March 23, 1965 R. A. VON LINDE 3,174,526

ATOMIZING BURNER UNIT

Filed Aug. 23, 1960 2 Sheets-Sheet 1

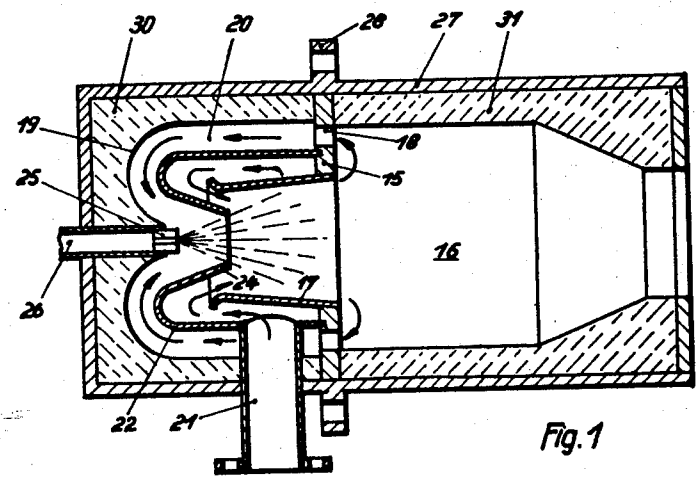
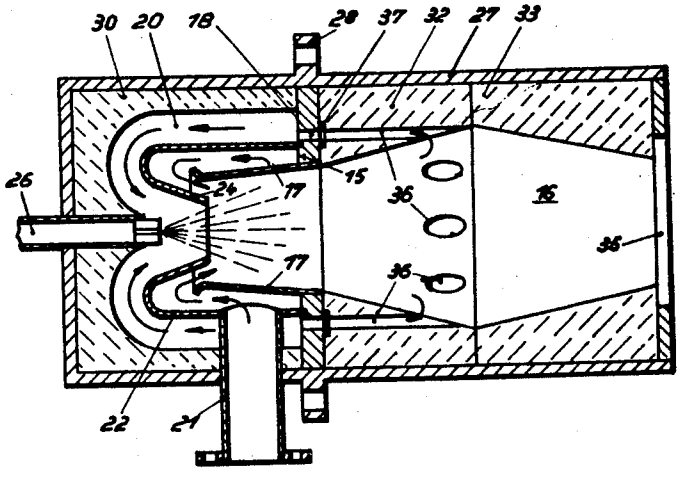


Fig. 1

Fig. 2



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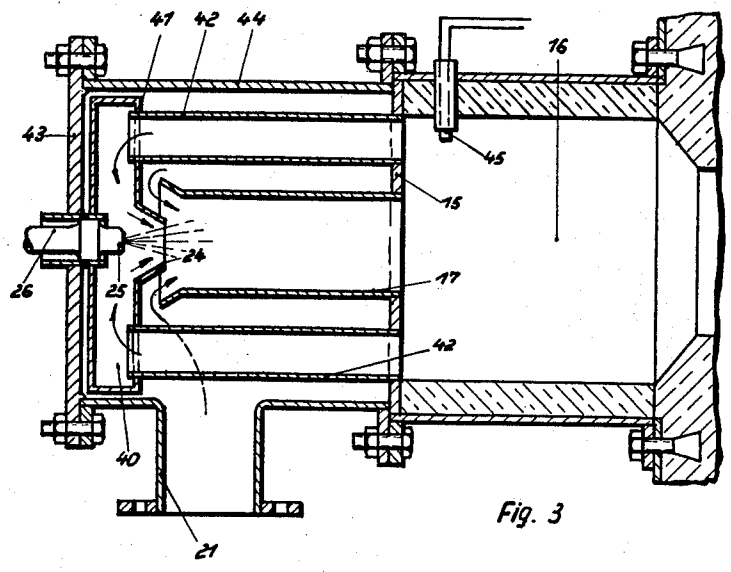
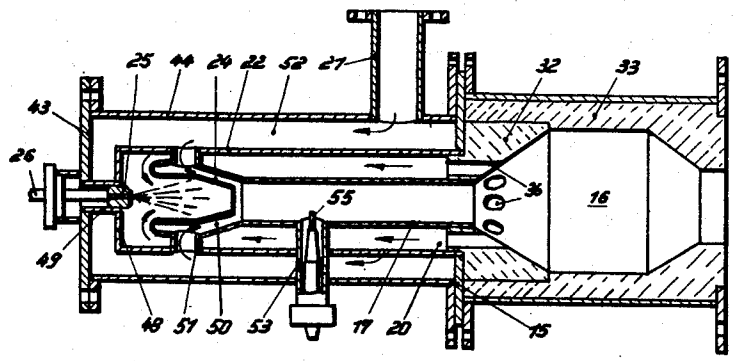


Fig. 3

Fig. 4



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ATOMIZING BURNER UNIT

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The present invention relates to an atomizing burner, especially for fluid fuels, provided with a burner pipe or mixing tube in which the combustion air supplied at relatively high velocities absorbs the finely divided fuel supplied thereto and additionally draws or sucks in hot combustion gases from a chamber in open communication with the combustion space.

With the known burners of this general type, the atomizing nozzle is so arranged that the fluid fuel is atomized within the combustion air stream which is surrounded by a gaseous envelope consisting of drawn-back or sucked-back combustion gases.

These combustion gases, the thermal contents of which could contribute very significantly to the rapid evaporation and preparation of the fuel mist, therefore, intermix themselves in the known prior art burners only subsequently with the fuel suspended in the combustion air and, therefore, can fulfill only incompletely the tasks assigned thereto. It is true that by preheating the combustion air, the preparation of the fuel may be improved considerably; however, the heat exchanger installation required therefor would increase considerably the cost of such an installation.

These disadvantages are avoided in the present invention by arranging the fuel atomizing nozzle in a prechamber, to which is supplied, in accordance with the present invention, the part of the combustion gases taken from the combustion chamber, and by discharging or terminating this prechamber in a mixing nozzle to which is admitted the combustion air. With such an arrangement, the combustion gases drawn or sucked-back to the mixing nozzle may give off the thermal contents thereof at relatively high temperatures directly to the fuel mist whereby a very rapid and complete evaporation and preparation of the fuel, as well as an advantageous mixture formation and therewith a very short and clear flame, i.e., a flame free of carbon black or soot, is formed.

These properties are also assured in case when a mixture very rich in combustible contents or constituents is supplied to the burner. Consequently, with the burner according to the present invention not only very high combustion temperatures may be achieved, which are of particularly great value with industrial furnaces, for example, for smelting or forging furnaces or the like, but also gas mixtures may be produced thereby with equally good combustion which, by reason of the large contents in reducing effective component parts form a suitable furnace atmosphere for the heat treatment, for instance, of work tools.

Accordingly, it is an object of the present invention to provide a burner of the type mentioned hereinabove which eliminates the aforementioned disadvantages encountered in the prior art devices and which additionally improves the combustion characteristics thereof.

Another object of the present invention is the provision of an atomizing burner in which the preparation of the fuel is considerably improved in a simple manner and without the necessity of relatively expensive installations such as heat exchangers.

Another object of the present invention resides in the provision of an atomizing burner arrangement in which optimum use is made of the thermal contents of the combustion gases drawn back from the combustion chamber into the atomizing unit so as to increase the rapidity and quality of the fuel preparation.

Still another object of the present invention resides in the provision of an atomizing burner arrangement in which an advantageous mixture formation is assured with a minimum of impurities in the resulting flame so as to render the gas mixtures produced thereby particularly suitable as reduction-effective atmosphere for furnaces.

A further object of the present invention resides in the provision of an atomizing burner which produces a gas mixture containing relatively large contents in reducing components appropriate for the heat treatment of work tools.

