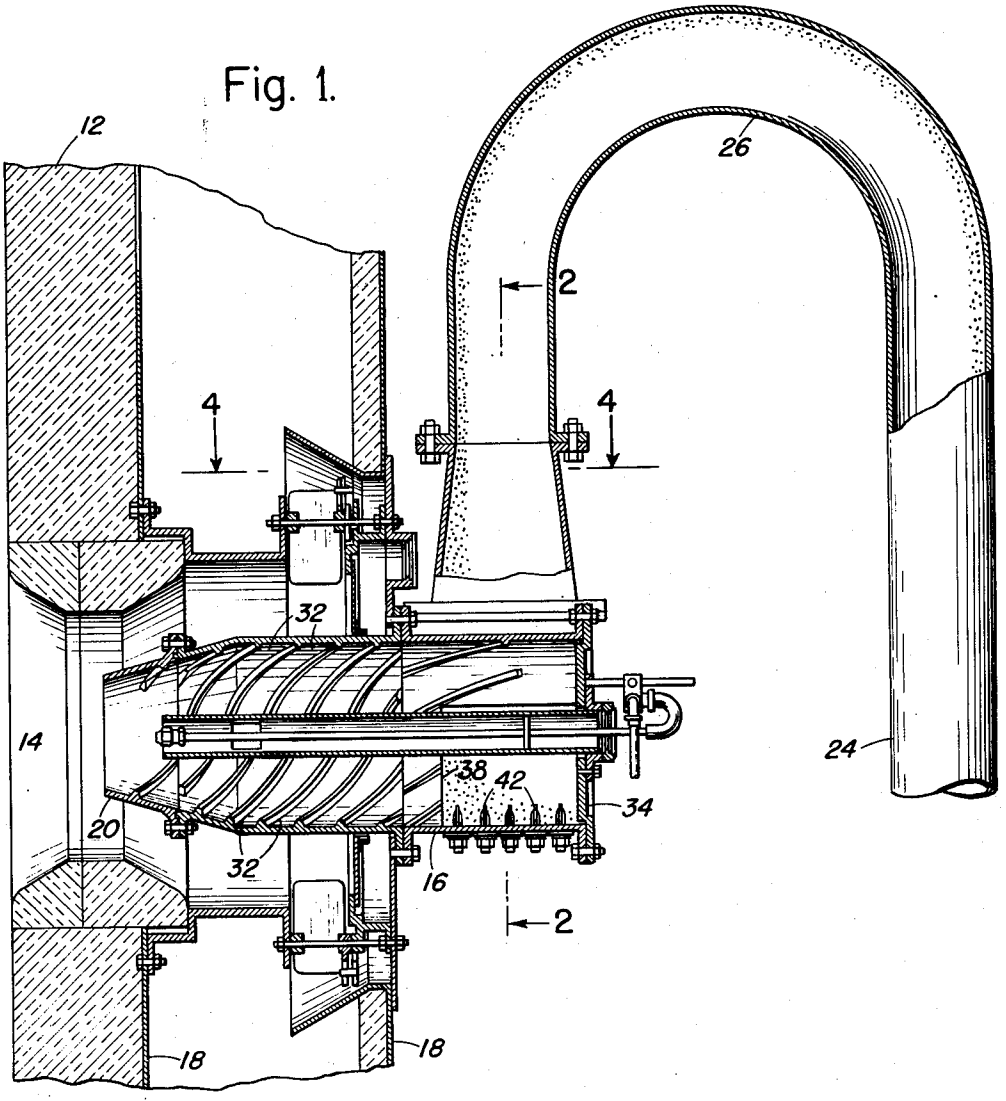
Oct. 28, 1952 J. J. RAGUSAN 2,615,407

DISTRIBUTOR MEANS FOR PULVERIZED FUEL BURNERS

Filed June 28, 1949 2 SHEETS—SHEET 1

Fig. 1.



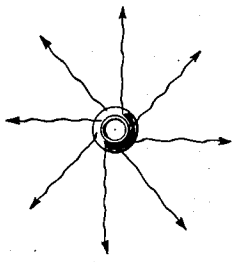


Fig. 6

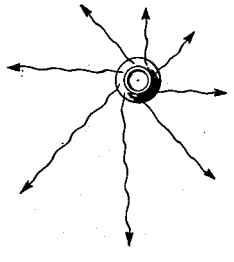


Fig. 7.

