

F. D. SHINDEL.

THERMO ELECTRIC GENERATOR.

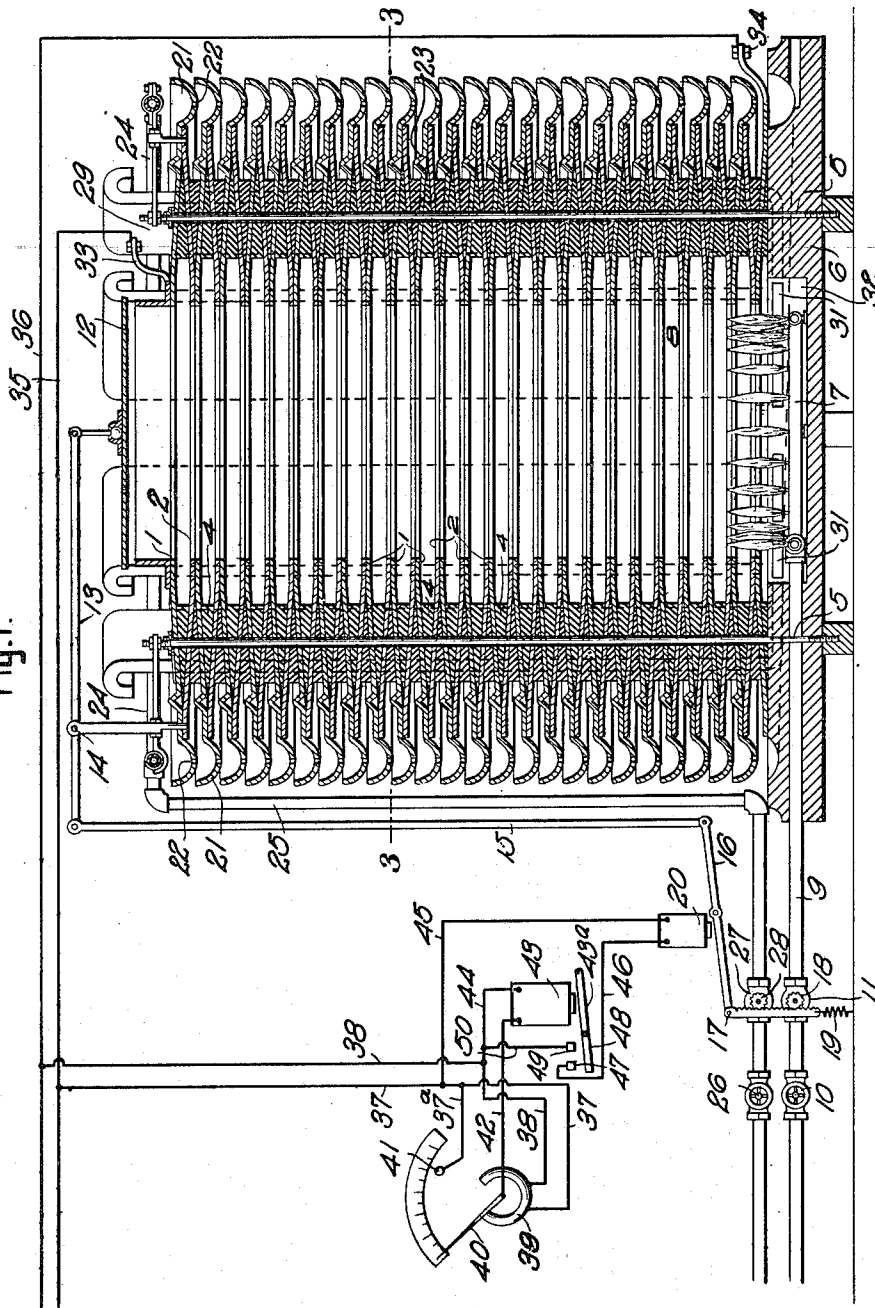
APPLICATION FILED OCT. 29, 1915. RENEWED SEPT. 7, 1917.

1,286,429.

Patented Dec. 3, 1918.

2 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

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2 SHEETS—SHEET 2.

