May 6, 1958 W. F. JACKSON ET AL 2,833,843

PILOT BURNER AND THERMOCOUPLE THEREFOR

Filed Oct. 15, 1954 2 Sheets-Sheet 1

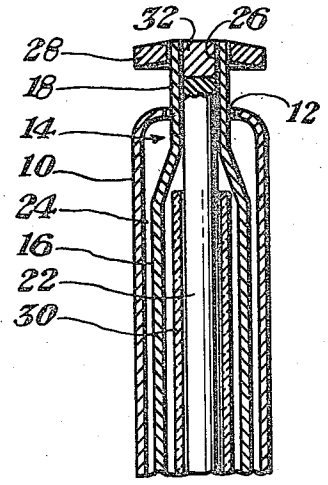


Fig. 1.

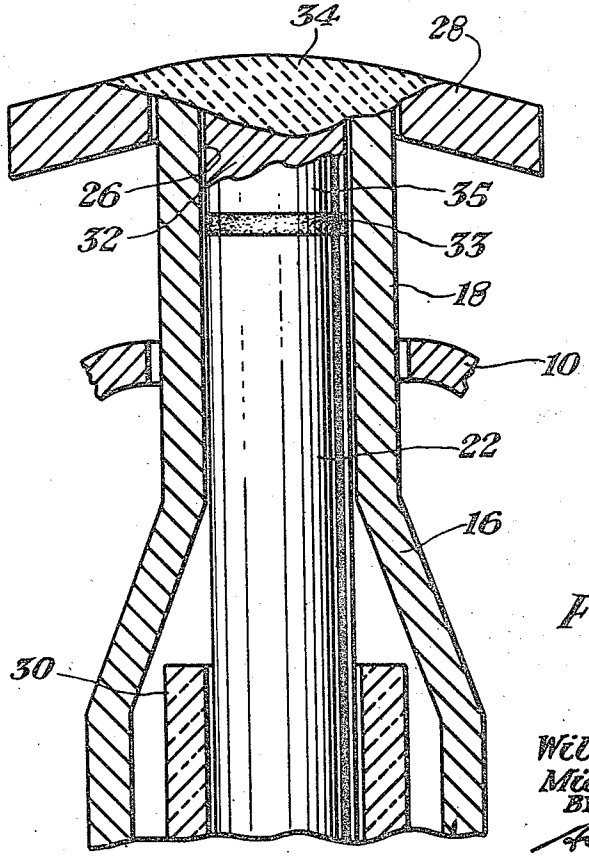


Fig. 2.

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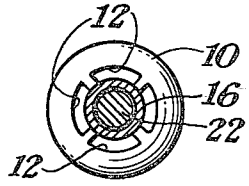


Fig. 4.

Fig. 3.

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PILOT BURNER AND THERMOCOUPLE THEREFOR

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4 Claims. (Cl. 136—4)

This invention relates to a combination pilot burner and thermocouple generator unit and more particularly to such a unit employing a pilot burner of the non-primary aerated type.

In the past, thermostatic safety control devices depended entirely upon a pilot burner which was separated from its correlated thermocouple and joined therewith by a comon mounting means. In these combinations, the pilot burner consumed a relatively large amount of fuel in the two-fold function of igniting the main burner and playing upon, at most, a small portion of the thermocouple in order to maintain energization of an electromagnet for maintaining a fuel supply valve member in open position. These devices were handicapped in that a relatively large pilot burner was needed in order to produce a flame adequate for heating the thermocouple which was located in the path of only a small portion of the flame.

Besides being bulky, expensive, overly gas consuming, and requiring many installing manipulations to effect replacement, these combinations produced what is referred to as "hot range" and "hot kitchen" conditions. The flame emanating from the pilot burner, when the main burners of the range were not in use, was so great that a marked rise in temperature could be observed in the range structure and in the immediate vicinity.

In very recent years, the advent of pilot burner-thermocouple units solved many of the former problems, but reduced the disadvantages only to a slightly less degree. Such units included a small thermocouple housed within the pilot burner casing and required a small flame which was sufficient for heating a thermocouple hot junction. These units although a step toward ultimate perfection in the use of pilot burners and thermostatic safety devices are still deficient in eliminating the main disadvantages presently found in the conventional separated pilot burner-thermocouple systems.

The pilot burner-themocouple unit, of late, utilizes a gas and air mixture or primary aerated mixture in much the same manner as formerly and therefore is subject to all the disadvantages encountered with such mixture. In preparing a gas-air mixture, use is made of an orifice of extremely close tolerances to permit the passage of the proper amount of gas into a mixing chamber. Since the flow of gas through the orifice is very sensitive to the area of the opening, a slight amount of clogging thereat would immediately affect the amount of gas entering the mixing chamber resulting in a serious contraction of the burner flame which may not be capable thereafter of igniting the main burner.

