

Oct. 26, 1937.

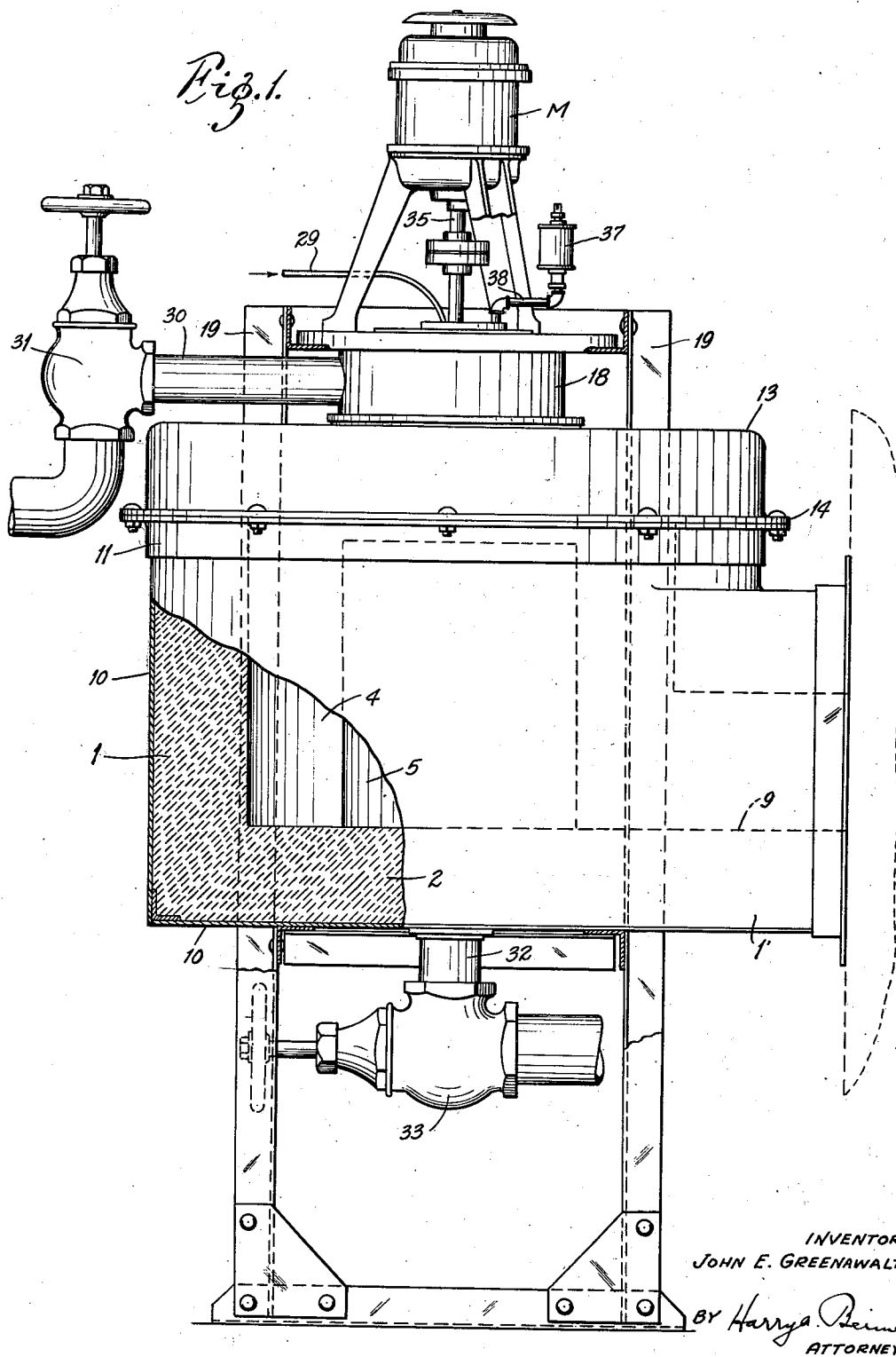
J. E. GREENAWALT

2,097,153

DOWN DRAFT FURNACE

Filed Aug. 19, 1933

2 Sheets-Sheet 1



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Fig. 3.

