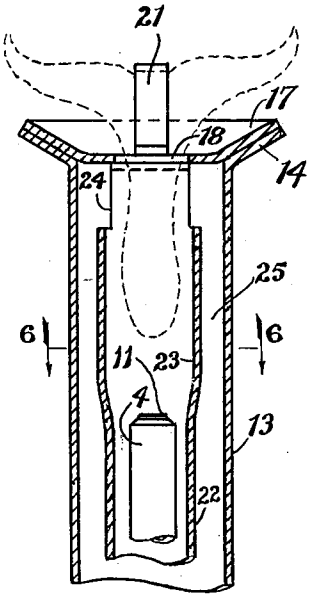
March 18, 1952 J. L. HARRIS ET AL 2,589,804

INTERNALLY FIRED SAFETY PILOT GAS BURNER

Filed Nov. 12, 1946

Fig. 5.



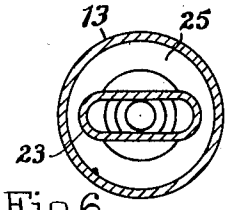


Fig. 6.

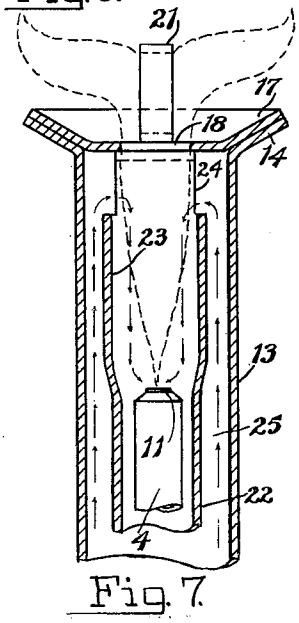


Fig. 7.

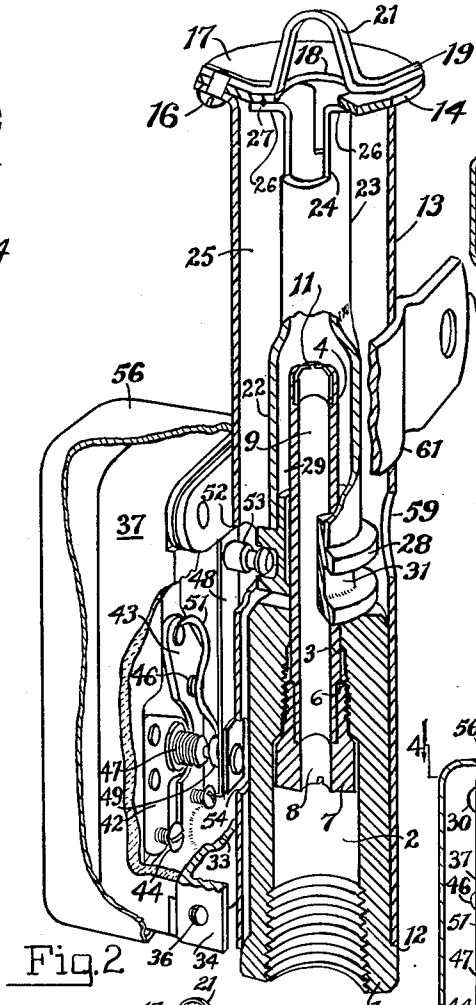


Fig. 2.

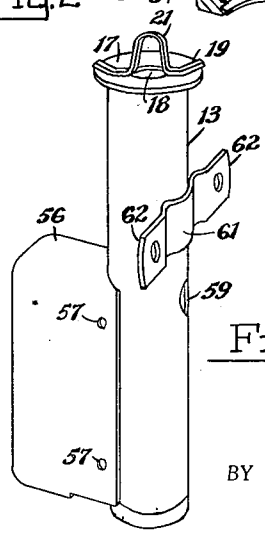


Fig. 1.

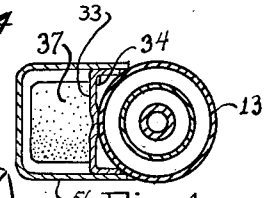


Fig. 4.