In much the same manner, the primary air flowing in the passageway to the mixing chamber must be properly protected against linting and any such clogging of the passageway would immediately manifest itself at the flame tip of the pilot burner. Manufacture and installation of an orifice of exact tolerances as well as the fabrication of a lint filter has greatly increased the cost of the present day unit. Further, since the orifices in these units are sensitive to varying conditions, the orifices may have to be replaced in order to accommodate different types of domestic gases with differing pressures and densities, thereby increasing the cost of the unit and the installation thereof.

Another disadvantage of the present day pilot burner-thermocouple unit is the relative high gas consumption rate and the tendency of the unit to produce "hot range" or "hot kitchen" conditions. Although, these units utilize a smaller flame than in previous embodiments of the pilot burner-thermocouple combination, there is, nevertheless, a tendency on the part of the pilot burner to cause a "hot range" only to a lower degree.

Many unsuccessful attempts have been made toward accomplishing an ideal "cold range" pilot burner of the type utilized for controlling a thermomagnetic gas supply valve. Most notable of the solutions to the problems involved were directed to reducing the size of the pilot burner to insure a small flame and increase the voltage output of the thermocouple. However, the present day pilot burners, especially of the type housing a thermocouple, are of the aerated type and these have definite limitations for pilot burner size in order to obtain successful operation. It is generally known in the art that the primary aerated type pilot burner has a narrow B. t. u. output range and in order to maintain a useful flame at the burner tip, the minimum of that range must be kept at a relatively high value because a certain amount of gas must flow into the mixture chamber from the orifice with sufficient velocity to draw air from the atmosphere for proper mixture thereof.

On the other hand, the non-primary type pilot burner has a relatively wide B. t. u. output range and the raw gas flowing to the burner may be turned down to an extremely small output value to maintain a useful flame at the burner tip. In operation, the raw gas literally drifts upward through the interior of the burner body and out into the atmosphere by way of suitable flame ports where the gas aerates and burns at approximately the same time. In this type of burner an output of an extremely low number of B. t. u.'s per hour can be easily achieved and still produce sufficient heat to maintain a thermomagnetic valve in open position and to ignite a main burner.

The present invention is directed to a pilot burner-thermocouple unit which avoids the disadvantages found in similar present day units. To this end, a pilot burner of the non-primary aerated type is provided and takes the form of a tubular member surrounding an elongated thermocouple and including a plurality of annular flame ports at one end adjacent the hot thermojunction of the thermocouple. An orifice functioning in the nature of a flow limiter is provided in the raw gas inlet portion of the burner tubular member. Since primary air is not required to be premixed with the gas, it is sufficient that the orifice be adapted to restrict somewhat the amount of gas entering the burner rather than allowing the gas to flow within precise limits. The burner is adapted to maintain energization of a thermomagnetic valve while in the open position and to ignite a main burner with an output of relatively low consumption. Accordingly it is an object of the present invention to accomplish a proper igntion of the main burner and heating of a thermostatic safety control device employing a pilot burner which consumes an extremely small amount of gas at all times.

In addition, a novel welding process is employed to form and insure maximum heating of the hot thermojunction and at the same time to prevent the formation of carbon at this point. To this goal, a piece of wire of the same material as that of one of the thermocouple elements is butt welded to the extreme tip of the other thermocouple element so that a small piece of the wire

remains unmelted. The end of the wire remote from the butt weld is then welded to the thermocouple element of like material and insulates the other thermocouple element from the raw gas and flame.

Another object of the invention is to utilize a compact pilot burner-thermocouple unit comprising conventional parts in simple arrangement for reducing the cost of manufacture, installation and replacement.

Another object of the invention is to elimiate "hot range" and "hot kitchen" conditions caused by the present day pilot burner-thermocouple units.

Another object of the invention is to increase the turn down characteristics of a pilot burner-thermocouple unit, insuring quiet operation thereof and reducing the usual inherent flash back tendencies of the present day pilot burners.

Other objects and advantages will become apparent from the following description taken in conjunction with the accompanying drawing wherein;

Fig. 1 is a fragmentary sectional view of the present invention in one stage of assembly;

Fig. 2 is an enlarged fragmentary sectional view of a detail;

Fig. 3 is a sectional view of a combination generator-pilot burner embodying this invention; and

Fig. 4 is a sectional view taken on the lines IV—IV of Fig. 2.

Referring to Figs. 1 and 3, there is shown a thermocouple-pilot burner combination comprising a pilot burner tubular body 10 having an inturned end provided with a plurality of equally spaced slots 12 forming flame ports. In this instance, four such ports are provided. A thermocouple, generally indicated by the reference numeral 14, is accommodated and supported within the body 10.

