

No. 615,541.

Patented Dec. 6, 1898.

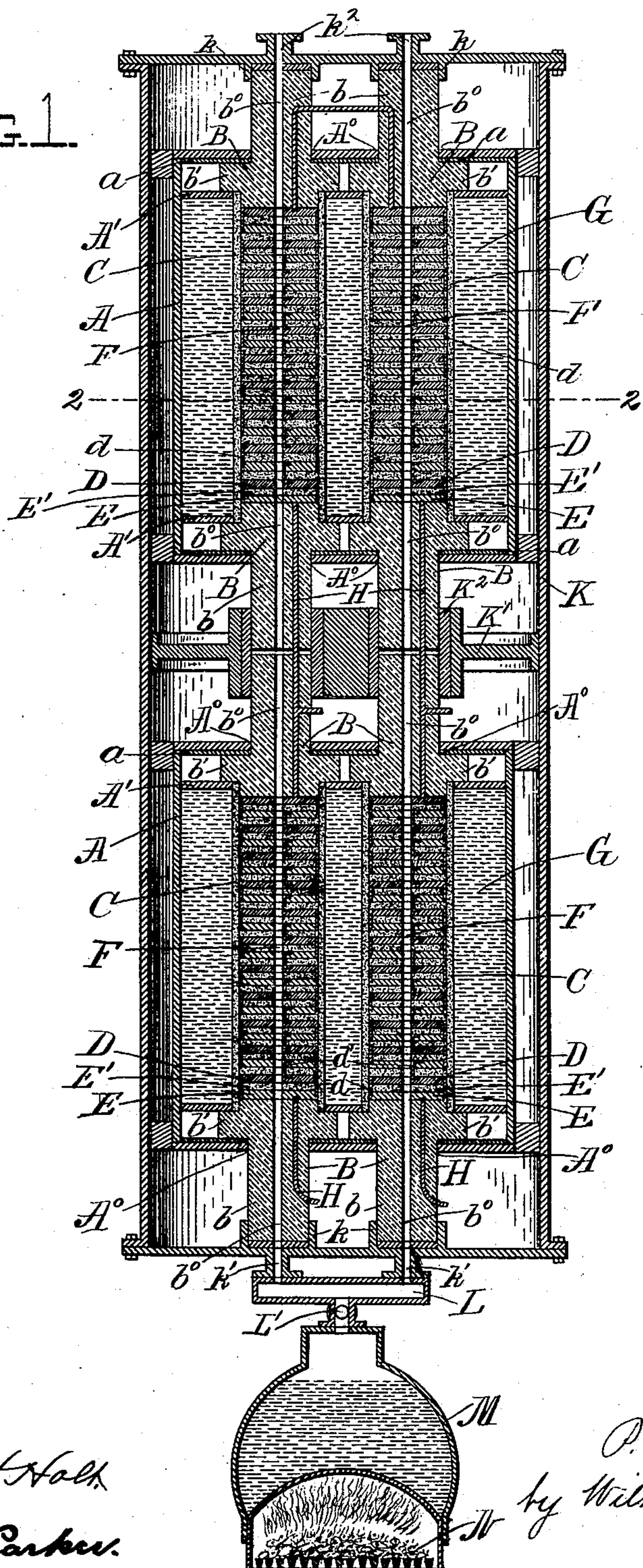
P. A. EMANUEL.  
ELECTRIC BATTERY.

(Application filed May 17, 1898.)

(No Model.)

2 Sheets—Sheet 1.

FIG. 1.



Witnesses  
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# UNITED STATES PATENT OFFICE.

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## ELECTRIC BATTERY.

SPECIFICATION forming part of Letters Patent No. 615,541, dated December 6, 1898.

Application filed May 17, 1898. Serial No. 680,986. (No model.)

*To all whom it may concern:*

Be it known that I, PHILIP ALBERT EMANUEL, a citizen of the United States, residing at Aiken, in the county of Aiken and State of South Carolina, have invented certain new and useful Improvements in Electric Batteries; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My present invention relates to improvements in thermo and hydro electric batteries; and the said invention has for its object the direct conversion of fuel into electric energy, and this is accomplished by improving thermo-electric batteries and combining their action with that of hydro-electric currents.

In order to accomplish the above-mentioned object, my said invention consists of the novel construction and combinations herein-after more fully described and claimed.

In the accompanying drawings, which form a part of this specification, Figure 1 represents a vertical central sectional view of my improved thermo and hydro-electric battery. Fig. 2 represents a sectional view of the same, taken along the line 2 2 of Fig. 1. Fig. 3 represents a plan view of one of the elements before it is placed in the battery, and Fig. 4 represents a vertical central sectional view of another form of battery constructed according to my invention.

Similar letters refer to similar parts throughout the several views.

A A represent two vessels composed of earthenware, glass, hard rubber, wood, metal, or other suitable material. The vessels A A are provided at each end with openings A<sup>o</sup>, and into these openings fit the stoppers B. The necks b of the stoppers pass through the openings A<sup>o</sup>, while the flange b' rests in engagement with the packing a inside of the vessel. These stoppers B may be composed of glass, glazed earthenware, wood, hard rubber, vulcanized fiber, or other suitable material and are each provided with a longitudinal passage or channel b<sup>o</sup>. The stoppers are further held in position by the plates A', which fit into the vessels A and engage the stopper-flanges b'. Passing longitudinally through

the vessels A and with their ends engaging the inner ends of the stoppers B are a plurality of tubes C, of unglazed earthenware, wood, or other suitable porous material.

Within each of the tubes C is placed a thermopile consisting of a plurality of thermo-electric couples. These couples consist of metal disks D and E, each of which has an opening through its center. These disks, constituting the elements of the piles, may be stamped out in the shape as shown in Fig. 3, where d represents strips of the metal left around the periphery of the disks and used for connecting the elements of the couples together. The elements or disks are adapted to fit closely into the tubes C, as wads into a cartridge-shell, and are placed in position in the tubes and connected together in the following order: At or near the bottom of each tube is located a disk or element E of one polarity. Next above this disk is placed a disk of earthenware E', having a central aperture, which registers with the aperture of the element next to it. Above this earthenware disk is placed another element D of different polarity from the element on the opposite side of the earthenware disk. Then the two elements of opposite sides of the earthenware disks constituting a couple are joined at their peripheries by the strips d, which are bent up or down and made to lap over the disks or elements to which they are joined. An earthenware disk is then placed over this couple and a similar couple placed over the earthenware disk, and so on through the series. The disks or elements of each couple are joined at their peripheries by the strips d, and the couples are joined or connected with each other at or near their centers by the metal strips d', passing through the apertures of the disks, as shown. When the elements have been thus placed in the porous tubes C and separated from each other by the earthenware disks E', as described, the piles are held securely at each end between the stoppers. The openings through the disks of the piles form a continuous channel or passage F, passing through each pile and registering with the passages or channels through the stoppers. When the vessels A A are placed one above the other, as shown, the passages of the lower stoppers of the upper vessel regis-



ter with the passages of the stoppers of the lower vessel, and in this way a continuous passage is afforded through the stoppers and piles. The piles and tubes C in each of the vessels A A are surrounded by a cooling liquid G, which is preferably water. The several piles may be electrically connected together in any convenient way. For this purpose the stoppers are provided with the conductors H, which pass through the body of said stoppers and connect with the elements, as shown.

Inclosing the vessels A A and stoppers B is a casing K, of metal, wood, or other suitable material. The ends of this casing are provided with inside circular flanges, which form sockets  $k$ . Into these sockets  $k$  fit the outer ends of the extreme upper and lower stoppers B, and coinciding with the passages through these stoppers are the inlets and outlets  $k^1$  and  $k^2$ , respectively. The inlets  $k^1$  are connected with a steam-chamber L, and this steam-chamber is in turn connected, through a valve L', with the steam-dome of a boiler M. This boiler is provided with a furnace N of any suitable kind.

The valve L' may operate to admit steam into the battery either intermittently or continuously, as may be desired.

A spider K' is secured to the inside of the casing K and engages the sleeves K<sup>2</sup> surrounding the recess of the stoppers which pass into the bottom and top of the upper and lower vessels A A, respectively. The space between the ends of these stoppers within the said sleeves may be varied. It may be increased so as to form an expanding-chamber for the expansion of steam or it may be diminished so that the stoppers meet.

The couples composing the thermopiles may be bismuth-zinc, copper-bismuth, iron-antimony, bismuth-nickel, cobalt-iron, bismuth-antimony, bismuth-selenium, or any metal or alloy couples which may be found convenient for the purpose.

It is well known that thermo-electric currents are produced by an electromotive force arising from the difference of temperature in two heterogeneous substances. Thus if the peripheries of the disks forming the couples, as herein described, be kept cool and their centers heated a current will flow from one element of the couple to the other if they are electrically connected. According to my invention this heating of the couples is accomplished by passing steam from the boiler M up through the channels or passages F, and therefore in contact with the centers of the disks D and E. The peripheries of the disks forming the couples are kept cool by the water which surrounds the tubes C and passes through their pores. The effect of the heat of the steam and cold of the water thus acting upon the couples will be a constant electric current of low potential. In order to increase the electromotive force of this current,

I make use of the hydro-electric property of the steam. The steam is discharged from the boiler through the piles at high pressure, and the friction of the vesicles of water which are carried with the steam against the channels or passages through which they pass causes the steam to become charged with positive electricity. This positive electricity, which is also produced by the expansion and condensation of the steam, becomes absorbed by the negative electricity of the piles, and thus builds up their electromotive force as it were and strengthens their action. Not only is the steam used to heat the thermal series or couples and to strengthen their electromotive force, but it also acts to draw the surrounding cooling liquid against the peripheries of the couples by causing a partial vacuum in the channels or passages through the piles. The steam also acts to carry off anything that might tend to accumulate in the said passages.

While I have shown and described herein a certain form of battery, many obvious changes may be made therein. Thus while I have shown two vessels A A, one placed above the other and both containing thermopiles, I may employ only one vessel A and one set of thermopiles, or the number of vessels may be increased to a larger number than two; and, again, while I have shown a plurality of piles contained in each vessel A, I may inclose each pile in a separate vessel, as shown in Fig. 4, when A<sup>2</sup> represents the inclosing vessel; and, indeed, I may make many alterations and changes in the above-described invention without departing from the spirit thereof; but—

What I do claim, and desire to secure by Letters Patent of the United States, is—

1. A thermo-electric pile, which consists of a plurality of thermo-electric couples separated from each other by porous diaphragms and inclosed in a porous casing, substantially as described.

2. A thermo-electric pile, which consists of a plurality of thermo-electric couples with the said couples and the elements constituting said couples separated from each other by porous diaphragms and inclosed in a porous casing, substantially as described.

3. The combination with a vessel containing a cooling liquid, of a porous tube carried within said vessel and surrounded by said liquid, and a plurality of thermo-electric couples inclosed within said tube, substantially as described.

4. The combination with a vessel containing a cooling liquid, of a plurality of porous tubes carried within said vessel and surrounded by said cooling liquid, a plurality of thermo-electric couples inclosed within said tubes, and a plurality of porous diaphragms separating the elements of the couples, and also the couples from each other within said tubes, substantially as described.



5. A thermo-electric pile, consisting of a plurality of thermo-electric couples inclosed in a porous casing, each of the said couples being composed of a pair of metal disks electrically connected at their peripheries with each other of the same couple, and the several couples being electrically connected together at or near the center of the said disks, substantially as described.

6. A thermo-electric pile, consisting of a plurality of thermo-electric couples inclosed in a porous casing, the said couples being composed of a pair of metal disks electrically connected together at their peripheries, the several couples being electrically connected together at or near the centers of said disks, and porous diaphragms separating the elements of each couple and the couples themselves from each other within said tubes, substantially as described.

7. In a thermo-electric pile, the combination with a porous casing, of a plurality of thermo-electric couples inclosed in said casing, the said couples having apertures through them which form a longitudinal passage through said pile, means for separating the elements of the couples and the couples themselves from each other, and means for heating the said couples in the vicinity of said passage and for cooling them around their outer portions, substantially as described.

8. In a thermo-electric pile, the combination with a porous casing, of a plurality of thermo-electric couples inclosed in said casing, the said couples having apertures through them which form a longitudinal passage through said pile, means for separating the elements of the couples and the couples themselves from each other, and means for passing steam through the said passage and for cooling the outer portions of said couples, substantially as described.

9. The combination with a vessel containing a cooling liquid, of a porous tube carried within said vessel and surrounded by said liquid, a plurality of thermo-electric couples inclosed in said porous tube, each of the said couples being composed of a pair of metal disks electrically connected at their peripheries with each other of the same couple and the several couples being electrically connected together at or near the center of said disks, the said disks being provided with apertures which form a longitudinal passage through said pile, and means for passing steam through said passage, substantially as described.

10. The combination with a vessel containing a cooling liquid, of a plurality of porous tubes carried within said vessel and surrounded by said cooling liquid, a plurality of thermo-electric couples inclosed in each of said porous tubes, each of said couples being composed of a pair of metal disks electrically connected at their peripheries with each other of the same couple and the several couples

being electrically connected together at or near the center of said disks, the said disks being provided with apertures which form a longitudinal passage through said pile, and means for passing steam through said passage, substantially as described.

11. The combination with a vessel having openings at each end, porous tubes carried within said vessel, stoppers having a longitudinal passage through them and inserted in the openings at the ends of said vessel and engaging the ends of said tubes, thermo-electric piles carried within said tubes, each of said piles having a passage passing longitudinally through it and connecting with the passages through said stoppers, a cooling liquid carried by said vessel and surrounding the said tubes and means for heating said couples along the passage through them, substantially as described.

12. The combination with a vessel having openings at each end, porous tubes carried within said vessel, stoppers having a longitudinal passage through them and inserted in the openings at the ends of said vessel and engaging the ends of said tubes, each of the said stoppers being provided with an annular flange which engages the inner portion of the said vessel, thermo-electric piles carried within said tubes, each of said piles having a passage passing longitudinally through and connecting with the passages through said stoppers, a cooling liquid carried by said vessel and surrounding the said tubes, a source of steam-supply, and means for passing said steam through said passages, substantially as described.

13. The combination with a vessel, of partition-plates carried within the said vessel near each end of the same with openings passing through said plates and through the ends of the vessels, stoppers provided with an annular flange and inserted in said openings with the flanges of said stoppers held between the partition-plates and ends of the vessels, said stopper being provided with passages passing longitudinally through them, a plurality of porous tubes carried within said vessel and closed at each end by said stoppers, a thermo-electric pile carried within each of said tubes having a longitudinal passage through them adapted to connect with the passage through said stoppers, a cooling liquid carried within said vessel and surrounding said tubes, and means for heating said piles along the passage through them, substantially as described.

14. The combination with a vessel, of a plurality of porous tubes mounted therein, a thermo-electric pile carried in each of said tubes, each of said piles having a passage passing longitudinally through it, a cooling liquid carried within said vessel and surrounding said tubes, a second vessel located below the aforesaid vessel, a plurality of tubes mounted in said vessel, a thermo-electric



tric pile carried in each tube, each of the  
said piles having a passage passing longitudi-  
nally through it, the passages through the  
piles of one vessel connected with the pas-  
sages through the piles of the other vessel, a  
5 casing inclosing both vessels having inlets  
and outlets connected with said passages, a  
source of steam-supply and means for pass-

ing the steam through the said passages of  
said piles, substantially as described. 10

In testimony whereof I affix my signature  
in presence of two witnesses.

PHILIP A. EMANUEL.

Witnesses:

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G. C. MOSELEY.