

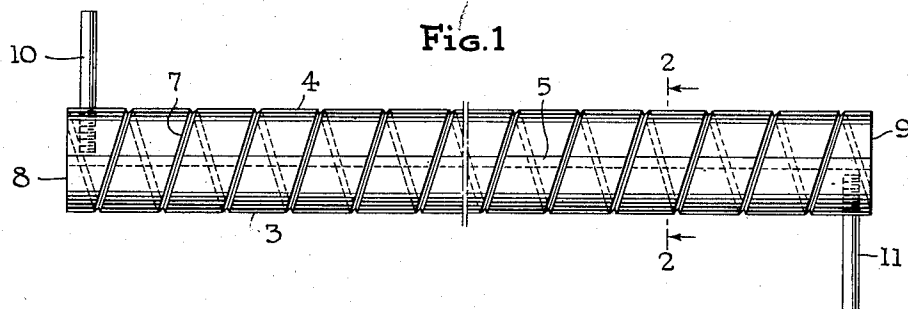
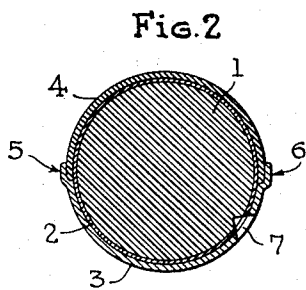
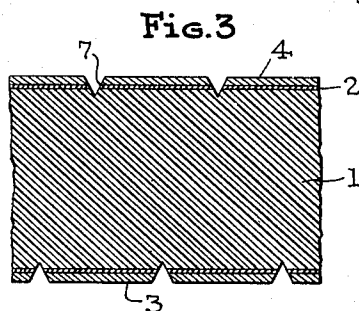
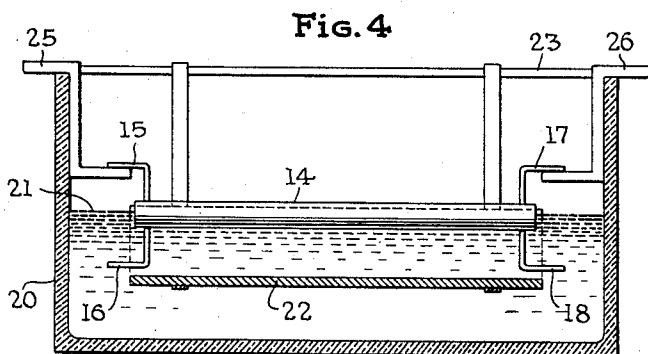
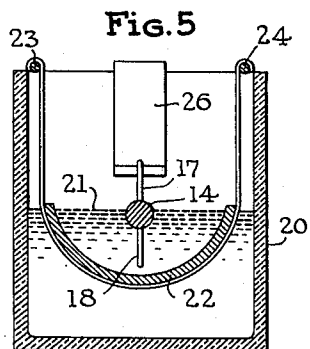
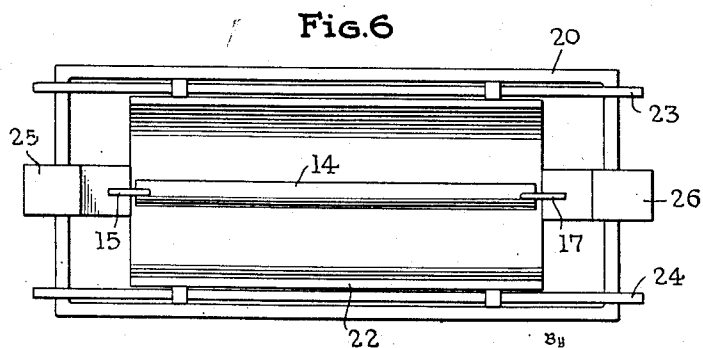
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METHOD OF CONSTRUCTING THERMOPILES

Original Filed March 9, 1950



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METHOD OF CONSTRUCTING THERMOPILES

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Original application March 9, 1950, Serial No. 148,660. Divided and this application March 15, 1951, Serial No. 215,877

1 Claim. (Cl. 29-155.5)

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The present invention relates to improvements in methods of constructing thermopiles or the like.