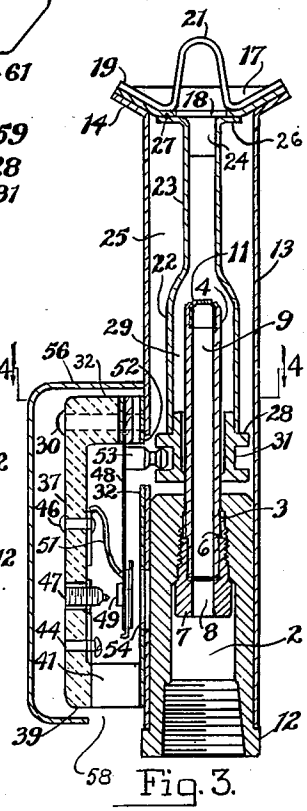


Fig. 3.

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INTERNALLY FIRED SAFETY PILOT GAS BURNER

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Application November 12, 1946, Serial No. 709,128

7 Claims. (Cl. 158—115)

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This invention relates generally to a burner structure of the type commonly employed for igniting a main burner. And the present invention is directed toward and has as an object the provision of a burner structure affording a blow-out proof floating flame having at all times a portion shieldably disposed within a mixture confining passage, and another portion capable of igniting a burner positioned adjacent such passage.

Another object of the present invention is to provide a blow-out proof pilot burner structure embodying relatively movable parts affording a speedy response suitable for controllably effecting a prompt shut-off of fuel feed in the event the supply of fuel is terminated or the flow thereof becomes so slow as to render flame failure likely or probable, or operation of the burner undesirable.

Another object of the present invention is to provide a pilot burner structure embodying relatively movable, expandable parts constructed and combined in an improved manner affording a blow-out proof flame suitable for igniting a main burner and suitable for maintaining a workable temperature difference between such parts irrespective of variations in ambient temperature.

Another object of the present invention is to provide an improved pilot burner structure embodying parts constructed and combined with each other and with a gas emitting nozzle in a manner insuring the formation of a combustible mixture under conditions resulting in the production of a blow-out proof flame having at all times a portion thereof disposed in direct heat imparting relation to one of such parts, and another portion thereof capable of igniting a burner disposed adjacent the pilot structure, irrespective of variations in fuel flow over a wide range.

Still another object of the present invention is to provide a durable, relatively inexpensive and positively acting safety pilot structure minimizing the number and intricacy of the parts thereof.

Another object of the present invention is to provide a safety pilot structure embodying passage forming parts constructed and combined with each other and with a gas emitting nozzle so as to provide a blow-out proof igniting flame partially confined within an inner passage at all times, and of such character that the flame moves farther into such passage and imparts more heat to the flame confining walls thereof as the flow of fuel increases.

Another object of the present invention is to

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provide a pilot burner structure embodying a fuel emitting nozzle and parts constructed and combined for relative expansion in generally spaced passage forming relation in a manner insuring the formation of a blow-out proof igniting flame partially confined at all times within a passage afforded by one of such parts and in a manner insuring the transfer of heat from one to another of the parts primarily by conduction through joined portions thereof.

Another object of the present invention is to provide a pilot burner structure embodying a fuel emitting nozzle and parts constructed and combined for relative expansion in generally spaced passage forming relation in a manner insuring the formation of a blow-out proof igniting flame partially confined at all times within a passage afforded by one of such parts and in a manner maintaining a marked workable difference in the temperature between said one part and another of the parts junctioned therewith, irrespective of variations in ambient temperature and irrespective of variations in fuel flow throughout a normally expectant range.

The construction and application of apparatus embodying the invention will become readily apparent as the disclosure progresses and points out additional objects, advantages and features of construction considered of special importance, and in some instances of general application, although shown and described as applied to a switch actuating mechanism. Accordingly, the present invention may be considered as comprising parts constructed and/or combined or correlated as hereinafter more fully set forth in the appended claims and in the detailed description, reference being had to the accompanying drawing illustrating but one embodiment of the invention, and in which:

Fig. 1 is a perspective view of a safety pilot apparatus embodying the invention;

Fig. 2 is an enlarged view similar to Fig. 1, with parts cut away to show the construction, combination, and coaction of parts;

Fig. 3 is a central, vertical section taken through the pilot valve structure and through the switch mechanism mounted thereon;

Fig. 4 is a section taken on line 4—4 of Fig. 3;

Fig. 5 is a central vertical section through the upper portion of the tube structure shown in Figs. 2 and 3 illustrating the manner in which the flame moves away from the nozzle when the gas pressure is low;

Fig. 6 is a section taken on line 6—6 of Fig. 5; and

Fig. 7 is a view similar to Fig. 5 illustrating the

path of air flow, the formation of a combustible mixture, and the flame resulting therefrom.