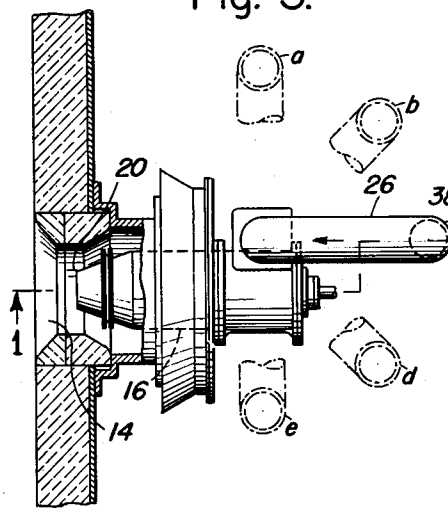
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DISTRIBUTOR MEANS FOR PULVERIZED FUEL BURNERS

Filed June 28, 1949 2 SHEETS—SHEET 2

Fig. 5.



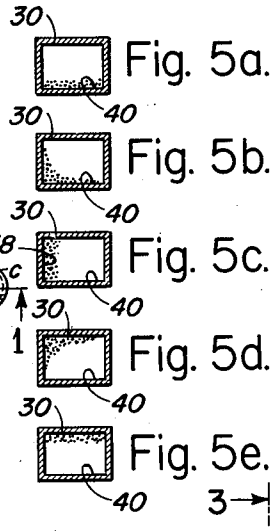
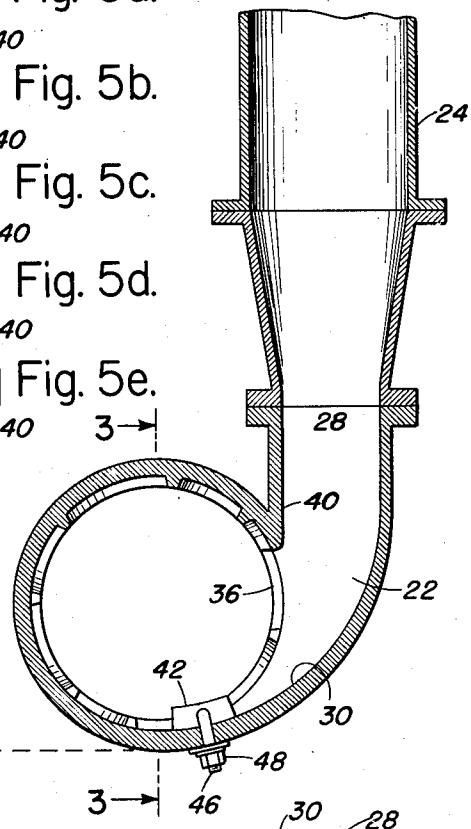


Fig. 2.



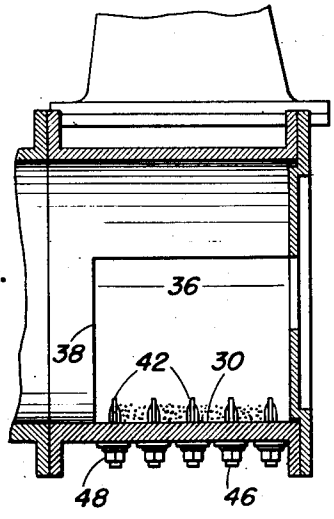


Fig. 3.

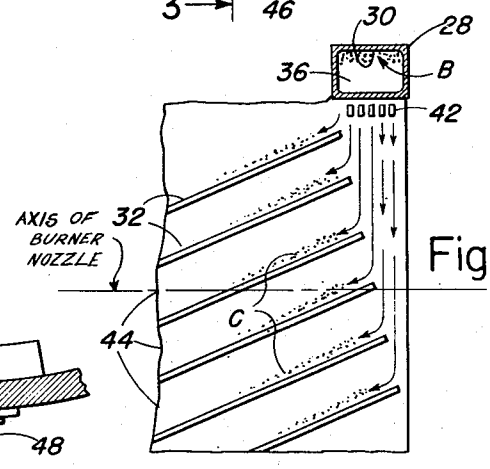


Fig. 4.

