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BURNER CONSTRUCTION

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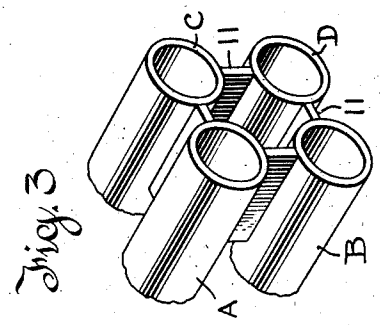


Fig. 3

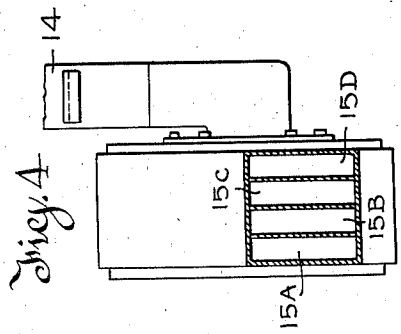


Fig. 4

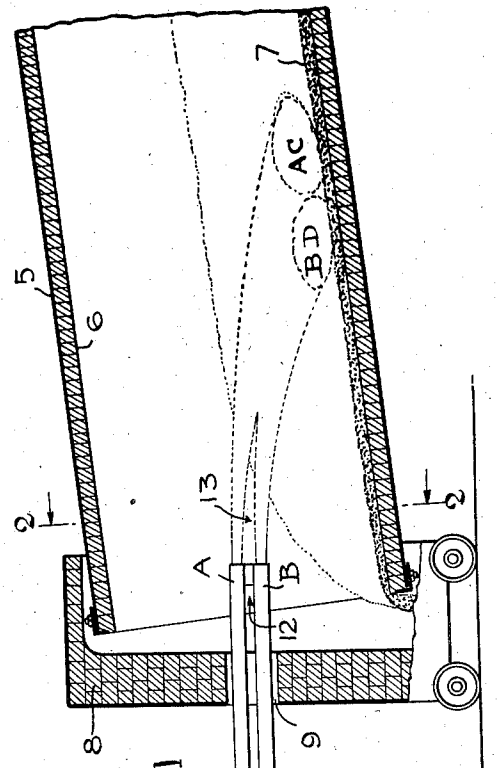


Fig. 1

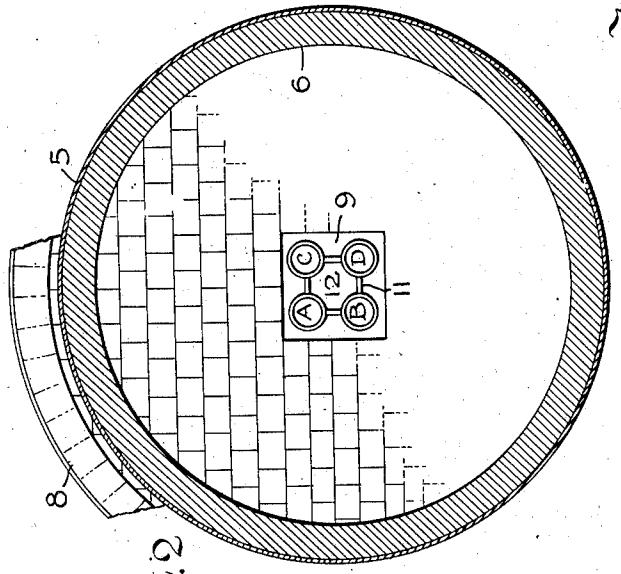
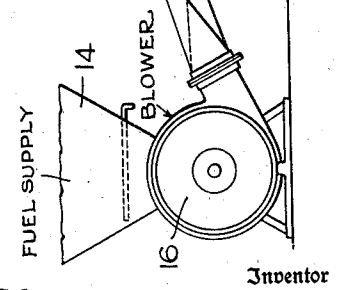


Fig. 2



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BURNER CONSTRUCTION

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3 Claims. (Cl. 263—32)

This invention relates to burner constructions and particularly to burners of the type used in the firing of rotary kilns. The invention is useful in the burning of various materials, but finds particular application in burning materials which require temperatures higher than those necessary for burning lime, as for example in the dead-burning or refractories and fluxes and the like, where sintering temperatures are necessary.

In the prior art relating to the firing of rotary kilns, the usual practice is to employ a single burner placed at or near the discharge end of the kiln. Such a burner produces an expanding circular flame resulting in a zone of maximum temperature that extends around the entire interior circumference of the kiln, this zone being referred to as the firing zone. With such an arrangement the heat from the burner is transferred largely to the lining of the kiln, and thence to the material under treatment, except for the small segment of the circumference which is covered by the material being burned. The material in that segment receives a portion of its heat directly from the flame itself, but much of the heat is received only from contact with the heated refractory lining as the material rolls around the kiln. Such a practice places a severe burden on the refractory lining, is inefficient, and decreases the life of the lining.