In the illustrated embodiment of the invention, 1 designates a generally cylindrical body member having a bore or passage 2 extending coaxially therethrough. Passage 2 is counter-bored to provide an internal shoulder 3 adjacent one end thereof, and is additionally counter-bored or further enlarged immediately adjacent shoulder 3 and adjacent the inlet end thereof. The enlargement adjacent shoulder 3 is internally threaded, as is also the inlet end portion of the passage, the latter providing means for connecting body member 1 to a suitable source of gas supply, such as a conduit (not shown). A nozzle member 4 projects or extends through passage 2 to a point considerably beyond body member 1 and is provided with an external shoulder 6 adapted for seating engagement with an element 7 having an external portion in screw threaded engagement with the internally threaded portion of passage 2 and having an opening 8 therethrough in coaxial alignment with the passage 9 in the nozzle member 4. The discharge end of the nozzle member 4 may be provided with a suitable cap 11 which is formed with a metering orifice. The inlet end portion of body member 1 is provided with an external shoulder 12.

An outer tube 13 is disposed in telescoped relation about body member 1 with an end thereof abutting shoulder 12. Tube 13 may be fixedly secured to body member 1 in any suitable manner, preferably a press fit. The end of tube 13 remote from body member 1 is provided with an annular outer off-set flange 14 to which is secured, in any suitable manner, such as by screws or rivets 16 (only one of which is shown), a cap structure 17 having a centrally disposed elongated opening 18 therethrough. Cap structure 17 may also be provided with a flame deflecting member 19 which in turn may be secured to the cap structure by means of the screws or rivets 16, and includes an intermediate portion 21 disposed in transverse spaced opposed relation with respect to elongated opening 18.

Disposed within and spaced from outer tube 13 is an inner tube having a portion 22 of generally circular cross section disposed in spaced surrounding relation with respect to nozzle member 4 and which merges into a mixture forming and flame confining portion 23 of generally elliptical or elongated cross section, aligned with and conforming in general with the shape of the elongated opening 18 in the cap structure 17. The portion of the inner tube of elliptical or elongated cross section has opposed end-wall portions thereof adjacent its discharge end cut away or removed to provide a pair of aligned openings 24 therethrough placing the upper interior or discharge end thereof in communication with the passage 25 between the tubes. The inner tube has opposed wall portions 26 at the discharge end thereof bent over to abuttingly engage the underside of cap structure 17 and is preferably fixedly secured thereto as by means of spot welds 27. The lower end of cylindrical portion 22 of the inner tube is provided with an annular control member actuator 28 fixed thereto for movement therewith relative to nozzle member 4. Actuator 28 is disposed in passage closing relation with respect to space 29 between nozzle member 4 and inner tube portion 22 and is provided with an external annular groove 31.

