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(54) **DIRECT FIRED HEATER WITH IMPROVED SET-UP FEATURES**

(75) Inventors: **Robert T Jauch JR.**, Portage, MI (US); **Bruce Owen**, Wayland, MI (US)

Correspondence Address:
EDWARD J. TIMMER
P. O. BOX 770
RICHLAND, MI 49083 (US)

(73) Assignee: **AbsolutAire, Inc.**

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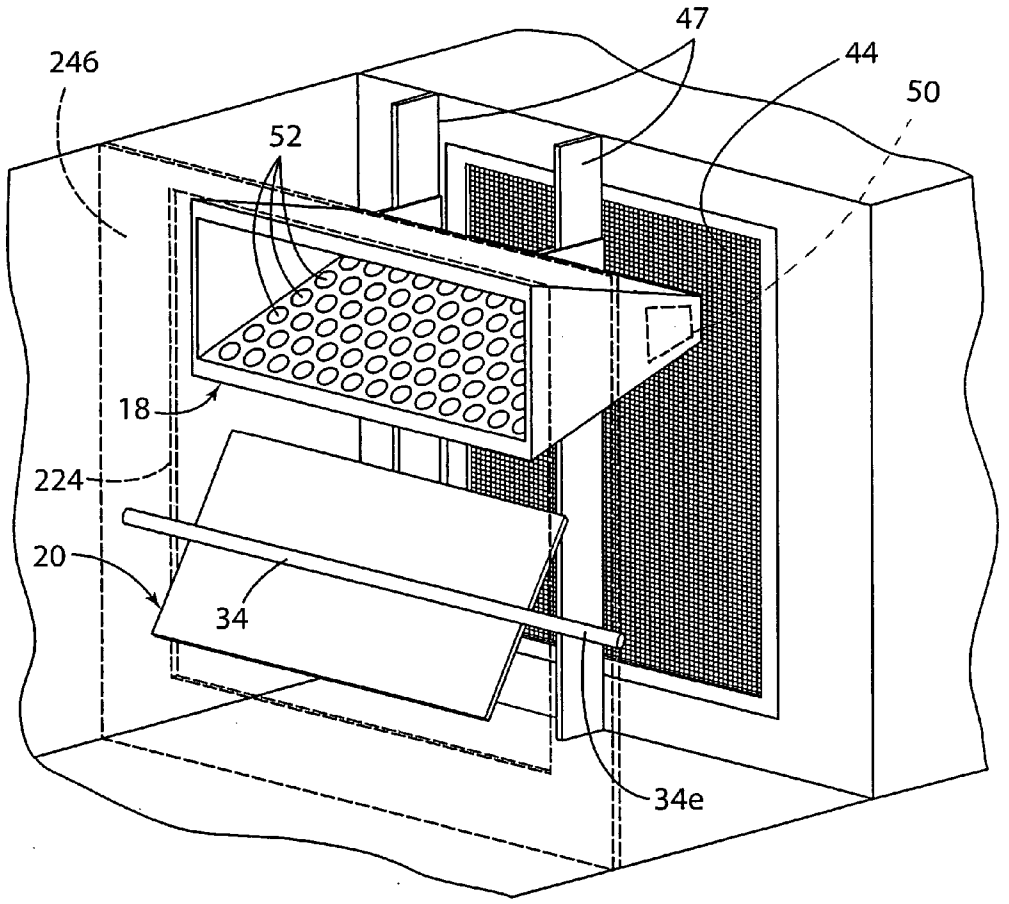
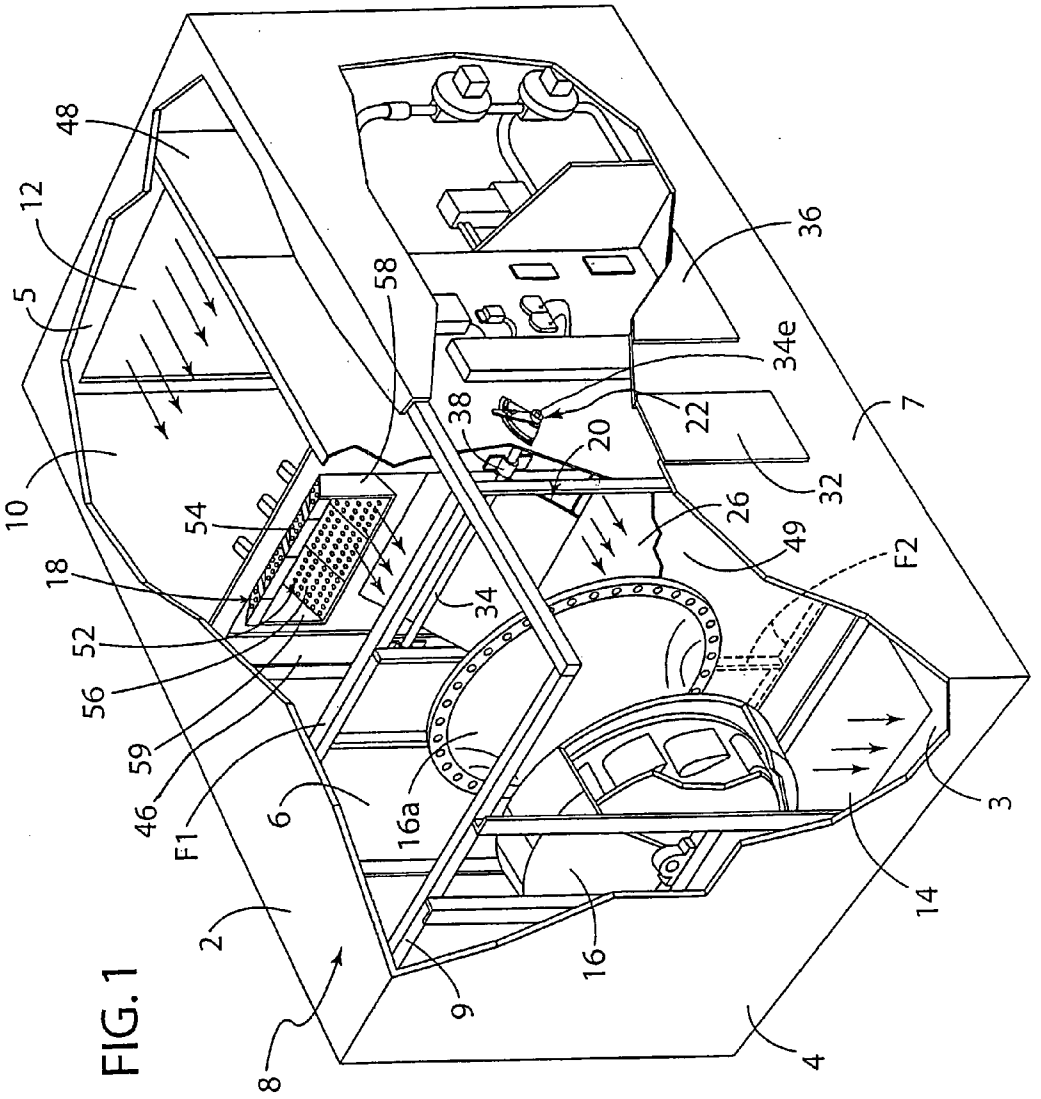
(57) **ABSTRACT**

