

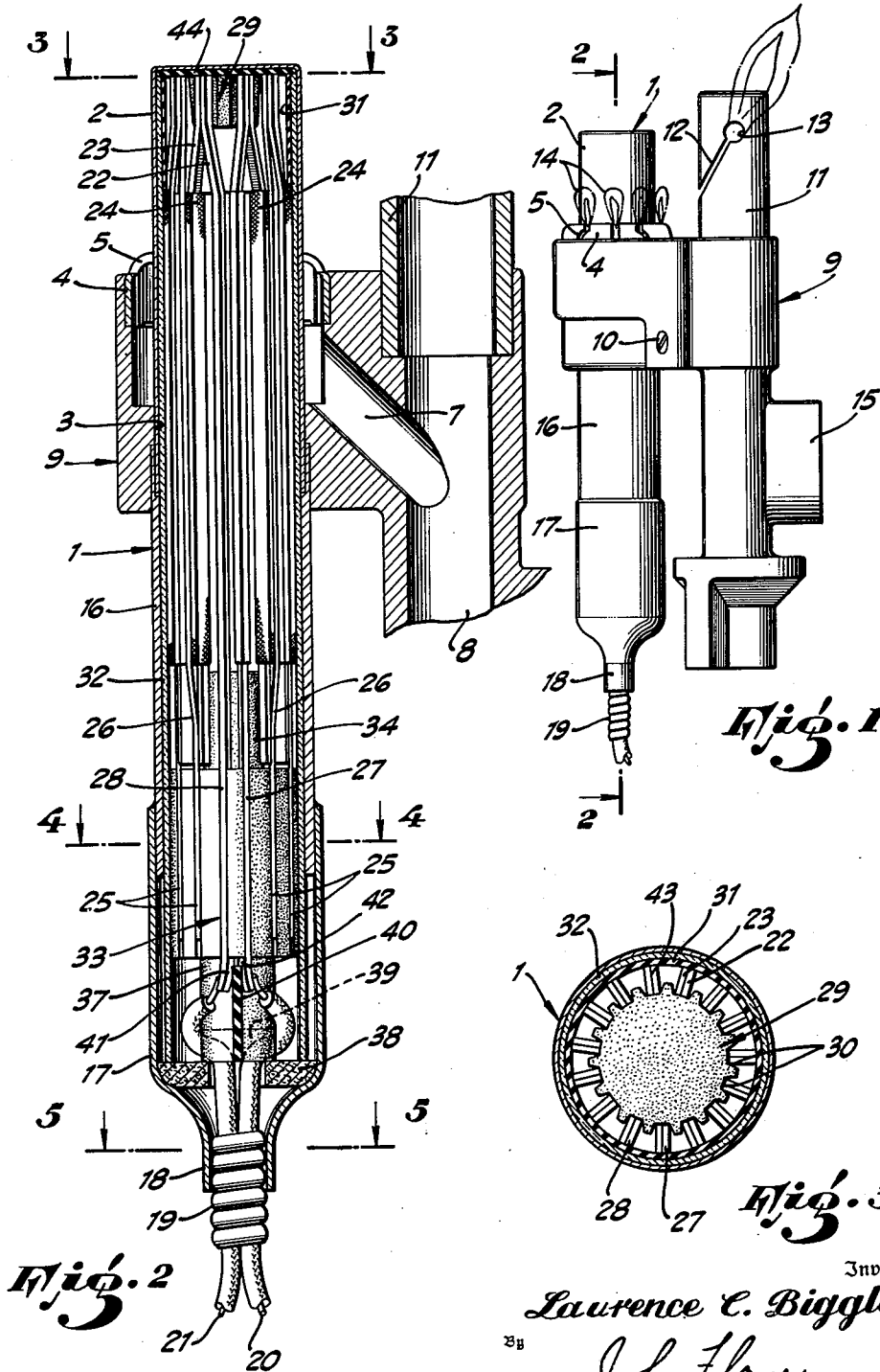
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L. C. BIGGLE
THERMOPILE STRUCTURE

