July 21, 1959 A. BOGOT ET AL 2,895,435

TILTING NOZZLE FOR FUEL BURNER

Filed March 15, 1954

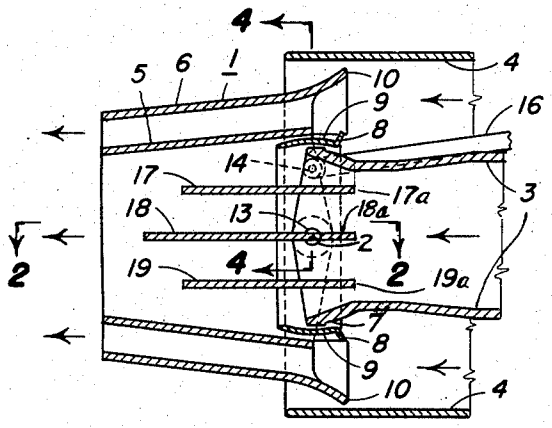


FIG. 1

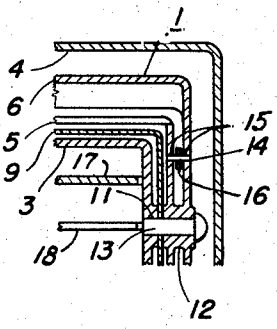


FIG. 4

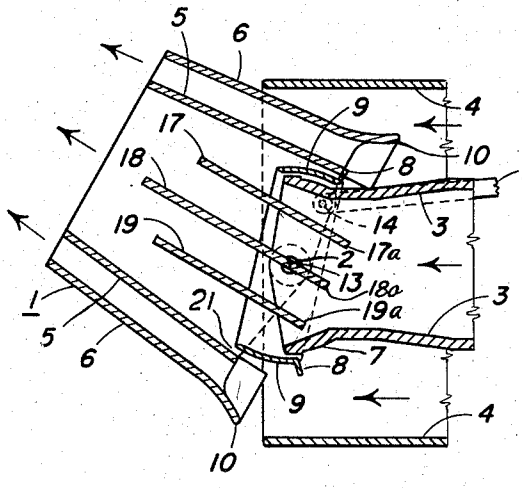


FIG. 3

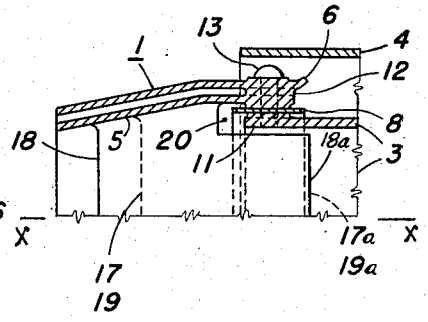


FIG. 2

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United States Patent Office 2,895,435 Patented July 21, 1959

2,895,435

TILTING NOZZLE FOR FUEL BURNER

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Application March 15, 1954, Serial No. 416,313

4 Claims. (Cl. 110—28)

This invention relates to an improvement in tilting nozzles and particularly to tilting nozzles for burners directing a fuel-air mixture into a fluid cooled furnace of a vapor generating unit.

Large steam generating units are provided with furnaces having walls which are lined with cooling tubes through which the boiler water is circulated and steam generated. The products of combustion flowing through such a furnace are cooled by the heat absorption of the wall tubes. Upon leaving the furnace offtake the products flow over a superheater to heat the generated steam and over other heat absorbing surface by which heat is withdrawn from the products. By directing the fuel-air streams into the furnace in such a manner that the flame mass occurs within the furnace nearer to or farther from the offtake, the heat absorption by the wall tubes from the products of combustion will be respectively less or more and the temperature of the products at the offtake will be higher or lower. In this manner the temperature of the products of combustion exposed to the superheater are respectively higher or lower and a control of the temperature of the steam leaving the superheater may be accomplished. To effect such control of the superheated steam temperature, the burners have been placed in the furnace walls at a location remote from the furnace offtake and the burner nozzles arranged to direct the fuel-air streams either toward or away from the furnace offtake or in intermediate directions. Such method of combustion zone control within a furnace and a disclosure of the adjustable burner nozzles or tips is shown in the U. S. patent to Kreisinger et al. 2,363,875, issued November 28, 1944.

With the fuel nozzles heretofore used, the distribution of fuel-air mixture and the velocity of the mixture leaving the nozzle is substantially uniform across the discharge area of the nozzle when the nozzle is aligned with the pipe delivering the mixture to the nozzle and when the distribution and velocity in the delivery pipe is substantially uniform. However, when the nozzle is tilted out of alignment with the delivery pipe, a definite maldistribution of the fuel-air mixture occurs at the nozzle discharge, becoming worse with increase in the tilt, thereby producing a relatively poor ignition pattern and incomplete combustion in the furnace. In addition fuel leakage occurs within the nozzle which upon burning results in coke deposits within the nozzle interfering with its smooth operation.

It is an object of this invention to overcome these objections by improved burner nozzles which will provide substantially uniform distribution of the fuel-air mixture leaving the nozzle and substantially uniform velocity across the discharge opening of the fuel nozzle into the furnace.

It is another object of the invention to eliminate deposits of coke which hinder the proper flow and distribution of the air-fuel mixture.

Additional objects and advantages will become apparent from the following description of an illustrative embodiment of the invention when read in conjunction with the accompanying drawings wherein:

Fig. 1 is a cross section through the fuel delivery pipe of a burner and its associated tiltable nozzle and taken in the plane in which the nozzle can be tilted.

Fig. 2 is half of a cross section taken on line 2—2 of Fig. 1, the other half being symmetrical about the axis X—X.

Fig. 3 is a cross section similar to Fig. 1, showing the nozzle tilted to the extreme position out of alignment with the fuel pipe.

Fig. 4 is a fragmentary cross section taken on line 4—4 of Fig. 1 showing means for tilting the nozzle.

The figures show a burner construction of the type in which the burner nozzle generally designated as **1**, may be rotated about a transverse axis **2** at the end of a fuel delivery pipe **3** thereby delivering fuel optionally in a direction in alignment with the axis of the fuel pipe **3** or in a direction at an angle thereto. The fuel delivery pipe **3** receives a supply of fuel and air mixture from a source, not shown, which flows through the pipe **3** as shown by the arrows, toward the nozzle **1** while distributed across the area of the pipe in a substantially uniform stream. The fuel delivery pipe **3** lies centrally within an air conduit **4** through which a supply of secondary air for combustion flows. The conduit **4** extends past the axis **2** about which the nozzle **1** rotates.

The burner nozzle **1**, the fuel delivery pipe **3** and the air conduit **4** are shown rectangular in cross section. The nozzle comprises a conduit **5** within an outer conduit **6**. The inner conduit **5** overlies the fuel pipe **3** at their juncture, the fuel pipe being flared at **7** to accommodate rotation of the inner end of tube **5** about the axis **2**. A seal plate **8** is provided having sides **9**. These sides form the symmetrical portions of an imaginary cylinder (see Fig. 1) which has its center at the axis **2**. Seal plate **8** occupies the space between the end of nozzle tube **5** and the flared end **7** of fuel pipe **3**. The inner end **10** of outer conduit **6** lies within and closely adjacent the walls of the secondary air conduit **4** and the secondary air flows from conduit **4** through the open space between the nozzle tubes **5** and **6** to discharge in a sheath around the fuel-air mixture issuing from the inner tube **5**. The fuel pipe **3** and nozzle **1** are provided with bearings **11** and **12** respectively (Figs. 2, 4) containing pins **13**. A pin **14** is offset with respect to pins **13** and rests in bearings **15** (Fig. 4) provided in the walls of the inner and outer nozzle tubes **5** and **6**. A connecting rod **16** engages pin **14** and extends through the secondary air conduit **4** to a control lever (not shown) by which it may be moved longitudinally of the fuel pipe **3** and thereby rotate the nozzle **1** about the axis **2** to any position between that shown in Fig. 1 and that shown in Fig. 3. Fig. 3 shows the nozzle **1** rotated in one direction from its position when aligned with the fuel pipe **3** and it may be rotated in the opposite direction as well.

Heretofore the fuel nozzle **6** contained no baffling and as earlier mentioned the distribution of the fuel-air mixture and the velocity of the mixture leaving the nozzle was substantially uniform across its discharge area only when the nozzle was aligned with the fuel pipe **3** and when the distribution within the fuel pipe **3** was substantially uniform. However as soon as the nozzle **6** was tilted out of alignment with the fuel pipe **3**, a definite maldistribution of the fuel-air mixture occurred at the nozzle discharge opening growing worse with increase in tilt. This created unequal velocity distribution at the nozzle outlet resulting in poor ignition and incomplete combustion in the furnace. Furthermore fuel leakage occurred from tube **5** into tube **6** adjacent pipe **3** which fuel burned there and coked. In the tilted nozzle position the stream of fuel and air being forced into an upward turn (see Fig. 3) would concentrate along the lower deflecting wall of nozzle conduit **5** and would issue from the nozzle adjacent said wall at a relatively high velocity.

The fuel-air mixture leaving adjacent the upper wall of nozzle conduit 5 or on the inside of the turn would have a low velocity or even tend to flow in a reversed direction.

In accordance with the invention, baffles or division walls 17, 18 and 19 are provided within the nozzle conduit 5 arranged in planes substantially parallel to fluid flow and dividing the conduit 5 into a multiplicity of parallel channels. In the preferred embodiment of Fig. 1 three baffles are shown. The middle wall 18 extends along the center line of conduit or tube 5 from the axis 2 to a point spaced from the discharge end of tube 5, and has a portion 18*a* extending a predetermined distance beyond axis 2 in an upstream direction and being rigidly aligned with division wall 18 at all tilting positions of the nozzle.