The thermocouple 14 includes an outer thermocouple element 16 of tubular form having a reduced annular neck portion 18 projecting exteriorly of the burner 10 and providing an inner annular wall for the flame ports 12. A rod-like inner thermocouple element 22 is positioned interiorly of the element 16 and has its uppermost end projecting partly into the neck portion 18 and secured in a manner to be described hereinafter. It is to be noted that the burner body 10 and the elements 16 and 22 are preferably arranged about a common axis with the outer element 16 being concentric with the burner body 10. Since the outer thermocouple element 16 is of smaller diameter than the body 10 an annular passageway 24 is provided therebetween and serves to transmit the flow of raw fuel from a fuel supply source (not shown) to the burner flame ports 12.

As shown in Figs. 1 and 2 the upper end of the inner element 22 is somewhat shorter than the neck portion 18 of the outer element 16, leaving a recess 26 at the terminal end of the neck portion 18 to accommodate a filling material to be described hereinafter. An annular retaining disc 28 is secured to the terminal end of the neck portion 18 spaced from but overlying the burner flame ports 12 and serves to spread the flow of raw gas emitted by the flame ports 12. To complete the thermocouple structure, an insulation sleeve 30 of suitable material, such as "Fiberglas," is provided between the outer element 16 and the inner element 22 and terminating short of the neck portion 18.

The tubular body 10, the outer element 16 and the retaining disc 28 are all preferably made from 27% chrominum steel, the inner conductor element 22 being made from the well known alloy constantan which consists of approximately 45% nickel and 55% copper. It is well known in the art that nickel, in the presence of sulphur-carrying fuel gas, deposits a quantity of undesirable carbon formation on the metal due to cracking of the fuel gas. Previous methods of welding inner and outer thermocouple elements consisted simply of fusing the ends of the elements, such as by the well-known "Heliarc"

welding process until a solid junction was formed at the ends. However, since the inner thermocouple element formed part of the resulting welded junction, nickel was included therein. Consequently, fuel gas which was permitted to flow around the welded junction caused an appreciable formation of carbon at this point.

To eliminate such contact of gas with the nickel present in the inner element 22, a piece of chromium steel wire 32, which is devoid of nickel, is butt-welded at 33 to the upper extremity of the inner element 22 within the previously described recess 26 as shown in Fig. 2. In that figure, a quantity of unmelted nickel-free metal 35 from the chrominum steel wire 32 remains in the recess 26 and the retaining disc 28, the narrow neck portion 18 and the adjacent upper portion of the wire 32 are then fused together.

The finished weld alloy designated by the reference numeral 34 consists of the chromium steel furnished by the element 16, the disc 28 and the nickel-free chromium steel from the adjacent portion of the wire 32. Thus, an insulating body in the form of the unmelted chromium steel 35 remains between the nickel-bearing inner element 22 and the weld 34. In this manner, the thermocouple 14 is formed with a hot thermojunction which comprises the rigid welded connection 33 for the upper extremity of the thermocouple element 16 and the lower portion of the wire 32.

As shown in Fig. 3, the lower end of the tubular burner body 10 is received in a bore 36 formed in a burner support 38 and is welded therein or otherwise secured to the support 38 by any suitable means. In order to prevent the escape of gas between the edges of the bore 36 and the exterior wall of the member 10, a suitable sealing material 37 is provided therebetween and may take the form of the welding material if the member 10 is welded to the support 38. An angular passageway 40 is formed in the support 38 and communicates with the annular passageway 24 for conducting raw fuel gas thereto. Integral with the support 38 and extending therefrom substantially parallel with the body 10 is a nipple 42 which has a chamber 44 in communication with the passageway 40. A gas supply tube 46 is coupled to the nipple 42 by any suitable means, and serves to deliver a supply of gas to the chamber 44 through a small orifice or flow limiter 48 housed within the nipple 42.

The lower end of the outer thermocouple element 16 is received in a bore 50 formed in the lower section of the support 38 and is suitably soldered therein at 52 with silver solder. An insulated lead wire 54 is connected, axially at 56 as by silver solder, to the lower end of the inner thermocouple element 22 to form the cold junction of the thermocouple 14. A lead tube 58 encases the insulated wire 54 and is connected to the lower end of the element 16 by means of the same silver solder joint 52 used to connect the element 16 to the support 38. It will be apparent that the wire 54 and the tube 58 serve as conductors for transmitting the electricity generated by the thermocouple 14 to an energizing coil of a thermomagnetic valve (not shown).