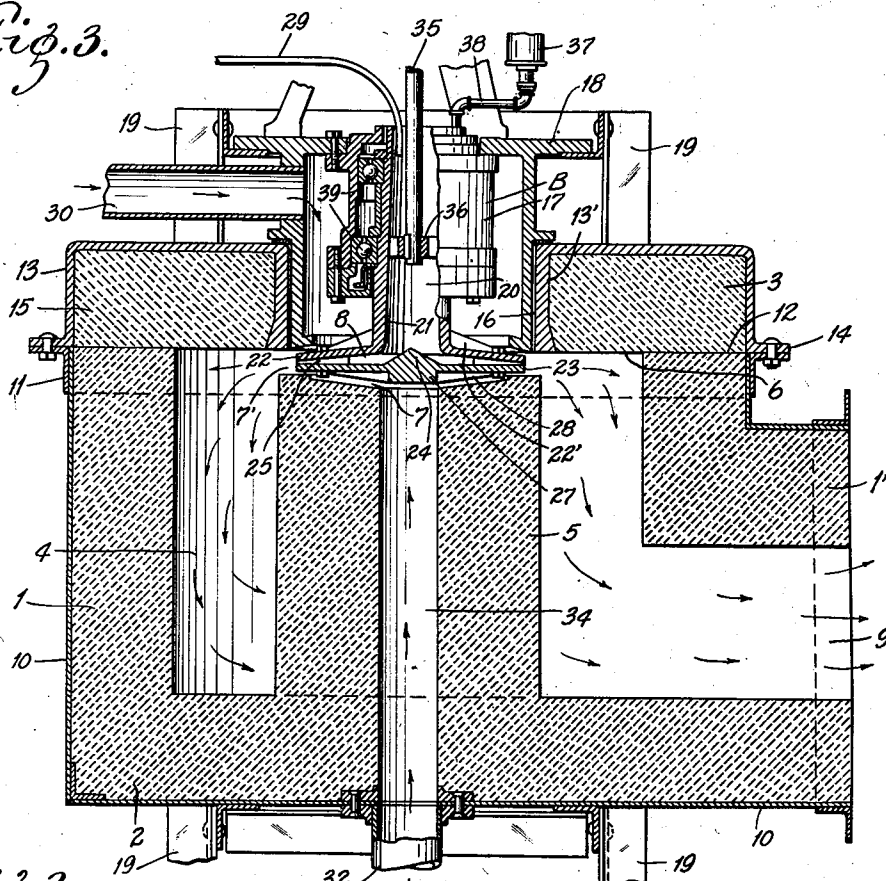


Fig. 2.

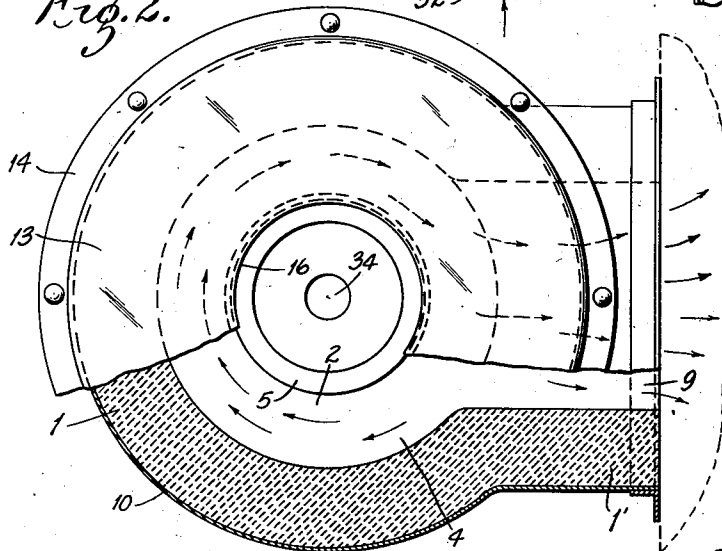
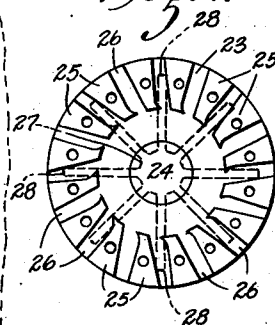


Fig. 4.



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DOWN DRAFT FURNACE

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Application August 19, 1933, Serial No. 685,821

6 Claims. (Cl. 158-4)

My invention has relation to improvements in furnaces more particularly for down draft combustion and it consists in the novel features of construction more fully set forth in the specification and pointed out in the claims.

The principal object of the invention is to provide a furnace that is especially adapted for furnishing the heat necessary to the operation of other apparatuses, such as hot water or steam boilers, incinerating furnaces and metallurgical furnaces including sintering apparatus. The furnace is, therefore, essentially a primary combustion furnace from which the hot gases and products of combustion discharge to some other apparatus where the heat of the primary furnace is utilized. However, I do not wish to be understood as restricting the invention to association with some other apparatus as the furnace is a completely operative device in itself.

A further object of my invention is to provide a furnace in which the fuel and the air are subjected to a swirling movement through the combustion chamber of the furnace to insure a thorough commingling of the fuel and the air, thus insuring complete combustion.

In addition to the above objects I have provided a furnace in which the fuel and air are subjected to great turbulence to effect an extremely rapid and intense combustion within the combustion chamber resulting in an extremely high temperature therein.

