United States Patent

Boucher et al.

[15] **3,692,014**

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[54] **PILOT AND MAIN FUEL GAS SUPPLY MEANS FOR PRESSURIZED GAS-FIRED SPACE HEATER**

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[73] Assignee: **General Electric Company**

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[52] **U.S. Cl.**.....**126/110 R,** 431/43, 431/90, 431/285

[51] **Int. Cl.** **F23g 9/08,** F24h 3/08

[58] **Field of Search** .126/91 A, 110 R, 110 B, 116 R; 431/42, 43, 47, 59, 90, 285

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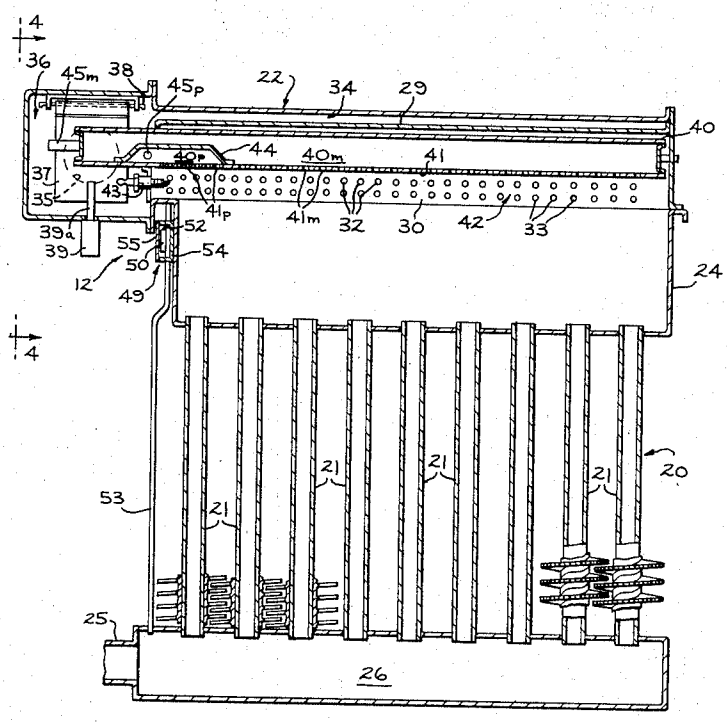
[57] **ABSTRACT**

This invention provides improved means for supplying pilot and main fuel gas to the fuel gas-air mixing area of a gas-fired space heater employing pressurized combustor means to produce a highly intense heat source flame. These improved means include control, igniter, and sensor means for assuring that fuel gas will be first supplied to the mixing area pilot portion and ignited therein before any fuel gas is supplied to the mixing area main portion. In particular accordance with the present invention, pilot gas ignition sensor means are provided which are located wholly outside of the mixing area and are thus spared from direct exposure to the intensely hot flame.

