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(54) **DEMAND RADIANT HEATING SYSTEM**

(75) Inventors: **Joseph B. Wortman**, Grosse Pointe; **Cory A. Weiss**, Warren, both of MI (US)

(73) Assignee: **Detroit Radiant Products Company**, Warren, MI (US)

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Related U.S. Patent Documents

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(52) **U.S. Cl.** ..... **237/2 R**; 237/2 A; 237/70; 236/36; 126/92 AC

(58) **Field of Search** ..... 237/2 A, 2 R, 237/70; 236/36; 126/91 A; 431/62, 12, 18

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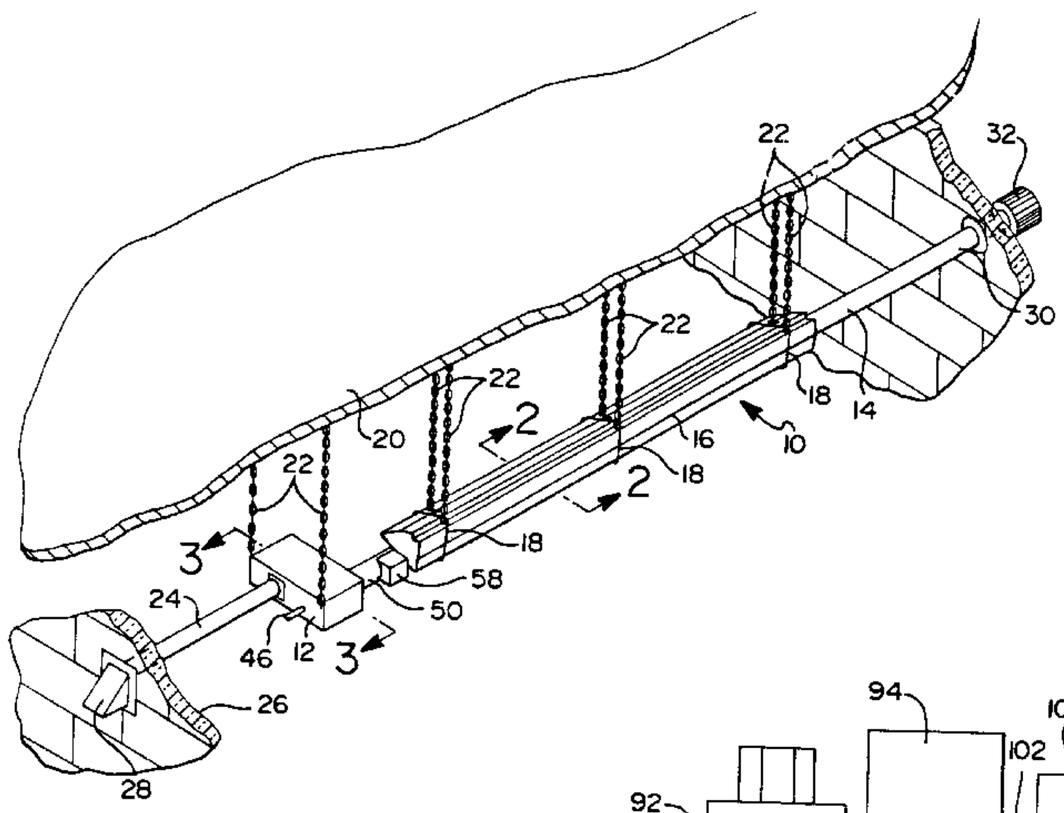
Primary Examiner—Harold Joyce
Assistant Examiner—Derek S. Boles
(74) *Attorney, Agent, or Firm*—Howard & Howard

(57) **ABSTRACT**

A demand radiant heating system includes an elongated radiant heating tube and a burner operatively connected to the tube and a fuel regulator connected to the burner for providing fuel to the burner at a plurality of fuel pressures to provide demand heating.

