Feb. 25, 1936. R. J. MATHIAS 2,031,966

CENTRIFUGAL THERMOELECTRIC MACHINE

Filed Nov. 26, 1934

Fig.1.

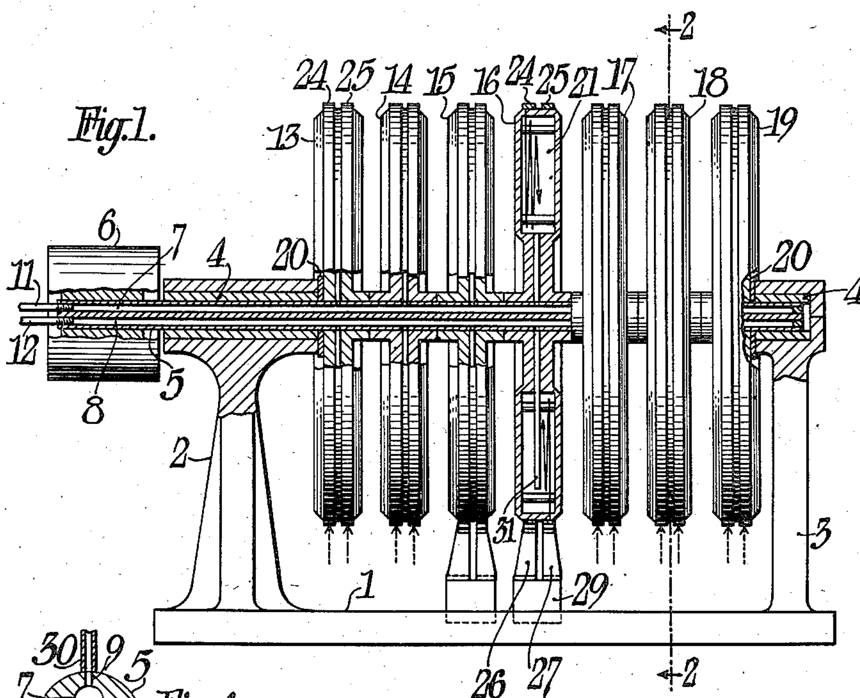


Fig.5.

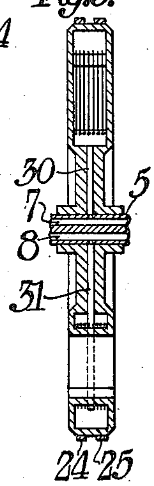
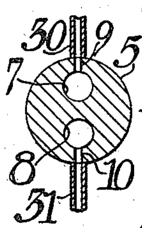


Fig.4.



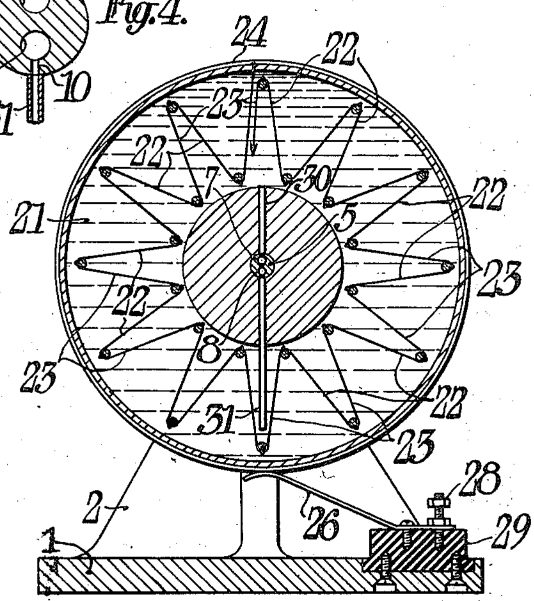


Fig.2.

Fig.6.

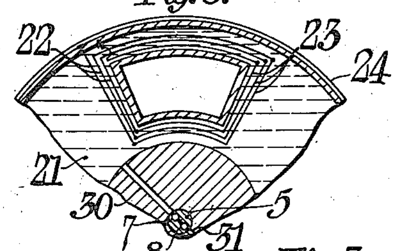
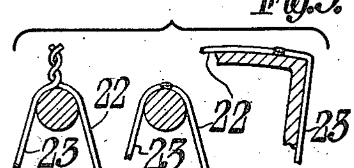


Fig.3.



