Jan. 12, 1943. W. A. RAY 2,307,956

THERMOELECTRIC GENERATOR

Filed June 17, 1940

Fig. 1

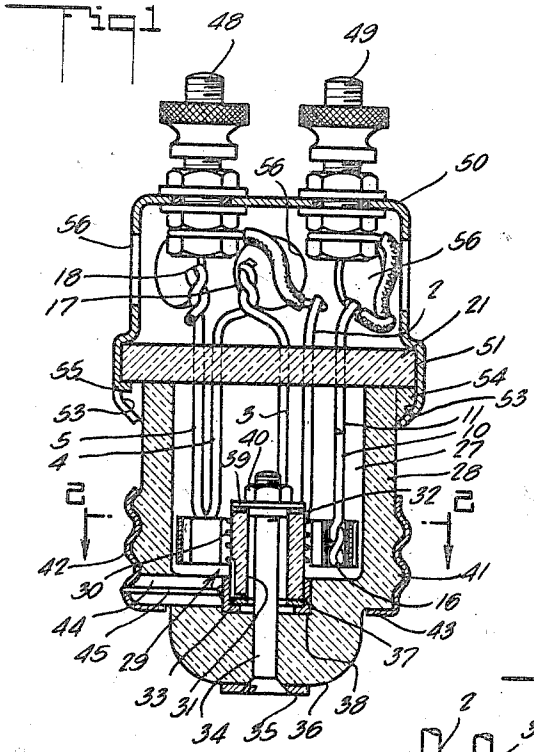


Fig. 4

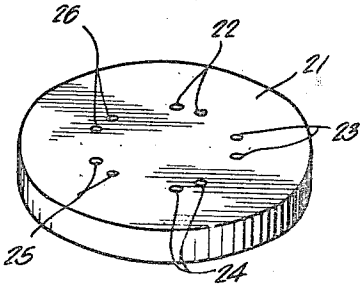


Fig. 8

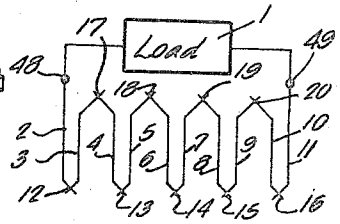


Fig. 7

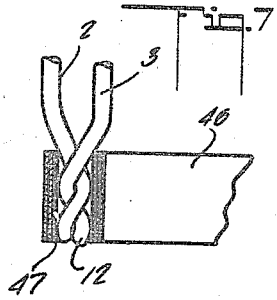
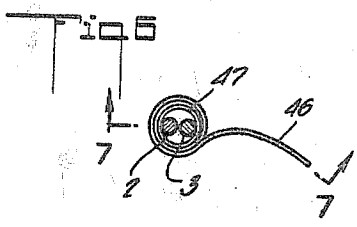


Fig. 6



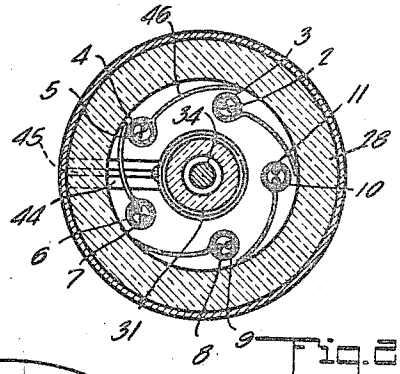


Fig. 2

Fig. 3

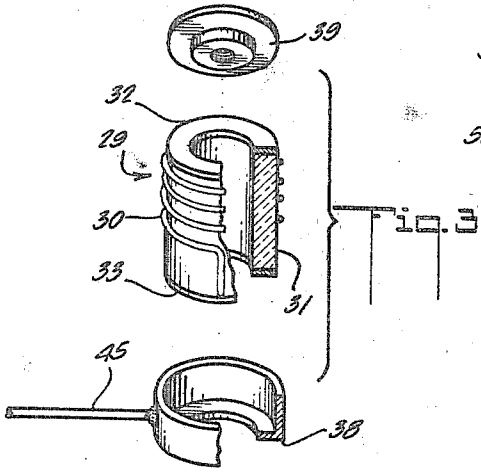
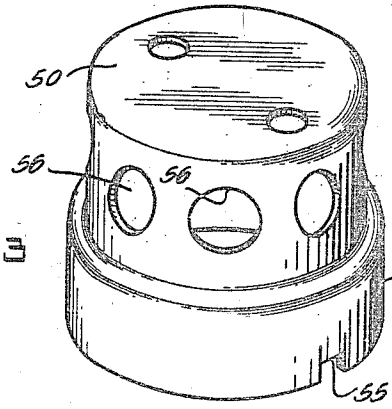


Fig. 5



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THERMOELECTRIC GENERATOR

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Application June 17, 1940, Serial No. 341,005

2 Claims. (Cl. 136—4)

This invention relates to a thermoelectric generator. The principles of thermoelectricity are now well understood; it is necessary merely to state that when conductors made from dissimilar metals or alloys are joined together, and heat applied to the junction, an electric current is generated. This current is a function of the temperature differential between this "hot junction" and the "cold junctions" where the free ends of the conductors are joined to a circuit. It has been common to utilize a thermopile having several hot and cold junctions, formed by joining alternate lengths of the dissimilar conductors, and applying heat to alternate junctions only. In this way, a series arrangement of individual thermocouples is obtained. In another form of thermopile, the individual thermocouples may be connected in parallel. The specific nature of the connections, as well as the number of junctions and the physical proportions of the elements may be chosen to comply with the desired characteristics of the thermopile.