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 4

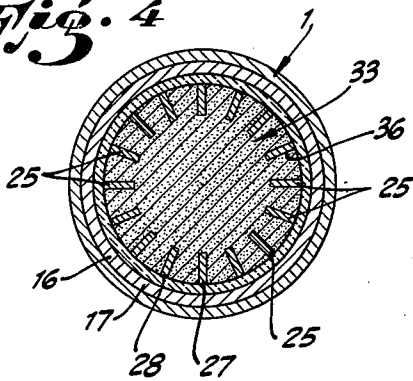
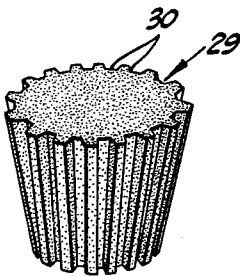


Fig. 6

Fig. 5

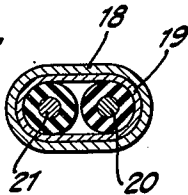


Fig. 8

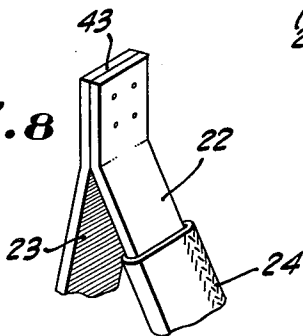


Fig. 7

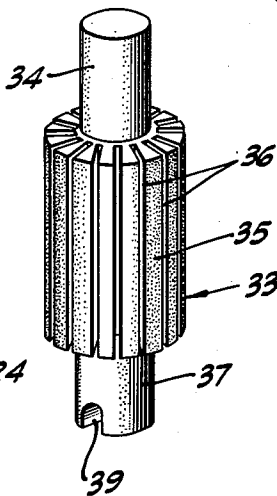
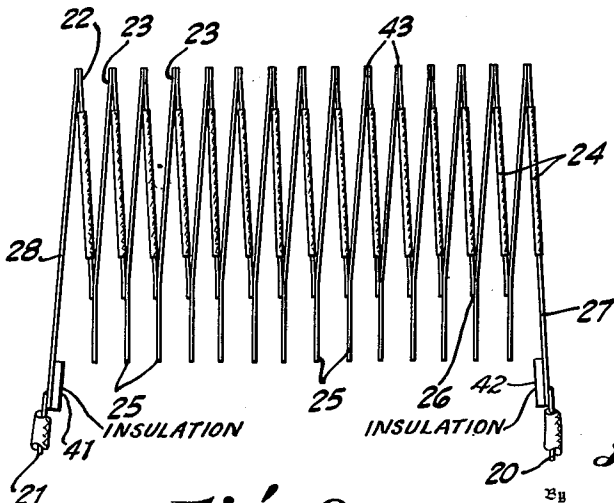


Fig. 9

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UNITED STATES PATENT OFFICE

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THERMOPILE STRUCTURE

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12 Claims. (Cl. 136-4)

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This invention relates to thermocouples, and especially to a structure in which a number of thermocouples are placed in series in order to increase the generated electromotive force.

The principle of operation of thermocouples is now well understood. Usually, one or more lengths of dissimilar metals or alloys are connected or joined as by welding, the two kinds of material alternating. Now if every other junction is heated, while the other junctions are unheated, an electromotive force is generated, which depends upon the temperature difference between the "hot" and "cold" junctions.

Such thermocouples are extensively used for control purposes, such as in safety systems for gas burners. In such instances, the pilot flame or the main burner flame is caused to heat the hot junctions. While the flame is in existence, a safety valve is maintained open by aid of the electrical control provided by the thermocouple or thermopile. When the flame goes out the thermocouple or thermopile is inactive, and the valve is caused to close.

It is one of the objects of this invention to improve in general, thermocouple structures of this character.

It is another object of this invention to provide a thermocouple structure that can be readily assembled within a protecting sheath, and that ensures excellent heat transfer from the sheath to the hot junctions.

It is still another object of this invention to provide a structure of this character to simplify the manner of supporting the thermopile on a pilot burner.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of one embodiment of the invention. For this purpose there is shown a form in the drawings accompanying and forming part of the present specification. The 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 drawings:

Figure 1 is an elevation of a thermopile and pilot burner assembly incorporating the invention;

Fig. 2 is an enlarged sectional view, taken along a plane corresponding to the line 2-2 of Fig. 1;

Figs. 3, 4, and 5 are cross-sectional views, taken

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along planes corresponding to lines 3-3, 4-4, and 5-5 of Fig. 2;

Fig. 6 is a pictorial view of a spacer utilized in connection with the thermopile structure;

Fig. 7 is a pictorial view of a core and support utilized in connection with the thermopile;

Fig. 8 is a further enlarged pictorial view of one of the hot junctions of the thermopile; and

Fig. 9 is a diagrammatic representation of the conducting elements of the thermopile structure.