20 Claims, 2 Drawing Sheets



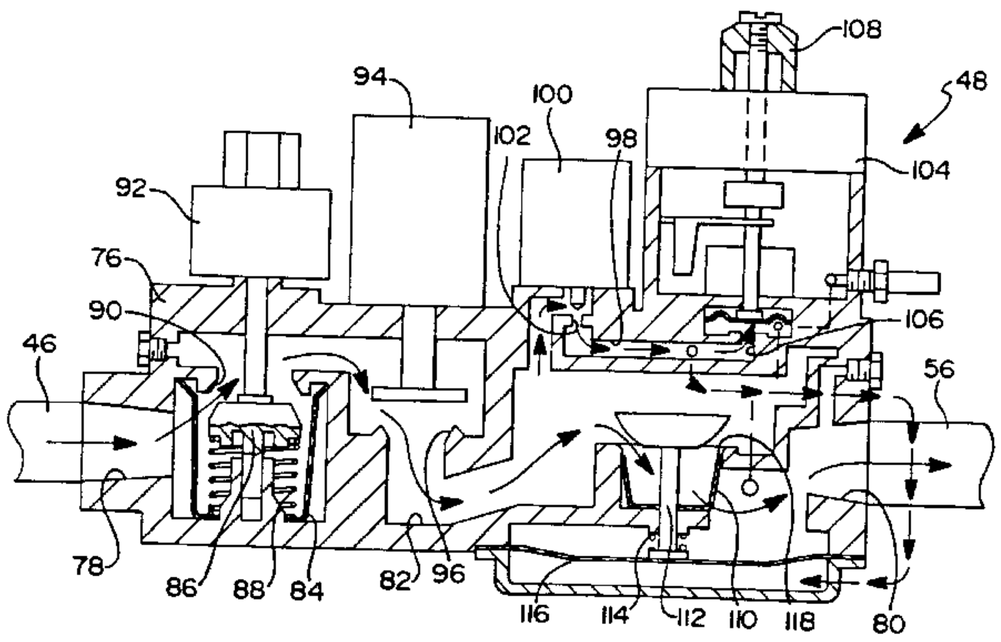


FIG 1

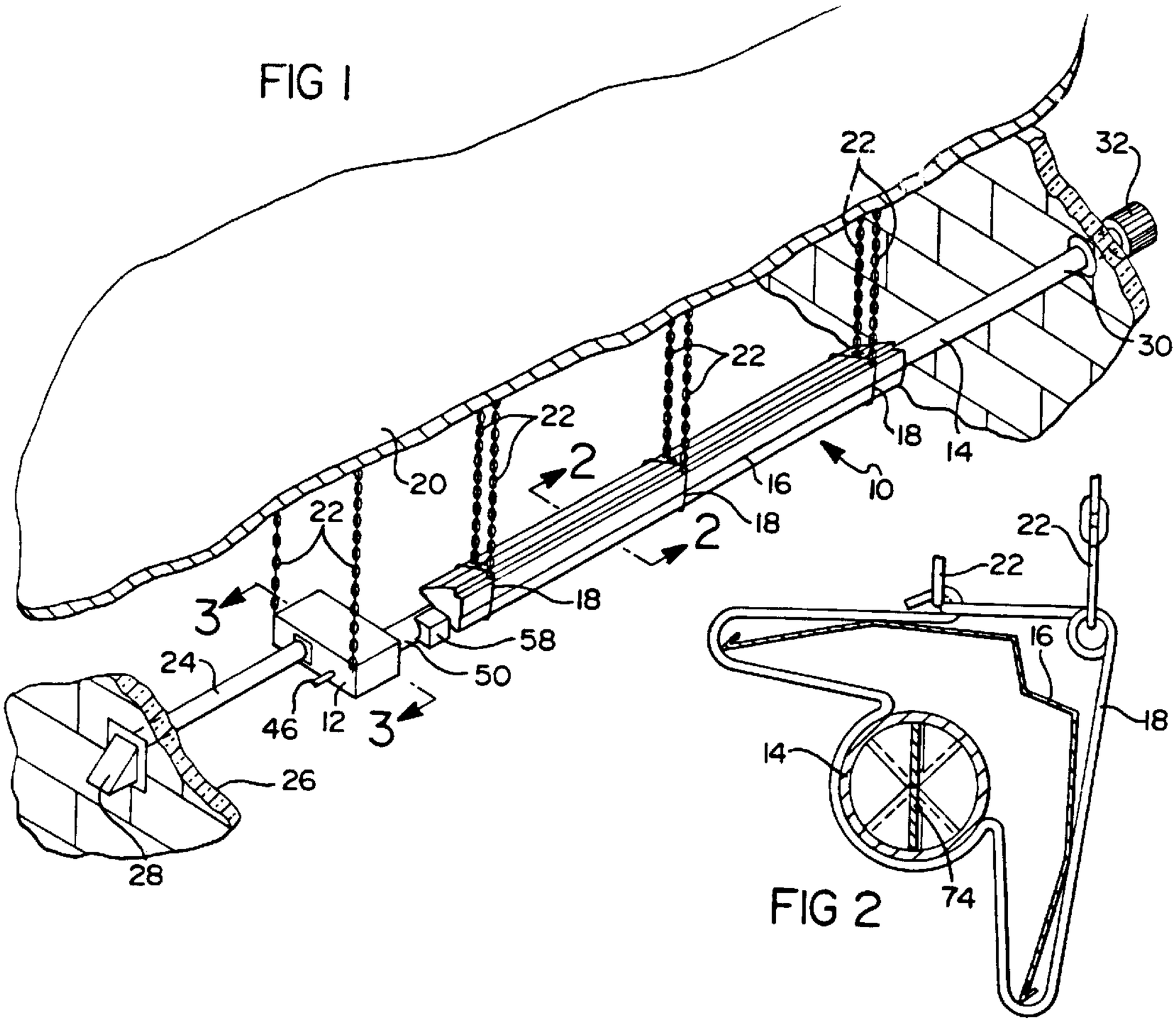
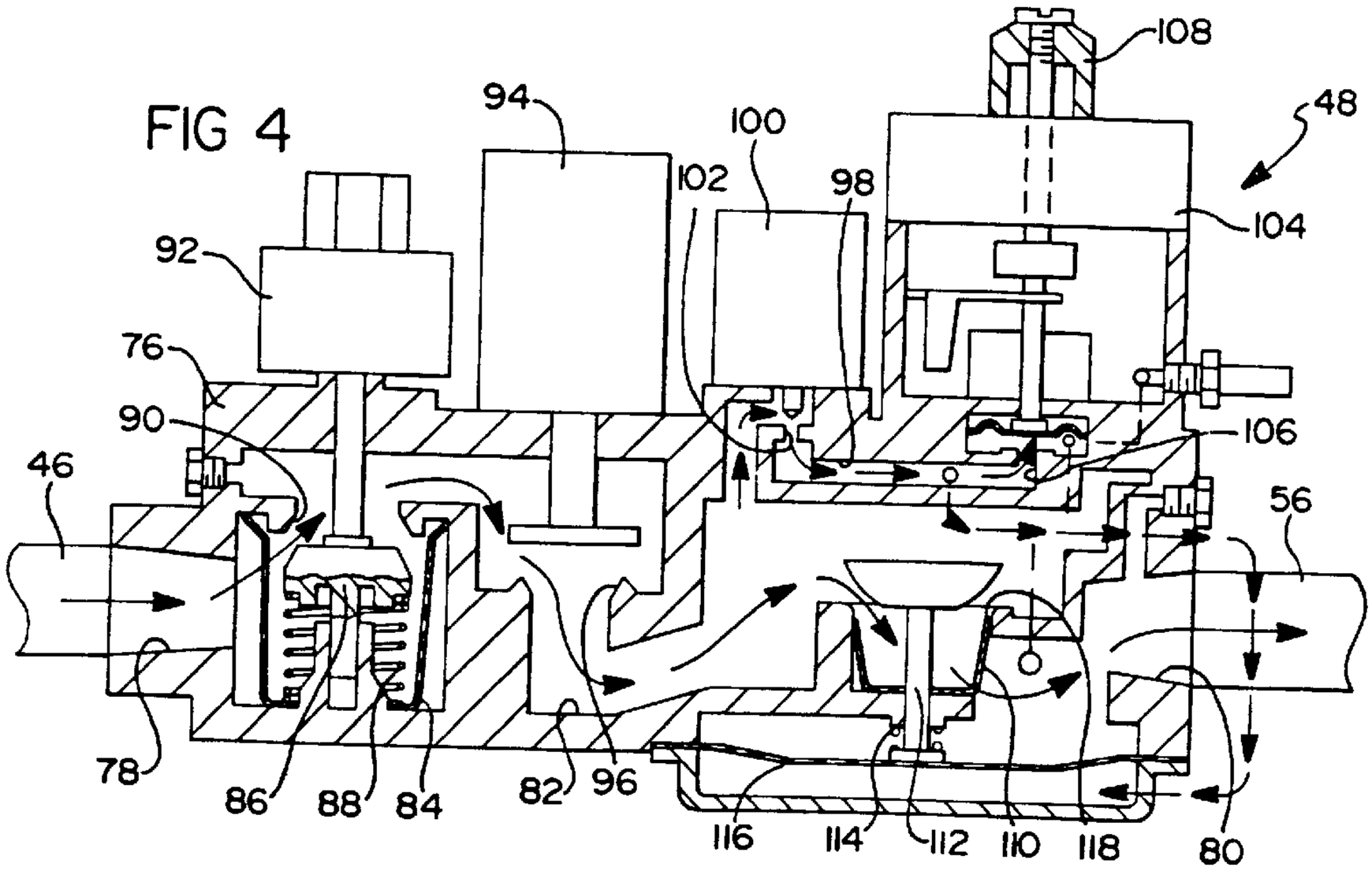


