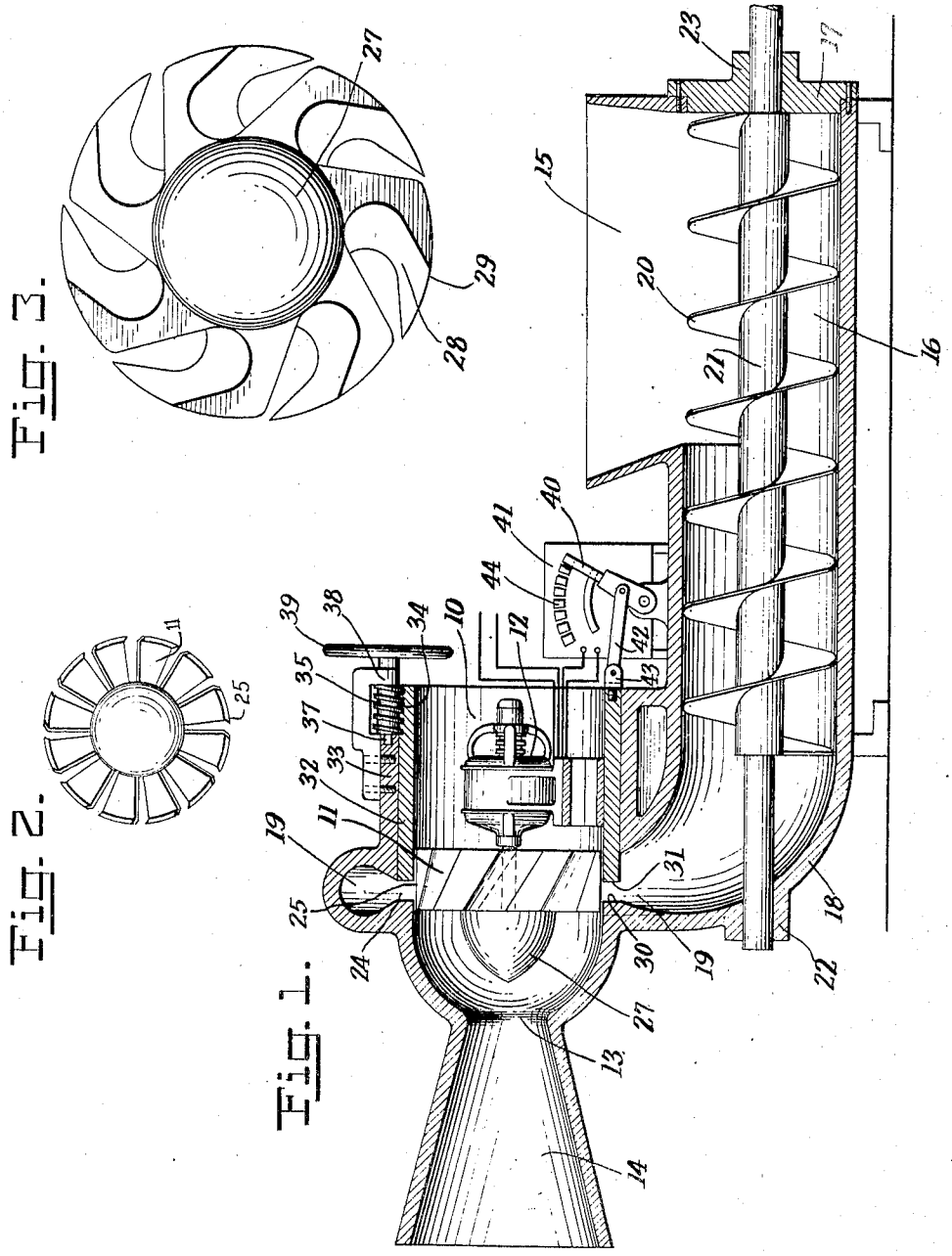
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METHOD AND APPARATUS FOR BURNING FUEL

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METHOD AND APPARATUS FOR BURNING FUEL.

