Oct. 14, 1958 O. VON SWIETOCHOWSKI 2,855,873

CYCLONE FURNACE

Filed June 15, 1956 2 Sheets-Sheet 1

Fig. 1

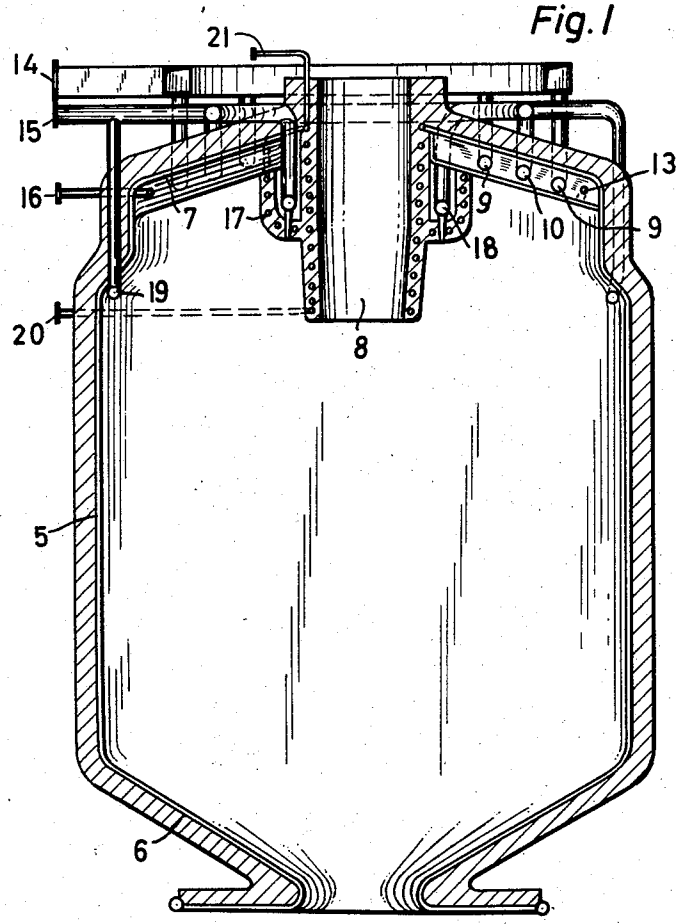
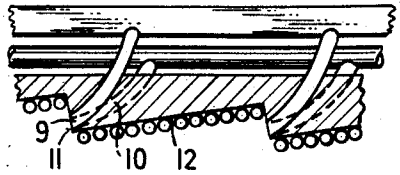


Fig. 2



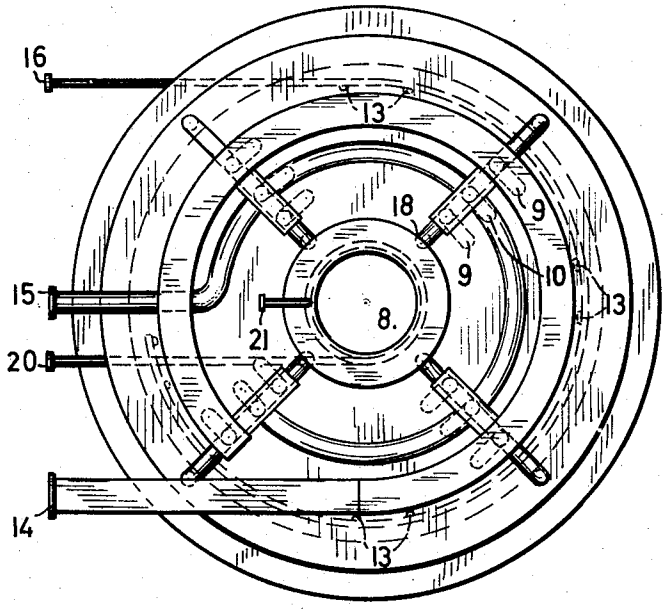
INVENTOR.
O. Von Swietochowski
BY
Glascock Downing & Seebold
ATTYS.

Oct. 14, 1958 O. VON SWIETOCHOWSKI 2,855,873

CYCLONE FURNACE

Filed June 15, 1956 2 Sheets-Sheet 2

Fig. 3



INVENTOR.
O. Von Swietochowski
BY
Glascock Downing & Seebold
ATTYS

United States Patent Office

2,855,873

Patented Oct. 14, 1958

2,855,873

CYCLONE FURNACE

Olivier von Swietochowski, Koln-Dellbruck, Germany

Application June 15, 1956, Serial No. 591,725

Claims priority, application Germany June 23, 1955

8 Claims. (Cl. 110—28)

This invention relates to an improved cyclone furnace.

Cyclone furnaces for melting of incombustible substances, contained in the fuel and/or additionally introduced are known in which the furnace proper consists of a multi-sided or cylindrical combustion chamber in the periphery of which are arranged supply connections or nozzles for the fuel, air and in some cases for fly ash from the furnace itself, or it may be from another furnace or furnaces. By means of devices for blowing in these materials a high-speed rotary motion and thereby centrifugal force is generated, the purpose of which is to increase the temperature of combustion, to lengthen the path over which combustion is effected for a given size of chamber and to separate the particles of ash which melt during the combustion on to the walls where they collect together and are led off downwardly to a discharge opening. Further essential components of such furnaces are the bottom closure with the discharge opening for the fluid slag and the cover from which leads a central off-take duct for the essentially gaseous products of combustion which projects into the chamber to prevent the flame from passing directly into the off-take.

Although the prior art cyclone combustion chambers exhibit the advantageous features of small size and good ash melting, they have high wall temperatures at which a part of the slag evaporates and forms a firmly adhering coating on the following boiler tubes. Additionally, they show an incomplete combustion of the coarser coal particles which are encased by the liquid slag at the inner wall of the combustion chamber.

Accordingly, it is a principal object of the present invention to substantially overcome the hereinbefore recited limitations of the prior art cyclone furnaces by arranging the chamber nozzles in a manner to slant against the combustion chamber axis from the ceiling thereof so that the flame is given an axial component and a tangential component, and thus takes a downward helical course whereafter it is diverted and the waste gases are drawn off axially upward through the off-take. In order to protect the mouths of the nozzles against radiation from the flame according to a development of the invention the cover is made up of sector shaped parts arranged at different inclinations to the horizontal so that looking at the periphery a saw tooth profile results. The nozzles are arranged in each second part surface and in particular the direction of the nozzles is made substantially perpendicular to the steeper sector surfaces which connect two adjacent flatter sector surfaces which is constructionally advantageous. The height of the steeper sector surfaces need be no more than is appropriate to the diameter of the nozzles.

The inclination of the individual nozzles can be the same but it may also be advantageous to incline the fuel and air nozzle differently in order to obtain rapid and uniform mixing together of fuel and air. It may further be advantageous to arrange nozzles for secondary air between a plurality of fuel nozzles arranged on the same, or a greater, radius. In order to avoid particles of fuel

not being fully burnt at or near the chamber wall, according to a further development of the invention air nozzles are provided at the outer margin of the cover by which a screen of air is formed along the wall through which the fuel particles must pass before they reach the chamber wall. It will depend on the properties of the fuel which of the above alternatives or which combination of these various features is used.

If a plurality of fuel or air nozzles are arranged along the same radius they can be directed parallel to one another but it may be advantageous so to arrange individual burners or air nozzles or to make them adjustable so that their axes are inclined to one another. In this way the centrifugal forces can within certain limits be adapted to the fineness of grinding of the fuel and the mixing is also improved.

According to a development of the invention the combustion air is injected at a different and preferably much higher speed than the fuel, i. e., mixture of fuel and conveying air, in order to accelerate the reaction by the relative speed between them.

In order to burn out and melt fly-ash separated in boiler flues and filters and coming from the same or other furnaces, fly-ash nozzles are arranged in the cover which open on the same radii as the fuel or air nozzles and which lie between these. Most advantageous, however, is the arrangement of these nozzles in a circle which lies outside the fuel and air nozzles.

In order better to achieve the rotational movement by a corresponding formation of the cover, instead of arranging the lower end of the central off-take so that it projects in the form of a flange into the chamber, an eversion of the cover downwardly into the combustion chamber is provided which enables air alone or mixed with fuel and/or fly-ash to be supplied through its outer surface in such direction and with such speed that the downwardly directed whirl is reinforced and the disappearance of the whirl inwardly consequent upon the destruction of the kinetic energy through friction and the increase in volume proceeding with the combustion is to a great extent eliminated. At the lower end of the everted part a flange-like extension can be provided whereby further guiding of the whirl is obtained.

Other objects and many of the attendant advantages of the instant invention will be more readily understood from the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a vertical section of the combustion chamber;

Fig. 2 is a detail side view, with part of the wall removed, and

Fig. 3 is a plan view with the cover removed.

Referring now to the drawings wherein like reference characters designate like parts throughout the several views, and more particularly to Fig. 1 the melting chamber furnace comprises a substantially cylindrical tube system **5** with a contraction **6** at the lower end. The side wall tubes **5** at the same time constitute the cover **7** through which the substantially cylindrical gas off-take **8** projects. Through the annular cover **7** project burners **9** between each two of which a secondary air nozzle **10** is arranged. Around the central gas off-take **8** is arranged an eversion **17** of the cover in which additional nozzles **18** are provided which serve for air or for air fuel mixture.

In Fig. 1 further air nozzles **19** are shown which are arranged beneath a stepped increase in diameter of the outer wall, such nozzles in this example only being shown at one level.

As more clearly shown in Fig. 2 the cover looking at the periphery is stepped in saw-tooth formation. It con-

sists of alternate steep and flatter parts **11** and **12** respectively. The burners **9** and secondary air nozzles **10** open through the former steep parts **11**. Only the flatter parts are provided with cooling tubes.

Fig. 3 shows the nozzle arrangements as seen from above. The media to be injected are led to the nozzles by ring shaped pipes **14**, **15**, **16**, which carry respectively the fuel air mixture, the secondary air, and the fly-ash. In the example selected for illustration, there are four rows of fuel nozzles **9**, each consisting of two nozzles arranged on the same radius with the four radii at 90° to one another and between the two nozzles on each radius there is one secondary air nozzle **10**. The fly-ash nozzles **13** are arranged in a circle which lies near the cylindrical outer wall of the chamber **5** outside the circle of the outermost burner nozzles **9**. The arrangement illustrated is to be regarded solely as one of the numerous possibilities of nozzle arrangement, the number, grouping and distribution of which will be suited to the operating conditions, the size of the boiler plant or the like.

The invention can be given numerous modifications. These consist not only as above mentioned in the most varied combinations of the features described, but for example also in the modifications which can be given to the shape of the cover which can also be made flat or of truncated slightly conical form with its base downwardly directed so that the slag which may be deposited thereon can easily run off the saw-tooth edges, too steep an inclination of the cover not being desirable as a rule in the interests of satisfactory movement in the chamber. Further, the nozzles need not be arranged on common radii because although this arrangement of radii through the saw-tooth formation has been found advantageous, if this form of cover is not used the nozzles can be arranged in any other desired manner uniformly or non-uniformly distributed. The alternate arrangement of the nozzles on the same radius can follow in any desired sequence, so that for example, the number of nozzles for the material to be melted such as fly-ash can be less than the number of pulverised fuel nozzles or of air nozzles.

I claim:

1. A cyclone furnace comprising a vertically set cylindrical chamber, a bottom closure for said chamber converging towards a central outlet for molten slag, a cover for said chamber having a central opening, a downwardly everted portion immediately surrounding the opening and a slightly downwardly sloping portion extending from the everted portion to the wall of the chamber, said cover being of saw-tooth form in cylindrical section, a plurality of pairs of fuel nozzles, each pair projecting through one of the steeper saw-tooth portions of said cover, a secondary air nozzle between each pair of fuel nozzles, a plurality of nozzles for the injection of fly-ash arranged in a circle projecting through said cover near the wall of said chamber and a plurality of additional air nozzles located to inject a screen of air close to the wall of said chamber.

2. A furnace as set forth in claim 1, wherein said chamber bottom and cover comprise a system of cooling tubes.

3. A water-cooled whirling combustion device comprising, a combustion chamber of substantially circular cross-section, a discharge opening formed in the bottom of said chamber, a cover for said chamber having a centrally located gas off-take opening therethrough, a first circularly arranged plurality of fuel burners on said cover at a spaced distance from said opening, a second circularly arranged plurality of fuel burners on said cover at a greater spaced distance from said opening, a third circularly arranged plurality of secondary air supply nozzles on said cover at a distance from said opening between said first and second circularly arranged burners, a fourth circularly arranged plurality of fly ash nozzles on said cover, the mouths of said burners and nozzles being inclined relative to the axis of said chamber thereby to effect a whirling motion of the gaseous products for melting and to throw the solid particles outward and downward along the boundary wall of said chamber toward said discharge opening.

4. A water-cooled whirling combustion device according to claim 3 wherein said burners and nozzles are all inclined at different angles in respect to the axis of said chamber.

5. A water-cooled whirling combustion device according to claim 3 wherein said cover includes a plurality of radially extending saw-toothed surfaces having one face thereof slightly inclined relative to the chamber axis and within which faces are arranged the mouths of said burners and nozzles.

6. A water-cooled whirling combustion device according to claim 5 wherein said saw-toothed surfaces have another face substantially perpendicular to the slightly inclined faces, and a plurality of cooling tubes arranged on said face.

7. A water-cooled whirling combustion device according to claim 3 and further including at least one outwardly stepped portion on the side walls of said chamber, and a plurality of additional nozzles arranged therethrough.

8. A water-cooled whirling combustion device according to claim 3 wherein said gas take-off opening comprises a partially double walled cylinder having a plurality of injection nozzles extending therethrough.

References Cited in the file of this patent

UNITED STATES PATENTS

901,232	Eldred	Oct. 13, 1908
1,180,792	Norrman	Apr. 25, 1916
1,966,054	Wheeler	July 10, 1934
2,464,791	Bonvillian et al.	Mar. 22, 1949

FOREIGN PATENTS

1,089,285	France	Sept. 29, 1954