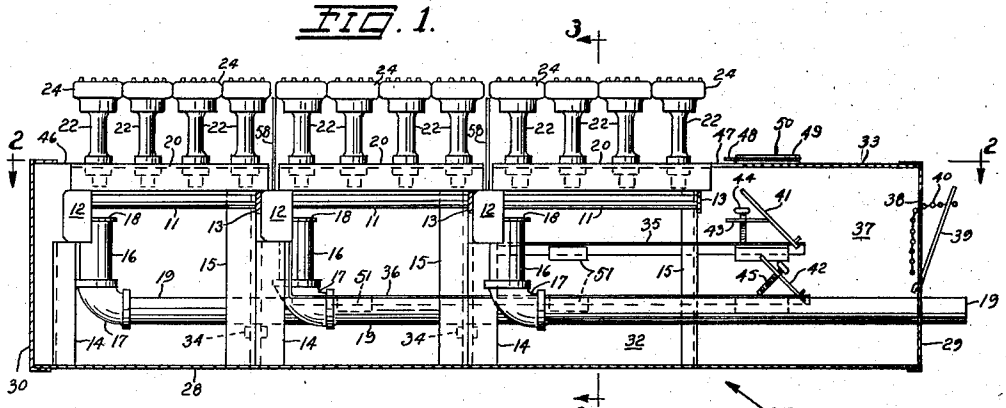
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GAS BURNER

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FIG. 1.



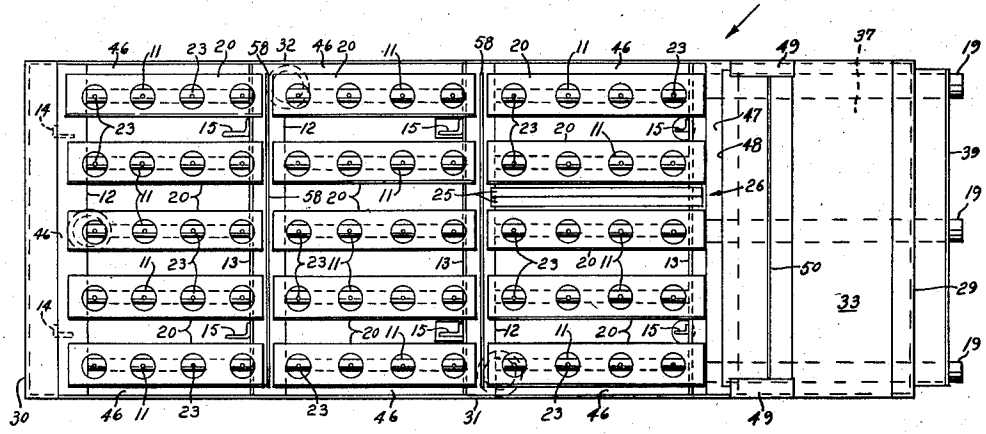


FIG. 2.

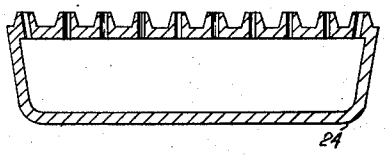


FIG. 5.

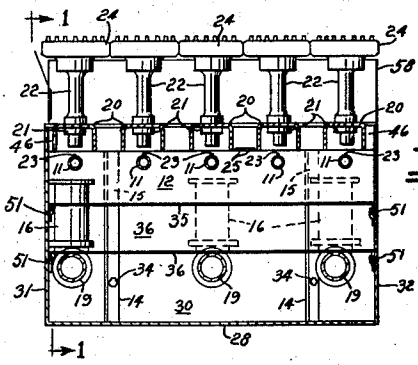


FIG. 3.

