

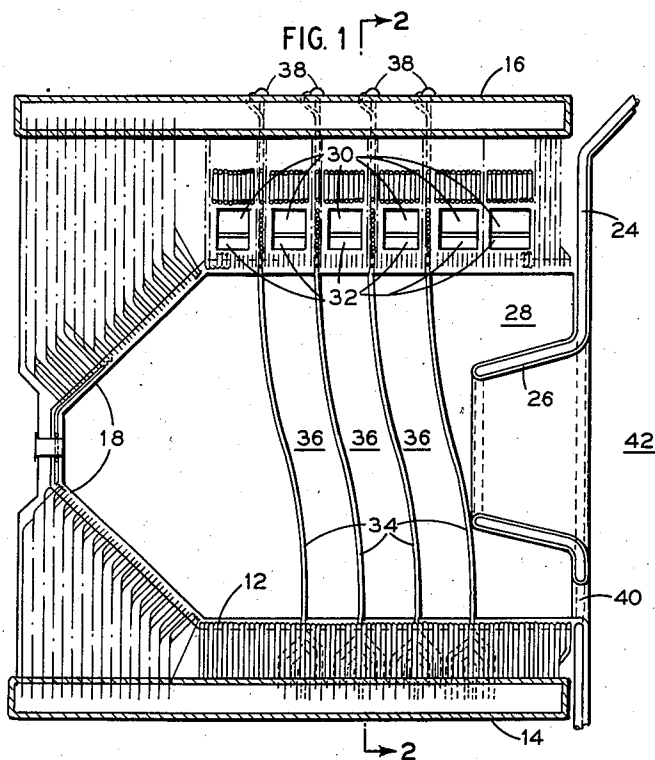
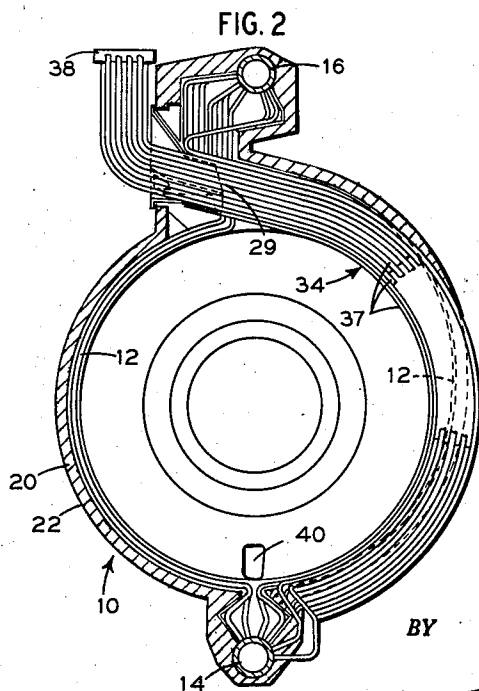
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CYCLONE FURNACE

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CYCLONE FURNACE

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6 Claims. (Cl. 110—28)

The present invention relates in general to the construction and operation of apparatus for burning ash-containing solid fuel, and more particularly, to the construction and operation of a cyclone type furnace designed for the burning of an ash-containing crushed or granular fuel above the fuel ash fusion temperature. Furnaces of this general type are described in U. S. Patent No. 2,594,312.