The thermopile structure 1, as shown in Figs. 1 and 2, has a cylindrical head 2 that is made of good heat conducting material, and within which are arranged the hot junctions. It may conveniently be made from thin stainless steel. This head 2 is telescoped within an aperture 3 in a pilot burner casting 9. The head 2 is arranged to be heated by a series of flames 14 arranged circumferentially around the head 2. These flames project through the jets 5 formed as slots in a spacer member 4. This spacer member 4 has a downwardly extending flange which rests on a shoulder formed above the aperture 3. This flange defines an annular space around the head 2 into which fuel may be led. A fuel port 7 is shown as extending transversely into a vertical port 8 that extends downwardly through the pilot burner 9 for connection to an appropriate supply of fuel and air.

In order to hold the thermopile structure firmly in the pilot burner 9, a set screw 10 may be provided extending radially of the aperture 3, and extending through a wall of the burner.

The upper end of port 8 is arranged to support the pilot burner 11. Fuel is led through the port 8 to this pilot burner which is ignited from the flames 14 at jets 5. This pilot burner has a helical slot 12 leading to a pilot burner opening 13. The lower end of the slot 12 is in sufficiently close proximity to the flames 14 to cause ignition of the pilot burner.

A projection 15, extending from the pilot burner 9, serves as a convenient means for attaching the pilot burner to any appropriate support in relation to the main burner.

The head 2 (Fig. 2) telescopes within a tube 16 and may be welded thereto. The lower end of tube 16 in turn is telescoped within a base member 17. The base member 17 terminates in an oval projection 18 (Figs. 2 and 5) within which a metal armored cable structure 19 extends. This armored cable structure 19 includes the insulated terminal conductors 20 and 21 for the thermopile.

In the present instance there are fifteen hot

junctions 43 arranged annularly within the head 2 and adjacent the top thereof. These hot junctions are formed by alternate conductors, such as 22 and 23 (Figs. 2, 3, 8, and 9). The conductors may respectively be made of Copel and Chromel. One set of alternate conductors, such as the Copel conductors 22, may be provided with a sleeve of insulation 24 made, for example, of braided fibre glass. Furthermore, the conductors are of strip form, the ends being superposed and welded together.

The conductors 22 and 23 form a zig-zag pattern, with the hot junctions 43 at the top and the cold junctions 26 at the bottom, as indicated at Fig. 9. These conductors actually are arranged in generally parallel arrangement, the Chromel conductors 23 having extensions 25 that project below the cold junctions 26. The conductor 20 is joined to the end Copel conductor 27, and the other terminal conductor 21 is joined to the end Chromel conductor 28. In this way, a thermopile arrangement is effected.

In order to hold and space the conductors within the shield or shell formed by the head 2, tube 16, and the base 17, use is made of the spacer now to be described.

Thus, a spacer 29 (Figs. 2, 3, and 6) made of refractory material, such as a ceramic, is inserted in the top of the head 2. It is of generally tapered construction, and is formed with a plurality of slots 30 corresponding in number to the number of hot junctions. These slots are quite shallow, and their inner surfaces engage the inner edges of the conductors 22 and 23. Due to the tapered configuration of the spacer 29, the outer edges of these conductors are urged into firm contact with a thin layer of insulation 31, such as mica. This insulation, in turn, is in contact with a glass sleeve 32 which is in close contact with the inner surfaces of the head 2 and tube 16. This glass tube extends substantially to the bottom of the base member 17, as shown in Fig. 2.

