

No. 773,839.

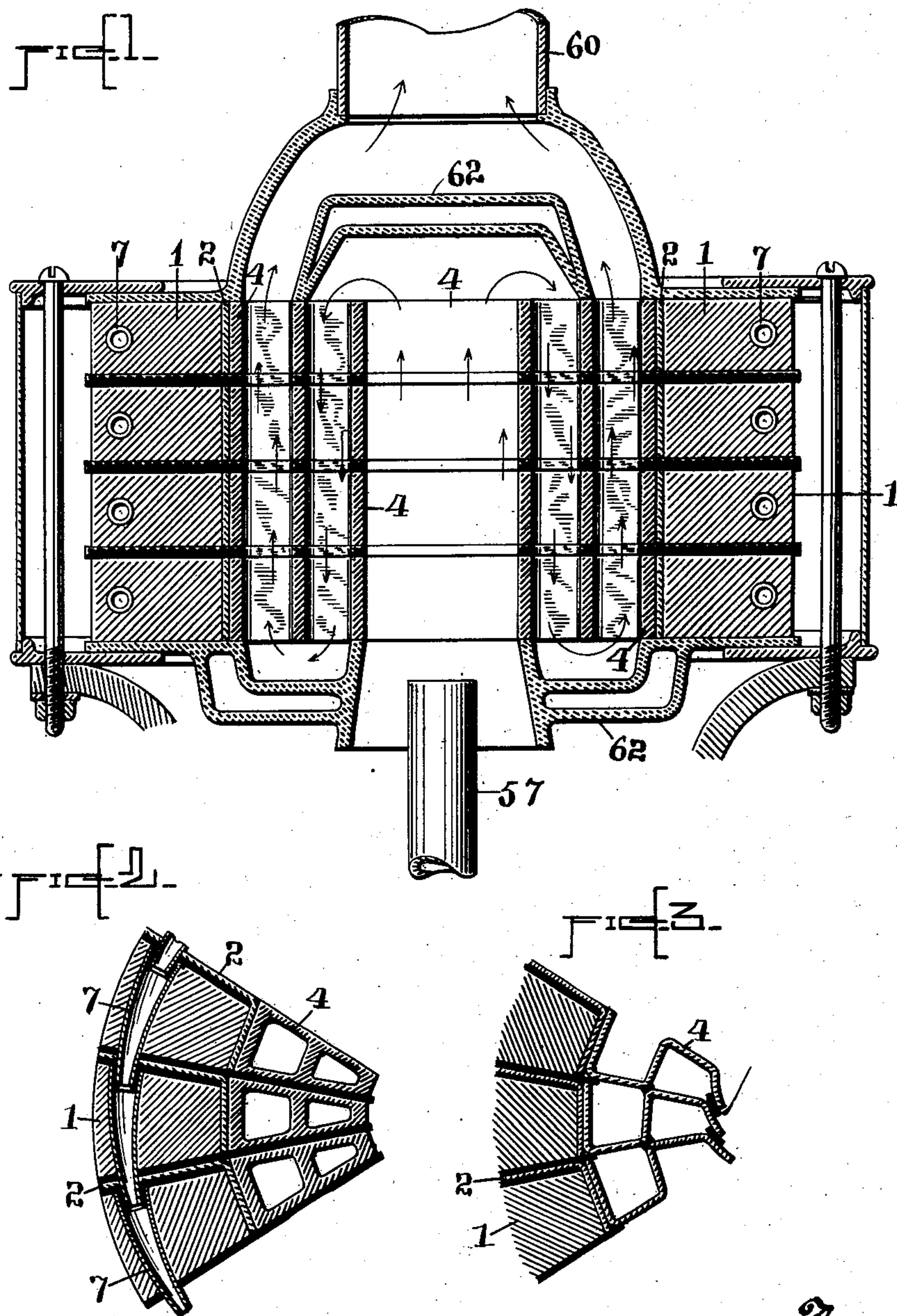
PATENTED NOV. 1, 1904.

M. J. WIGHTMAN.  
THERMO ELECTRIC GENERATOR.

APPLICATION FILED APR. 8, 1901. RENEWED APR. 7, 1904.

NO MODEL.