It has been a customary practice to introduce the fuel and air into the combustion chamber of a cyclone furnace through ports arranged tangentially along the circumferential wall thereof, with the quantity and distribution of fuel and air being regulated by suitable dampers. When the quantity and distribution of fuel and air to the respective supply ports are uniform, the fuel and air streams entering the combustion chamber are rapidly ignited and the high velocity of the burning fuel and air causes the gas stream to follow a generally helical path along the circumferential wall of the combustion chamber in the direction of the gas outlet thereof. If individual supply ports are cut off or the flow of fuel and air thereto is reduced, this being a condition prevalent at almost every load since the design of firing equipment normally requires provision for peak loads, that is, loads in excess of the normal continuous operating load, the quantity and distribution of fuel and air to the respective ports will no longer be uniform. In this circumstance, while the entering fuel and air streams follow a generally helical path of travel, there is some flow laterally or longitudinally of the combustion chamber adjacent the ports that are idle or operating at relatively reduced fuel and air supply because of the pressure differential existing between the zones of fuel and air entry of the respective ports. This flow of burning fuel and air adjacent the idle ports results either in coking thereof or overheating with subsequent wastage or both. The tendency toward overheating can be avoided to some extent by keeping the dampers of idle air ports slightly open, but this measure has the disadvantage of diluting the neighboring fuel and air streams with attendant delay in ignition thereof.

The present invention avoids the foregoing difficulty by providing baffle means along the length of the combustion chamber. In particular, the present invention provides a cyclone furnace having walls including fluid cooled tubes defining a combustion chamber of substantially circular cross-section having a gas outlet at one end thereof. A plurality of ports for introducing fuel and air into the combustion chamber are arranged at spaced positions along the length of the chamber substantially tangentially to the circumferential wall thereof. Baffle means are spaced along the length of the combustion chamber and form therebetween passages leading from separate ports and terminating at a point angularly spaced from the point of fuel and air entry thereto. The outer boundaries of the passages are formed by the circumferential wall of the combustion chamber. With this arrangement, the baffles impede or substantially prevent the flow of gases longitudinally of the combustion cham-

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ber adjacent the ports. In addition, when the occasion arises, the dampers of idle ports may be kept slightly open for port cooling purposes without affecting the ignition of the fuel and air streams discharging from adjacent in-service ports.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which a preferred embodiment of the invention is illustrated and described.

Of the drawings:

Fig. 1 is a sectional elevation of a cyclone furnace constructed in accordance with the invention; and

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1.

While various kinds of liquid and gaseous fuels can be burned in the cyclone furnace construction illustrated, the construction illustrated and hereinafter described is especially designed and particularly adapted for burning coarsely pulverized or "granulated" bituminous or semi-bituminous coal.

In the embodiment illustrated, the cyclone type furnace 10 is of horizontally elongated substantially circular cross-section, the circular boundary wall being formed by closely spaced studded fluid cooled tubes 12 covered by a layer of refractory material, each tube having a semi-circular bent portion to form the circumferential wall. The lower ends of the wall tubes 12 are connected to a supply header 14 and their upper ends to a discharge header 16. The front end portion of the furnace is tapered outwardly in cross-section and formed by closely spaced circular studded fluid cooled tubes 18 of progressively smaller diameter connected at their lower ends to the header 14 and at their upper ends to the header 16. These tubes are also covered by a layer of suitable refractory material. Several layers of high temperature insulation 20 are applied to the outer side of the wall tubes 12 and 18 and the outer side of this insulation is covered with a casing 22. The rear of the furnace is partially closed by a row of closely spaced fluid cooled tubes 24 having bent portions forming an inwardly projecting gas outlet throat 26 of circular cross-section flaring towards its discharge end and arranged co-axially of the furnace chamber. An annular pocket 28 is thus formed between the throat and the circumferential furnace wall and which in operation causes the whirling gas stream to substantially reverse its direction before entering the throat.

As shown in Fig. 2, the wall tubes 12 along one side are bent radially outwardly along an involute curve for a major portion of the furnace chamber length starting at the inner end of the tapering portion of the furnace chamber. These tubes cooperate with the corresponding tubes at the opposite side of the furnace chamber to define an axially elongated inlet 29 for air and fuel. The inlet 29 includes pairs of superposed ports 30 and 32 at spaced positions along the length of the inlet arranged substantially tangentially to the outer end of the involute curved portion of the circumferential wall of the furnace chamber, the ports 30 being for the introduction of secondary air into the chamber and the ports 32 for the introduction of fuel and primary air. Suitable dampers, not shown, may be provided to regulate the supply of fuel and air to the respective ports.

A series of baffles 34 of helical form extending transversely of the furnace chamber are spaced along the length of the chamber and form therebetween passages 36 leading from separate ports 30, 32 and terminating at a point spaced substantially angularly about 180° from

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the point of fuel and air entry thereto. Each of the baffles 34 includes a row of closely spaced studded and refractory covered fluid cooled tubes 37 having their upper portions disposed between intermediate pairs of fuel and air ports 30, 32 and terminating in a header 38 and having their lower ends connected to the header 14. The inner margin of each baffle 34 includes an intermediate portion within the combustion chamber of partly circular formation extending in the direction of fuel and air travel from a point subjacent the ports 32 to a point in line with the portions of the wall tubes 12 adjacent the bottom of the combustion chamber. Thus the perpendicular distance from the circumferential wall of the combustion chamber to the inner margin of each baffle gradually diminishes from the point of fuel and air entry to a point adjacent the bottom of the combustion chamber. The outer boundaries of the passages 36 are formed by the circumferential wall of the combustion chamber. With the baffles so arranged, gas flow longitudinally of the combustion chamber adjacent the ports 30, 32 is impeded or substantially prevented. It is preferred that there be no baffle between the two innermost pairs of ports 30, 32 to avoid disrupting the gas flow reversing action effected by the annular pocket 28.

A slag outlet 40 is provided in the lower part of the furnace chamber adjacent the gas outlet throat 26 for the discharge of molten slag resulting from combustion. With an inclined furnace chamber, the discharge end of the baffles 34 must terminate before the slag outlet 40 or the baffles must be provided with openings to allow the molten slag to tap.

While not indicated on the drawing, it is to be understood that all tubes and headers are suitably connected into the fluid circulation system of the fluid heating unit with which the cyclone furnace is associated.

In the operation of the cyclone furnace construction described, coarsely pulverized or "granulated" bituminous or semi-bituminous coal, carried in a stream of preheated primary air, is introduced tangentially through the ports 32. Streams of secondary air are admitted tangentially through the ports 30 in the same direction of rotation and at the outer side of the streams of fuel laden air discharging from the ports 32. The baffles 34 direct the burning fuel and air streams in a helical path of travel along the circumferential wall toward the rear of the furnace where the gases are caused to reverse direction within the annular pocket 28 before entering the throat 26. The gases then discharge into a laterally adjacent chamber 42 of a fluid heating unit, not shown. Molten slag resulting from combustion continuously discharges through the opening 40 into the chamber 42.

While in accordance with the provisions of the statutes we have illustrated and described herein a specific form of the invention now known to us, those skilled in the art will understand that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention covered by our claims, and that certain features of the invention may sometimes be used to advantage without a corresponding use of other features.

What is claimed is:

1. A cyclone furnace having walls defining a combustion chamber of substantially circular cross-section, fluid cooling means for said walls, means defining a restricted gas outlet at one end of said chamber, means forming a plurality of ports at spaced positions along the length of said chamber arranged substantially tangentially to an involute curved portion of the circumferential wall of said chamber for introducing fuel and combustion air thereto, and baffle means each including fluid cooled tubes spaced along the length of said chamber and forming therebetween curved passages leading from separate ports and terminating at a point spaced substantially angularly from the point of fuel and air entry thereto,

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the outer boundaries of said passages being formed by the circumferential wall of said chamber, said baffle means being arranged to impede gas flow longitudinally of said chamber adjacent to said ports and to direct the fuel and air streams discharging into said chamber in a helical path of travel along the circumferential wall thereof.

2. A cyclone furnace having walls defining a combustion chamber of substantially circular cross-section, fluid cooling means for said walls, means defining a restricted gas outlet at one end of said chamber, means forming a plurality of ports at spaced positions along the length of said chamber arranged substantially tangentially to the circumferential wall of said chamber for introducing fuel and combustion air thereto, and a series of baffles of helical form spaced along the length of said chamber and forming therebetween passages leading from separate ports, each of said baffles extending transversely of said combustion chamber and having an inner margin of partly circular formation extending from the zone of fuel and air entry to a point spaced substantially angularly therefrom in the direction of fuel and air travel, the outer boundaries of said passages being formed by the circumferential wall of said chamber, said baffles being arranged to impede gas flow longitudinally of said chamber adjacent to said ports and to direct the fuel and air streams discharging into said chamber in a helical path of travel along the circumferential wall thereof.

3. A cyclone furnace having walls defining a combustion chamber of substantially circular cross-section, fluid cooling means for said walls, means defining a restricted gas outlet at one end of said chamber, means forming a plurality of ports at spaced positions along the length of said chamber arranged substantially tangentially to one end of an involute curved portion of the circumferential wall of said chamber for introducing fuel and combustion air thereto, and a series of baffles each including fluid cooled tubes spaced along the length of said chamber and forming therebetween curved passages leading from separate ports and terminating at a point spaced substantially angularly from the point of fuel and air entry thereto, the outer boundaries of said passages being formed by the circumferential wall of said chamber, said baffles being arranged to impede gas flow longitudinally of said chamber adjacent to said ports and to direct the fuel and air streams discharging into said chamber in a helical path of travel along the circumferential wall thereof.

4. A cyclone furnace having walls defining a combustion chamber of substantially circular cross-section, fluid cooling means for said walls, means defining a restricted gas outlet at one end of said chamber, means forming a plurality of ports at spaced positions along the length of said chamber arranged substantially tangentially to one end of an involute curved portion of the circumferential wall of said chamber for introducing fuel and combustion air thereto, and a series of baffles each including fluid cooled tubes spaced along the length of said chamber and forming therebetween curved passages leading from separate ports, each of said baffles extending transversely of said combustion chamber and having an inner margin of partly circular formation extending from the zone of fuel and air entry to a point spaced substantially angularly therefrom in the direction of fuel and air travel, the outer boundaries of said passages being formed by the circumferential wall of said chamber, said baffles being arranged to impede gas flow longitudinally of said chamber adjacent to said ports and to direct the fuel and air streams discharging into said chamber in a helical path of travel along the circumferential wall thereof.

5. A cyclone furnace having walls defining a combustion chamber of substantially circular cross-section, fluid cooling means for said walls, means defining a restricted gas outlet at one end of said chamber, means forming a plurality of ports along the length of said chamber arranged substantially tangentially to the circumferential

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wall of said chamber for introducing fuel and combustion air thereto, and baffle means separating said ports and arranged to impede gas flow longitudinally of said chamber adjacent to said ports and to direct the fuel and air streams discharging into said chamber in a helical path of travel along the circumferential wall thereof, said baffle means projecting inwardly from the circumferential wall of said chamber and extending circumferentially from said ports to a point spaced angularly therefrom.

6. A cyclone furnace having walls defining a combustion chamber of substantially circular cross-section, fluid cooling means for said walls, means defining a restricted gas outlet at one end of said chamber, means forming a plurality of ports along the length of said chamber arranged substantially tangentially to the circumferential wall of said chamber for introducing fuel and combustion air thereto, and fluid cooled baffle means disposed between said ports and arranged to impede gas flow longi-

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tudinally of said chamber adjacent to said ports and to direct the fuel and air streams discharging into said chamber in a helical path of travel along the circumferential wall thereof, said baffle means projecting inwardly from the circumferential wall of said chamber and extending circumferentially from said ports to a point spaced substantially angularly therefrom in the direction of fuel and air travel.

References Cited in the file of this patent

UNITED STATES PATENTS

707,216	Duc	Aug. 19, 1902
2,476,507	Parmele	July 19, 1949
2,636,484	Bailey et al.	Apr. 28, 1953

FOREIGN PATENTS

1,092,350	France	Nov. 10, 1954
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