These and further objects, features and advantages of the present invention will become more obvious from the following description when taken in connection with the accompanying drawing which shows, for purposes of illustration only, four embodiments in accordance with the present invention and wherein:

FIGURE 1 is a cross-sectional view of a first embodiment of an atomizing burner in accordance with the present invention, and

FIGURES 2 through 4 are cross-sectional views, similar to FIGURE 1, of three further modified embodiments of atomizing burners in accordance with the present invention.

Referring now to the drawing, wherein like reference numerals are used throughout the various views to designate corresponding parts, and more particularly to the embodiment of FIGURE 1, reference numeral **16** designates therein a combustion chamber which is limited at one end thereof by an annularly shaped flange **15** of a mixing tube or burner pipe **17**. Apertures **18** are provided within the annular flange **15** which discharge into an annular space **20** limited at the front end thereof by a toroidal surface **19**. The inner boundary surface of this annular space **20** is constituted by the outer wall surface of an intermediate jacket or wall **22** to which is connected the air supply pipe or conduit **21** and which passes over into a mixing nozzle **24** arranged concentrically to the mixing tube or burner pipe **17**. A fuel supply line **26** provided with an atomizing nozzle **25** terminates in the mixing nozzle **24**. The wall **22** and the mixing pipe **17** define therebetween an annular channel to which is supplied combustion air through the pipe connecting member **21**. The combustion air thereby flows about the freely exposed end surface of the mixing pipe **17** into the mixing chamber formed by the pipe **17**. As a result of its flow energy, the combustion air draws in through the mixing nozzle **24** the combustion gases together with the combustible particles of the fuel distributed and prepared therein which are present in the prechamber **20** and continuously flow through the apertures **18** from the combustion space **16** into the prechamber **20**.

The annular space **20** forming a prechamber is surrounded by a ceramic hollow body **30** whereas the combustion chamber **16** is constituted by the hollow space of a fire-proof hollow body member **31**. The casing **27** of the burner is provided with a flange **28** by means of which the burner may be so secured at the edge of the firing aperture of a heat-consuming device (not illustrated), for example, of an industrial furnace or of a gas producer which serves for purposes of obtaining neutral or reducing gaseous atmospheres that the combustion chamber **16** extends into the firing space thereof.

The embodiment of FIGURE 2 distinguishes itself from the embodiment of FIGURE 1 essentially by the fact that the section of the combustion chamber **16** adjoining the mixing pipe or burner tube **17** is enlarged conically. This section is formed by the hollow space of a ceramic body **32**. In order to supply a partial stream of combustion gases, required within the meaning of the present invention for the mixture formation, from the combustion chamber **16** to the apertures **18** and therewith to annular

prechamber space 20, the hollow body member 32 is provided with several channels 36 which, on the one hand, terminate in the conical inner wall of the hollow body member 32 and, on the other, in an annular groove 37 facing the apertures 18. The combustion chamber 16 is closed off by a hollow conical portion formed by the surrounding casing part 33 which decreases in cross section in the direction toward the discharge aperture 35.

In the embodiment of FIGURE 3, one end each of several tubes 42 are inserted into the flange 15, and at the other end terminate and discharge into a prechamber 40 having an end wall 41 provided with a mixing nozzle 24. The atomizing nozzle 25 is arranged with an aperture of the other end wall of this prechamber 40. A hollow space defined by cylindrical casing 44 and an end wall 43 serves for purposes of guiding the combustion air which thereby absorbs heat from the combustion gases sucked in through the pipes 42 out of the combustion chamber 16 and, therefore, absorbs in a preheated condition the mixture consisting of fuel, mist and combustion gases. A spark plug 45 of known construction serves thereby for purposes of igniting the mixture.

In the burner embodiment illustrated in FIGURE 4, the mixing pipe 17 discharges into a conical section 32 of the combustion chamber 16. A plurality of annularly distributed channels 36 are thereby provided in the walls of this section 32. The channels 36 terminate in an annular cylindrical prechamber 20, the inner wall of which is constituted by the mixing pipe 17 and the outer wall of which is constituted by a jacket or wall 22. The wall 22 is secured at one end thereof at the annular flange 15 and at the other end thereof is closed off by means of an end wall 48 into which is inserted a connecting pipe 49 for the insertion therein of the fuel nozzle 25. The mixing pipe 17 thereby forms the forward portion of a chamber 50 into which extends a mixing nozzle 24 and which is in open communication by means of lateral hollow connecting conduit portions 51 with the cylindrical hollow space 52. The annular space 52 is thereby defined by the flange 15, by the end wall 43 and the cylinder jackets 22 and 44 which are provided with an air-supply connecting member 21. A tubular connecting member 53 extending in tight sealing arrangement through the tubular walls 44, 22 and 17 serves for the support of a spark plug 55. The hollow body section 32 consisting of ceramic material forms an inner insert for a hollow body 33 terminating the combustion chamber 16.

Operation

The burner in accordance with the present invention operates as follows:

The combustion air supplied through the connecting pipe 21 flows with relatively high velocity into the mixing pipe or burner tube 17 and produces thereby at the orifice of the connecting portion or mixing nozzle 24 a vacuum or underpressure. Consequently, a mixture-stream enters into the airstream which mixture-stream reaches the mixing nozzle 24 from the combustion chamber 16 along the path indicated by the arrows. This mixture-stream absorbs the fuel injected from the nozzle 25 in finely distributed form and forms in the first section of the mixing pipe a very hot core stream which mixes completely with the combustion air only shortly ahead of the end of the mixing pipe 17. By reason of the fact that the liquid fuel is injected directly into the hot drawn- or sucked-back combustion gases, a very homogeneous, well-prepared and, therefore, also completely unobjectionably burning mixture results therefrom which burns even with a shortage of air with a short constant flame without the formation of soot and carbon black, and which supplies a mixture usable as furnace atmosphere having a high content in reducing gas particles. If the stoichiometric quantity of air, i.e., the quantity of combustion air exactly necessary for complete combustion of the supplied fuel quantity, is supplied to the burner, there results the advantage in accordance with the present invention that relatively high flame temperatures may be readily attained.

The heat exchange between the sucked-back combustion gases and the combustion air obtained through the wall 22 (FIGURE 1) or through the walls of the pipes 42 (FIGURE 3) results in keeping the temperature of the combustion gases within the vicinity of the atomizing nozzle 25 within a limit favorable for the vaporization and preparation of the fuel mist. This is so as with excessive temperatures undesired side reactions may occur which may lead to a cracking of the fuel and thereby lead to the formation of soot, carbon black, or the like. On the other hand, this heat exchange is effective in such a manner that the combustion air also assumes a temperature favorable for the operation of the combustion process.

While I have shown and described four embodiments in accordance with the present invention, it is understood that the same is not limited thereto but is susceptible of many changes and modifications within the spirit and scope thereof, and I, therefore, do not wish to be limited to the details shown and described herein, but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

I claim:

1. An atomizing burner unit, especially for liquid fuels, comprising combustion chamber means, wall means forming prechamber means, means to enable combustion gases to pass from said combustion chamber means into said prechamber means, mixing pipe means in communication with said prechamber means, means for supplying combustion air at relatively high velocities to said mixing pipe means to thereby draw-in hot combustion gases from said combustion chamber means through said prechamber means into said mixing pipe means, said wall means including two essentially concentric wall parts surrounding said mixing pipe means constituting therebetween two hollow spaces disposed one about the other, of which the outer space forms said prechamber means in open communication with said combustion chamber means and the inner space forms a part of said means for supplying combustion air, a mixing nozzle portion secured to the inner one of said two essentially concentric wall parts and in communication with said mixing pipe means and fuel atomizing means for distributing finely divided fuel toward said mixing pipe means into the drawn-in combustion gases.

