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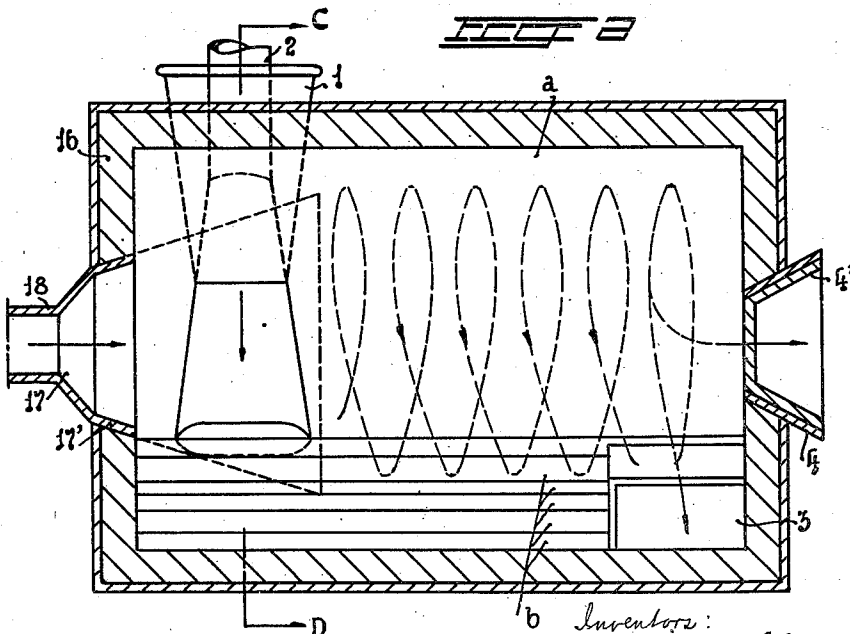
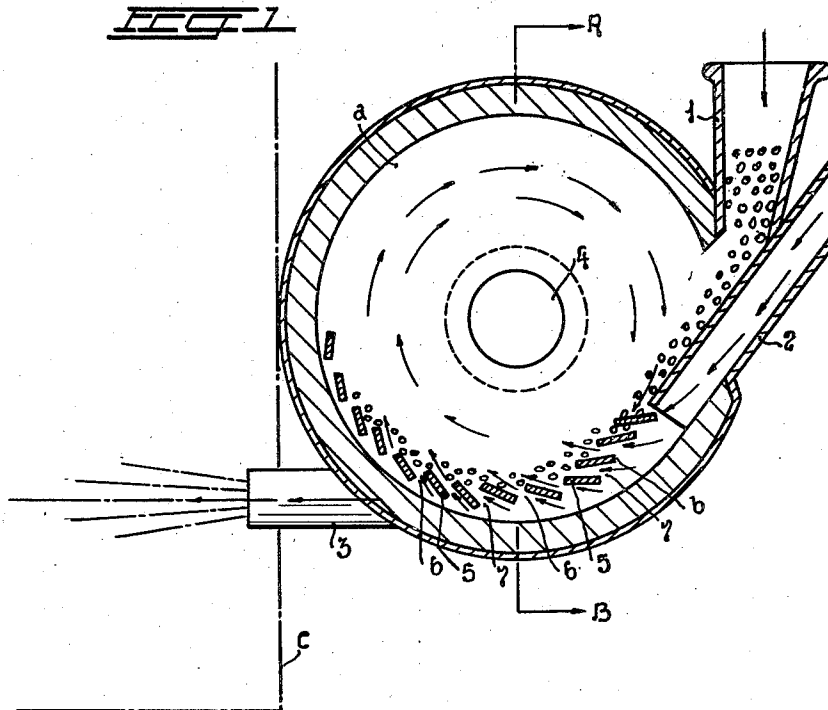
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2,395,103