Features of the direct fired heater can facilitate and improve setup and operation thereof. The direct fired heater can include a housing forming an airflow passage and the airflow passage having an inlet and an outlet; an air moving device to flow air from the inlet to the outlet; gas fired burner disposed in the housing; a pivotal airflow damper disposed in the housing relative to the gas fired burner to control the air flow rate through the burner; and an adjusting device for adjusting the damper from outside the airflow passage. Sensing probes disposed in the airflow passage upstream and downstream of the burner and a pressure differential measuring instrument, such as a manometer, disposed outside of airflow passage in communication with the upstream sensing probe and the downstream sensing probe can measure the differential pressure upstream and downstream of the burner. A shut-off switch also in communication with the sensing probes controls a valve that can interrupt gas flow to the burner when the pressure differential between the upstream and downstream sensing probe is out of a predetermined pressure differential range.




48
12
5
58
36
34e
38
22
20
7
10
54
26
32
49
F2
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59
46
F1
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16a
3
14
2
16
9
8
4

FIG. 1

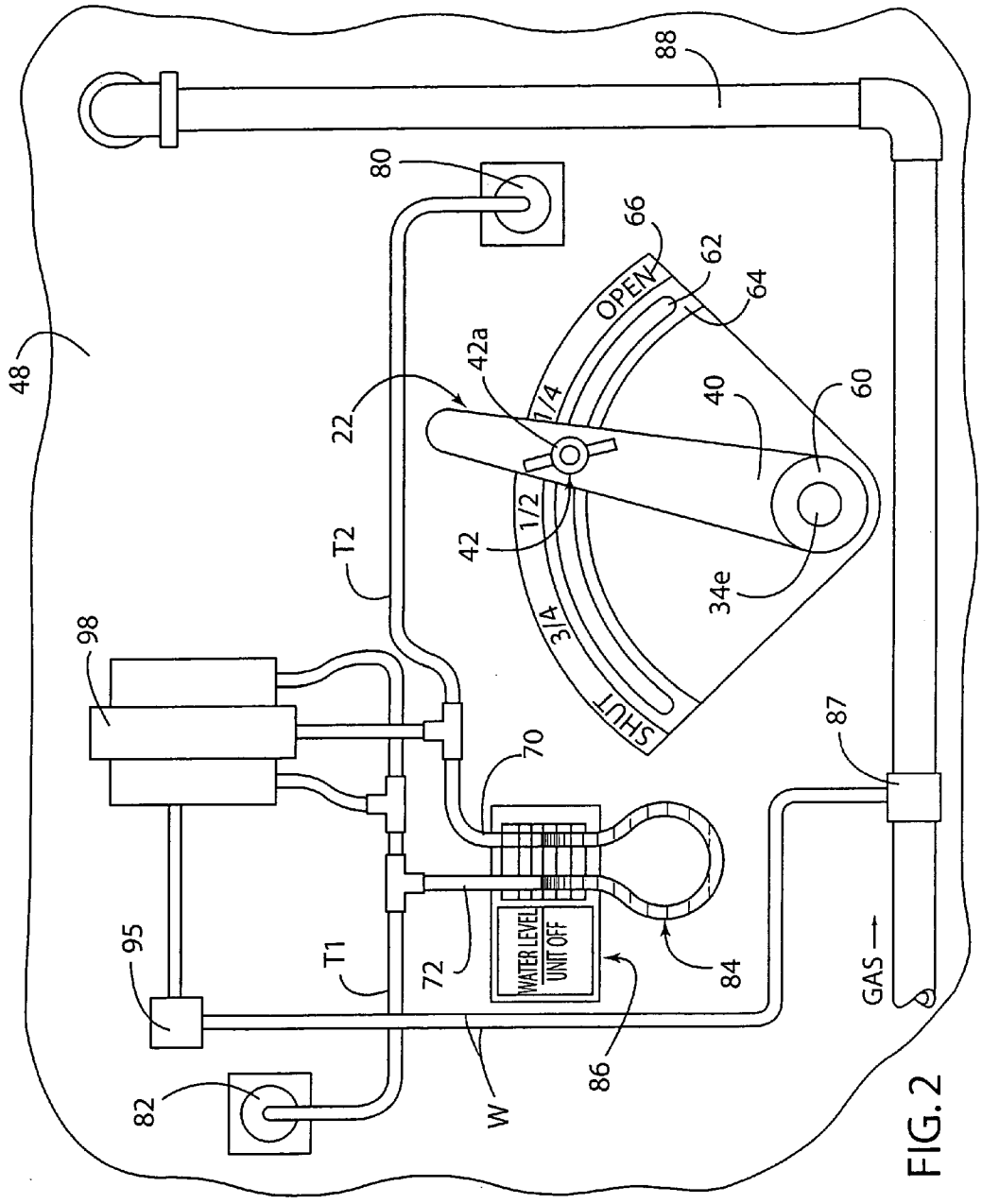

88
80
66
62
64
OPEN
1/4
42a
22
48
40
60
1/2
42
T2
34e
3/4
SHUT
98
70
87
95
T1
72
WATER LEVEL
UNIT OFF
84
GAS
82
W
86

FIG. 2

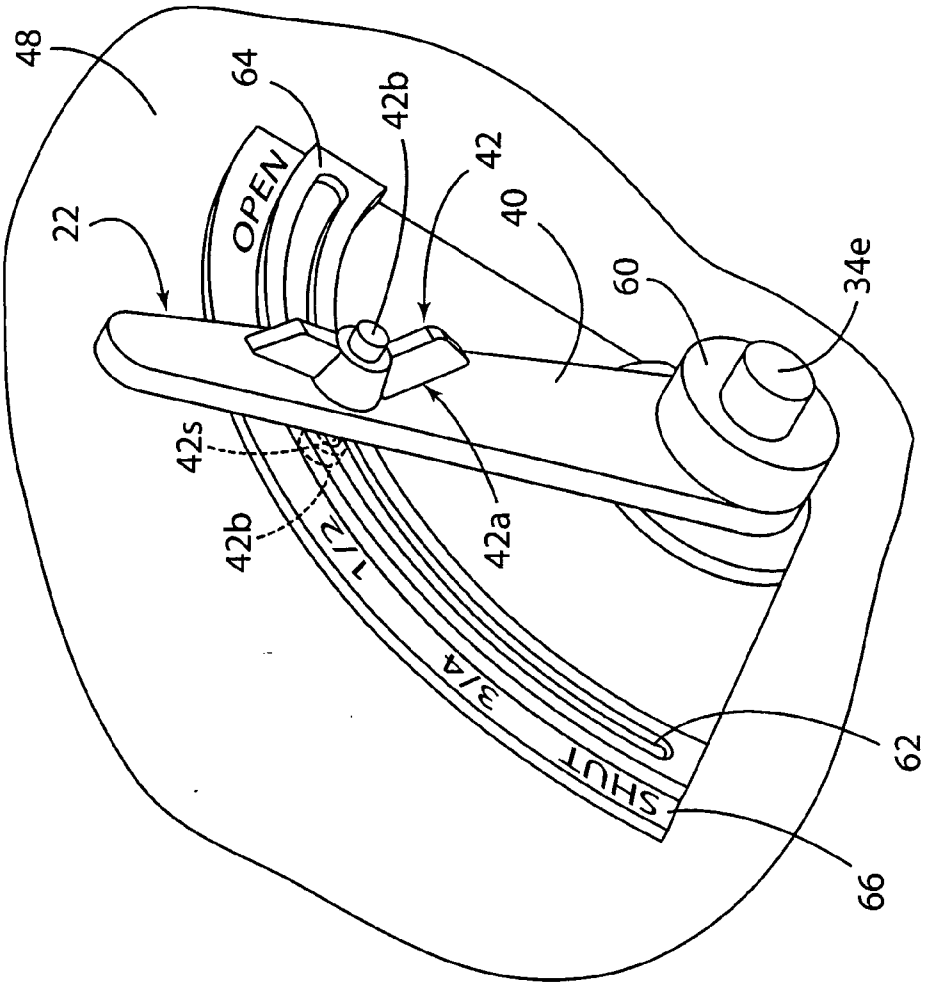


FIG. 3

FIG. 4

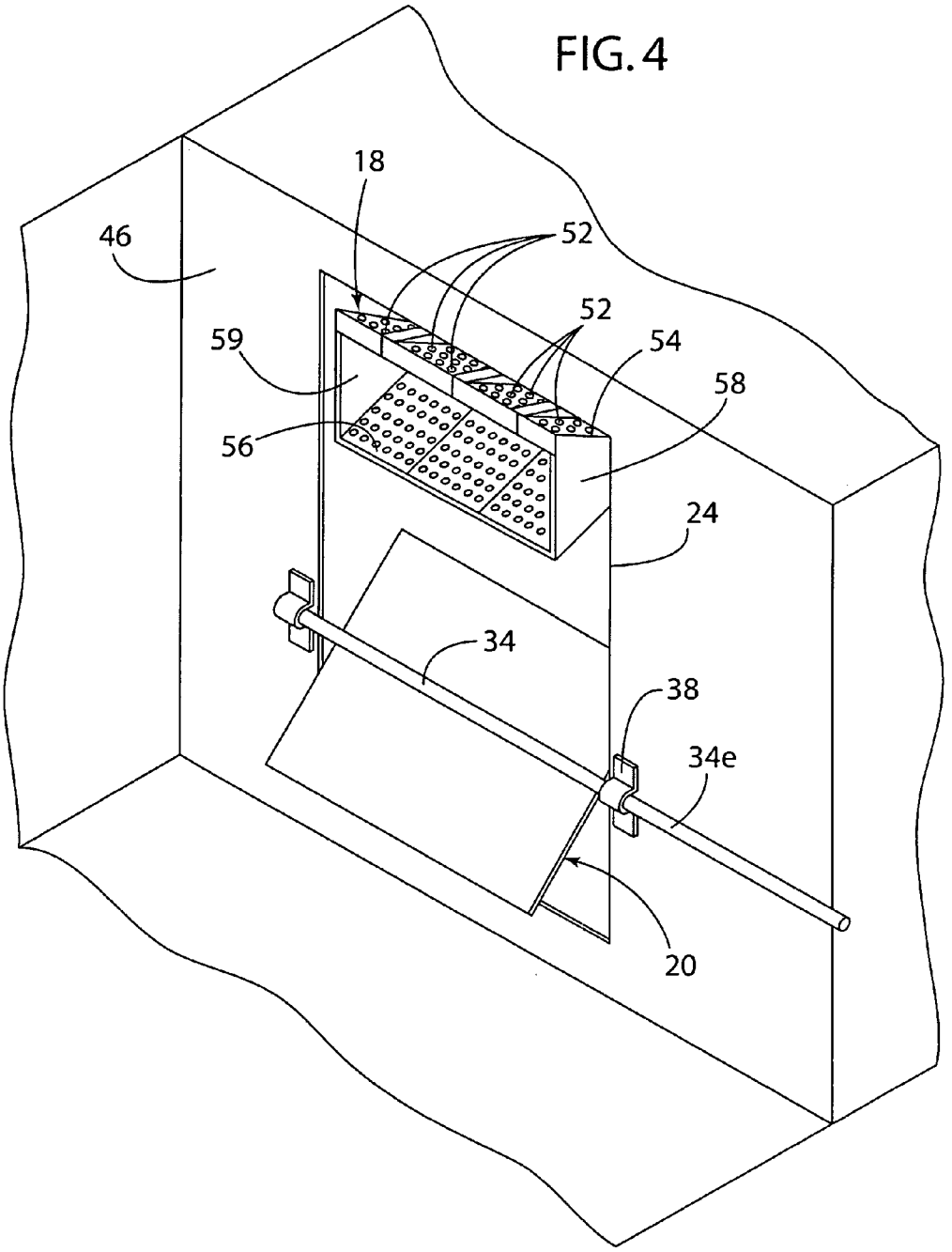
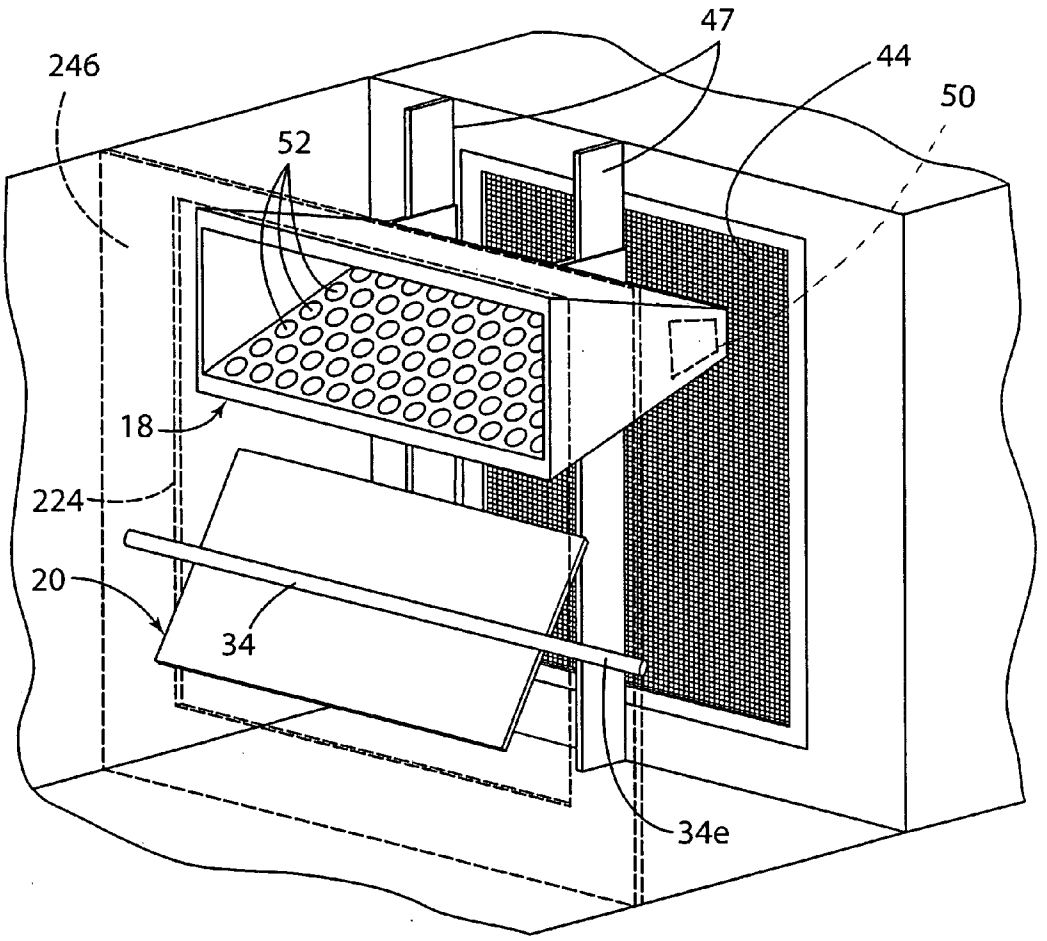


