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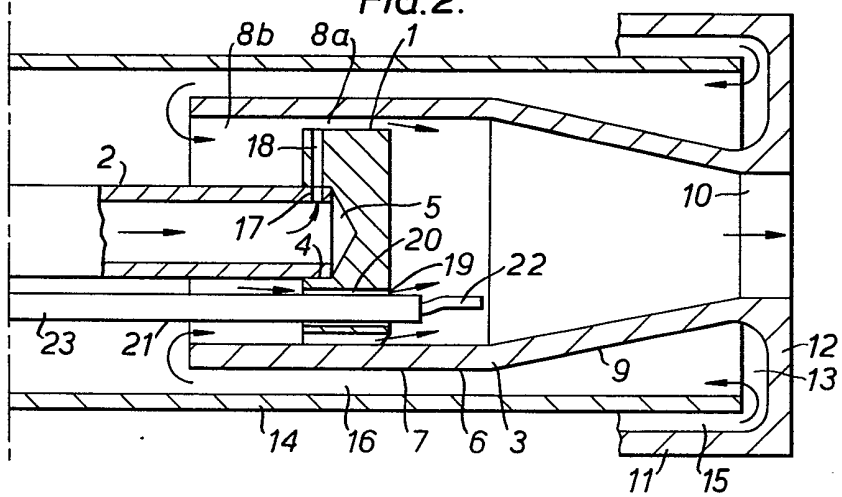
(54) **Burner assembly**

(57) A burner assembly for a fluidised bed comprises a fuel supply conduit 2 terminating in a nozzle 1 which extends with annular clearance 8a into a combustion chamber located within a tunnel 3. The nozzle 1 is provided with radially directed fuel outlet passages 18 where the fuel mixes with air entering the clearance 8a from passages 15, 16 and 8b.

Nozzle 1 is also provided with an aperture 19, located between two adjacent fuel ports 18. Extending through the aperture 19 is an electrically operated flame detection probe 21 with an electrode tip 22. An annular clearance 20 permits air to enter tunnel 3 from the clearance 8b independently of the clearance 8a.

The air flows around the probe 21 to form a cone of flame which enables an electrical current to be passed through the probe 21 between its tip 22 and the metallic earthed tunnel 3.

FIG.2.