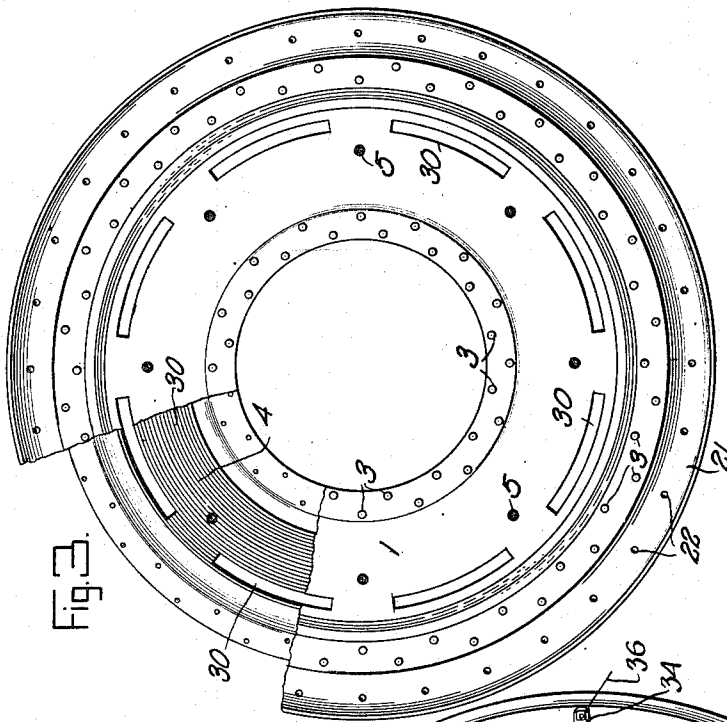


Fig. 3.

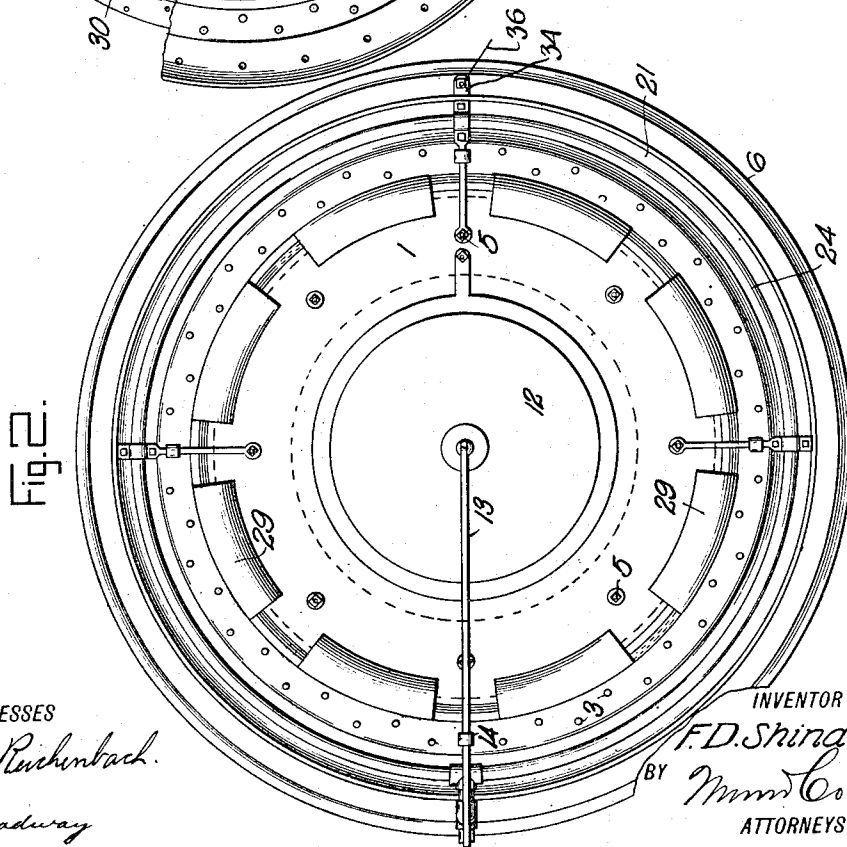


Fig. 2.

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THERMO-ELECTRIC GENERATOR.

1,286,429.

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Patented Dec. 3, 1918.