FIG. 5



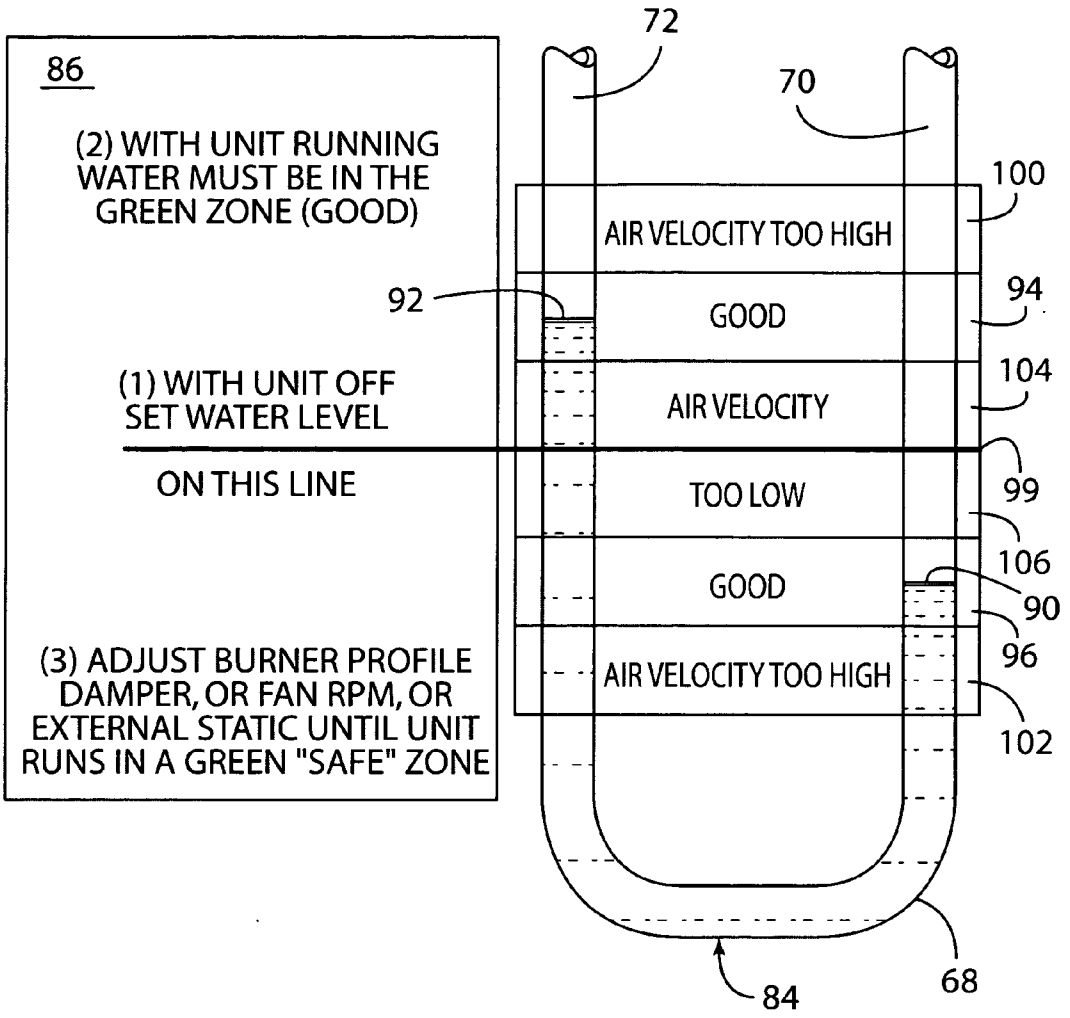

86
(2) WITH UNIT RUNNING WATER MUST BE IN THE GREEN ZONE (GOOD)
(1) WITH UNIT OFF SET WATER LEVEL
ON THIS LINE
(3) ADJUST BURNER PROFILE DAMPER, OR FAN RPM, OR EXTERNAL STATIC UNTIL UNIT RUNS IN A GREEN "SAFE" ZONE
72
70
100
AIR VELOCITY TOO HIGH
92
94
GOOD
104
AIR VELOCITY
99
TOO LOW
106
GOOD
90
96
AIR VELOCITY TOO HIGH
102
84
68

FIG. 6

DIRECT FIRED HEATER WITH IMPROVED SET-UP FEATURES

RELATED APPLICATIONS

[0001] This application claims benefits and priority of provisional application Ser. No. 60/660,920 filed Mar. 11, 2005.