These objects, as well as others inherent in the invention, will be better apparent from a detailed description of the same in connection with the accompanying drawings, in which:

Figure 1 is a side elevation of my improved furnace with parts broken away and the burner assembly shown associated with the furnace; Fig. 2 is a top plan of the furnace with the burner assembly removed and the top thereof broken away so as to look down into the combustion chamber of the furnace; Fig. 3 is a vertical longitudinal section taken on a medial plane through the furnace and burner assembly, parts of the latter being broken away and parts left in elevation; and Fig. 4 is an inside plan view of one of the fuel distributing head members showing the fuel discharge passageways.

Referring to the drawings, it will be seen that the furnace comprises a circular wall 1 and bottom 2 of a suitable refractory material which together with the removable top wall 3 enclose a combustion chamber 4, in the center of which is a refractory column 5 built up from the bottom 2. The column 5 being cylindrical gives

to the combustion chamber 4 an annular form and said column terminates a short distance below the lower surface 6 of the top 3 which forms the upper bounding surface of the combustion chamber so as to provide a space 7 to receive a fuel distributing head 8 to be described more in detail hereinafter. The peripheral portion 7' of this space 7 obviously serves as an inlet for the fuel which will also be more fully described. An outlet 9 for the products of combustion is formed in the wall 1 and through an extension 1' thereof, said outlet leading from the bottom of the combustion chamber 4 so that the outlet will be spaced some little distance vertically from the inlet 7'. The wall 1 and bottom 2 of the furnace are enclosed in a sheet metal casing 10 and an angle iron flange 11 secured to the casing 10 contiguous to the top surface 12 of the wall 1 on which the furnace top or cover 3 rests. The cover 3 is formed of a circular channel-shaped shell 13 having a peripheral flange 14 and suitable refractory material 15 disposed within the shell 13. The inner circular wall 13' of the shell 13 defines an opening or throat 16 for receiving what I choose to term a burner B which furnishes the fuel to the furnace. The particular burner illustrated is not indispensable to my improved furnace as any means for injecting fuel and air into the furnace in proper condition for the combustion may be utilized. However, in order that the invention may be clearly understood I will describe briefly the burner B which is illustrated.

The burner B includes the fuel distributing head above alluded to which is rotatably mounted within the bearing member 17 supported by a cylindrical housing 18, the latter in turn being supported by the structural members 19, 19, which also carry the furnace. The fuel distributing head 8 comprises a tube 20 having a conical inner surface 21 widening toward the bottom of the tube which terminates in a flange 22, on the upper surface of which are a number of radially disposed ribs or vanes 22'. A disk 23 having a central conical boss 24 and a series of peripheral radially disposed bosses 25 is bolted against the flange 22 so that the boss 24 projects toward the center of the tube 20 and the bosses 25 maintain the disk in spaced relation with the flange 22. The radially disposed bosses 25 divide the peripheral space between the flange 22 and disk 23 into a plurality of fuel discharge passages 26 (see Figs. 3 and 4). On the outer surface of disk 23 is a central boss 27 from which radiate a plurality of vanes 28 which operate

as fan blades on the distributing head 8, as will be apparent in the description of the operation of the furnace. A fuel pipe 29 leading from any suitable source of fluent fuel (such as oil) extends through the open end of the tube 20 so that fuel will drop in a regulated amount into said tube.

An air inlet pipe 30 controlled by a valve 31 leads into the side of the housing 18, and a second air inlet pipe 32 controlled by a valve 33 leads into an air port 34 passing through the center of the column 5. Thus, by regulating the valves 31 and 33 air in measured quantities will be conducted to both sides of the fuel distributing head 8. As explained above, the fuel distributing head is rotatably supported by the bearing member 17 and is adapted to be rapidly rotated by means of a motor M, to which the head is directly connected by means of a shaft 35 keyed to a spider 36 within the tube 20. 37 is an oil cup from which oil is fed through the pipe 38 to the bearings 39 within the bearing member 17.

The action of my improved furnace is as follows:

The oil is delivered against the inside surface of tube 20 from the feed pipe 29 where it is spun out to a very thin film uniformly over the inside surface of the tube by the centrifugal force and surface tension, it being understood that the tube 20 is rotated at a very high rate of speed (approximately 3500 R. P. M.). On account of the conical shape of the tube, it being wider at the bottom than at the top, the oil film moves slowly and evenly downwardly, all the while being whirled around the inner surface of the tube by the centrifugal force. Ultimately the oil reaches the flange 22 and as it moves outwardly over the inner surface of this flange it is still further attenuated on account of the increase in diameter as the oil approaches the periphery of the flange. When the oil reaches the bosses 25 between flange 22 and lower disk 23 it enters the radial fuel passages 26, all of said passages receiving approximately the same amount of oil on account of the uniform distribution of the oil by the centrifugal force over the inner surface of the flange 22. By the time the oil passes through the passages 26 and is about to be discharged therefrom it is not only uniformly distributed around the fuel distributing head 8, but is also in a very fine state of division, or atomization, so that it may be very easily and quickly vaporized the instant it enters the combustion chamber 4. Of course, air is sucked into the tube 20 through the open top thereof and this air is thoroughly mixed with the particles of oil discharging from the passages 26. Air also passes through the housing 18 and through the port 34 to both sides of the fuel distributing head 8 and enters the inlet 7' to the combustion chamber 4 on both sides of the circular spray of mixed fuel and air issuing from the distributing head 8. There are thus two air supplies for the fuel, the primary air supply entering the combustion chamber 4 intimately mixed with the fuel from the distributing head 8, and the secondary air supply entering the combustion chamber on both sides of the spray of mixed fuel and air. I have found in practice that the amount of primary air should be between 20% and 50% of the entire air supply required for complete combustion, the amount of secondary air, of course, not being so critical provided there is sufficient secondary air to com-

plete the combustion of the fuel. The velocity with which the secondary air passes through the air and fuel intake 7' is increased by the vanes 22' on the flange 22 and vanes 28 on the disk 23. Of course, the same result may be obtained by increasing the pressure at the source of supply of the secondary air.

The high rotative speed of the distributing head 8 causes an intense turbulence in the circular space 7' which serves as the fuel and air inlet. This turbulence makes the vaporization of the fuel very rapid so that there is obtained an explosive mixture almost as soon as the fuel and the air enter the combustion chamber 4. Therefore, combustion proceeds immediately and continuously as the mixed gases are whirled downwardly through the annular combustion chamber on their way to the outlet 9. The locating of the outlet 9 or flue in a horizontal plane below the inlet 7' compels the gases and flaming particles to move downwardly and results in high efficiency and complete combustion without the use of excess air and without the formation of smoke. The central refractory column 5 assists in producing this result as it gives to the combustion chamber its annular shape which cooperates with the rapidly rotating distributing head to produce the swirling turbulence for intensifying combustion.

Having described my invention, I claim:

1. A furnace for burning fluent fuel comprising side walls and top and bottom walls enclosing a combustion chamber, a fuel distributing head having peripheral outlets adjacent to the top wall of said chamber, means for feeding fuel to said distributing head, means for admitting air to said head, means for rotating said distributing head to project said fuel and air into said combustion chamber at a velocity sufficient to prevent combustion in said distributing head, means within the combustion chamber for shielding the fuel distributing head from the heat of combustion, and an outlet flue for the products of combustion near the bottom wall of said combustion chamber.

2. A furnace for burning fluent fuel comprising side walls and top and bottom walls enclosing a combustion chamber, a column disposed on the bottom wall within said chamber and spaced from the side walls thereof, the top of said column also being spaced from the top wall of the combustion chamber, means in the space between the top of said column and the top wall of the combustion chamber for feeding fuel and air to the combustion chamber, and said chamber having an outlet for the products of combustion, said outlet being disposed near the bottom wall of the combustion chamber whereby the products of combustion are forced to travel through the combustion chamber.

3. A furnace for burning fluent fuel comprising side walls and top and bottom walls enclosing a combustion chamber, a column disposed on the bottom wall within said chamber and spaced from the side walls thereof, said column also having one end spaced from the top wall of the combustion chamber, means located in a plane between said top wall and the top of the column for discharging fuel and air into the combustion chamber, said column having a passageway for air leading to said combustion chamber, and said chamber having an outlet for the products of combustion, said outlet being disposed adjacent to the bottom wall of the furnace.

4. A furnace for burning fluent fuel comprising

side walls and top and bottom walls enclosing a combustion chamber, a column disposed within said chamber, the top of said column being spaced from the top wall of the combustion chamber,

5 means adjacent to said top wall for feeding fuel and primary air into the combustion chamber, said column having a passage way for supplying secondary air to the combustion chamber, and said combustion chamber having an outlet for
10 the products of combustion adjacent the bottom wall thereof.

5. A furnace for burning liquid fuel comprising an annular combustion chamber, a circular fuel distributing head at one end of said combustion chamber, said head having peripheral discharge orifices, means for conducting air to the periphery of said head at one side thereof, means
15 for rotating said head to effect a distribution of

fuel in the form of a circular sheet, and said chamber having an outlet for the products of combustion at the end thereof opposite to the fuel distributing head.

6. A furnace for burning liquid fuel comprising an annular combustion chamber, a fuel distributing head at one end of said combustion chamber, means for rotating said fuel distributing head to effect a discharge of fuel into the combustion chamber by centrifugal action, said
10 head having its rotation axis coincident with the longitudinal axis of the combustion chamber, means for conducting air to the periphery of said head at both sides thereof, and said chamber
15 having an outlet for the products of combustion at the end thereof opposite to the fuel distributing head.

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