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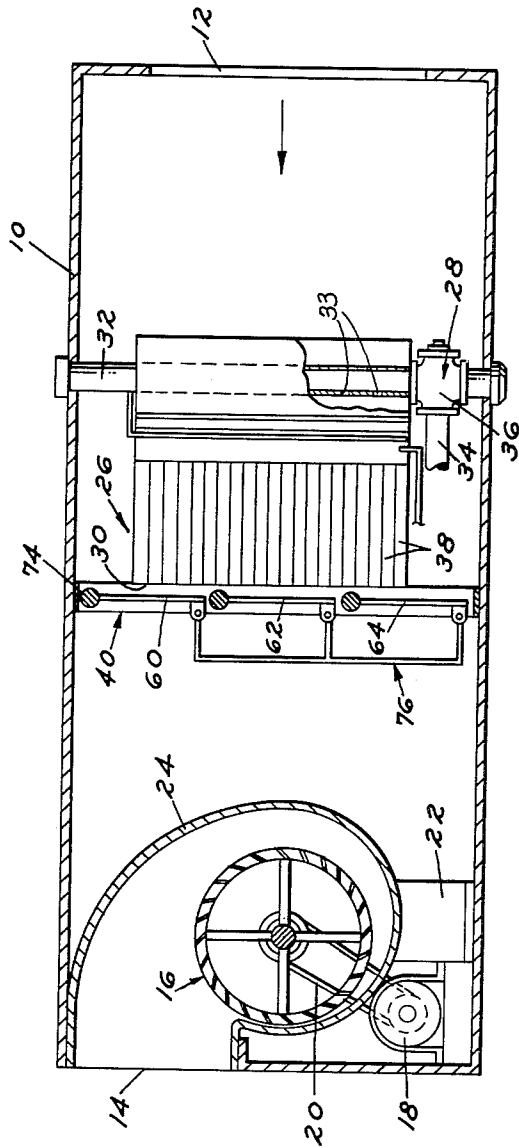
J. A. HARRISON

3,199,848

FUEL GAS FIRED HEATER WITH AUTOMATIC DAMPER MEANS

Filed Jan. 9, 1963

2 Sheets-Sheet 1



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INVENTOR.
JAMES A. HARRISON
BY
Burton & Parker
ATTORNEYS