FIELD OF THE INVENTION

[0002] The present invention relates to a direct fired heater having features to facilitate and improve the operational setup of the heater.

BACKGROUND OF THE INVENTION

[0003] Heaters for buildings can be either indirect or direct fired. The traditional indirect fired heater heats a heat exchanger, such as a tube or plate, for heating air as the air passes over the exchanger. Unlike an indirect fired heater, a direct fired heater does not have a heat exchanger. The burner in a direct fired heater combusts fuel directly into the air stream being heated. The combustion byproducts are released directly into the air stream, which is then directly discharged into the space being heated.

[0004] Direct fired heaters are preferred over indirect fired heaters for heating large and industrial buildings. In particular, indirect heaters have a low energy efficiency, heat stratification, poor indoor air quality, and require filtration of outside air, dust, and dirt. In contrast, direct fired heaters are generally about 99.8% energy efficient and provide uniform space temperatures due to a slight positive pressure that also forces out smoke, odors, and other contaminates. Direct fired heaters also provide better indoor air quality and are lower in cost to operate when compared to indirect heaters because of the high efficiency of the direct fired system.

[0005] Direct fired heaters can be constructed in a variety of configurations. Typically, the burner is arranged upstream of the fan to draw the air through the heater, which is a draw-through configuration. Alternatively, a blow-through configuration can be used where the burner is downstream of the fan or blower discharge.

[0006] During the operational setup of a direct fired heater, the airflow in the direct fired heater is adjusted to achieve optimal combustion efficiency. In the past, setup of the heater involved a technician taking pressure measurements downstream and upstream from the burner using a portable manometer not permanently attached to the heater and moving the position of a plate inside of the heater in response to the pressure measurements to adjust the airflow. The plate was fastened in an adjusted position inside the heater using screws. This setup procedure is inconvenient because the technician must stop the operation of the heater to gain access to the interior of the heater, unfasten the plate, adjust its position, restart the heater, take another set of pressure measurements, turn off the heater, adjust the plate position in response to the second set of pressure measurements, and restart the heater. Furthermore, this inconvenient process of adjusting the damper in response to pressure measurement is often repeated until optimal airflow is achieved. The present invention provides a direct fired heater having features that overcome the above disadvantages.

SUMMARY OF THE INVENTION

[0007] An embodiment of the invention involves a direct fired heater comprising a housing forming an airflow passage and the airflow passage having an inlet and an outlet; an air moving device to flow air from the inlet to the outlet; a gas fired burner disposed in the housing; a pivotal airflow damper disposed in the housing relative to the gas fired burner to control the air flow rate through the burner; and an adjusting device for adjusting the damper from outside the airflow passage. The housing can have a mixing chamber downstream from the burner for mixing partially combusted air from the burner and uncombusted air that passes through the damper to provide tempered air.

[0008] In an illustrative embodiment of the invention, the pivotal damper is located adjacent to the gas fired burner in the airflow passage and can pivot about an axis transverse relative to the longitudinal axis of the airflow passage. The pivotal damper can include a pivotal shaft having an end portion residing outside of the airflow passage. The end portion of the pivotal shaft can reside between an interior wall of the housing defining the airflow passage and an exterior wall of the housing, where the exterior wall has an access to the end portion. The pivotal position of the damper can be adjusted by means of an adjustable arm provided on the end portion of the shaft.

[0009] In another illustrative embodiment of the invention, the direct fired heater comprises a housing forming an airflow passage and the airflow passage having an inlet and an outlet, an air moving device to flow air from the inlet to the outlet, a gas fired burner disposed in the housing, an airflow damper disposed in the housing relative to the gas fired burner to control the air flow rate through the burner, an upstream sensing probe disposed in the airflow passage upstream of the burner and the damper, a downstream sensing probe disposed in the airflow passage downstream of the burner and the damper, a pressure differential measuring instrument disposed outside of the airflow passage in communication with the upstream sensing probe and the downstream sensing probe for measuring a differential pressure between the upstream sensing probe and the downstream sensing probe, and an adjusting device to adjust the damper in response to the pressure differential measuring instrument. The damper can be a conventional damper or a pivotal damper as described above. A mixing chamber can also be provided as described above.

[0010] In an illustrative embodiment of the invention, the upstream and downstream sensing probes each can comprise a static or pitot tube. The pressure differential measuring instrument can be a fluid containing differential manometer comprising a U shaped conduit having a first tubular arm in communication with the downstream sensing probe, a second tubular arm in communication with the upstream sensing probe, a first fluid level in the first arm, and a second fluid level in the second arm such that the fluid levels indicate differential pressure between the upstream sensing probe and downstream sensing probe.

[0011] In another illustrative embodiment, a visual indicia is disposed outside of the airflow passage for viewing in conjunction with the first and second fluid levels of the manometer to facilitate adjustment during operational setup of the direct fired heater.

[0012] In yet another illustrative embodiment of the invention, the direct fired heater also includes a shut-off switch in

communication with the upstream sensing probe and the downstream sensing probe where the switch interrupts gas flow to the burner when a pressure differential between the upstream and downstream sensing probe is out of a predetermined pressure differential range. For example, the shut-off switch can close a valve in a supply line for supplying gas to the gas fired burner.

[0013] A method embodiment of the invention comprises a method for controlling a direct fired heater where air is drawn through a passage in a housing and a portion of the air is combusted by a burner comprising the steps of sensing pressure upstream and downstream from an airflow damper, and adjusting the plate from outside of the passage until the measured pressure differential upstream and downstream of the damper falls into a predetermined range. In operation of the direct fired heater, gas flow to the burner is shut off when the pressure differential is outside of a predetermined range.

DESCRIPTION OF DRAWINGS

[0014] **FIG. 1** is a perspective view with portions of the housing broken away to show the internal features of the direct fired heater.

[0015] **FIG. 2** is an enlarged, fragmented view of the manometer, shut-off switch, pivotal shaft, adjustable arm, and a locking means disposed on wall **48**.

[0016] **FIG. 3** is a greatly enlarged, fragmented of the adjustable arm, end portion of the pivotal shaft, and locking means.

[0017] **FIG. 4** is an enlarged, fragmented schematic view of a burner and damper assembly.

[0018] **FIG. 5** is an enlarged, fragmented schematic view of a burner, support members for the burner, damper, and air inlet. Interior wall **48** is omitted in both **FIGS. 4 and 5** to clearly show the burner and damper assembly.

[0019] **FIG. 6** is a greatly enlarged, fragmented view of the indicia and manometer that are be disposed on wall **48**.

DETAILED DESCRIPTION OF THE INVENTION

[0020] Direct fired heaters can vary greatly and are sometimes considered custom built for the application since the heater is configured for the size of the area to be heated, location of the heater, performance desired, and componentry selected. A direct fired heater pursuant to this invention can be mounted upon the roof, adjacent to an exterior wall, or in the interior of the building to be heated. The outside ambient air flows through the heater, where it is heated, and is discharged into the area to be heated. A duct can be used to flow the heated air into the building when the heater is remotely mounted from the building.

[0021] The invention is described below and is especially useful in draw-through direct fired heaters but is not limited thereto as other configurations such as blow-through direct fired heaters can benefit from the present invention.

[0022] Referring to **FIGS. 1-5**, an embodiment of the invention comprises a direct fired heater having a housing **8** forming an airflow passage **10** and the airflow passage **10** having an inlet **12** and outlet **14**; an air moving device **16** to flow air from the inlet **12** to the outlet **14**; a gas fired burner **18** disposed in the airflow passage **10** of the housing **8** to generate tempered air; a pivotal damper **20** disposed in the housing **8** relative to the gas fired burner **18** to control the air flow rate through the burner; and an adjusting device **22** disposed on wall **48** to adjust the damper from outside the airflow passage **10**.

[0023] In an illustrative embodiment of the invention, the housing **8** can be an elongated enclosure having a top wall **2**, bottom wall **3**, front wall **4**, back wall **5**, left side wall **6**, and right side wall **7**. The housing **8** can be constructed of aluminized steel walls with a protective finish that are supported by steel framing **9** although other suitable materials can be used for the housing. The interior side of the housing walls **2**, **3**, **4**, **5**, **6**, and **7** can form the airflow passage **10** in the housing **8**. The inlet **12** can comprise an opening across all of wall **5** or a portion thereof. The housing may also include interior walls and exterior walls, for example, to form a single-wall or double-wall housing.

[0024] The inlet **12** can have pretreatment apparatus **44**, **FIG. 5**, for pretreating the outside ambient air such. The pretreatment apparatus **44** can be a commercially available screen or filter but is not limited thereto as air conditioning coils or other air treatment apparatuses can be used. For example and not limitation, the pretreatment apparatus **44** is shown in **FIG. 5** as a filter that can remove contaminates from the outside ambient air.

[0025] Outside ambient air is drawn from the inlet **12** and through the airflow passage **10**. The amount of outside air flowing in the airflow passage **10** can range from 100% to 20% by volume with the balance being air from an optional air return that returns interior air of the room or building. When air from the optional air return is used, the return air is mixed with the heated air downstream from the burner **18**.

[0026] In the passage **10**, the air is drawn to flow through the gas fired burner **18** and the opening **24** adjacent to the burner, for example, as shown in **FIG. 1**. The air drawn through the burner **18** is used for combustion of the fuel by the burner and provides partially combusted air.

[0027] The gas fired burner **18** is in communication with a gas supply line **88**, which can supply either natural or liquid propane gas or any other suitable gaseous fuel to the burner **18**. The gas flows into the burner **18** via the burner manifold **50**, **FIG. 5**. The burner manifold **50** emits natural or propane gas into an area which is defined by a baffle assembly comprising an upper baffle **54**, lower baffle **56**, and side baffles **58**, **59**. The baffles **54**, **56** have a plurality of apertures **52** that allow air from passage **10** to pass through the baffles **54**, **56**. The natural or propane gas emitted from the manifold **50** is mixed with air flowing through a plurality of apertures **52** in the upper baffle and lower baffles **54**, **56**. The airflow through the burner manifold **50** is kept at a constant velocity during operation of the direct fired heater. The apertures **52** function as an air intake for the burner **18** to move air through the baffles **54**, **56** and into the burner **18**. The air and gas mixture is ignited by an igniter disposed adjacent the burner manifold **50** to provide partially combusted air. The burner **18** can be a commercially available fixed-profile, in-line gas fired burner.

[0028] For purposes of illustration and not limitation, the gas fired burner **18** can be controlled by a commercially available electronic temperature control system and flame

safeguard system although other systems can be used in the practice of the invention. Such electronic temperature control and safeguard systems are commercially available in direct fired heaters manufactured by AbsolutAire Inc. of Kalamazoo, Mich.

[0029] The gas fired burner **18** can be disposed above the damper **20** and mounted to one or more support members **47** as shown in **FIG. 5**. The support members **47** can be a vertical beam or other suitable support member that supports the gas fired burner when the burner is positioned in an opening **24** in wall **46** as shown in **FIGS. 4 and 5**.

[0030] The remainder of the air in airflow passage **10**, i.e. the air not drawn through the burner **18**, is uncombusted ambient air and flows through the opening **24** in interior housing wall **46**.

[0031] Pursuant to a feature of the invention, a pivotal damper **20** can be provided to control the air flow rate through the burner **18**. The air flow rate increases through the apertures **52** of the burner **18** as the damper **20** closes relative to opening **24** and the air flow rate decreases through the apertures **52** of the burner **18** as the damper **20** opens relative to opening **24**. For example and not limitation, the damper **20** shown in **FIG. 5** is horizontally oriented in opening **24** when open and vertically oriented when closed to adjust air flow restriction therein. The damper **20** can reside in opening **24** although the invention envisions that the damper can be located at other locations in the housing to control the air flow rate through the burner.

[0032] The damper **20** is disposed in the housing **8** adjacent to the burner **18** in the opening **24** and in the airflow passage **10**. The invention envisions that two openings can be provided in the wall **46** so that the burner can reside in an opening separate from the damper. The damper **20** can be a pivotal damper attached to a pivotal shaft **34** to pivot the damper **20** about an axis transverse relative to the longitudinal axis of the airflow passage **10**. Shaft **34** can be supported by brackets **38** mounted to the interior wall **46**, which intersects with wall **48**. The pivotal shaft includes an end portion **34***e* that can reside outside of the airflow passage **10** and can be disposed on interior wall **48** or outside of housing **8**. If a single-walled housing is used, the end portion **34***e* extends from a hole in the wall **48** into the space defined by interior wall **48** and exterior wall **7** such that the end portion **34***e* resides in the space between interior wall **48** and exterior wall **7**. **FIG. 1**, offered for illustration and not limitation, shows wall **48** broken away with the end portion **34***e* residing between interior wall **48** and exterior wall **7**. Access to the space between wall **48** and wall **7** can be provided by access doors **32**, **36** in the outer wall **7**.

[0033] Referring to **FIG. 3**, the adjusting device **22** can comprise an adjustable arm **40** on the end portion **34***e* to rotate the pivotal shaft **34**, which in turn rotates the damper **20**, for adjustment. A fastening means **60**, which can be a nut or other suitable fastener, secures the adjustable arm **40** to the end portion **34***e* of the shaft **34**. The adjustable arm **40** can be an elongated handle that extends from the end portion **34***e* for movement forward and backward about the longitudinal axis of the shaft **34**. The adjusting device **22** is not limited to an adjustable arm as other arms such as, but not limited to, handles, shafts, cranks, levers, or other devices suitable for adjusting the damper can be used. The adjusting device **22** can adjust the air flow rate through the burner to facilitate the set-up of the heater.

[0034] A locking means **42** can be provided to maintain the position of the adjustable arm **40**, which in turn maintains the position of the damper **20** in the airflow passage **10**. The locking means **42** is disposed on the distal end of arm **40** and can comprise a wingnut **42***a* and a bolt **42***b*. The threadable shaft **42***s* of the bolt **42***b* extends through slot **62** in wall **48** with the head of the bolt located behind the interior wall **48**. The wingnut **42***a* can be tightened about the shaft **42***s* to maintain the position of the arm **40** or loosened to move arm **40** for adjusting the position of the damper **20**. The slot **62** in wall **48** is arcuate having a track **64** that extends around the edges of the slot **62**. The track **64** provides a surface for which the locking means **42** can be secured while received in the slot **62**. A visual indicia region **66** is located adjacent the upper peripheral edge of the track **64** and has a series of markings to indicate the position of the damper **34** such as shut, ¾, ½, or open in the opening **24** for adjusting the damper to a position. The orientation of the arm **40**, slot **62**, track **64**, and visual indicia region **66** could alternatively be downward or generally vertical depending on the heater configuration. With respect to **FIG. 1**, the adjusting device **22** advantageously allows a technician to adjust the damper **20** from outside the interior wall **48** so that the inconvenient process of stopping the operation and accessing the interior of the heater, unfastening the plate, and manually adjusting the position of the plate in the interior of the heater can be avoided.

[0035] In mixing chamber **26**, which is downstream of burner **18** and damper **24**, the partially combusted heater air from burner **18** and the uncombusted ambient air passing through the damper **20** are mixed and provide tempered (heated) air. As shown in **FIG. 1** and offered for illustration and not limitation, the mixing chamber **26** can be formed by walls **6**, **46**, **48**, and **49**. When air from the optional air return is used, the return air is received into the mixing chamber **26** with the uncombusted air.

[0036] Air moving device **16** flows the tempered air from the mixing chamber **26** to outlet **14** to heat the space that will be heated, typically a commercial or industrial facility. The air moving device **16** can be disposed in, on, or exterior from housing **8**. The air moving device **16** can have an air intake **16***a* mounted to wall **49**, which is shown broken away in **FIG. 1**. The wall **49** can be supported by frames F**1** and F**2**. For purposes of illustration and not limitation, the air moving device **16** can be a commercially available backward-inclined fan or a squirrel cage blower although other devices that move air can be used in practice of the invention. The outlet **14** can be disposed on the bottom wall **3** or other walls such as including, but not limited to, wall **4**, **7**, **10** of the housing **8** depending on the configuration of air moving device **16**. While the discharged tempered air does contain combustion byproducts, set-up and operation of the heater pursuant to this invention provides air quality that conforms to the American National Standards Institute Z-83.4 and Z83.18 for indoor air quality.

[0037] Pursuant to another feature of the invention, as shown in **FIGS. 2 and 6**, the direct fired heater can further include an upstream sensing probe **80**, a downstream sensing probe **82**, and a pressure differential measuring instrument **84** disposed outside of the airflow passage **10** in communication with the upstream sensing probe **80** and the downstream sensing probe **82**.

[0038] The damper **20** in this embodiment can be a pivotal damper as mentioned above or a single slideable blade, a plurality of louvers, or other type of conventional airflow damper. In still another embodiment, the damper can be a motorized damper comprising a motor that is in communication with the shaft **34** to move the shaft **34**, which in turn moves the position of the damper **20** in opening **24**.

[0039] The probes **80**, **82** are disposed outside of the airflow passage **10** and each can be received in an aperture in the interior wall **48** depending on the configuration of the heater. The upstream sensing probe **80** is in communication with the airflow upstream of the burner **18** and damper **20** and can protrude into the airflow passage **10**. The downstream sensing probe **82** is in communication with the airflow downstream of the burner **18** and damper **20** and can protrude into the mixing chamber **26**. The probes **80**, **82** are able to sense any one or a combination of the velocity pressure, total pressure, static pressure, or the air velocity of the airflow in the passage **10**. Each probe **80**, **82** is preferably a conventional static tube or pitot tube that senses the velocity pressure although other types of electrical, mechanical, or pneumatic probes can be used in the practice of the invention. Furthermore, it is also envisioned that more than two sensing probes can be used to sense the parameters of the airflow in the passage **10**.

[0040] The pressure differential measuring instrument **84** is communicated to probes **80**, **82** via tubing T**1**, T**2** and displays a reading that corresponds to the pressure differential between upstream sensing probe **80** and downstream sensing probe **82**. The pressure differential measuring instrument **84** can be a fluid containing differential manometer, as seen in **FIGS. 2 and 6**, comprising a U shaped conduit **68** having a first tubular arm **72** in communication with the downstream sensing probe **82**, a second tubular arm **70** in communication with the upstream sensing probe **80**, a first fluid level **92** in the first arm **72**, and a second fluid level **90** in the second arm **70**. The liquid in the manometer can be water or any other suitable liquid. For purposes of illustration and not limitation, the pressure differential measuring instrument can be a commercially available manometer although other pressure differential measuring devices can be used in practice of the invention.

[0041] A visual indicia **86** is located outside of the airflow passage **10** and can be disposed on wall **48** behind the pressure differential measuring instrument **84**. The indicia **86** has a first predetermined set region **94** and second predetermined region set **96** relative to which the first and second fluid levels **92**, **90** can be adjusted during operational set up of the direct fired heater. The technician adjusts the damper **20** to place the first and second fluid levels **92**, **90** in the first and second predetermined set regions **94**, **96**. For example, when the heater is inoperational, the first and second fluid levels **92**, **90** will be at the middle line **99** of the visual indicia **86**. When the heater is turned on without adjustment, the first and second fluid levels **92**, **90** may be outside regions **94**, **96** such as in the air velocity too high regions **100**, **102** or in the air velocity too low regions **104**, **106**. The technician is able to use this information provided by the fluid levels **92**, **90** and the visual indicia **86** to conveniently adjust the damper **20** from outside the housing wall **48**. From this information, the technician can adjust the damper **20** to a position where the first and second fluid levels **92**, **90** are in the "good" predetermined regions **94**, **96** designated on the indicia **86** as "good zones" having a green color to provide desired air quality.

