June 7, 1955 — P. L. BETZ — 2,710,055

THERMOELECTRICALLY OPERATED SAFETY DEVICES

Original Filed Oct. 14, 1940 — 2 Sheets-Sheet 1

Fig. 1a.

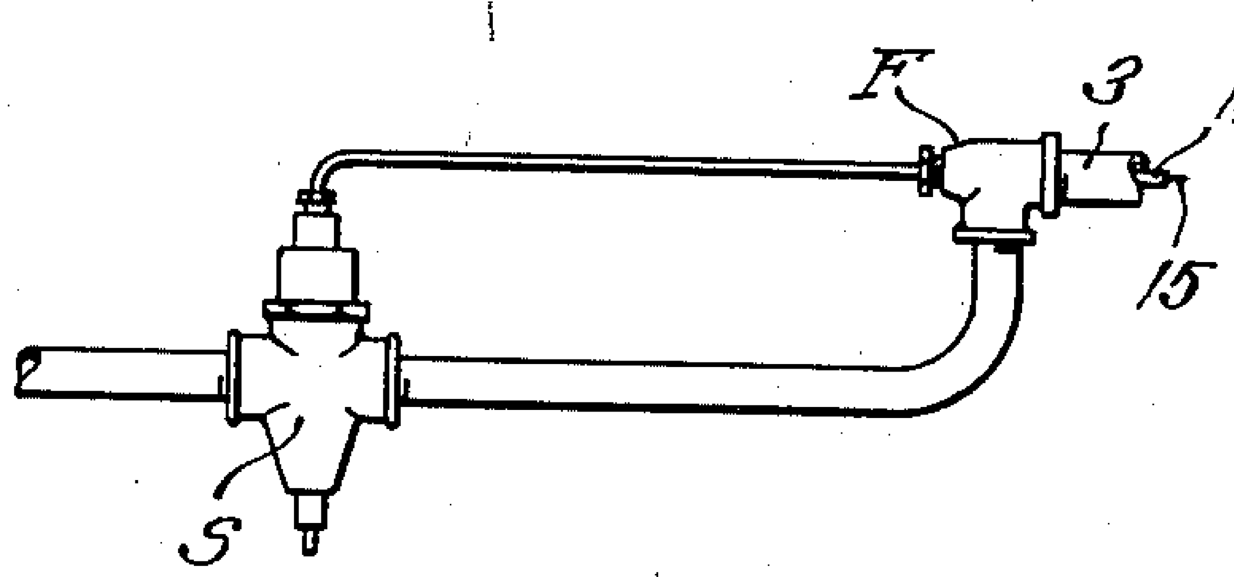


Fig. 1.

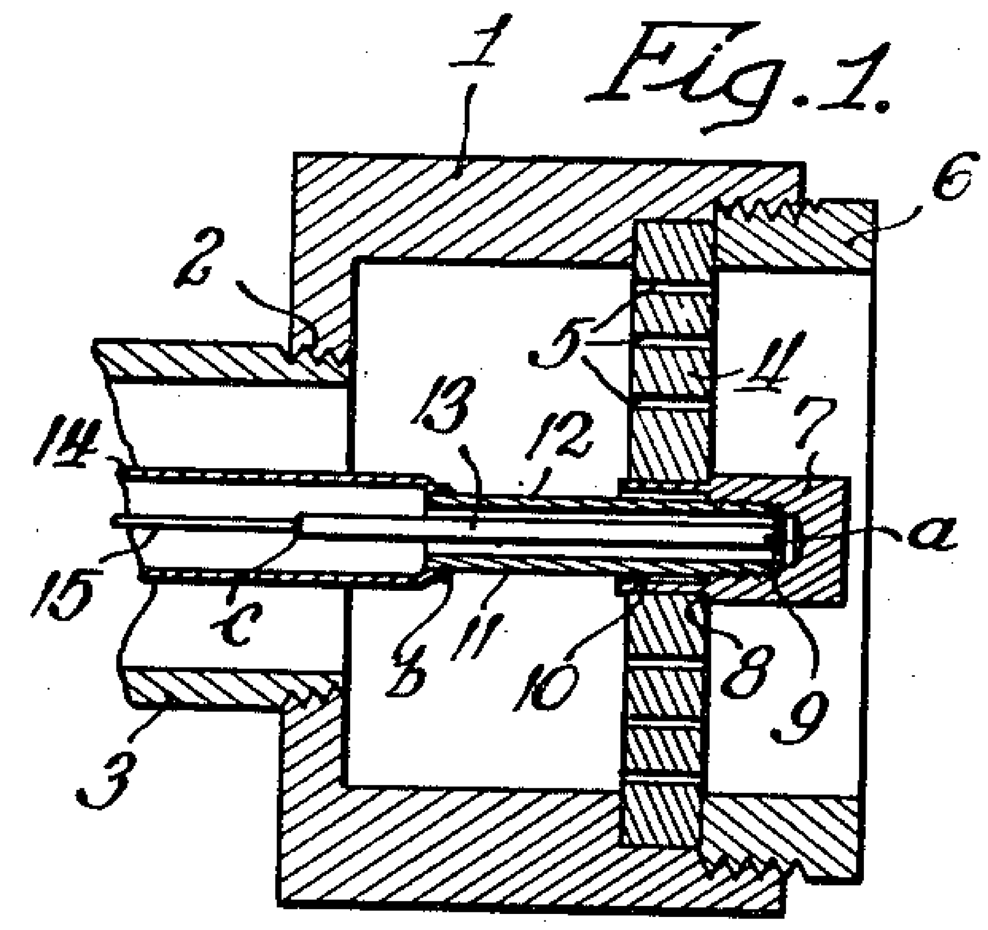


Fig. 2.

