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Grozegno et al.

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[54] **BURNER ASSEMBLY HAVING A TERTIARY AIR NOZZLE**

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[52] **U.S. Cl.** **431/184**

[51] **Int. Cl.**[2] **F23M 9/00**

[58] **Field of Search** 431/181, 182, 183, 184, 431/187, 188; 239/403, 404, 405, 406

[56] **References Cited**

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Attorney, Agent, or Firm—Marvin A. Naigur, Esq.; John E. Wilson, Esq.; Warren B. Kice, Esq.

[57] **ABSTRACT**

A burner assembly for mounting adjacent an opening in the wall of a furnace, including at least one fuel burner member disposed in a sleeve having an end portion terminating adjacent the opening. A first supply of combustion air for the fuel is directed from a location external of the sleeve toward the opening and a second supply of combustion air is introduced into the sleeve. A cup shaped insert is disposed in the sleeve for defining a nozzle having an annular discharge opening for discharging the second supply of air towards the stream of fuel discharging from the burner member.

9 Claims, 3 Drawing Figures

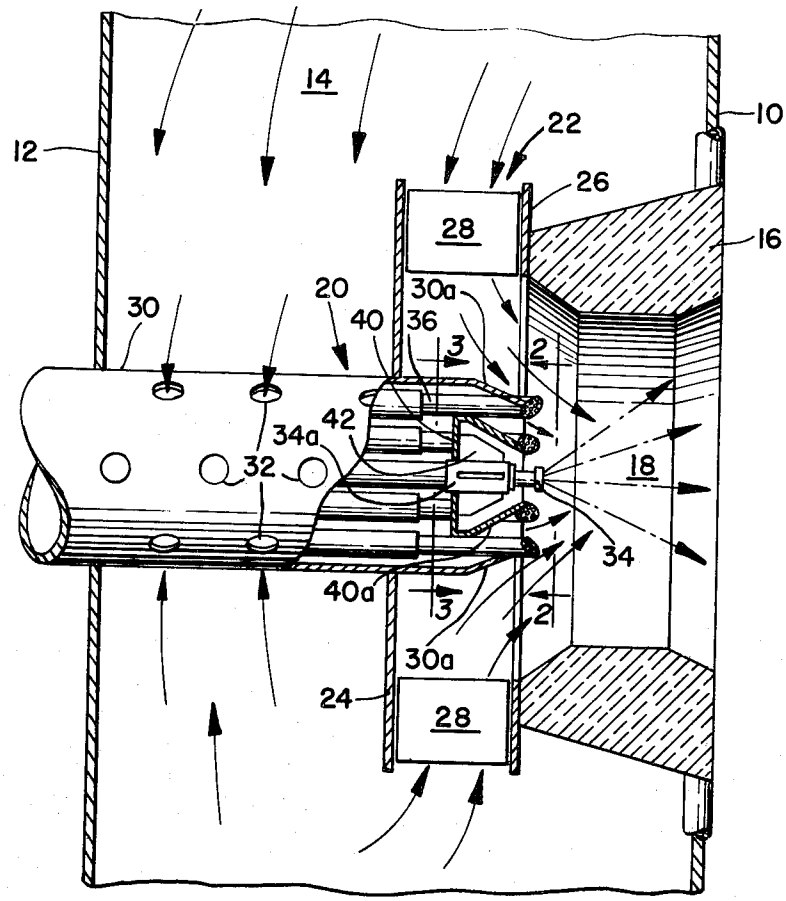


FIG. 1.

