

1

3,076,498

RADIANT CUP GAS BURNER

John Roger Williams, Ambler, and Harry C. Santisi,
Philadelphia, Pa., assignors to Selas Corporation of
America, Dresher, Pa., a corporation of Pennsylvania
Filed May 20, 1960, Ser. No. 30,640
4 Claims. (Cl. 158-113)

The present invention relates to industrial gas burners, and more particularly to a radiant cup type of burner in which a mixture of fuel gas and primary air is mixed at the cup with secondary air, to burn in the cup and heat the same to incandescence.

In most low pressure secondary air burners, difficulty is encountered in initiating combustion of fuel-air jets as they are being discharged from a fuel nozzle and in keeping the flames rooted to the discharge orifices. The secondary air pulled or blown into the burner cavity sweeps directly in front of the gas ports and tends to lift the flames from the ports, resulting in an unstable operation, particularly at lower temperatures, as when a furnace is starting up.

In the burner of the present invention, there is provided a distributor member that extends through an opening in a burner block into the base of a cup-shaped depression formed in one face thereof. The distributor member is provided with a plurality of radially directed ports through which fuel and primary air are discharged into the cup. Secondary air is introduced into the cup around the distributor in such a fashion that it does not pass directly in front of the ports. Therefore, ignition of the gas can be initiated prior to the time the secondary air begins to mix therewith.

It is an object of the invention to provide a secondary air burner of the radiant cup type, which is stable in operation, and which will produce a cup of uniform radiance. It is a further object of the invention to provide a secondary air burner which will operate on gas of changing B.t.u. values without apparent change in burner characteristics.

The various features of novelty which characterize our 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 we have illustrated and described a preferred embodiment of the invention.

In the drawings:

FIG. 1 is a view, in section, of one form of the invention.

FIG. 2 is a view of the end of the distributor looking from the right in FIG. 1, and

FIG. 3 is a view partly in section of a modified form of the invention.

Referring to FIG. 1, there is shown, in section, a portion of a furnace wall 1, which has built into it a tunnel block 2 of a suitable refractory material. This block is provided with a central opening that receives in it a burner assembly, including a cup block 3 and a well block 4. These blocks are cemented together, as shown at 5, with the right end of the cup block engaging a chamfered edge 6 formed in the tunnel block. A breakable cement is used to seal the space between the two blocks around the edge 6. The right face of cup block 3 is provided with a cup-shaped depression 7, which is extended by a conical surface 8 of the tunnel block 2. It is noted that the three blocks 2, 3 and 4 could be made as a single piece of refractory if it was so desired. It is preferred, however, to make these blocks individually, as shown, because of their weight and because of the fact that they

2

can be more easily assembled if they are separate. Also, at times, it may be desirable to make them of different materials.

A casing 11, in the form of a metal casting, is attached by cement to the left or outer face of the well block. This casing is provided with an outwardly extending flange 12 that abuts the outer face of the furnace wall, and which can be attached thereto by means of suitable bolts. A gasket 10 is preferably placed between the flange and the furnace wall. The casing is also provided with an inwardly extending flange 13 that serves, along with tie bolts 14, one of which is shown, to help to hold the casing and the two blocks 3 and 4 together as a unit. As shown herein, each tie bolt has a bent end, which is received in a suitably cut out portion in the well block and extends rearwardly therefrom. The outer end of the tie bolt is threaded so that a screw extending through flange 13 can be threaded into the bolt to hold the parts together in the relative positions shown in the drawing. The assembly, consisting of casing 11 and blocks 3 and 4, is moved bodily into position in block 2 when a burner is installed.

An axially disposed opening 9 extends from the base of cup 7 through the cup and well blocks and the center of flange 13. An inspirator assembly, smaller in diameter than opening 9, extends through this opening from the exterior of the furnace into the cup. This assembly includes a distributor member 17, whose end projects into the cup, and a venturi member 18, which are fastened together and to the flange 13 by means of bolts 19 that extend through suitable flanges formed on the parts 17 and 18. It is noted that the distributor and the venturi could be cast as a single piece if so desired. It is easier, however, to cast and machine them as separate pieces and assemble them in the manner shown. The venturi includes a bell 21 across the end of which is fastened a spider 22 that holds a gas spud 23 concentric therewith. Gas is fed through a supply opening 24 and through the spud 23 into the venturi 18. A shutter 25, received between the end of the bell and the spider, can be adjusted in order to control the amount of air that can be aspirated with the gas. The shutter can be locked in its adjusted position by a screw 26. It is also noted that the left end of the central passage of the spider is closed by a plug 27, which can be removed and placed in the gas supply opening 24 if it is desired to bring the supply of gas axially into the burner.