9 Claims, 5 Drawing Figures



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SHEET 1 OF 2

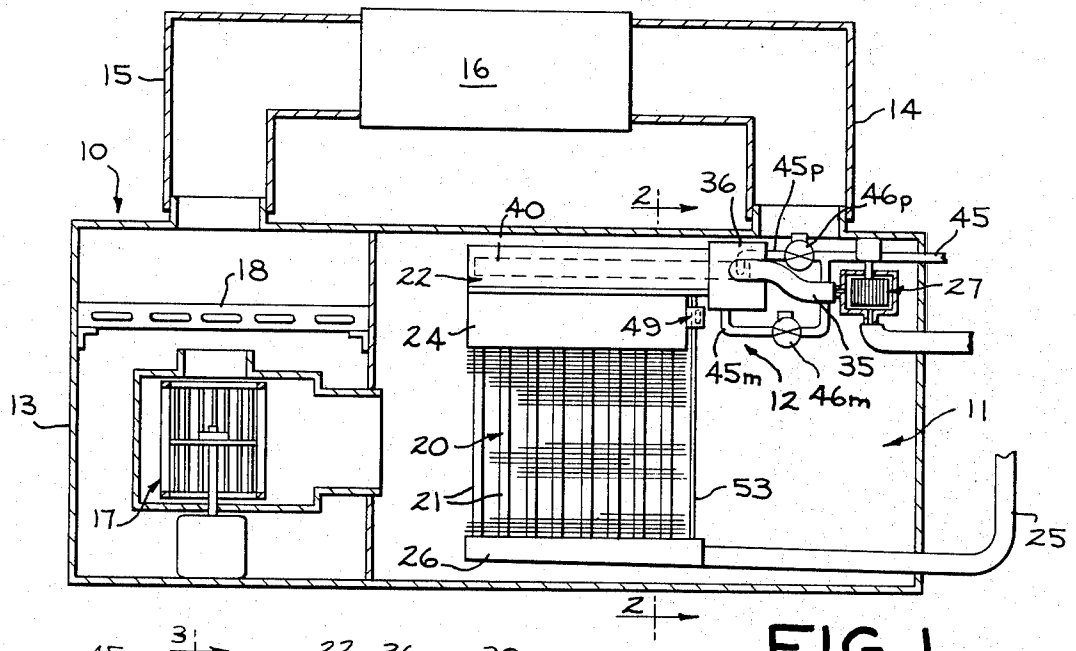

FIG. 1

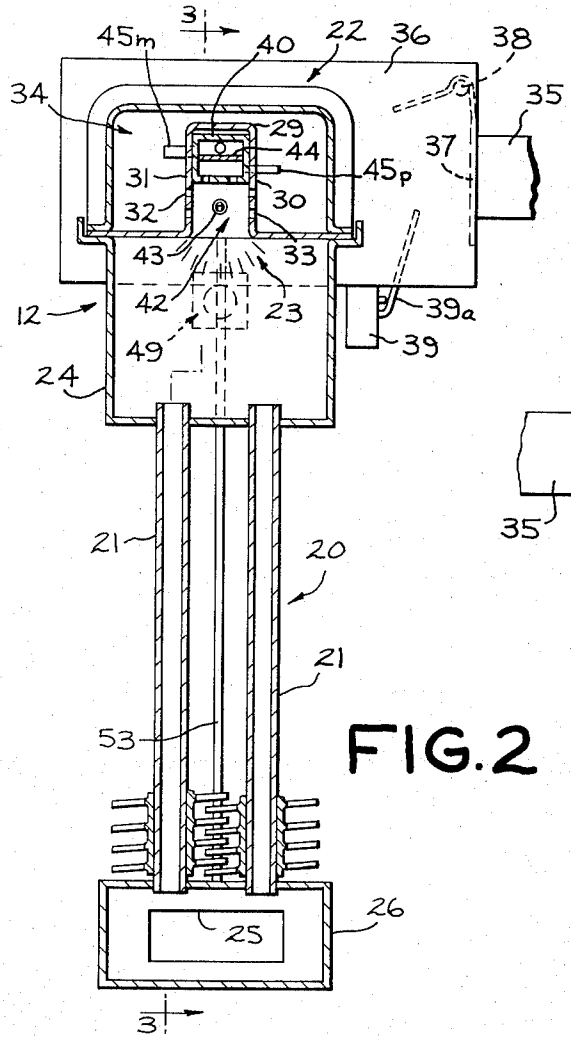