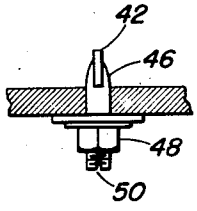


Fig. 9.

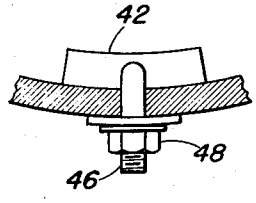


Fig. 8.

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2,615,407

DISTRIBUTOR MEANS FOR PULVERIZED FUEL BURNERS

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Application June 28, 1949, Serial No. 101,756

2 Claims. (Cl. 110—104)

1

This invention relates to pulverized fuel burners and particularly to improved means for uniformly distributing finely ground coal and the like into and from such burners, especially when same are horizontally disposed.

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 or tangential entrance into the fuel nozzle and spiral rifling in the latter. The rotative movement imparted to the fuel and air mixture produces turbulence and a centrifugal force which causes it to "fan 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 properly operated burner of the type here considered appears to radiate from the burner center and form a uniform and annular disc.

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 the flame fans out from the central burner axis 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 fanning out of the flame effective, it is necessary that the pulverized coal (or other fuel) should be uniformly distributed around the periphery of the tip of the fuel 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 primary air mixture to the volute or tangential entrance of a horizontally disposed burner and the rifling therein imparts a rotative movement to the coal and air mixture causing the coal to be concentrated

2

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 inlet to the burner nozzle which will cooperate with the burner 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.

One illustrative embodiment of the invention is shown by the accompanying drawings wherein:

Figure 1 is a sectional elevation, taken on line 1—1 of Fig. 5, 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 Figure 1 showing the new adjustable deflecting means in the volute entrance to the fuel burner for directing the fuel stream so as to cause the fuel to be introduced to the inlet of the burner nozzle uniformly thereby attaining a uniform discharge of the fuel and air mixture from the tip of the burner nozzle;

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

Figure 4 is a sectional view on the line 4—4 in Fig. 1 with the adjacent part of the cylindrical inlet portion of the burner nozzle developed into a plane represented by dotted line A as indicated in Fig. 2;

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 with showings of 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 a sectional view taken at line 4—4, Fig. 1 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;

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 nozzle;

Figure 8 is an enlarged side view of one of the new adjustable deflecting vanes; and

Figure 9 is an enlarged front view of the same adjustable deflecting vane.

Typical burner to be benefitted

In Fig. 1 the numeral **12** designates a vertical wall of a furnace having an opening **14** therein into which the tip of a horizontally disposed fuel burner nozzle designated as a whole by the numeral **16** extends for introducing fuel and air into the furnace. The burner nozzle **16** projects through an air duct **18** supplying secondary air for the combustion of the fuel around the tip **20** of the burner nozzle **16**. The burner nozzle **16** has a volute entrance section **22** (as shown in Fig. 2) to which the fuel and air mixture is supplied through the fuel pipe **24** having a bend **26** therein near the burner. Pipe **24** may approach the burner nozzle **16** from various positions, such as those designated by the reference letters *a*, *b*, *c*, *d*, and *e* in Fig. 5.

The fuel pipe **24** may be cylindrical as shown while near the entrance portion **28** of the burner the cross section thereof is rectangular so that it has a flat volute undersurface **30** (see Fig. 2) extending parallel to the burner axis for the width of the entrance **28**. The interior wall of the cylindrical burner nozzle **16** is provided with a plurality of helical ribs **32** extending from adjacent tip **20** rearwardly throughout nearly the length of the burner nozzle. Ribs **32** terminate short of the outer end wall **34** of the burner nozzle, and progressing clockwise around the burner nozzle the end of each successive helical rib extends further across the inlet opening **36** (see Fig. 4) than its predecessor which is nearer said inlet opening.