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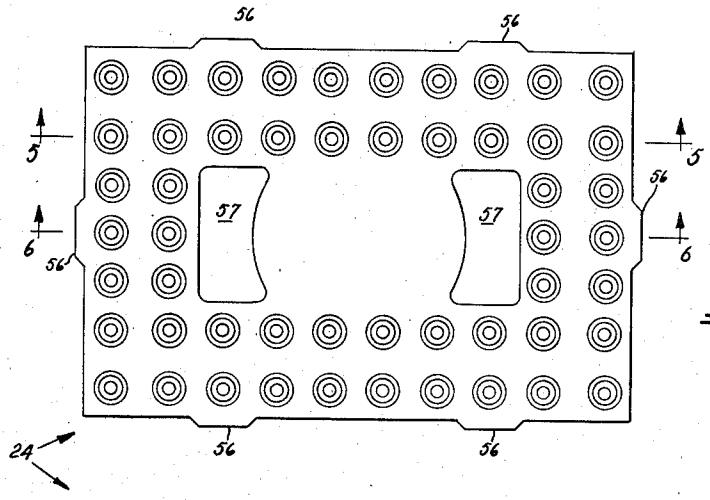


FIG. 4.

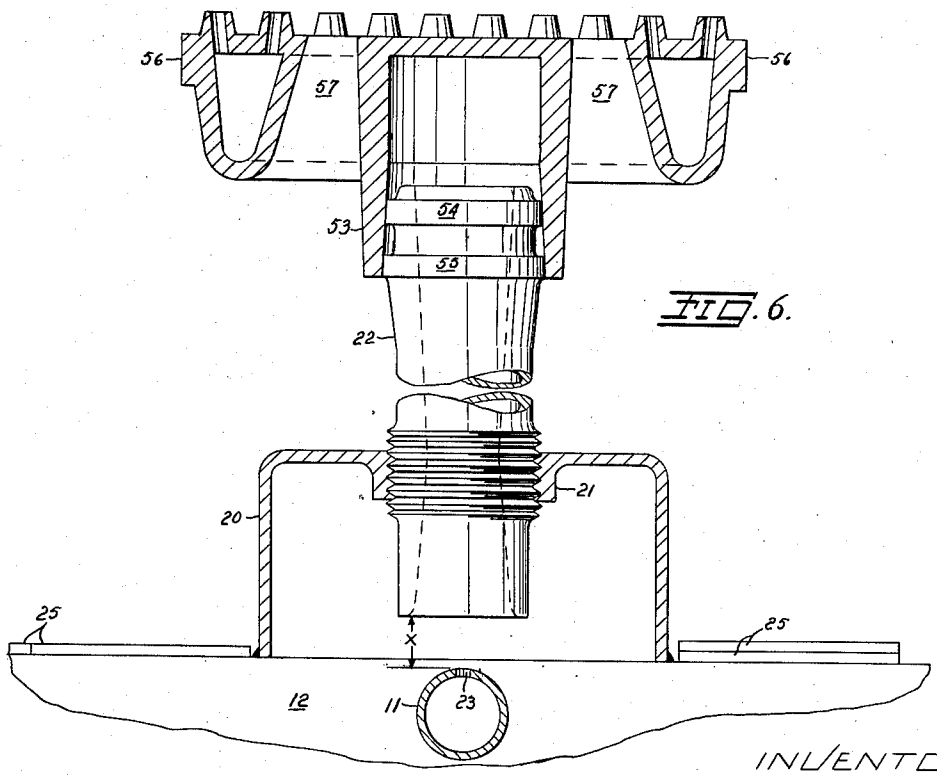


FIG. 6.

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GAS BURNER

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Application May 23, 1957, Serial No. 661,171

6 Claims. (Cl. 158—106)

This invention relates generally to commercial or industrial size gas burning equipment of the type in which multiple primary gas flames are jetted upwardly into a combustion chamber from a planar hearth interrupted by openings therethrough for the upward emission into the combustion chamber of secondary air streams for the purpose of completing the combustion in the combustion chamber of the gaseous fuel mixture in the primary gas flames.