FIG. 2

FIG. 4

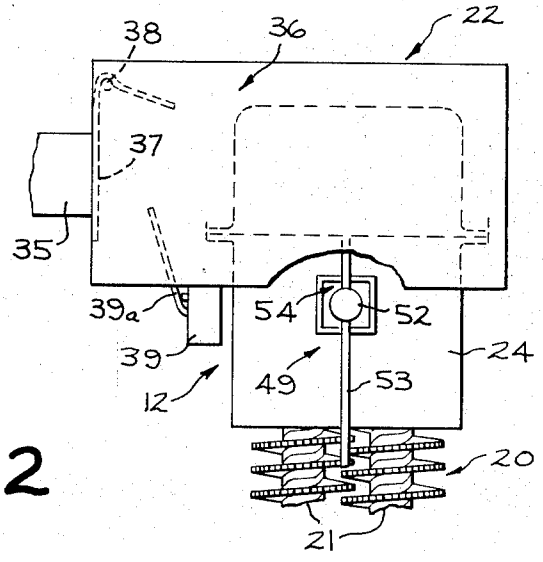

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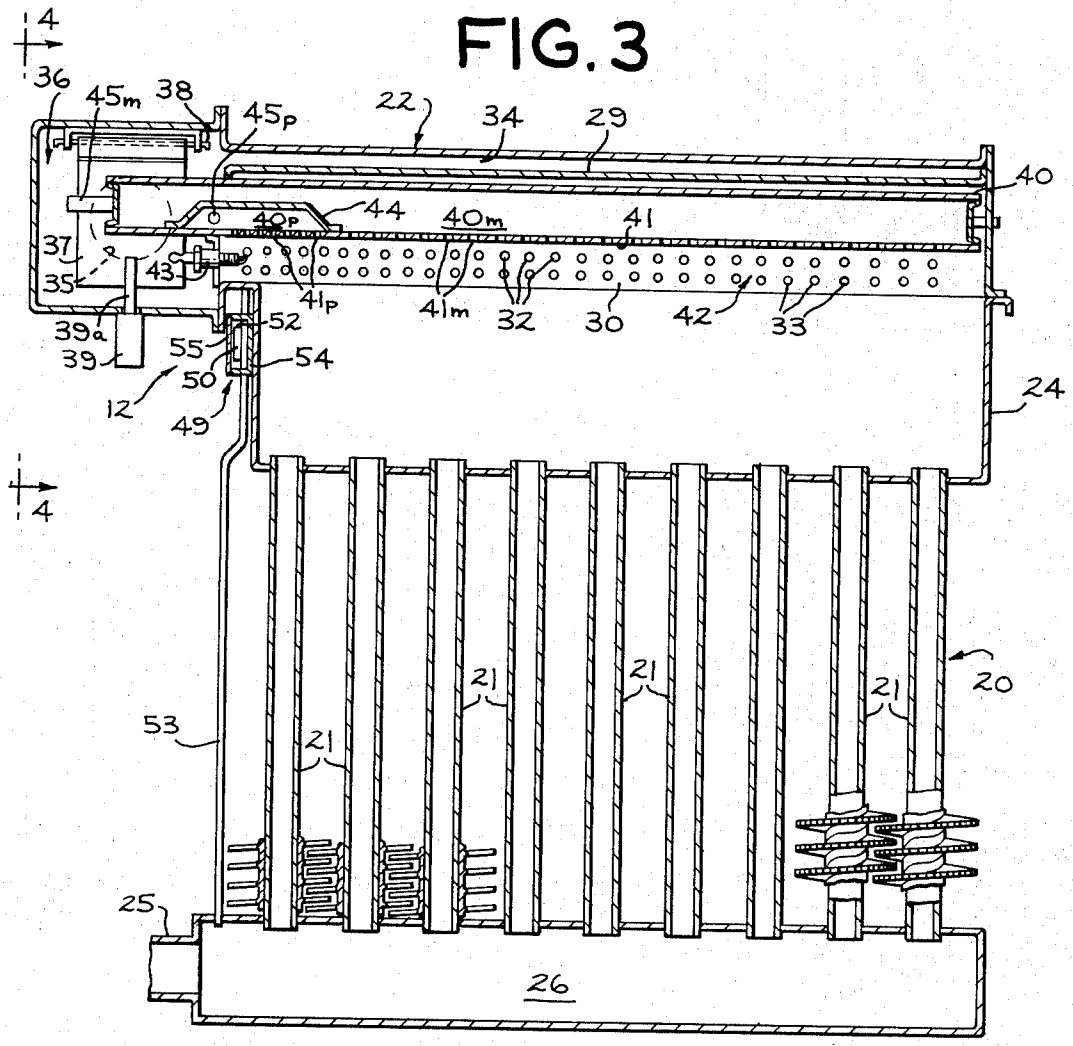
FIG. 3



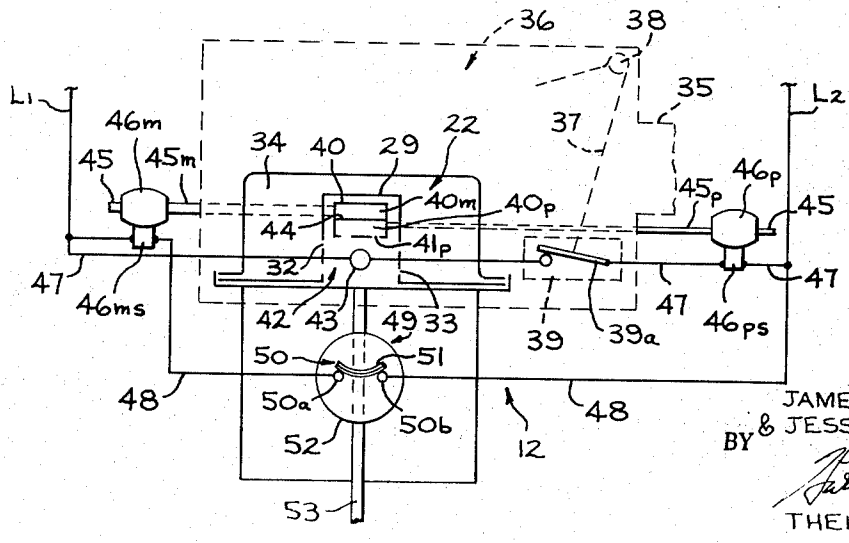


FIG. 5

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PILOT AND MAIN FUEL GAS SUPPLY MEANS FOR PRESSURIZED GAS-FIRED SPACE HEATER

BACKGROUND OF THE INVENTION

This invention relates to means for supplying heat to a space such as a room, house, building or the like and, more particularly, to improved means for supplying pilot and main fuel gas to the fuel gas-air mixing area of a gas-fired space heater employing pressurized combustor means to produce a highly intense heat source flame.

U.S. Pat. Nos. 1,703,854 — Fonseca, 1,842,339 — Doen, and 3,213,922 — Weber are noted merely as being of interest in that they describe conventional fuel gas supply means that are employed with conventional atmospheric burners for gas-fired heaters. These prior-art fuel gas supply means are clearly distinguished from the present invention in that they are employed with a conventional atmospheric burner rather than pressurized combustor means and their pilot ignition sensors are located either closely adjacent to or in direct contact with the burner flame.

Copending, commonly-assigned, U.S. patent applications Ser. No. 47,433, filed June 18, 1970, by Roy W. Abbott (now Patent 3,670,713) and Ser. No. 66,800, filed Aug. 25, 1970 by James D. Boucher (now Patent 3,667,451), are hereby incorporated herein by reference. These patent applications describe gas-fired space heaters which are superior to conventional means in that they permit considerable weight and volume reduction in heat exchanger means material by employing a combination of highly efficient heat exchanger means for transferring heat generated by combustion of a fuel gas-air mixture to an air stream circulated between the heat exchanger and the space to be heated, and pressurized high intensity combustor means for mixing fuel gas with pressurized combustion air to produce and ignite the fuel gas-air mixture.

The pressurized combustor means described in these aforenoted patent applications include a trough having side walls pierced by pressurized combustion air inlet apertures, and fuel gas supply conduit means that extend through the trough and have a surface pierced by apertures through which fuel gas can enter the trough and be turbulently mixed with the pressurized combustion air in a gas-air mixing area defined by the apertured trough side walls and conduit means surface. This turbulent mixture of fuel gas and pressurized combustion air is ignited within the mixing area to provide an extremely intense heat source flame whose combustion products are discharged to the inlet end of the heat exchanger through hollow interconnecting conduit means.

Typically, the heat intensity of this flame is at least 300,000 BTU of heat per hour per cubic foot of the interconnecting conduit means, a far greater intensity level than was encountered with the atmospheric burners that have heretofore been most frequently employed in conventional gas-fired space heaters.

Copending, commonly-assigned U.S. Patent application Ser. No. 93,722, filed Nov. 30, 1970, by Theodore C. Brandt et al (now Patent 3,677,892) describes in detail means which are particularly adapted for supplying pilot and main fuel gas to the fuel gas-air mixing area of a gas-fired space heater of the aforedescribed type. These Brandt et al. fuel gas supplying means include control, igniter, and sensor means for assuring that fuel gas will be first supplied to the mixing area pilot portion and be ignited therein before any fuel gas is supplied to the mixing area main portion. While these Brandt et al means have performed fairly satisfactorily, the sensor which they employ to sense pilot gas ignition is located within the mixing area and are thus subjected to direct exposure to the intensely hot flame. Because of this, the sensor is expensive in construction and must be replaced frequently.

The present invention is particularly concerned with providing improved means for supplying pilot and main fuel gas to the fuel gas-air mixing area of such gas-fired space heaters that employ pressurized combustor means to product a highly intense heat source flame wherein the construction cost and replacement frequency of the pilot ignition sensor means can be greatly reduced.