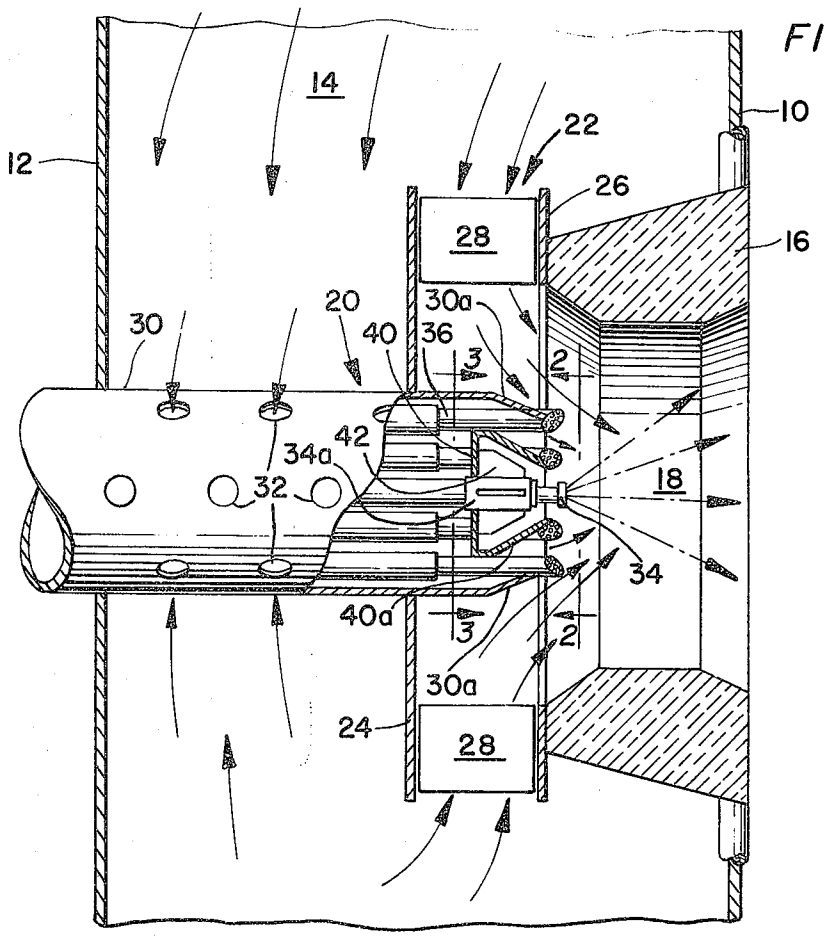


FIG. 2.

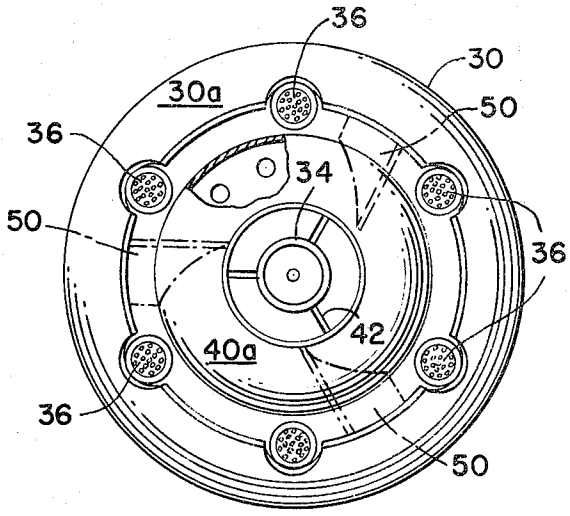
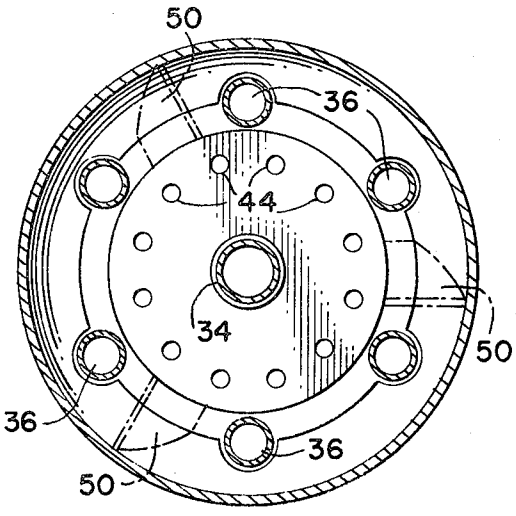


FIG. 3.



BURNER ASSEMBLY HAVING A TERTIARY AIR NOZZLE

BACKGROUND OF THE INVENTION

This invention relates to a burner assembly for use in a furnace or the like and, more particularly, to such an assembly in which two separate supplies of combustion air are directed toward the fuel stream discharging from a burner member.