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To all whom it may concern:

Be it known that I, FRANK D. SHINDEL, a citizen of the United States, and a resident of Northampton, in the county of Northampton and State of Pennsylvania, have invented a new and Improved Thermo-Electric Generator, of which the following is a full, clear, and exact description.

This invention relates to generators of electric current, and more particularly to thermo-electric generators.

The invention has for its general objects to improve and simplify the construction of apparatus of this character so as to be reliable and efficient in use, comparatively simple and inexpensive to manufacture, and so designed as to be of high efficiency and low internal ohmic resistance.

A further object of the invention is the provision of a thermo-electric generator in which the couples of dissimilar metal are so arranged as to be effectively heated and cooled in such a way and at such points as to produce a current of maximum strength for an apparatus of minimum size.

A more specific object of the invention is the provision of a generator in which the couples of dissimilar metal are of annular form and so arranged as to produce a hollow cylindrical structure the interior of which may be heated by gases from a special burner or by gases passing off through a smoke stack, chimney, stove flue or the like, whereby the inner edges of the couples are heated, the outer edges being cooled by the flow of water or other cooling liquid, and further by the flow of cold air supplied to the burner when a special burner is required for the generator.

Another object is the provision of automatic regulating means whereby the heating and cooling are regulated according to the consumption of current in the circuit supplied by the generator, the regulating being effected by means for controlling the cooling water supply or the heat, or both.

With such objects in view, and others which will appear as the description proceeds, the invention comprises various novel features of construction and arrangement of parts which will be set forth with particularity in the following description and claims appended hereto.

In the accompanying drawings, which illustrate one embodiment of the invention

and wherein similar characters of reference indicate corresponding parts in all the views,

Figure 1 is a central vertical section of the generator;

Fig. 2 is a plan view thereof; and

Fig. 3 is a horizontal section on the line 3-3, Fig. 1.

The generator comprises a series of pairs of dissimilar metal rings 1 and 2, as copper and cast iron respectively, the said rings being of the same diameter and oppositely dished so that the inner edges will lie in different planes from the outer edges. The rings are arranged in superimposed relation with the inner marginal portions of the iron rings 2 in contact with the top of the inner marginal portions of the copper rings 1, and the outer marginal portions of the iron rings 2 are in contact with the under sides of the corresponding portions of the copper rings. The contact portions of the rings are fastened together by rivets 3, and also the edges are preferably electrically welded so that the very best electrical connections are secured. The portions of the rings between the inner and outer edges are kept out of contact by interposed rings or washers 4, the mean diameters of which are the same as the mean diameters of the rings 1 and 2. These insulating rings 4 are made of compressed asbestos or equivalent material, and alternate rings taper inwardly and outwardly in cross-sectional form so as to conform to the zigzag arrangement of the plates or rings 1 and 2. The rings 1, 2 and 4 are rigidly fastened together by bolts 5 which are suitably insulated from the rings and which are fastened at their lower ends to a supporting base 6. The inner and outer edges of the metallic rings project inwardly and outwardly respectively from the insulating rings so that the structure resulting is a hollow cylinder having internal and external annular metallic ribs. The internal metallic ribs are adapted to be heated in any suitable manner, as, for instance, by the flue gases passing from a furnace or stove. As shown in the present instance a burner 7 may be arranged in the bottom of the chamber 8 so that the heated gases will flow upwardly and effectively heat the inner edges of the metallic couples 1 and 2. The burner 7 may be of the gas or vapor type and supplied with fuel through a pipe 9

controlled by a hand valve 10 and a regulating valve 11. At the top of the flue or chamber 8 may be arranged a damper 12 connected with and suspended by a lever 13 which is fulcrumed on a suitable support at 14, and this lever 13 is connected by a link 15 with another lever 16, which latter is in turn connected with a rack 17 meshing with a pinion 18 on the stem of the valve 11, there being a spring 19 connected with the rack for moving the same in one direction. The rack is moved in the opposite direction by an electromagnet 20 which operates on the lever 16, such electromagnet 20 being responsive to current of a certain value developed by the generator.