SUMMARY OF THE INVENTION

This invention provides improved means for supplying pilot and main fuel gas to the fuel gas-air mixing area of a gas-fired space heater of the aforedescribed type that employs pressurized combustor means to produce a highly intense heat source flame. These improved fuel gas supplying means include control, igniter, and sensor means for assuring that fuel gas will be first supplied to the mixing area pilot portion and ignited therein before any fuel gas is supplied to the mixing area main portion. In particular accordance with the present invention, pilot gas ignition sensor means are provided which are located wholly outside of the mixing area and are thus spared from direct exposure to the intensely hot flame. Because of this, the construction cost and replacement frequency of the sensor means can be greatly reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated in the accompanying drawings, wherein:

FIG. 1 is a somewhat schematic, partly-sectioned, front elevational view of a space air-conditioning unit utilizing gas-fired space heater means incorporating a presently preferred form of the improved pilot and main gas supply means of the present invention;

FIG. 2 is an enlarged fragmentary sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a fragmentary sectional view taken along line 3—3 of FIG. 2;

FIG. 4 is a partly-broken, fragmentary view taken along line 4—4 of FIG. 3 with the cover and the switch removed from the pilot ignition sensor means air-shield box; and

FIG. 5 is a schematic wiring diagram showing the electrical circuitry for the control means of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings and, more particularly to FIG. 1 thereof, there is illustrated, somewhat schematically, an air-conditioning unit 10 utilizing gas-fired space heater means 11 incorporating a presently preferred form of improved fuel gas supply means, generally designated 12 and shown in detail in FIGS.

2–5, provided in accordance with the present invention. The air-conditioning unit **10** includes a cabinet **13** that is fluid-connected by supply and return conduit means **14** and **15** to a space **16** (shown in block), such as a room, house, building or the like, so as to condition air contained within the space **16** as by supplying heat to or removing heat from an air stream that is circulated between the space **16** and the cabinet **13** by space air blower means **17** mounted within the cabinet **13**. The air-conditioning unit **10** mounts the gas-fired space heater means **11** within the cabinet **13** to supply heat to the space air stream in combination with cooling means, including an evaporator section **18** also contained within the cabinet **13**, to remove heat from the space air stream.

The gas-fired heater means **11** are generally similar to those described in the aforenoted patent applications. They employ highly efficient heat exchanger means **20** comprising a plurality of metal, generally vertically arranged, finned heat exchanger tubes **21** for transferring heat generated by combustion of a gas-air mixture to the air stream circulated by the blower **17** between the heat exchanger means **20** and the space **16**. The heat exchanger means **20** is combined with high intensity combustor means **22** which fuel gas with pressurized air to provide and ignite the gas-air mixture and produce a downwardly extending highly intense heat source flame **23** (FIG. 2). The combustor means **22** is interconnected to the upper ends of the heat exchanger tubes **21** by hollow metal interconnecting conduit means **24** such that the products of combustion from the heat source flame **23** are forced downwardly through the heat exchanger **20** and outwardly to the atmosphere through a vent **25** by blower means **27** which supply the pressurized combustion air. The vent **25** is connected to an exhaust plenum **26** provided at the bottom or outlet ends of the heat exchanger tubes **21**.

The combustor **22** includes an inverted generally horizontally arranged trough **29** having a pair of opposed, spaced apart, downwardly extending long side walls **30** and **31** that are provided with a plurality of apertures which define primary combustion air inlet apertures **32** and secondary combustion air inlet apertures **33**. The upper surfaces of the inverted trough **29** are surrounded by the combustion air supply plenum **34** that is fluid-connected to the combustion air supply blower **27** via a combustion air blower discharge conduit **35** and a hollow box-like combustion air inlet control chamber **36**. The control chamber **36** is similar to that described in detail in copending, commonly-assigned U.S. patent application No. 69,043, filed Sept. 2, 1970, by Richard C. Barnett et al. and includes a similar damper **37** pivotally mounted within the control chamber **36** by hinge means **38** adjacent the connection of the conduit **35** to the chamber **36** and an adjustable, normally-open, electric control switch **39** which has its actuator **39***a* interposed between the damper **37** and the combustion air supply plenum **34** and is actuatable to closure by engagement by the lower portion of the damper **37**.