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J. A. HARRISON

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2 Sheets-Sheet 2

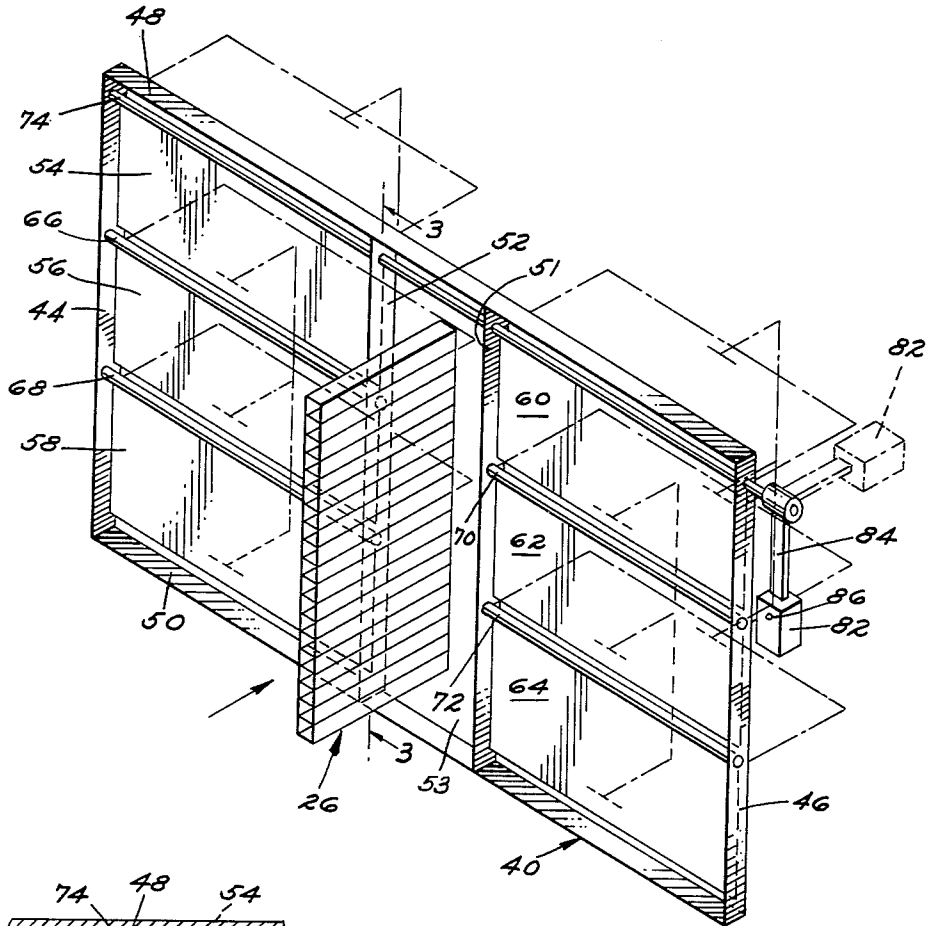


FIG. 1

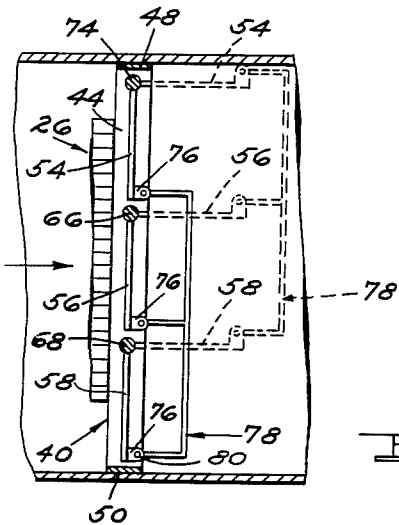


FIG. 2

INVENTOR.

JAMES A. HARRISON

BY

Burton & Parker

ATTORNEYS

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3,199,848

FUEL GAS FIRED HEATER WITH AUTOMATIC DAMPER MEANS

James A. Harrison, 24450 Telegraph Road,
Southfield, Mich.

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8 Claims. (Cl. 263-19)

This invention relates to fuel gas fired heaters, and in particular to a burner for such a heater having an air damper associated therewith for maintaining a constant pressure drop across the burner automatically under all conditions.

The automatic damper disclosed herein is particularly designed to be used with a fuel gas fired heater such as those shown in my applications for patent Serial No. 239,103, filed November 19, 1962, and Serial No. 154,995, filed November 27, 1961. These heaters are of the direct fired, make-up air type, i. e., fuel gas is burned directly in the air to be heated, which is drawn from the outside and blown into the space to be warmed. The burner shown herein is similar in construction to that of the former application, but it will be apparent that other burners could be utilized as well to practice the invention.

In the use of fuel gas fired heaters such as those described in the above-identified applications for patent, wherein the burner is operated in a moving air stream, a shutter or damper is provided to effect a resistance to air flow and thus force combustion air through the burner wherein it is mixed with fuel gas to provide a combustible mixture. The damper is ordinarily set at a predetermined position to effect the desired flow of combustion air through the burner, providing the ideal air-gas ratio for complete combustion. This is commonly done by determining the pressure drop across the burner required to produce the correct air-gas mixture, and then setting the air damper at that position which will provide such pressure drop.

If the rate of flow of combustion air through the heater remains constant, the damper or shutter can be secured in a predetermined position, and a constant pressure drop across the burner can be achieved. Under such unvarying conditions, the air-gas ratio in the burner remains constant, and complete combustion is achieved. However, there are many factors present in the conventional make-up air heater which can effect the rate of flow of air through the heater. Some systems incorporate a multi-speed blower for changing the rate of air flow. In heaters provided with air filters, the filters may become clogged with dirt and dust, varying the air flow through the heater. In fact, any obstruction in the duct system of the heater could cause a variation in the air flow. If the setting of the shutter or damper is not changed to compensate for such variations in air flow, the pressure drop across the burner changes, resulting in an unwanted flow condition. The air-gas ratio within the burner is thrown off, and complete combustion is not achieved.