In order to provide a proper support for the extensions 25, use is made of a core member 33 (Figs. 2, 4, and 7). This core member 33 may also be made of a ceramic material that is provided with an upper cylindrical extension 34 around which the cold junctions 26 extend. The body portion 35 of the member is also cylindrical and provided with slots 36 to accommodate the ends 25. The lower extension 37 of the core member 33 rests upon a bottom insulation washer 38 (Fig. 2) such as of asbestos, through which the conductors 20 and 21 extend. In order to permit these conductors to pass outwardly of the lower extension 37, this lower extension may be provided with a slot 39. Furthermore, an insulation strip 40 is inserted between the ends of the thermopile conductors 27 and 28. These ends may be provided with short insulation strips 41 and 42.

Immediately below the top of the head 2 there is an insulation washer 44 disposed on top of the spacer member 29.

The width of the conductors 22 and 23 is such that, when the core 29 is urged firmly into place in the head 2, the outer edges of these conductors are urged outwardly into firm contact with the insulation member 31 and, therefore, in good heat transmitting relation to the head 2. The tapered configuration of the core member 29 serves to provide this outwardly directed force. These conductors are sufficiently elongated so that the cold junctions 26 are maintained at a considerably lower temperature than

the hot junctions 43. This ensures proper temperature differentials between the hot and cold junctions.

One manner of assembling the parts includes the insertion of all of the parts within the glass sleeve 32 in their proper relation, as is clearly evident from Fig. 2, with the exception of the wedge member 29. The upper end of the sleeve is provided with the thin layer of insulation 31. The wedge member is then inserted into the upper end of the glass sleeve 32 and insulation 31, each pair of conductors forming the hot junction being received within a groove 30 provided in the periphery of the wedge or conical member 29. Since the wedge member tapers downwardly and inwardly, its downward insertion forces the hot junctions outwardly against the inner surface of the thin layer of insulation 31.

The tubular head 2 is then telescoped over the glass sleeve 32 until it meets the tube 16, to which it is welded. The upper end of the tube 2 engages the upper end of the wedge 29 holding it in its wedged position within the hot junctions, and securing their conductors in firmly wedged relation against the inner surface of the mica insulation 31.

The inventor claims:

1. In a thermocouple structure: a sheath made from heat conducting material; a plurality of conductors joined in series, adjacent conductors being of thermoelectrically dissimilar metals to form an alternate series of hot and cold junctions, the hot junctions being entirely within the sheath; and wedging means disposed centrally within said hot junctions, the wedging portion of said means urging the hot junctions toward the inner surface of the sheath; said wedging means being separate from and movable within said sheath to exert a wedging force against said hot junctions.

2. In a thermocouple structure: a cylindrical sheath made from heat conducting material; a plurality of conductors joined in series, adjacent conductors being of thermoelectrically dissimilar metals to form an alternate series of hot and cold junctions disposed within said sheath, said conductors being in side by side relationship so that the hot junctions are all adjacent; and tapered means disposed centrally in the sheath, the tapered portion of said means urging said hot junctions outwardly toward the inner surface of the sheath; said tapered means being separate from and movable axially within said sheath to exert a wedging force against said hot junctions.

3. In a thermocouple structure: a sheath made from heat conducting material; a plurality of annularly disposed longitudinally extending conductors joined in series, adjacent conductors being of thermoelectrically dissimilar metals to form an alternate series of axially spaced hot and cold junctions, the hot junctions being entirely within the sheath; and a wedge member within the sheath and centrally of the annularly disposed conductors adjacent the hot junctions, the wedged portion of said member urging the hot junctions toward the inner surface of the sheath; said wedge member being separate from and movable within said sheath to exert a wedging force against said hot junctions.

4. In a thermocouple structure: a sheath made from heat conducting material; a plurality of annularly disposed longitudinally extending conductors joined in series, adjacent conductors being of thermoelectrically dissimilar metals to form an alternate series of axially spaced hot and

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cold junctions, the hot junctions being entirely within the sheath; and a tapered member formed of insulation material and disposed within the sheath and centrally of the annularly disposed conductors adjacent the hot junctions, the tapered portion of said member urging the hot junctions toward the inner surface of the sheath; said tapered member being separate from and movable axially within said sheath to exert a wedging force against said hot junctions.