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This invention relates to a method and apparatus for burning fuel and, more particularly, to a burner adapted to produce a readily combustible suspension in air of fuels of a semi-solid nature, such as the stiff pastes formed of solid and liquid fuels, or of other plastic fuels of similar nature.

Composite fuels of the type indicated are commonly formed of minute particles of powdered fuel, from which the ash may have been removed to a greater or less extent, and of a liquid fuel which surrounds the particles with a film or layer of oil and serves to unite the particles into a coherent paste of a nature intermediate that of the solid and liquid fuels of which it is composed and having characteristics different from those of either of its constituents. The stiffness and consistency of these pastes may vary with the proportions and characteristics of their constituents, being usually of sufficient stiffness that they do not flow readily, and may be burned on a suitable grate in the manner of solid fuels. Because of the greater flexibility in controlling combustion and in the consumption of the fuels, when fuels are burned in flames in the manner of fluid fuels, and the resulting greater efficiencies and economies in combustion, it is highly desirable to burn such fuels by atomizing and diffusing them in a current of air, so that they may be quickly ignited and burned, and then projecting the mixture of commingled air and fuel into a combustion chamber. Owing to the physical characteristics of the composite fuels of the above mentioned types, in which the separate particles are tenaciously held together by their enveloping films of oil, they cannot be handled in the same manner as liquid fuels, which flow readily and are easily broken up to a mist, nor in the manner of pulverized fuels, which are already in a fine state of division and partly mixed with air.

An object of my present invention is to provide a method and apparatus by which fuels of the above indicated types and characteristics may be divided and suspended in a current of air and enabled to be burned in the manner of fluid fuels.

Another object of the invention is to provide an apparatus in which fuels of the above indicated types may be finely divided and suspended in a current of air and the quantity of air automatically controlled and regulated in accordance with the requirements of the fuel.

A further object of the invention is to provide an apparatus in which the fuel paste is positively and mechanically separated into finely divided particles and dispersed into a gaseous medium.

A still further object of the invention is to provide an apparatus by which the composite fuels of the above indicated types may be fed and dispersed throughout air in condition to be readily ignited and burned, at a uniform and controllable rate.

With these and other objects in view, which will appear from the further and detailed description of the invention, the invention comprises the method and apparatus described and set forth in the following specification and claims.

The various features of the invention are illustrated in the accompanying drawings, in which:

Fig. 1 is a longitudinal vertical sectional view of a fuel burning apparatus embodying a preferred form of my invention,

Fig. 2 is a front view of a combined fan and cutting or disintegrating element forming a part of the fuel burning apparatus, and

Fig. 3 is a front view of a modified form of combined fan and disintegrating device.

In my present invention a current or blast of air is produced in a suitable conduit from which it passes into and through a nozzle and is directed into a combustion chamber of a furnace in which the fuel is to be burned. A supply of the fuel paste is forced through an annular opening in the conduit into the stream or blast of air immediately before it enters the nozzle, and is thus directed radially inwardly into the air current. The advancing, inner, annular, edge of this fuel paste is continuously sheared off in thin particles and carried into the body of the air stream by means of cutting or shearing blades which are preferably rotated at the inner edge of the fuel together with the fan or other air blast generating means. The fuel is thus broken up into fine particles, or separated into the minute particles of which it is formed, and dispersed throughout the air blast and carried through the nozzle into the furnace. The rate of supply of the fuel is controlled by controlling the width of the orifice or opening through which it is forced

into the air blast and the velocity of the air blast is regulated automatically in accordance with the width of the fuel inlet orifice by a suitable control means as by varying the speed of the blast generating fan.

