electrolyte.

A still further object of the invention is to provide a battery which is constructed to withstand severe handling without breaking or becoming activated, but which is so constructed that the ampoule employed for confining the electrolytic gas will shatter upon firing of the projectile containing the battery, thus causing the battery to become fully operative.

A battery made in accordance with the present invention comprises a casing containing longitudinal stacks each comprising anode and cathode elements which are normally separated by a cell space for receiving an electrolyte. The stacks are mounted in a radial series and define an axial recess containing a frangible ampoule and also a suitable means for breaking the ampoule when the battery is subjected to a substantial force of setback, as in firing a projectile in which the battery is mounted. The ampoule is filled with an electrolytic gas under a pressure which is sufficient to distribute the gas throughout the cells when the ampoule is fractured.

In the preferred form of the battery, the gas is forced under pressure from the ampoule into the cell between the electrode elements of each stack, where it combines

chemically with a solution absorbed in a layer of blotting paper, or the like, to form an electrolyte which immediately activates the battery. I prefer to employ hydrochloric acid gas, although other gaseous mixtures which will dissolve in the aqueous solvent in the blotting paper to form an electrolyte are suitable.

An important feature of the present invention resides in the use of a gaseous electrolyte which will permeate throughout the battery without the aid of centrifugal force or setback. Deferred action type batteries having an ampoule containing liquid electrolyte are known. However, when an ampoule containing a liquid electrolyte is broken, the force of setback forces the liquid rapidly to the rear end of the battery, thereby preventing the liquid from being distributed properly throughout the cells, and often the battery generates a low voltage or remains completely unactivated. If the battery is subjected simultaneously to centrifugal force and a force of setback, there is a tendency for the liquid to spread radially while it is being acted upon by the force of setback, but this momentary spread is frequently insufficient to generate the required voltage or even to begin activation of the battery in the short activation time required.

For a better understanding of the invention reference may be had to the accompanying drawing, in which

Fig. 1 is a longitudinal sectional view of one form of the new battery;

Fig. 2 is a perspective view of a cross section of the battery taken on the line 2—2 of Fig. 1, and

Fig. 3 is a perspective view of a portion of one of the stacks, with parts broken away to show the construction more clearly.

Referring to the drawing, the numeral **10** indicates a casing made of a suitable electrically insulating, electrolyte-impervious material such as Bakelite, and having a side wall **11**, a rear wall **12**, and a terminal block **13** which closes the front end of the casing. The terminal block includes a plurality of turrets **14** in which are positioned contact jaw terminals, one of which is shown at **15**.

In the terminal block is a relief valve **16** which is formed of rubber, although any suitable relief valve, such as a ball-type relief valve, may be employed. Mounted on the rear wall **12** and extending forwardly therefrom, axially of the casing, is a puncturing element **17** which is shown in the form of a tapered stem terminating at its front end in a sharpened point. A series of longitudinal stacks or electrode elements **18** are mounted radially in the casing, and the inner portions thereof define an axial recess **19** for receiving a frangible ampoule **20** containing an electrolytic gas under substantial pressure.

Each stack **18** preferably comprises adjacent cells each including a strip of zinc foil **21**, a strip of lead foil **22** coated with lead dioxide, and a sheet of wetted blotting paper **23** separating the lead and zinc strips, adjacent cells being separated by waxed paper **24**. The zinc and lead foils constitute the electrodes, and the blotting paper provides a carrier for an aqueous solution which combines with the gas from the ampoule, when the latter is punctured. The waxed paper **24** provides insulation between adjacent cells or sets of electrodes. The blotting paper **23** is preferably wetted with a water-glycerine solution, in lieu of water alone, to prevent freezing at low temperatures. A suitable number of stacks of electrodes is provided to produce the desired voltages at the terminal jaws **15**. The positive plate of one cell is in contact with the negative plate of the adjoining cell, and the cells are connected together as indicated diagrammatically by the wires in Figure 2.

Surrounding the puncturing element **17** within the recess **19** is a compression spring **25**, the upper end of

which normally projects above the point of the puncturing element. The ampoule **20**, which is formed of glass or other frangible material, is fitted loosely in the recess **19** and has its lower end portion seated in the upper end coil of the spring **25**. The ampoule is formed with a constricted neck **26** which is positioned above the point of the puncturing element and has an end closure disk **27** for engagement by the puncturing element. The ampoule is limited against upward movement by the terminal block **13**. In this connection, it will be understood that a suitable cushioning means or potting compound may be employed for protecting the ampoule against accidental breakage resulting from rough handling. Prior to its installation, the ampoule is filled under pressure with an electrolytic gas, such as hydrochloric acid gas, although any gas which will serve to activate the battery when it disperses through the cells is suitable.

In one use of the new battery, it is first positioned in a projectile and is electrically connected with the components of an electrically operated fuze. When the projectile is fired, the initial force of setback, resulting from acceleration imparted to the projectile, drives the ampoule downwardly, compressing the spring **25** and puncturing the disk **27** with the sharpened point of the element **17**. Upon puncturing of the disk, the gas immediately expands and disperses under the gaseous pressure throughout the battery, reacting with the aqueous solution absorbed in the strips of blotting paper **23** to produce a liquid electrolyte. This electrolyte immediately provides the necessary chemical action with the zinc and lead foils **21** and **22** in the stacks **18** for causing the battery to produce immediately its rated voltage, which is conducted to the terminals **15** and then to the fuze of the projectile.