The walls 17 and 19 are parallel to wall 18 but extend to points beyond the transverse plane through the axis 2 into the outlet end of the fuel pipe 3. We have found that by the proper extensions of the wall or baffle ends 17*a*, 18*a* and 19*a* beyond the axis 2 and commensurate with their proper spacing from the walls of the nozzle tube 5 and the adjacent walls of fuel pipe 3, the fuel-air mixture leaving each of the channels formed by the baffles 17, 18 and 19 can be made to have substantially the same average velocity and fuel loading. Too long an extension of the baffles or too small a spacing of the baffles from the nozzle tube 5 or from the walls of fuel pipe 3 will produce a too high velocity of the mixture issuing from the top of the nozzle tube 5 when tilted upward and a too low velocity at the top when tilted downward. Too short an extension of the baffles or too large a spacing of the baffles from the nozzle tube 5 or walls of fuel pipe 3 will produce the opposite results, a too low velocity of the mixture issuing from the top of the nozzle tube 5 when tilted upward and a too high velocity at the top when tilted downward. The cutaway portions 20 (see Fig. 2) of the baffles adjacent the side walls of nozzle tube 5 accommodate the tip 7 of fuel pipe 3.

Obviously in smaller or larger nozzles 1, there may be respectively a lesser or greater number of division walls or baffles provided within the nozzle conduit 5.

It was found when operating with a nozzle not equipped with our inventive improvement and with the nozzle tilted as shown in Fig. 3, that leakage of finely pulverized coal occurred from within the nozzle tube 5 at point 21 (see Fig. 3) between the bottom portion 9 of seal plate 8 and the adjacent fuel-air deflecting wall of nozzle tube 5 into the outer air channel. Burning of this fine coal resulted in coke deposits within this air channel or at its discharge end interfering with the proper air flow. This leakage is now overcome by the installation of the baffle walls 17, 18, 19, which correct the concentration of the air-fuel mixture along the deflecting wall of the nozzle tube 5 and the resulting relatively unequal pressure there when the nozzle is tilted.

Thus when the nozzle is tilted upwardly a higher pressure zone is created on the outside of the turn causing a higher velocity and a lower pressure zone is created on the inside of the turn causing a lower velocity or even sometimes eddy currents. In our invention as illustrated in Fig. 3 this is eliminated and compensated for automatically by restricting the flow area between edge 19*a* and the wall 7 at the outside of the turn and increasing the flow area between wall 17 and the wall of fuel pipe 3 at the inside of the turn when tilting the nozzle upwardly. The opposite, of course, results when tilting the nozzle downwardly. In either case the unequal velocities through the nozzle are made substantially equal by restricting the flow in the high pressure zone and encouraging the flow in the low pressure zone.

While the preferred embodiment of our invention has been here shown and described, it will be understood that changes in construction, combination and arrangement of parts may be made without departing from the spirit and scope of the invention as claimed.

We claim:

1. In a conduit for conveying a fluid and having a tiltable nozzle at the discharge end thereof for receiving said fluid in a stream substantially uniform across the conduit's flow area and for discharging said stream uniformly across the nozzle's discharge area, an outlet portion of said conduit operatively connected to said tiltable nozzle, said outlet portion forming a single and undivided flow channel, means for pivoting and tilting said nozzle in a plane about an axis perpendicular to the longitudinal axis of said conduit, a division wall normal to said plane arranged within said nozzle in the direction of flow forming two parallel flow channels, a portion of said division wall extending a substantial distance beyond said pivoting axis in an upstream direction, and at all tilting positions being rigidly aligned with said division wall, said extended portion having a length sufficient, upon tilting said nozzle with respect to said conduit, to cause the effective flow area between said portion and said conduit's wall to be restricted on one side and to be enlarged on the opposite side thereof to such an extent that, because of the turbulence being created by virtue of said portion being extended into said fuel stream, the solid fuel concentration of said fluid leaving each of said channels remains substantially equal regardless of the tilted position of said nozzle.

2. A conduit according to claim 1 wherein said nozzle's division wall is arranged in a plane passing through the longitudinal axis of said nozzle and through the axis of said pivoting means.

3. A conduit according to claim 1 having a nozzle with at least one additional division wall and extended portion rigidly aligned therewith, and arranged parallel to the division wall of claim 1, whereby the nozzle's flow area is divided into three flow channels.

4. A conduit for conveying a fluid and having a tiltable nozzle at the discharge end thereof for receiving said fluid in a stream substantially uniform across the conduit's flow area and for discharging said stream uniformly across the nozzle's discharge area, an outlet portion of said conduit operatively connected to said tiltable nozzle, said outlet portion forming a single and undivided flow channel, means for pivoting and tilting said nozzle about an axis perpendicular to the longitudinal axis of said conduit, one inner and two outer division walls arranged within said nozzle in parallel planes and in the direction of flow forming four parallel flow channels within said nozzle, a portion of each of said outer division walls extending a substantial distance beyond said pivoting axis in an upstream direction and at all tilting positions being rigidly aligned with each respective divison wall said extended portions having a length sufficient, upon tilting said nozzle with respect to said conduit, to cause the effective flow area between each of said portions and said conduit's wall to be restricted on one side and to be enlarged on the opposite side thereof, to such an extent that, because of the turbulence being created by virtue of said portion being extended into said fuel stream, the solid fuel concentration of said fluid leaving each of said channels remains substantially equal regardless of the tilted position of said nozzle.

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