Aug. 3, 1937. L. M. J. STOUFF 2,088,879

FURNACE FOR BURNING GRANULAR FUEL AND THE LIKE

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Fig. 2

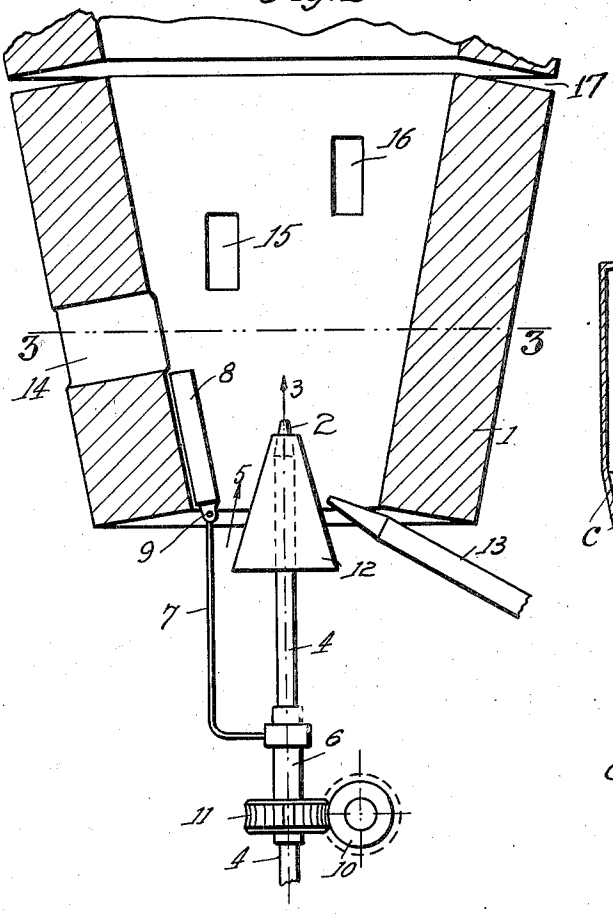


Fig. 1

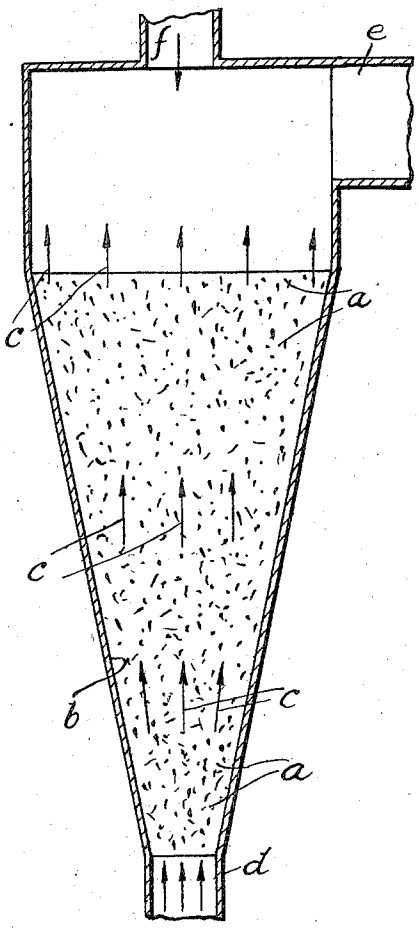
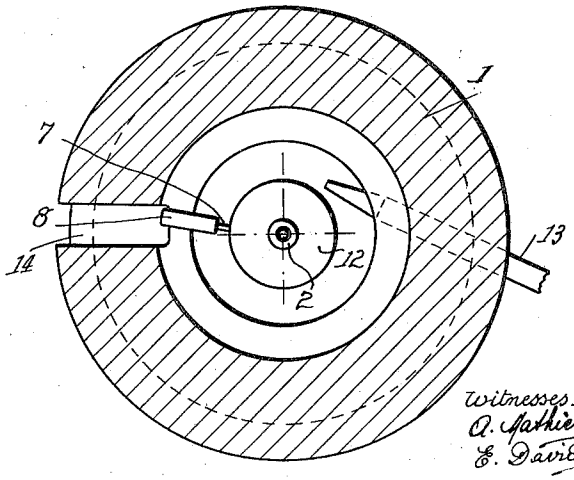


Fig. 3



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FURNACE FOR BURNING GRANULAR FUEL AND THE LIKE

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2 Claims. (Cl. 110—28)

This invention relates to a furnace for burning granular fuel and more particularly to a furnace of the kind in which the granular fuel is delivered to the upper end of the combustion chamber and falls through the combustion chamber against an upwardly directed air stream by which the fuel particles are held in suspension during combustion, the ash being continuously removed from the bottom of the furnace.

The object of the present invention is to provide a new or improved furnace of the type just referred to which will be efficient and stable in operation.

There already exist processes where combustion of the fuel takes place in a current of air. These processes, however, necessitate the use of pulverized fuel which is usually burnt upon a grate. On the other hand the present invention does not necessitate pulverization and permits of using granular fuel of all grain sizes from $\frac{1}{10}$ mm. to 30 mm. for example. There is no longer a grate or carrying surface, but merely the lateral walls of the chamber, and the fuel grains are constantly in gaseous suspension.

In the previous processes the fuel had only a limited stay in the chamber and had to be burnt during this period contrary to the present invention in which the fuel is permanently in a gaseous suspension in the chamber and where it remains indefinitely if it is not burnt.

In the known processes the flame does not fill the furnace, contrary to the present invention where the chamber walls guide the ascending air current and where the grains in aerodynamic suspension are distributed homogeneously in the whole.

In furnaces of the general character above referred to it has been proposed to make the furnace combustion chamber of conical or similar form with a view to regulating the air stream in the furnace chamber in such manner as to enable fuel particles to remain in suspension in the furnace for a sufficient period to permit combustion. For example, it has been proposed to design the furnace in such a way that the velocity of the air remains substantially the same at all heights of the combustion chamber.

In accordance with the present invention a furnace of the kind referred to is arranged so that the fuel particles are held in suspension in the furnace in a stable and permanent manner during the course of combustion by an upwardly directed gas stream whose velocity is substantially uniform at all points in any one horizontal section of the furnace and decreases progressively from the lower to the upper end of the furnace in a proportion sufficient to ensure the stability and permanence of the stay of the grains in the furnace, so that the whole of the furnace space is filled with fuel particles. This result is brought about by constructing the furnace in the form of a truncated cone having an angle of no more than about 25° and of such length that the cross sectional area at the upper end of the furnace is not less than 15 times the cross sectional area of the lower end of the furnace and preferably from 50 to 100 times. Owing to this arrangement very important technical advantages will be obtained, among which the main advantages are the following; the combustion will be homogenous, that is, in a horizontal plane, taken at any desired level of the furnace, the density of the fuel and its percentage of carbonic gas and oxygen will be constant at all points; any desired fuel, even in relatively thick particles, may be burned, whereby the pulverization thereof and the provision of a surface for carrying large material will be avoided; a mixture of particles of any dimension may also be used without objection; moreover the combustion will fill up the entire furnace, whereby a maximum of heat will be produced per cubic meter of the furnace space to be heated.

Air may be in part blown into the furnace at other levels and more particularly together with fuel. If necessary a portion of the combustion gases taken at any point of the plant may be injected together with air.

The air entry orifices are symmetrically disposed around the periphery of the cone in order not to disturb the homogeneity of the gaseous current, and the air is introduced radially to avoid turbulence.

In order to facilitate the comprehension of my invention, I have illustrated the latter by way of example in the accompanying drawing, wherein:

Fig. 1 is a diagrammatical section of a furnace according to my invention.

Fig. 2 is a vertical axial section of the lower part of one form of furnace.

Fig. 3 is a horizontal section on line 3—3 of Fig. 2.

Referring to Fig. 1 the combustion chamber *b* is made of the shape of a vertical truncated cone, the apex of which is turned downwardly. The angle formed between the walls, that is, the angle of the cone is 24°, the ratio between the bases of the truncated cone being equal to 16. Through said combustion chamber I cause a current of air to pass upwardly in the direction of the ar-

rows *c*, whilst the fuel is charged at *f* into the chamber.

Owing to the dimensions adopted, the walls fit the diverging form of the current of air and the fuel remains in stable suspension until it will be completely burned. The velocity of air at the lower part is sufficient for preventing the heaviest grains of fuel from being lowered until the combustion thereof will be complete. The velocity of the gases at the upper part is sufficiently low to prevent the unburned smallest particles of fuel from being carried away by said gases, the supporting power of which is too weak for compensating the weight of such particles.

Generally it will be observed that each grain of fuel accomplishes a rapid irregular oscillating movement around a medium level and substantially in a vertical direction. Owing to such oscillation an intense renewal of air will be produced at the surface of the grain, whereby the combustion thereof will be highly enhanced.

A very rapid oscillating movement being imparted to the grains *a*, the latter will bombard the walls *b*. If openings are provided at suitable points of said walls, for instance at the top and bottom, a certain amount of slag or dross will be discharged through said openings. The two ends *d* and *e* of the furnace, through which air is admitted and gas discharged respectively, may entirely or in part fulfill the function of the openings mentioned.

The furnace shown in Figs. 2 and 3 has its lower part provided with fireproof walls **1**, forming a truncated cone. Arranged centrally in the lower open end of said truncated cone is a pipe **4**, through which compressed air is supplied into the furnace in the direction of the arrow **3**. As this arrangement is operated like an injector, an induced current of air will pass through the free annular space **5** between the pipe **4** and the walls **1** of the furnace.

Slag or dross will drop freely through said annular space, wherein it will meet with an upward current of air and be cooled by the latter.

Loosely arranged on the pipe **4** is a sleeve **6**, on which a vertical rod **7** is mounted. A scraper or poker **8** is secured to the end of said rod **7** by means of a horizontal pivotal connection **9**. Through the agency of gear-wheels **10** and **11** rotary movement around the axis of the furnace will be imparted to the scraper **8** to bring the latter into frictional engagement with the lower wall and remove slag or dross therefrom, which will drop through the above mentioned annular space. However if certain portions thereof adhere too strongly to the walls, the scraper **8** will be moved away from the wall around the pivotal connection **9**.

Arranged on the end of the pipe **4** is a plug **12** of truncated cone shape. The conicity of said plug corresponds to the conicity of the furnace walls **1**, but the apex of the cone is turned in opposite direction, that is upwardly. By adjusting the plug **12** upwardly or downwardly, the dimensions of the air supply opening **5** will be modified without preventing slag or dross from dropping freely through the same.

A jet of compressed air is directed through the pipe **13** into the furnace. The pipe **13** is arranged substantially tangentially to a horizontal circumference, the centre of which is situated on the axis of the furnace, whereby the jet of compressed air will be caused to detach slag or dross from the walls by its whirling movement.

Provided in the walls **1** of the furnace are other air supply openings **14**, **15**, **16**. Upon closing said openings more or less, the temperature at the base of the furnace will be varied as required. A further air supply is provided at **17**, formed of a horizontal slot extending around the wall of the furnace.

I claim:

1. In a granular fuel burning furnace, the combination with a combustion chamber constructed in the form of a vertical truncated cone having an angle of not more than 25° and of such length that the cross sectional area at the upper end of the furnace is not less than about 15 times the cross sectional area of the lower end of the furnace and means for introducing the granular fuel downwardly through the combustion chamber, of a compressed air supply pipe in the open lower end of the combustion chamber, means on said pipe coacting with the furnace wall to form an annular opening around the pipe, through which a flow of secondary air is induced, a scraper mounted to rotate about the compressed air supply pipe to act on the walls of the combustion chamber near the base thereof, and means for supporting said scraper in such a way that it is capable of yielding in a direction away from the wall of the combustion chamber when encountering an obstruction, as described.

2. In a granular fuel burning furnace, the combination with a combustion chamber constructed in the form of a vertical truncated cone having an angle of not more than 25° and of such length that the cross sectional area at the upper end of the furnace is not less than about 15 times the cross sectional area of the lower end of the furnace and means for introducing the granular fuel downwardly through the combustion chamber, of a compressed air supply pipe in the open lower end of the combustion chamber, means on said pipe coacting with the furnace wall to form an annular opening around the pipe, through which a flow of secondary air is induced, means mounted to rotate on said compressed air supply pipe for scraping the walls of the combustion chamber near the base thereof, and a second compressed air supply pipe in the base of the combustion chamber to produce a jet substantially tangential to the furnace walls, as described.

LOUIS MARIE JOSEPH STOUFF.