The outer edges of the couples 1 and 2 are adapted to be cooled by water or any equivalent cooling medium, and for this purpose the copper rings 1 have annular troughs 21 formed at their peripheries, and these troughs have fine apertures 22 in the bottom of each so that water can flow downwardly from one trough to another, thereby cooling the metal so that the outer edges of the metallic couples will be considerably lower in temperature than are the inner edges. The copper rings 1 may be provided with upstanding annular ribs 23 inwardly from the troughs so that there is no danger of water entering between the metallic plates and forming electric grounds. Disposed over the uppermost trough 21 is an annular pipe 24 having apertures in its bottom to discharge water into such uppermost trough. This pipe 24 is connected with a supply pipe 25 that has a hand valve 26 and a regulating valve 27, the stem of which has a pinion 28 which meshes with the rack bar 17. To further cool the outer edges of the rings 1 and 2 air supply ducts 29 extend vertically through the rings, such rings having openings 30 for the passage of the ducts 29. The lower ends of these ducts connect with ports 31 which open into a chamber 32 in the base plate 6 for holding the burner 7. The upper ends of the ducts terminate above the generator and are bent downwardly and open so that air can enter free from dirt and other particles.

The regulation of the generator is electromechanical. The positive and negative terminals 33 and 34 are connected with service wires 35 and 36, respectively, and connected across this circuit by wires 37 and 38 is a coil 39 of a galvanometer which has a needle 40 that forms a movable contact adapted to engage with a relatively fixed contact 41 which may be adjustable for different operating conditions. The contact 40 is connected by a wire 42 with an electromagnet 43 that is also connected by a wire 44 with the wire 38. One terminal of the electromagnet 20 is connected by a wire 45 with the wire 37, and the other terminal is adapted to be connected with the wire 38 by wires 46, contacts 47, 48

and 49, and wire 50. By this arrangement of electrical devices the heating and cooling of the thermoelectric couples of the generator can be regulated. When the electric pressure in the supply mains 35 and 36 exceeds a certain point the contact 40 engages the contact 41 and thereby causes current to flow from the wires 35, 37 and 37^a, contacts 41 and 40, wire 42, electromagnet 43, wires 44, 38 and 36. This energizing of the electromagnet 43 causes the armature 43^a to be attracted so as to engage the contact 48 with the contacts 47 and 49, thereby closing the circuit of the magnet 20, resulting in current flowing through the wires 37 and 45, electromagnet 20, wire 46, contacts 47, 48, 49, wire 50 and wire 38. The energizing of the electromagnet 20 attracts the lever 16 so that the fuel and water valves 11 and 27 are actuated to cut down the supply of fuel and water, and at the same time the damper 12 is raised to allow heat to escape from the generator. When the foregoing action takes place, fuel and water being diminished, the voltage of the generator will start to drop and the contact 40 will then move away from contact 41, which will open the circuit of the magnet 43, whose armature will in turn open the circuit of the magnet 20, which after being de-energized will permit the spring 19 to open the fuel and water valves to increase the flow in the same, which will, of course, produce the effect first mentioned; that is, of the increasing of voltage and causing the contact 40 to move toward 41. The cycles or frequency of these operations will depend upon the amount of current taken from the generator.

Referring to the openings 30 in the rings 1 and 2, it will be observed that only narrow portions are left between adjacent openings, which so reduces the cross-section of the metal that the rapid conduction of heat from the inner to the outer edges of the rings is prevented. It will be understood that the action of the heat on the inner edges of the rings 1 and 2 and of the cold on the outer edges produces electrical pressures, and as the rings are connected in series the pressures are added together so as to develop a considerable electromotive force at the terminals 33 and 34.

From the foregoing description taken in connection with the accompanying drawings, the advantages of the construction and method of operation will be readily understood by those skilled in the art to which the invention appertains, and while I have described the principle of operation, together with the device which I now consider to be the best embodiment thereof, I desire to have it understood that the device shown is merely illustrative and that such changes may be made when desired as fall within the scope of the appended claims.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. In a thermo-electric generator, the combination of thermo-couples connected in series in the form of rings of dissimilar metal alternately arranged, insulating material disposed between adjacent rings and cooperating therewith to form a body having internal and external ribs formed by the metal rings, a burner in the bottom of the body for heating the inner edges of the rings, air supply ducts extending downwardly through the rings to supply air to the burner and to assist in cooling the outer portions of the rings, and means for subjecting the outer edges of the rings to the action of a cooling fluid.