2 SHEETS—SHEET 1.



Witnesses:  
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E. L. Lawler

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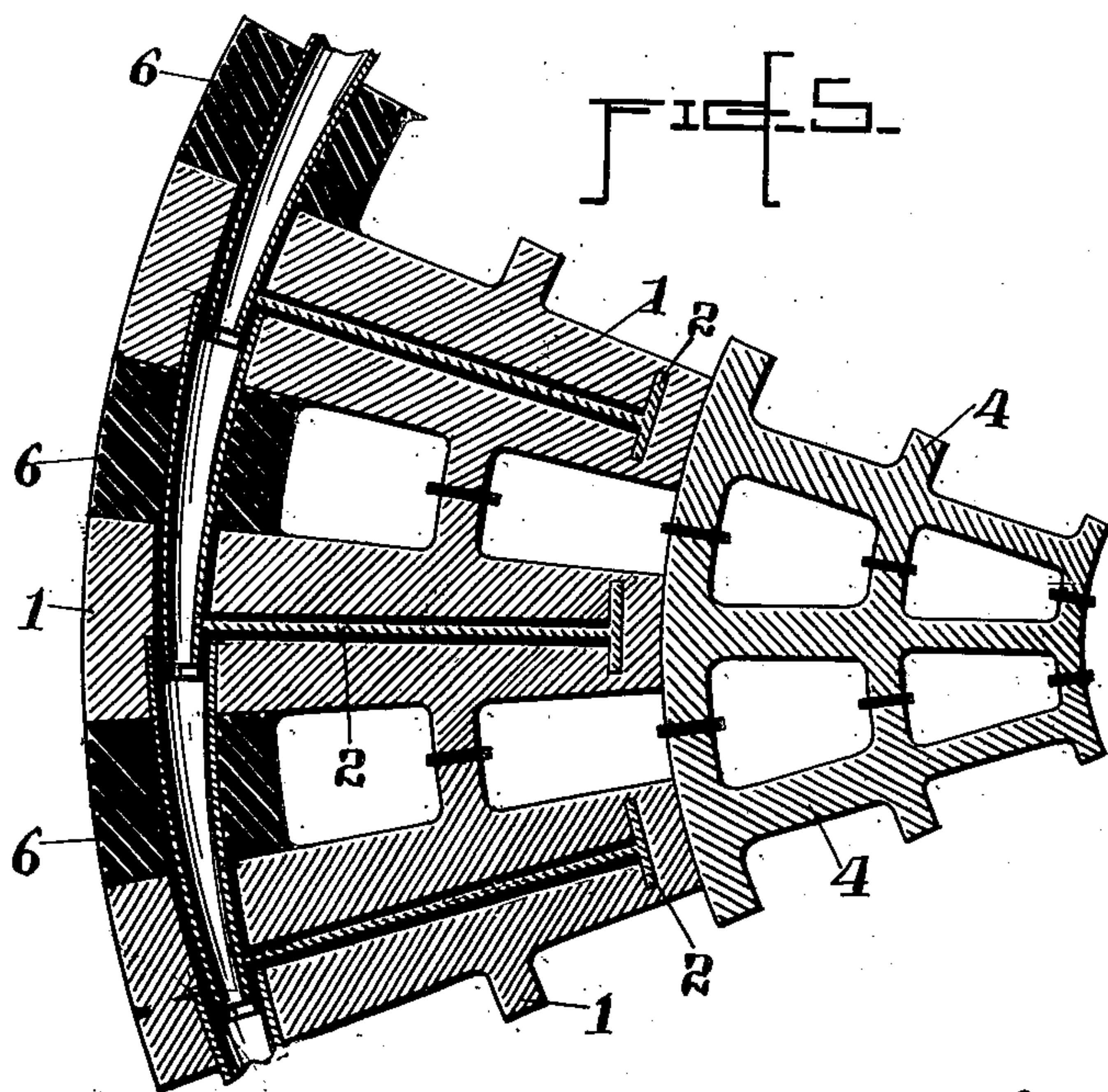
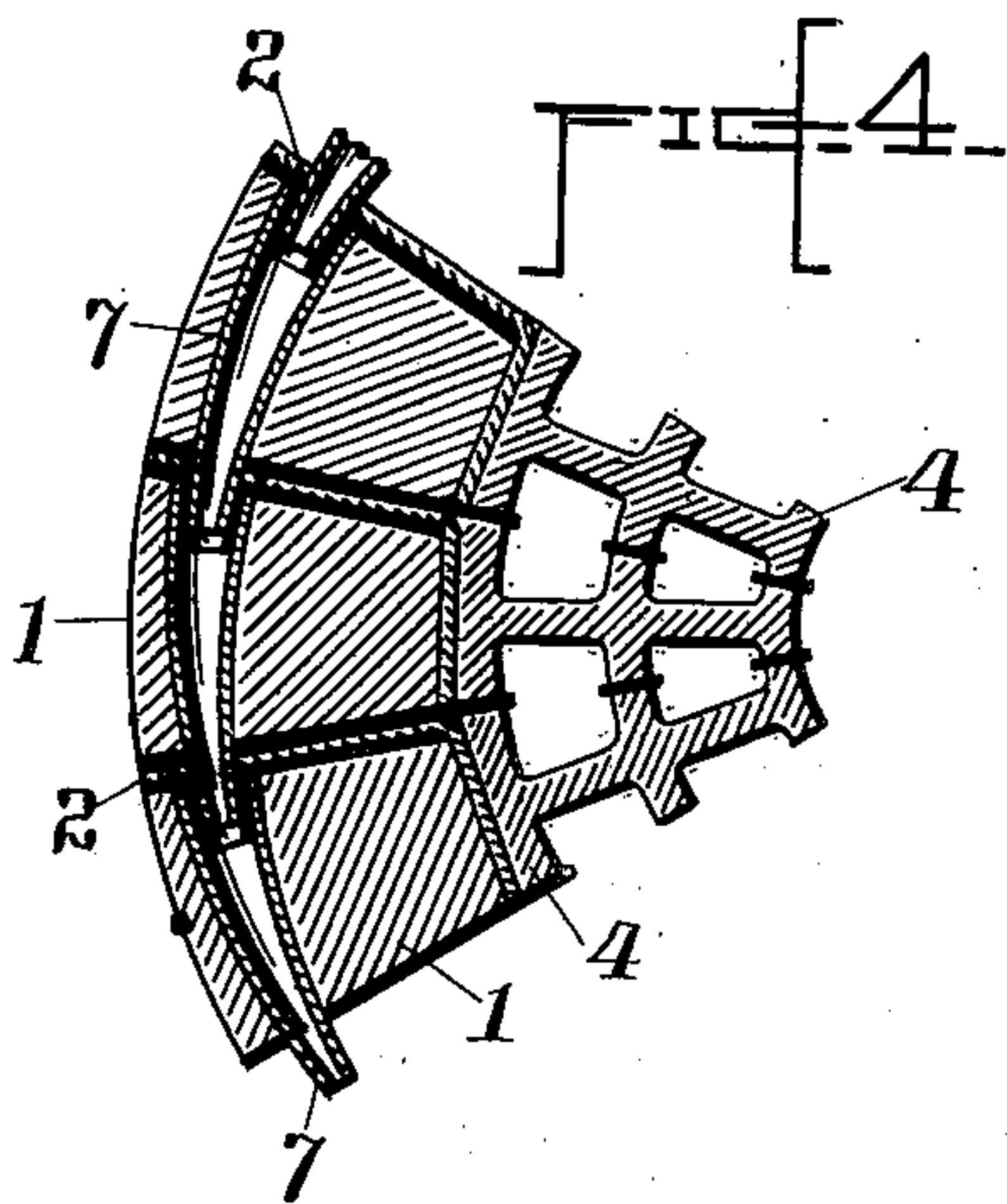
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NO MODEL.