It will be seen from FIG. 1 that the right or discharge end of the distributor member 17 is enlarged, as shown at 28, to the size of opening 9, and is then reduced in diameter with the outer surface being formed as a cone, as indicated at 29, with the angle of the cone being approximately 15° to the axis. The enlarged portion 28 is provided with a plurality of circumferentially spaced slots 31, the outer ends of which terminate in a curve 32 that is directed radially outward toward the cup. A row of gas ports 33 is provided in the conical portion of the distributor, with a port located between each of the slots 31, and with the ports extending perpendicularly to the surface of the distributor. A second row of gas ports 34, also perpendicular to the surface of the distributor, is provided to the right of the ports 31. Referring to the drawing, and in particular to FIG. 2, it will be seen that the ports 34 are so located that the major portion of their areas are beyond the edges of the slots 31. With this position of the ports, and the curve 32 of the slots, air flowing through the slots will not move directly in front of the ports.

In the operation of the burner, gas under pressure is supplied through the intake 24 and the spud 23 into the venturi. This gas aspirates primary air in a volume that

is dependent upon the adjustment of shutter 25 and the pressure of the gas. The gas and primary air mixture flows through the distributor 16, and is discharged into cup 7 in a generally radial direction substantially parallel to the cup surface at the edge of opening 9, through the two series of ports 33 and 34. This mixture will burn as jets along the surface of the cup, thereby heating the cup surface to incandescence. Secondary air is drawn through ports 35 that are formed in the axial portion of casing 11 to flow through the annular space in opening 9 around the distributor end into the cup through slots 31. It will be seen, from an inspection of the drawing, that the secondary air is directed generally radially along the cup between the ports 33 and between the ports 34. Due to the curvature 32 at the outer end of slots 31, and due to the spacing of ports 34 slightly beyond the edges of the slots, and because of the conical shape of the distributor end, the secondary air cannot sweep directly in front of any of the ports. The secondary air will therefore mix with the primary air and gas as it is moving across the cup to complete combustion. This arrangement of the ports and the secondary air slots insures that there will be no tendency for the secondary air to blow the flame away from the ports. Thus, the primary air and gas can be ignited immediately as it leaves the ports, and the flames will be rooted to the outer ends thereof. This insures that the burner can be readily ignited, and that it will burn with a stable flame, thus giving an even radiance to the cup over its entire surface.

If during the course of the operation of the burner the B.t.u. content of the gas being used should vary, so that for complete combustion a different amount of air is required, this can easily be obtained by adjusting shutter 25 and an annular shutter 36 that is received around the axial portion of casing 11, and which is used to vary the effective opening of ports 35. Alternatively, the burner shutters can be adjusted for an average condition, with the furnace draft being varied to vary the amount of secondary air, and the gas pressure being varied to maintain the burning rate. Thus, the burner can operate efficiently with a varying B.t.u. gas, as is frequently encountered in refineries for example. Regardless of the amount of secondary air this is used, this air is introduced into the burner cup in such a fashion that it will have no effect on the combustion characteristics of the burner.

Referring to FIG. 3 of the drawing, there is shown another embodiment of the invention which differs from that previously described in the discharge end of the distributor. In that figure, it will be seen that the distributor is a cylindrical casting 37 that is smaller in diameter than, and is received within the axial opening 9 of burner block 3. This distributor has an enlarged portion 38 on its end, which is substantially the same diameter as opening 9. Immediately beyond the enlarged portion, there is a radial flange or cut back portion 39, from which projects a conical end 41 that has an angle of approximately 15° with the axis of the burner. Secondary air slots 42 are milled at spaced intervals circumferentially of the enlargement 38. It will be noted that these slots are not as deep as the radial extent of portion 39. A pair of rows of discharge ports 43 and 44 are provided extending perpendicularly to the conical portion 41 of the distributor. Ports 43 are located between slots 42, whereas ports 44, which are closer to the end of the distributor, are aligned substantially axially with the slots.