Inventor:

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Patented Feb. 25, 1936 2,031,966

UNITED STATES PATENT OFFICE

2,031,966

CENTRIFUGAL THERMOELECTRIC MACHINE

Robert J. Mathias, Cincinnati, Ohio

Application November 26, 1934, Serial No. 754,925

5 Claims. (Cl. 136—4)

This invention relates to thermo-couple generators of electricity and more specifically relates to a generator in which useful temperature conditions are maintained in a fluid which surrounds or envelops the thermo-couple junctions, by centrifuging the fluid.

Most fluids contain molecules of different temperatures; these molecules may be made to take certain annular positions about an axis by centrifuging the fluid—the heavier and usually cooler molecules being forced towards the outer periphery, and the lighter and usually warmer molecules taking a position towards the inner periphery. It is the function of this machine to take advantage of this action through the placement of thermo-couple junctions in such annular positions, as to utilize the various temperature conditions maintained there.

As to the thermo-electric action within thermo-couples, physicists have long been acquainted with the fact that when certain pairs of different metals or alloys are joined together, as by twisting or joining together the ends of two different metal wires, then if the two opposite junctions are maintained at different temperatures, electromotive force is created within the junctions and metals. Generally this causes an electric current to flow in the circuit of the metals. The direction of the current flow depends on the metallic elements selected, as well as the temperatures created in opposite junctions. The reverse action is also known—that an electric current supplied to the thermo-couple circuit, tends to create temperature differences at the thermo-couple junctions.

Suitable thermo-couples may be made from copper wire and iron wire; or constantan wire and iron wire, by twisting, welding or otherwise making electrical connection of the ends. In doing this, the junction must consist of two different metal wire ends. Bismuth, platinum, lead, silver and antimony are some other metals frequently joined together in the making of thermo-couples.

The electric energy, or heating and cooling effects, that may be created in any thermo-couple circuit with but two junctions is quite small, being commonly measured electrically in micro-volts per degree of temperature difference, or, fractions of calories thermally. To increase the amount of energy, thermo-couple circuits are often made with thermo-couples connected in series.

Considerable information on the actions and effects within thermo-couples is available in countless texts on physics and electricity, and further elaboration is hardly necessary here.

More specifically, my invention comprises a radial arrangement of thermo-couples, with opposite junctions placed towards the outer and inner diameter of the structure respectively. These junctions utilize the different temperature conditions maintained thereby centrifuging a fluid contained within the structure and in thermal contact with the thermo-couple junctions.

It is an object of my invention to provide a thermo-couple generator of electricity. A further object is to provide such a generator in which temperature differences at the junctions of the thermo-couples is maintained by centrifuging a fluid in contact with the thermo-couples. Another object is to provide such a generator in which the junctions of the thermo-couples are arranged annularly. Further objects will appear hereinafter.

In the accompanying drawing, in which like reference numerals refer to like parts:

Figure 1 is a longitudinal elevational view of the machine, with certain parts shown in section,

Figure 2 is a transverse vertical section, taken along the line 2—2 of Figure 1,

Figure 3 illustrates various forms of junctions,

Figure 4 is an enlarged cross-section of the rotor shaft, with radial conduits indicated in positions,

Figure 5 is a vertical section of an alternative form of rotor unit, the lower quadrant being rotated 45° to throw it into section, and

Figure 6 is a fragmentary section of the alternative form of rotor unit taken through the center of Figure 5.

A base 1 and pedestals 2 and 3 form the support of the machine. The pedestals 2 and 3 are fitted with bearings 4 in which the shaft 5 is free to revolve. A pulley 6 is keyed to the shaft 5.

The shaft 5 is drilled longitudinally to provide conduits 7 and 8, and is drilled radially to provide ports 9 and 10, which are 180 degrees apart.