2 SHEETS—SHEET 2.



Witnesses:

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# UNITED STATES PATENT OFFICE.

MERLE J. WIGHTMAN, OF NEW YORK, N. Y., ASSIGNOR TO THE PYRO ELECTRIC COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

## THERMO-ELECTRIC GENERATOR.

SPECIFICATION forming part of Letters Patent No. 773,839, dated November 1, 1904.

Application filed April 8, 1901. Renewed April 7, 1904. Serial No. 202,077. (No model.)

*To all whom it may concern:*

Be it known that I, MERLE J. WIGHTMAN, a citizen of the United States, and a resident of New York city, in the county of New York and State of New York, (whose post-office address is 50 Broadway,) have invented certain new and useful Improvements in Thermo-Electric Generators, of which the following is a specification.

The object of my invention is to secure compactness, high efficiency, and uniformity of action in the couples of the thermo-electric generator.

In order to obtain a high degree of efficiency in any thermocouple, it is necessary that there should be a transfer from the hot to the cooler portion of the couple of a large quantity of heat. This would naturally be accomplished by constructing the heat-collecting tip of the couple of sufficiently large heat-absorbing capacity, so as to be capable of absorbing a large amount of heat from the heating agent circulating over or through the same; but in order that said agent shall pass out of the device at as low a temperature as possible, so as to secure high efficiency, the heat-absorbing tips must be large, and this fact interferes with the construction of a compact and practical generator. I aim to avoid this difficulty as far as possible by constructing the generator, whether made of one or more couples, in such a manner that the heating agent shall come successively into contact with those portions of the couple which are successively at lower degrees of temperature or heat potential. In other words, I make the heating agent—as, for instance, the hot gases of combustion from the gas-flame—follow or circulate in the general direction of the fall of heat potential or drop in temperature in the couple itself. In adapting this principle to a single couple the gases should theoretically be made to flow in a direct line from the hottest toward the coolest portion of the couple, and theoretically it would be possible to so construct the device that the gases or other heating agent would give up

all their heat and emerge at the temperature of the cooler portion of the couple. In practice, however, it is desirable to use distinct heat flues or passages through which the agent flows successively, those flues or portions of flues which are nearest the cold junction being those through which the agent flows last and those nearest the heating junction or portion of the couple being those into which it is first introduced, so as to follow, as already described, the drop of heat potential in the couple. This principle when applied to a generator built up from a number of couples lends itself readily to the attainment of another object of my invention, which is to secure uniform heating of all the couples of the generator. In ordinary forms of generator, in which the couples are arranged in circles around the heating-chamber, difficulty is experienced in heating all the layers of the generator to the same temperature. This difficulty I avoid by causing the heating agent to pass by a return flue or passage toward its outlet in a reverse direction, so that as it nears the outlet it shall successively heat those couples of the pile which are nearest the inlet, and therefore are in contact with the heating agent when the latter is at its highest temperature. Any number of heating flues or passages may be provided in which the heating agent shall circulate alternately in reverse directions, those passages which are nearest the outlet being, however, arranged nearest the cold junction or portions of the pile.

Another feature of my invention relates to the construction of the heating extension or tip of a thermocouple; and it consists, substantially, in so forming or constructing it that when the couples are assembled in a pile the said extensions shall in conjunction with one another form the flues or passages for the heating agent. This part of my invention consists, moreover, broadly, in so constructing the couples that when they are assembled they shall in conjunction with one another form heat flues or passages in which the heating agent may circulate backward and forward



through the pile any desired number of times. The flues or passages so formed may be confined to the heating extensions or tips of the couples or may be extended to take in the metal or portion of the couple constituting one of the elements thereof.

Referring to the accompanying drawings, Figure 1 is a partial vertical section of a thermo-electric pile embodying my invention. Fig. 2 is a partial longitudinal section through one of the layers of couples from which the pile is built up. Fig. 3 is a similar section showing a modified form of heating tip or extension. Fig. 4 is a similar view of another modification. Fig. 5 is a similar view of a modification wherein the heating flues or passages extend into the space between the couples, so that the metal of one element of each couple shall constitute a wall of the heating-flue.