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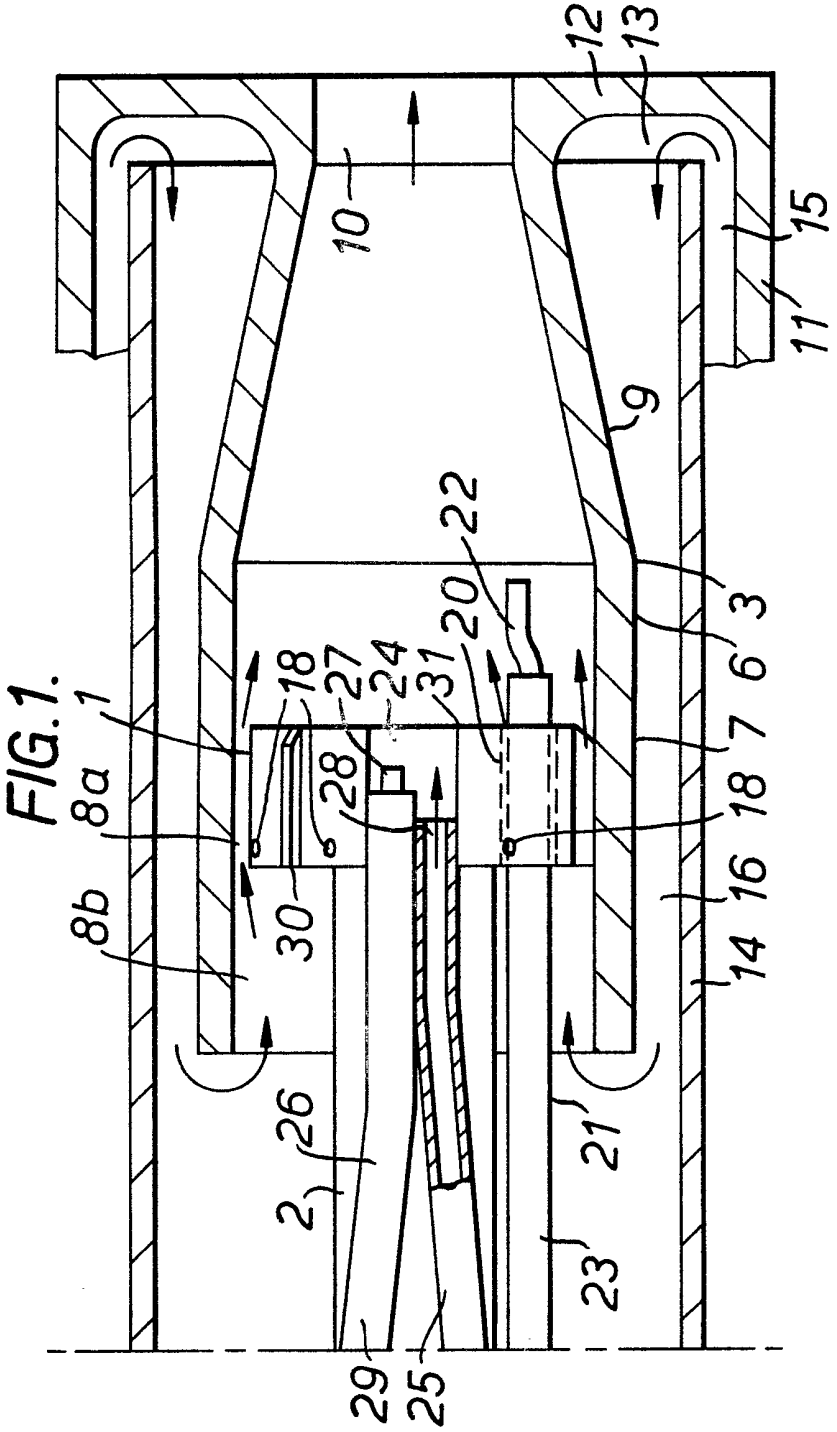
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8a
8b
30
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FIG.1.