In accordance with conventional designs of burner assemblies associated with relatively large installations such as the furnace portion of a vapor generator or the like, combustion air for the burner is discharged from a windbox towards the combustion zone, which is usually located in, or immediately adjacent to, an opening in the furnace wall. This air is commonly referred to as secondary air and usually comprises all, or at least a very large percentage of the total combustion air requirements for the burner. In some of these arrangements, an additional supply of air, commonly referred to as tertiary air, is introduced through the interior of the burner assembly for discharge towards the combustion zone. This tertiary air supplies a relatively low percentage of the complete combustion air requirements for the burner such as, for example, 1 percent.

In these type of designs, a spin is often imparted to the secondary air passing from the windbox towards the opening in the furnace wall in the vicinity of the fuel burner member in order to increase its turbulence and produce a hotter combustion zone. As a result of this spin, a low pressure zone is created in the immediate vicinity of the burner tip to increase flame stability in this area. The tertiary air is normally routed either directly into one end of the sleeve or from a duct connecting the windbox to the sleeve and passes directly through the sleeve to the low pressure zone for aiding combustion in this zone.

However, these designs have proven disadvantageous when applied to installations in which the burner assemblies and their associated components are very large. In particular, as the size of the units increase, relatively large holes or gaps occur in the center of the vortex created by the spinning secondary air, thus causing improper combustion and related problems. Also, with the recent emphasis placed on reducing air pollutants, and especially nitric oxides resulting from the combustion at the burner, some burners have been operated in an off-stoichiometric mode, i.e. with the combustion air delivered to the burners being less than the theoretical amount to support complete combustion, and often as low as 75 percent of this amount. Although reducing the formation of nitric oxides, this type of operation has also resulted in flame pulsations and vibrations, which often cannot be overcome by supplying tertiary air to the combustion zone in the traditional manner discussed above.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide a burner assembly for relatively large installations which can operate at off-stoichiometric conditions while minimizing flame pulsations and vibrations.

It is a further object of the present invention to provide a burner assembly of the above type which includes means defining a nozzle within the sleeve portion of the burner assembly for discharging the tertiary air in a particular pattern.

It is a still further object of the present invention to provide a burner assembly incorporating a cup-shaped insert cooperating with an outer sleeve to define a discharge nozzle for the tertiary air having an annular discharge opening directed toward the axis of the fuel stream from the burner.

Toward the fulfillment of these and other objects, the burner assembly of the present invention comprises a sleeve having an end portion terminating adjacent said opening, at least one fuel burner member disposed in said sleeve and adapted to discharge a stream of fuel towards said opening, means for introducing a second supply of combustion air for said fuel into said sleeve for discharge from said end portion towards said opening, and means cooperating with said sleeve for directing said second supply of air from said sleeve towards said fuel stream.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view depicting a burner assembly incorporating features of the present invention; and

FIGS. 2 and 3 are enlarged sectional views taken along the lines 2—2 and 3—3, respectively, of FIG. 1 and incorporating an alternate feature of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The assembly of the present invention will be described in connection with a vapor generator for the purposes of example, with the reference numeral **10** in FIG. 1 of the drawings referring to a fin tube wall which forms a portion of the furnace section of the generator.

A casing wall **12** cooperates with the fin tube wall **10** to define an interior portion **14**, it being understood that the latter is bounded by upper and lower walls, as viewed in FIG. **1**, to define an enclosure, or windbox, which receives air from a source, such as a fan (not shown), with the direction of the air flow being shown in general by the solid flow arrows in FIG. **1**.

An annular refractory collar **16** extends in an opening formed in the fin tube wall **10** with its inner surface being shaped to define a throat portion surrounding a combustion zone **18**.

A burner assembly, shown in general by the reference numeral **20**, extends through the casing wall **12**, with one end of the assembly terminating substantially near the leading end of the collar **16**. The burner assembly **20** is supported in a coaxial relationship to the collar **16** by the casing wall **12** and by a register assembly fixed relative to the collar and shown in general by the reference numeral **22**. The latter assembly **22** is formed by a pair of spaced plates **24** and **26** having central openings formed therein through which the burner assembly **20** extends. The central opening in the plate **24** is sized so as to support the burner assembly **20** with a minimum clearance, while the central opening in the plate **26** is larger than the outer diameter of the burner assembly to permit air flow, as will be described in detail.