Supply pipes 11 and 12 are screwed into the conduits 7 and 8 of the shaft respectively. These supply pipes are journaled so as to permit supply of a fluid through the shaft when the shaft is in revolution.

Mounted and keyed to the shaft 5, are seven cylindrical units 13, 14, 15, 16, 17, 18 and 19. These units and the shaft on which they are mounted, form the rotor of the structure. Thrust or spacer washers 20, are provided to minimize end-play. The general construction of these rotor units 13, 14, 15, 16, 17, 18 and 19 is the same, in that they are cast or molded from a suitable insulating material, such as bakelite, glass, cellulose acetate or the like—and which can be cast with suitable inserts as hereinafter described. The molding of countless electrically non-conducting, or insulating materials in diverse shapes, sizes and inserts is well known to those skilled in the molding art, and further description of these operations is not necessary in this application.

Cast also in each rotor unit is a structure of thermo-couples illustrated diagrammatically in Figure 2 as 22 and 23; and also indicated conventionally in Figure 1 in rotor 16. While innumerable pairs of metals may be chosen as previously mentioned; in this machine one metallic element is represented as 22 (such as iron) the other metallic element as 23 (such as copper). The metallic elements alternate in the arrangement and by their connections, form an assembly of thermo-couples connected in series. In the diagram of Figure 2 one end of the series is shown in contact with a slip ring 24. The other end carries an arrow indicating a continuation of the progression, around and around in the rotor, until the series fills the chamber 21; whereupon the remaining end is connected to a second slip ring 25, indicated in rotor 16 of Figure 1. To avoid short-circuiting of thermo-couples which are in contact with each other at various points in the winding, the individual thermo-couples are coated with electric insulating enamel or varnish, so that the entire thermo-couple structure becomes electrically insulated.

The number of thermo-couples in each rotor is exceedingly large, and may be still further increased by increasing the width of the rotor unit.

The construction of the thermo-couple structure in one of the rotor units is essentially one of thousands of thermo-couples of small wire, or of thin stampings of the sheet metals, or of other adaptable shapes and cross-sections. Junctions may be formed by welding, soldering, mechanical fastening, or otherwise connecting the ends of the two different metals to each other. To one skilled in the art in the formation of wire coils, webs, networks, and other windings, together with the maintenance of suitable electric insulation between the elements of the unit, the construction of such a thermo-couple structure as above described will be readily apparent.

A reason for the size and plurality of rotor units in this drawing is in the adaptability of such a construction for use in the inventions of my application Serial Number 754,926, for Thermo-electric motor-generator and my application Serial Number 754,927, for Thermo-electric turbine, all of even date, to which reference is made.

Referring again to slip-rings 24 and 25, these may be of copper, and a pair of rings encircle each rotor. It is to these slip-rings that electrical end connections of the thermo-couple assembly are made—and through which rings, along with contact fingers 26 and 27, and terminals 28, that electric current may be supplied or taken off from the machine.

Contact fingers 26 and 27, are mounted on fiber insulating blocks 29, fastened to the base 1. Contact fingers are shown in Figure 1, only on rotor units 15 and 16, although they are intended to be used with all rotor units and are indicated for simplicity by arrows properly positioned at the slip-rings.

Figure 3 illustrates how thermo-couple junctions may be made by twisting, welding or brazing the wire ends.

A variation in arrangement of the thermo-couples is illustrated in the modified rotor unit of Figures 5 and 6 in which the radial arrangement of individual thermo-couples is not followed; nevertheless opposite junctions are still located towards inner and outer diameters respectively. The ends of the thermo-couple assembly are also fastened to slip-rings on the rotor unit. There is illustrated in Figure 6, only one quadrant of the four designed for each rotor unit, and while such a construction can function satisfactorily in the machine of this application, a further and more efficient use is indicated in my application Serial No. 754,926, of even date.

