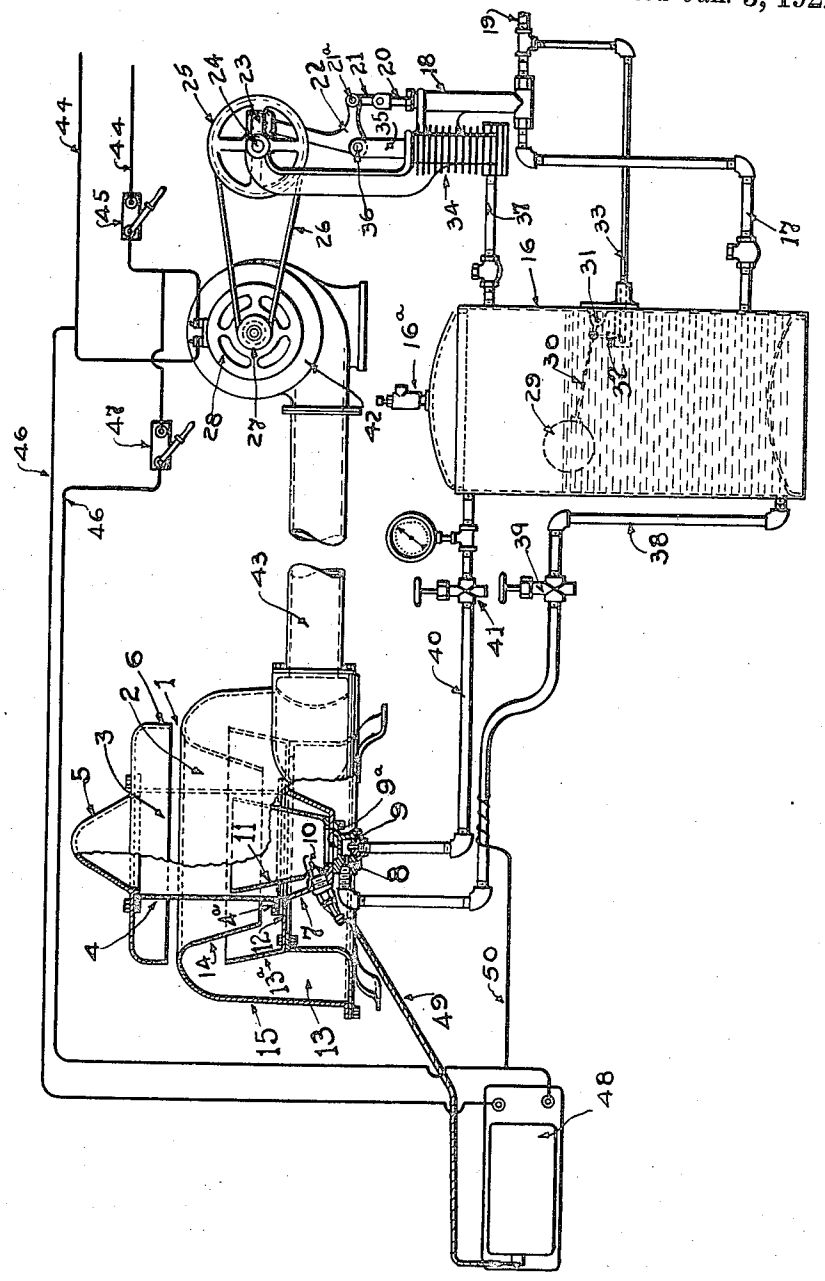
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METHOD OF BURNING FUEL AND APPARATUS THEREFOR.

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METHOD OF BURNING FUEL AND APPARATUS THEREFOR.

1,402,243. Specification of Letters Patent. Patented Jan. 3, 1922.

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To all whom it may concern:

Be it known that I, ROBERT F. METCALFE, a citizen of the United States, residing at Erie, in the county of Erie and State of Pennsylvania, have invented new and useful Improvements in the Methods of Burning Fuel and Apparatus Therefor, of which the following is a specification.

By this invention fuel is consumed producing what is known as a white flame and the fuel can be completely consumed in a very short flame so that no soot or deposit results in an ordinary installation. The fuel is further completely consumed so as to produce a maximum of heat with a given quantity of fuel and at the same time large quantities of fuel are burned in small space. This is very desirable in many installations.

In carrying out my invention in the preferred manner I first spray the fuel into a vaporizing chamber and supply air for a partial combustion. The air introduced is only sufficient to consume enough of the fuel in this chamber to completely vaporize the fuel and to heat the mixture. The resultant product is then expelled from the vaporizing chamber to the main mixing chamber and here mixed with air, which air is introduced in a large volume but at a comparatively low velocity and in quantities to afford a complete combustion. The result is a white flame and by reason of the heated condition of the gases and the warming of the air mixed therewith a comparatively short flame is produced even where a large quantity of fuel is burned and if the burner is used in connection with comparatively cold surfaces, such as boilers, no soot or other deposit results. The system also permits of the burning of a large quantity of fuel very efficiently and with practically no noise.

I have illustrated the apparatus forming the subject matter of the invention and by which the process may be performed in the following drawing showing the apparatus with the burner in section.

1 marks the flame nozzle, 2 the mixing chamber from which the flame nozzle leads, and 3 a vaporizing chamber, the walls of which have the perforations 4. A cap 5 of the vaporizing chamber is extended by means of a flange 6 to form the upper edge of the nozzle 1. The vaporizing chamber is mounted on a base 7, the lower end of the chamber being provided with a flange 4^a which is secured to the base 7.

Fuel, ordinarily kerosene or hydrocarbon, is delivered through a jet 8 and this is sprayed by means of an air jet 9 through an opening 9^a. The mixture is ignited by an electric spark 10. A deflecting cup-shaped plate 11 is arranged in the bottom of the vaporizing chamber 3 and the sprayed fuel is carried through this baffle or cup into the vaporizing chamber. Supplemental air is admitted through an opening 12 between the flange 4^a and the base 7 and enters the vaporizing chamber through a small slot between the upper edge of the baffle 11 and the walls of the chamber 3.

The size of the opening 12 is so regulated as to supply just sufficient air to burn such a portion of the fuel as will completely vaporize the fuel in the vaporizing chamber and in addition this partial combustion in the vaporizing chamber heats the mixture. The resultant product issues from the openings 4 in the form of a highly heated gas slightly diluted by the gases which are consumed in the vaporizing chamber.

I prefer to mix the additional air to complete combustion with these heated gases in a mixing chamber and give the air a slight preliminary heating while so confining the air as to be assured of a complete mixture preliminary to the delivery to the flame nozzle. An air delivery chamber 13 surrounds the mixing chamber 2. The outer wall 15 of the chamber 13 has a downwardly extending lip or baffle 14 which forms the outer wall of the mixing chamber. An upwardly extending flange 13^a is arranged on the base 7 and extends into the air chamber 13 between the outer wall and baffle 14 so that the air delivered to the air chamber is deflected downwardly by the lip 14 and delivered to the mixing chamber from the bottom and in a direction sweeping the lower wall of the vaporizing chamber. This wall, it will be understood, due to the burning of mixture within the vaporizing

chamber is maintained at an incandescent temperature and in consequence the air is heated as it enters the mixing chamber and the slight confinement of the air with the gases through the restriction at the flame nozzle assures a complete mixture so that the combustion is completed within a comparatively short distance from the flame nozzle. The flame produced is a white flame and the burning is accomplished with very little noise even where large quantities of fuel are consumed. A very high efficiency is also attained in the consumption of fuel.

It will be understood that in order to get the right fuel and air delivery for the proper spraying into the vaporizing chamber the air and fuel through the jets 8 and 9 should be properly controlled. This is well understood and while wide ranges of pressure on the air and fuel may be used I have found that a pressure of twenty pounds is very satisfactory. In order to burn just sufficient fuel to accomplish the full vaporization the amount of air through the opening 12 should be considered. I have found that with a vaporizing chamber of four inches in diameter an opening between the base and bottom of the wall of the vaporizing chamber of approximately one-eighth of an inch will give the proper air opening for this partial combustion. I have also found that a flame nozzle approximately one inch wide and ten inches in diameter with the parts in approximately the proportions shown will give very satisfactory results.