Referring to Fig. 1, I have shown a pile consisting of four horizontal layers. Each couple may be of any desired form and may embody, as usual in the art, an element 1, consisting of a block of some alloy, such as zinc or antimony, and an element 2, consisting of an alloy of nickel and copper, or said elements may consist of any other desired materials assembled in any desired way. In Fig. 2 the hot junction of the elements, as indicated, is formed by bringing the strip of metal constituting the element 2 around to the inner end of the element 1, where it is united with said element in the usual manner. The element 1 at its side is insulated from the element 2 by a strip of mica or other material, as usual in the art, and said elements are joined up in electric series in the usual manner. A duct for the flow of a cooling fluid is indicated at 7 in each couple, said duct being connected so as to form a continuous duct and insulated where necessary at the points where they are coupled together, as more particularly described in another application for patent filed by me July 13, 1900, Serial No. 23,454. Soldered or brazed to the junction of the couples at their inner ends where the heat is to be applied are suitable heating extensions, (designated by the numeral 4.) These are of brass, copper, or other good conductor. Each heating extension preferably is formed to provide two passages, as shown in Figs. 2, 3, and 4; but each might have a greater number, or, if desired, one of said ducts or passages might be dispensed with. The form which these heating extensions take may be considerably varied; but those for adjoining couples should be suitably insulated by some refractory material, as shown in the figures of the drawings by the heavy black line. When the couples are assembled in a pile, the layers are separated from one another by the usual intervening layers of asbestos or similar material, and the layers are clamped together in

a frame in the manner indicated or in any other suitable way.

57 indicates the gas-burner, by means of which the heating agent in the shape of hot gases of combustion may be applied to the pile. The circulation of said agent is indicated by the arrows as passing up through the central passage formed within the assembled ends of the couples, then down through the heating extensions at their extremities, and then through the passages in the heating extensions, which are still farther removed from the central flue, and out through the chimney 60. As will be seen, the gases as they gradually part with their heat pass in contact successively with those portions of the couples which are cooler, and by passage in inverse order through the successive flues the heating of the couples of the different layers may be practically equalized, so that the total amount of heat taken up or applied to the upper layers will be the same as that of the lower ones. The gases are directed from one flue to the other by properly-formed heads or caps 62, of fire-clay or other refractory material, the lower one of which has a flange shown as clamped against the lower layer of couples. Said heads are also preferably made hollow, so that they may have air-space, which shall aid in making them insulators of heat, and thereby preventing the escape or dissipation of heat from the heating agent.

In the modification of my invention shown in Fig. 5 there are four distinct heat-flues provided, through which the gas may be made to circulate first down, then up, then downwardly and upwardly again and out. The element 2 of the pile is in this modification shown as embedded in the element 1, and the body of the latter is so formed that adjoining couples may form the heat flue or passages when assembled in the pile. As will be seen, the general direction of the flow of the heating agent is that of the drop of heat potential in the couple, so that as the gas or agent cools it shall successively come into contact with portions of the couple which are successively cooler, since they are nearer the cold portion of the couple.

In the modification shown in Fig. 5 the element 2 is joined to a tube through which the cooling fluid is circulated, and said tube constitutes the electrical connection between the element 2 and the element 1 of an adjoining couple in the electric series. Suitable blocks of insulated material are interposed between the couples of each layer at their cold ends, as indicated at 6.

It is obvious that the invention may take many other forms, all embodying the general principles hereinbefore set forth, and that the invention is readily applicable to other constructions of thermo-electric couples and thermo-electric piles.



I claim as my invention—

1. A thermo-electric pile in which the couples are formed as described to constitute between adjoining couples heat-flues for the  
5 circulation of the heating agent.
2. A thermo-electric pile in which the couples are provided with heating extensions formed as described to constitute flues for the circulation of the heating agent.
- 10 3. The combination with a thermo-electric couple, of means for circulating the heating agent so that it shall follow the direction of the fall of heat potential or drop in temperature in said couple.
- 15 4. A thermo-electric pile having a return heat flue or flues for the heating agent in which said agent circulates in a reverse direction so

as to equalize the heating of the couples, as and for the purpose described.

5. A thermo-electric pile provided with heating extensions formed to constitute two or more heat-flues in which the heating agent circulates so as to heat the couples in reverse order thereby equalizing the heating of the couples of the pile, as and for the purpose  
20 described.

Signed at New York, in the county of New York and State of New York, this 5th day of October, A. D. 1900.

MERLE J. WIGHTMAN.

Witnesses:

DELBERT H. DECKER,  
ETHEL L. LAWLER.