Referring now to the operation of the machine. The rotor units 13, 14, 15, 16, 17, 18 and 19 contain an electrically non-conductive fluid which completely fills the annular chambers therein, and which completely surrounds the countless thermo-couples and thermo-couple junctions. I may use any suitable electrically non-conducting fluid, such as transformer oil, glycerin, and the like or even a conducting fluid, if the thermo-couple wires are well insulated. If the rotor be revolved through application of suitable power at pulley 6, the molecules of the fluid will all be acted upon by centrifugal force. If a portion of the fluid be withdrawn now through the passage-way 31, and in its place hot fluid be supplied, through passage-ways 7 and 30, then the hot molecules will take an annular position towards the inner periphery of the chambers, while the cooler molecules will remain at the outer periphery of the chamber. Since opposite thermo-couple junctions are also placed at these inner and outer peripheries and acquire temperatures of the fluid at those positions, through conduction of heat, electric current is produced in the thermo-couple structure and taken off at slip-rings 24 and 25.

As hot molecules lose some of their heat, becoming cooler and denser, they are forced by centrifugal force towards the outer periphery, and the hotter molecules supplied in the fluid take the inner annular position.

One exception to the production of electric current in this machine exists in that instance wherein temperatures of opposite junctions have become equally higher and lower than the "neutral-point" of the pair of metals used in the thermo-couples. No net electric current will be available under circumstances as these. The theory of this subject, as well as that of direction of current flow, is treated in innumerable physics texts.

If the cycle just previously described be reversed, and electric energy be supplied the thermo-couple structure from an external source, then heating and cooling effects will be created at opposite thermo-couple junctions; and through the heat exchange and centrifugal action in the fluid, cold fluid may be made to pass through passage-ways 31 and 8; or hot fluid passed through passage-ways 30 and 7.

While in Figs. 5 and 6 I have shown four quadrants or units, it will be understood that I may employ six, eight, ten, twelve or even more thermo-couple units spaced an equal number of degrees apart about the axis of the rotor and contained in the rotor casing.

What I claim as my invention and desire to be secured by Letters Patent of the United States is:

1. A thermo-electric machine comprising a rotatable casing containing an electrically non-conductive liquid and mounted upon an axis, a thermo-couple system contained therein and enveloped by said liquid, one set of junctions of which system are located near the periphery of said casing and the other set of junctions of which system are located in proximity to the center of said casing, and means for removing electricity from said system when the casing is rotated upon its axis.

2. A thermo-electric machine comprising a cylindrical rotatable casing containing an electrically non-conductive liquid and mounted upon an axis, a thermo-couple system contained therein and enveloped by said liquid, one set of junctions of which system are located substantially annularly near the periphery of said casing and the other set of junctions of which system are located substantially annularly near the center of said casing, and means connected with said thermo-couple system for removing electricity therefrom when the casing is rotated upon its axis.

3. A thermo-electric machine comprising a cylindrical rotatable casing containing an electrically non-conductive liquid and mounted upon an axis, a thermo-couple system contained therein and enveloped by said liquid, the elements of which system are substantially radially positioned with respect to the axis of the casing and one set of junctions of which system are substantially annularly located near the periphery of the casing and the other set of junctions of which system are substantially annularly located near the center of the casing, and means for removing electricity from said system when the casing is rotated upon its axis.

4. A thermo-electric machine comprising a cylindrical rotatable casing containing an electrically non-conductive liquid and mounted upon an axis, four quadrants of thermo-couples contained therein and located 90° apart, and enveloped by said liquid, one set of junctions of each quadrant being located near the periphery of said casing and the other set of junctions of each quadrant being located in proximity to the center of said casing, and means connected with the four quadrants for removing electricity therefrom when the casing is rotated upon its axis.

5. A thermo-electric machine comprising a shaft and means for rotating the shaft, a casing containing an electrically non-conductive liquid mounted upon said shaft and adapted to rotate therewith, a thermo-couple system contained in the casing having one set of junctions near the periphery and the other set near the center of said casing, and which are enveloped by said liquid, openings in the shaft and the casing for introducing hot electrically non-conductive liquid thereto and openings in the shaft and casing for removing cold liquid therefrom, and means for removing electricity from said system when the casing is rotated upon its axis.

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