It is therefore the primary object of the invention to provide a fuel gas fired heater having an automatically adjustable, constant pressure drop air damper or shutter therein, which damper is self-adjusting to insure a substantially constant flow of combustion air through the heater burner under variations in the total rate of flow of air through the heater and thus achieve complete combustion under various operating conditions.

Other objects, advantages and meritorious features

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will more fully appear from a consideration of the specification, claims and accompanying drawings, wherein:

FIG. 1 is a vertical section taken through the fuel gas fired heater embodying my invention;

FIG. 2 is a schematic perspective view of the burner assembly showing the automatic air damper and its relationship to the burner; and

FIG. 3 is a cross-sectional view of the air damper taken along line 3-3 of FIG. 2.

The invention as shown is embodied in what is generally known as a direct fired make-up type fuel gas-air heater of the character disclosed in my patent application Serial No. 239,103. The heater shown in FIG. 1 generally comprises a housing or duct 10 which is closed on both sides, top and bottom, and which is provided with openings at the front and rear ends as indicated at 12 and 14. Disposed within the duct 10 is a blower 16 which is preferably a conventional centrifugal type blower driven in any suitable fashion such as by the electric motor 18 connected to the blower by a belt drive 20. The blower 16 may be supported in duct 10 on a supporting bracket or the like 22. As is well understood in the art, the blower is provided with a housing 24, and rotation of the blower creates a partial vacuum adjacent its rotational axis, and blows air through the housing 24 for discharge out of the heater through opening 14. The partial vacuum created in duct 10 induces air to enter duct 10 through the front end opening 12 and pass to the blower 16 so that air flows through the duct 10 from opening 12 out through opening 14, as indicated by the arrow in FIG. 1. When used as a make-up air heater opening 12 will be positioned to draw air from outside the space to be heated, and opening 14 will be arranged to discharge heated air into the space to be heated. Of course the heater could be located remote from the space to be heated, and an extension duct utilized to convey the heated air from opening 14 to the space to be heated.

To heat the air flowing through duct 10, there is provided a burner assembly generally indicated at 26 in FIG. 1 and a fuel gas manifold assembly generally indicated at 28. The manifold assembly serves to furnish fuel gas to the burner assembly, wherein it is mixed with a portion of the air flowing through duct 10 to provide a combustible mixture which will burn along the downstream edge 30 of the burner assembly 26.

Details of the construction of burner assembly 26 and manifold assembly 28 are fully disclosed in my prior application Serial No. 239,103 and will not be repeated herein. The manifold assembly generally comprises an upright tube 32 connected at its lower end to a fuel gas supply pipe 34 through a four-way coupling 36. Preferably there is connected in the supply pipe 34 a temperature responsive fuel gas control valve (not shown). Also, as is conventional practice in the industry, a fuel gas pressure regulating valve is provided in the gas supply line upstream of the gas control valve. Tube 32 is provided along its length with a plurality of gas escape orifices 33 in gas discharge relation with the burner assembly 26, and a piston-like valve element free floating within the tube. As the incoming gas forces the piston upwardly in the tube 32, more and more gas orifices are exposed, and the B.t.u. output of the heater is increased, as more fully described in my prior application Serial No. 239,103 above referred to.

Disposed adjacent the manifold and in fuel gas receiving relation therewith is the burner assembly 26, which includes an arrangement of burner tubes 38 spaced from the manifold to allow the entry of both the gas escaping from the gas tube 32 as well as a portion of the air flowing through the duct 10, which air enters through opening 12. Air and fuel gas are mixed together with-

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in the tubes 38, and the resultant mixture burns at the downstream end 30 of the burner assembly 26.