A plurality of vanes **28** are journalled between the two plates **24** and **26** of the register assembly **22** for pivotal movement with respect thereto. Although only two vanes **28** are shown in FIG. **1**, it is understood that several additional vanes are disposed in a circular relationship around the burner assembly **20**. Although not

shown in the drawings, it is understood that the angular position of the vanes **28** may be adjustable by cranks or the like, in order to direct the air in a particular path through the register assembly **22** and through the enlarged central opening in the plate **26** to the combustion zone **18.**

Referring specifically to FIGS. **1–3,** the burner assembly comprises an outer tubular sleeve **30** having its leading end portion **30***a* bent radially inwardly. A plurality of spaced openings **32** are formed through the wall of the sleeve **30** for emitting air from the windbox **14** into the interior of the sleeve. A primary fuel gun, or burner, **34** is supported within the sleeve **30** in a coaxial relationship thereto and is adapted to discharge a stream of fuel towards the combustion zone **18** in a substantially conically shaped discharge pattern as shown by the dashed flow arrows in FIG. **1.** A plurality of auxiliary fuel guns, or burners, **36** are disposed in a radially spaced relationship from the gun **34** and extend along a circle as better shown in FIGS. **2** and **3.** These guns are for the purpose of discharging another fuel towards the combustion zone **18** which can serve as a primary fuel or as a startup, or auxiliary, fuel. As an example of the types of fuels that can be utilized in the burner assembly of the present invention, oil could be used in the gun **34** as a primary fuel, and gas could be used in the guns **36** for the purpose of burning in conjunction with the oil. Although not shown in the drawings, it is understood that an igniter gun and a flame detector, or scanner, can also be supported in the sleeve **20,** for operation in a conventional manner.

A substantially cup-shaped insert **40** is disposed within the leading end portion of the sleeve **30** and includes an inwardly bent wall portion **40***a* extending slightly divergent to the wall portion **30***a* of the sleeve **30,** to define a discharge nozzle portion having an annular flow and discharge path for the air admitted into the sleeve **30** through the openings **32.** A plurality of web portions **42** connect the insert **40** to the gun support sleeve **34***a* for the purpose of supporting the insert within the sleeve **30.**

As better shown in FIG. **3,** a plurality of openings **44** extend through the base portion of the insert **40** for allowing a small portion of air entering the interior of the sleeve **30** through the openings **32** to bleed directly to the combustion zone **18.**

In operation, the angular position of the vanes **28** may be adjusted to impart a spin to the air passing from the windbox **14** through the register assembly **22** and the opening in the plate **26** to the combustion zone **18.** As a result of the spin imparted to the air, a vortex is created in the central portion of the combustion zone to define a low pressure area for the flame resulting from ignition of the fuel discharging from the gun **34.** A large percentage of the air passing through the openings **32** into the sleeve **30** passes through the annular discharge opening of the nozzle defined between the cooperating wall portions **30***a* and **40***a* of the sleeve and insert **30** and **40,** respectively, and towards the central or axial portion of the fuel discharge pattern from the gun **34.** The remaining, relatively small, portion of the air passing through the openings **32** into the sleeve **30** passes directly through the openings **44** to the combustion zone **18.** It is understood that the design is such that the total supply of tertiary air entering the interior of the sleeve through the openings **32** is relatively high, such as 10 percent of the total air supplied to the combustion zone **18.**

It can be appreciated that in relatively large installations in which the vortex created by the air from the register **22** spinning around the combustion zone **18** is relatively large, that the tertiary air passing through the interior of the sleeve **30** will supply the remaining air needed for optimum combustion. Especially in situations in which the burner assembly is operated in an off-stoichiometric mode, i.e. in which the total air input to the combustion zone **18** is less than the theoretical amount required for complete combustion, the supply of the tertiary air to the combustion zone in the foregoing manner maintains the flame from the combusting fuel from the gun **34** close to its tip and reduces turbulence in the flame envelope, thus preventing flame front pulsations with possible troublesome vibrations. This, in turn, further reduces the formation of pollutants, primarily in the form of nitric oxides, generated in the flame envelope.

