April 30, 1946. H. KREISINGER ET AL 2,399,234

PULVERIZED FUEL BURNER

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Fig. 1

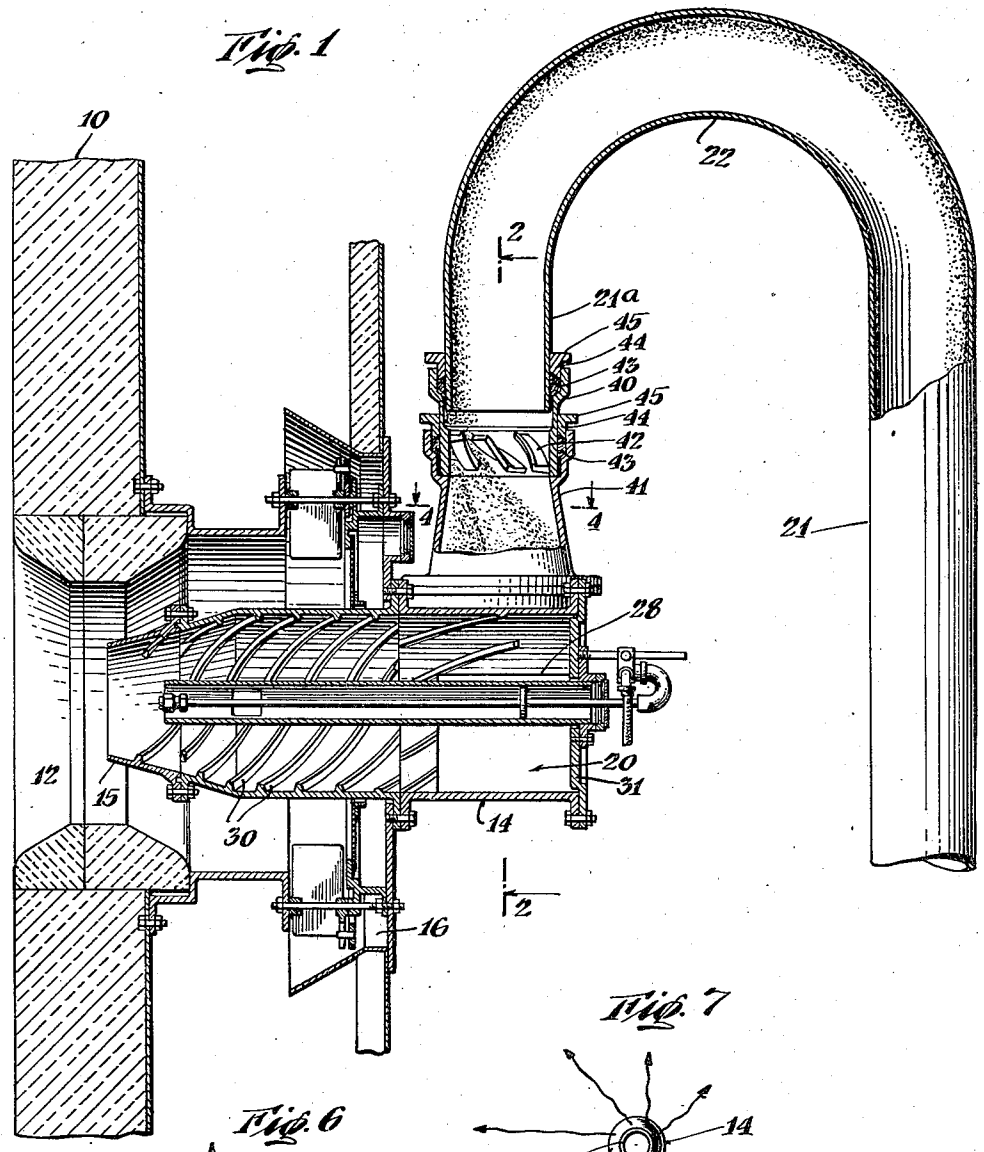

Fig. 7

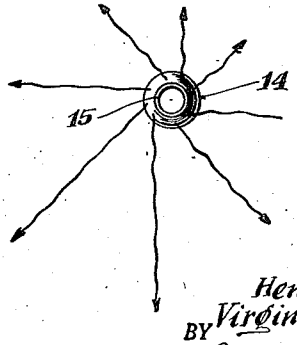

Fig. 6

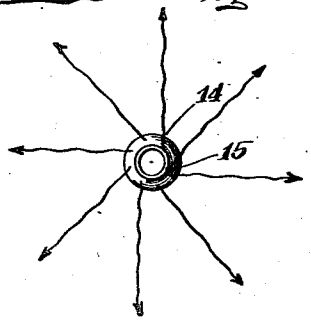