In accordance with the present invention, the improved means **12** are provided for supplying pilot and main fuel gas to the combustor means **22**. These improved fuel gas supplying means **12** are generally similar to, but are an improvement of, those described in detail in the aforenoted Brandt et al. patent application. The improved means **12** include a hollow box-like fuel gas supply conduit **40** that extends longitudinally through the inverted trough **29** with its long axis arranged generally horizontally. Its lower surface **41** is pierced by a plurality of fuel gas inlet apertures that have their axes arranged generally vertically and are located above the trough primary combustion air inlet apertures **32**. The apertured trough side walls **30** and **31** and gas conduit surface **41** define a gas-air mixing area **42** wherein fuel gas entering via the gas conduit apertures can be mixed with pressurized combustion air admitted via the trough wall apertures **32** and **33** and be ignited by igniter means, such as a spark plug **43**, to produce the heat source flame **23** which extends along substantially the entire length of the open lower or outlet end of the inverted trough **29**.

The intensity of the flame **23** is generally similar to that produced by the pressurized combustor means described in the aforenoted patent applications and is typically at least 300,000 BTU of heat per hour per cubic foot of the interconnecting conduit means **24**. This is a far higher flame heat intensity level than has been obtained with the atmospheric combustion means heretofore most frequently employed in conventional gas-fired space heaters.

As best shown in FIGS. **2**, **3** and **5**, the present invention preferably provides integrated means for supplying both pilot and main fuel gas to the combustor fuel gas-air mixing area **42** by installing partition means **44** within the gas supply conduit **40**, which is thus divided by the partition means **44** into a first or pilot portion **40***p* and a second or main portion **40***m*. As illustrated, the partition means **44** is mounted adjacent one of the corners of the conduit **40** and the pilot portion **40***p* is fluid-connected to a first or pilot group of gas inlet apertures **41**p which pierce the gas supply conduit lower wall **41**, while the main portion **40***m* is fluid-connected to a second or main group of the gas inlet apertures **41**m that also pierce the gas supply conduit lower wall **41**. The pilot **40***p* and the main **40***m* portions of the gas supply conduit **40** are fluid-segregated from one another by the partition means **44** and, preferably, the pilot group of gas inlet apertures **41***p* comprises approximately 10 per cent of the total number of all such fuel gas inlet apertures, while the main group of gas inlet apertures **41***m* comprises the remaining approximately 90 per cent thereof.

In the illustrated embodiment of the invention, both the pilot **40***p* and main portions **40***m* of the fuel gas supply conduit **40** are fluid-connected to a common source **45** of fuel gas, such as natural gas, propane, or the like. The pilot portion **40***p* is fluid-connected to the fuel gas source **45** via first or pilot piping means **45***p* including a normally-closed electrically-powered first or pilot control valve **46***p*. The main portion **40***m* is fluid-connected to the fuel gas source **45** via second or main piping means **45***m* including a normally-closed, electrically-powered second or main control valve **46***m*.

As best shown in FIG. **5**, the normally-closed electrically-powered pilot control valve **46***p* has its solenoid **46***ps* electrically connected by conductor means **47** across power source lines L_1 and L_2 in electrical series with the spark plug **43** and the normally-open damper-actuatable air control switch **39**, and by conductor

means **48** in electrical parallel with other electrical circuitry which includes the solenoid **47***ms* of the normally-closed main control valve **46***m* that is connected in electrical series with pilot gas ignition sensor means **49**.

In particular accordance with the present invention, the pilot gas ignition sensor means **49** are located wholly outside of the combustor fuel gas-air mixing area **42** and are thus spared from direct exposure to the intensely hot flame **23**. In the illustrated embodiment, the sensor means **49** comprises a normally-open, inexpensive, thermally-sensitive switch **50** including a bimetallic switch actuator **51** that is adapted to move to a position closing or bridging the normally-open contacts **50***a* and **50***b* of the switch **50**. The switch actuator **51** is mounted in a heat-transferring relationship to a metal disc **52** that is, in turn, welded to the exterior of a metal by-pass conduit or tube **53** which extends between and fluid-connects the portion of the fuel gas-air mixing area **42** adjacent the pilot group of gas inlet apertures **41***p* to the exhaust plenum **26** such that fluid can pass therebetween without passing through the heat exchanger means **20**. While various materials may be employed to construct the by-pass conduit **53**, good results have been obtained using a tube having its upper portion made of Hastelloy X and its lower portion made of **409** stainless steel.