Extending across the duct 10 at the downstream end 30 of the burner assembly 26 there is positioned an air shutter or damper generally indicated by numeral 40. Such damper preferably includes a peripheral frame having vertical end members 44 and 46, and top and bottom members 48 and 50, which may be secured to the inwardly facing walls of duct 10 as by bolts, rivets or the like. In addition, there are two spaced-apart vertical supporting members 51 and 52, one on each side of, and spaced laterally from the burner assembly 26 to provide an open area indicated at 53. As shown in FIG. 2, the damper 40 is provided with six movable blades 54, 56, 58, 60, 62 and 64. The blades 56, 58, 62 and 64 are pivotally mounted within frame 40 on the short shafts 66, 68, 70 and 72, respectively, which have their opposite ends journaled in the frame members 44, 52 and 46, 51, as shown. The uppermost pair of blades, 54 and 60, are pivotally mounted on a long shaft 74 extending completely across the damper 40, and supportingly journaled in the vertical frame members 44, 46, 52 and 51. Each of the damper blades is provided at its lower edge with a projecting bracket 76 (see FIG. 3), which may be secured to each blade as by welding. Each vertically aligned set of blades such as blades 54, 56 and 58, are mechanically connected together for conjoint movement by linkage 78, as shown in FIG. 3, which is pivotally secured as at 80 to each of the brackets 76. The set of blades 54, 56 and 58 is operatively connected to the set of blades 60, 62 and 64 by the long shaft 74, so that all six blades move in unison.

The damper blades are yieldingly biased toward the closed position as shown in solid lines in FIGS. 2 and 3 by means such as the weight indicated at 82 (FIG. 2). The direction of air flow is indicated by the arrows in FIGS. 2 and 3. A lever arm 84 is rigidly mounted on shaft 74, and the weight 82 is adjustably mounted on the lever arm 84. This may be accomplished by providing a cut-out in the weight 82 through which the lever arm is slidably received, and threading a set screw 86 into the weight to bear against the arm and lock the weight in any predetermined position on the arm. As the amount of biasing force exerted is dependent upon the product of weight multiplied by the length of the lever arm, the force tending to move the blades toward their closed position may be easily and effectively varied by repositioning the weight 82 on the lever arm 84. Of course, as will be obvious to one skilled in the art, the blades could be biased hydraulically, pneumatically or electrically instead of by the weight as shown.

Referring to FIG. 2, the burner assembly is schematically shown at 26. As can be seen, the vertically disposed frame members 51 and 52 are spaced laterally from the edges of the burner tubes, providing an open space adjacent the burner through which air may freely flow. Thus, even if the damper blades are tightly closed, the duct 10 is not completely blocked, and some air in addition to that received within the burner tubes is allowed to by-pass the damper 40.

In the fuel gas fired heater shown in the drawings, the output of the heater is varied merely by varying the rate of supply of fuel gas to the manifold assembly 28. The rate of flow of air through the burner assembly 26 should remain substantially constant during variation in the firing rate of the heater. Thus, the rate of flow of air through each of the burner tubes 38 remains the same throughout the range of operation of the heater. For example, if it is desired to operate the heater at one-half capacity, fuel gas will be delivered through the manifold tube 32 to the lower half of the burner tubes 38, wherein fuel gas and air will be mixed to provide a combustible mixture which will burn at the downstream end 30 of the tubes 38 that are operative. Although no fuel gas will be delivered to the upper one-half of the burner tubes 38,

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air will flow through such tubes at the same rate it does through the operative tubes. Variation in the firing rate of the heater may then be accomplished by merely varying the rate of fuel gas delivery to the manifold assembly 28, while the rate of flow of air to the burner assembly 26 remains constant.

While it is necessary to retain the rate of flow of air through the burner assembly 26 constant throughout the operating range of the heater, there are various factors that may operate to change the total rate of flow of air through the heater or the duct 10. The blower 16 could, for example, be a multi-speed blower, in which case the air flow would be dependent on the blower speed. If the system is provided with air filters (not shown) to insure dirt free air being delivered to the space to be heated, the filters may become clogged with dirt and dust, which would result in a variation in the flow. The presence of any kind of an obstruction in the duct system of the heater would likewise cause a variation in the flow of air through the system.