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Fig. 5

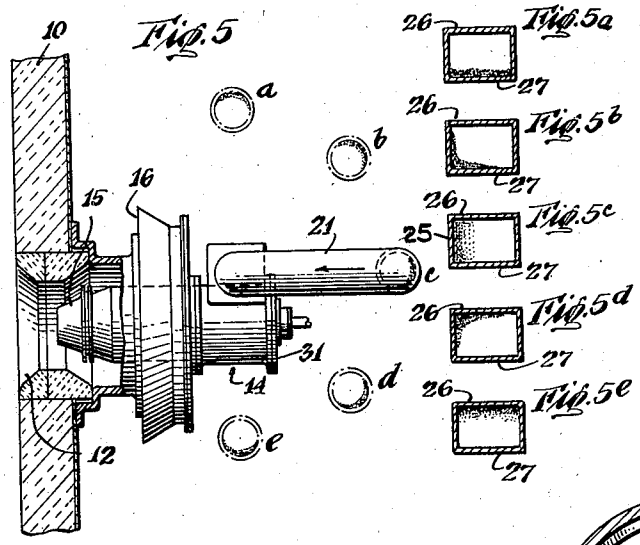


Fig. 5a

Fig. 5b

Fig. 5c

Fig. 5d

Fig. 5e

Fig. 2

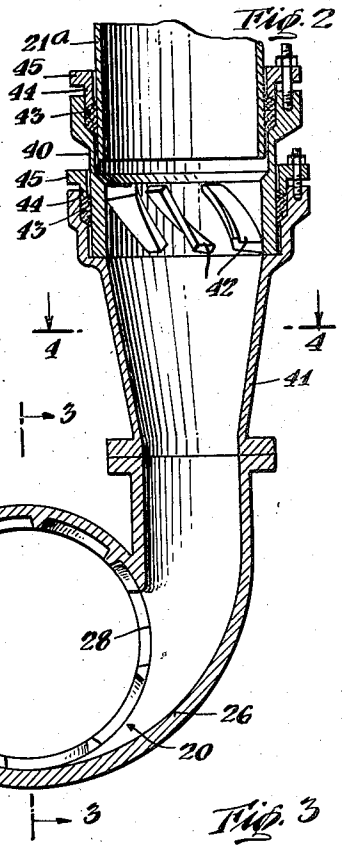


Fig. 4

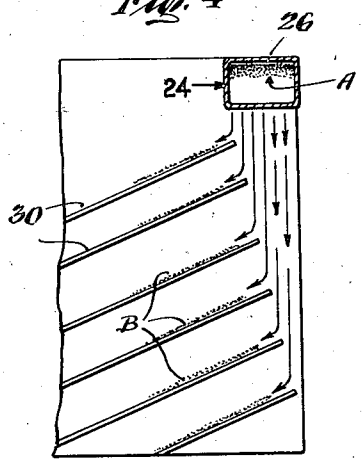
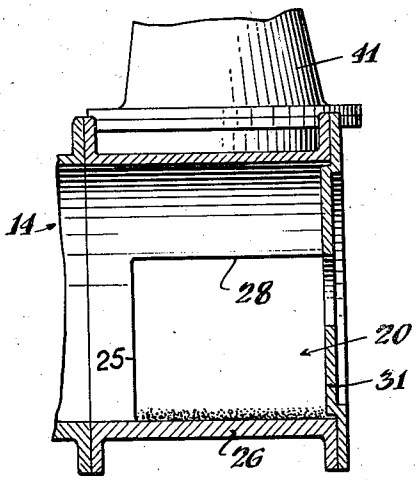