The bimetallic actuator **51** is adapted to move to a position bridging the switch contacts **50***a* and **50***b* (FIG. 5) and electrically energizing the solenoid **47***ms* to open the main gas valve **47***m* only if it has sensed emission of a predetermined amount of heat from the by-pass conduit **53**. This should occur only after ignition of fuel gas admitted via the pilot group of gas inlet apertures **41***p* and the subsequent passage of the products of combustion therefrom downwardly through the by-pass conduit **53**.

As further shown, the sensor means **49** are preferably housed within a generally rectangular box **54** that is provided with a readily removable access cover **55**. The purpose of this box **54** is to shield the heat-sensitive sensor means switch **50** from the air stream that is circulated between the air conditioner cabinet **13** and the space **16** by the blower means **17**.

With the aforedescribed arrangement of the present invention, the gas-fired heater means **11** can be activated in the following manner. First, the combustion air supply blower **27** is started and the combustion air control switch actuator **39***a* is adjustably positioned as described in detail in the aforenoted Barnett et al. application, such that it is engaged by the damper **37** and pivoted to its closed position (FIG. 5) only just when the flow of combustion air from its supply blower **27** to the combustor gas-air mixing area **42** is such that there will be optimum mixing therein of the combustion air and the fuel gas.

Movement of the actuator **39***a* to its closed position by the damper **37** will then simultaneously electrically connect the solenoid **46***ps* of the pilot control valve **46***p* and the spark plug **43** across the electric power source lines L_1 and L_2, thus opening the normally-closed pilot control valve **46***p* and admitting fuel gas to the mixing area **42** from the fuel gas source **45** via the pilot piping means **45***p* and the pilot group of fuel gas inlet apertures **41***p*. This fuel gas is next turbulently mixed with the pressurized combustion air that is admitted to the mixing area via the adjacent primary combustion air inlet apertures **32** and this turbulent "pilot" mixture is ignited by the now-energized spark plug **43** and then further turbulently mixed with the pressurized combustion air that is admitted via the secondary combustion air inlet apertures **33**. This produces a "pilot" portion of the total heat source flame **23** covering only about 10 per cent of the downwardly opening trough mouth adjacent the spark plug **43**.

At least a part of the products of combustion from the ignition of this pilot portion of the fame **23** will now pass downwardly through the by-pass conduit **53** and, will cause a sufficient amount of heat to be emitted from the bypass conduit **53** to actuate the bimetallic switch actuator **51** to close the normally-open contacts **50***a* and **50***b* of the pilot ignition sensor means switch **50** and thereby electrically connect the solenoid **46***ms* across the electrical power source lines L_1 and L_2. This will, of course, operate the normally-closed main control valve **46***m* to be opened to allow admission of fuel gas to the fuel gas-air mixing area **42** from the fuel gas source **45** via the main piping means **45***m* and the main group of fuel gas inlet apertures **41***m* of the fuel gas supply conduit **40**. The gas thus admitted will then be ignited by the pilot portion of the heat source flame **23** which has already been ignited by the spark plug **43** as previously described.

As best shown in FIGS. **1–3**, the remaining structure comprising the air conditioning unit **10** is generally similar to that described in the aforenoted Boucher patent application.

It should be apparent to those skilled in the art that while there has been described what, at present, is considered to be presently preferred embodiments of this invention in accordance with the Patent Statutes, changes may be made to the disclosed apparatus without actually departing from the true spirit and scope of this invention. It is, therefore, intended that the appended claims shall cover such modifications and applications that may not depart from the true spirit and scope of the present invention.

What is claimed is:

1. In a gas-fired heater for supplying heat to a space such as a room, house, building and the like, and including heat exchanger means for transferring heat generated by combustion of a fuel gas-air mixture to an air stream circulated between the heat exchanger means and the space to be heated, in combination with combustor means for mixing fuel gas with pressurized combustion air and igniting that mixture to produce an intense heat source flame whose combustion products are discharged into the heat exchanger means inlet and forced through the heat exchanger means and outwardly to the atmosphere through a vent connected to an exhaust plenum at the outlet of the heat exchanger means and wherein said combustor means includes a trough having side walls pierced by pressurized combustion air inlet apertures and hollow fuel gas supply conduit means that extend through said trough and have a surface pierced by apertures through which fuel gas can enter said trough and be turbulently mixed with said pressurized combustion air in a gas-air mixing area defined by said apertured trough side walls and conduit means surface, improved means for supplying fuel gas

to said mixing area and igniting it therein, said improved means comprising:

a. first means for fluid-connecting a source of fuel gas to said mixing area, said first means including hollow conduit means having a surface located within said mixing area and pierced by a first group of apertures through which fuel gas can enter said mixing area;

b. second means for fluid-connecting a source of fuel gas to said mixing area, said second means comprising hollow conduit means having a surface located in said mixing area and pierced by a second group apertures through which fuel gas can enter said mixing area;

c. igniter means mounted in said mixing area; and

d. control means for controlling admission of fuel gas to said first and second means such that fuel gas will be first supplied to said mixing area via said first group of fuel gas inlet apertures and ignited by said igniter means before any fuel gas is supplied to said mixing area via said second group of fuel gas inlet apertures, said control means including:

1. a first control valve for fluid-connecting said first group of fuel gas inlet apertures to their fuel gas source,

2. a normally-closed electrically powered second control valve for fluid-connecting said second group of fuel gas inlet apertures to their fuel gas source,

3. sensor means mounted wholly outside of said mixing area for sensing ignition of fuel gas entering said mixing area through said first group of inlet apertures, and

4. means for electrically interconnecting said sensor means with said second control valve such that said normally-closed second control valve will not be operated to open unless said ignition has been sensed by said sensor means.

2. The invention of claim 1, wherein said sensor means comprises a thermally-sensitive electric switch.

3. The invention of claim 2, further including by-pass conduit means for fluid-connecting a portion of said mixing area adjacent said first group of inlet apertures to said exhaust plenum such that fluid can pass between said portion of said mixing area and said exhaust plenum without passing through said heat exchanger means.

4. The invention of claim 3, wherein:

a. said thermally-sensitive switch includes a thermally-sensitive switch actuator,

b. said switch actuator is mounted adjacent said by-pass conduit means to receive heat emitted therefrom, and

c. said switch actuator is operable in response to receipt of a predetermined amount of heat to actuate said thermally sensitive switch to cause said normally-closed second control valve to open.

5. The invention of claim 4, wherein said switch actuator comprises a bimetallic member.

6. In a gas-fired space heater combining heat exchanger means for transferring heat generated by combustion of a fuel gas-air mixture to an air stream circulated between the heat exchanger means and the space to be heated, with combustor means for mixing fuel gas with pressurized combustion air in a gas-air mixing area and igniting that mixture to produce a heat source flame whose combustion products are discharged into the heat exchanger means inlet and forced through the heat exchanger means and outwardly to the atmosphere through a vent connected to an exhaust plenum at the heat exchanger means outlet and further including first and second means for fluid-connecting a source of fuel gas to said mixing area, igniter means mounted in said mixing area, and control means for controlling admission of fuel gas to said first and second means such that fuel gas will be first supplied to said mixing area via said first means and ignited by said igniter means before any fuel gas is supplied to said mixing area via said second means and wherein said control means include a first control valve for fluid-connecting said first means to its fuel gas source, a normally-closed electrically powered second control valve for fluid-connecting said second means to its fuel gas source, sensor means for sensing ignition of fuel gas entering said mixing area through said first means, and means for electrically interconnecting said sensor means with said second valve such that said second valve will not be operated to open unless said ignition has been sensed by said sensor means, an improvement comprising:

a. by-pass conduit means for fluid-connecting a portion of said mixing area adjacent said first means to said exhaust plenum such that fluid can pass between said mixing area portion and said exhaust plenum without passing through said heat exchanger means, and

b. said sensor means being mounted wholly outside of said mixing area and adjacent to said by-pass conduit means.

7. The invention of claim 6, wherein said sensor means comprises a thermally-sensitive electric switch.

8. The invention of claim 7, wherein:

a. said thermally-sensitive switch includes a thermally-sensitive switch actuator,

b. said switch actuator is mounted adjacent said by-pass conduit means to receive heat emitted therefrom, and

c. said switch actuator is operable in response to receipt of a predetermined amount of heat to actuate said thermally sensitive switch to cause said normally-closed second control valve to open.

9. The invention of claim 8, wherein said switch actuator comprises a bimetallic member.

* * * * *