Coal leaving the inlet **36** of the burner in a uniform ribbon indicated by the dots B (see Fig. 4) on the flat bottom surface **30** of the volute **22** flows into the burner nozzle and encountering successive helical ribs **32** is sheared off or diverted axially through the burner nozzle in the form of a number of smaller ribbons indicated by the dots C, each of these ribbonlike streams travelling in a helix between two adjacent ribs **32** to the tip **20** of the burner nozzle. The rotative movement of the coal mixture through the burner nozzle 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 leaving the volute section **22** of burner nozzle **16**, the coal is distributed uniformly across the inlet **36** on the flat surface **30** and before encountering successive helical ribs **32** it will be uniformly discharged into the furnace as indicated in Fig. 6.

The problem to be solved

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; such lack of uniform distribution being indicated in Fig. 7. For example, if the section of the fuel supply pipe ahead of bend **26** approaches the burner in a position in front thereof as indicated at *c* in Fig. 5, the coal in passing around the bend **26** 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 nozzle the coal is concentrated against the side wall **38** of the volute section **22** at the inlet **36** to the burners as indicated by the dots in Fig. 5*c*. Consequently, in the "ribbons" of coal passing between helical ribs **32** near the burner nozzle inlet there is a relatively large amount of coal while between the ribs further around the burner nozzle 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 nozzle 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 nozzle, 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 nozzle 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 nozzle and thus equal amounts of fuel will be sheared off by successive helical ribs **32** that it encounters; as a result each of the segmental ribbons of coal travelling spirally to the tip **20** of the burner nozzle contains equal amounts and therefore the annular ring of coal at the burner nozzle tip has substantially equal amounts of coal in its different segments. Thus substantially uniform amounts of coal are discharged all around the tip **20** as indicated in Fig. 6.

When the fuel feed pipe **24** 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 **40** of the outlet as indicated in Fig. 5*a* and Fig. 2 but will pass across the outlet opening **36** and thus flow towards the spiral ribs **32** in the same manner as when forming a ribbon on the flat bottom **30** of the inlet to the burner nozzle.

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 of the burner nozzle. 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 nozzle as outlined above.

Fuel distributor means of this invention

To overcome such uneven distribution and delivery of fuel to the inlet port **36** of the burner nozzle **16** when the fuel pipe is installed in such unfavorable positions the preferred embodiment of my invention here illustrated provides a series of individually adjustable deflecting vanes **42** ca-

pable of intercepting a stream of coal passing along the wall **38** (see Figs. 1 and 3) of the volute inlet section **22** and converting an incoming flow of such material that is non-uniformly distributed along the axial dimension of the volute inlet's outer peripheral wall **30** into a flow beyond the vanes which is substantially uniform at its point of entrance into the spaces **44** formed by helical ribs **32**.

To accomplish this each of vanes **42** is individually and rotatably mounted on the flat peripheral surface **30** of the volute inlet **22** in any suitable manner as by means of a threaded shank **46** and a securing nut **48**. Each vane can be adjusted angularly to the direction of flow of the material by imparting turning movement thereto through a slot **50** in the outer end of threaded shank **46**. This slot is cut parallel to vane **42** so as to indicate the angular position of such vane.

Adjustment is made to each vane **42** individually depending on variable position of fuel pipe **24** (as shown on Fig. 5*a*, *b*, *c*, *d* and *e*) and as indicated by shape of flame observed through observation door of furnace under actual operating conditions until this flame attains the form of an annular round disk resulting from a uniform emission of the pulverized coal around the periphery of the nozzle tip **20** substantially in the manner shown in Fig. 6.

While the adjustable deflector vanes **42** of my invention are particularly applicable to fuel supply systems having horizontally disposed burners, they may also be utilized to angularly displace the coal stream with respect to its direction of flow when entering a vertically disposed burner or when entering burners for tangential firing so that a uniform distribution of coal across the burner is effected.

Invention successfully solves problem

The high practical utility of the new fuel distributor means herein disclosed has been convincingly confirmed by successful operating results obtained in actual installation of the improvement on pulverized fuel burners of the type illustrated herein.

Experimental test installations initially made have proven so satisfactory that the improvement is expected to go into widespread commercial use in, and be made a standard part of, future installations which call for a correction in the distribution of pulverized fuel that is supplied to burners such as are here illustrated.

