G. MARCONI.

ELECTRIC ACCUMULATOR.

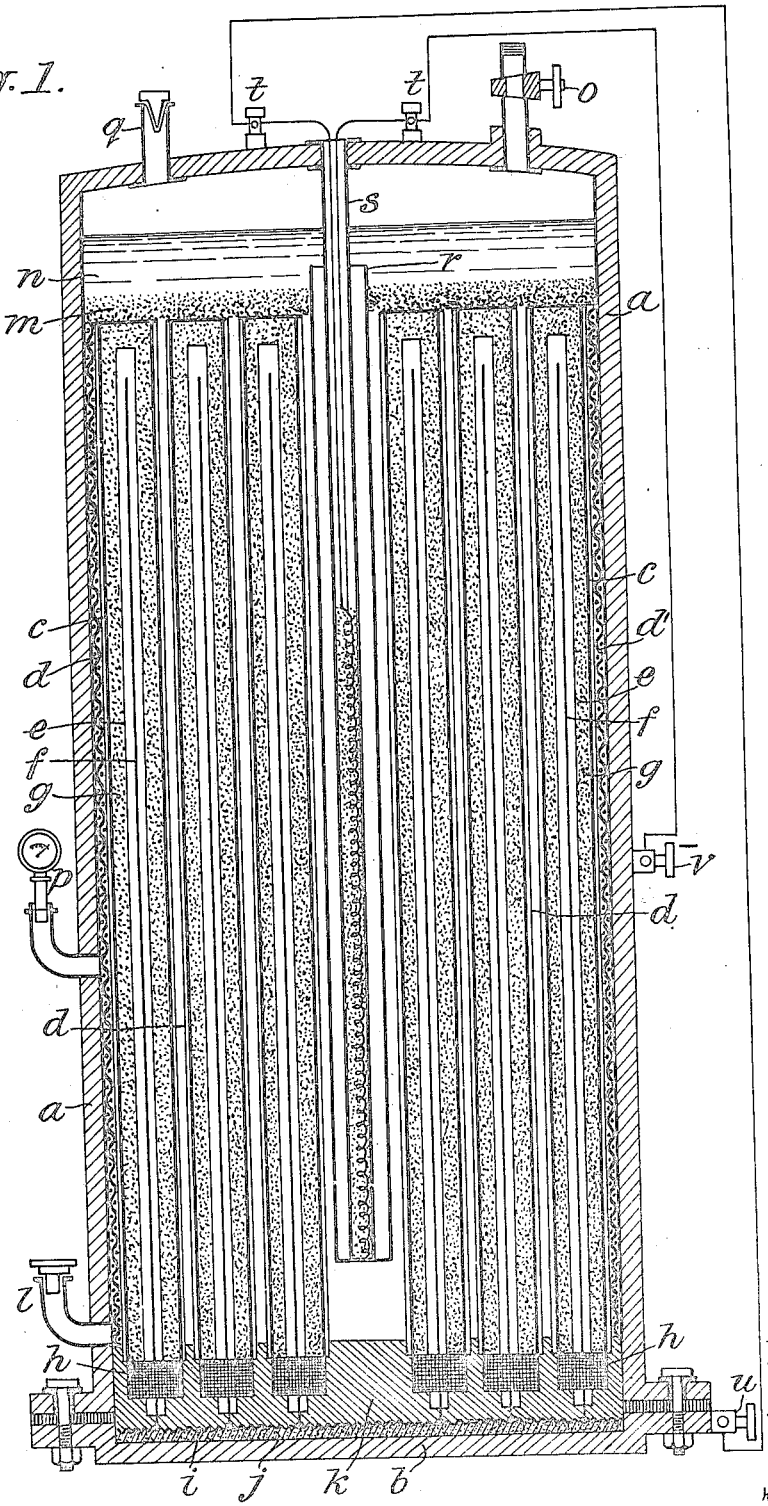
APPLICATION FILED MAR. 9, 1918.

1,377,722.

Patented May 10, 1921.

2 SHEETS—SHEET 1.

Fig. 1.



Inventor,
Guglielmo Marconi,
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his Attorneys.

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2 SHEETS—SHEET 2.

Fig 2.

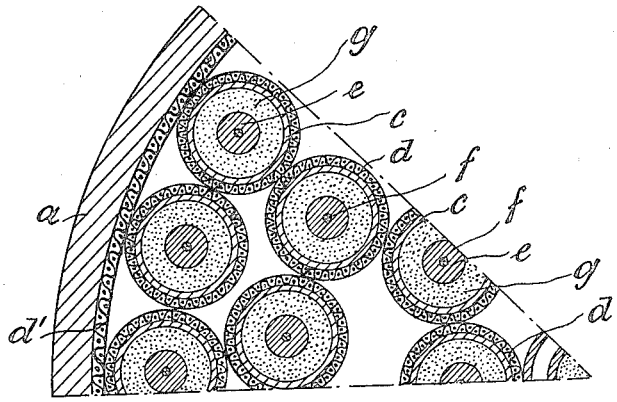
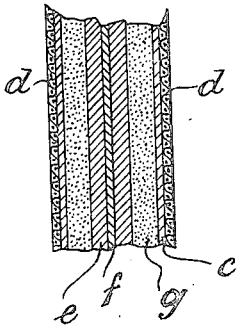


Fig 3.



