

(No Model.)

2 Sheets—Sheet 1.

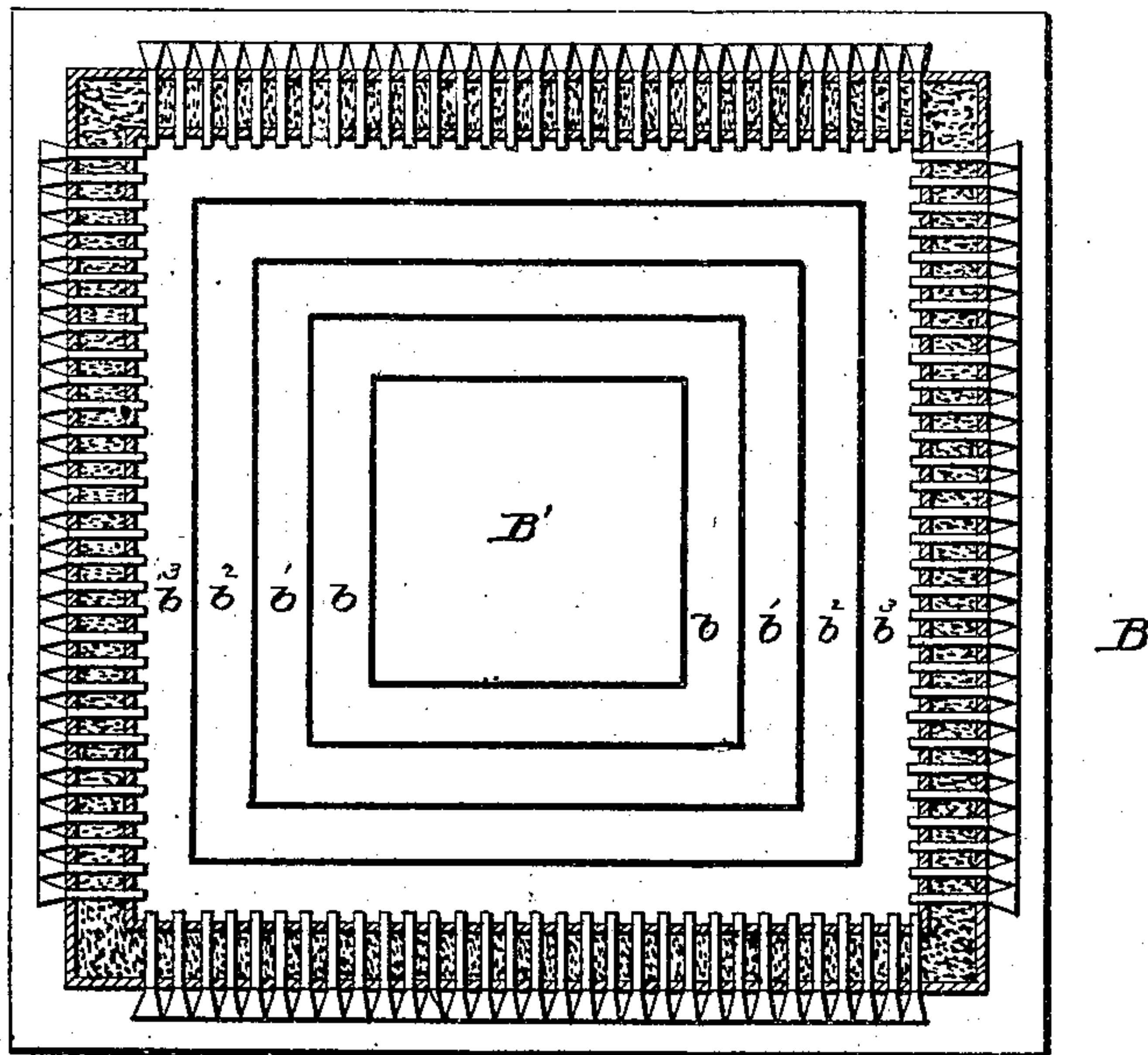
H. WOODWARD.

THERMOPILE.

No. 394,090.