It is one of the objects of this invention to provide a simple, compact and inexpensive thermoelectric device.

The hot junctions of a thermopile may be heated in any convenient manner, but in order to make it possible to install the device near any desired location, this invention contemplates the use of electric power as the source of heat. It is accordingly another object of this invention to provide an electrically heated thermopile, and preferably one arranged to be inserted in an ordinary socket outlet such as is encountered in commercial lighting circuits.

Thermoelectric devices of this character may be conveniently utilized as a source of low voltage direct current energy for operating control apparatus, such as are needed for example in heating and ventilating systems.

This invention possesses many other advantages, and has other objects which may be made more easily apparent from a consideration of one embodiment of the invention. For this purpose there is shown a form in the drawing accompanying and forming part of the present specification. This form will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of this invention is best defined by the appended claims.

Referring to the drawing:

Figure 1 is a sectional view, drawn on an enlarged scale, of an embodiment of the invention;

Fig. 2 is a sectional view taken along plane 2—2 of Fig. 1;

Fig. 3 is a pictorial view of elements of a heating unit, used in connection with the invention, the parts being shown separated, and one of the parts being shown in partial section;

Fig. 4 is a pictorial view of a cover member adapted to be used in connection with the invention;

Fig. 5 is a pictorial view of a cap adapted to be utilized with the invention;

Fig. 6 is a greatly enlarged end view of a hot junction of one of the thermocouples utilized with the invention;

Fig. 7 is a greatly enlarged sectional view taken along plane 7—7 of Fig. 6; and

Fig. 8 is a wiring diagram illustrating the mode of use of the thermocouple device.

In the present instance the thermoelectric generator is shown as including a plurality of thermocouples to form a thermopile. As shown diagrammatically in Fig. 8, these thermocouple structures are shown as connected in series to operate a load l; the number of thermocouples being a matter of choice. The thermocouples are formed by the pairs of conductors 2—3, 4—5, 6—7, 8—9 and 10—11. Each of the thermocouples is formed of dissimilar metals as heretofore explained; for example, Chromel and Copel. They are joined in series as illustrated more clearly in Fig. 8, the lower junctions 12, 13, 14, 15 and 16 forming the hot junctions. The upper junctions 17, 18, 19 and 20 form the cold junctions. The conductors 2 and 11 form the terminal conductors.

As shown most clearly in Figs. 1, 6 and 7, the junctions may be conveniently formed by twisting the ends of the respective conductors together; and if desired by joining them more permanently as by welding or fusion.

In the present instance the thermocouple conductors 2 to 11 inclusive are shown as passing through a cover member 21 (Figs. 1 and 4). This cover 21 is preferably made from a refractory insulation material such as porcelain or the like. To accommodate the thermocouple conductors the cover 21 is shown as having the pairs of apertures 22, 23, 24, 25 and 26.

The hot junctions 12 to 16 inclusive are shown as extending into the hollow space 27 of a hollow body 28. This hollow body 28 is also preferably made of a refractory insulation material such as porcelain. These hot junctions are thus disposed in an annular fashion about the axis of the body 28 which is of generally cylindrical

form. The cover member 21 serves to enclose the hollow space 27 and is held in closed relation in a manner to be hereinafter described.

Heat is radiated to the annularly arranged hot junctions 12 to 16 inclusive from an electric heating unit 29. This heating unit is shown as supported at the bottom of the space 27. It comprises a coil of wire 30 (Figs. 1 and 3) disposed around a refractory cylindrical hollow insulation support 31. The conductor 30 may be made from nichrome or other electrical heating wire. Its terminals may be connected to the conducting top and bottom washers 32 and 33.

In order to support the heating unit 29 in a substantially central position with respect to the hot junctions of the thermocouples a supporting post 34 is utilized. This post passes centrally through the body 31. It conveniently takes the form of a flat head screw with the threaded end extending above the heating unit 29. The screw 34 may pass through a terminal washer 35 disposed on the outside of the lower end 36 of the supporting body 28. In order that the post 34 may securely hold the heating unit 29 in place, the body 28 is provided with a recess 37 in the end portion 36, and in communication with the space 27. In this recess is set a supporting cup 38 of conducting material. The heating unit support 31 seats within the cup. By the aid of the washer 33 an electrical connection is made from the lower terminal of the wire 30 to the cup 38.

At the upper end of the heating unit 29 a conducting flanged washer 39 (Figs. 1 and 3) is provided. The flange of this washer overlies the washer 32 and provides an electrical connection to the upper terminal of the wire 30. The post 34 passes through the washer 39 and the nut 40 holds the assembly together.

The connections to the electrical heating unit 29 may be readily made by the aid of an ordinary screw socket outlet of a commercial electric supply system, or the like. For this purpose the lower portion of the body 28 is provided with the helical corrugations 41. Over these corrugations is disposed a conventional form of screw shell 42, of copper or brass. This screw shell is shown as having a bottom flange 43 for holding the shell in place. The body 28 furthermore has a recess 44 through which a connecting lead 45 may pass to connect the cup 38 with the screw shell 42. The upper terminal of the wire 30, being in electrical connection with the post 34 is similarly in electrical connection with the lower washer 35. The lower end 36 of the body 28 is purposely made of reduced size to simulate an ordinary plug that may be screwed into a conventional electric socket. The washer 35 is adapted to contact with one of the terminals of the socket, and the screw shell 42 is adapted to cooperate with the corresponding screw shell forming the other terminal of the socket.

In this manner the thermoelectric device may be compactly and conveniently arranged and supported. It may be utilized wherever a terminal commercial socket is available.

The transfer of heat from the heating unit 29 to the hot junctions is provided mainly by radiation from the exposed radiating surfaces of the wire 30. In order to increase the absorption of radiated heat at the hot junctions, each of these hot junctions is provided with an absorbing member exposing an extended absorbing surface to the radiated heat. Referring more particularly to Figs. 2, 6 and 7, the heat absorbers may be in the form of extremely thin metal members 46, such as metal foil. Each of these absorbers may be twisted or wrapped around the corresponding hot junction as illustrated most clearly in Fig. 6. A tail portion extends substantially from one hot junction to the next one. In this way a substantially continuous absorbing surface is presented to the radiated heat. The surface of the tinfoil absorbers 46 directed toward the heating unit 29 is purposely made rough or mat or darkened in order to facilitate the absorption of heat. Further, to ensure against possible short circuiting between the adjacent hot junctions by the absorbers 46, a very thin sleeve 47 of nonconducting material such as mica, may be interposed between the absorber 46 and the thermocouple junction conductors. This very thin mica does not appreciably retard transfer of heat from the absorbers 46 to the hot junctions. The thickness of the foil forming the absorber 46 is exaggerated in Figs. 6 and 7.

The terminal conductors 2 and 11 may be joined to appropriate binding posts 48 and 49 (Fig. 1). These binding posts 48 and 49 are shown in this instance as supported by a metallic cap 50 shown to best advantage in Fig. 5. This metallic cap 50 has a depending flange 51 which may telescope over the periphery of the cover 21. The lower edge 52 of the flange 51 may be crimped over the sloping surface 53 of a flange 54 formed integral with the body 28. The cap 50 is thus secured to the body 28. In order to hold the cover 21 in place with respect to the cap 50, the flange 51 is further provided with several upset portions 55 adapted to be turned inwardly in appropriate slots formed in the flange 54 to engage the lower surface of the cover 21.

The hollow body 28 being closed by the cover 21, there is an assurance against unnecessary dissipation of heat from within the hollow space 27 of the body 28. The heating unit 29 acts efficiently to heat the hot junctions.

The cold junctions 17, 18, 19 and 20 being disposed outside of the body and within the cap 50 may be kept quite cool by being directly exposed to the air. For this purpose the cap 50 is shown as provided with a number of large ventilating apertures 56.

The mode of operation of the structure is quite clear from the foregoing. It may be screwed into any appropriate outlet socket. The radiating heat produced by the heating unit 29 serves to elevate the temperature of the hot junctions 12 to 16 inclusive, as compared with the temperature of the relatively cool junctions 17 to 20 inclusive. Accordingly a load connected to the binding posts 48 and 49 may be supplied with the desired low potential direct current energy.

What is claimed is:

1. In a thermoelectric generator, a hollow body open at one end, an electric heating unit supported centrally of the body and radiating heat toward the walls of the body, a series of thermocouples having their hot junctions interposed between the unit and the walls of the body, a central conducting post extending into the body through the closed end of the body and electrically connected to one terminal of said unit, a conducting screw shell carried exteriorly of the body and connected to the other terminal of said unit, said shell and post being adapted to cooperate with a plug socket to conduct electrical power to the unit, a cover for the body, the conductors forming the couples passing through said cover, and a cap disposed over the cover for hous-

ing the cold junctions, said cap having passages for circulation of air around said cold junctions.

2. In a thermoelectric generator, a hollow body open at one end, an electric heating unit in the form of a hollow coil supported centrally of the body, a series of thermocouples having their hot junctions interposed between the unit and the walls of the body, so as to be heated by said unit, a central conducting post passing through the closed end of the body and into said coil and clamping said coil to the body, said post having an exterior exposed end, and in electrical connection with one terminal of said unit, a conducting screw shell carried exteriorly of the body and electrically connected to the other terminal of said unit, said shell and post being adapted to cooperate with a plug socket to conduct electrical power to the unit, and a cover for the body, the thermoelectric conductors being supported by said cover in such manner that the cold junctions extend out of the body.

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