In operation, assuming that the thermocouple-pilot burner unit, as shown in Fig. 3, is suitably connected for use in a heating appliance so that the pilot burner body 10 is in proper lighting relationship with the main burner (not shown) of the appliance to which gas will be supplied under control of a thermostatic valve (not shown) so as to maintain the appliance at a desired heating temperature, then a gas cock (not shown) is turned to the open position. This will permit the flow of raw gas to the flame ports 12 where the gas is ignited by any conventional means by way of the tube 46, the chamber 44, the passageway 40 and the passageway 24. By reason of this invention a relatively small number of B. t. u.'s per hour is consumed.

The annular ports 12 cause a circular sleeve of flame to form around the neck portion 18 of the thermocouple

14, which flame is retained and stabilized sufficiently by the retaining disc 28 to reduce the possibility of its accidental extinguishment. The disc 28 also serves to spread the flow of gas issuing from the ports 12 and thereby produce turbulence so that it will burn a blue flame despite the lack of primary air. Further, the disc 28 offers more surface area to be heated by the flame thereby producing a better heat-conducting path to the hot thermojunction.

From the foregoing description, it will be apparent that by the present invention, a low gas consuming pilot burner has been combined with a sensitive and relatively powerful thermocouple generator. Heretofore, devices of this general character have utilized a mixture of primary air and gas to serve as fuel for the pilot burner but with little success in establishing a low gas consuming burner, because of the speed at which the gas must flow through an orifice in order to induce a sufficient amount of air to mix therewith. The present invention obviates this limitation by utilizing a pilot burner of the non-aerated type which is capable of adequately heating a built-in thermocouple even though the gas consumption is extremely low, such gas consumption being less than that which is possible with the aerated or "Bunsen" burner type.

Another feature of the present invention resides in the novel formation of the hot thermojunction wherein the nickel ingredient of the inner thermocouple element is prevented, in any way, from coming in contact with the surrounding atmosphere of the pilot burner unit by the provision of an insulator in the form of an unmelted mass of chromium stainless steel between the element and the surrounding atmosphere. In this way, the nickel ingredient is not liquified as would be the case in conventional welding processes and cannot mix with the other elements of the hot thermojunction so as to be exposed to the atmosphere.

While the embodiment of the invention has been shown and described with considerable particularity, it is to be understood that the invention is not restricted thereto as the same is capable of receiving a variety of mechanical expressions, as will be apparent to those skilled in the art. It will be understood that many changes may be made in the details of construction and arrangement of parts without departing from the scope of this invention as defined in the appended claims.

We claim:

1. A method of forming the hot thermojunction for a thermocouple having an elongated nickel-containing conductor encased in a nickel-free metallic cylinder comprising the steps of positioning a relatively short piece of nickel-free metallic rod in axial alignment and in end to end abutting relationship with respect to said conductor, fusibly uniting, as by a weld, the abutting ends of said conductor and said rod, inserting said conductor and said rod into a nickel-free metallic cylinder with the united ends adjacent an open end thereof, and fusibly uniting, as by a weld, the other end of said rod with the portion of said cylinder adjacent said open end whereby said second weld is composed of a nickel-free alloy.

2. In a thermocouple, a first thermocouple element of nickel containing metal, a tubular thermocouple element of nickel-free metal in radially spaced coaxial relation to said first element and projecting beyond one end thereof to form a recess, and an insert portion of nickel-free metal in said recess having one end welded to said one end of said first element, said portion having its opposite end welded to said tubular element leaving an unmelted section of nickel-free metal between said first element and the surrounding atmosphere.

3. In a combination pilot burner and thermocouple, a first thermocouple element of a first metal, a tubular thermocouple element of substantially nickel-free metal in radially spaced coaxial relation to said first element and projecting beyond one end thereof to form a recess, an insert portion of substantially nickel-free metal in said recess having one end welded to said one end of said first element to form a hot thermojunction, means located adjacent said thermojunction for directing a flame upon said projection adjacent said thermojunction, and flame retaining means of substantially nickel-free metal welded to the opposite end of said portion and to said projection leaving an unmelted section of substantially nickel-free metal between said first element and the surrounding atmosphere.

4. In a combination pilot burner and thermocouple, a first thermocouple element of nickel containing metal, a tubular thermocouple element of nickel-free metal in radially spaced coaxial relation to said first element and projecting beyond one end thereof to form a recess, an insert portion of nickel-free metal in said recess having one end welded to said one end of said first element to form a hot thermojunction, a tubular fuel conducting member enveloping said tubular element and terminating in radial flame ports on one side of said thermojunction for directing flame upon said projection adjacent said thermojunction, and a flame retaining plate of nickel-free metal positioned on the opposite side of said thermojunction from said flame ports, said plate being welded to the opposite end of said portion and to said projection leaving an unmelted section of nickel-free metal between said first element and the surrounding atmosphere.

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