Referring more particularly to the accompanying drawings, a current of air into which the fuel is to be dispersed and carried into the combustion chamber, is driven through a conduit 10 by a fan 11 or other suitable means, which may be driven by a motor 12 mounted in the conduit. The conduit 10 is contracted at its forward portion to a throat 13 from which extends a flaring nozzle portion 14 through which the blast of air is directed into a combustion chamber or furnace, not shown.

A supply of the plastic fuel, to be dispersed into the air current and burned, is charged into a hopper 15 at the rear of the conduit 10 and sinks downwardly into the rear end portion of a conveyor tube 16, which is closed at its rear end by a closing plate 17 bolted to the tube, and which curves upwardly at 18 at its forward end and leads or merges into an annular chamber 19 encircling the conduit 10 to the rear of the nozzle throat 13. The plastic fuel is forced forwardly in the tube 16 and into the annular chamber 19 by means of a screw conveyor 20 rigidly mounted on a rotatable shaft 21 which is journaled at its front end in a bearing 22 in the upwardly curving portion 18 of the conveyor tube and which projects through a rear bearing 23 in the plate 17 to a position outside of the tube at which it may be driven from a suitable power source.

From the annular chamber 19 the plastic fuel is squeezed through a narrow annular opening 24 leading from the chamber 19 into the air conduit 10, passing radially inwardly in a thin, flat sheet. As the annular inner edge of the sheet of fuel is forced inwardly it contacts with and is sheared by cutter blades 25 which are rotated at a very rapid speed around and close to the inner edge of the annular fuel inlet orifice or opening 24. The cutter blades 25 may be conveniently mounted on the outer edges of the blades of the fan 11 or preferably formed integral with the fan blades, as indicated in Fig. 2. The fan blades are preferably of the propeller type and at the axial portion or hub of the fan to the front of the blades is a cone 27 conforming to, and spaced from, the converging walls of the conduit 10, causing the air blast to flow through the outer portion of the fan in intimate contact with the fuel cutting blades and then converge to the throat 13. As the blades 25 rotate at a high rate of speed and the inner edge of the sheet of fuel converges to the blades relatively slowly, a succession of very thin shearings are cut from the edge of the fuel and thrown into the air stream, where they are dispersed and carried forward as a fine fuel suspension. The cutter blades thus serve to separate the fuel particles into the minute particles of which the paste was formed.

In place of the fan and blade construction shown in Fig. 2, the form shown in Fig. 3, which is better adapted to smaller types of burner, may be employed. In this type of cutter fan, the fan or propelling surface is indicated at 28 and the cutting edge at 29, the fan being cast in a single piece to give the required fan and cutter surfaces.

The screw conveyor 20 serves to convey the fuel from the hopper 15 and press it into the chamber 19 to fill this chamber and maintain it filled under a definite pressure, sufficient clearance or slip being permitted between the screw conveyor and the walls of the conveyor tube to avoid the building up of a pressure above that required. The rate at which fuel is supplied from the chamber 19 is, therefore, dependent on the size or width of the inlet orifice or opening 24 and may be varied by varying the width of this opening.

For this purpose the opening 24 is formed by or between an edge or shoulder 30, in fixed position to the chamber 19, and by the end edge 31 of a cylindrical shell 32 mounted to slide longitudinally in an outer shell 33 which may be, and preferably is, integral with the chamber 19. By moving the cylinder 32 to or from the edge 30, the width of the opening 24 may be controlled and the rate of supply of fuel controlled accordingly. To slide the cylinder 32 to and from the edge 30 to the required adjusted positions, the upper outer surface of the cylinder 32 is provided with a threaded recess 34 in which is threaded a worm or screw 35 mounted in fixed bearings 37 and 38 on the outer shell 33 and rotated by means of a hand wheel 39. By a suitable rotation of the hand wheel 39, the cylinder 32 may be moved longitudinally to vary the width of the opening 24 and in this manner to adjust and control the quantity of fuel fed through the opening 24.