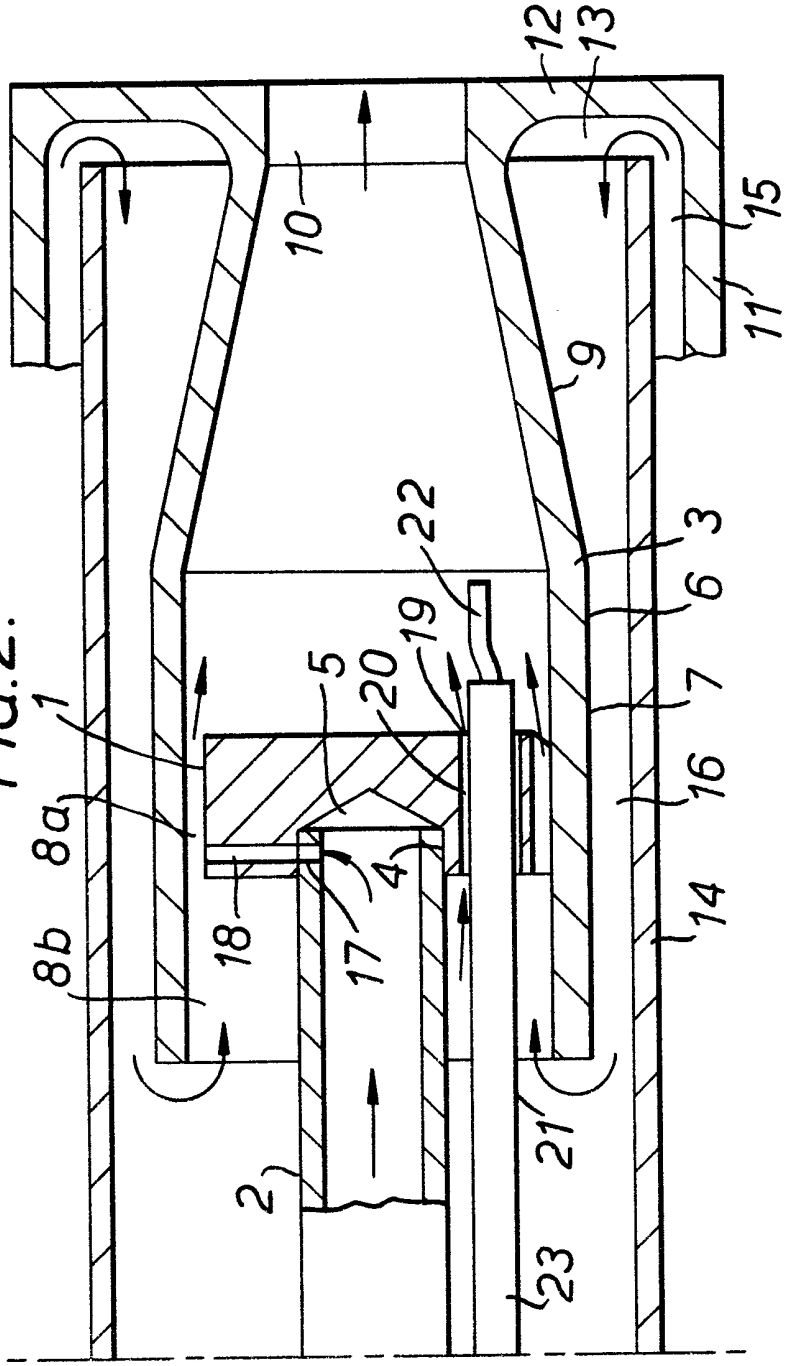

FIG.2.

SPECIFICATION

Fuel-fired burner assembly

The present invention relates to a fuel-fired burner assembly particularly though not exclusively for use within a tubular heating element of the type which, in use, is immersed in molten metal salts or fluidised beds of solid particles for conductive heating or which may be used in an enclosed or partially enclosed chamber to provide radiant and convective heating.

According to the present invention, there is provided a fuel-fired burner assembly including a fuel nozzle and a combustion chamber into which the fuel nozzle extends with clearance, the nozzle being such as to discharge the fuel into the clearance, and the assembly being arranged such that air is supplied, in use, to the combustion chamber by way of the clearance where the fuel and air mix before entering the combustion chamber wherein the assembly is also arranged to permit a residual supply of air to enter the combustion chamber independently of the clearance.

An embodiment of the present invention will now be particularly described with reference to the accompanying drawings in which:-

Figure 1 is a diagrammatic longitudinal section in one plane of the burner assembly and

Figure 2 is a diagrammatic longitudinal section in another plane at right angles to the plane in Figure 1.

Referring to the drawings the burner assembly comprises a metal eg steel fuel nozzle 1 mounted on the forward end of a metal eg. steel fuel supply pipe 2 and a metallic tunnel 3 into which the nozzle 1 and the pipe 2, in part, extend with clearance, the tunnel 3 forming a combustion chamber for fuel entering the tunnel 3.

The nozzle 1 is of generally cylindrical shape and is provided with a recess which has a cylindrical portion 4 into which the forward end of the pipe 2 is inserted and which recess terminates in a conical portion 5 although this could be flat. The pipe 2 which, in use conveys fuel gas to the nozzle 1 is welded to the nozzle 1.

The tunnel 3 has a central section 6 comprising a cylindrical rear portion 7 into which the nozzle 1 and part of the pipe 2 extend co-axially so that an annular clearance is formed between the portion 7 and the nozzle 1 and pipe 2. The external diameter of the nozzle 1 is greater than that of the pipe 2 so that the annular clearance 8a between the nozzle 1 and the tunnel 3 is less than that 8b between the pipe 2 and the tunnel 3.