Also, it has been discovered that with the arrangement of the present invention the ignition of the fuel from the gun **34** starts at the outside of the flame envelope in the combustion zone **18** and doesn't burn completely out until the fuel is further out into the furnace. As a result, a longer and more even burning of the fuel is achieved, which further contributes to a lower flame temperature and a reduction of nitric oxides.

According to an alternate feature of the present invention, a plurality of swirl vanes, shown in FIGS. **2** and **3** by the dashed lines and by the reference numerals **50,** can be provided to impart a swirling effect to the tertiary air discharging from the nozzle defined between the wall portions **30***a* and **40***a* of the sleeve **30** and insert **40,** respectively. In this connection, the swirl vanes are disposed between the wall portions **30***a* and **40***a* and extend at an acute angle with respect to the axis of the assembly. It has been discovered that the swirling effect imparted to the air as in discharges from the nozzle holds the flame in the combustion zone **18** at the vicinity of the tip of the burner **34** and thus permits the advantages discussed above, yet reduces the total quantity of air that must be supplied to the combustion zone.

It is noted that when operating in the off-stoichiometric mode as discussed above, the remaining air required for complete theoretical combustion can be supplied to the interior of the furnace through overfire ports or idle burner openings, which are not shown in the above drawings.

Of course, variations of the specific construction and arrangement of the burner assembly disclosed above can be made by those skilled in the art without departing from the invention as defined in the appended claims.

What is claimed is:

1. A burner assembly for mounting adjacent an opening in the wall of a furnace, comprising a collar having one end portion extending in said wall opening, another end portion located externally of said furnace, and a through opening communicating with the interior of said furnace, a sleeve disposed externally of said furnace and having an end portion cooperating with said other end portion of said collar to define a first annular flow passage communicating with said collar opening, a substantially cup-shaped insert disposed in said sleeve with the base of said insert disposed inwardly from said end portion of said sleeve and having a plurality of

openings extending therethrough, the wall of said insert cooperating with said end portion of said sleeve to define a second annular flow passage communicating with said collar opening, at least one burner member disposed in said sleeve and adapted to discharge a stream of fuel into said collar opening, and windbox means surrounding said end portion of said sleeve and communicating with said first flow passage for receiving air and directing same to said first flow passage for passage to said collar opening, said sleeve having a plurality of openings extending therethrough for directing air through said second flow passage and through said openings in said base of said insert, for passage to said collar opening.

2. The assembly of claim **1** wherein said burner member is coaxially disposed relative to said sleeve and wherein said flow passages direct air towards the axes of said burner member and said sleeve.

3. The assembly of claim **2** wherein a portion of the wall of said insert and said end portion of said sleeve extend at an angle to said axes to direct air towards said axes.

4. The assembly of claim **1** further comprising means disposed in said first flow passage for swirling air as it discharges to said collar opening.

5. The assembly of claim **1** further comprising register means disposed in said windbox and surrounding said end portion of said sleeve, said register means communicating with said first flow passage for directing air to said first flow passage, and vane means disposed in said register means for varying the flow path of air through said register means and to said first flow passage.

6. The assembly of claim **1** wherein a first burner member extends in a coaxial relationship with said sleeve and a plurality of additional burner members are disposed in a radially spaced relationship to said first burner member and are spaced along a circle.

7. The assembly of claim **6** wherein said first burner member is adapted to discharge a fuel that is different from the fuel discharged by said additional burner members.

8. The assembly of claim **1** wherein the amount of air passing through the openings in said sleeve is approximately 10% of the total amount of air passed to said collar opening.

9. The assembly of claim **1** wherein the total amount of air passed to said collar opening is less than the theoretical amount required for complete combustion.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,897,199 Dated July 29, 1975

Inventor(s) Walter P. Gorzegno

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Inventor's name should read -- Walter P. Gorzegno --.

Signed and Sealed this

twenty-seventh Day of *January 1976*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks