

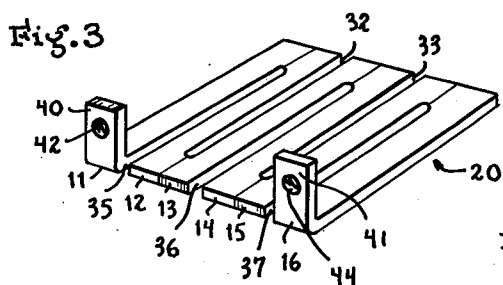
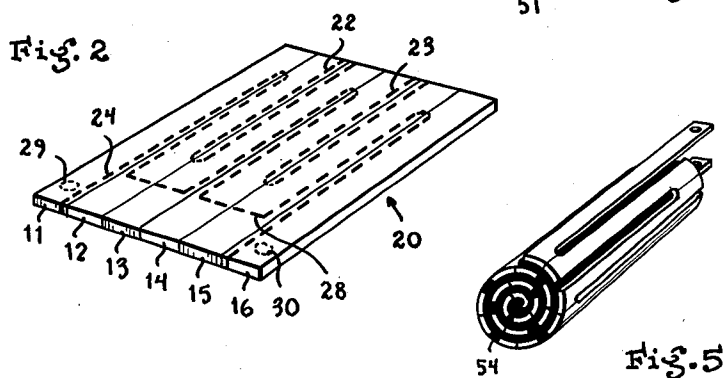
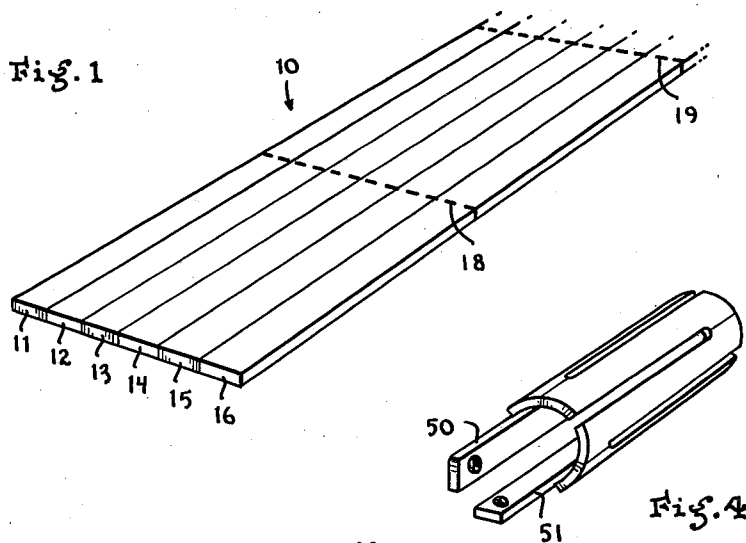
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THERMOCOUPLE

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THERMOCOUPLE

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Original application May 13, 1940, Serial No. 334,812, now Patent No. 2,278,744, dated April 7, 1942. Divided and this application September 4, 1941, Serial No. 409,553

5 Claims. (Cl. 136—5)

This invention relates to new and novel thermocouple elements and the present application is a division of our application Serial No. 334,812, filed May 13, 1940, which has now matured into Patent No. 2,278,744 issued April 7, 1942, and which is directed to methods for constructing the devices.

An object of our invention is the provision of a novel thermocouple which can be formed with a relatively simple process and at a low cost of production. The invention relates particularly to the production of new, novel and improved thermocouple elements which are rugged, compact and capable of the generation of a relatively high voltage or current.

A thermocouple is composed of a pair of metals having dissimilar thermo-electric characteristics, which metals are permanently joined at one end to form a hot junction and are adapted to be electrically joined at the other end to form a cold junction. Where a plurality of thermocouples are employed, the device is known as a thermopile. Thermocouples are usually relatively expensive to construct and this is particularly true in the case of thermopiles.

The present invention provides a thermocouple in the form of a flat member which can be formed by a plurality of cutting operations. These cutting operations may if desired be accomplished by stamping. The various units are formed from a long strip composed of a plurality of component strips of dissimilar metals secured together along their longitudinal edges, this strip being cut transversely at spaced points to provide a plurality of relatively short sections. The material along the joints between the component strips of each section is then cut away for the greater portion of the length of the strips to provide series connected thermocouple members. The resulting unit may then be rolled, if desired, to provide a more compact arrangement.