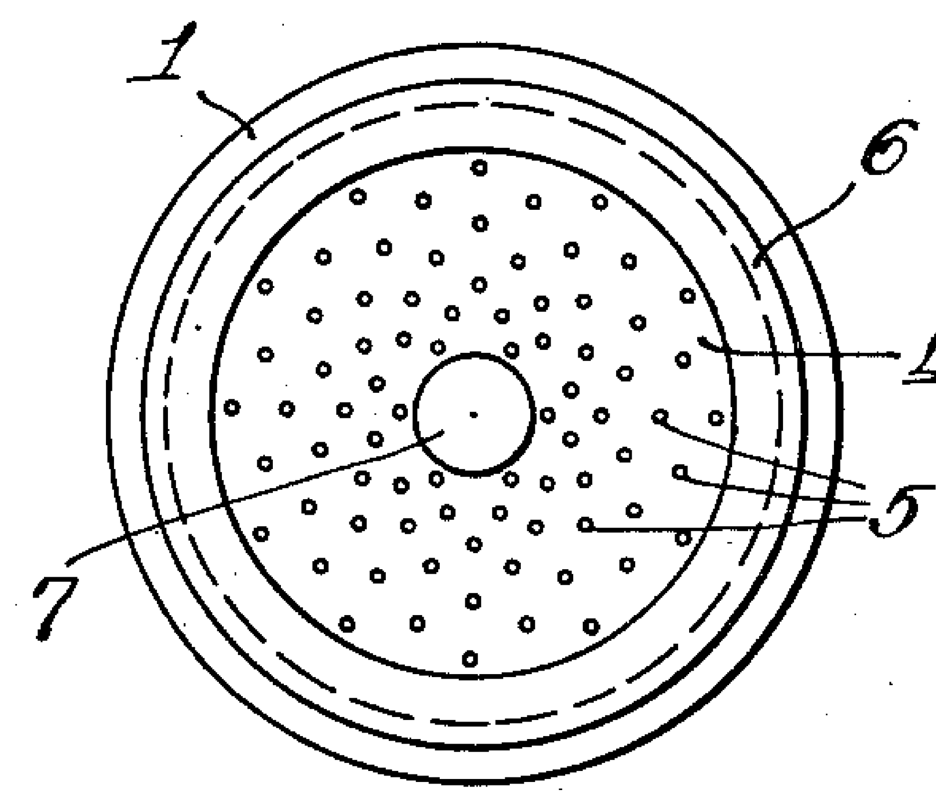


Fig. 3.