Each rate of supply of fuel through the opening 24 requires a definite rate of supply of air through the conduit 10 and, with each change or adjustment of the fuel supply through the opening 24, the rate or velocity of the passage of air through the conduit is correspondingly adjusted. This may be done by any suitable means, preferably, by adjusting the speed of the motor 12 and fan 11 in accordance with the position of the cylinder 32. For this purpose, the controlling arm 40 of a speed controlling rheostat 41 is connected by means of a link 42 to a lug 43 mounted on the cylinder 32 and thus moved directly from the cylinder over a series of rheostat contact points 44 to correspond with the position of the cylinder 32. Through this mechanism, therefore, an adjustment of the cylinder 32 to control the quantity of fuel

fed through the opening 24 automatically adjusts the quantity of air supplied by the fan 11 to that required for the complete combustion of the fuel.

To obtain the finely divided state of the fuel which is desired for the efficient combustion of the fuel, the fan 11 is rotated at a very high speed, and by providing a sufficient number of cutting blades, which also act as the fan blades, a very fine division of the fuel is obtained and, immediately as the fine particles of fuel are separated from the body of the fuel in the conduit 10, air is supplied to surround these particles. The revolution of the fan, moreover, gives a whirling motion as well as a directional motion to the air in the conduit 10 and consequently produces an excellent and thorough mixture of fuel and air for delivery to the nozzle or combustion chamber 14.

When the burner apparatus is used in connection with steam raising or other purposes where pressure regulators may be used, the pressure regulators may be attached to the hand wheel 39 or other communicating means between the pressure regulator and the screw 35, thus obtaining an entirely automatic burner which will supply the desired heat to the boilers or other apparatus.

As changes of construction could be made within the scope of my invention, it is desired that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. A method of burning plastic fuels which comprises generating a current of air, feeding a thin annular sheet of plastic fuel radially inwardly into said air current, and shearing particles from the inner edge of said fuel and dispersing them into said air current.

2. A method of burning plastic fuels which comprises feeding a thin annular sheet of plastic fuel radially inwardly into a current of air, and mechanically removing fine particles from the inner edge of said fuel and dispersing them into said air current.

3. A method of burning plastic fuels which comprises generating a whirling current of air, feeding a plastic fuel annularly and radially into said current of air, and shearing particles from the inner edge of said fuel and carrying them and dispersing them into said current of air.

4. A method of burning plastic fuels which comprises generating a current of air, feeding plastic fuel radially into said current of air as a flat annular sheet, and removing particles from the inner edge of said sheet and dispersing them throughout said current of air.

5. A method of burning plastic fuels which comprises generating a current of air, feeding plastic fuel radially into said current of air as a flat annular sheet, removing fine particles from the inner edge of said sheet and carrying them into and dispersing them in said air current, and controlling the thickness of said sheet of fuel and the velocity of said air current in proportion to each other.

6. Apparatus for burning fuels which comprises means for generating a current of air, means for feeding fuel in a thin, annular sheet radially inwardly into said current of air, and means for shearing particles from the inner edge of said sheet and dispersing them throughout said current of air.

7. Apparatus for burning fuel which comprises means for generating a current of air, means for feeding fuel radially into said current of air as a flat annular sheet, means for removing particles from the inner edge of said sheet and dispersing them in said air current, and means for automatically controlling the thickness of said fuel sheet and the velocity of said air current in proportion to each other.

8. Apparatus for burning fuel which comprises means for generating a current of air, means for feeding fuel radially into said current of air as a flat annular sheet, means for removing particles from the inner edge of said sheet and dispersing them in said air current, and means for automatically controlling the velocity of said air current in proportion to the rate of feeding of said fuel.

9. Apparatus for burning fuel which comprises an air passage, an annular chamber encircling said passage and having an annular opening into said passage, means for generating a current of air through said passage, and means for forcing plastic fuel radially inwardly from said annular chamber through said opening into said air current.