The operation of this form of the burner is the same as that described in connection with the embodiment of FIGS. 1 and 2. In this form, the cut back portion 39, combined with the position of ports 44 in the outer portion of cone 41 and their angular direction, is such that the streams of air flowing through slots 42 are displaced radially beyond the outer ends of ports 44 a distance sufficient so that they will have no effect on ignition or burning characteristics of gas being discharged through these ports.

The capacity of the burner will depend upon a number of factors, including the B.t.u. content of the fuel gas being used, the gas pressure and the furnace draft. Generally speaking, the higher the furnace draft, the more secondary air can be drawn into the burner cup. With more air, it is possible to burn more fuel. Also, by varying the amount of air drawn into the furnace for a given amount of fuel gas, the furnace atmosphere can be changed from reducing to oxidizing.

From the above description, it will be seen that we have provided a burner in which primary air and secondary air can be combined in the necessary volume with the gas being burned. It will also be seen that the discharge ports for the primary air and gas are so located with respect to the discharge ports for the secondary air that the streams of secondary air can have no effect upon the combustion characteristics of the gas. It is noted furthermore that by providing slots in the end of the distributor so that secondary air is introduced in a plurality of streams, rather than a single annular stream, that more even burning is obtained around the entire periphery of the cup. When air is introduced into a burner in an annular stream, it is practically impossible to obtain an even flow of air completely around the burner. When air is introduced in a plurality of slots, however, the slots can be so dimensioned and located that the air is distributed evenly entirely around the burner. Furthermore, as noted above, the slots are so placed and directed that the secondary air can be made to mix better with the primary air and gas to enhance the combustion rather than to affect it undesirably.

While in accordance with the provisions of the statutes, we have illustrated and described the best form of embodiment of our invention now known to us, 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 our invention may be used to advantage without a corresponding use of other features.

What is claimed is:

1. In a burner, the combination of a block having an opening therethrough with one end of the opening terminating in one face of the block, a hollow fuel distributor received in said opening with a closed end thereof extending beyond said face, said distributor being of a diameter smaller than said opening except adjacent to said end where it is enlarged to be received snugly in said opening, said enlarged portion being provided with a plurality of axially extending slots spaced circumferentially around it, said extending end having an outer surface that is frustoconical in shape with the diameter diminishing toward said end and provided with a first row of ports in the conical surface, having axes positioned perpendicular to said face and located circumferentially between said slots and a second row of ports in said surface having axes perpendicular to said surface and axially closer to said end and displaced circumferentially with respect to said first row of ports whereby the two rows of ports will not be axially aligned, means to supply a fuel-air mixture to said distributor to flow through said ports, and means to supply air to said opening to flow through said slots, said second row of ports being circumferentially and axially displaced with respect to said slots so that the air flowing through said slots will not impinge directly upon and disturb the flow of mixture through said second row of ports as said mixture is leaving said second row of ports.

2. The combination of claim 1 in which the extending portion of said distributor in which said rows of ports are located is smaller in diameter than said enlarged end.

3. The combination of claim 1 in which the ends of said slots adjacent to said end of said distributor are directed radially.

4. The combination of claim 1 in which said face of said block is provided with a cup-shaped depression and said opening terminates in the base of said cup, said ports

5

being directed substantially parallel to the surface of said depression at the edge of said opening.

References Cited in the file of this patent

UNITED STATES PATENTS

1,598,996	Wheelock -----	Sept. 7, 1926
2,024,510	Crisenberry -----	Dec. 17, 1935

5

2,561,795
2,582,577
2,667,216

6

Hess et al. -----	July 24, 1951
Zink et al. -----	Jan. 15, 1952
Zink et al. -----	Jan. 26, 1954

FOREIGN PATENTS

Germany -----	July 3, 1922
Switzerland -----	Oct. 2, 1950