FIG 2

FIG 4



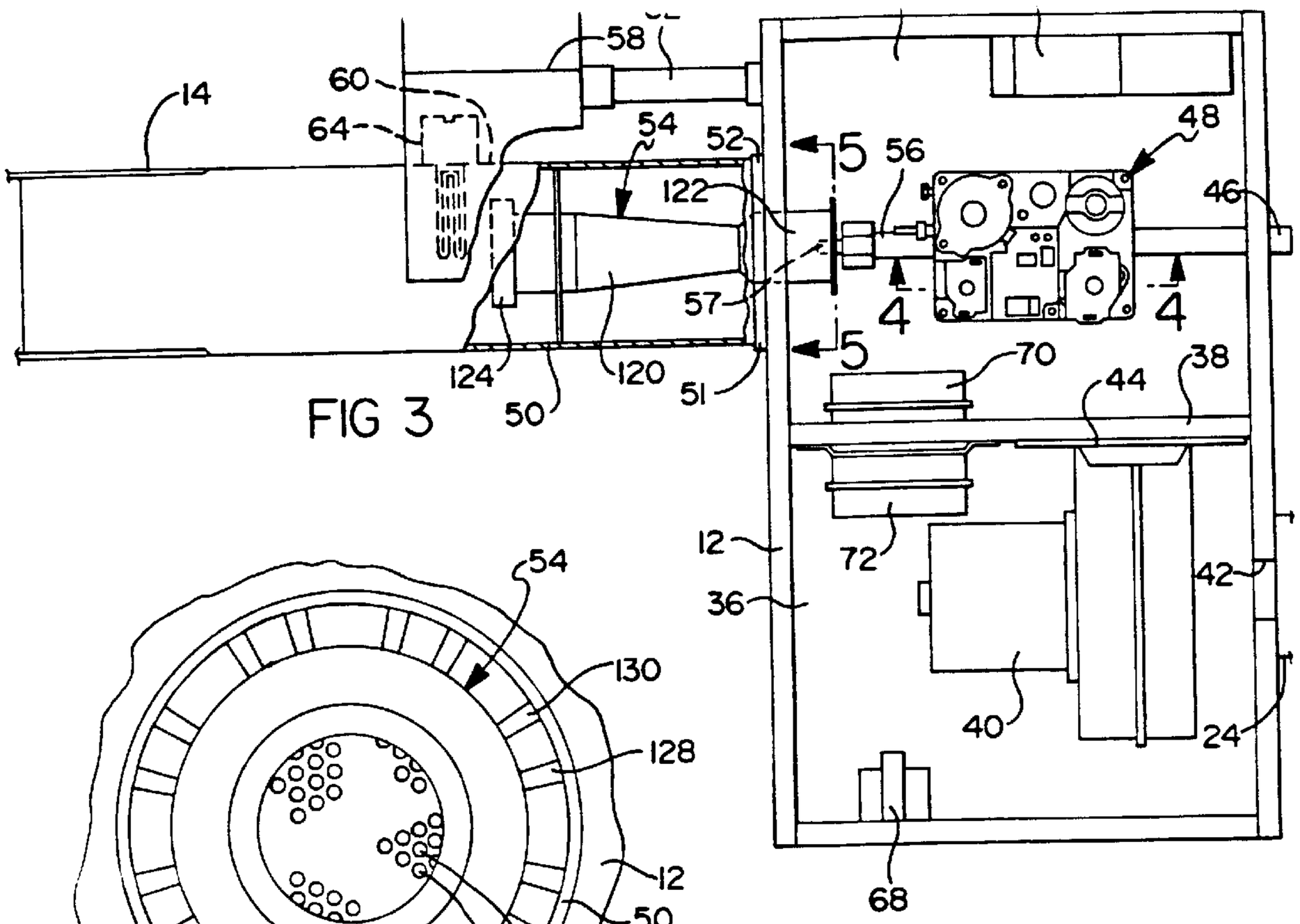


FIG 3

FIG 5

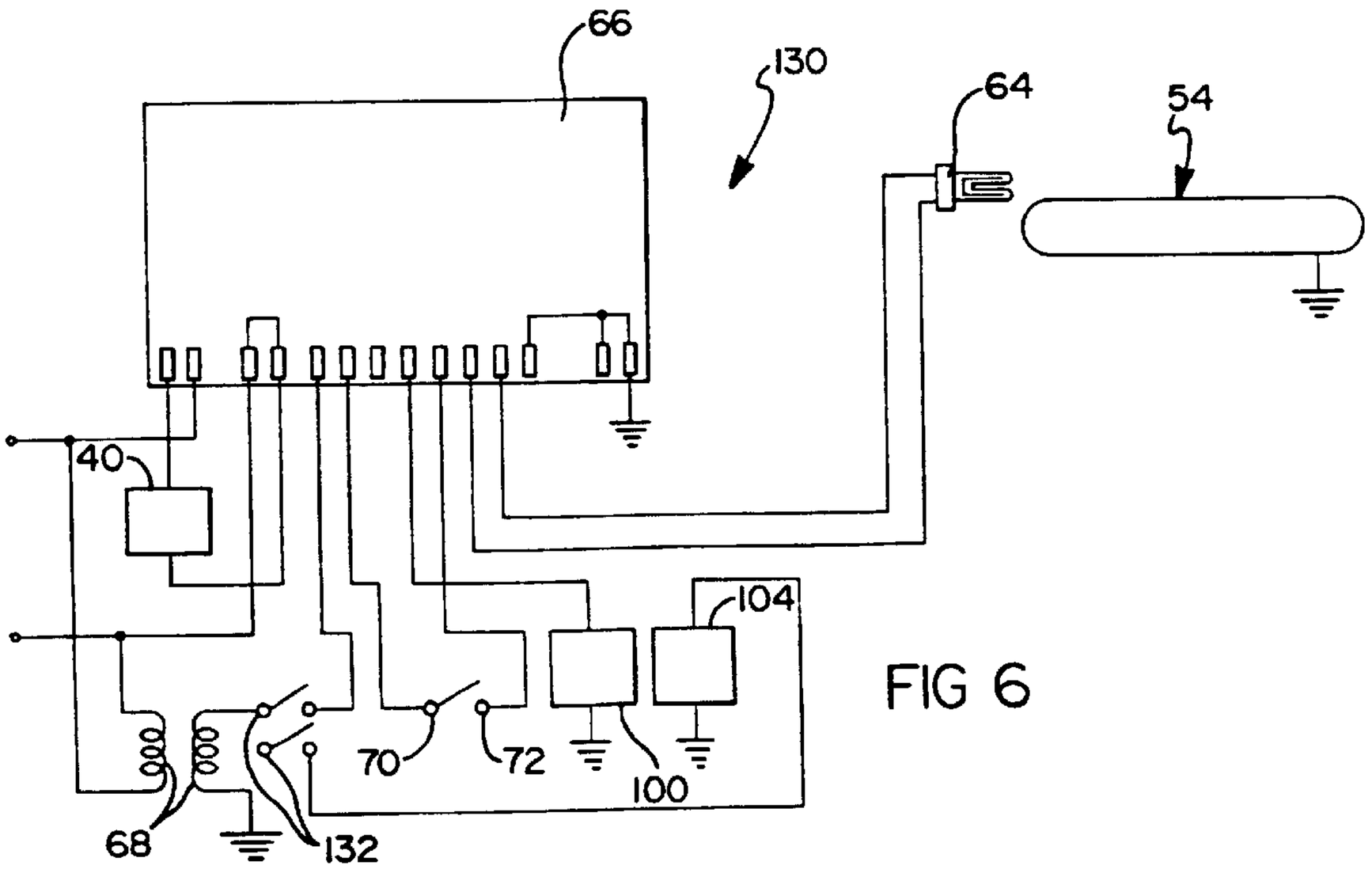


FIG 6

DEMAND RADIANT HEATING SYSTEM

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to radiant heating systems and, more particularly, to a demand type of radiant heating system.

2. Description of the Related Art

It is known to provide a radiant heating system to heat a specific location in a building such as a warehouse. Typically, the radiant heating system includes a radiant heating tube having an inlet end and an exhaust end. A relatively short tube of smaller diameter than the radiant heating tube is positioned in the inlet end and spaced from an inner surface thereof to define a cylindrical passage for flow of air. A burner is positioned within the short tube. The burner has an inlet end to receive air and fuel and mixing the same and an exit end for emitting the air/fuel mixture for combustion. An example of such a radiant heating system is disclosed in U.S. Pat. No. 4,390,125 to Rozzi, the disclosure of which is hereby incorporated by reference.

Although the above-patented radiant heating system works well, it suffers from the disadvantage that it operates only on one fuel pressure setting and at predetermined times and cannot provide demand heating at any time. Another disadvantage is that a separate fuel control and regulator are used for fuel control. Yet another disadvantage is that the burner has an ignitor at one end and a separate radiant sensor for the burner which results in more parts. A further disadvantage is that the burner handles only relatively small air/fuel mixture.

SUMMARY OF THE INVENTION

It is, therefore, one object of the present invention to provide a demand type of radiant heating system.

It is another object of the present invention to provide a radiant heating system having a high demand and low demand.

It is yet another object of the present invention to provide a single fuel control capable of dual regulation.

It is still another object of the present invention to provide a single ignitor and sensor.

It is a further object of the present invention to provide a new and improved burner for a radiant heating system.

To achieve the foregoing objects, the present invention is a demand radiant heating system including an elongated radiant heating tube having an inlet end and an exhaust end. The demand radiant heating system also includes a burner operatively connected to the inlet end of the radiant heating tube. The demand radiant heating system further includes means operatively connected to the burner for providing fuel to the burner at a plurality of fuel pressures for demand heating. The fuel and air is mixed and burned by the burner to heat the radiant heating tube and exhaust gases exit the exhaust end.

one advantage of the present invention is that a radiant heating system is of a demand type providing high and low demand heating at any time. Another advantage of the present invention is that a single fuel control is provided