Prior to this improvement no uniformly successful expedient for solving the problem stated had been available; all earlier-proposed methods of solution proving far less effective than the present one and in certain cases aggravating rather than minimizing the difficulty.

But by use of the present improvement it now becomes possible to correct the most stubborn situations and to do this simply, reliably and cheaply; proof as to the practical success of such correction being based on actual operating experience (as earlier mentioned) rather than mere theory alone.

Although I have illustrated and described but one preferred embodiment of the invention, it will be recognized that changes in the construction may be made without departing from the spirit of the invention as defined by the appended claims.

Having thus fully described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a pulverized fuel burner the combination of a burner nozzle of generally circular cross section and having an inlet end and an open outlet adapted to communicate with a combustion chamber; tangential fuel feed means including an inlet port in the peripheral wall of said burner nozzle disposed to introduce the fuel suspended in primary air transversely into the nozzle inlet end; said tangential fuel feed means also including a fuel guiding section having an inner volute surface which tangentially adjoins both the peripheral inner surface of said burner nozzle and said tangential fuel feed means; a plurality of individual deflecting vanes disposed in a longitudinal row in spaced relation across the said burner nozzle's inner peripheral surface that tangentially adjoins said tangential fuel feed means; a plurality of helical ribs disposed on the inner surface of said peripheral burner nozzle wall causing said suspended fuel to advance helically in a peripheral layer to the outlet of said burner nozzle, said helical ribs commencing at points located at distances from said longitudinal row of deflecting vanes which progressively increase in a circumferential direction along said burner nozzle's inner peripherical surface, the rib nearest said inlet port in the direction of material flow terminating adjacent the nozzle side of the inlet port and successive ribs about the wall of said nozzle in direction of material flow extending progressively further across said inlet port; each of the aforesaid deflecting vanes being pivoted about a vane axis which is substantially normal to the peripheral inner surface of the aforesaid burner nozzle and each vane having two wings oppositely and radially disposed with respect to said vane axis; and individual adjusting means for positioning said vanes angularly to the direction of pulverized fuel flow therepast through said tangential fuel feed means whereby these deflecting vanes may be set so as to convert an incoming flow of pulverized fuel that is non-uniformly distributed across said peripheral inlet port into a flow beyond the deflecting vanes which is substantially uniform at its point of entrance between the aforesaid helical ribs.

2. In a pulverized fuel burner, the combination of a burner nozzle of generally circular cross section and having an open outlet adapted to communicate with a combustion chamber; an inlet passage for said burner nozzle including an inlet port in the peripheral wall of the nozzle remote from the said open outlet end and adapted to supply said burner nozzle in a direction tangential to the inner surface thereof with a stream of pulverized fuel suspended in primary air; said passage also including a fuel guiding section having an inner volute surface which tangentially adjoins the inner peripheral wall surface of said burner nozzle; a plurality of helical ribs disposed on the inner surface of said peripheral burner nozzle wall forming a plurality of helical channels and causing said suspended fuel to advance helically in a peripheral layer substantially within said channels to the outlet of said burner nozzle, the inlets to said channels being spaced uniformly in the direction of said nozzle's axis across the width of said inlet port but placed at a distance which progressively increases therefrom in the direction of pulverized fuel flow; a plurality of individual deflecting vanes spacedly disposed on said burner nozzle's inner peripheral surface that tangentially adjoins said inlet passage in a direction substantially parallel to the axis of said nozzle and adjacent the aforesaid

peripheral inlet port but intermediate the entrance to said helical channels and said port so that each deflecting vane occupies a portion of said peripheral inlet port, each vane being pivoted about a vane axis which is substantially normal to the peripheral inner surfaces of the aforesaid burner nozzle and each vane having two wings oppositely and radially disposed with respect to said vane axis; and individual adjusting means for positioning said vanes angularly to the direction of pulverized fuel flow therepast through said peripheral inlet whereby these deflecting vanes may be set so as to convert an incoming flow of pulverized fuel that is non-uniformly distributed across said peripheral inlet port into a

flow beyond the deflecting vanes which is substantially uniform at its point of entrance into the aforesaid helical channels.

JAMES J. RAGUSAN.

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