10. A fuel burning apparatus which comprises an air conduit, an annular chamber having an annular opening into said air conduit, means for generating a current of air in said air conduit, means for forcing a plastic fuel through said annular chamber and said annular opening into said air conduit, and means for mechanically shearing fuel particles from the inner edge of said fuel as it clears said orifice.

11. A fuel burning apparatus which comprises an air conduit, an annular chamber having an annular opening into said air conduit, means for generating a whirling current of air in said air conduit, means for forcing fuel from said annular chamber through said annular opening into said air conduit, and means for shearing fuel particles from the inner edge of said fuel into said current of air.

12. A fuel burning apparatus which comprises an air conduit, an annular chamber having an annular opening into said air con-

duit, means for generating a current of air in said air conduit, means for forcing fuel from said annular chamber through said annular opening into said air conduit, means for varying the width of said opening and means for shearing particles from the inner edge of said fuel into said current of air.

13. A fuel burning apparatus which comprises an air conduit, an annular chamber encircling said air conduit and having an opening into said air conduit, means for generating a current of air in said air conduit, means for forcing fuel from said annular chamber through said opening into said air conduit, and means for shearing fuel particles from the fuel forced through said opening into said air conduit.

14. A fuel burning apparatus which comprises an air conduit, an annular chamber encircling said air conduit and having an annular opening into said air conduit, a fan in said air conduit, means for forcing fuel from said annular chamber through said opening into said air conduit, and means for shearing fuel particles from the fuel forced through said opening into said air conduit.

15. A fuel burning apparatus which comprises an air conduit, an annular chamber encircling said air conduit and having an annular opening into said air conduit, a fan in said air conduit, means for forcing fuel from said annular chamber through said opening into said air conduit, means for shearing fuel particles from the fuel forced through said opening into said air conduit, means for varying the width of said annular opening and means for varying the speed of said fan in accordance with the width of said opening.

16. A fuel burning apparatus which comprises an air conduit, an annular chamber encircling said air conduit and having an annular opening to said air conduit and an annular shoulder forming one edge of said opening, a cylinder forming an inner wall for said conduit and having an end edge slidable to and from said shoulder to adjust the width of the opening from said annular chamber, and means for moving said cylinder to and from said shoulder.

17. A fuel burning apparatus which comprises an air conduit, an annular chamber encircling said air conduit and having an annular opening to said air conduit and an annular shoulder forming one edge of said opening, a cylinder slidably mounted in said conduit and having an end edge forming the opposite edge of said opening from said shoulder, means for sliding said cylinder to bring said edge to or from said shoulder, a fan for generating a current of air in said conduit, and means for regulating the speed of said fan in relation to the position of said cylinder.

18. A fuel burning apparatus which comprises an air conduit, an annular chamber encircling said air conduit and having an annular opening to said air conduit and a fixed annular shoulder forming one edge of said opening, a cylinder slidable longitudinally in said conduit and having an edge forming the opposite edge of said annular opening from said shoulder, means for forcing fuel to said annular chamber and through said annular opening at a definite pressure, a fan means for generating a current of air in said conduit and for shearing particles of fuel from the inner edge of said annular orifice into said conduit, means for sliding said cylinder to vary the width of said orifice, and means for adjusting the speed of said fan in accordance with the width of said opening.

19. A fuel burning apparatus which comprises an air conduit, an annular chamber encircling said air conduit and having an annular opening to said air conduit and a fixed annular shoulder forming one edge of said opening, a cylinder slidable longitudinally in said conduit and having an edge forming the opposite edge of said annular opening from said shoulder, a conveyor tube communicating with said annular chamber, means for forcing fuel through said conveyor tube into said annular chamber and through said opening to said air conduit, a fan means for generating a current of air in said conduit and for shearing particles of fuel from the inner edge of said annular orifice into said conduit, means for sliding said cylinder to vary the width of said orifice, and means for adjusting the speed of said fan in accordance with the width of said opening.

In testimony whereof, I affix my signature.

EARL P. WETMORE.