The thermopile of this invention comprises a metallic ribbon having the configuration of a helix and having sections of one metal alternating with sections of another metal connected in series in overlapping relationship. The metals are properly separated from each other in the electromotive force series of elements to obtain a thermoelectric action. Each section is of such length that alternate junctions between the metals are grouped on one side of the helix and intermediate junctions are grouped on substantially the opposite side of the helix.

Relatively simple and inexpensive methods are employed in constructing this thermopile. A core of any desirable form such as a rod, and comprising dielectric material, is coated on one side with a layer of one of the metals of the thermopile, and the other side of the core is coated with a layer of the other metal of the thermopile. These layers are so applied that the longitudinal edges thereof are in overlapping contact with each other. A cutting instrument is then applied to the coated core and a cut is made through the coatings into the core in the form of a helix extending from one end of the core to the other. Thus, it is seen that a thermopile is formed having the herein-described structure.

The invention is described hereinbelow in further detail, by way of example, with reference to the accompanying drawing in which:

Fig. 1 is a side view of a thermopile according to the invention;

Fig. 2 is an enlarged sectional view on line 2-2 of Fig. 1;

Fig. 3 is an enlarged vertical section taken longitudinally of a fragment of the thermopile shown in Fig. 1;

Figs. 4, 5 and 6 are diagrammatic views showing respectively a vertical longitudinal section, a vertical lateral section, and a plan view of apparatus to illustrate steps in a method of making the thermopile.

In constructing a thermopile of the present invention, a rod of dielectric material 1 of any desired length and cross-section is provided with a thin conductor coating 2 of relatively high electrical resistance as compared with the metals employed in the thermopile. By employing the thus coated rod as an electrode, one side is electroplated with one of the metals 3, such as copper, to serve in the thermopile. The opposite side is electroplated with a different metal 4, such as nickel. The edges of the metal layers 3 and 4 overlap as at 5 and 6 on substantially diametrically opposite sides of the rod 1.

After the metal layers 3 and 4 are provided, the coated rod is revolved on its longitudinal axis

while a continuous cut 7 is made through the applied layers and partly into the dielectric material of the rod 1. The cut 7 is substantially in a helical line extending from one end 8 to the other end 9 of the rod 1. A helical strip or ribbon is thereby formed with a section 3 of copper and a section 4 of nickel in each turn, each end of each section firmly contacting and overlapping the end of the next adjacent section, thereby forming the thermocouples of the pile. Edges between the turns in the ribbon are maintained separated by a space equal to the width of the cut 7. A terminal may be provided at each end of the helical thermopile as at 10 and 11.

The rod 1 shown, is circular in cross-section though this may be rectangular, elliptical, or any desired and suitable shape. In each case the pile formed is considered substantially helical in its configuration. The rod 1 may also be tubular, if desired, and provided with closed ends.

The material of the dielectric in the rod 1 may be any suitable insulating substance. Plastics are preferred and these may include any of various types such as phenolic, cellulose, acrylic, vinyl, urea formaldehyde or other resins. They may be thermoplastic or thermosetting depending on the conditions under which the thermopile is to be employed.

In making a thermopile by an electroplating process, for example, a rod 14 of dielectric material is provided with means whereby it may serve as a cathode. For this purpose, a pair of angular metal supporting means is screwed into the side of rod 14, at each end as at 15, 16, 17, and 18. The metal supporting means in each end extend in opposite directions from the side of the rod. The rod with these attachments is then provided with a conductor coating of relatively high resistance, namely, in the following manner: The rod is cleaned with alcohol and submerged in a 5 per cent solution of tin chloride for 15 minutes. The rod is removed and washed, and coated with a film of silver of such thinness that its resistance is relatively high. This is done by placing the rod in a bath prepared from 20 parts of a solution A and 1 part of a solution B, the formula of each solution being that indicated below.

Solution A

50 Silver nitrate.....	grams.....	6
Caustic soda.....	do.....	6
25% ammoniac.....	cc.....	12
Water.....	liter.....	1

Solution B

55 Sugar.....	grams.....	100
Sulphuric acid.....	cc.....	20
Water.....	liter.....	1

60 The rod is removed from the silvering bath

after about 15 minutes and is washed and dried. It is now ready for electroplating. It is noted that the silver film covers the entire surface of the rod and makes electrical contact with the metal supporting means 15, 16, 17 and 18.

Instead of silver, it is possible to attach a thin continuous layer of carbon particles to the surface of the rod, and then to subject the coated rod to the electroplating process described below.

For purposes of exemplification, the electroplating apparatus shown in Figs. 3, 4 and 5, comprises a tank 20 containing electrolyte 21. 22 represents an anode of the metal to be deposited on the rod 14. The anode 22 is electrically connected to and suspended from conductors 23 and 24. The silvered rod 14, serving as a cathode, is suspended in the electrolyte by means of conductor elements 25 and 26 upon which the ends of the metal supporting means 15 and 17 rest. Proper connections are made to complete an electric circuit through the electrolyte.

To coat one side of the rod 14 with copper, for instance, the rod is positioned in a copper bath, as shown in Fig. 3, and the level of the bath is maintained so that the rod is submerged to a depth slightly greater than its radius. After the copper is deposited to a thickness substantially greater than the thickness of the silver film, the rod is removed from the copper bath, washed, dried, and the other side of the rod is coated with nickel, for instance, by placing it in a nickel bath and supporting it by the means 16 and 18 in a manner similar to that in which it is supported in the copper bath. As in the case of the copper bath, the level of the nickel bath is maintained so that the rod is submerged to a slightly greater depth than its radius to insure overlapping of the deposited metal layers, as shown in Figs. 1 and 2.

After the copper and nickel layers are deposited on the rod 14, in the manner described, one of the metal supporting means 16 and 17 at either end is removed and the angle end of the metal supporting means 15 and 18 is cut off to form the terminals similar to the terminals 10 and 11 in Fig. 1. By the electroplating process described, good electrical contact is made between the deposited metal layers and these terminals.

Electroplating is preferred, but an alternative method of applying the metals of the thermopile to a core, comprises shielding substantially one longitudinal half of the core while exposing the other half to a metal vapor to obtain a coating, then shielding the resulting metal coating with the exception of a strip along each edge of said coating, and exposing the remainder of the surface to vapor of a different metal until a coating of the latter metal is formed which overlaps the said first metal in said strips.

The helical cut is next made in the side of the rod through the coatings and into the dielectric material underneath. A ribbon of any desired width may thus be obtained with terminals at either end. The thermocouples in the pile are in alignment on opposite sides of the helix. The dielectric material serves to mount the metals of the pile on a solid base of any desired length usable as a thermopile unit and for easy installation. A simple, efficient pile is readily constructed and adapted to various uses. Its electromotive force may be easily varied with the length of the helix, by the number of turns in the helical ribbon, by the metals used, by coupling any number of these piles, and by other means.

The invention as hereinabove set forth is embodied in particular forms and manner but may be variously embodied within the scope of the claim hereinafter made.

This is a division of application Serial No. 148,660 filed March 9, 1950.

I claim:

A method of making a thermopile, which method consists of the following succession of steps in the order stated: coating with one metal substantially one longitudinal half of a rod-like core of uniform cross section and consisting of a dielectric plastic material, coating the remaining portion of the core and a strip along each edge of the said one metal with a different metal for forming thermoelectric connections on the surface of said core, and cutting a kerf through the resulting coatings and into the rod-like plastic core on a line extending continuously around the core in the form of a helix, to provide a rod-like product consisting of a helix of metal in ribbon form with sections of said one metal alternating with sections of said different metal in series in overlapping relationship and attached to the surface of the solid plastic core in raised position with respect to the material of the said core.

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