Patented Dec. 4, 1888.

—fig. 3.



—fig. 2.

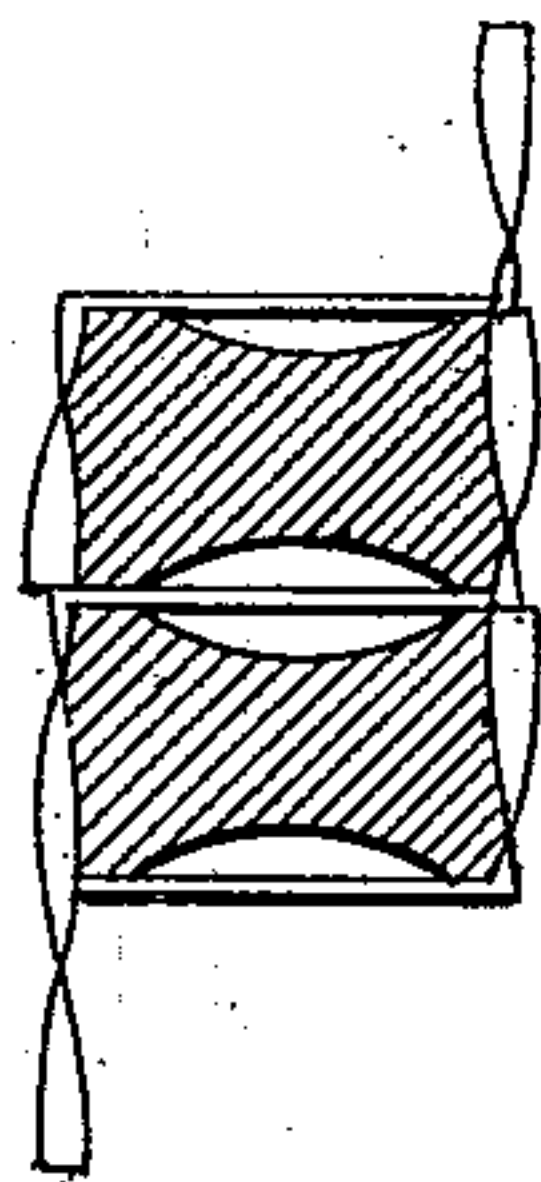
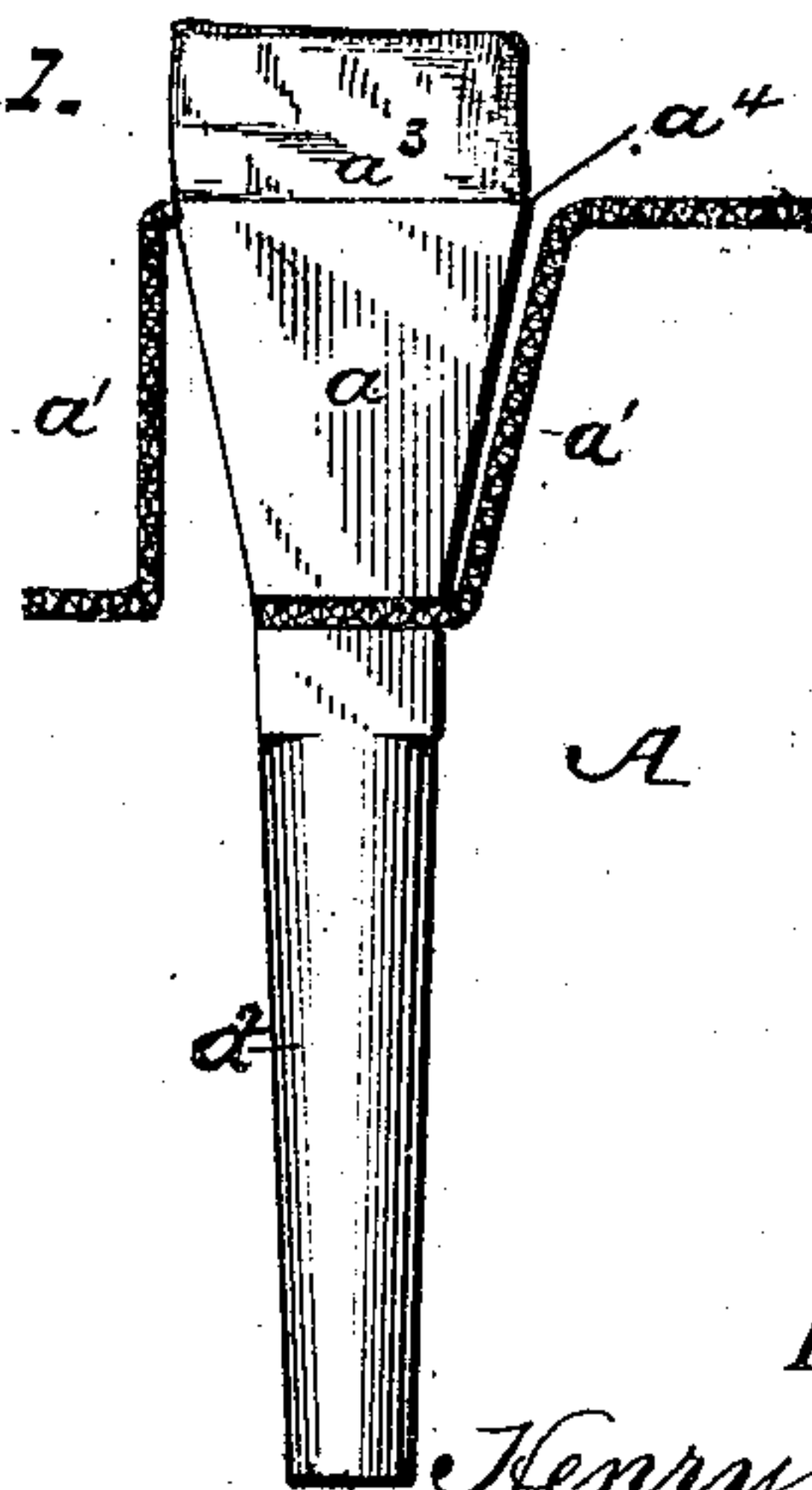