[0042] Pursuant to still another feature of the invention a shut-off supply switch **98** is communicated to sensing probes **80**, **82** via tubing T**1** and T**2** to receive measurements therefrom. The switch **98** compares the pressure differential between the sensing probes **80**, **82** with a predetermined pressure differential range (i.e. good zones) as calibrated by a technician for the specific burner and heater configuration. When the pressure differential is outside of the predetermined pressure differential range (good zones), the switch **98** sends a signal to a flame relay **97** that sends a signal to close the valve **87**, which interrupts gas flow to the burner **18**. The switch **98** and valve **87** can be connected via a connecting means that can be an electrical, mechanical, or pneumatic conduit sufficient to send a signal from the switch **98** and relay **97** to valve **87**. The connecting means is preferably conventional electrical wires W that receive an electrical signal. The valve **87** has an actuating mechanism that can be mechanical, electrical, or pneumatic to close and open the valve in response to a signal from the shut-off switch **98** to stop gas from reaching the burner **18** and can be a conventional solenoid valve. The invention also envisions that more than one valve **87** can be used in practice of this invention. The supply line **88** is in communication with a source of gas and can be a conventional pipe for gas having conventional dimensions such as diameters of one inch (1"), one and a quarter inches (1¼'), etc. During operation of the direct fired heater, if the pressure differential between the probes **80**, **82** is outside of the predetermined range (good zones) the switch **98** through the relay **95** closes the valve **87** to prevent the heater from operating under potentially dangerous conditions, i.e. the combustion byproducts could possibly be outside the ANSI standards.

[0043] This invention envisions a direct fired heater having one or more of the above features to facilitate and improve set-up of the heater for operation to heat a space.

[0044] It is to be understood that the invention has been described with respect to certain specific embodiments thereof for purposes of illustration and not limitation. The present invention envisions that modifications, changes, and the like can be made therein without departing from the spirit and scope of the invention as set forth in the following claims.

We claim:

1. A direct fired heater comprising a housing forming an airflow passage and said airflow passage having an inlet and an outlet, an air moving device to flow air from said inlet to said outlet, a gas fired burner operatively associated with the housing, a pivotal airflow damper disposed in said housing relative to said gas fired burner to control the air flow rate through said burner, and an adjusting device to adjust said damper from outside said airflow passage.

2. The direct fired heater in claim 1 wherein said pivotal damper is adjacent to said gas fired burner in said airflow passage.

3. The direct fired heater in claim 1 wherein said pivotal damper pivots about an axis transverse relative to the longitudinal axis of said airflow passage.

4. The direct fired heater in claim 1 wherein said housing has a mixing chamber downstream from said burner for

mixing partially combusted air from said burner and uncombusted air that passes through said damper to provide tempered air.

5. The direct fired heater in claim 1 wherein said pivotal damper has a pivotal shaft having an end portion residing outside of said airflow passage.

6. The direct fired heater in claim 5 wherein said adjusting device comprises an adjustable arm on said end portion to rotate said shaft and by which the damper is pivoted, and a locking means to maintain the adjusted position of said adjustable arm.

7. A direct fired heater comprising a housing forming an airflow passage and said airflow passage having an inlet and an outlet, an air moving device to flow air from said inlet to said outlet, a gas fired burner disposed in said housing, an airflow damper disposed in said housing relative to said gas fired burner to control the air flow rate through said burner, an upstream sensing probe disposed in said airflow passage upstream of said burner and said damper, a downstream sensing probe disposed in said airflow passage downstream of said burner and said damper, a pressure differential measuring instrument disposed outside of said airflow passage in communication with said upstream sensing probe and said downstream sensing probe, and an adjusting device to adjust said damper in response to said pressure differential measuring instrument.

8. The direct fired heater in claim 7 wherein said upstream sensing probe is a static tube or pitot tube.

9. The direct fired heater in claim 7 wherein said downstream sensing probe is a static tube or pitot tube.

10. The direct fired heater in claim 7 wherein said pressure differential measuring instrument is a fluid containing differential manometer comprising a U shaped conduit having a first tubular arm in communication with said downstream sensing probe, a second tubular arm in communication with said upstream sensing probe, a first fluid level in said first arm, and a second fluid level in said second arm.

11. The direct fired heater in claim 10 further comprising a visual indicia disposed outside of said airflow passage for viewing in conjunction with said first fluid level and said second fluid level of said differential manometer so that said first and second fluid levels can be adjusted during operational set up of said direct fired heater.

12. The direct fired heater in claim 7 wherein said damper pivots about an axis transverse relative to the longitudinal axis of said airflow passage.

13. The direct fired heater in claim 12 wherein said damper has a rotatable shaft having an end portion residing outside of said airflow passage.

14. The direct fired heater in claim 13 wherein said adjusting device said damper comprises an adjustable arm on said end portion to rotate said shaft and by which the damper is rotated; and a locking means to maintain the adjusted position of said adjustable arm.

15. The direct fired heater in claim 7 wherein said housing has a mixing chamber downstream from said burner and damper for mixing partially combusted air from said burner and uncombusted air that passes through said damper to provide tempered air.

16. The direct fired heater in claim 7 further comprising a supply line for supplying gas to said gas fired burner and having a valve to control the gas supply to said gas fired burner, and a shut-off switch in communication with said upstream sensing probe and said downstream sensing probe wherein said switch controls said valve to interrupt gas flow to said burner when a pressure differential between said upstream and downstream sensing probe is out of a predetermined pressure differential range.

17. A direct fired heater comprising a housing forming an airflow passage and said airflow passage having an inlet and outlet, an airflow passage disposed in said housing and having an inlet and an outlet, an air moving device to flow air from said inlet to said outlet, a gas fired burner disposed in said housing, an airflow damper disposed in said housing relative to said gas fired burner to control the air flow rate through said burner, an upstream sensing tube disposed in said airflow passage upstream of said burner and damper, a downstream sensing tube disposed in said airflow passage downstream of said burner and damper, a fluid containing differential manometer comprising a U shaped conduit having a first tubular arm in communication with said downstream sensing tube, a second tubular arm in communication with said upstream sensing tube, a first fluid level in said first arm, and a second fluid level in said second arm, a visual indicia disposed outside said airflow passage for viewing in conjunction with said first fluid level and said second fluid level of said differential manometer, an adjusting device to adjust said damper in response to said differential manometer, a supply line for supplying gas to said gas fired burner and having a valve to control the gas supply to said gas fired burner, and a shut-off switch in communication with said upstream tube and said downstream tube wherein said switch controls said valve to interrupt gas flow to said burner when a pressure differential between said upstream and downstream sensing tubes is out of a predetermined pressure differential range.

18. Method for controlling a direct fired heater where air is drawn through a passage in a housing and a portion of the air is combusted by a burner comprising sensing pressure upstream and downstream from an airflow damper, and adjusting said damper from outside of said passage until the measured pressure differential upstream and downstream of said damper falls into a predetermined range.

19. The directed fired heater of claim 5 wherein said end portion resides between an interior wall of said housing defining said airflow passage and an exterior wall of said housing, said exterior wall having an access to said end portion.

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