TURBULENT BURNER FOR FUELS IN GENERAL

Filed Nov. 11, 1944

2 Sheets-Sheet 1



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FIG 3

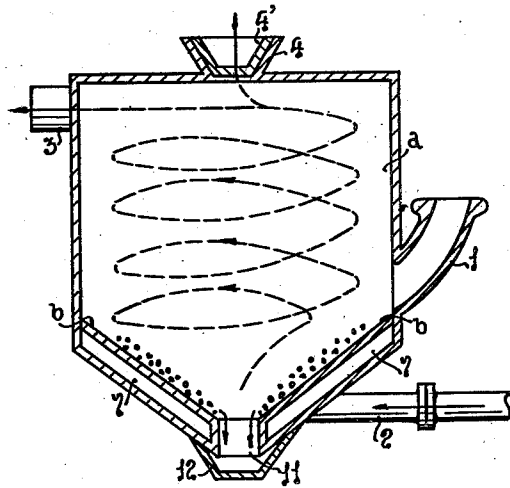
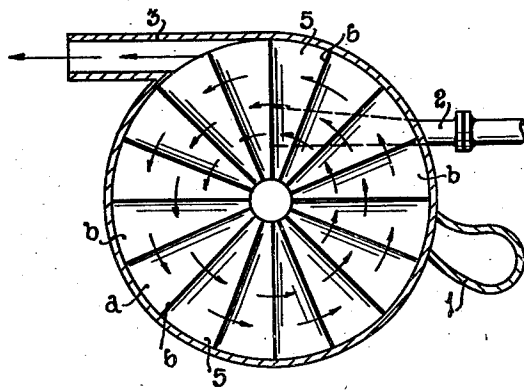


FIG 4



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TURBULENT BURNER FOR FUELS IN
GENERAL

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10 Claims. (Cl. 110—1)

This invention relates to a turbulent burner for fuels in general, the main object of which is to provide a unit capable of substituting any existing type of burner in its multiple applications, especially the industrial type of furnace.

Several types and systems of burners, of different characteristics, are known, the most current types of which consume liquid fuels; however, in view of the fact that liquid fuels are not always available, and in many cases become scarce or even non-existing, it becomes necessary to replace these burners for burners of the type which are adapted for the consumption of coal, firewood or other solid fuels.

Notwithstanding the apparent advantages of burners of solid fuels their industrial application has always created a problem since it is not always possible to obtain high temperatures unless fuels of a high caloric index are employed.

In view of this problem it has been necessary to resort to the use of other fuels such as oil mill residues, expeller, sunflower seed shell, bran, wheat, corn, etc., which consist of high grade combustible substances that render them often suitable for the purpose indicated; however, up to the present date the results obtained have been unsatisfactory.

This is due to the lack of suitable means for burning said substances, the composition of which consist of small particles or compact amorphous bodies which on entering the furnaces, tend to accumulate, forming semipasty masses which prevent the passage of air through the air inlets, thus producing an imperfect and incomplete combustion, leaving a great amount of residues and lava, and failing to take full advantage of the fuel as well as impairing the proper functioning of the burner itself.

The main object of this invention is to overcome all these disadvantages in an essentially simple way, permitting the consumption of any kind of type fuel, whether liquid, solid or pulverized, with a higher efficiency than has been obtained up to the present with the conventional type of burner.

The main characteristic of this invention consists in a chamber within which air is injected under pressure in order to produce turbulence in such a way as to create a cyclonic character with revolutions affording a practically absolute internal combustion of the fuel, since the extremely high temperature reached within the chamber provokes the nearly instantaneous decomposition of the fuel constituents, to such an extent that, apart from the residues of mineral

ashes, the other products of decomposition are eliminated through consumption.

For this purpose the chamber of the turbulent burner is provided with one or more tangential inlets for compressed air; said inlets are directed in such a way, that the air is forced to rotate within the chamber cavity, which, to that effect, is shaped with essentially cylindrical walls, said walls converting said rotation, in combination with the corresponding fire outlet, in a helicoidal movement of the air. The resultant trajectory of the latter in its course through the chamber is sufficient for a complete combustion of the fuel, because, by the centrifugal force created by said rotation the unburned particles of fuels cannot reach the central outlet.

Attention should be drawn to the form in which the apparatus operates to prevent, during the process, the accumulation of fuels or obstruction of its action by the formation of lava, slags or ashes. The bed of the chamber is permanently cooled by the compressed air entering for rotation therein, thus the fuel penetrating from the corresponding hopper is prevented from adhering to the bed and remains loose so, as by fusion the mineral parts of the ashes acquire the spheroidal state, instead of agglomerating, they disperse in their granular shape, facilitating and simplifying thereby their extraction and elimination.

All this emphasizes that the fundamental principle on which the present invention is based, is the combustion of the fuel in the chamber itself independently of the precinct of the hearth. In this way all the heat units of the fuel, which experiments a complete reaction, are taken advantage of, and, considering the fact that the incandescent gases are expelled in conjunction with the impulse and pressure of the air injected into the chamber, it is evident that the effect attained is similar to that of the burners generally known as liquid fuel blowers or fire pipes.

There are several other objects in the present invention in addition to those already mentioned, one of which is that this burner solves the problem of scarcity of mineral fuels, since it is possible through its use to obtain similar results with residues or substances heretofore considered waste, or unable to use for high temperatures.

Another object of the present invention is to provide a turbulent burner which, regardless of the type of fuel employed, is applicable to any type of furnace hearth or fire chamber in general.

Still another object of this invention is to provide a burner system of high temperature of the

desired cleanliness, without smoke or disagreeable odours, thus eliminating the necessity of forced draughts and secondary air currents, since, as already mentioned, the major part of the gases, combustible or not, (proceeding from a total or partial distillation, and/or from a total or partial cracking, and/or from a total or partial destruction of the molecular chains which as a whole constitute the fuel) are eliminated or ejected from the turbulent burner completely burnt or inert.

A further object of this invention is to provide a unit of any desired size, either similar to those used in the heavy industries, or again of a reduced portable size, all of which have the added advantage of being dismountable and of consisting of parts which are easily replaced.

Another object is to obtain great advantages in performance due, not only to the complete utilization of the fuel, but also to the form of producing the heat with practically no undesired irradiations.

Another object of the present invention is to attain a total combustion of the fuel, notwithstanding the high speed impressed upon the gases; this is due to the long trajectory covered as a result of the turbulence, and the above mentioned fact of retaining the unburned particles in the inside of the combustion chamber; the process being completed without any auxiliary devices, inasmuch as the result is obtained by means of an injection of air, the volume of which is slightly in excess of the amount theoretically required for the combustion of the fuel.

A further object is to avoid the egression of fuel incompletely burnt, by means of the cyclonic system.

Other objects of the present invention will be apparent from the following description, which, for the sake of clearness and understanding, has been illustrated with several drawings of the preferred embodiments of the turbulent burner, all of which are only illustrative examples, and in which:

Fig. 1 represents a cross sectional elevational view of the turbulent burner showing its simple structure and graphically indicating the method by which the injected air, partly being fed in conjunction with the fuel, the balance being directed through the different passages in the chamber bed, in such a manner that, while refrigerating the latter, it promotes combustion and starts, at the same time, revolving in the direction indicated by the arrows, until finally it takes a winding course and is projected from its corresponding fire-spout in potent flames of incandescent gases towards a hearth chamber or the like.

Fig. 2 is a longitudinal section of the same turbulent burner which, in this case, is cylindrical, the arrows in the drawings graphically indicating the helicoidal course acquired by the gases during combustion until they are expelled, combustion finished, through either of the two spouts or mouths provided in the chamber of the apparatus.

Fig. 3 shows another embodiment of the turbulent burner apparatus which, in the present case, has a vertical cylindrical body, while its lower section or hearth is a truncated cone provided with a slag and ash pit; and finally,

Fig. 4 shows a plan view of the apparatus illustrated in Fig. 3.

In the different figures the same numbers and letters of reference designate like or corresponding elements or parts throughout the description.

As shown in the drawings, *a* is the chamber or hearth of the turbulent burner with a corresponding flooring or grate *b*, a feedhopper *1* and a towel for compressed air *2* originated from a fan, compressor or the like, said burner having outlet means indistinctly constituted by muzzles *3* or *4*.

The chamber flooring or grate *b* is constructed by a plurality of segments *5* which, adopting the disposition of window blinds or the like, provide a bedding arrangement in echelon, the flanks of which have openings or passages *6* all oriented in the same direction and allowing the air from the conduit or cavity *7* below the grate *b* to pass through to the interior of chamber *a*. At the same time, segments *5*, which are of reduced thickness, are kept cool by the air flowing beneath them through the conduit or cavity *7*.

The openings or passages *6* are placed obliquely and tangentially in relation to the contour of the chamber *a* and give to the products of the combustion a course which, inside the chamber, takes the character of helicoidal revolution, such as shown in the different drawings.

In the illustration represented by Figs. 1 and 2, hopper *1* is formed by an entrance to the body of the chamber, so that the charge of the hopper enters tangentially into the chamber flooring or bottom *b*, as clearly illustrated in Fig. 1.

The air enters under pressure through conduit *2* directly into precinct *7*, so as to create the turbulence within the chamber.

In the illustration of Figs. 3 and 4 the cylinder constituting the chamber *a* is vertical and the chamber grate *b* is formed by a lower section of truncated cone shape, said grate *b* being formed by segments *5* which in this case are radially disposed in sectors, leaving between them the spacings necessary to obtain the same effect as in the embodiment of Figs. 1 and 2; in other words, through the corresponding openings or passages *6* formed by the stepped position of the successive segments *5*, the air in precinct *7* is directed obliquely and, on reaching the walls of chamber *a*, it starts a substantially helicoidal rotation, as shown in Fig. 3, said rotating cycle ending at the corresponding outlet which, in the present case, is constituted by spout *3*, since spout *4*, in this instance, is closed by cover *4'*.

As the grate *b* of chamber *a* in the embodiment of Figs. 3 and 4 is a truncated cone, it ends in the center concurrently with the ash collector *11* which leads into ash pit *12* receiving the ashes and slag originated from the combustion.

In view of the fact that, sometimes, the draught at the outlet of the chamber does not exist, the helicoidal course of the products of the combustion, when necessary, will have to be assisted by an air drive from the rear end wall *16*; for this purpose the latter is provided, when necessary, with an air impeller *17* consisting of a feeder or injector connected to the tube *18* deriving from a source of compressed air, said impeller *17* having a bell *17'* wherefrom a diverging stream of air is projected, which is capable of impelling the gases that, having started a rotating motion by the action of the oblique disposition of passages *6*, have been forced to enter in turbulence; thus, they acquire the helicoidal displacement until they reach the outlet muzzle *3* or *4*.

Operation

In order to start the firing of the turbulent burner, it is necessary to pre-heat it so as to obtain a relatively high temperature in the cham-

ber *a*, for which purpose a small amount of charcoal, for instance, is introduced and kept burning until a temperature of about 500° C. to 600° C. is reached. The feeding of the fuel and the regulation of the air then take place.

As previously stated, the fuel, which may be a solid or liquid matter of any nature, is introduced by gravity or by the impulsion and dosage furnished by hopper 1, and deviated and dispersed about the chamber grate *b*. The current of air, which from the towel 2 is directed into conduit 7, cools the segments 5 and flows through the air passages 6 towards the fuel, in order, not only to feed and speed the combustion, but also to drive the resultant gases of the combustion in an oblique direction corresponding to the orientation of segments 5, and in such a manner, that when said gases encounter the curved walls of chamber *a*, they start to rotate, and acquire a helicoidal motion; and, since the outlet muzzle 3 is displaced in relation to the inlet from towel 2, said rotation, assisted by the air impeller 17 is originated in spiral, thus providing a prolonged trajectory for the gases, sufficient for completing the combustion in spite of the speed attained by them; said gases, at the end of their course, are expelled ignited in such a way that they provide a potent flame similar to that produced by any conventional blower. This flame projects itself into the boiler or utilization means *c*, as shown in Fig. 1.

Due to the high temperature of the chamber and to the cooling action performed by the incoming air from conduit 7 on segments 5 of grate *b*, the pieces of particles of fuel, when falling on said segments 5, after being decomposed by the heat do not adhere thereto, on account of the refrigerating action of the latter; whereupon the remaining non-distillable fuel, i. e., the ashes and slag, as a result of the evaporation of gases, retains a free granular form and is dispersed by the effect of the existing air streams, thus providing space for the incoming fuel, which is supplied constantly and regularly in accordance with the dosage corresponding to the consumption of the fuel.

The non-combustible gases which are emitted together with the carburents as a result of the high temperatures inside the chamber, are also eliminated by consumption and, consequently, when the incandescent flame is expelled from the outlet muzzle 3, it does not produce disagreeable odours or emanations, providing thereby a substantially clean system which compares favorably with any of the conventional types of fuel burner systems.

The disposal of the ashes or slags does not interfere with the operation of the burner in itself because, as already stated, the ashes or slags are converted into loose granules which are easily collected by a simple discharge. The discharge is particularly simple in the embodiment shown in the illustration of Figs. 3 and 4, since there they can be removed by the action of gravity as they gather in the collector 11 and eventually fall into the ash pit 12.

The chamber grate *b* may have several configurations provided the segments 5 remain in contact with the air precinct or conduit 7 for refrigerating purposes, and provided they have the oblique openings or passages 6 to give place to the revolution of the gases inside the chamber *a*.

Instead of using the tangential outlet 3, the other outlet muzzle 4 can be put into operation, closing, for that purpose, outlet muzzle 3 and re-

moving cover 4'. In this case the ignited fluid is expelled by accumulation and projects also like a dart, in the form of a potent flame, from the side or the upper part of the burner, according to the embodiment employed.

In such case, an actual effect of cyclonic selection of fuel particles or ashes in suspension is produced, allowing only the substantially clean gases to be expelled from the burner.

From the foregoing it will be apparent to those skilled in the art that, on carrying the present invention into practice, minor variations may be introduced as regards the construction and appearance of the turbulent burner described, without departing from the spirit and scope of this invention as clearly defined in the appended claims.

We claim:

1. In a turbulent burner, a cylindrical chamber formed by a cylindrical wall and end walls, a grate within said chamber and extending substantially parallel to one of said walls, said grate forming a plurality of air passages which are directed substantially tangential to said cylindrical wall, means in said cylindrical wall for supplying fuel to said chamber substantially tangentially to the same and above said grate, means for supplying air under pressure to the space under said grate and tangentially with respect to said cylindrical wall, whereby said air when passing through said grate picks up the fuel with a helicoidal motion and prevents the fuel from settling down on said grate, and means for discharging the combustion gases from said chamber.
2. In a turbulent burner, a cylindrical chamber formed by a cylindrical wall arranged with its axis horizontally and end walls, a grate within said chamber and extending substantially parallel to the lower half of said cylindrical wall, said grate providing a plurality of longitudinal slots extending lengthwise of said cylindrical wall and constituting air passages which are directed substantially tangential to said cylindrical wall, means at one end of said cylindrical chamber for supplying fuel to said chamber at a point above the grate in the same and substantially tangentially with respect to said cylindrical chamber, means for supplying air under pressure to the space under said grate at the last named end of the chamber and tangentially with respect to said cylindrical wall, whereby said air when passing through said grate picks up the fuel with a helicoidal motion and prevents the fuel from settling down on said grate, and means at the opposite end of said chamber for discharging the combustion gases therefrom.
3. In a turbulent burner, a cylindrical chamber formed by a cylindrical wall arranged with its axis horizontally and end walls, a grate within said chamber and extending substantially parallel to the lower half of said cylindrical wall, said grate providing a plurality of longitudinal slots extending lengthwise of said cylindrical wall and constituting air passages which are directed substantially tangential to said cylindrical wall, means at one end of said cylindrical chamber for supplying fuel substantially tangentially to said cylindrical wall into said chamber at a point above the grate in the same, means for supplying air under pressure to the space under said grate at the last named end of the chamber and tangentially with respect to said cylindrical wall, whereby said air when passing through said grate picks up the fuel with a helicoidal motion and prevents the fuel from settling on said grate, and

means at the opposite end of said chamber for discharging the combustion gases therefrom, said means comprising a discharge nozzle extending substantially tangentially outwardly from the cylindrical wall adjacent the end wall at the last named end of the cylindrical chamber.

4. In a turbulent burner, a cylindrical chamber formed by a cylindrical wall arranged with its axis horizontally and end walls, a grate within said chamber and extending substantially parallel to the lower half of said cylindrical wall, said grate providing a plurality of longitudinal slots extending lengthwise of said cylindrical wall and constituting air passages which are directed substantially tangential to said cylindrical wall, means at one end of said cylindrical chamber for supplying fuel to said chamber substantially tangentially to said cylindrical wall and at a point above the grate in the same, means for supplying air under pressure to the space under said grate at the last named end of the chamber and tangentially with respect to said cylindrical wall, whereby said air when passing through said grate picks up the fuel with a helicoidal motion and prevents the fuel from settling on said grate, and means at the opposite end of said chamber for discharging the combustion gases therefrom, said means comprising a discharge nozzle extending substantially tangentially outwardly from the cylindrical wall adjacent the end wall at the last named end of the cylindrical chamber, a second discharge nozzle mounted in the center of said last named end wall, and cover means for said nozzles, whereby selectively any one of said nozzles may be used for the discharge of the combustion gases from said cylindrical chamber.

5. In a turbulent burner, a cylindrical chamber formed by a cylindrical wall arranged with its axis horizontally and end walls, a grate within said chamber and extending substantially parallel to the lower half of said cylindrical wall, said grate providing a plurality of longitudinal slots extending lengthwise of said cylindrical wall and constituting air passages which are directed substantially tangential to said cylindrical wall, means at one end of said cylindrical chamber for supplying fuel to said chamber substantially tangentially to said cylindrical wall and at a point above the grate in said chamber, means for supplying air under pressure to the space under said grate at the last named end of the chamber and tangentially with respect to said cylindrical wall, whereby said air when passing through said grate picks up the fuel with a helicoidal motion, means in the center of the end wall adjacent said fuel and air supply means for injecting a second air stream axially into the cylindrical chamber, and means at the opposite end of the chamber for discharging the combustion gases therefrom.

6. In a turbulent burner, a cylindrical chamber formed by a cylindrical wall arranged with its axis horizontally and end walls, a grate within said chamber and extending substantially parallel to the lower half of said cylindrical wall, said grate comprising a plurality of longitudinal bars extending lengthwise of said cylindrical wall and providing air passages between the same which are directed substantially tangential to said cylindrical wall, means at one end of said cylindrical chamber for supplying fuel to said chamber at a point above the grate in the same, means for supplying air under pressure to the space under said grate at the last named end of the chamber and tangentially with respect to said cylindrical wall, whereby said air when passing through said grate

picks up the fuel with a helicoidal motion, means in the center of the end wall adjacent said fuel and air supply means for injecting a second air stream axially into the cylindrical chamber, and means in the center of the opposite end wall of the cylindrical chamber for discharging the combustion gases from said chamber.