Secured to outer tube 13 is a bracket having

a central portion 32 disposed in abutting relation with respect to the external side wall of tube 13 and similar off-set edge portions 33 spaced from tube 13 and terminating in edge flanges 34 bent inward toward the tube for braced edge engagement therewith. Each flange 34 is provided with a pair of vertically spaced internally threaded holes 36. A hollow switch box 37 formed of suitable ceramic insulating material, such as lava, is disposed with its marginal edges abutting the bracket side edges 33 to form a switch enclosing housing therewith. Box 37 is preferably detachably secured to the bracket by means of screws 30 passing through openings therein and into aligned internally threaded openings in the bracket side portions 33. The lower or bottom wall 39 of box 37 is preferably cut away to provide an opening for inserting wires therethrough. The wall of box 37 disposed in spaced opposed relation with respect to the bracket is provided with a pair of spaced plate-like elements 42 and 43 mounting similar screw type binding posts or terminals 44. Plate-like elements 42 and 43 are secured to box 37 by means of rivets or the like 46. Plate element 42 is provided with an adjustable contact 47. Box 37 also mounts a spring blade 48 with its free portion disposed in spaced opposed relation with respect to the relatively fixed contact 47 carried by plate element 42 and is provided with a contact 49 adapted for engagement with the fixed contact. Plate element 43 is electrically connected with the contact 49 on spring blade 48 by means of a wire 51. Portions of the switch mounting bracket and of outer tube 13 disposed directly opposite the actuator 28 carried by the inner tube are cut away to provide an opening 52 therethrough. The opposed portion of spring blade 48 is provided with an actuating arm or knob 53 which extends through such opening and into the external groove 31 formed in actuator 28. The bracket and outer tube also have wall portions thereof cut away directly opposite the contact 49 on spring blade 48 to provide a relief opening 54 permitting a greater degree of contact opening movement of the spring blade than would otherwise be permitted.

Switch box 37 is preferably enclosed in a cover 56 spaced therefrom and secured to the bracket by means of screws 57 passing through openings in the cover alignable with the internally threaded openings 36 in the bracket flange portions 34. The bottom wall of the cover 56 has a slot or opening 58 therethrough aligned with the opening 41 in the bottom wall of switch box 37 for receiving the wires or other conductors attached to terminals 44. Outer tube 13 is provided with an opening 59 therethrough placing the passage 24 between the inner and outer tubes in communication with the atmosphere. And if desired, the pilot burner structure hereinabove described may be attached to a suitable support by means of a bracket 61 secured to an intermediate wall portion of the outer tube in any suitable manner, such as by spot welds or the like (not shown) and provided with lateral apertured extensions 62 for the passage of bolts or the like therethrough.

In operation, air enters the space between the inner and outer tubes, passage 25, through opening 59, and due to the inspirating effect of the fuel emitted from nozzle member 4 air enters the upper portion of the inner tube through opening 24 and flows downward therein adjacent the end walls thereof in counter-flow relation to the

fuel flow, as indicated by the arrows on Fig. 7. Air, upon entering the inner tube as just described, mixes with the gas flowing from nozzle member 4 immediately adjacent thereto, and consequently a combustible mixture is formed within the portion of the inner tube of non-symmetrical or elongated cross section at a point adjacent its junction with the portion of cylindrical cross section. Upon igniting the combustible mixture thus formed, the resulting flame projects from the tube generally in the manner indicated in Fig. 7. And it has been found that the nozzle end of the flame moves toward and away from, but not out of, the discharge end of the tube as the fuel flow decreases and increases, respectively. Consequently, the flame is always partially confined within and directly heats the upper portion of the inner tube, thus maintaining a workable temperature difference between the inner and outer tubes, irrespective of variations in fuel flow and irrespective of variations in ambient temperature. This result is primarily attributable to the construction combining the inner tube with the nozzle member 4 in a manner such that though the tube may move relative to the nozzle, only an insignificant amount of air may enter between the tube and nozzle, the flow of fuel from the nozzle being therefore, capable of causing air to enter the tube through the openings 24 and to then flow toward the nozzle in counter-flow relation to the fuel flow.