The central part 6 of the tunnel 3 also comprises a conically shaped front portion 9 terminating in an outlet 10 for the combustion products of the fuel gas.

The tunnel 3, also comprises an outer cylindrical sleeve 11, only part of which is shown, and which is co-axial with the central part 6 of the tunnel 3. The sleeve 11 and the front portion 9 are joined by an annular front wall 12 so that a channel 13 is formed between the sleeve 11 and the central part 6. Extending into this channel 13 but terminating short of the wall 12 is a further cylindrical sleeve 14 which is closed at its rear end (not shown). The sleeve 14 forms an outer annular passageway 15 with the sleeve 11 and an inner annular passageway 16 with the central tunnel part 6. In use, air, preferably preheated, is supplied into the outer passageway 15 and is caused to flow in the direction of the arrows through the inner passageway 16 and towards the nozzle body 1 and through the clearance 8 into the central section 6 of the tunnel 3.

The pipe 2 is provided at points close to its forward end with a number, say six in all, of circumferentially spaced apertures 17 (only one shown in Figure 2). These apertures 17 communicate with corresponding circumferentially spaced and radially directed ports 18 extending through the body of the nozzle 1 and terminating in the annular clearance 8a between the nozzle 1 and the tunnel 3. Thus, in use, fuel conveyed along the fuel supply pipe 2 is caused to issue through the nozzle 1 as a number of radially directed streams into the clearance 8a where they meet and mix with the air passing through the clearance 8a. The fuel then enters the tunnel 3 as a fuel/air mixture.

Referring to Figure 1, the nozzle body 1 is also provided with a through-going aperture 19 between two adjacent fuel ports 18, the aperture 19 being aligned with the axis of the nozzle 1 but radially offset therefrom to connect the clearance 8b directly with the tunnel 3 totally independently of the clearance 8a.

Extending, with annular clearance 20 through the aperture 19 is an electrically operated flame detection probe 21 of conventional design and operation. The probe 21 has an electrode, the tip 22 of which is disposed within the central section 6 of the tunnel 3 while the remainder is sheathed with an insulating material 23 which extends through the aperture 19. The annular clearance 20 between the probe 21 and the wall of the aperture 19 permits a residual supply of air to enter the tunnel 3 from the clearance 8b independently of the clearance 8a.

Referring to Figure 1, the nozzle body 1 is also provided with a circumferential recess 24 between two adjacent radial fuel ports 18. Mounted within the recess 24 are located a pilot fuel gas tube 25 and an ignition electrode 26 whose tip 27 is located adjacent the tube outlet 28, the remainder of the electrode 26 being sheathed with an insulating sheath 29. The pilot tube 25 effects ignition of the air/gas mixture entering the central part 6 of the tunnel 3 as is conventional after its own ignition by the electrode 26.

Referring to Figure 1 the nozzle 1 itself may be supported within the rear portion 7 of the central section 6 by any convenient means, some of which are described in UK Patent Specification No. 1404578. Preferably however, the nozzle body 1 is provided with a number of circumferentially spaced rectangular blades 30 (only one shown) which are welded to the outer surface of the nozzle 1 and are equispaced between the radial fuel gas ports 18. In this way, the nozzle 1 is free to slide longitudinally in the rear portion 7 of the central tunnel section 6, the supply pipe 2 and the conical tunnel portion 9 providing the

only limitation to the extent of movement.