2. In a thermo-electric generator, the combination of thermo-couples connected in series in the form of rings of dissimilar metal alternately arranged, insulating material disposed between adjacent rings and cooperating therewith to form a body having internal and external ribs formed by the metal rings, a burner in the bottom of the body for heating the inner edges of the rings, air supply ducts extending downwardly through the rings to supply air to the burner and to assist in cooling the outer portions of the rings, means for subjecting the outer edges of the rings to the action of a cooling fluid, and an electrically regulated damper cooperating with the burner.

3. The combination of a thermo-electric generator, a burner for heating the same, a fluid cooling device for the generator, a damper cooperating with the burner, and an electrical means responsive to the terminal voltage of the generator for controlling the damper and the supply of fuel and cooling fluid to the burner and cooling means respectively.

4. In a thermo-electric generator, a stack of coaxially disposed rings, alternate rings being formed from a given metal and being dished downwardly and the remaining rings being formed from a dissimilar metal and dished upwardly, alternate pairs of neighboring rings being joined at their inner edges and the remaining pairs of neighboring rings being joined at their outer edges, means for heating one set of junctions, and means providing ducts for cooling fluid traversing said rings intermediate their inner and outer edges, whereby the transfer of heat to the other set of junctions is largely prevented.

5. In a thermo-electric generator, a stack of coaxially disposed rings, alternate rings being formed from a given metal and being dished downwardly and the remaining rings being formed from a dissimilar metal and dished upwardly, alternate pairs of neighboring rings being joined at their inner edges and the remaining pairs of neighboring

rings being joined at their outer edges, means for heating the inner set of junctions, means for cooling the outer set of junctions, and means providing ducts for cooling fluid traversing said rings intermediate their inner and outer edges, whereby the transfer of heat to the outer set of junctions is largely prevented.

6. In a thermo-electric generator, a stack of coaxially mounted rings, alternate rings being dished upwardly and the remaining rings being dished downwardly, alternate pairs of immediately adjacent rings being joined at their inner edges and the remaining pairs of immediately adjacent rings being joined at their outer edges, all joined rings being of dissimilar metals, means for heating one set of junctions, and means providing ducts for cooling fluid traversing said rings intermediate their inner and outer edges, whereby the transfer of heat to the other set of junctions is largely prevented.

7. In combination, a thermo-electric generator comprising hot and cold junctions, means for supplying heat to the hot junctions thereof, means for supplying cooling fluid to the cold junctions thereof, and electro-responsive means subject to the terminal voltage of said generator and arranged to control said supplies of heat and of cooling fluid, respectively.

8. In combination, a thermo-electric generator comprising hot and cold junctions, means for supplying heat to the hot junctions, means for supplying cooling fluid to the cold junctions, and electro-responsive means connected across the terminals of said generator and arranged to control the supply of said cooling fluid, said electro-responsive means being adjusted to increase the supply of said cooling fluid when the voltage of said generator is less than a predetermined amount, and to decrease the supply of said cooling fluid when the voltage of said generator exceeds said predetermined amount.

9. In combination, a thermo-electric generator comprising hot and cold junctions, means for supplying heat to said hot junctions, means for supplying cooling fluid to said cold junctions, and electro-responsive means connected across the terminals of said generator and arranged to control said supplies of heat and of cooling fluid, respectively, said electro-responsive means being adjusted to increase the amount of heat supply and of cooling fluid when the voltage of said generator is less than a predetermined value and to decrease the amount of heat supply and of cooling fluid when the voltage of said generator exceeds said predetermined value.

10. The combination of a thermo-electric generator, a burner for heating the same, a fluid cooling device for said generator, a

damper cooperating with the burner, and electrical means responsive to the terminal voltage of said generator for controlling the damper and the supply of fuel and cooling fluid to the burner and cooling means respectively.

11. The combination of a thermo-electric generator, means for supplying heating medium thereto, a fluid cooling device for said generator, a damper controlling the flow of heating medium through said generator, and

electrical means responsive to the terminal voltage of said generator for controlling said damper and the supply of cooling fluid to the cooling means.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FRANK D. SHINDEL.

Witnesses:

W. T. KLEPPINGER,

W. I. ROWLAND.