Stated somewhat differently, heat is conducted from the hot spot portion of the inner tube, the portion directly contacted by the flame, in both directions therethrough to the upper and lower portions of the outer tube joined therewith. And in this connection it should be noted that the temperature difference between the inner and outer tubes theoretically will remain nearly constant as the ambient temperature changes, since although an increase in ambient temperature tends to decrease the rate of heat dissipation from the outer tube, due to a corresponding increase in the temperature thereof, the temperature of the inner tube is also increased an amount corresponding to the increase in ambient temperature due to the fact that though heat input to the inner tube remains substantially constant for a given fuel flow the higher temperature of the outer tube, because of the increased ambient temperature results in a decrease in the temperature gradient between the inner and outer tubes and therefore a decrease in the rate of heat conduction from the inner tube to the outer tube, thereby increasing the temperature of the inner tube until the rate of heat conduction from the inner tube to the outer tube is again equal to the rate of heat input to the inner tube. Moreover, it should also be noted that the rate of heat input to the inner tube, and thereby the temperature difference between the inner and outer tubes, will vary as the flow of fuel changes, since the size of the portion of the flame confined within the inner tube varies accordingly. However, the temperature of the inner tube will always be considerably higher than that of the outer tube, irrespective of variations in ambient temperature, so long as the flow of fuel continues and is in excess of an abnormally low or undesirable value. Under such abnormal conditions it should be apparent that the temperature of the inner and outer tubes will be nearly alike, since the flame moves upward in the inner tube to a point such that it imparts nearly as much heat to the outer tube as it does to the inner tube. In general, it will be seen that for all normal ranges of fuel flow, the herein described pilot burner structure maintains an effective temperature difference throughout the normal range of fuel flow between the inner and outer tubes which varies in accordance with changes in fuel flow.

In Figs. 2 and 3, the various parts are shown in positions conforming to a cold or shut down condition in which the outer and inner tubes are at substantially the same temperature, and in which the contacts 47 and 49 are open. If the flow of fuel is resumed and the combustible mixture ignited, the temperature of the inner tube will almost immediately become considerably higher than the temperature of the outer tube, due to the direct heating effect of the confined portion of the flame. Consequently, the inner tube will expand relative to the outer tube and cause the lower or nozzle end of the former to move longitudinally relative to the latter in a direction effecting a contact closing movement of actuator 28 and switch arm 48. As previously pointed out, a variation in fuel flow will vary the length of that portion of the flame confined within the inner tube and consequently the temperature of the inner tube, and also the temperature of the outer tube. However, variations in fuel flow will not effect a switch opening movement of the switch actuator carried by the free end of the inner tube unless the flow of fuel ceases, or the rate thereof decreases to an abnormally low or undesirable value. In this connection, best results are obtained with a construction affording a flame confining passage having a cross-sectional configuration such that the flame will directly contact one or more wall portions of the passage-defining structure with at least one wall portion thereof spaced from the flame sufficiently to afford an air inspirating duct or passage portion such that the flow of fuel from the nozzle causes air to enter the passage at a point remote from the nozzle end thereof, and to then flow toward the nozzle in counter-flow relation to the fuel flow. For example, a flame confining passage having an elongated or non-symmetrical cross-sectional configuration as herein illustrated affords two such ducts or passage portions. However, a passage having a cross-sectional configuration affording only one such duct or passage portion will operate satisfactorily, and in fact better than a passage of circular cross-section, since with the latter form of passage it is likely that the confined flame will be entirely surrounded by a thin layer of in-flowing air, which tends to reduce the rate of heat transfer from the flame to the walls defining the passage. In general, the inner and outer tubes may be formed of any suitable material, although it is preferable to select materials having a high degree of corrosive resistance and being capable of withstanding high temperatures. And in order to compensate for a decrease in the temperature difference between the inner and outer tubes caused by the nozzle end of the confined portion of the flame moving upward toward the discharge end of the inner tube and thereby increasing the effective range of operation, it may be desirable to select tube materials having different coefficients of expansion, there being stainless steel alloys on the market particularly suitable for such application.

Apparatus embodying the invention may be of a form differing materially from that herein shown and described for purposes of illustration.

And it should therefore be understood that it is not intended to limit the invention to apparatus and parts constructed and/or combined in the exact manner herein disclosed, as various modifications within the scope of the appended claims may occur to persons skilled in the art.