5. In a thermocouple structure: a cylindrical sheath made from heat conducting material; a plurality of conductors joined in series, adjacent conductors being of thermoelectrically dissimilar metals to form an alternate series of hot and cold junctions, said conductors being in side by side relationship so that the hot junctions are all adjacent; said hot junctions being annularly spaced and disposed within the sheath; and a conical member disposed within the sheath and centrally of the hot junctions, the conical portion of said member urging the hot junctions outwardly toward the inner wall of the sheath; said conical member being separate from and movable axially within said sheath to exert a wedging force against said hot junctions.

6. In a thermocouple structure: a cylindrical sheath made from heat conducting material; a plurality of conductors joined in series, adjacent conductors being of thermoelectrically dissimilar metals to form an alternate series of hot and cold junctions, said conductors being in side by side relationship so that the hot junctions are all adjacent; said hot junctions being annularly spaced and disposed within the sheath; and a conical member disposed within the sheath and centrally of the hot junctions, the conical portion of said member urging the hot junctions outwardly toward the inner wall of the sheath; said member having slots in its periphery to accommodate the inner edges of the conductors forming the hot junctions; said conical member being separate from and movable within said sheath to exert a wedging force against said hot junctions.

7. In a thermocouple structure: a sheath made of heat conducting material; a plurality of conductors joined in series, adjacent conductors being of thermoelectrically dissimilar metals to form an alternate series of hot and cold junctions, the hot junctions being entirely within the sheath; and a tapered member disposed centrally of said conductors and having a tapered portion wedging the said hot junctions between the member and the inner surface of said sheath; said tapered member being separate from and movable within said sheath to exert a wedging force against said hot junctions.

8. In a thermocouple structure: the combination of a plurality of pairs of elongated thermocouple elements annularly disposed in substantially parallel axial relation to each other and electrically joined in series to form a thermopile having axially displaced hot and cold junctions; a cylindrical sheath enclosing the said thermopile; a wedge shaped member disposed axially of said thermopile and having a wedge portion exerting an outward radial thrust on said hot junctions; said wedge-shaped member being separate from and movable axially within said sheath to exert a wedging force on said hot junctions; and a thin

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cylindrical cover member having one closed end telescoping over said sheath and said thermopile.

9. In a thermocouple structure: the combination of a plurality of pairs of elongated thermocouple elements annularly disposed in substantially parallel axial relation to each other and electrically joined in series to form a thermopile having axially displaced hot and cold junctions; a cylindrical sheath enclosing the said thermopile; a wedge shaped member in the form substantially of a frustum of a cone disposed axially of said thermopile with a frusto-conical portion of said member exerting an outward radial thrust on said hot junctions; and a thin cylindrical cover member having one closed end telescoping over said sheath and said thermopile.

10. In a thermocouple structure: the combination of a plurality of pairs of elongated thermocouple elements annularly disposed in substantially parallel relation to each other and electrically joined in series to form a thermopile having axially displaced hot and cold junctions; a sheath enclosing the said thermopile; and a wedge-shaped member in the form substantially of a frustum of a cone disposed axially of said thermopile and having a frusto-conical portion exerting an outward radial thrust on said hot junctions.

11. In a thermocouple structure: the combination of a plurality of pairs of elongated thermocouple elements annularly disposed in substantially parallel relation to each other and electrically joined in series to form a thermopile having axially displaced hot and cold junctions; a sheath of heat conducting material; and a wedge-shaped member in the form substantially of a frustum of a cone disposed axially of said thermopile for exerting a radial thrust on said hot junctions and having a frusto-conical portion urging said hot junctions toward said sheath.

12. In a thermocouple structure: the combination of a plurality of pairs of elongated thermocouple elements annularly disposed in substantially parallel relation to each other and electrically joined in series to form a thermopile having axially displaced hot and cold junctions; a sheath of heat conducting material; and a wedge-shaped member disposed axially of said thermopile and having a wedge surface tapering toward the axis of the thermopile, said wedge surface of said member exerting a radial thrust on said hot junctions and urging said hot junctions toward said sheath; said wedge-shaped member being separate from and movable axially within said sheath to exert a wedging force on said hot junctions.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,197,818	Tozier	Apr. 23, 1940
2,202,533	Mason	May 28, 1940
2,266,416	Duclos	Dec. 16, 1941
2,349,306	Ray	May 23, 1944
2,374,701	Ray	May 1, 1945
2,407,517	Ray	Sept. 10, 1946
2,416,455	Ray	Feb. 25, 1947