INDUSTRIAL GAS BURNER

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INDUSTRIAL GAS BURNER
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The present invention relates to industrial gas burners, and more particularly to a burner of this type which has been built into it for means for preheating the combustion air.

It is customary in many cases to use recuperators of one type or another to preheat the combustion air used in furnace burners. In all systems of which I am aware, the air for all burners is heated at a central point, and is then distributed to the various burners. An arrangement of this type requires a large amount of insulated piping which is both expensive and bulky.

It is an object of this invention to provide means for preheating the air for individual burners. It is a further object of the invention to withdraw heated products of combustion directly from a furnace and to pass them through a burner to preheat air being supplied to that burner.

It is further, and more specific, object of the invention to provide a burner that is so constructed that products of combustion in a furnace are withdrawn through the burner in heat exchange relation with combustion air that is being supplied through the burner.

In carrying out the invention, gas and air are supplied through concentric tubes to be discharged in a substantially radial direction in a cup-shaped cavity formed in a burner block. The gas and air mix as they are discharged into the cavity and burn along its surface to heat the same to incandescence. Hot products of combustion forming the atmosphere of a furnace chamber, in the wall of which the burner block is placed, having a natural involute pattern to the center of the gas and air discharge. These products of combustion are withdrawn through the center of the gas and air tubes and in heat exchange relation therewith. Preferably some means is provided to control the withdrawal of the products of combustion through the burner tubes, and thereby the degree of preheat that is obtained.

It is, therefore, a further object of the invention to provide furnace burners in which the amount of preheat for the air may be controlled individually for each burner used in a furnace.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

In the drawings:
FIG. 1 is a section through one form of the burner;
FIG. 2 is the end view of the fuel distributor looking from the left in FIG. 1;
FIG. 3 is a section taken on line 3—3 of FIG. 1; and
FIG. 4 is a section of the discharge end of a modified form of the burner.

Referring to the drawings, there is shown a refractory block 4 of high temperature ceramic material that is built into a furnace wall and forms a portion thereof. This block is provided on its furnace face with a cup or depression 2 that has concentric with its base an opening 3 extending through the block. This opening forms a continuation of an opening that is provided through the remainder of the furnace wall in which the block is set. A fuel and air distributor member 4 extends through the opening provided in the furnace wall and may be of any length depending upon the thickness of this wall. The end of the distributor is received snugly in, and extends substantially to, the end of opening 3 with the end of the distributor projecting slightly into the base of the depression, as best shown in the drawing.

Distributor 4 includes a plurality of concentric tubes 5, 6, and 7. It is noted that the inner tube 7 has a plurality of radially extending heat exchange ribs 8 projecting from a portion of the length thereof. Outer tube 5 is provided at its left, or inner end, with a flange 9 extending radially inward therefrom, and the flange has a plurality of openings 11 forming discharge orifices drilled in it. These openings extend radially and at an angle to the axis of the tube. The outer or right end of tube 5 is provided with a threaded inlet opening 12 and a radially extending flange 13. Outer tube 5 is fastened to center tube 6 by means of bolts 14 which extend through flange 13 and a second flange 15 that is suitably welded to the surface of tube 6. It is noted that a gasket 16 is used between the two flanges in order to form a gas tight connection, since space 17 between tubes 5 and 6 is the gas passage of the burner.

Central tube 6 has attached to its inner end by a set screw 20 or other suitable means, a hollow cylindrical member 18 that is provided with its outer surface with a plurality of helically extending ribs 19. The spaces between these ribs form helical air passages 21 through which air is discharged into the burner cup. The outer end of tube 6 has suitably attached thereto a casting 22 that is provided with a threaded inlet 23.

Center tube 7 is received concentrically in tube 6 and is supported therein by ribs 8 as well as by a sealing nut 24 which serves to hold this tube in position both axially and radially, of tube 6 and casting 22. A nozzle 25 extends into tube 7 and is directed rearwardly for a purpose to be described. This nozzle can be located in the restricted throat of a venturi-shaped insert 26 if it is so desired.

In the assembly of the burner, the inner end of tube 6 abuts against the back surface of flange 9 to form annular space 17 which communicates with discharge openings 11, and these parts are held in position by the attachment between flanges 13 and 15. The distributor 4 itself is supported in any suitable manner in the opening in the furnace wall and burner block by attachments that can engage either tube 5 or casting 22. The burner is located axially of the furnace wall and block 1 in such a fashion that its inner end extends into the base of cup 2 as shown in the drawing. Inner tube 7 with its ribs 8 is moved against the rear end of cylindrical member 18 in order to form an annular air space between tubes 6 and 7 leading to the helical passages 21. It is noted that the ribs 8 on the surface of tube 7 extend substantially to the end of tube 6 so that the air space is divided into a plurality of axial passages communicating freely with the interior of casting 22.

In the operation of the burner, the gas is supplied through inlet 12 to space 17 and air is supplied through inlet 23 to casting 22. The gas and air in substantially stoichiometric proportions and under pressure flow through the respective passages and are discharged into cup 2. The swirling air moving in a helical path through passages 21 is thrown radially outwardly across the surface of the cup by centrifugal force and mixes with gas being discharged radially through ports 11. This mixing of the gases takes place to form a combustible mixture that burns along the surface of the depression to heat the same to incandescence. Hot products of combustion are discharged into the furnace chamber of which the burner block 1 forms a portion of the wall.