Fig. 3



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PULVERIZED FUEL BURNER

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Application February 14, 1942, Serial No. 430,936

4 Claims. (Cl. 110—104)

This invention relates to pulverized fuel burners and particularly to improved means for uniformly supplying finely ground coal etc., to horizontally disposed burners.

In horizontally disposed pulverized fuel burners the fuel and air mixture is given a rotative movement in passing through the burner because of a volute entrance into the fuel nozzle and spiral rifling in the latter. The rotative movement imparted to the fuel and air mixture produces turbulence and causes it to "bush out" or spread into a flame cone upon its entrance into the furnace. Seen through an observation door in the furnace wall opposite the burner the flame from a well designed and operated horizontal burner appears to radiate from the center of the burner forming an annular disk.

Even distribution of fuel and air to a furnace with a horizontally disposed burner is more difficult than with burners disposed vertically and firing downwardly into the furnace. Ordinarily there are fewer burners and therefore the streams of fuel entering the furnace are larger; the path of the burning mixture between the tip of the burner and the generating bank also is usually shorter than with vertical firing. Consequently, the distribution of coal and air over the entire cross section of the moving stream of burning mixture from the burner wall to the generating bank must be accomplished in a short distance from the burners and the distribution must be uniform throughout this section. If the distribution is not uniform, certain parts of the furnace get too much fuel and too little air and other parts get too much air and too little fuel. It will readily be seen that the more bushy the flame is the shorter the distance from the burner in which the fuel and air can be spread uniformly across the entire cross section of the furnace. To make bushing of the flame effective, it is necessary that the pulverized coal should be uniformly distributed around the periphery of the tip of the coal nozzle and this is a most difficult problem to solve because it is affected not only by burner design but by the shape and arrangement of the fuel piping.

Feeding the coal and air mixture to the volute entrance of a horizontally disposed burner and the rifling therein impart a rotative movement to the coal and air mixture causing the coal to be concentrated along the inner wall of the nozzle so that it is discharged from the nozzle tip in an annular ring. Some segments of this ring may contain more coal than others because bends in the piping to the burner and the direction of approach of the piping with respect to the burner inlet may cause the coal and air mixture to be introduced to the inlet at one side or the other of the latter so that some segments of the annular ring at the nozzle tip receive less coal than others. Consequently, when the coal in these segments is discharged approximately radially into the furnace, certain parts of the furnace get too much fuel and too little air while other parts get too much air and too little fuel.

An object of this invention is to provide an improved means in the fuel pipe supplying a burner which will cooperate with the burners to produce a uniform distribution of fuel at the tip of the latter so as to effect a more efficient combustion of the fuel and use of the associated furnace. In the accompanying drawings:

Figure 1 is a sectional elevation of a horizontally disposed fuel burner for introducing fuel into a furnace;

Figure 2 is an enlarged sectional view on the line 2—2 in Fig. 1 showing adjustable deflecting means in the fuel supply pipe for directing the fuel stream so as to cause the fuel to be introduced to the inlet of the burner uniformly to attain a uniform discharge of the fuel and air mixture from the tip of the burner;

Figure 3 is a sectional view on the line 3—3 in Fig. 2 illustrating the manner of introduction of fuel stream to the inlet of the burner to effect uniform discharge from the burner tip;

Figure 4 is a sectional view on the line 4—4 in Figure 1 or 2 with the adjacent part of the cylindrical inlet portion of the burner developed into the plane of the sheet;