In conventional fuel gas fired heaters, variations in the rate of air flow through the system cause a corresponding variation in the rate of flow through the burner assembly itself, with a consequent variation in the pressure drop across the burner. If the rate of flow of air through the burner varies, the air-gas ratio in the burner will change, and complete combustion will not be achieved. By providing the novel construction disclosed herein, the ideal air-gas ratio in the burner is retained substantially constant under all conditions, and complete combustion is assured.

Supposing, for example, that under ideal conditions, with blower 16 operating at full capacity, and with no obstructions to affect the flow through duct 10, that the desired pressure drop across the burner 26 is achieved when the damper blades are wide open, as shown in phantom lines in FIG. 2 and by the dotted lines in FIG. 3. Weight 82 is selectively positioned along lever 84 and locked by set screw 86 at that point which will just barely retain the damper wide open under those conditions. Therefore, when blower 16 is rotated at full speed by motor 18, the pressure of the air induced to flow through duct 10 in the direction of the arrows, will act against the damper blades to shift them to their fully open positions. As the blades are connected together by the linkage 78 and shaft 74 for conjoint movement, each blade will be fully open. If for any reason, such as variation in blower speed, clogged air filters, obstruction of opening 12, or the like, the rate of flow of air through the duct 10 is lessened, the pressure of the air against the damper blades will be correspondingly reduced, and the blades will move toward their closed position under the biasing influence of the weight 82. This of course reduces the effective cross sectional area of the duct 10 in direct relation to the reduction in air pressure against the blades of damper 40, so that the rate of flow of air through the burner 26 and the pressure drop thereacross remains substantially constant. The proper air-gas ratio is thus maintained in the burner, and complete combustion is achieved. The term combustion air, as it is used herein, refers to that air which actually passes through the burner. The remainder of the air flowing through the heater may be appropriately referred to as air of dilution. Thus it is the rate of flow of combustion air which must be retained substantially constant to assure an ideal air-gas ratio under all operating conditions.

What I claim is:

1. In a fuel gas fired heater: means for inducing a flow of air through said heater; means for delivering fuel gas to said heater under pressure; a burner defining a plurality of burner port openings for receiving and dividing a portion of said air into a plurality of individual combustion air streams and gas escape orifice means for introducing fuel gas into said air streams; and a movable air control damper supported in said heater alongside of said

burner in said air stream, and including means yieldingly biasing the damper to a normally closed position preventing said flow of air from by-passing said burner, said damper responsive to increased air pressure thereagainst to be shifted to progressively more open positions permitting increasing amounts of air flowing through the heater to by-pass said burner in direct proportion to the increase in air pressure differential across said damper to thereby maintain the rate of flow of said combustion air through said burner port openings substantially constant during variations in the total rate of flow of air through said heater.

2. In a fuel gas fired heater, a duct; means for inducing a flow of air through the duct; a burner in said duct having burner port opening means adapted to receive combustion air flowing through the duct; means for delivering fuel gas to said burner including gas discharge orifice means for directing fuel gas into the combustion air in the burner to provide a combustible air-gas mixture; and means for maintaining the rate of flow of combustion air to said burner substantially constant, said means including a movable air damper supported in the duct immediately laterally adjacent said burner, and biasing means yieldingly urging said damper to a normally closed position blocking the flow of air by-passing said burner, and movable to progressively more open positions in response to increased air pressure differential thereacross to thereby vary the open area of the duct adjacent the burner in direct proportion to the rate of flow of air through said duct.

3. In a fuel gas fired heater, a duct; means for inducing a flow of air through said duct; fuel gas delivery means for supplying fuel gas under pressure to said heater; a burner including a burner member coupled to said fuel gas delivery means and adapted to receive and mix together fuel gas and combustion air to provide a combustible mixture; means for maintaining the rate of flow of combustion air through said burner substantially constant, said means including an air damper positioned in said duct immediately adjacent said burner and movable between open and closed positions to vary the effective open cross-sectional area of the duct, damper control means connected to said damper and responsive to variations in the rate of flow of air through said duct at said burner member to reposition said damper in direct relation to the air pressure differential across said damper to thereby maintain the rate of flow of combustion air through said burner member substantially constant throughout variations in the total rate of flow of air through the duct.