What is claimed is:

1. A safety pilot burner comprising a fuel emitting nozzle, a first tube forming a mixing and flame confining passage extending from said nozzle in the general direction of fuel flow to a discharge end opening to atmosphere, the portion of said first tube adjacent said discharge end having a cross-section other than circular, a second tube disposed in surrounding, spaced relation with said first tube and having one end adjacent said discharge end of said first tube, a heat conducting member rigidly uniting said one end of said second tube and said discharge end of said first tube and forming an end-wall closing the space between said tubes, a support fixedly mounting the other end of said second tube, said first tube having a relatively high thermal coefficient of expansion and said second tube having a relatively lower thermal coefficient of expansion, control means operatively connected to said first tube and actuated by expansion of said first tube, an opening in said second tube adjacent said other end thereof for admitting air to the space between said first and second tubes, the wall of the other than circular cross-sectioned portion of said first tube having an opening therein at a point furthest from the central longitudinal axis of said first tube, whereby flow of fuel through said first tube causes air to flow from said space between said first and second tubes, through said opening in said first tube and to then flow through said first tube toward said nozzle in counter-flow relation to the fuel flow with a minimum cooling effect on said first tube and a maximum cooling effect on said second tube.

2. A safety pilot burner comprising a fuel emitting nozzle, a first thermally expansible tube forming a mixing and flame confining passage extending from said nozzle in the general direction of fuel flow to a discharge end opening to atmosphere, the portion of said first tube adjacent said discharge end having a cross-section other than circular, a second thermally expansible tube disposed in surrounding, spaced relation with said first tube and having one end adjacent said discharge end of said first tube, a heat conducting member rigidly uniting said one end of said second tube and said discharge end of said first tube and forming an end-wall closing the space between said tubes, a support fixedly mounting said other end of said second tube, control means operatively connected to said first tube and actuated by expansion of said first tube, an opening in said second tube adjacent said other end thereof for admitting air to the space between said first and second tubes, the wall of the other than circular cross-sectioned portion of said first tube having an opening therein at a point furthest from the central longitudinal axis of said first tube, whereby flow of fuel through said first tube causes air to flow from said space between said first and second tubes, through said opening in said first tube and to then flow through said first tube toward said nozzle in counter-flow relation to the fuel flow with a minimum cooling effect on said first tube permitting maximum thermal expansion thereof and a maximum cooling effect on said second tube permitting minimum thermal expansion thereof.

3. A safety pilot burner comprising a fuel emitting nozzle, a first thermally expansible tube forming a mixing and flame confining passage extending from said nozzle in the general direction of fuel flow to a discharge end opening to atmosphere, the portion of said first tube adjacent said discharge end having a cross-section other than circular, a second thermally expansible tube disposed in surrounding, spaced relation with said first tube and having one end adjacent said discharge end of said first tube, means rigidly uniting said one end of said second tube and said discharge end of said first tube and forming an end-wall closing the space between said tubes, said last mentioned means including a heat conducting member forming a path of relatively high heat conductance between said tubes, a support fixedly mounting the other end of said second tube, control means operatively connected to said first tube and actuated by expansion of said first tube, an opening in said second tube adjacent said other end thereof for admitting air to the space between said first and second tubes, the wall of the other than circular cross-sectioned portion of said first tube having an opening therein at a point furthest from the central longitudinal axis of said first tube, whereby flow of fuel through said first tube causes air to flow from said space between said first and second tubes, through said opening in said first tube and to then flow through said first tube toward said nozzle in counter-flow relation to the fuel flow with a minimum cooling effect on said first tube permitting maximum thermal expansion thereof and a maximum cooling effect on said second tube permitting minimum thermal expansion thereof.

4. A safety pilot burner comprising a fuel emitting nozzle, a first thermally expansible tube forming a mixing and flame confining passage extending from said nozzle in the general direction of fuel flow to a discharge end opening to atmosphere, the portion of said first tube adjacent said discharge end having a generally elliptical cross-section, a second thermally expansible tube disposed in surrounding, spaced relation with said first tube and having one end adjacent said discharge end of said first tube, means rigidly uniting said one end of said second tube and said discharge end of said first tube and forming an end-wall closing the space between said tubes, said last mentioned means including a heat conducting member forming a path of relatively high heat conductance between said first and second tubes, a support fixedly mounting the other end of said second tube, control means operatively connected to said first tube and actuated by expansion of said first tube, an opening in said second tube adjacent said other end thereof for admitting air to the space between said first and second tubes, the wall of the elliptical cross-sectioned portion of said first tube having an opening therein disposed at one endpoint of the major axis of the elliptical cross-section, whereby flow of fuel through said first tube causes air to flow from said space between said first and second tubes, through said opening in said first tube and to then flow through said first tube toward said nozzle in counter-flow relation to the fuel flow with a minimum cooling effect on said first tube permitting maximum thermal expansion thereof and a maximum cooling effect on said second tube permitting minimum thermal expansion thereof.