Figure 5 is a plan view of the burner shown in Fig. 1 with diagrammatic illustrations of several angular positions for the fuel pipe in approaching a bend therein leading to the burner and shows the consequent effect upon the flow and distribution of the fuel produced by the bend in the piping;

Figures 5*a*, 5*b*, 5*c*, 5*d* and 5*e* are sectional views similar to Fig. 3 showing the distribution of the coal with respect to the burner inlet for the several positions of the fuel supply pipe shown in Fig. 5;

Figure 6 is a diagrammatic view illustrating the uniform discharge of coal from a horizontally disposed fuel burner; and

Figure 7 is a diagrammatic view similar to Fig. 6 illustrating a non-uniform discharge of coal from the burner tip resulting from a non-uniform feeding of the coal across the inlet to the burner.

In Fig. 1 the numeral 10 designates a vertical wall of a furnace having an opening 12 therein into which the tip of a horizontally disposed fuel burner designated as a whole by the numeral 14 extends for introducing fuel and air into the furnace. The burner 14 projects through an air duct 16 supplying secondary air for the combustion of the fuel around the tip 15 of the burner 14. The burner 14 has a volute entrance section 20 as shown in Fig. 3 to which the fuel and aid mixture is supplied through the fuel pipe 21 having a bend 22 therein near the burner. Pipe 21 may approach the burner 14 from various positions, such as those designated by the reference letters *a*, *b*, *c*, *d*, and *e* in Fig. 5.

The fuel pipe 21 may be cylindrical as shown while near the entrance portion 24 of the burner the volute section thereof is rectangular so that it has a flat horizontal undersurface 26 extending parallel to the burner axis for the width of the entrance 24. The interior wall of the cylindrical burner 14 is provided with a plurality of helical ribs 30 extending from adjacent tip 15 rearwardly throughout nearly the length of the burner nozzle. Ribs 30 terminate short of the outer end wall 31 of the burner; progressing clockwise around the burner the end of each successive helical rib extends further across the inlet opening 28 than its predecessor which is nearer the offtake. Coal entering the inlet 28 of the burner in a uniform ribbon indicated by the dots A on the flat bottom surface 26 of the volute 20 flows into the burner and encountering successive helical ribs 30 is sheared off or diverted axially through the burner in the form of a number of smaller ribbons indicated by the dots B, each of these ribbonlike streams travelling in a helix between two adjacent ribs 30 to the tip 15 of the burner nozzle. The rotative movement of the coal mixture through the burner concentrates the coal along the walls of the nozzle so that on reaching the nozzle tip a large part of the coal is concentrated in an annular ring having the tip of the nozzle as its outside circumference. The different segments of this ring of coal concentrated at the burner tip are thrown nearly radially into the furnace space and if, on entering the volute section 20 of burner 14 the coal is distributed uniformly across the inlet 28 on the flat surface 26 it will be uniformly discharged into the furnace as indicated in Fig. 6.