2. An atomizing burner unit, especially for liquid fuels, comprising combustion chamber means, wall means forming prechamber means terminating at one end thereof in mixing nozzle means and also forming mixing pipe means in communication with said mixing nozzle means, said prechamber means being in communication near the other end thereof with said combustion chamber means to enable combustion gases to flow from said combustion chamber means through said prechamber means into said mixing nozzle means, inducting means including combustion air supply means for supplying combustion air at relatively high velocities to said mixing pipe means to thereby draw-in hot combustion gases from said combustion chamber means through said prechamber means into said mixing pipe means by the flow energy in said combustion air, and fuel injection means arranged in said prechamber means for injecting finely divided fuel into said mixing nozzle means to be mixed therein with the drawn-in combustion gases prior to admixture thereof with said combustion air, said wall means including two concentrically arranged wall portions and a third wall portion forming said mixing pipe means, said two first-mentioned wall portions and said third wall portion forming therebetween two hollow spaces disposed one about the other, the outer of which constitutes a portion of said prechamber means and the inner of which constitutes a portion of said combustion air supply means.

3. An atomizing burner unit according to claim 2,

wherein said fuel injection means includes atomizing nozzle means arranged essentially concentrically to said mixing nozzle means.

4. An atomizing burner unit according to claim 2, wherein said mixing pipe means terminates in a section of said combustion chamber means which increases conically in cross section in the direction of flow of the combustion gases, said section having an inner wall provided with channels in communication with the prechamber means and with said combustion chamber means.

5. An atomizing burner unit, especially for liquid fuels, comprising combustion chamber means, wall means forming prechamber means terminating at one end thereof in mixing nozzle means and also forming mixing pipe means in communication with said mixing nozzle means, said prechamber means being in communication near the other end thereof with said combustion chamber means to enable combustion gases to flow from said combustion chamber means through said prechamber means into said mixing nozzle means, inducting means including combustion air supply means for supplying combustion air at relatively high velocities to said mixing pipe means to thereby draw-in hot combustion gases from said combustion chamber means through said prechamber means into said mixing pipe means by the flow energy in said combustion air, and fuel injection means arranged in said prechamber means for injecting finely divided fuel into said mixing nozzle means to be mixed therein with the drawn-in combustion gases prior to admixture thereof with said combustion air, said wall means including a first wall portion constituting an inner wall of said prechamber means and a second wall portion rigidly connected with said first wall portion and constituting said mixing nozzle means, and a third wall portion forming said mixing pipe means and defining in conjunction with said first and second wall portions a passage forming part of said air supply means,

said air supply means including an annular gap provided between said second and third wall portions for the admission of the combustion air into said mixing pipe means.

6. An atomizing burner unit comprising a mixing section having an upstream end, a mixing nozzle disposed essentially coaxially to and partially within said upstream end of said mixing section, a combustion section, return conduit means extending rearwardly from said combustion section into communication with said mixing nozzle to supply hot combustion gases essentially equally around the periphery of said mixing nozzle, fuel atomizing means disposed essentially coaxially to said mixing nozzle for dispersing finely divided fuel into the hot combustion gases passing through said mixing nozzle to vaporize said fuel prior to admixture with combustion air, said upstream end of said mixing section being spaced from said mixing nozzle to provide passage means therebetween, and conduit means for supplying combustion air into said passage means for educting hot combustion gases and dispersed fuel vaporizing therein from said mixing nozzle into said mixing section.

7. An atomizing burner unit according to claim 6, wherein said return conduit means include a plurality of spaced tubular members.

References Cited in the file of this patent

UNITED STATES PATENTS

687,535	Machlet	Nov. 26, 1901
2,048,321	Carruthers et al.	July 21, 1936
2,701,608	Johnson	Feb. 8, 1955
2,722,372	Edwards	Nov. 1, 1955
2,734,560	Harris et al.	Feb. 14, 1956

FOREIGN PATENTS

1,044,190	France	June 17, 1953