which is capable of dual regulation. Yet another advantage of the present invention is that the demand radiant heating system has a single glow bar which both ignites air/fuel mixture and senses flame presence to serve as an ignitor and a sensor. Yet another advantage of the present invention is that the demand radiant heating system has a new and improved burner to handle larger air/fuel mixtures.

Other objects, features and advantages of the present invention will be readily appreciated as the same becomes better understood after reading the subsequent description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a demand radiant heating system according to the present invention.

FIG. **2** is a sectional view taken along line **2—2** of FIG. **1**.

FIG. **3** is a sectional view taken along line **3—3** of FIG. **1**.

FIG. **4** is a sectional view taken along line **4—4** of FIG. **3**.

FIG. **5** is a sectional view taken along line **5—5** of FIG. **3**.

FIG. **6** is a schematic diagram of an electrical system for the demand radiant heating system of FIG. **1**.

DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

Referring to FIG. **1**, a typical installation of a demand radiant heating system **10**, according to the present invention, is illustrated in a building such as a warehouse to heat a specific location therein. The demand radiant heating system **10** includes a component housing **12** and an elongated linear radiant heating tube **14** which extends therefrom. The demand radiant heating system **10** includes a reflector **16** secured to the tube **14** by suitable means such as a plurality of brackets **18** as illustrated in FIG. **2**. The component housing **12** and brackets **18** are suspended from a ceiling **20** of the building by suitable means such as chains **22**.

The demand radiant heating system **10** also includes an intake tube **24** connected to the component housing **12** and extending through a wall **26** of the building to allow air to enter the component housing **12**. The intake tube **24** may have a shield **28** at the end thereof The radiant heating tube **14** also extends through a wall **30** of the building to allow cooled exhaust gases or combustion products to exit to the atmosphere outside of the building being heated. The tube **14** may have a vent cap or member **32** at the end thereof to vent the exiting exhaust gases. It should be appreciated that in some buildings the air intake may be through the ceiling **20** and/or the gases may be exhausted directly through the ceiling **20** or within the building at a point above the heating system **10**. It should also be appreciated that the chains **22** space the heating system **10** from the ceiling so as to avoid undue heating of the ceiling **20**.

Referring to FIG. **3**, the component housing **12** is internally divided into two compartments **34** and **36** that are gas sealed from each other by a divider **38**. The component housing **12** includes an air blower **40** mounted within the compartment **36**. The blower **40** draws ambient air from the intake tube **24** through an aperture **42** in the component housing **12** and expels it into the compartment **34** through an aperture **44** in the divider **38**. It should be appreciated that the amount and pressure of intake air is controlled by the

size of the blower **40** and the blower intake so as to result in an optimum air/fuel mixture.

The component housing **12** also includes a fuel line **46** that extends into the compartment **34** to allow fuel from a fuel source (not shown) to enter the component housing **12**. The fuel is typically natural gas although any suitable fuel such as propane may be used. The component housing **12** further includes a regulator, generally indicated at **48**, mounted within the compartment **34** and connected to the fuel line **46**. The fuel regulator **48** is of a two-stage type to provide fuel at two different pressures for low demand and high demand heating to be described.

The demand radiant heating system **10** also includes a relatively short burner tube **50** interconnecting the radiant heating tube **14** and component housing **12**. The burner tube **50** has a flange **51** secured to the component housing **12** by suitable means such as fasteners (not shown). Pressurized air in the compartment **34** passes into the burner tube **50** via an aperture **52** in a wall of the component housing **12**. The demand radiant heating system **10** includes a burner, generally indicated at **54**, disposed in the burner tube **50** and extending through the aperture **52** into the compartment **34**. The regulator **48** has a connecting line **56** and fuel orifice **57** extending into one end of the burner **54**. It should be appreciated that fuel enters the burner **54** through the connecting line **56** and fuel orifice **57**.

The demand radiant heating system **10** further includes a substantially gas-tight sensor housing **58** mounted on the burner tube **50** over an aperture or opening **60** therein. The sensor housing **58** is also connected to the compartment **34** of the component housing **12** via an air tube or conduit **62**. Pressurized air from the compartment **34** passes through the air tube **62** into the sensor housing **58** and through the opening **60** into the burner tube **50**. The demand radiant heating system also includes a glow bar ignitor **64** mounted in the sensor housing **58** and in line with the opening **60**. The glow bar ignitor **64** serves as an ignitor for igniting the air/fuel mixture in the burner **54** and as a sensor to open the circuit thereto when the glow bar ignitor **64** reaches a predetermined temperature, for example, 2,200° F. Such a glow bar ignitor **64** is commercially available from the Norton Company of Worcester, Mass.

The demand radiant heating system **10** also includes an ignition control module **66** mounted in the compartment **34** and connected to the glow bar ignitor **64** as will be described. The demand radiant heating system **10** further includes a transformer **68** mounted in the compartment **36** and connected to the ignition control module **66** and a source of power (not shown) such as 120 V AC as will be described. The demand radiant heating system **10** further includes a pair of differential pressure switches such as a burner pressure switch **70** mounted on the divider **38** in the compartment **34** and an intake pressure switch **72** mounted on the divider **38** in the compartment **36**. The burner pressure switch **70** senses the air flow in the compartment **34** and shuts off the system **10** before it produces over a predetermined amount of carbon monoxide (CO) such as 0.04%. The intake pressure switch **72** senses the air flow in the compartment **36** and shuts off the system **10** before it produces over a predetermined amount of carbon monoxide (CO) such as 0.04%. It should be appreciated that the switches **70** and **72** are connected by suitable means to the ignition control module **66** and to an atmospheric pressure reference.

Referring to FIG. **2**, the radiant heating tube **14** may include an elongated sinuous deflector **74** disposed therein to cause the exhaust gases to follow a helical path. The deflector **74** serves to control the velocity of the exhaust gases and to control the pressure and velocity of the exhaust gases within the tube **14**. It should be appreciated that the radiant heating tube **14** may be U-shaped and contain a plurality of the deflectors **74**.

Referring to FIG. **4**, the fuel regulator **48** includes a housing **76** having an inlet **78** and an outlet **80** interconnected by an internal primary passageway **82**. The fuel line **46** is connected to the inlet **78** and the connecting line **56** is connected to the outlet **80**. The regulator **48** also includes a conical inlet screen **84** disposed in the primary passageway **82** after the inlet **78** and a manual valve **86** disposed adjacent thereto. The manual valve **86** is loaded by a spring **88** to open and close a first opening **90** in the primary passageway **82**. The manual valve **86** has a manual fuel knob **92** for adjusting the position of the manual valve **86** relative to the first opening **90**. The fuel regulator **48** also includes a redundant (pilot) solenoid **94** for opening and closing a second opening **96** in the primary passageway **82**. The fuel regulator **48** has a secondary passageway **98** connected to the primary passageway **82** after the second opening **96** and communicating with the outlet **80**. The fuel regulator **48** includes a main solenoid **100** for opening and closing a first opening **102** in the secondary passage way **98** and a second stage solenoid **104** connected to the regulator valve **106** for increasing and decreasing a manifold pressure of the fuel. The second stage solenoid **104** includes a low regulator adjust **108** connected to the regulator valve **106** to adjust the manifold pressure for a first and second stage of operation. The fuel regulator **48** also includes a conical outlet screen **110** disposed in the primary passageway **82** before the outlet **80** and a main valve **112** disposed in the primary passageway **82** before the outlet screen **110**. The main valve **112** is loaded by a spring **114** and controlled by a diaphragm **116** to open and close a third opening **118** in the primary passageway **82**. The diaphragm **116** moves the main valve **112** in response to fuel pressure from the second passageway **98** to the outlet **80** on one side of the diaphragm **116**. Such a fuel regulator **48** is commercially available from White-Rodgers, St. Louis, Mo.

In operation, fuel enters the inlet **78** and flows past the inlet screen **84**, manual valve **86** and opening **96**, main valve **112**, outlet screen **110** and through the outlet **80**. If high demand is required, the second stage solenoid **104** is energized and exerts force on the regulator valve **106**, increasing the manifold pressure for a first stage of operation. If low demand is required, the second stage solenoid **104** is de-energized and relaxes the regulator valve **106**, decreasing the manifold pressure for a second stage of operation. The fuel regulator **48** provides a low fuel pressure such as 1.6 inch W.C. for low demand and a high fuel pressure such as 3.5 inch W.C. for high demand over a ambient temperature range of −40° F. to 175° F.

Referring to FIGS. **3** and **5**, the burner **54** is illustrated. The burner **54** has a venturi tube portion **120** having an inlet end **122** and outlet end **124**. The inlet and outlet ends **122** and **124** each have a plurality of openings **126**, preferably circular, to allow air and fuel to pass therethrough. The inlet end **122** has a plurality of vanes **128** spaced circumferentially thereabout to swirl the air passing the exterior of the inlet end **122**. The outlet end **124** also has a plurality of vanes **130** spaced circumferentially thereabout to swirl the air passing the exterior of the outlet end **124**. The vanes **128** and **130** locate and support the inlet end **122** and outlet end **124** in the burner tube **50**.

Referring to FIG. **6**, a schematic diagram of an electrical circuit **130** for the demand radiant heating system is illus-

trated. The electrical circuit **130** includes the ignition control module **66** connected to a source of power such as 120 V alternating current. The ignition control module **66** is also connected to the glow bar ignitor **64**, which is adjacent the burner **54**, the main solenoid **100** and the blower **40**. The electrical circuit **130** includes the transformer **68** connected across the source of power and a two-stage thermostat **132** connected to the transformer **68**. The thermostat **132** is also connected to the second stage solenoid **104**. The electrical circuit **130** also has the switches **70** and **72** connected to the ignition control module **66**. Such a thermostat **132** is commercially available from White-Rodgers Division of Emerson Electric Co., St. Louis, Mo. It should be appreciated that the thermostat **132** allows the radiant heating system **10** to provide demand heating at any time the temperature of the space being heated is below a predetermined temperature.

In operation, air enters the intake tube **24** through the vent member **28** and flows into the component housing **12** through the opening **42**. The blower **40** pressurizes the air and passes the pressurized air into the compartment **34**. Pressurized air from the compartment **34** flows through the air conduit **62**, sensor housing **58** and opening to cool the glow bar ignitor **64**. Pressurized air from the compartment **34** also flows past the burner **54** whereby the air is swirled by the vanes **128** and **130** into the burner tube **50**. Pressurized air from the compartment **34** further flows through the openings **126** and into the burner **54**.

The ignition control module **66** receives voltage from a source of power and controls the blower **40**. The transformer **68** reduces the voltage from 120 volts AC to 24 volts DC to the two-stage thermostat **132**. The thermostat **132** may be set at a first predetermined temperature, for example 70° F., for a low demand temperature setting and at a second predetermined temperature, for example 60° F., for a high demand temperature setting. If the temperature in the space being heated is below 60° F., the thermostat **132** triggers power to the second stage solenoid **104** to increase the manifold pressure of the fuel. When the temperature rises above 60° F., the thermostat **132** cuts off or opens power to the second stage solenoid **104** to decrease the manifold pressure of the fuel. When the temperature rises above 70° F., the thermostat **132** cuts off or opens power to the ignition control module **66**. It should be appreciated that a low fuel pressure provides less fuel for burning, resulting in less radiant heat, and a high fuel pressure provides more fuel for burning, resulting in more radiant heat.

The fuel from the fuel regulator **48** flows through the connecting line **56** and fuel orifice **57** to mix with the air entering the openings **126** of the burner **54**. The ignition control module **66** triggers power to the glow bar ignitor **64** to ignite the air/fuel mixture in the burner. **54**. The ignition results in combustion of the air/fuel mixture and hot exhaust gases or combustion products are produced. When these gases reach a predetermined temperature sensed by the ignitor **64**, the module **66** cuts off or opens power to the ignitor **64**. The hot exhaust gases are swirled by the deflectors **74** to heat the radiant heating tube **14** which radiates heat to the space being heated. The exhaust gases cool due to heat transfer and exit the radiant heating tube **14** through the vent member **32**.

The present invention has been described in an illustrative manner. It is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation.

Many modifications and variations of the present invention are possible in light of the above teachings. Therefore, within the scope of the appended claims, the present invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A demand radiant heating system comprising:

an elongated radiant heating tube having an inlet end and an exhaust end;

a burner tube connected to said inlet end of said radiant heating tube;

a housing defining an air tight compartment connected to said burner tube,

a blower for continually forcing air into said air tight compartment;

a burner at least partially disposed in said burner tube, said burner having an inlet end to receive air and fuel, means for mixing air and fuel, and an exit end for emitting the air/fuel mixture for combustion closely adjacent thereto; and

single fuel means disposed in said air tight compartment and operatively connected to said inlet end of said burner for providing regulation of fuel to said burner at a plurality of predetermined pressures for demand heating, whereby fuel and air is mixed and burned by said burner to heat said radiant heating tube and exhaust gases exit said exhaust end; and

temperature means connected to said fuel means for triggering said predetermined pressures at a plurality of temperature settings.

2. A demand radiant heating system as set forth in claim **1** wherein said fuel means comprises a fuel regulator having a low fuel pressure for low demand heating and a high fuel pressure for high demand heating.

3. A demand radiant heating system as set forth in claim **1** wherein said temperature means comprises a two-stage thermostat having a low demand temperature setting and a high demand temperature setting.

4. A demand radiant heating system comprising:

an elongated radiant heating tube having an inlet end and an exhaust end;

a burner operatively connected to said inlet end of said radiant heating tube, said burner having an inlet end, an outlet end, and a venturi shaped tube portion interconnecting said inlet end and said outlet end;

fuel means operatively connected to said burner for providing fuel to said burner at a plurality of predetermined pressures for demand heating, whereby fuel and air is mixed and burned by said burner to heat said radiant heating tube and exhaust gases exit said exhaust end;

wherein said inlet end and said outlet end of said burner each have a plurality of openings to allow air and fuel to pass therethrough.

5. A demand radiant heating system comprising:

an elongated radiant heating tube having an inlet end and an exhaust end;

a burner operatively connected to said inlet end of said radiant heating tube, said burner having an inlet end, an outlet end, and a venturi shaped tube portion interconnecting said inlet end and said outlet end;

fuel means operatively connected to said burner for providing fuel to said burner at a plurality of predetermined pressures for demand heating, whereby fuel and air is mixed and burned by said burner to heat said radiant heating tube and exhaust gases exit said exhaust end; and

wherein said inlet end and said outlet end of said burner each have a plurality of vanes spaced circumferentially thereabout to swirl air passing thereby.

6. A demand radiant heating system as set forth in claim **1** including means disposed adjacent said burner for igniting an air/fuel mixture in said burner and for sensing a predetermined temperature of said burner.

7. A demand radiant heating system as set forth in claim **6** wherein said igniting and sensing means comprises a glow bar ignitor.

8. A demand radiant heating system comprising: an elongated radiant heating tube having an inlet end and an exhaust end;

a burner tube connected to said inlet end of said radiant heating tube;

a housing defining an air tight compartment connected to said burner tube;

a blower for continually forcing air into said air tight compartment;

a burner at least partially disposed in said burner tube, said burner having an inlet end to receive air and fuel, means for mixing air and fuel, and an exit end for emitting the air/fuel mixture for combustion closely adjacent thereto;

a single fuel regulator disposed in said air tight compartment and operatively connected to said burner for providing regulation of fuel to said burner at a low fuel pressure for low demand heating and a high fuel pressure for high demand heating, whereby fuel and air is mixed and burned by said burner to heat said radiant heating tube and exhaust gases exit said exhaust end; and

temperature means connected to said fuel regulator for triggering said low fuel pressure and said high fuel pressures at a plurality of temperature settings.

9. A demand radiant heating system as set forth in claim **8** wherein said temperature means comprises a two-stage thermostat having a low demand temperature setting for triggering said low fuel pressure and a high demand temperature setting for triggering said high fuel pressure.

10. A demand radiant heating system comprising:

an elongated radiant heating tube having an inlet end and an exhaust end;

a burner tube connected to said inlet end of said radiant heating tube;

a burner at least partially disposed in said burner tube; a fuel regulator operatively connected to said burner for providing fuel to said burner at a low fuel pressure for low demand heating and a high fuel pressure for high demand heating, whereby fuel and air is mixed and burned by said burner to heat said radiant heating tube and exhaust gases exit said exhaust end;

said burner having an inlet end, an outlet end, and a venturi shaped tube portion interconnecting said inlet end and said outlet end; and

wherein said inlet end and said outlet end of said burner each have a plurality of openings to allow air and fuel to pass therethrough.

11. A demand radiant heating system comprising: an elongated radiant heating tube having an inlet end and an exhaust end;

a burner tube connected to said inlet end of said radiant heating tube;

a burner at least partially disposed in said burner tube;

a fuel regulator operatively connected to said burner for providing fuel to said burner at a low fuel pressure for low demand heating and a high fuel pressure for high demand heating, whereby fuel and air is mixed and burned by said burner to heat said radiant heating tube and exhaust gases exit said exhaust end;

said burner having an inlet end, an outlet end, and a venturi shaped tube portion interconnecting said inlet end and said outlet end; and

wherein said inlet end and said outlet end of said burner each have a plurality of vanes spaced circumferentially thereabout to swirl air passing thereby.

12. A demand radiant heating system as set forth in claim **8** including means disposed adjacent said burner for igniting an air/fuel mixture in said burner and for sensing a predetermined temperature of said burner.

13. A demand radiant heating system as set forth in claim **12** wherein said igniting and sensing means comprises a glow bar ignitor.

14. A demand radiant heating system comprising:

an elongated radiant heating tube having an inlet end and an exhaust end;

a burner tube connected to said inlet end of said radiant heating tube;

a housing defining an air tight compartment connected to said burner tube;

a blower for continually forcing air into said air tight compartment;

a burner at least partially disposed in said burner tube, said burner having an inlet end to receive air and fuel, means for mixing air and fuel, and an exit end for emitting the air/fuel mixture for combustion closely adjacent thereto;

a single fuel regulator disposed in said air tight compartment and operatively connected to said burner for providing dual regulation of fuel to said burner at a low fuel pressure for low demand heating and a high fuel pressure for high demand heating;

a two-stage thermostat connected to said fuel regulator and having a low demand temperature setting for triggering said low fuel pressure and a high demand temperature setting for triggering said high fuel pressure; and

whereby fuel and air is mixed and burned by said burner to heat said radiant heating tube and exhaust gases exit said exhaust end.

15. A demand radiant heating system as set forth in claim **14** including a glow bar ignitor disposed adjacent said burner for igniting an air/fuel mixture in said burner and for sensing a predetermined temperature of said burner.

16. A demand radiant heating system comprising:

an elongated radiant heating tube having an inlet end and an exhaust end;

a burner operatively connected to said inlet end of said radiant heating tube;

a single fuel regulator operatively connected to said burner for providing regulation of fuel to said burner at a plurality of predetermined pressures for demand heating; and

temperature means operatively connected to said single fuel regulator for triggering said predetermined pressures at a plurality of temperature settings.

17. A demand radiant heating system comprising:

an elongated radiant heating tube having an inlet end and an exhaust end;

a burner operatively connected to said inlet end of said radiant heating tube;

a single fuel regulator operatively connected to said burner for providing regulation of fuel to said burner at a plurality of predetermined pressures for demand heating; and

a thermostat operatively connected to said single fuel regulator for triggering said predetermined pressures at a plurality of temperature settings.

18. A demand radiant heating system comprising:

an elongated radiant heating tube having an inlet end and an exhaust end;

a housing operatively connected to said inlet end of said radiant heating tube;

a burner at least partially disposed in said housing, said burner having an inlet end to receive air and fuel and an exit end for emitting an air and fuel mixture for combustion closely adjacent thereto;

a single fuel regulator disposed in said housing and operatively connected to said inlet end of said burner for providing regulation of fuel to said burner at a plurality of predetermined pressures for demand heating; and

temperature means operatively connected to said single fuel regulator for triggering said predetermined pressures at a plurality of temperature settings.

19. A demand radiant heating system comprising:

an elongated radiant heating tube having an inlet end and an exhaust end;

a housing operatively connected to said inlet end of said radiant heating tube;

a burner at least partially disposed in said housing;

a single fuel regulator operatively connected to said burner for providing a low fuel pressure for low demand heating and a high fuel pressure for high demand heating; and

a thermostat operatively connected to said single fuel regulator for triggering said low fuel pressure and said high fuel pressure at a plurality of temperature settings.

20. A demand radiant heating system comprising:

an elongated radiant heating tube having an inlet end and an exhaust end;

a housing defining an air tight compartment operatively connected to said heating tube;

a burner operatively connected to said inlet end of said radiant heating tube;

a single fuel means disposed in said air tight compartment and operatively connected to said burner for providing regulation of fuel to said burner at a plurality of predetermined pressures for demand heating; and

temperature means operatively connected to said single fuel means for triggering said predetermined pressures at a plurality of temperature settings.

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(12) **EX PARTE REEXAMINATION CERTIFICATE** (6910th)

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(54) **DEMAND RADIANT HEATING SYSTEM**

(75) Inventors: **Joseph B. Wortman**, Grosse Pointe, MI (US); **Cory A. Weiss**, Warren, MI (US)

(73) Assignee: **Detroit Radiant Products Co.**, Detroit, MI (US)

Reexamination Request:
No. 90/006,773, Sep. 10, 2003

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F23N 5/02	(2006.01)
F23N 5/10	(2006.01)
G05D 23/00	(2006.01)

(52) **U.S. Cl.** ..... **237/2 R**; 237/2 A; 237/70; 236/36; 126/92 AC

(58) **Field of Classification Search** ..... 431/12, 431/9, 10, 67, 62, 63, 66, 353; 236/1 E, 1 EA, 236/1 EB, 36; 126/91 A, 116 A; 237/70; 137/489, 489.5, 490, 495
See application file for complete search history.

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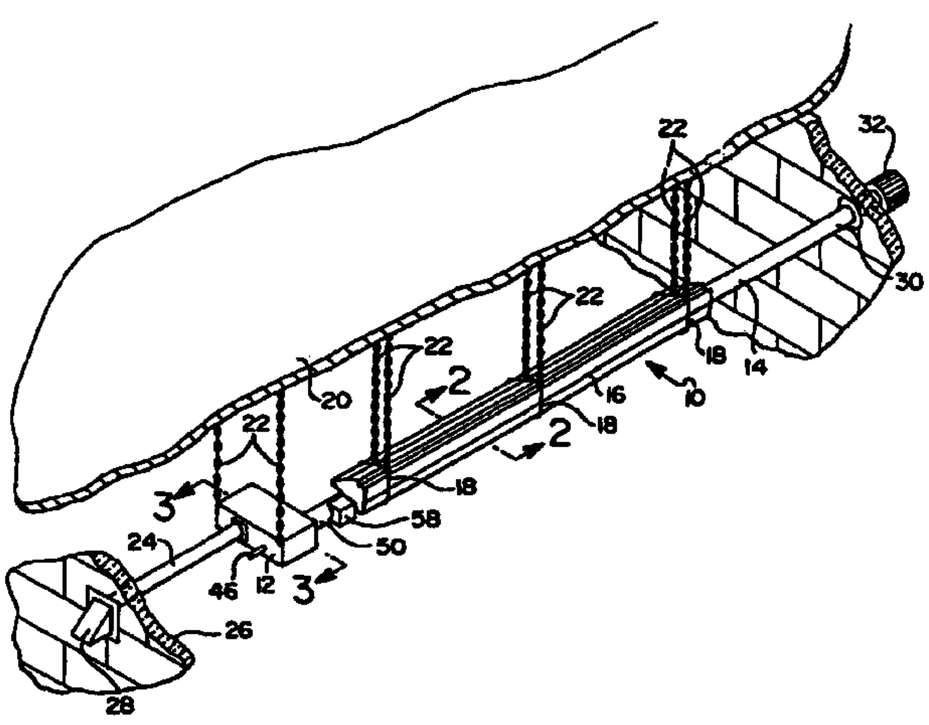
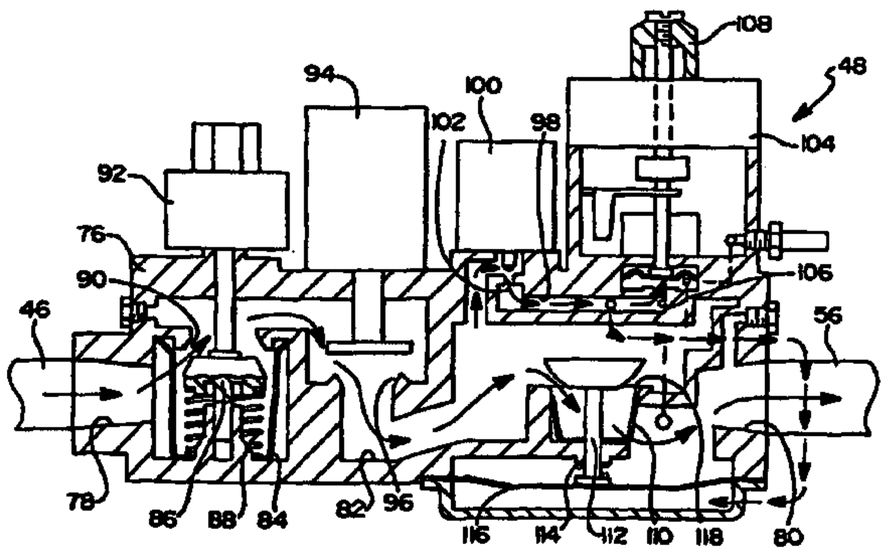
Primary Examiner—Sara S Clarke

(57) **ABSTRACT**

A demand radiant heating system includes an elongated radiant heating tube and a burner operatively connected to the tube and a fuel regulator connected to the burner for providing fuel to the burner at a plurality of fuel pressures to provide demand heating.





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EX PARTE REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 307

THE PATENT IS HEREBY AMENDED AS INDICATED BELOW.

Matter enclosed in heavy brackets [ ] appeared in the original patent but was deleted by the reissue patent; matter printed in italics was added by the reissue patent. Matter enclosed in heavy double brackets [[ ]] appeared in the reissue patent but is deleted by this reexamination certificate; matter printed in boldface is added by this reexamination certificate.

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

The patentablity of claims **1–9**, **11–15** and **20** is confirmed.

Claims **16–19** are cancelled.

Claim **10** is determined to be patentable as amended.

10. A demand radiant heating system comprising:

an elongated radiant heating tube having an inlet end and an exhaust end;

a burner tube connected to said inlet end of said radiant heating tube;

a burner at least partially disposed in said burner tube; a fuel regulator operatively connected to said burner *having a means* for providing fuel to said burner at a low fuel pressure for low demand heating and a high fuel pressure for high demand heating, whereby fuel and air is mixed and burned by said burner to heat said radiant heating tube and exhaust gases exit said exhaust end;

said burner having an inlet end, an outlet end, and a venturi shaped tube portion interconnecting said inlet end and said outlet end; and

wherein said inlet end and said outlet end of said burner each have a plurality of openings to allow air and fuel to pass therethrough.

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