For a more complete understanding of the invention, reference is made to the accompanying specification, claims and drawing of which:

Figure 1 is a perspective view of the strip from which the individual sections are cut;

Figure 2 is a view of one individual section of the strip with dotted lines to indicate where the material is cut away;

Figure 3 is a perspective view of one form of the completed thermocouple device; and

Figures 4 and 5 are perspective views of modified forms of our device.

The first step in the novel process of the present invention is to form a strip comprising a plu-

5 rality of pairs of metallic strips, each pair comprising two strips of dissimilar thermo-electric characteristics, said strips all being joined along their longitudinal edges. As previously indicated, this strip is shown in Figure 1. Referring to this figure, the strip itself is designated by the reference numeral 10 and the component strips are designated by the reference numerals 11 to 16. Strips 11, 13 and 15 may, for example, be formed of Constantan, an alloy composed of approximately 50 per cent copper and 50 per cent nickel, and strips 12, 14 and 16 may be formed of stainless steel. It will be understood that in place of Constantan and stainless steel any two other 15 metals having proper thermo-electric characteristics may be employed. The strips 11 to 16 are secured together in any suitable manner. One desirable method is to roll these members together while hot so as to weld them together in the rolling process. If the members are formed by such a rolling process, it is possible to have the strip 10 in the form of a continuous strip.

At uniformly spaced points designated by the dotted lines 18 and 19, the strip 10 is cut transversely to the length thereof to provide a plurality of short sections. One of these sections is shown in Figure 2 and is designated by the reference character 20.

25 The last step in the formation of one form of the thermopile is to remove material adjacent the joints to electrically separate the component strips for the greater portion of their length. The dotted lines 22 and 23 enclose the areas cut away along the joints between strips 12 and 13 and between strips 14 and 15. It will be noted that by cutting away this portion two slots are provided separating the strips 12 and 13 on the one hand and strips 14 and 15 on the other hand for the greater portion of the length of these strips. A dotted line 24 encloses the portion which is cut out adjacent one end of the section and which is cut out between strips 11 and 12, 13 and 14, and 15 and 16. It will be noted that between strips 11 and 12, 13 and 14, and 15 and 16 the dotted lines extend within a short distance of the far end of section 20 but still leaves the dissimilar strip contiguously joined to adjacent strips for a substantial distance. The dotted line 24 further encloses a rectangular piece extending from the near end of its strip to the portion 28 of dotted line 24. It will be noted that this rectangular portion includes the near ends of strips 12, 13, 14 and 15 leaving a portion of strips 11 and 16 projecting outwardly from the remaining portion of section 20. The dotted lines 29 and 30 enclose

circular portions to provide apertures through the projecting ends of strips 11 and 16.

The particular manner in which the portions outlined in dotted lines are removed forms no part of the present invention, although it is to be understood that such material can be removed by a single die stamping operation, using dies of relatively simple form.

In Figure 3 one form of the completed product is shown. The slots formed by cutting away the portion enclosed by dotted lines 22 and 23 are designated in this figure by reference numerals 32 and 33. The slots between members 11 and 12, 13 and 14, and 15 and 16 are designated by the reference numerals 35, 36 and 37, respectively. It will be noted that alternate slots extend from opposite ends of the section. The result is that strips 11 to 16 are connected together in series by the remaining uncut portions of the joints between these strips. It is usually desirable, where a plurality of thermocouples are employed, to connect them in series as is done by extending alternate slots in alternate directions in the manner shown. It is also possible to connect the constituent thermocouples in parallel by extending the slots in the same direction and providing suitable jumpers to connect the various elements together.

The projecting ends of strips 11 and 16 are designated in Figure 3 by the reference characters 40 and 41, the apertures therethrough formed by the removal of the material within dotted lines 29 and 30 being designated by the reference numerals 42 and 44. It will be noted that the projecting ends 40 and 41 have been bent upwardly. These ends are designed to form terminal portions for the thermopile unit and may if desired also be employed for maintaining the unit. The apertures 42 and 44 may be tapped so as to provide for the reception of screws therein.