4. In a fuel gas fired heater: an air supply duct; means for inducing a flow of air through said duct; fuel gas delivery means for delivering fuel gas under pressure to said heater; a burner member coupled to said fuel gas delivery means and defining burner port opening means arranged within said duct to receive combustion air and mix the fuel gas and combustion air together to provide a combustible mixture; an air damper extending across said duct immediately laterally adjacent said burner member; said damper including louvers movable between open and closed positions to vary the effective cross-sectional area of said duct adjacent said burner member; control means coupled to said louvers and yieldingly biasing the louvers to a closed position in opposition to the force exerted on the louvers by the pressure of the air stream flowing in said duct to thereby vary the effective open area of the duct at said burner member in direct relation to the static air pressure differential in the duct across said damper, whereby the rate of flow of combustion air through said burner port opening means is maintained substantially constant irrespective of variation in the total rate of flow of air through the duct.

5. A fuel gas fired heater comprising in combination: an air duct; means for inducing a flow of air through said duct; an air control damper positioned in said duct

for selectively varying the effective cross-sectional area of the duct and having an opening therein; a burner member positioned within said opening in the damper and defining a plurality of burner ports for receiving and dividing combustion air flowing through said damper opening into a plurality of individual combustion air streams; means for delivering fuel gas under pressure to said burner including gas escape orifice means arranged to direct fuel gas into said combustion air streams; said air damper including a plurality of movable blades connected together for conjoint movement; and biasing means operably connected to said blades and urging the blades toward a closed position blocking air flow by-passing said burner member, said biasing means yieldingly shiftable in response to increased air static pressure differential across said blades to permit shiftable movement of the blades to progressively more open positions in direct relation to the increase in air pressure differential to thereby maintain the rate of flow of combustion air through said burner ports substantially constant during variations in the rate of flow of air through said duct.

6. A fuel gas fired heater comprising, in combination: a duct; a blower for inducing a flow of air through the duct; a burner assembly defining a plurality of burner port openings positioned in the duct for receiving and dividing combustion air into a plurality of individual combustion air streams; a fuel gas delivery assembly including a fuel gas manifold and means for delivering fuel gas under pressure to the manifold and gas escape orifice means opening outwardly of the manifold to direct fuel gas into the individual combustion air streams; fuel gas control valve means for varying the rate of fuel gas delivery to said manifold; an air damper extending transversely across the duct and including a plurality of damper blades pivotally supported on opposite sides of said burner assembly substantially at the downstream end thereof, said damper blades being coupled together for conjoint pivotal movement between open and closed positions to vary the effective cross-sectional area of said duct; and means operatively connected to said damper and yieldingly biasing said damper blades to a normally closed position blocking said duct adjacent said burner assembly, said damper blades responsive to increased air pressure thereagainst being shifted counter the force exerted by said biasing means toward said open position permitting a portion of said air to flow through the duct by-passing said burner assembly, to thereby vary the effective cross-sectional area of the duct adjacent said burner assembly in direct proportion to the air static pressure differential across said damper and maintain the rate of flow of combustion air through said burner port openings substantially constant irrespective of variations in the total rate of flow of air through the duct.

7. The invention as defined in claim 6 characterized in that said burner port openings and said air damper are disposed in spaced relation transversely within said duct to provide an open area therebetween through which a portion of said air may freely flow by-passing both said burner port openings and said damper.

8. The invention as defined in claim 6 characterized in that said means yieldingly biasing said damper blades comprises a lever arm having a weight mounted thereon and adjustably positionable along the lever arm to selectively vary the biasing force exerted against the damper blades, and locking means for locking the weight in a predetermined position along said lever arm.

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75 JAMES W. WESTHAVER, *Primary Examiner.*