The compression spring **25** serves to position the ampoule snugly against the end of a recess **13***a* in the terminal plate **13** to prevent the ampoule from accidentally contacting the puncturing element. The valve **16** is adjusted to permit the escape of excess gas so that damage to the battery by excessive gas pressure will be prevented. It will be understood that the casing of the battery is effectively sealed to prevent the escape of the gas and to prevent the aqueous solution in the blotting paper strips from evaporating. The stacks **18** may be held in position in the casing **10** and in any desired manner, as by securing their outer portions in longitudinal slots **29** in the inner surface of side wall **11**.

I claim:

1. In a primary cell, deferred action type battery having a sealed casing and electrode elements mounted in spaced relation to each other in the casing to provide an electrolyte space between said elements, the combination of a frangible ampoule in the casing, an electrolytic gas under pressure in the ampoule, and means for fracturing the ampoule to release the gas therefrom whereby the gas is dispersed under its own pressure into said space and into co-action with the electrode elements to activate the battery.

2. In a primary cell, deferred action type battery having a sealed casing and electrode elements mounted in spaced relation to each other in the casing to provide an electrolyte space between said elements, the combination of an absorbent material in said space normally separating said elements, a liquid saturating said material, a frangible ampoule in the casing, an electrolytic gas under pressure in the ampoule, and means for fracturing the ampoule to release the gas therefrom whereby the gas is dispersed under its own pressure into said space to combine with said liquid and produce an electrolyte for activating the battery.

3. In a primary cell, deferred action type battery having a sealed casing and electrode elements mounted in spaced relation to each other in the casing to provide an electrolyte space between said elements, the combination of an absorbent material in said space normally separating said elements, an aqueous liquid saturating said material, a frangible sealed ampoule in the casing, hydrochloric acid gas under pressure in the ampoule, and means for fracturing the ampoule to release said gas therefrom whereby the gas is dispersed under its own pressure into said space to combine with said liquid and produce an electrolyte for activating the battery.

4. In a primary cell, deferred action type battery having a sealed casing and electrodes comprising alternate layers of zinc foil and lead foil coated with lead dioxide and mounted in spaced relation to each other in the casing to provide an electrolyte space between said elements, the combination of an absorbent material in said space normally separating said electrodes, a liquid saturating said material, a frangible ampoule in the casing, an electrolytic gas under pressure in the ampoule, and means for fracturing the ampoule to release the gas therefrom whereby the gas is dispersed under its own pressure into said space to combine with said liquid and produce an electrolyte for activating the battery.

5. In a primary cell, deferred action type battery having a sealed casing and electrode elements mounted in spaced relation to each other in the casing to provide an electrolyte space between said elements, the combination of a frangible ampoule in the casing, an electrolytic gas under pressure in the ampoule, and means for fracturing the ampoule by the force of setback resulting from high acceleration of the battery to release the gas therefrom whereby the gas is dispersed under its own pressure into said space and into co-action with the electrode elements to activate the battery.

6. In a primary cell, deferred action type battery having a sealed casing and electrode elements mounted in spaced relation to each other in the casing to provide an electrolyte space between said elements, the combination of a frangible sealed ampoule in the casing, and electrolytic gas under pressure in the ampoule, means for fracturing the ampoule to release the gas therefrom whereby the gas is dispersed under its own pressure into said space and into co-action with the electrode elements to activate the battery, and a safety valve mounted in said casing for releasing excess gas pressure from the casing.

7. In a primary cell, deferred action type battery for use in electrically detonated projectiles, said battery having a sealed casing and electrode elements radially mounted to define an axial recess and mounted in spaced relation to each other to provide an electrolyte space between said elements, the combination of an absorbent material in said space separating said elements, a liquid normally saturating said material, a frangible ampoule slidably positioned in said axial recess, an electrolytic gas under pressure in the ampoule, a puncturing element mounted in said recess, and a compression spring in said recess for resisting sliding movement of said ampoule toward said puncturing element, said ampoule being slidable under setback to compress the spring and shatter the puncturing element, whereby the gas is released and dispersed under its own pressure into said space and into co-action with the electrode elements to activate the battery.

8. In a primary cell, deferred action type battery for use in electrically operated projectiles, said battery having a sealed casing and electrode elements radially mounted to define an axial recess and mounted in spaced relation to each other to provide an electrolyte space between said elements, the combination of an absorbent material in said space separating said elements, a liquid normally saturating said material, a frangible ampoule slidably positioned in the forward end of said axial recess, an electrolytic gas under pressure in the ampoule, a puncturing element mounted in the rearward end of said recess, and a compression spring in said recess surrounding and normally extending beyond the puncturing element

for resisting sliding movement of said ampoule toward said puncturing element, said ampoule being slidable under setback to compress the spring and shatter the puncturing element, whereby the gas is released and dispersed under its own pressure into said space and into co-action with the electrode elements to activate the battery.

9. In a primary cell, deferred action type battery having a sealed casing containing a frangible ampoule and an electrolytic fluid in the ampoule, the combination of a plurality of sets of electrode elements radially mounted in the casing to define an axial recess in which said ampoule is slidable, each set including anode and cathode members disposed in spaced relation and defining an electrolyte space extending radially from said recess, a puncturing element mounted in said recess, and a compression

spring in said recess for resisting sliding movement of said ampoule toward said puncturing element, said ampoule being slidable under setback to compress the spring and engage the puncturing element, whereby said fluid is released for dispersion radially into said space and into co-action with the electrode elements to activate the battery.

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