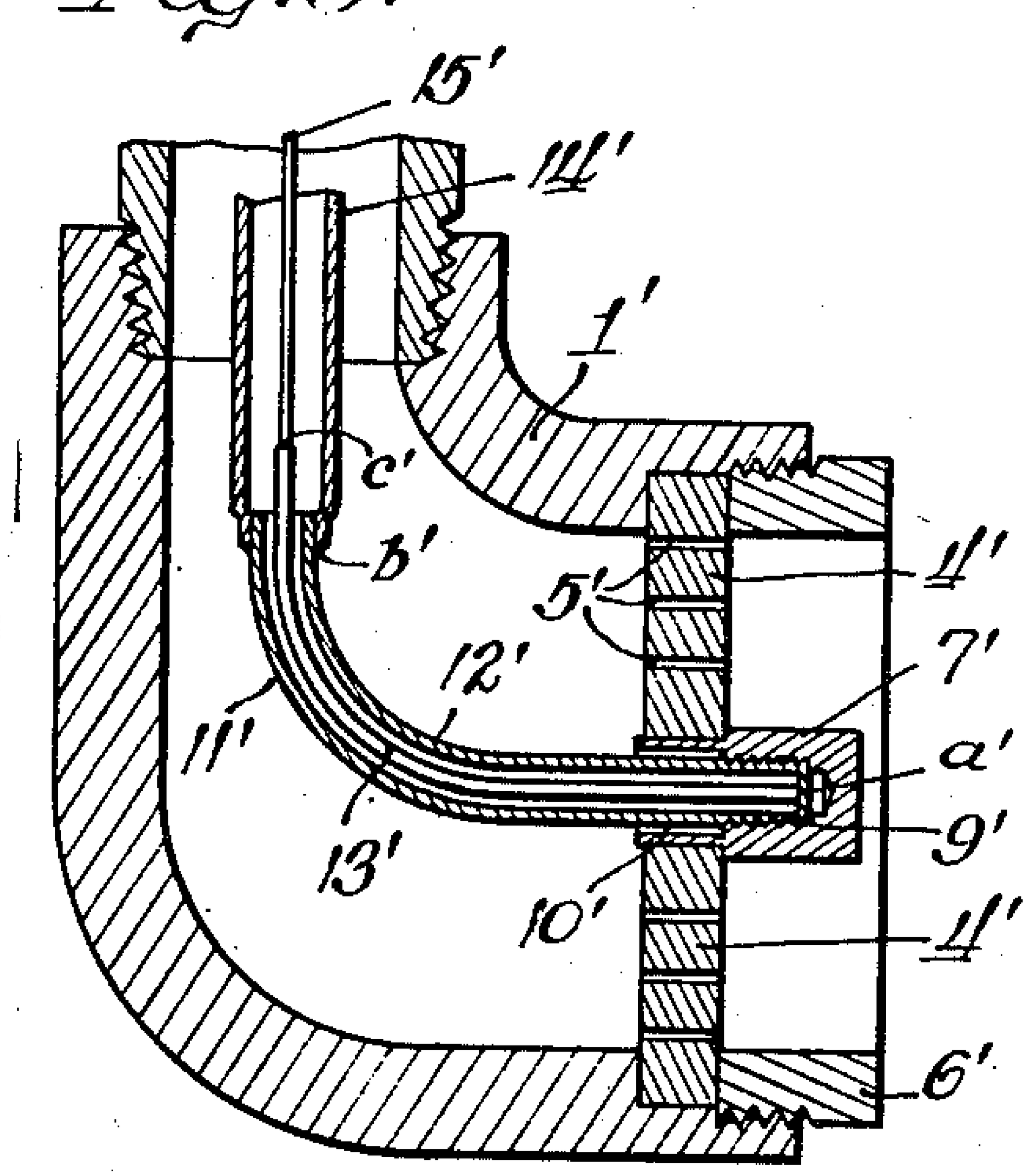
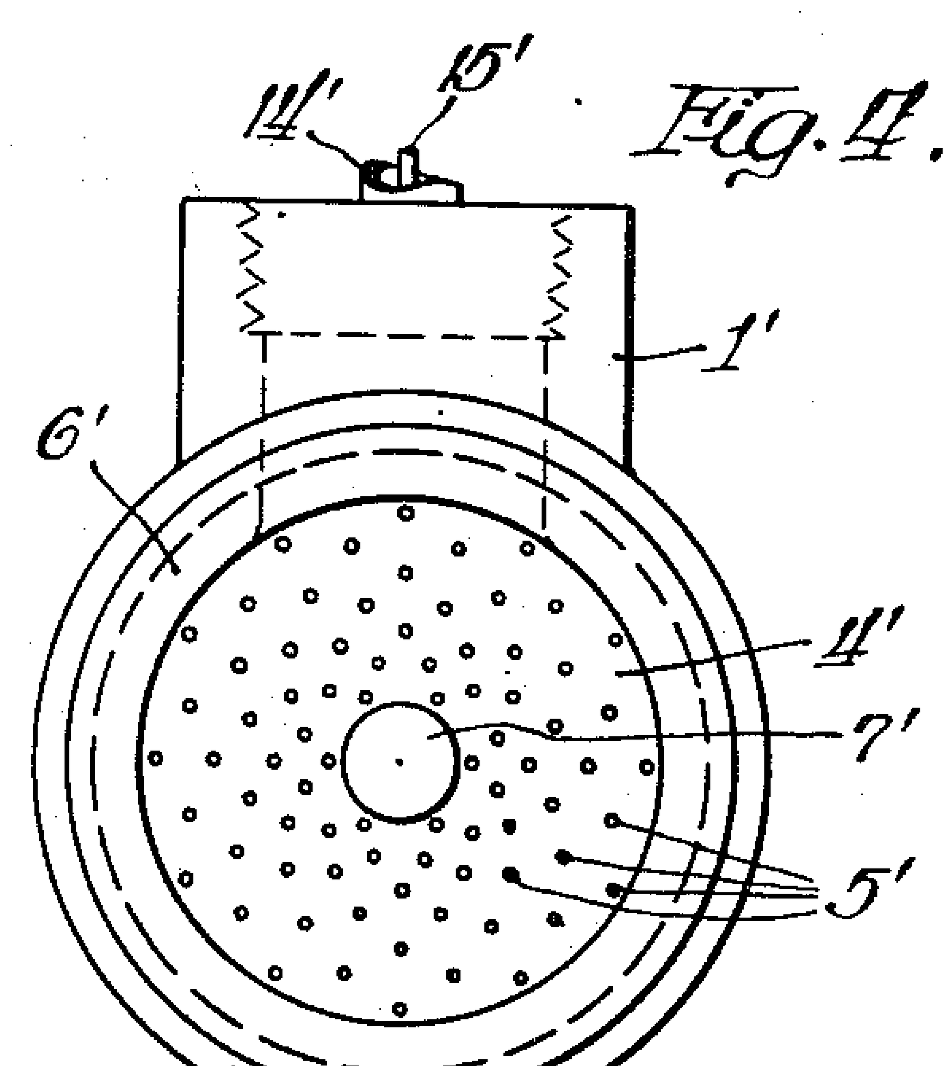


Fig. 4.



Inventor:
Paul L. Betz.

By Brown, Jackson, Boettcher & Dienner
Attys.

THERMOELECTRICALLY OPERATED SAFETY DEVICES

Original Filed Oct. 14, 1940 2 Sheets-Sheet 2

Fig. 5

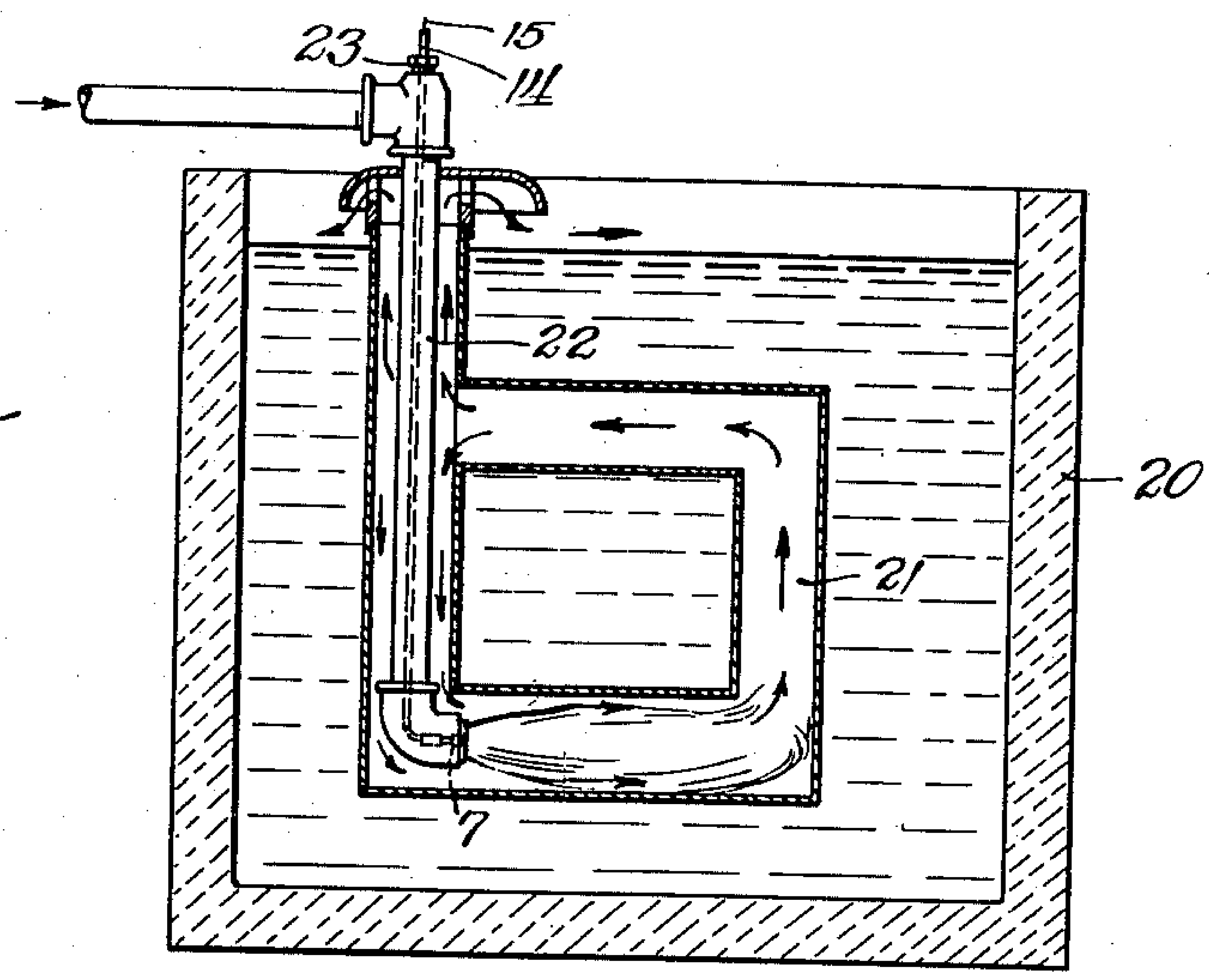


Fig. 6

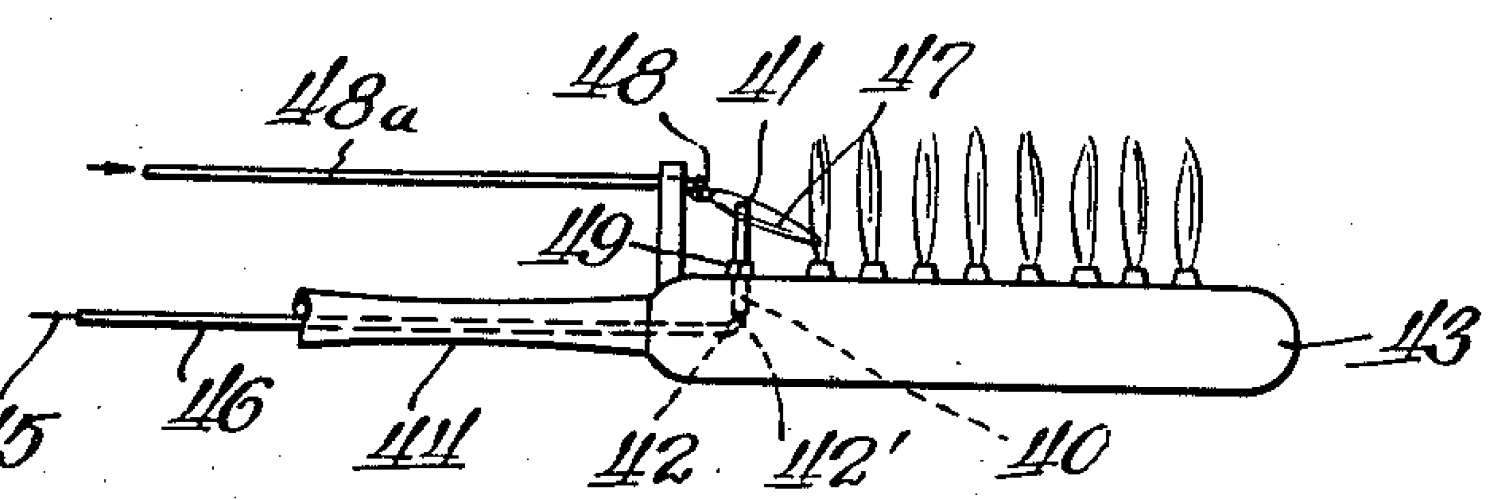


Fig. 7

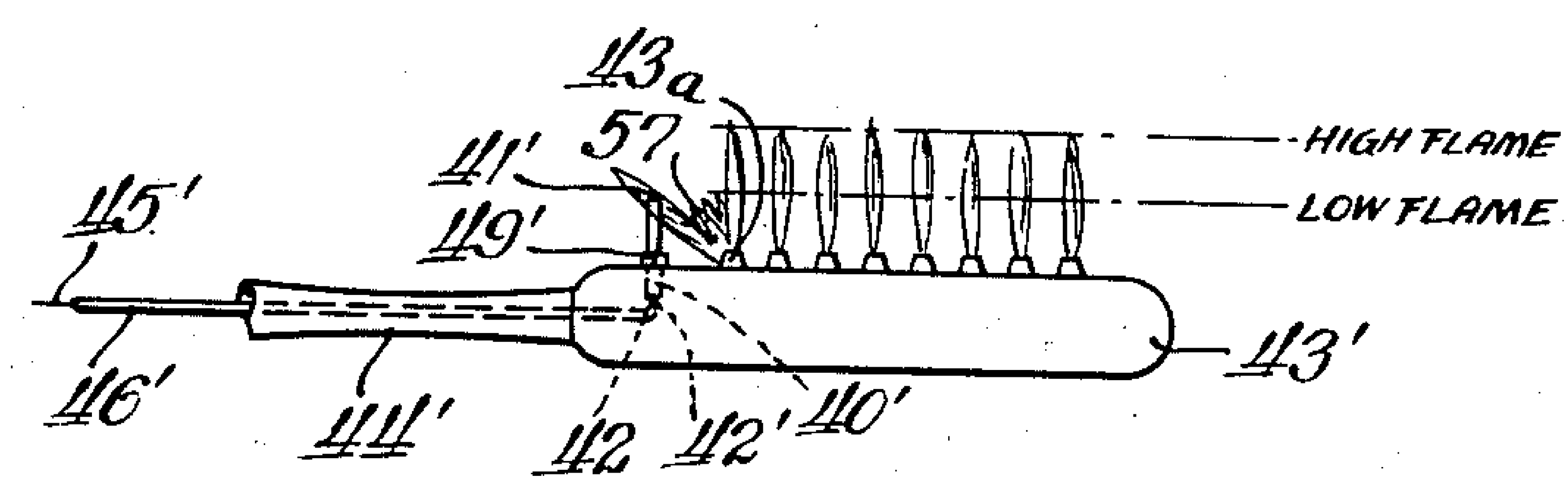
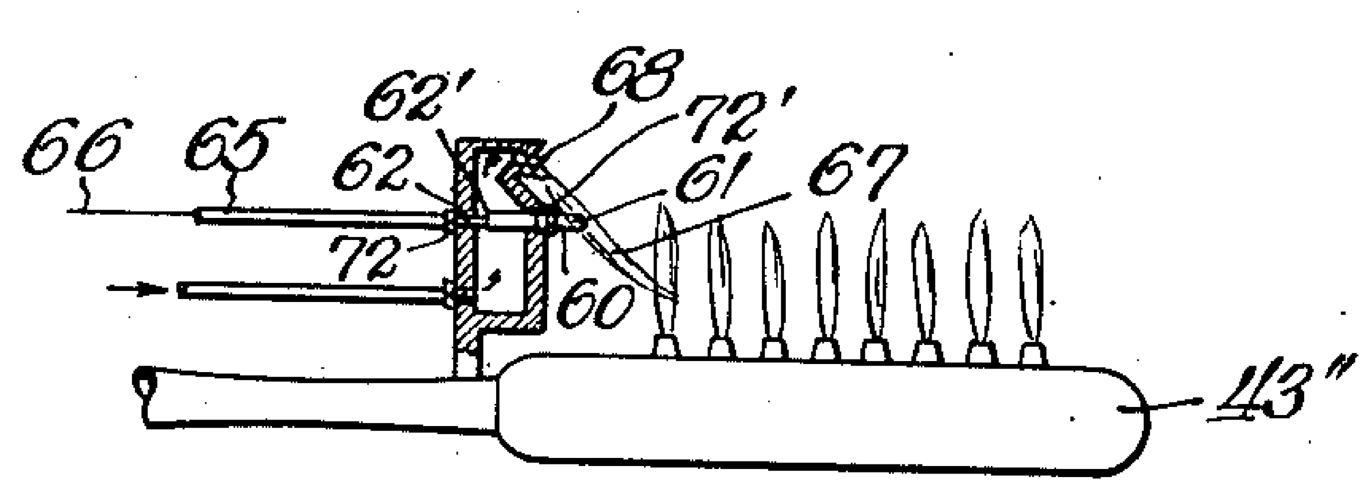


Fig. 8



Inventor.
Paul L. Betz.
By Brown, Jackson, Boettcher & Dienner
Att'ys

United States Patent Office

2,710,055

Patented June 7, 1955

2,710,055

THERMOELECTRICALLY OPERATED SAFETY DEVICES

Paul L. Betz, Baltimore, Md., assignor to Consolidated Gas Electric Light and Power Company of Baltimore, Baltimore, Md., a corporation of Maryland

Continuation of application Serial No. 724,668, January 27, 1947, which is a division of application Serial No. 361,079, October 14, 1940, now Patent No. 2,482,238, dated September 20, 1949. This application November 13, 1951, Serial No. 255,937

6 Claims. (Cl. 158—115)

This invention relates, in general, to thermoelectrically operated safety devices, and has particular relation to an improved combination of the thermocouple means of such a device with the burner with which it is associated and the means for supplying fuel to the burner.

The present application is a continuation of my copending application Serial No. 724,668, filed January 27, 1947 (abandoned subsequent to the filing of the instant application), which latter application was a division of my then copending application Serial No. 361,079, filed October 14, 1940, which has matured into U. S. Patent No. 2,482,238, issued September 20, 1949.

In the patent to Sebastian Karrer, No. 2,097,838, granted November 2, 1937, for "Safety Device for Gas Burners," one method of presenting the thermocouple to the pilot flame is indicated. Here the "hot" junction is subjected to a flame inside the burner compartment, and the "cold" junction is subjected to room temperature existing outside the burner compartment.

Another method of applying the thermocouple of a thermoelectrically operated safety device is indicated in the patent of Paul L. Betz and Sebastian Karrer No. 2,156,235, granted April 25, 1939. Here the "cold" and "hot" junctions of the thermocouple are inside the burner compartment, and, in the absence of a pilot flame, are subjected to the ambient temperature within the burner compartment.

The present invention provides still another method of applying the thermocouple of a thermoelectrically controlled device such that, upon extinction of the flame at the "hot" junction, both "cold" and "hot" junctions are forcibly cooled by unignited combustible gas mixture.

One of the main objects of this invention is to provide forced cooling for the junctions of a thermocouple so that upon extinction of the flame at the "hot" junction, the junctions rapidly attain substantially the same temperature.

Another object of the invention is to provide for cooling, particularly by the relatively cool fuel mixture in passing through the burner body, the "cold" junctions of the thermocouple at the same time that the "hot" junction is subjected to the heat of the burner flame so that a relatively large temperature difference is provided between the "hot" and "cold" junctions of the thermocouple.

Another object of the invention is to provide a device of the class described having various features of novelty and advantages and which particularly comprises a hollow burner body having a port adjacent which a flame is adapted to burn outside the burner body, means for supplying a fuel mixture of gas and air into the hollow burner body for passage to the port to maintain the flame, and a thermocouple mounted in said burner body and having "hot" junction means disposed outside the hollow burner body and subjected to the heat of the flame, and "cold" junction means disposed within the hollow interior of the burner body to be cooled by the fuel mixture in passing through the burner body.

Another object of the invention is to provide in a unitary fuel burner and thermoelectric generator device, the combination of a first thermoelement surrounded by tubular concentric wall members which define a fuel passage leading to a flame port adjacent which a flame is adapted to burn, with one of the wall members constituting a second dissimilar thermoelement; the outer ends of such wall members and the outer end of the first thermoelement being all joined together with the junction between the first thermoelement and the tubular wall member which constitutes the second thermoelement forming a hot junction subjected to the heat of the flame; the wall member which constitutes the second thermoelement being disposed in contact with and directly cooled by fuel passing to the flame port; and the first thermoelement being protected from contact with fuel passing to the flame port and positioned to be indirectly cooled by such fuel.

Further features and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 is a sectional view illustrating the application of a thermocouple to a straight type of burner head in accordance with the present invention;

Figure 1A is a more or less diagrammatic view on reduced scale, illustrating the fuel supply pipe for the burner head shown in Figure 1 and the safety shutoff valve in the fuel supply pipe;

Figure 2 is an end view of the burner head shown in Figure 1;

Figure 3 is a sectional view indicating the application, in the manner of Figure 1, of a thermocouple to an angular type of burner head;

Figure 4 is an end view of the burner head shown in Figure 3;

Figure 5 is a view, partially in section and partially in elevation, illustrating the use of a burner of the type shown in Figures 3 and 4, with a radiator of the recirculating type; and

Figures 6, 7, and 8 are fragmentary and more or less diagrammatic views illustrating further embodiments of the present invention.

The embodiments of the invention shown in the drawings are illustrative of preferred constructions as applied to particular devices. While these applications are described in considerable detail, it is to be understood that this is for purposes of illustration only. Other relationships between the thermocouple and the pilot burner and/or main burner are contemplated within the scope of the present invention.

In one type of gas-burning equipment the burners are supplied with air and gas mixed in such proportions as to require no additional primary or secondary air to effect proper combustion. These burners may be operated inside a radiator—that is, surrounded by the material to be heated—and have been found to be particularly suitable for such applications as metal melting, solution heating, and the like. One particular relationship of burner, radiator, and material to be melted, such as type metal, is illustrated in Figure 5, which will be described more in detail as this description proceeds.

Referring to Figures 1, 1A and 2 which illustrate the application of a thermocouple following the present invention to a straight type of burner head, a burner casing or hollow burner body is indicated at 1. The casing or burner body 1 has a threaded aperture 2 to receive a fuel supply pipe 3. A burner face plate is shown at 4 having ports 5, and is held in place in any suitable manner as by means of an externally threaded retaining ring 6. If desired, however, burner face plate 4 may be welded in position in casing 1. Where ring 6 is employed, it projects from the tubular body 1 beyond the apertured partition 4 and partially confines the flame which starts from the apertured partition so as to direct it against the hot junction *a* of the thermocouple.

A metal plug 7 is positioned in the burner face plate 4. As illustrated, plug 7 has a shoulder 8 which abuts plate 4 when in position. Plug 7 may be applied to the burner face plate 4 in any suitable manner, as by welding, threading, or, as illustrated, by means of a driving fit. Plug 7 is bored out with bore holes of two diameters . One bore, indicated at 9, is of suitable diameter to be threaded to receive the threaded end of a thermocouple 11, and the other bore, indicated at 10, is of larger diameter so that plug 7 does not touch thermocouple 11 except at the threaded extremity.

In Figure 1, the thermocouple 11 consists of a tubular metal thermo-element 12 enclosing an inner metal thermo-element 13 which is welded or joined at *a* to the closed end of the thermo-element 12 The two thermo-elements 12 and 13 are of different thermoelectric characteristics. The junction of elements 12 and 13 at *a* is the "hot" junction of the thermocouple. The "cold" junctions are located at the junction *b* of the thermo-element 12 and lead member 14, and at the junction *c* of thermo-element 13 and lead member 15. The "cold" junctions are located inside the burner head or immediately adjacent thereto. A straight thermocouple is shown in Figure 1.

In operation, the flame at ports 5 in burner face plate 4 is modulated between two rates of gas flow, one being the full flame in which the flame cones project some distance from the surface of plate 4 and the other being the pilot flame in which the flame cones are quite short. In both cases, heat from the flames at burner face plate 4 flows to the protruding portion of plug 7 and is conducted to the "hot" junction of thermocouple 11. Leads 14, 15 of the thermocouple are connected to the operating winding of a suitable safety device indicated at S, and the thermoelectric current maintains the said safety device in the "on" or energized position. Should the flames at burner face plate 4 be extinguished, the "hot" junction *a* of the thermocouple will be cooled by the unignited air-gas mixture issuing from burner ports 5, and the "cold" junctions *b* and *c* will be cooled by the relatively cool air-gas mixture flowing to burner ports 5, thereby resulting in a decay of the thermo-electric current and the safety device will move to the "off" or deenergized position.