However, if some sectors of the ring of coal at the nozzle tip contain more coal than others, the adjacent part of the furnace receives more coal than parts of the furnace opposite the sectors having the smaller amounts of coal as indicated in Fig. 7. For example, if the section of the fuel supply pipe ahead of bend 22 approaches the burner in a position in front thereof as indicated at C in Fig. 5, the coal in passing around the bend 22 concentrates against the outer wall thereof as indicated by the dots. In passing around the bend the coal enters inlet 28 concentrated against the opposite wall of the pipe and upon reaching the burner the coal is concentrated against the side wall 25 of the volute section 20 at the inlet 28 to the burners as indicated by the dots in Fig. 5*c*. Consequently, in the "ribbons" of coal passing between helical ribs 30 near the burner inlet there is a relatively large amount of coal while between the ribs further around the burner wall and remote from the inlet there is much less coal, if any. Figs. 5*b* and 5*d* also indicate unequal distribution of fuel across the inlet to the burner as a consequence of the coal being thrown against the outer wall in the fuel pipe in passing around the bend when the pipe approaches the burner from a position in front but to one side thereof as indicated at *b* and *d* in Fig. 5. As contrasted with such uneven distribution of fuel at the inlet of the burner, Fig. 5*e* shows the distribution at the inlet when the coal in passing around the bend concentrates against the outer wall of the fuel pipe approaching from the left of the burner in Fig. 5 and in passing around the bend reaches the position shown in Fig. 5 where it is uniformly distributed across the inlet to the burner and thus equal amounts of fuel will be sheared off by successive helical ribs 30 that it encounters as a result all of the segmental ribbons of coal travelling spirally to the tip 15 of the burner contains equal amounts and therefore the annular ring of coal at the burner tip has substantially equal amounts of coal in its different segments. Thus substantially uniform amounts of coal are discharged all around the tip 15 as indicated in Fig. 6. When the fuel feed pipe 21 comes in from the right hand side of the burner as shown by the position *a* in Fig. 5, the fuel concentrating on the outer side of the bend after passing the latter will reach the inlet concentrated against the top wall 27 of the outlet as indicated in Fig. 5*a* but will pass across the outlet opening 28 and thus flow towards the spiral ribs 30 in the same manner as when forming a ribbon on the flat bottom 26 of the inlet to the burner.

However, it is not always possible to locate the fuel piping so that it approaches the burner from a position which produces a uniform distribution in a ribbon across the inlet to the burner. In many installations it is necessary to install the feed pipe, or it is found to be installed in some position resulting in an unequal distribution across the inlet opening to the burner as outlined above.

To overcome such uneven distribution and delivery of fuel to the inlet of the burner when the fuel pipe is installed in such unfavorable positions, the present invention provides an adjustable sleeve section 40 in the part of fuel supply pipe 21 adjacent the burner 14. Sleeve 40 is provided on part of its inside wall with a series of deflecting vanes 42 capable of intercepting the stream of coal passing along the wall of the supply pipe at one side thereof in an undesirable location and turning the stream angularly about the axis of the supply pipe into a position on another part of the pipe wall from which it will pass on to the burner inlet 28 distributed substantially evenly across the width of the latter. As shown in Fig. 2 a section 41 of feed pipe adjacent the volute inlet portion 20 of burner 14 is belled at its open end and receives the lower end of the adjustable sleeve 40. The upper end of the latter is also belled to receive preceding section 21*a* and is rotatable about the axis of the feed pipe of which the section 21*a* is a part. Packing 43 is mounted between the bell portion of the section 41 and the adjustable deflector sleeve 40 and between the latter and the outer wall of the lower end of the section 21*a*. There are also provided collars 44 having flanges 45 which may be tightened down gland-like against the packings to compress the latter to prevent rotation of the deflector sleeve 40 with respect to the feed pipe sections 21*a* and 41. Such tightening is effected when the deflector vanes 42 have been turned in to such angular position in the feed line as to dispose them in the proper loca-

tion for interrupting the stream of coal flowing along the pipe wall in an undesirable location and angularly displacing it about the pipe axis into a position on the inner pipe wall such that it will flow as a uniform ribbon across the flat portion **26** of the volute entrance section **20** of the burner.

Thus in fuel supply pipes provided with a deflector section in accordance with the present invention the deflecting sleeve **40** may be adjusted to a position in which its deflecting vanes **42** intercept a stream of coal flowing along the pipe and direct it by deflection into a location such that the coal is distributed uniformly across the inlet to the burner. It has been found that if a heavy concentration in the stream of fuel enters the burner inlet near the middle of wall **26** it distributes itself more or less evenly over the full width of the inlet. This is because when the mass of material enters the volute section **20** in a central position on its outer wall **26** the action of centrifugal force tends to spread the mass laterally to form a ribbon of substantially uniform thickness or depth across the inlet. If, however, the heaviest concentration moves toward one side of the inlet as in the position shown in Figs. 5*b*, *c* or *d*, the fuel does not adjust itself evenly across the inlet and the flames in the furnace are "one-sided." In such cases the concentration of the fuel stream may be shifted and dispersed by adjusting sleeve **40** so that the vanes **42** deflect the coal towards the middle of the inlet **28** to the burner.

The deflecting vanes **42** are placed at a suitable angle to the axis of the sleeve **40** to effect sufficient rotation of the coal stream about the axis of the fuel supply pipe to concentrate the coal along the lower flat wall **26** at the inlet to the burner as indicated in Fig. 3. The deflecting vanes **42** may project from the inner wall of the adjustable sleeve **40** so as to occupy approximately half of its cross-sectional area or may intercept more or less of this area according to the amount of correction of the angular position of the fuel stream within the pipe that has to be effected.

While the adjustable deflector vanes **42** are particularly applicable to fuel supply systems having horizontally disposed burners, they may also be utilized to angularly displace the coal stream about the axis of a fuel pipe leading to a vertically disposed burner so that a uniform distribution of coal across the burner inlet is effected.

What we claim is:

1. In apparatus for supplying a mixture consisting of pulverized material in flotation in a current of air having a cylindrical nozzle provided with a volute inlet passage adjacent its outer end causing the mixture to flow tangentially into the nozzle and to impart a rotary movement to the mixture; longitudinally extending helical ribs equally spaced peripherally on the inner wall of said nozzle for maintaining a rotary movement of the mixture in its travel axially of the nozzle, the rib nearest said inlet passage in the direction of material flow terminating adjacent the nozzle side of the passage and successive ribs about the wall of said nozzle in the direction of material flow extending progressively further across said inlet passage so that adjacent ribs deflect substantially equal amounts of material axially of the nozzle from a stream of material distributed substantially uniformly across said inlet opening.

2. In apparatus for supplying a mixture consisting of pulverized material in flotation in a current of air having a cylindrical nozzle provided with a volute inlet passage adjacent its outer end causing the mixture to flow tangentially into the nozzle and to impart a rotary movement to the mixture; longitudinally extending helical ribs equally spaced peripherally on the inner wall of said nozzle for maintaining a rotary movement of the mixture in its travel axially of the nozzle, the rib nearest said inlet passage in the direction of material flow terminating adjacent the nozzle side of the passage and successive ribs about the wall of said nozzle in the direction of material flow extending progressively further across said inlet passage so that adjacent ribs deflect substantially equal amounts of material axially of the nozzle from a stream of material distributed substantially uniformly across said inlet opening; a material supply conduit connected to said inlet passage; and deflecting vanes disposed on only a part of the inner wall of said conduit and occupying a portion of the cross-sectional area thereof and adjustable for positioning them peripherally of said conduit to dispose them to intercept a stream of material flowing in concentrated form in one location on the inner wall of said conduit and to angularly shift said stream about the axis of said conduit to another location from which it may flow along the wall of said conduit to enter said inlet portion of said nozzle distributed substantially uniformly across the wall of said passage that parallels the nozzle axis.

3. In apparatus for supplying pulverized material in flotation in a current of air having a cylindrical nozzle provided with a volute inlet passage adjacent its outer end; a material supply pipe connected to said inlet passage; and deflecting vanes disposed on only a part of the inner wall of said pipe and occupying only a portion of the cross-sectional area thereof for angularly displacing a major portion of the material flowing therethrough toward the middle of the outer wall of said inlet passage parallelling the axis of said nozzle.

4. In a conduit for carrying pulverized material in flotation in a current of air, a plurality of deflecting vanes inclined with respect to the axis of said conduit and circumferentially spaced in contiguous relation to form a group located on only a part of the inner wall of said conduit and occupying only a portion of the cross-sectional area thereof and adjustable for positioning them peripherally of said conduit to dispose them to intercept a stream of material flowing in concentrated form in one location on the inner wall of said conduit and to angularly shift said stream about the axis of said conduit to another location from which it may flow along the wall of said conduit distributed substantially uniformly across the latter.

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