Fig. 1.



Witnesses:

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R. M. Elliott

by

Inventor :

Henry Woodward,

R. S. Dyrenforth.
his Attorney.

(No Model.)

2 Sheets—Sheet 2.

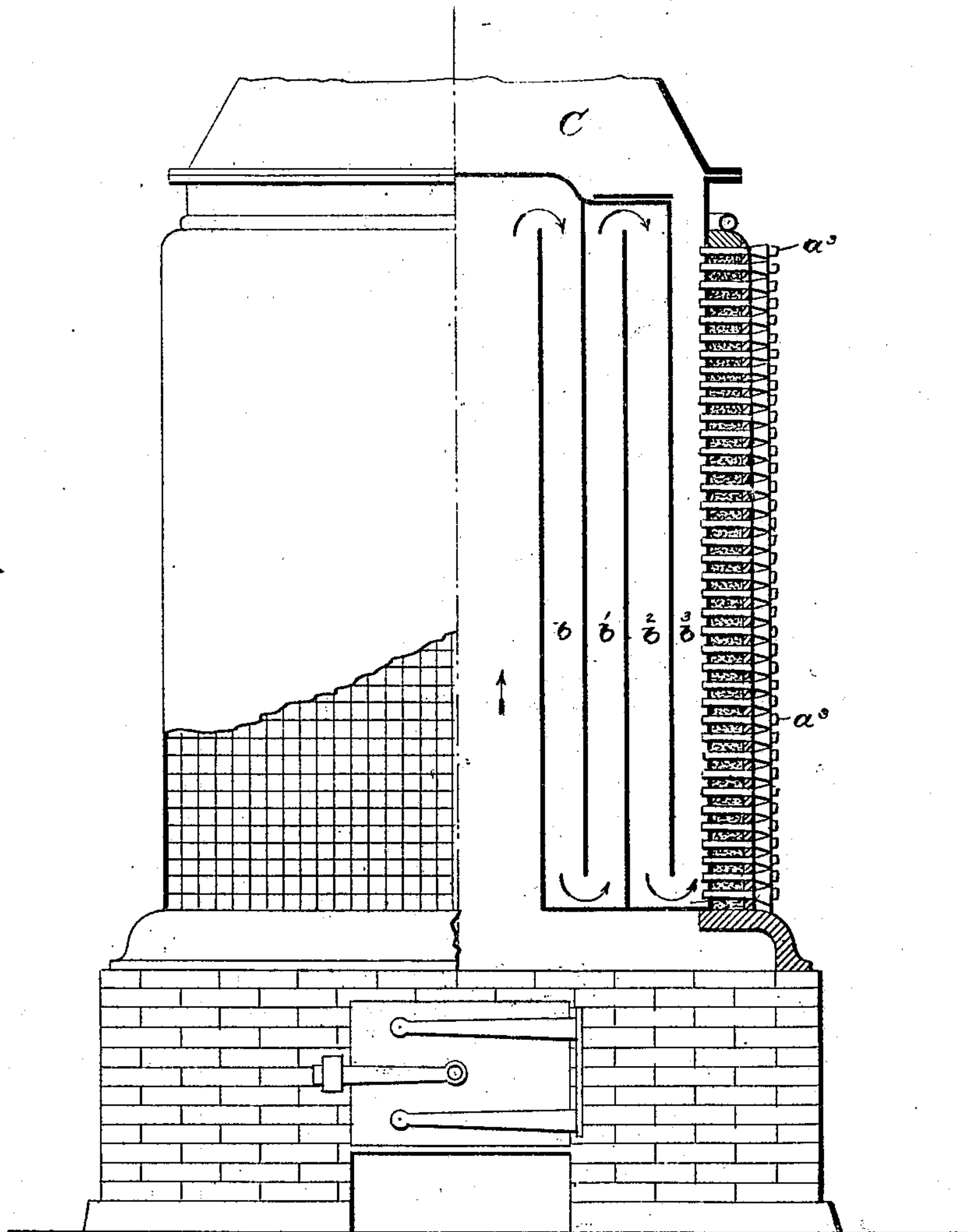
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Fig. 4



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UNITED STATES PATENT OFFICE.

HENRY WOODWARD, OF DETROIT, MICHIGAN, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE WOODWARD ELECTRICAL COMPANY, OF SAME PLACE.

THERMOPILE.

SPECIFICATION forming part of Letters Patent No. 394,090, dated December 4, 1888.

Application filed October 7, 1887. Serial No. 251,697. (No model.)

To all whom it may concern:

Be it known that I, HENRY WOODWARD, a subject of the Queen of Great Britain, residing at Detroit, in the county of Wayne and State of Michigan, but at present at the city of Toronto and Province of Ontario, Canada, have invented certain new and useful Improvements in Thermopiles; 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.

This invention relates to thermo-electric generators.

The object is to produce a generator of electricity which will be of high efficiency, and which will be at once comparatively inexpensive of production and durable in use; furthermore, to produce a structure in which the elements are properly arranged for heating and cooling to form a generator.

With these objects in view the invention consists in a novel element for use in a thermo-electric generator; furthermore, in the combination; with said element, of a piece of metal, preferably copper, to act as a cooler and also to lower resistance; furthermore, in the combination, with said element, of a piece of metal, preferably copper, to act as a cooler and lower resistance, and of a heat conductor or staff; furthermore, in a structure in which elements are properly arranged for heating; and, finally, in various novel details of construction, all as hereinafter fully described.

In the accompanying drawings, forming part of this specification, and in which like letters of reference indicate corresponding parts, Figure 1 is a side elevation showing one form of element. Fig. 2 is a detail view showing another form of element. Fig. 3 is a horizontal sectional view of the furnace, showing the manner of arranging and connecting the elements; and Fig. 4 is an elevation of the furnace, partly in section, showing the arrangement of the flues.