It has also been proposed in the prior art to utilize a plurality of separate burners directed at different longitudinally spaced points in the kiln. Such an arrangement increases the expense of the firing zone and assists in efficient combustion of the fuel, since a plurality of small circular flames are substituted for the single large circular flame of a single burner. It requires more complicated fuel feeding apparatus, is difficult to control and produces too much temperature variation from one part of the firing zone to another.

In both the single and the multiple burner arrangements described above it has been proposed to direct the flame onto the material under treatment, thereby heating the material by direct flame impingement rather than by conduction from the refractory lining. In the single flame arrangement the flame is so large that its center does not receive enough combustion air for efficient combustion. The multiple flame arrangement fails to produce uniform heating.

The problems discussed above are particularly present in the firing of rotary kilns with pulverized coal as a fuel, but also to a minor degree when other fuels such as oil are used. When powdered coal is used, for example, a portion of the combustion air is supplied in admixture with the fuel and serves as the propelling force to blow the powdered fuel into the kiln. This air is commonly known as the primary air. Proper dispersion of the powdered fuel requires that approximately 20% of the total amount of air needed for combustion be primary air. If the amount is increased substantially above 20%, the pressure is too high and the fuel is blown into the kiln at too high a velocity for satisfactory flame production. Consequently, experience has led to the general adoption of about 20% as the amount of combustion air which should be mixed with the pulverized fuel during grinding and blowing it into the kiln. The remainder of the combustion air is drawn into the discharge end of the kiln by the draft maintained therein. Ordinarily this air amounts to about 80% of the total combustion air required.

This auxiliary air, known as secondary air, has access to the stream of pulverized fuel ejected from the burner only on its outer surface and must gradually work its way toward the center of the combustion area. This condition slows down the combustion and tends to produce a long lazy flame of relatively low intensity, a condition which is well suited to the burning of lime and other materials requiring low temperatures, but unsatisfactory for the treatment of materials requiring higher temperatures as in dead-burning and sintering.

The primary object of the present invention is to provide a burner arrangement capable of supplying a portion of the secondary air directly to the interior of the combustion zone so that the combustion rate is accelerated, and a hot, intense flame is produced.

In burning pulverized fuel it is usual to direct the fuel into a pulverizing mill and thence into a blower, which discharges the fuel under pressure through a pipe leading to the burner in the kiln. It has been discovered that there is a tendency for the fuel supplied in this way to concentrate in one side of the pipe, particularly where that pipe is square in cross section, and thus to cause unequal fuel distribution to the firing or combustion zone. This condition may be alleviated to some extent by splitting the stream of fuel into several sections, each receiving its proportional amount of primary air. In this way the tendency of the fuel to concentrate in any particular portion of the pipe may be counteracted. Further, by adjusting the rate of supply to the particular section or sections which vary from

the others, equal distribution of the fuel may be made to the firing zone.

Such an arrangement yields several circular flames of smaller diameter than the single flame conventionally used, and makes it possible to spread the fuel streams and the resulting flames so that they approach each other and merge as the distance from the burner nozzle increases. The forward motion of the fuel stream creates a partial vacuum in the space between the flames, drawing heated secondary air from the kiln into the space and into the center of the coalescing flames, thus expediting and accelerating the combustion of the fuel and producing a hotter flame. The combustion may be further accelerated and the mixing of the fuel streams with secondary air further facilitated by inserting a pipe in the space formed by the several burners and delivering air under pressure through this pipe. As a consequence of this arrangement the fuel streams and the secondary air mix more rapidly and efficiently than with either single burner or multiple burner arrangements of the prior art. The result is rapidity and intensity of combustion not hitherto achieved, and higher temperatures than have been possible with prior art arrangements utilizing the same amount of fuel.

The invention will be described in connection with the drawing in which:

Figure 1 is a longitudinal sectional view of a portion of a rotary film fired by a burner embodying the present invention;

Fig. 2 is a sectional view substantially on line 2—2 of Fig. 1, but with portions of the kiln closure omitted;

Fig. 3 is a perspective view of the burner arrangement per se; and

Fig. 4 is a view partially in section of the fuel blower showing the discharge pipes leading to the burner.

In the drawing reference character 5 designates a portion of a rotary kiln having the usual refractory lining 6, and through which material designated 7 is passing to the discharge end of the kiln. 8 designates a closure also lined with refractory and capable of being rolled toward and away from the discharge end of the kiln. This closure in the position shown prevents excessive loss of heat from the kiln, but when rolled away provides access to the kiln for inspection or repair.

The closure 8 contains an opening 9 through which four burner pipes A, B, C and D project into the kiln. This opening serves as an inlet for secondary air which flows to a secondary air tube 12 formed by pipes A, B, C and D and plates 11 joining the discharge ends or nozzles of the pipes as indicated in Fig. 3, and thence to the zone indicated 13. Each of these pipes is connected to a blower 16 having fuel discharge openings 15A, 15B, etc., connected respectively to the four burner pipes, bearing corresponding letters. When powdered fuel from a suitable pulverizing apparatus is supplied to the hopper 14, it is blown through the pipes under the pressure of primary air and ejected to form four flames to which secondary air is supplied through tube 12. The jet effect of the flames from the burner pipes will ordinarily induce adequate flow of secondary air through pipe 12. However, the use of positive means for forcing air through this tube is contemplated where the induced flow is inadequate. In this way, tendency of the material to concentrate at any particular point in the pipes is offset by division of the discharge from the blower into four separate streams delivering to the four burners. The primary air supply is in this way broken up into four separate streams which result in four spaced flames surrounding a central zone 13 into which secondary air is supplied through pipe 12. Consequently, by suitably directing the pipes A, B, C and D and by suitable adjustment of both the fuel and the primary air, the resulting flame can be caused to impinge directly upon the material 7 to be treated, and to provide a longitudinally elongated zone of maximum flame intensity with complete combustion of all the fuel.

Obviously the dimensions of the pipes A, B, C and D and the secondary air pipe 12 may vary with conditions, such as the size of the kiln, the type of fuel used, and other factors resulting from special conditions. Without limiting the invention it may be pointed out that in practice satisfactory operation has been obtained using pipes A, B, C and D each six inches in diameter connected by plates 11 two inches wide and four inches long. Thus the tube 12 is made to supply an adequate amount of secondary air for combustion of fuel fed through the burner pipes A, B, C and D, and the point of maximum flame temperature spaced sufficiently with respect to the ends of the burner to prevent their destruction by melting. It will be obvious that by elongating the tube 12 rearwardly the temperature of the secondary air drawn into the vortex between the four flames may be reduced.

For efficient combustion it is desirable to have the secondary air as hot as possible, consistent with proper protection of the discharge ends of the burner pipes against destruction by overheating. An arrangement such as that shown results in a temperature of the order of 200° F. higher than is obtainable with prior art burner arrangements utilizing the same amount of fuel. It is possible not only to adjust the supply of primary and secondary air for efficient and substantially perfect combustion, but it is also possible to adjust the locus of the flame impingement by placement of the separate burner pipes. For example, if in using an arrangement such as that shown in Figs. 1 and 4, there should be a tendency to supply more fuel from one of the pipes than from the others, the inequalities can be adjusted by causing the hottest flame to cooperate with the coolest flame, and thus to assist in causing uniformity of the resultant flame coming from the four individual flames.

This is well illustrated in Fig. 1 when it is assumed that the fuel discharge is greatest from pipe A and least from pipe C, with intermediate amounts discharged from B and D. By causing substantial coincidence of the locus of impingement of B and D and similarly for A and C, and placing the two loci in juxtaposition, as indicated, the flame in the combustion zone may be made substantially uniform and to cover a substantial elongated area. Other adjustments are contemplated as they may be dictated by conditions.

While the pipes A, B, C and D are arranged to form a four sided polygon, it is obvious that the inventive concept may be carried out by increasing or decreasing the number of pipes and thus changing the cross sectional configuration of the secondary air tube.

What is claimed is:

1. The method of operating a fuel burner in firing a rotary kiln by direct impingement of

flame upon the material to be fired which comprises, supplying fuel and primary air from a single source to a plurality of burner pipes having the inherent characteristic of producing flames of diverse intensities, combining flames of different intensities in pairs whereby the resultant flame has substantially uniform intensity, and focusing the resultant flame of each pair directly upon the material in the kiln in longitudinal juxtaposition to the resultant flame from each other pair to form a single elongated flame of substantially uniform intensity throughout.

2. The method of operating a fuel burner in firing a rotary kiln by direct impingement of flame upon the material to be fired which comprises, supplying fuel and primary air from a single source to a plurality of burner pipes having the inherent characteristic of producing flames of diverse intensities, combining flames of different intensities in pairs whereby the resultant flame has substantially uniform intensity, focusing the resultant flame of each pair directly upon the material in the kiln in longitudinal juxtaposition to the resultant flame from each other pair to form a single elongated flame of substantially uniform intensity throughout, and delivering secondary air to the combustion zone encompassed by the flames from the individual burner pipes.

3. A fuel burner for rotary kilns and the like, comprising a rotary blower having a single discharge opening; means for supplying primary air and fluent fuel of substantial mass to said blower, whereby the blower discharges from said opening, a mixture in which the proportions vary in different strata across the discharge stream because of centrifugal effects; a plurality of burner pipes extending from said opening and receiving in parallel their component portions of said stream; juxtaposed nozzles, one for each such pipe, the nozzles being paired to receive fuel of different concentrations and being focused to direct their coalescent flame in longitudinal juxtaposition to the coalescent flame from another pair similarly placed, whereby each pair of flames is caused to impinge upon the material passing through the kiln at a point spaced longitudinally from the point of impingement of another pair of flames to produce a substantially uniform elongated resultant flame; and means for delivering secondary air to the zone encompassed by the individual flames from said nozzles.

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