7. In a turbulent burner, a cylindrical chamber formed by a cylindrical wall arranged with its axis vertically and having a top and bottom wall, a grate within said chamber and extending substantially parallel to said bottom wall, said grate comprising a plurality of grate bars extending radially with respect to the axis of the cylindrical chamber and providing air passages between the same which are inclined in a manner to deflect air passing through the same from below substantially helically into the cylindrical chamber above the grate, means at the lower end of said chamber and above said grate for supplying fuel into said cylindrical chamber, means for supplying air under pressure to the space below the grate and tangentially with respect to said cylindrical wall, whereby said air when passing through said grate picks up the fuel with a helicoidal motion, and means at the upper end of said chamber for discharging the combustion gases therefrom.

8. In a turbulent burner, a cylindrical chamber formed by a cylindrical wall arranged with its axis vertically and having a top and bottom wall, said bottom wall having the shape of a downwardly facing truncated cone having a central discharge opening for solid incombustible material, a grate within said chamber and extending substantially parallel to said truncated bottom wall, said grate comprising a plurality of grate bars extending radially with respect to the axis of the cylindrical chamber and providing air passages between the same which are inclined in a manner to deflect air passing through the same from below substantially helically into the cylindrical chamber above the grate, means at the lower end of said chamber and above said grate for supplying fuel into said cylindrical chamber, means for supplying air under pressure to the space below the grate and tangentially with respect to said cylindrical wall, whereby said air when passing through said grate picks up the fuel with a helicoidal motion, and means at the upper end of said chamber for discharging the combustion gases therefrom.

9. In a turbulent burner, a cylindrical chamber formed by a cylindrical wall arranged with its axis vertically and having a top and bottom wall, said bottom wall having the shape of a downwardly facing truncated cone having a central discharge opening for solid incombustible material, a grate within said chamber and extending substantially parallel to said truncated bottom wall, said grate comprising a plurality of grate bars extending radially with respect to the axis of the cylindrical chamber and providing air passages between the same which are inclined in a manner to deflect air passing through the same from below substantially helically into the cylindrical chamber above the grate, means at the lower end of said chamber and above said grate for supplying fuel into said cylindrical chamber, means for supplying air under pressure to the space below the grate and tangentially with respect to said cylindrical wall, whereby said air when passing through said grate picks up the fuel with a helicoidal motion, and means at the upper end of said chamber for discharging the combustion gases therefrom, said means com-

prising a discharge nozzle extending substantially tangentially outwardly from the cylindrical wall adjacent the top wall of said cylindrical chamber.

10. In a turbulent burner, a cylindrical chamber formed by a cylindrical wall arranged with its axis vertically and having a top and bottom wall, said bottom wall having the shape of a downwardly facing truncated cone having a central discharge opening for solid incombustible material, a grate within said chamber and extending substantially parallel to said truncated bottom wall, said grate comprising a plurality of grate bars extending radially with respect to the axis of the cylindrical chamber and providing air passages between the same which are inclined in a manner to deflect air passing through the same from below substantially helically into the cylindrical chamber above the grate, means at the lower end of said chamber and above said grate

for supplying fuel into said cylindrical chamber, means for supplying air under pressure to the space below the grate and tangentially with respect to said cylindrical wall, whereby said air when passing through said grate picks up the fuel with a helicoidal motion, and means at the upper end of said chamber for discharging the combustion gases therefrom, said means comprising two alternately employable discharge nozzles, each of which being provided with a detachable cover, one of said discharge nozzles extending substantially tangentially outwardly from the upper end of said cylindrical wall, and the other one of said discharge nozzles being arranged in the center of the top wall of said cylindrical chamber.

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