In the drawings, A represents the generator proper, of substantially the shape designed to be used in carrying the invention into effect, and composed of an element, a cooler,

and a heat-conductor. The element is composed of two portions—one, *a*, of soft metal, which may be zinc, but is in this instance, by preference, an alloy of antimony and zinc; the other of a strip or strips *a'* of hard metal which may be perforated or in the form of wire-gauze, and of sufficient length to be bent in the shape and into the position shown in the drawings. The strips are attached to opposite ends of the soft-metal portion in any manner that will insure their being held firmly in place and will prevent their detachment upon the application of a suitable degree of heat. This structure will of itself perform the function of an element; but to facilitate the application of heat to one end, which will be the inner end in use, it is preferred to attach a heat-conductor, in this instance a staff, *a*², of hard metal, preferably iron; and that strip *a'*, which will then be on what in use will be the inner end of the soft metal *a*, may be attached to the staff by solder, and then both be attached to the soft metal; while, in order to get a greater difference in temperature between the ends of the element, it is preferred to provide the end which will be the outer end in use with a good conductor of heat—such as a piece of copper, *a*³. The end designated as the outer end is, for the sake of precision, marked in the drawings *a*⁴.

To get strong effects in the use of my element, it is necessary to connect up a number of them in such a manner that the electric current may pass uninterruptedly from one to another, whether the elements be arranged in a battery-chain, or in rows or tiers, and the elements should also be so arranged that they may be equally and evenly heated.

To connect two or more elements, these may be placed in such position that one or both ends will be left exposed, one of the metal strips, or both of these, being then bent, so that a portion will cover an end or the ends of the soft metal, and heat being applied, or additional metal being supplied, the metal strip being perforated, the molten metal flows through, and upon cooling insures secure attachment. A strip may be secured to the outer end of the soft metal *a* by placing the

end of the strip at the end of the mold and filling the mold with the metal in a molten condition; or both strips may be secured to the soft metal by placing ends of each at the ends of the mold; or, as before stated, a strip having been attached to the outer end, the other strip may be attached to the inner end, together with the staff. Instead of connecting the elements by solder or fusing, they may be connected by clamping.

Properly to heat the elements they should be arranged in a suitable furnace. Such a furnace is designated in the drawings by the letter B, and is provided with a number of concentric passages, b b' b^2 b^3 , arranged about a central flue, B' . The advantage of having many concentric passages is that any carbon in the form of soot or carbonaceous substance, which would otherwise be deposited upon the staff or other part of the generator, will be lodged upon the walls of the passages before getting to the generator, while, additionally, heat is utilized and conserved by confining the gases carrying it for a longer period than usual before discharging them.

The outer walls of the furnace may be of brick, but are preferably of open-work sheet-iron covered with a suitable cement, or with a composition of cement and slag-wool.

In building up a generator-furnace the staffs of the elements forming the chain before described are embedded in cement, as shown in Fig. 2, while the cement is in plastic condition, the ends extending through the cement and through the openings in the sides of the furnace, in order that heat may come in contact with them. The ends are then connected up.

The elements are heated in the following manner: The products of combustion from the fire pass up through the flue B' , as indi-

cated by the arrow in Fig. 4, then down through the passage b , where they enter the passage b' , and so on through the other passages until they escape through the chimney C, at the top of the furnace, having parted with a great portion of their heat.

In heating the furnace charcoal or coke is preferred, as either produces a clean and regular fire, giving a heat which will be equally distributed.

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

1. In a thermo-generator, an element consisting of soft metal, and the perforated metal or metallic-gauze strip, substantially as described.

2. In a thermo-generator, an element consisting of soft metal and a strip of perforated metal or metallic gauze, and a suitable hard-metal conductor attached to the element, substantially as described.

3. In a thermo-generator, the combination, with an element consisting of soft metal and a strip or strips of perforated metal or metallic gauze, of a piece of metal to act as a cooler, and a heat conductor or staff, substantially as described.

4. A thermo-generator consisting of the flue, the concentric passages leading one into the other, the outer casing provided with openings, and the elements extending through the openings to be brought in contact with the heat, substantially as described.

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

HENRY WOODWARD.

Witnesses:

JNO. S. ANDERSON,
ADAM H. MEYERS.