The device of Figure 4 is similar to Figure 3 with the exception that after the portions between the component strips are cut away, the strip is subjected to a rolling operation. It will be noted that in this species, the terminals 50 and 51 corresponding to terminals 40 and 41 of Figure 3 are not bent transversely to the strip but merely extend longitudinally therefrom. The form of Figure 4 is desirable where the burner is of the conventional type with a flame of substantially circular cross-section.

In Figure 5 there is shown a still further modification of our device. In this form of the device, there are a relatively large number of component strips so as to provide a large number of thermocouple units. The strip itself is of considerably greater width than in the species of Figures 1 to 4 and is preferably of somewhat thinner material. After the strip is subjected to the stamping operation indicated in dotted lines in Figure 2, the strip has a layer of insulating material disposed adjacent it and is rolled spirally to form the compact unit shown in Figure 5. In this figure, the insulating layer is designated by the reference numeral 54. It will be noted that in the form shown, there are ten thermocouples and in spite of this, the space occupied is not particularly greater than that occupied by the species of Figure 4. The device does have the disadvantage however over that of Figures 3 and 4 in that a somewhat greater time is required for cooling of the hot junction of the thermocouples due to the fact that they are closer together and hence radiate the heat more slowly. Where the time of response is not of the utmost importance however,

the arrangement of Figure 5 is desirable by reason of its relative compactness.

It will be seen that by reason of the present invention, it is possible to manufacture thermocouples or thermopiles by an extremely simple process. The thermocouple elements produced in accordance with the invention may be rugged, compact and capable of the generation of relatively high current or voltage. While we have shown a specific embodiment of our invention, it is to be understood that the scope thereof is to be limited only by the appended claims.

We claim as our invention:

1. A thermocouple member having a plurality of strips of dissimilar thermo-electric characteristics contiguously joined together along their longitudinal edges and extending for a substantial distance, said member having slots therethrough electrically separating said strips for the greater portion of their length, and said member being spirally rolled with insulating material disposed between adjacent layers of the spiral.

2. A thermopile member comprising at least four thin strips contiguously joined together for a substantial distance along portions of their longitudinal edges with said edge portions in abutting relation, each two adjacent strips being of materials of dissimilar thermoelectric characteristics and being joined only adjacent one end, said members having a slot formed between adjacent pairs of strips and extending a substantial distance so that any one strip is being joined to the adjacent strip on one side at the opposite end from that at which it is joined to the adjacent strip on the other side so that said strips are separated for the greater portion of their length by a plurality of slots extending alternately from opposite ends of the member, and said member being spirally rolled with insulating material disposed between adjacent layers of the spiral.

3. A thermopile member formed from a single sheet of material comprising a plurality of alternate strip members of dissimilar thermoelectric characteristics, longitudinally abutting in side-by-side relationship, each two adjacent strips being joined only adjacent one end, any one strip being joined to the adjacent strip on one side at the opposite end from which it is joined to the adjacent strip on the other side, said members having slots formed between each other and extending alternately from opposite ends of the member, and said member being spirally rolled with insulating material disposed between adjacent layers of the spiral.

4. A thermopile, formed as a rigid structure, comprising, alternate strips of metal having dissimilar thermoelectric characteristics which longitudinally abut each other in side-by-side relationship, said structure having slots formed between the several strips which are narrower in cross dimension than either strip to thereby give self-supporting rigidity to said structure, said slots extending alternately from opposite ends of said structure so that each two adjacent strips are joined only adjacent one end and any one strip is joined to an adjacent strip on one side at the opposite end from which it is joined to the adjacent strip on the other side, the two laterally opposite end strips being substantially longer than a plurality of intermediate strips, and arranged so that said structure may be vertically or horizontally supported on said end strips.

5. A thermopile, formed as a rigid structure, comprising alternate strips of metal having dissimilar thermoelectric characteristics which lon-

gitudinally abut each other in side-by-side relationship, said structure having slots formed between the several strips which are narrower in cross dimension than either strip, to thereby give self-supporting rigidity to said structure, said slots extending alternately from opposite ends of said structure so that each two adjacent strips are joined adjacent only one end and any one strip is joined to an adjacent strip on one side at the opposite end from which it is joined to 10

the adjacent strip at the other side, the two laterally opposite end strips being substantially longer than a plurality of intermediate strips to provide means for rigidly supporting said structure in a vertical or horizontal position, and said structure being rolled into a substantially cylindrical body, the axis of said cylinder being parallel with the longitudinal axis of said strip members.

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