The safety device may be generally of the type shown and described in the Karrer, and Betz and Karrer patents identified at the beginning of this specification, or of any other suitable or preferred form. Where it is desired to shut off the supply of fuel to the burner when the flames at the burner face plate 4 are extinguished, the safety device may be placed in the fuel supply pipe 3 leading to the burner, as shown at S in Figure 1A, or in any other suitable or preferred manner. The thermocouple leads may be brought out of the fuel pipe 3 for connection with the safety device by means such as a gas-tight compression fitting indicated at F.

The embodiment of the invention shown in Figures 3 and 4 is the same as the embodiment shown in Figures 1 and 2 except that instead of a straight thermocouple as in Figure 1, the thermocouple 11′ is bent to conform to the angular type of burner head to which it is applied. The outer thermo-element 12′ may be of tubular form as in the preceding embodiment of the invention, or of any other suitable form. The remaining parts in Figures 3 and 4 are designated by primed reference characters corresponding with the reference characters in Figures 1 and 2, and the operation is the same as described in connection with Figures 1 and 2.

Figure 5 illustrates the use of a burner of the type shown in Figures 3 and 4, with a radiator 21 of the recirculating type. This radiator comprises no part of the present invention. Radiator 21 is shown immersed in a pot 20 containing molten metal. The combustible air-gas mixture is supplied to the burner through a fuel supply pipe 22. The thermocouple leads 14 and 15 are disposed inside fuel supply pipe 22, and are brought out of the fuel pipe in any suitable manner as by means of a gas-tight compression fitting 23. As has been already stated, leads 14 and 15 are connected to the operating winding of a suitable electroresponsive control mechanism.

In the above, the particular construction described embodies the present invention as regards the forced cooling of the "hot" and "cold" thermojunctions for the case where the pilot or holding flame is the low flame of the gas burner. The "hot" junction is not in direct contact with the flames, there being interposed the plug 7 through which heat is conducted to the "hot" junction. Other relationships between the thermocouple and the pilot and/or main burner flames are contemplated within the scope of the present invention. Some of these other arrangements will be covered by the following description.

Referring to Figure 6, a thermocouple, indicated at 40, has a "hot" junction at 41 and "cold" junctions at 42, 42′. The main burner 43 is provided with a suitable gas supply tube 44 through which the leads 45, 46 of the thermocouple extend. The pilot burner 48 is provided with a gas supply tube 48*a*. The hot junction 41 is heated by a pilot flame 47 and, upon extinction of the flame, unlighted gas issuing from pilot burner 48 cools the "hot" junction 41 and gas flowing to the burner 43 cools "cold" junctions 42, 42′. Thermocouple 40 is indicated as of the tubular construction shown more in detail in Figures 1 to 4 inclusive, and projects through the casing of burner 43 and is held by any suitable means, as, for example, by a compression fitting 49 which also prevents the leakage of gas around the thermocouple.

In Figure 7 the thermocouple and its mounting are similar to that in Figure 6, and since these parts have already been described, no further description will be given here. Primed reference characters, corresponding with the reference characters in Figure 6, have been used to designate like parts. In Figure 7 one of the ports 43*a* of burner 43′ is arranged to provide a flame 57 for the "hot" junction 41′ of the thermocouple 40′. The burner 43′ is intended to be operated between high and low positions, and therefore no separate pilot burner is required. If desired, burner 43 in Figure 6 may be provided with an auxiliary port to supplement heating the thermocouple by pilot flame 47 during operation of the main burner. Forced cooling of the thermocouple upon flame extinction takes place at the "hot" and "cold" junctions.

In Figure 8, forced cooling of the thermocouple 60 is accomplished by the gas flowing to and issuing from the pilot burner 68 when the pilot flame is extinguished. Thermocouple 60 has a "hot" junction at 61 and "cold" junctions at 62, 62′. Leads 65—66 are connected to the operating winding of a suitable safety device and to the respective thermo-elements of the thermocouple. "Cold" junctions 62, 62′ are located inside the pilot burner housing and are cooled by gas moving toward the pilot burner 68. A suitable compression fitting, as a compression fitting 72, permits bringing the thermocouple leads, the outer one of which may be tubular as shown more in detail in the preceding embodiment of the invention, through the housing of the pilot burner without the leakage of gas. A similar compression fitting 72′ permits the hot junction end of the thermocouple to pass through the pilot burner casing without the leakage of gas.

Upon failure of the pilot flame 67 of the embodiment of the invention shown in Figure 8, the "hot" junction is cooled by the relatively cool gas issuing from the pilot burner 68. If desired, an auxiliary port may be provided on the main burner 43″ to direct a flame to the "hot" junction of the thermocouple 60, thereby augmenting the heating of the thermocouple during the operation of the main burner. Here again, the extinction of the burner flames results in relatively cool gas forcibly cooling the "hot" and "cold" junctions of the thermocouple.

The embodiments of the invention shown in the drawings are for illustrative purposes only, and it is to be expressly understood that said drawings and the accompanying specification are not to be construed as a definition of the limits or scope of the invention, reference being had to the appended claims for that purpose.

I claim:

1. In a device of the class described, in combination, a hollow burner body having a wall provided with flame ports adjacent which and starting at said wall and projecting outwardly therefrom a flame is adapted to burn outside said wall, a tubular conduit opening into the interior of the burner body for supplying fuel thereto for passage to said ports to maintain the flame, a thermocouple comprising an outer tubular thermocouple element and an inner thermocouple element, said outer tubular thermocouple element extending through an opening in said wall of said burner body and joined outside said wall to said inner thermocouple element to form a hot thermojunction separated by said wall from the hollow interior of the burner body, an outer tubular lead conductor extending through said tubular conduit and into the interior of the burner body and joined therein to said outer tubular thermocouple element to form a second thermojunction, said outer tubular lead conductor by its extension through said tubular conduit being cooled ahead of the interior of the tubular body by the fuel supplied to the interior of the burner body by said conduit, and an inner lead conductor extending through said outer tubular lead conductor and joined to said inner thermocouple element to form a third thermojunction in proximity to said burner body.

2. In combination, a hollow main burner having port means adjacent to which a flame is adapted to burn outside the hollow interior of the main burner, a tubular conduit for supplying fuel to said main burner, a thermocouple extending through a wall of the main burner and having a hot thermojunction disposed outside and separated from the interior of the main burner, said thermocouple having cold thermojunction means disposed within the hollow interior of the main burner and thereby immersed in the fuel stream for the main burner, lead conductor means extending through said tubular conduit and connected in circuit with said thermocouple, and a pilot burner in juxtaposition to said main burner for igniting the same and for heating the hot thermojunction of the thermocouple.

3. In a device of the class described, in combination, a hollow burner body having port means adjacent which a flame is adapted to burn outside said hollow body, a tubular conduit opening into the interior of the burner body for supplying fuel thereto for passage to said port means to maintain the flame, a thermocouple comprising an outer tubular thermocouple element and an inner thermocouple element, said outer tubular thermocouple element extending through an opening in a wall of said burner body and joined outside said burner body to said inner thermocouple element to form a hot thermojunction separated from the hollow interior of the burner body, an outer tubular lead conductor extending through said tubular conduit and into the interior of the burner body and joined therein to said outer tubular thermocouple element to form a second thermojunction, an inner lead conductor extending through said outer tubular lead conductor and joined to said inner thermocouple element to form a third thermojunction in proximity to said burner body, the hollow burner body constituting a main burner, and a pilot burner in juxtaposition to the main burner for igniting the main burner and heating the hot thermojunction of the thermocouple.

4. In a device of the class described, in combination, a hollow burner body having port means adjacent which a flame is adapted to burn outside said hollow body, a tubular conduit opening into the interior of the burner body for supplying fuel thereto for passage to said port means to maintain the flame, a thermocouple comprising an outer tubular thermocouple element and an inner thermocouple element, said outer tubular thermocouple element extending through an opening in a wall of said burner body and joined outside said burner body to said inner thermocouple element to form a hot thermojunction separated from the hollow interior of the burner body, an outer tubular lead conductor extending through said tubular conduit and into the interior of the burner body and joined therein to said outer tubular thermocouple element to form a second thermojunction, an inner lead conductor extending through said outer tubular lead conductor and joined to said inner thermocouple element to form a third thermojunction in proximity to said burner body, the end of the tubular conduit opposite the end opening into the interior of the burner body being connected to a gas-tight compression fitting through which the tubular thermocouple element extends for connection with a thermoelectric safety control device.

5. In a unitary fuel burner and thermoelectric generator device, the combination of a first thermoelement, a second dissimilar tubular thermoelement concentrically surrounding said first thermoelement, said first and second thermoelements having outer ends joined to form a hot junction, an inner lead conductor joined to said first thermoelement to form therewith a first cold junction, an outer tubular lead conductor joined to said second thermoelement to form therewith a second cold junction, fuel supply means comprising a tubular jacket of non-porous material coaxially surrounding said first and second thermoelements and having a wall portion spaced from said second thermoelement to form therewith an annular fuel passage, said jacket extending axially rearwardly substantially beyond said first cold junction, whereby to dispose said cold junction intermediate the length of said fuel passage, and means operatively associated with said jacket and having flame port means for emission of fuel adjacent said hot junction, said hot junction being disposed forwardly of said flame port means, said second thermoelement being disposed in contact with and directly cooled by fuel flowing axially through said annular fuel passage toward said flame port means, and the disposition of said first cold junction intermediate the length of said annular fuel passage affording indirect cooling of said cold junction by the fuel flowing in the portion of the fuel passage surrounding said cold junction.

6. In a unitary fuel burner and thermoelectric generator device, the combination of a first thermoelement, a second dissimilar tubular thermoelement concentrically surrounding said first thermoelement, said first and second thermoelements having outer ends joined to form a hot junction, an inner lead conductor joined to said first thermoelement to form therewith a first cold junction, an outer tubular lead conductor joined to said second thermoelement to form therewith a second cold junction, fuel supply means comprising a tubular jacket of non-porous material coaxially surrounding said first and second thermoelements and having a wall portion spaced from said second thermoelement to form therewith an annular fuel passage, said jacket extending axially rearwardly substantially beyond said first cold junction, whereby to dispose said cold junction intermediate the length of said fuel passage, and means comprising a metallic transverse end wall portion operatively associated with said jacket and provided with flame port means for emission of fuel adjacent said hot junction, said hot junction being disposed forwardly of said flame port means, said second thermoelement being disposed in contact with and directly cooled by fuel flowing axially through said annular fuel passage toward said flame port means, and the disposition of said first cold junction intermediate and length of said annular fuel passage affording indirect cooling of said cold junction intermediate the length of said annular fuel passage affording indirect cooling of said cold

junction by the fuel flowing in the portion of the fuel passage surrounding said cold junction.

References Cited in the file of this patent

UNITED STATES PATENTS

2,132,057	Thornbery et al.	Oct. 4, 1938
2,198,896	Wetzel	Apr. 30, 1940
2,267,742	Mantz	Dec. 30, 1941
2,271,506	Mantz	Jan. 27, 1942
2,482,238	Betz	Sept. 20, 1949

FOREIGN PATENTS

485,539	Great Britain	May 20, 1938