In view of the fact that the gas and air are being dis-
charged radially, a low pressure area is created at the center of the distributor tip, thus causing an involution of the gases from the radially outward edges of depression 2 and the furnace chamber toward the center of the distributor. Ordinarily these gases would be completely recirculated helping to increase the temperature of the products of combustion that are withdrawn through tube 7 in order to reduce their temperature. One means for accomplishing this is shown in FIG. 4. It will be seen by referring to that figure that the inner end of tube 7 does not engage the back of member 18 as it does in the previously described embodiment of the invention. This tube is also provided with a reduced extension 27 that extends through the bore of member 18 to a point adjacent to the end thereof. It will be noted that the inner end of member 18 extends radially inward to a point substantially overlying the end of extension 27.

This burner operates in exactly the same fashion as the previously described embodiment. In this case, however, a small portion of air being supplied to the burner is discharged between the inner surface of member 18 and the outer surface of extension 27. The air is then withdrawn through tube 7 along with the products of combustion and thereby temper them from overheating tube 7 and damaging the burner.

From the above description it will be seen that I have provided an industrial burner in which there is means to preheat the air as it is flowing through the burner. Thus, preheated air is obtained to increase the temperature and efficiency of the furnace operation without the necessity for a large recuperator. Furthermore, a construction of this type does away with the necessity for a great amount of piping that is required to bring preheated air to a plurality of individual burners that are located at various points on a furnace. In addition, the construction shown herein permits preheating of the air to various burners individually as required by their particular location in a furnace, the amount of preheating being determined by the velocity of air being discharged through nozzle 25. This can be adjusted readily by an individual valve (not shown) that is used in the supply line to the nozzle.

The burner of this invention operates in the same manner as a conventional radiant cup-type burner, in that it produces a large amount of radiation as well as hot products of combustion that are directed into a furnace chamber. The hot products of combustion must be exhaussted from the chamber in some fashion, and removing a portion of them through tube 7 of the individual burners is an excellent way to preheat air. The products of combustion discharged through tube 7, which are a relatively small proportion of the total volume of the furnace gases, may either be discharged to the atmosphere or may be piped to a suitable flue.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit and scope of the invention set forth in the appended claims, and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

What is claimed is:

1. In a burner for use in a furnace wall, the combination of a tubular element having an end adapted to extend into a furnace chamber, means forming a first annular space in said element terminating in said end in a ring of radially directed discharge orifices adjacent to the periphery of said end, means forming a second annular space in said element terminating in a plurality of helically directed passages located in a ring within said ring of orifices, means in said element forming a passage extending from said end and concentric within said second annular space, means to supply fuel gas to said first mentioned annular space, means to supply combustion air to said second annular space, and means connected with said concentric passage to withdraw products of combustion through said concentric passage.

2. In a burner for use in a furnace wall, the combination of a refractory block having a cup-shaped depression in one surface thereof and an opening extending from the base of said depression to an opposite surface thereof, a fuel distributor extending through said opening with an end thereof adjacent to said base, means to supply air to said distributor, means in said distributor to discharge the air into said depression in a plurality of helically directed streams, whereby centrifugal force throws the air against the surface of said depression, means surrounding said air supply means to supply fuel gas to said distributor, means in the end of said distributor to direct the gas into said depression and plurality of helically directed streams to mix with the air and burn along the surface of said depression, means to withdraw products of combustion from said depression through the center of said distributor and means to vary the amount of products of combustion withdrawn from said depression.

3. In a burner, an elongated tubular element having an end thereof adapted to extend into a furnace, means forming a plurality of concentric passages in said element, means closing the end of the outer of said passages including a port formed with a plurality of radially directed orifices, means closing the end of the next inner passage including a port formed with a plurality of axially directed helical channels, and the inner passage forming an axially directed opening, means to supply fuel gas to said outer passage, means to supply combustion air to said next inner passage, and means in said inner passage to withdraw products of combustion through said opening in the end of said inner passage.

4. In a burner, a distributor element having a discharge end, means in said end to discharge fuel gas in a plurality of radially outwardly directed streams arranged in a circle, means in said end to discharge air in a plurality of axial and helically directed paths arranged in a circle inside said circle of gas streams, whereby centrifugal force throws said air stream radially outward to mix with said gas streams to form a combustible mixture and burn, so that the outward movement of said air and gas streams creates a low pressure area at the center of said end, and means in said end adjacent to the point
where said low pressure area is created forming a passage extending back in said distributor element through which products of combustion can pass, and means connected with said passage to withdraw products of combustion through said passage.

5. In a burner for use in a furnace wall, a distributor element adapted to extend through the well and comprising a plurality of concentric tubes, means closing the end of the annular space between the outer tubes, said means being provided with a ring of openings directed radially outwardly, means closing the end of the annular space adjacent to said first mentioned space, said last means comprising a plurality of helically extending ribs operative to form a plurality of passages terminating in said end and located in a ring, said tubes forming a passage inside said second mentioned space extending to the back of said element, means to supply gas to the outer one of said annular spaces, means to supply air to the other of said annular spaces and means in said passage to withdraw products of combustion through said passage.

6. The combination of claim 5 including a plurality of radially projecting ribs on the outer surface of the tube forming said passage, said ribs extending into said second annular space.

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CERTIFICATE OF CORRECTION

Patent No. 2,992,676

James B. Henwood

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, lines 56 and 58, for "port", each occurrence read -- part --.

Signed and sealed this 23rd day of January 1962.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents