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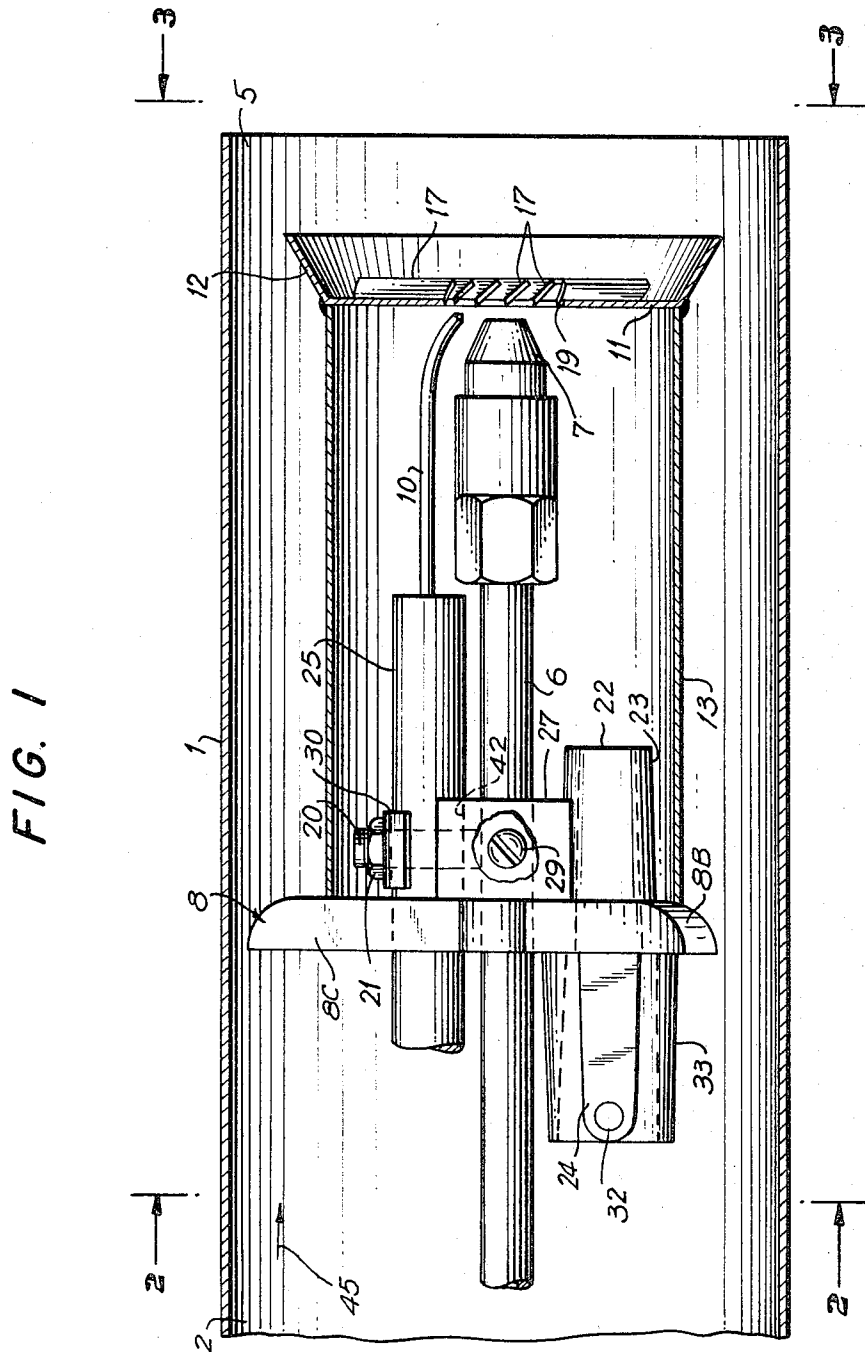
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CUP-CONE FLAME RETENTION BURNER

Filed Dec. 7, 1966

2 Sheets-Sheet 1



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FIG. 2

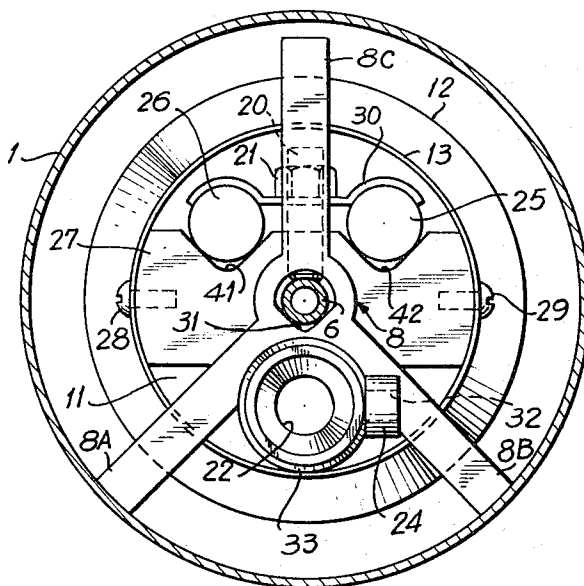
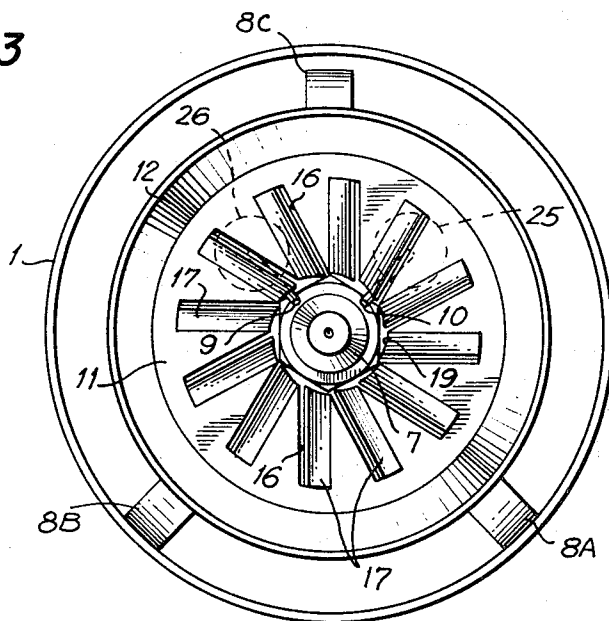


FIG. 3



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CUP-CONE FLAME RETENTION BURNER

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ABSTRACT OF THE DISCLOSURE

This invention relates to improvements in fluid fuel burners and particularly to tuyere structures wherein a fluid fuel such as a hydro-carbon oil is employed as a base and air as a major constituent is employed and supplied to the oil in an atomized state as it is ejected from the burner nozzle. More particularly the improvement comprises an annular diaphragm structure placed in the path of the air blast of the furnace to provide a spiral turbulence of the air so as to effect a more efficient combustion of the fluid fuel.

This invention relates to new and useful improvements in flame retention type fluid fuel burners.

More particularly this invention relates to an improved tuyere structure employed in fluid fuel burners wherein a diaphragm having a plurality of radially displaced vanes is disposed partially around the jet stream of the burner to provide a turbulence in the stream in the area of combustion of the fuel to effect a more complete combustion thereof.

With conventional burners, a combustion chamber is required to assure burning all of the oil that escapes the air pattern. By proper design of burners firing with flame retention characteristics, all the oil spray may be confined within the air pattern thus eliminating the need for a combustion chamber. For wet base boilers, the elimination of the insulating effect of the combustion chamber may result in an increase of approximately twenty percent in the boiler output. In addition, flame retention firing greatly improves flame stability thus eliminating the pulsation problem commonly obtained with conventional burners. Accordingly, flame retention burners are able to increase boiler output, improve flame stability, and eliminate the need for a combustion chamber.

Flame retention firing is accomplished by producing a more rapid mixing of the oil spray with the combustion air such that a proper air-fuel ratio for combustion is attained at the end of the air tube. According to the present invention this rapid mixing is accomplished by increasing the air turbulence by a spinner attached to the inner assembly. Employed with the burner is a gas deflection plate which helps establish the origin of the flame at the face of the spinner. The deflection plate or flange creates a low pressure area with eddy currents at the tip of the spinner blades and results in an improved flame stability.

The spinner and gas deflector are secured to the end of an internal cylinder surrounding the electrodes and nozzle of the burner so as to control and shape a portion of the jet stream of the tuyere. The above-described inner cylinder is supported concentrically within the fluid fuel burner air tube housing. This construction controls the burner air blast so that the stream of air surrounding the periphery of the flame confines the oil spray within a defined air pattern. The concentric arrangement of the inner cylinder supporting the spinner and gas deflection plate provides a long narrow symmetrical flame along the path of combustion with significantly reduced smoke and also provides a low air velocity area adjacent to the electrodes for improved ignition characteristics.

Therefore, it is a primary object according to the present invention to provide a fluid fuel burner having an increased combustion efficiency, improved flame stability, and improved ignition characteristics.

Another object according to the invention is to provide a fluid fuel burner which permits the elimination of the usual combustion chamber thereby improving the heat transfer to the boiler.

A still further object according to the present invention is to provide a means for assuring concentricity of the air spinning plate member to the burner air tube.

It is also a further object according to the present invention to provide a tuyere structure for fluid fuel burners that is simple in design, easy to manufacture, reasonable in cost, and easily assembled within the air tube of a fluid fuel burner.

A still further object of the present invention is to provide an improved tuyere structure that may be utilized in existing fluid fuel burners and inexpensively installed therein.

Other objects and features of the invention will become apparent from the following detailed description considered in connection with the accompanying drawings, which disclose an embodiment of the present invention. It should be understood, however, that the drawings are designed for purposes of illustration only and not as a definition of the limits of the invention, as to which reference should be made to the appended claims.

In the drawings, wherein similar reference characters denote similar elements throughout the several views;

FIGURE 1 is a cross-sectional view along the air-tube portion of a fluid fuel oil burner,

FIGURE 2 is a rear view of the construction of FIGURE 1 along section 2-2, and

FIGURE 3 is a front view of the construction of FIGURE 1 along section 3-3.

Referring to the drawings there is shown an air tube 1, which is comprised of a cylindrical metal casing extending at its inlet end 2, from an air blower of a fan (not shown). The front end portion of air tube 1 terminates along a plane perpendicular to its axis. Disposed concentrically within cylindrical air tube 1 and preferably near its outlet 5 in an inner cylinder 13 having a cross-sectional area smaller than air tube 1.

Within inner cylinder 13 is an oil supply pipe 6 which leads from the usual fuel pump (not shown) and terminates at a discharge end in spray nozzle 7. A pair of electrodes 9 and 10, projecting from insulators 26 and 25 respectively, extend over and along the length of fuel tube 6. The ends of electrodes 9 and 10 converge to form a spark gap in front of nozzle 7 in the path of the fuel vapor sprayed therefrom. The back of cylinder 13 is in contact in three places along its circumferential edge to a Y-support 8. Support 8 consists of three arms of equal length, 8A, 8B and 8C, which converge at its center in a V-shaped aperture 31 having a diameter slightly larger than fuel tube 6. The ends of arms 8A and 8B rest against the bottom portion of the inner circumference of air tube 1. Arms 8A and 8B are of sufficient length so that fuel tube 6 is supported through aperture 31, at the ends of the arms, in coaxial alignment with air tube 1. Arm 8C, shown angularly displaced equidistant from arms 8A and 8B, extends almost to the upper portion of the inner circumference of air tube 1. A small air gap is left between the end of arm 8C and the upper portion of inner circumference of air tube 1 to allow for the expansion and contraction of the air tube during the operation of the burner.

In front of support 8, and spanning across the circumference of inner cylinder 13, is a yoke 27. The ends of yoke 27 are shaped to correspond with the inner diameter of cylinder 13 and are secured thereto by means

of fasteners 28 and 29. Each of the upper portions of the arms of yoke 27 contains a V-shaped slot 41 and 42 for receiving and supporting insulators 26 and 25 respectively. Moreover, a clamp 30 having its ends shaped to fit around the upper portion of the circumference of insulator 26 and 25 is secured by means of self-locking nut 21 on threaded shaft 20 so as to urge the insulators into slots 41 and 42. The opposite end of shaft 20 is threaded into the body of yoke 27.

Support 8 is also employed to contain a cadmium photocell for use in detecting the light from a combustion flame in a well-known conventional manner. A bracket 24, secured to leg 8B of support 8, is pinned at one end to body 33 of the photocell by means of fastener 32. The longitudinal axis of photocell 23 is directed parallel to the axis of cylinder 13 so that its optical opening 22 is exposed to the flame.

Secured to the opposite end of cylinder 13, adjacent to outlet 5 of air tube 1, is a spinning plate or spinner 11, having a cone-shaped flange 12 which opens toward outlet 5. Flange 12 may be formed as an integral part of fluid spinner 11.

Fluid spinner 11 contains a plurality of radially displaced apertures 16, disposed around its axis defined by central opening 19. Apertures 16 are formed within spinner 11 by punching out a plurality of rectangularly spaced vanes 17 bent out of the plane defined by the surface of spinner 11 toward outlet 5. Vanes 17 serve as louvers for directing the flow of air surrounding the nozzle in a manner to be disclosed herein below.

In many applications it is advantageous to reverse the vanes. That is, the leading or cut edge falls on a line drawn radially from the center of the spinner rather than having the fold line on the aforementioned radial line. This has the advantage of providing additional clearance between the electrode tops and the spinner.

The opening 19 in spinner 11 surrounds the nozzle 7 and is communicative with the plurality of apertures formed by vanes 17. When the fluid fuel burner is in operation, the air flow indicated by arrow 45 within air tube 1, passes not only over the external portion of inner cylinder 13, but also through the interior of cylinder 13 at a reduced velocity. Vanes 17 impart a swirling motion to the air exiting from inner cylinder 13. The fluid fuel sprayed from nozzle 7 is thus surrounded by a primary air stream into which the oil droplets are discharged to mix therewith. Upon ignition by electrodes 9 and 10, the fuel mixture ignites and burns adjacent to the discharge on the front face of spinner 11.

Due to the air stream flowing through apertures 16 a cylinder of air issues therefrom, thereby providing air at the periphery of the flame to insure that the oil spray is confined within the cylindrical air pattern.

With the construction as defined above and the manner in which the elements are supported within air tube 1, the cylindrical sheet of air will be maintained at an even force and magnitude even if the burner assembly connected to fuel tube 6 becomes slightly misaligned from the axis of air tube 1. Since the entire assembly contained within inner cylinder 13 is depending fuel tube 6, any movement or misalignment in the air tube is trunnioned around the ends of the arms of support 8 so that the face of spinner 11 remains perpendicular to the air stream.

During the flow of air through vanes 17 it will be observed that there will be an outwardly directed radial component of air at the ends of the spinner vanes. This outwardly directed air flow hits deflection flange 12 and is redirected towards the center of combustion. Moreover that portion of the air flow intermediate cylinder 13 and air tube 1 flow past flange 12 will deflect off the inner wall of tube 1 and also be redirected toward the center of combustion.

As the outwardly directed radial component of air hits

the deflecting flange 12, it starts to recirculate setting up eddy currents which create a low pressure tending to pull oil droplets radially outward from nozzle 7. The low pressure resulting from these eddy currents pulls the oil droplets through a turbulent area in front of spinner 11 so that there is a thorough mixing of air and oil resulting in combustion taking place across the full face of the spinner.

Due to the presence of the inner cylinder 13, air blast 45 is reduced in velocity in the region of the nozzle and electrodes and thus permits a satisfactory ignition of the fluid fuel. The portion of air blast through the annulus intermediate cylinder 13 and tube 1 flows at a much higher velocity. This provides a cylindrical jet stream surrounding the combustion of the fluid fuel and produces a very long and narrow flame with good ignition.

In a practical embodiment of the present invention the fluid spinner 11 may be constructed from cold rolled steel or a high temperature metal or alloy such as titanium or stainless steel, having sufficient strength to withstand the heat generated by the combustion taking place across its full face.

While only a single embodiment of the present invention has been shown and described, it is obvious that modifications may be made thereunto without departing from the nature and scope of the invention.

What is claimed is:

1. A flame retention structure for use in the air tube of a tuyere burner having a fluid fuel nozzle and ignition means comprising:

cylinder means coaxially disposed in the air tube and surrounding the fluid fuel nozzle,

a support secured to said cylinder means for demountably supporting and aligning said cylinder means within the air tube,

spinner means secured to the end of said cylinder means adjacent to the outlet of said air tube, said spinner means including an aperture in front of said fluid fuel nozzle,

a Y-shaped member having three angularly spaced arms in contact with the inner circumference of the air tube, a yoke secured to said Y-shaped member for supporting the fuel nozzle coaxially within said cylinder means, said yoke having a pair of oppositely directed arms, and fastening means to secure said yoke arms to the periphery of said cylinder means at its opposite end from the outlet of the air tube,

a plurality of vanes formed as an integral part of said spinner and disposed around said aperture so that the flow of air through said spinner effects a turbulence of the air stream at the outlet of the air tube to effect an improved combustion of the flame produced by ignition of the fuel emitted by the nozzle and the flow of air intermediate the air tube and said cylinder means provides a cylindrical jet stream to produce a very long and narrow flame.

2. The structure as recited in claim 1 wherein said spinner means comprises a plurality of vanes radially disposed around said aperture and communicative therewith.

3. The structure as recited in claim 2 wherein said vanes are bent out of the plane of the spinner surface toward the outlet of the air tube.

4. The structure as recited in claim 3 additionally comprising gas deflector means secured to the periphery of said spinner means for deflecting the radial component of the flow of air emerging from said spinner vanes to re-enter the turbulent air stream effected by said spinner means.

5. The structure as recited in claim 4 wherein said gas deflector means comprises a cone-shaped flange having its base directed to the outlet of the air tube.

6. The structure as recited in claim 1 wherein said ignition means comprises a pair of electrodes having their exposed ends converging in a gap adjacent to the outlet

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of said fluid fuel nozzle and an insulator surrounding each of said electrodes at their connection to an electrical power source.

7. The structure as recited in claim 6 wherein said yoke arms include a V-shaped slot to receive and support each of said insulators. 5

8. The structure as recited in claim 7 comprising a bracket clamp mounted on said yoke and in contact with said insulators, and fastening means for securing said clamp to said yoke so that said insulators are frictionally retained within the slots of said yoke. 10

9. The structure as recited in claim 8 wherein said fastening means is a self-locking nut.

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