More particularly, this invention relates to improved means for setting at one time, a desired primary fuel to air ratio for a primary group of said primary gas flames; to improved means for setting at one time a desired total fuel to air ratio for a secondary group of said primary groups of said primary gas flames; and to improved means for setting at one time the maximum rate of supply of combustion air to be supplied to all of said secondary groups of said primary groups of gas flames when the total fuel being supplied to all of said gas flames is at a preset maximum rate.

In the form here disclosed for the practice of my invention, for example only, my burner is shown as comprising a plane horizontal gas burner hearth in rectangular plane, the hearth being shown as divided into three longitudinally abutting sections each of which sections is made up of twenty rectangular cast iron burner heads each formed with a plurality of raised ports for the emission of a plurality of primary gas flames. Each of the primary burner heads are formed with secondary air passages therethrough and thereabout to assure a sufficient amount and distribution of secondary air emitted upwardly through the hearth to complete the combustion of fuel gas delivered to the combustion space solely through the raised ports of the burner heads.

A principal object of my invention is to provide precision means for adjusting the fuel to primary air ratio desired for each individual burner head of my burner.

Since my burner as shown is composed of three sections, for proper control of the total air as divided among the many sections of the hearth a separate total air conduit leads to each of the three sections of the burner and three control dampers would usually be required, one to control the total air to each of the respective three sections of the burner.

It is a second object of my invention to provide an improved means for controlling the total air supplied to my entire burner. This I accomplish by providing at the front of my burner to remain outside the limits of the furnace a plenum chamber having only one inlet damper which is adjustably positionable to control the rate of total air supply to my burner. Leading from the plenum chamber to each of the three major burner sections are three separate conduits from the plenum chamber. To adjust the distribution of the controlled total air from the plenum chamber to the three burner sections it is now only necessary to provide two of the three conduits with controllable dampers for since the total air flow rate is determined by the plenum chamber inlet damper

the two conduit dampers can be set to divide the total air to the three burner sections as desired. It is seen that where with three individual conduit dampers they would have to be carefully calibrated and synchronized to operate efficiently, with my arrangement the main damper can easily and quickly be used to accommodate the air supply to the furnace heat required while the two conduit dampers stand stationary to split the supplied air between the burner sections.

How these and other objects are attained is explained in the following description referring to the attached drawings in which—

Fig. 1 is a side elevation view in partial section of my burner, along the line **1—1** of Fig. 3.

Fig. 2 is a plan view along the line **2—2** of Fig. 1.

Fig. 3 is a front elevation view in partial section along the line **3—3** of Fig. 1.

Fig. 4 is a plan view of one only of the raised port burner heads from the hearth of my burner.

Fig. 5 is a sectional elevation of a burner head viewed along the line **5—5** of Fig. 4.

Fig. 6 is a fragmental vertical section of my burner as viewed anywhere along a line similar to **6—6** of Fig. 4.

Like numerals of reference refer to like parts in the several figures of the drawings.

Referring now to the drawings, it is seen that in each of the burner group sections of my burner the fuel gas handling structure is similar and comprises a group of five laterally spaced longitudinally extending parallel horizontal gas distributor tubes **11** having their entrance ends welded into a gas header **12** and their outer ends deadended by being welded to flat bar **13**. A pair of short laterally spaced steel angles **14** welded to the underside of header **12** form supporting legs therefor and a pair of longer laterally spaced steel angles **15** longitudinally aligned with legs **14** form supporting legs for bar **13** to which they are welded. A large pipe nipple **16** threaded into reducing pipe elbow **17** at its lower end is notched at its upper end, partially closed with welded plate **18** and sealed by welding into header **12** as shown so that in each section elbow **17**, nipple **16**, plate **18**, header **12** and five distributor tubes **11** form a fuel gas manifold fed from outside the furnace by its respective pipe **19**.

Each of the self supporting fuel gas manifolds is completed as a structural unit by the addition of five elongated inverse U-shaped muffles **20**, each longitudinally centered over a respective tube **11** and each welded at its respective ends to the top of a gas header **12** and a bar **13**. Spaced longitudinally along each of muffles **20** as shown are internally threaded depending collars **21** into each of which a burner tube **22** is threadedly positioned for vertical adjustment. Individual gas emission holes **23** concentrically placed under each of burner tubes **23** are sized for the type of gas and rate of gas emission required to supply one of the burner heads **24** with its maximum fuel requirement when the gas pressure in tubes **11** is at its normal operating value.

Lying with their ends or headers **12** and bars **13** in each space between muffles **20** are a pair of elongated damper blades **25** as shown typically in Fig. 6 and at **26** only in Fig. 2. As shown at **26** in Fig. 2 or on the left of muffle **20** in Fig. 6, blades **25** may be laid side by side substantially to close the open spaces between muffles **20**, or as shown on the right of muffle **20** in Fig. 6, blades **25** may be variably overlapped to leave up to half the space between muffles **20** open.

As described, my burner is shown to be made of substantially similar structures each supported independently on its own four legs **14** and **15**. Of course a single structure as described can be used as a simple one-section

burner but my invention is most valuably practiced as a multi-section burner and is here shown as a three section burner first assembled without burner tubes **22** and burner heads **24** into an air box **27** having a bottom wall **28**, a front wall **29**, a rear wall **30**, a left side wall **31**, a right side wall **32** and a partial top wall **33**. The three sections of my burner are independently stable structures but provision is made to fasten the independent sections securely together by bolting legs **14** of one section with the abutting legs **15** of the adjacent sections as indicated by bolts **34**, shown only in Figs. 1 and 3.

Shown in Figs. 1 and 3 are a pair of horizontal air baffles **35** and **36** spaced as shown to cooperate with other parts of the burner structure and the walls of box **27** to form individual air chambers each leading from the plenum chamber **37** at the front end of box **27**. Air under atmospheric pressure enters plenum chamber **37** through opening **38** in front wall **29** and with all other resistances to air flow being substantially constant the air flow through opening **38** will be governing by the position of main damper **39** hinged as shown on box front **29**, gravity biased to open position and limited to a preset maximum opening by chain **40** hooked into damper **39** and front **29**. The balancing of the air delivered from plenum **37** to each of the three burner sections is done by positioning section dampers **41** and **42** hinged as shown on baffles **35** and **36** respectively. Damper **41** includes clip **43** through which thumb screw **44** is threadedly positioned to control the flow of air to the front burner section and damper **42** includes thumb screw **45** threadedly positioned to control the flow of air to the center burner section.

Secondary air from box **27** is allowed to flow to the space above box **27** and surrounding burner tubes **22** through the open spaces **46** on the outside of muffles **20** and through the spaces between muffles **20** except as restricted by the positioning of manually positioned damper blades **25** located as typically shown at **26**.

Gas burners of the present type are often installed in furnaces of boilers having a water cooled front wall relatively close to the front row of burner heads. Such a setting will have a tendency to supply insufficient secondary air to the front row of burner heads for the reason that the cold wall will tend to cause a down draft of combustion products along the wall and these combustion products will tend to smother the flame from the adjacent row of burner heads. To correct this condition where it occurs I have found that an additional opening **47** in the top wall of box **27** is required to supply additional secondary air to this front row of burner heads. The size of opening **47** is adjusted while the burner is on a trial run by positioning sliding damper **48** slidingly secured to top wall **33** by clips **49** at each end of damper **48**. Cleat **50** is both a stiffener and a handle for damper **48**.

Air baffles **35**, **36** have downwardly turned lateral edges designed to engage clips **51** secured to side walls **31**, **32** on which baffles **35**, **36** are supported.

When the air box **27** has been placed in the furnace as desired and the burner structures have been placed therein and bolted together and the air control baffles and dampers installed, then the burner tubes **22** are threaded into the collars **21** of muffles **20** until, see Fig. 6, the lower ends of each of the burner tubes **22** are at a distance above its fuel gas emission orifice **23** in manifold gas tube **11** which has been found to be best for this particular size burner, for the particular kind of gas, for the particular type of load, and for the other conditions, like altitude, which have to be considered. Previous experience will usually be available to the installer so that the distance X, Fig. 6, can be closely and correctly set before starting up the burner. But should the wrong data be supplied or a setting be made under conditions not previously experienced a burning trial or two will lead the installer to the correct value of X. The ability precisely and variably to set the distance X in the field and to do it rapidly and correctly for each burner tube is a major improvement in this field.

When all of the tubes **22** have been vertically positioned as required, the outwardly tapered entrance to the downwardly depending fuel inlet collars **53** of burner heads **24** are slipped over the two spaced parallel conical bands **54**, **55** formed on the upper end of each of tubes **22** whereby the tapered fits will adequately seal and secure the burner heads **24** to tubes **22**. However the angle of the taper is such that it is easy to remove head **24** from tube **22** whenever desired. As shown in Figs. 1 and 3 when the burner is completely set up the heads **24** are substantially in lateral abutment to form an essentially plane hearth. Actually, however, heads **24** are formed with spacing bosses **56** on the sides thereof to space the burner heads so that secondary air will penetrate the hearth around each burner head as well as through the secondary gas passages **57** formed through each of the burner heads **24**. Secondary air baffles **58**, each resting on the top of a respective header **12** between the adjacent ends of the muffles **20** of the burner sections confine the flow of secondary air to the particular part of the hearth for which it is intended.

Pilot flames and ignition means for gas burners are well known in the art and form no part of this invention. Also many types of control devices and program equipments are available and may be used as desired.

I prefer to operate my burner either with an all-on, all-off control cycle or by the well known method of using the burner as a whole and simultaneously modulating the flow of gas and air to the entire burner in response to the heat load on the furnace in which the burner is installed. Taking for example, the latter case, a space thermostat or a boiler control or some similarly responsive means will be used to control simultaneously a power means for positioning total air damper **39** and a power means for positioning a gas control valve, not shown, which feeds all three zone feed pipes **19**. With a proper linkage well understood by workers in the art the same power means can be arranged to modulate simultaneously both the main gas control valve and total air damper **39**.

It is plain that with the total burner air feed controlled by main damper **39** and synchronized with the main gas valve to give a constant fuel air ratio for the overall burner as heat output of the burner is modulated, dampers **48**, **41** and **42** must be set to divide the total air equally among the three sections of the burners. Similarly trimming gas valves, not shown, in each of the pipes **19** must be set to divide the total gas equally among the three zones. Then in each section of the burner damper blades **25** will be set to assure a minimum of primary air to each burner head through its burner tube **22**. Under these conditions with the X dimension, see Fig. 6, properly chosen the fuel gas emitted from each hole **23** into the entrance of each burner tube **22** will take with it the proportionate amount of primary air to maintain what will be substantially a constant fuel to primary air ratio even though both the fuel and air are individually modulated over a wide range of heat output of the burner.

Having thus noted some of the objects of my invention, illustrated and described a preferred way in which my invention may be practiced and explained its operation, I claim:

1. Gas burning equipment of the type in which multiple primary gas flames are jetted upwardly into a combustion chamber from a planar hearth interrupted by openings therethrough for the upward emission into the combustion chamber of secondary air streams for the purpose of completing the combustion in the combustion chamber of the gaseous fuel mixture in the primary gas flames, said equipment comprising a plurality of sections and each of said sections comprising an independently supported fuel gas handling structure; an air conduit for supplying combustion air to said structure and a plu-

rality of burner head means for receiving said fuel gas from said gas handling structure, receiving said combustion air from said air conduit and controlling the combustion of said gas in said air; said fuel gas handling structure comprising a horizontal gas header, a first leg structure secured to said header for supporting said header, a plurality of laterally spaced parallel horizontal gas distributor tubes, each sealed respectively at one end into said header normal thereto to receive gas therefrom, a horizontal metal bar spaced parallel to said header and secured to said tubes to close the other ends thereof, a second leg structure secured to said bar for supporting said bar, a plurality of inverted U-shaped parallel laterally spaced horizontal air muffles each aligned with a respective one of said tubes over which said muffle is supported at its ends on said header and said bar and secured respectively thereon, said tubes being formed along their top centerlines in a desired pattern with fuel gas emission holes of a desired size and said muffles being formed in vertical alignment with each of said holes in said tubes with a hole therethrough bounded by a threaded collar.

2. The equipment of claim 1 in which said independently supported gas handling structure is laterally enclosed in said air conduit and forms a partial closure for a horizontal top opening in said conduit having substantially the plan size of said structure and in which said equipment includes a plurality of pairs of secondary air dampers positioned one pair between each spaced two of said air muffles to rest with their respective ends on said header and said bar, each of said pair of dampers being manually positionable to close in any desired degree the space between its adjacent air muffles.

3. The equipment of claim 2 including a plurality of vertical burner head tubes, each of said burner head tubes being threadedly engaged near its lower end in a respective one of said collars bounding said holes in said muffles and each of said burner head tubes terminating at its upper end in a burner head separable therefrom, said burner heads together forming a substantially continuous planar hearth interrupted by spaced ports for the emission of a mixture of fuel gas and primary air from the interior of said burner heads into said combustion chamber and interrupted by secondary air openings through and around said burner heads for supplying secondary air to said combustion chamber.

4. The equipment of claim 3 defining a combustion chamber and a secondary air chamber, said secondary air chamber being separated from said air conduit by said plurality of air muffles and said secondary air dampers and said secondary air chamber being separated from said combustion chamber by said planar hearth formed by a plurality of said burner heads.

5. A gas burner comprising an independently supported fuel gas handling structure, means for supplying raw fuel gas to said structure, means forming an air chamber, means for supplying combustion air to said air chamber, and a plurality of burner head means for receiving said

fuel gas from said structure, receiving said combustion air from said air chamber and controlling the combustion of said gas in said air: said structure comprising a plurality of spaced parallel horizontal gas distributor tubes, means for conducting said fuel gas to the interiors of said tubes, means for supporting said tubes within said air chamber, each of said tubes being perforated along its top wall centerline with spaced gas emission holes, a plurality of spaced parallel horizontal air muffles, each of said muffles being inverted U-shaped in section and supported horizontally over a respective one of said tubes in longitudinal alinement therewith, each of said muffles being formed in vertical alinement with each of the holes in its respective one of said tubes with an internally threaded collar having a vertical hole therethrough; the top of said air chamber being formed of said air muffles with secondary air openings from said chamber therebetween and a plurality of secondary air dampers adjustably positionable in said air openings to limit the size of said openings as desired; each of said burner head means comprising a hollow burner head gravitationally held on the top of a hollow vertical burner head tube externally threaded near its lower end and threadedly positioned as desired in one of said collars of one of said muffles in vertical axial alinement with one of said gas emission holes in one of said gas distributor tubes; whereby the rate of flow of primary air inducted into the lower end of one of said burner head tubes by the gas jetting therein through one of said gas emission holes in one of said distributor tubes is adjustably determined by the openings of said secondary dampers and the elevation of the lower end of the said one of said burner head tubes above the said one of said emission holes.

6. A multi-section gas burner having a combustion air plenum chamber and a number of combustion air conduits equal to the number of sections in said burner, each of said conduits leading from said plenum chamber to a respective one of said burner sections and a number of combustion air dampers equal to the number of said conduits, said plenum chamber being formed with an air inlet opening in a wall thereof, one of said dampers being adjustably positionable in said opening in said wall of said plenum chamber to control the rate of flow of the total of the combustion air fed to said burner and the others of said dampers being adjustably positioned respectively one each in all except one of said combustion air conduits to proportion as desired the rates of air flow from said plenum chamber to each of said burner sections.

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