5. A safety pilot burner comprising a fuel emit-

ting nozzle, a first tube forming a mixing and flame confining passage extending from said nozzle in the general direction of fuel flow to a discharge end opening to atmosphere the portion of said first tube adjacent said discharge end having a cross-section other than circular, a second tube disposed in surrounding, spaced relation with said first tube and having one end adjacent said discharge end of said first tube, means rigidly uniting said one end of said second tube and said discharge end of said first tube and forming an end wall closing the space between said tubes, said last mentioned means including a heat conducting member forming a path of relatively high heat conductance between said tubes, a support fixedly mounting the other end of said second tube, said first tube having a relatively high thermal coefficient of expansion and said second tube having a relatively lower thermal coefficient of expansion, control means operatively connected to said first tube and actuated by expansion of said first tube, an opening in said second tube adjacent said other end thereof for admitting air to the space between said tubes, the wall of the other than circular cross-sectioned portion of said first tube having an opening therein at a point furthest from the central longitudinal axis of said first tube, whereby flow of fuel through said first tube causes air to flow from said space between said first and second tubes, through said opening in said first tube and to then flow through said first tube toward said nozzle in counter-flow relation to the fuel flow with a minimum cooling effect on said first tube and a maximum cooling effect on said second tube.

6. A safety pilot burner comprising a fuel emitting nozzle, a first thermally expansible tube forming a mixing and flame confining passage extending from said nozzle in the general direction of fuel flow to a discharge end opening to atmosphere, the portion of said first tube adjacent said discharge end having a generally elliptical cross-section, a second thermally expansible tube disposed in surrounding, spaced relation with said first tube and having one end adjacent said discharge end of said first tube, means rigidly uniting said one end of said second tube and said discharge end of said first tube and forming an end-wall closing the space between said tubes, said last mentioned means including a heat conducting member forming a path of relatively high heat conductance between said tubes, a support fixedly mounting the other end of said second tube, control means operatively connected to said first tube and actuated by expansion of said first tube, an opening in said second tube adjacent said other end thereof for admitting air to the space between said first and second tubes, the wall of the elliptical cross-sectioned portion of said first tube having openings therein disposed at the endpoints of the major axis of the elliptical cross-section, whereby flow of fuel through said first tube causes air to flow from said space between said first and second tubes, through said opening in said first tube and to then flow through said first tube toward said nozzle in counter-flow relation to the fuel-flow with a minimum cooling effect on said first tube permitting maximum thermal expansion thereof and a maximum cooling effect on said second tube permitting minimum thermal expansion thereof.

7. A safety pilot burner comprising a fuel emitting nozzle, a first tube forming a mixing and flame confining passage extending from said nozzle in the general direction of fuel flow to a discharge end opening to atmosphere, the portion of said first tube adjacent said discharge end having a generally elliptical cross-section, a second tube disposed in surrounding, spaced relation with said first tube and having one end adjacent said discharge end of said first tube, means rigidly uniting said one end of said second tube and said discharge end of said first tube and forming an end-wall closing the space between said tubes, said last mentioned means including a heat conducting member forming a path of relatively high heat conductance between said tubes, a support fixedly mounting the other end of said second tube, said first tube having a relatively high thermal coefficient of expansion and said second tube having a relatively lower thermal coefficient of expansion, control means operatively connected to said first tube and actuated by expansion of said first tube, an opening in said second tube adjacent said other end thereof for admitting air to the space between said first and second tubes, the wall of the elliptical cross-sectioned portion of said first tube having openings therein disposed at the endpoints of the major axis of the elliptical cross-section, whereby flow of fuel through said first tube causes air to flow from said space between said first and second tubes, through said opening in said first tube and to then flow through said first tube toward said nozzle in counter-flow relation to the fuel-flow with a minimum cooling effect on said first tube and a maximum cooling effect on said second tube.

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