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UNITED STATES PATENT OFFICE.

GUGLIELMO MARCONI, OF LONDON, ENGLAND.

ELECTRIC ACCUMULATOR.

1,377,722. Specification of Letters Patent. Patented May 10, 1921.

Application filed March 9, 1918. Serial No. 221,501.

To all whom it may concern:

Be it known that I, GUGLIELMO MARCONI, a subject of the King of Italy, residing at Marconi House, Strand, London, England, have invented a new and useful Improvement in Electric Accumulators, of which the following is a specification.

This invention relates to electric accumulators in which chlorin is employed as the active element at the positive pole and zinc or other metal at the negative pole.

According to this invention I employ a solution of an alkaline chlorid (which expression hereinafter means the chlorid of an alkali or of an alkaline earth) together with the chlorid of an electropositive metal such as zinc.

My invention is illustrated by the accompanying drawings, of which Figure 1 is a vertical section through an accumulator, Fig. 2 is a part transverse section to a larger scale, and Fig. 3 is a part vertical section.

a is a cylindrical container of steel having its interior coated with zinc to a thickness of from 1 to 2 mm. It is closed at the bottom by an insulated cover *b*. *c*, *c*, are porous cylinders of asbestos or porcelain closed at the top; each is surrounded with small gauze cylinders *d* (shown in Fig. 1 by straight lines only to avoid confusion of the drawing) of copper or iron wire coated with zinc and amalgamated and the whole assemblage is bound together by a large cylinder d_1 of similar gauze (shown in Fig. 1 in wavy lines) which fits close against the interior of the container *a*. In the middle of each cylinder *c* is a rod *e* of carbon having a metallic core *f* to increase its conductivity, the remainder of the interior of the cylinder being filled with powdered or granular porous carbon *g* of low resistance. The cores *f* are not essential, but if they are employed the carbon rods should be rendered impermeable by mixing with the paste of which they are formed a small quantity of a vitreous substance, such as an insoluble silicate or quartz. The lower end of each cylinder *c* is closed by a plug *h* of insulating cement unaffected by chlorin.

The ends of the cores *f*, or of the rods *e* if cores are not employed, are electrically connected to a disk *i* of wire gauze connected to the cover *b* by solder *j*.

k is a layer of insulating cement, such as sealing wax, asphalt or a mixture of bitumen and pitch, introduced hot through a tube *l*. Above the top of the cylinders *c* is a layer of carbon grains *m*, grains *m* being separated from carbon parts *e* and *g* by the ends of cylinders *c*. *n* is an aqueous solution of calcium chlorid and zinc chlorid which can be introduced through a cock *o*. *p* is a pressure gage filled with oil to prevent any corrosive action upon it, and *q* is a safety valve. In the center of the assemblage of cylinders *c* is a circulating tube *r* formed of porcelain, through which passes a closed tube *s* of metal coated with zinc and containing a coil the ends of which are connected to binding screws *t*. *u* is the positive terminal of the accumulator and *v* the negative terminal. One binding screw *t* is connected to the terminal *u* and the other to the terminal *v* so that a current may flow through the coil and heat it and so cause a circulation of the solution. After the whole has been assembled and the solution introduced air or hydrogen is forced into the container to a pressure of the order of twenty atmospheres.

The action of the accumulator is as follows:—

During charging the chlorid of zinc is decomposed into chlorin and zinc. The latter is deposited on the surface of the gauze constituting the negative electrode, and the chlorin which is liquefied by the pressure is partly absorbed by the powdered carbon, while some remains free in the solution. During discharge the reverse action takes place, the anions of chlorin and the cations of zinc recombining to form chlorid of zinc. The presence of the calcium chlorid prevents shortcircuiting being caused owing to the growth of filaments of zinc through the pores of the cylinders containing the positive electrodes, and decreases the diffusion of the chlorin through the liquid.

While I prefer zinc, I may use in place of it another electropositive metal, such as cadmium, or possibly nickel, iron, copper or manganese. Similarly, while I prefer calcium chlorid as being cheap and extremely soluble, I may employ in place of it the chlorid of some other alkali or alkaline earth metal, such as common salt.

I have used with success an accumulator having the following dimensions:—

Internal diameter of container *a*--	20 cm
Height	50 cm
Number of cylinders *c*	300
Internal diameter of *c*	8 mm
Thickness of sides of *c*	1 mm
Diameter of rods *e*	5 mm
Diameter of cores *f*	1 mm

Gauze *d'* is formed of wire of 0.2 mm. diameter of close mesh, weighing approximately 8 grams per square decimeter.

In place of wire gauze I may employ perforated strips of electrolytic zinc and the word "gauze" is hereinafter intended to be taken as including such strips.

The solution should be prepared with distilled water, and the chlorids of calcium and zinc should be pure and free from metals more electronegative than zinc.

The solution may consist of:—

600 grams of water.

500 to 550 grams of dry chlorid of calcium, and

400 grams of chlorid of zinc.

For accumulators in which weight and size are not of essential importance, it is possible to increase advantageously the diameters of the cylinders *c* and the thickness of their sides.

An accumulator so constructed has a capacity of about 1,100 ampere hours with an initial voltage of from 2 to 2.2 volts, the discharge rate being about five hours and the voltage drops to 1.6 volts.

What I claim is:—

1. In an electric accumulator, the combination of a closed container, electrodes therein, and an electrolyte in said container containing chlorin ions, the interior of said container being normally under pressure.

2. The method of operating an electrolytic cell comprising a container having an electrolyte therein having a chlorin anion which includes the step of maintaining the interior of said container at a pressure sufficient to liquefy chlorin at the temperature of the container.

3. In an electric accumulator, the combination of a closed container, a porous vessel therein, a carbon rod packed with granular carbon within the vessel, metal gauze surrounding the vessel and a solution of an alkaline chlorid and of the chlorid of an electropositive metal.

4. In an electric accumulator, the combination of a closed container, a porous vessel therein, a carbon rod packed with granular carbon within the vessel, metal gauze surrounding the vessel and a solution of calcium chlorid and of zinc chlorid.

5. In an electric accumulator, the combination of a closed container, a porous vessel therein, a carbon rod packed with granular carbon within the vessel, metal gauze surrounding the vessel and a solution of an alkaline chlorid and of the chlorid of an electropositive metal under pressure.

6. In an electric accumulator, the combination of a closed container, a porous vessel therein, a carbon rod packed with granular carbon within the vessel, metal gauze surrounding the vessel and a solution of calcium chlorid and of zinc chlorid under pressure.

7. In an electric accumulator, the combination of a closed container, a plurality of porous vessels therein, a carbon rod packed with granular carbon within each vessel, metal gauze surrounding each vessel and a solution of an alkaline chlorid and of the chlorid of an electropositive metal.

8. In an electric accumulator, the combination of a closed container, a plurality of porous vessels therein, a carbon rod packed with granular carbon within each vessel, metal gauze surrounding each vessel and a solution of calcium chlorid and of zinc chlorid.

9. In an electric accumulator, the combination of a closed container, a plurality of porous vessels therein, a carbon rod packed with granular carbon within each vessel, metal gauze surrounding each vessel, a solution of an alkaline chlorid and of the chlorid of an electropositive metal, and means whereby gas under pressure can be forced into the container.

10. In an electric accumulator, the combination of a closed container, a plurality of porous vessels therein, a carbon rod packed with granular carbon within each vessel, metal gauze surrounding each vessel, a solution of calcium chlorid and of zinc chlorid, and means whereby gas under pressure can be forced into the container.

11. In an electric accumulator, the combination of a closed container, a plurality of porous vessels therein, a carbon rod packed with granular carbon within each vessel, metal gauze surrounding each vessel, a solution of an alkaline chlorid and of the chlorid of an electropositive metal, means whereby gas under pressure can be forced into the container and means for causing a circulation of the solution.

12. In an electric accumulator, the combination of a closed container, a plurality of porous vessels therein, a carbon rod packed with granular carbon within each vessel, metal gauze surrounding each vessel, a solution of calcium chlorid and of zinc chlorid, means whereby gas under pressure can be forced into the container, and means for causing a circulation of the solution.

13. In an electric accumulator, the combination of a closed container, a plurality of porous vessels therein, a carbon rod packed with granular carbon within each vessel,

metal gauze surrounding each vessel, a solution of an alkaline chlorid and of the chlorid of an electropositive metal, a circulating tube and means operated by the current from the accumulator for heating the solution within such tube.

14. In an electric accumulator, the combination of a closed container, a plurality of porous vessels therein, a carbon rod packed with granular carbon within each vessel, metal gauze surrounding each vessel, a solution of calcium chlorid and of zinc chlorid, a circulating tube and means operated by the current from the accumulator for heating the solution within such tube.

15. In an electric accumulator, the combination of a closed container, a plurality of porous vessels therein, a carbon rod packed with granular carbon within each vessel, metal gauze surrounding each vessel, a solution of an alkaline chlorid and of the chlorid of an electropositive metal, means whereby gas under pressure can be forced into the container, a circulating tube and means operated by the current from the accumulator for heating the solution within such tube.

16. In an electric accumulator, the combination of a closed container, a plurality of porous vessels therein, a carbon rod packed with granular carbon within each vessel, metal gauze surrounding each vessel, a solution of calcium chlorid and of zinc chlorid, means whereby gas under pressure can be forced into the container, a circulating tube and means operated by the current from the accumulator for heating the solution within such tube.

In testimony that I claim the foregoing as my invention, I have signed my name this fourteenth day of February, 1918.

GUGLIELMO MARCONI.