In operation of the burner assembly, air, preferably preheated, is conveyed along the passageways 15 and 16 and in the passageway 16 the air effects a cooling of the central section 6 of the tunnel 3. The air then reverses its direction of flow to flow towards the nozzle 1 by way of the clearances 8a. Most of the air then enters the clearance 8b where the air undergoes an increase in velocity and reduction in pressure because of the reduction in area available for air flow in the clearance 8a as compared to the clearance in 8b. Fuel in gaseous or vaprous form is induced to flow into the clearance 8a as a number of streams via the ports 18 in the nozzle body 1 and the fuel meets and mixes with the air and flows into the rear portion 7 of the tunnel 3 downstream of the nozzle 1. On flowing past the pilot tube 25 from which a pilot flame issues the fuel/air mixture is ignited. On flowing past the nozzle body 1 the fuel/air mixture expands and partially clings to the tunnel 3 so cooling the tunnel 3 before circulating inwards against the downsteam end face 31 of the nozzle 1 and burning within the central section 6 of the tunnel 3 which serves as a combustion chamber.

A residual supply of air by-passes the clearance 8a and passes through the aperture 19 in the nozzle 1 by way of the clearance 20 so that the residual air flows around the probe 21 and forms a cone of flame which enables an electrical current to be passed through the probe 21 between its electrode tip 22 and the metallic tunnel 3 which is earthed.

Instead of an electrically operated flame detection probe an ultra-violet flame sensor may be mounted in the assembly with its sensor head aligned with but not obstructing the aperture 20. In this case the residual air flowing through the aperture mixes with the burning gases in the central tunnel section 6 to form a cone of more intense flame over the aperture 20 which can be more readily detected by the sensor.

After combustion, the exhaust gas leaves the tunnel outlet 10 after being accelerated as a result of its passage through the conically tapering portion 9 of the central tunnel section 6. Lower velocities are possible with a parallel tunnel.

The burner assembly can be incorporated into a tubular heater such as that described in our co-pending UK Patent Application No. , the heater also providing the preheat for the supply of air.

CLAIMS

1. A fuel-fired burner assembly including a fuel nozzle and a combustion chamber into which the fuel nozzle extends with clearance, the nozzle being such as to discharge the fuel into the clearance, and the assembly being arranged such that air is supplied, in use, to the combustion chamber by way of the clearance where the fuel and air meet and mix before entering the combustion chamber wherein the assembly is also arranged to permit a residual supply of air to enter the combustion chamber independently of the clearance.

2. An assembly as claimed in Claim 1 in which the fuel nozzle is mounted at the forward end of a fuel supply conduit, the nozzle body being so dimensioned as to extend radially outwardly from the conduit, means being provided to supply air towards the nozzle body and the nozzle body having an aperture connecting the air supply means to the combustion chamber so that a residual supply of air enters the combustion chamber by way of the aperture and independent of the clearance.

3. An assembly as claimed in Claim 1 or Claim 2 in which the nozzle body has a plurality of passages to supply fuels to the clearance as a plurality of streams.

4. An assembly as claimed in Claim 3 in which the passages are arranged in a circular formation around the axis of the nozzle and are radially directed outwardly from the axis of the nozzle.

5. An assembly as claimed in any of Claims 2 to 4 in which a forward portion of the fuel conduit extends with clearance into the combustion chamber.

6. An assembly as claimed in Claim 5 in which the radial clearance between the combustion chamber and the nozzle is less than that between the combustion chamber and the fuel conduit.

7. An assembly as claimed in any of the preceding claims in which the combustion chamber has a rearward portion into which the nozzle extends and an adjoining forward portion, the portions being cylindrical and the forward portion tapering conically forward.

8. An assembly as claimed in any of Claims 2 to 7 in which an electrically operated flame detection probe extends through the aperture with clearance to permit the residual supply of air to enter the combustion chamber, the probe having an electrode located within the combustion chamber for forming an electrical connection with an adjacent electrically conducting surface of the assembly by way of ionised combustion gas.

9. A burner assembly substantially as hereinbefore described with reference to the accompanying drawings.

10. A burner assembly adapted to operate substantially as hereinbefore described with reference to the accompanying drawings.

11. A tubular heating element incorporating the burner assembly claimed in any of the preceding claims.

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