Fuel and air are delivered from a tank 16, the fuel being delivered to the tank through a pipe 17 from a pump 18. Fuel is delivered to the pump through a pipe 19 from any convenient source of supply. A pump plunger 20 is connected by a link 21 and pin 21[a] with a connecting rod 22. The connecting rod operates on a crank 23, the crank being formed in a shaft 24. A drive pulley 25 is mounted on the shaft 24 and is driven through a belt 26 from a pulley 27. The pulley 27 is driven by a motor 28. A float 29 is arranged in the chamber 16 and mounted on an arm 30, the arm being pivoted at 31 at the wall of the tank. A valve 32 is carried by the arm 30 and controls an over-flow passage, the over-flow being connected by way of a pipe 33 with the pipe 19. The pump will ordinarily supply an excess of fuel and this excess will overflow or bypass through the pipe 33 to the pipe 19, thus maintaining a constant level in the tank 16.

An air pump 34 is provided with a plunger 35 and this plunger 35 is connected by a pin 36 with the connecting rod 22 so that it is operated with the oil pump. The pump discharges air by way of the pipe 37 to the tank 16. The excess of air is discharged through a loaded valve 16[a].

A pipe 38 leads from below the fuel level in the tank 16 to the jet 8. The pipe is provided with a valve 39 by which the flow to the jet may be controlled. A pipe 40 leads from above the fuel level to the air jet 9. A valve 41 is provided for controlling the air supply pipe.

A fan 42 is driven from the motor 28 and delivers air through a pipe 43 to the air chamber 13. The air is delivered at very low velocity and very low pressure so that very little power is required to deliver the requisite quantity of air. Electric current is supplied through the conductors 44 for driving the motor 28, the switch 45 controlling this circuit. Wires 46 lead from the conductors 44 to a spark coil 48 and wires 49 and 50 lead from the coil to the spark points 10. A switch 47 is provided for controlling the circuit through the wires 46.

What I claim as new is:—

1. The method of burning fuel which consists in delivering fuel and air to a chamber with the air deficient to consume the greater portion of the fuel; burning fuel in the chamber to vaporize the unconsumed fuel; expelling the resultant gases; and supplying air to complete the combustion of the expelled gases.

2. The method of burning fuel which consists in delivering fuel and air to a chamber with the air deficient to consume the greater portion of the fuel; burning fuel in the chamber to vaporize the unconsumed fuel; expelling the resultant gases; and supplying heated air to complete the combustion of the expelled gases.

3. The method of burning fuel which consists in delivering fuel and air to a chamber with the air deficient to consume the greater portion of the fuel; burning fuel in the chamber to vaporize the unconsumed fuel; expelling the resultant gases; and supplying air in large volume but low velocity to complete the combustion of the expelled gases.

4. The method of burning fuel which consists in delivering fuel and air to a chamber with the air deficient to consume the greater portion of the fuel; burning fuel in the chamber to vaporize the unconsumed fuel; expelling the resultant gases into a mixing chamber; and introducing air to the mixing chamber to continue the combustion.

5. The method of burning fuel which consists in delivering fuel and air to a chamber with the air deficient to consume the greater portion of the fuel; burning fuel in the chamber to vaporize the unconsumed fuel; expelling the resultant gases into a mixing chamber; and introducing heated air to the mixing chamber to continue the combustion.

6. The method of burning fuel which consists in delivering fuel and air to a chamber with the air deficient to consume the greater portion of the fuel; burning fuel in the

chamber to vaporize the unconsumed fuel; expelling the resultant gases into a mixing chamber; and introducing air of low velocity and large volume to the mixing chamber to continue the combustion.

7. The method of burning fuel which consists in spraying liquid fuel by means of air into a vaporizing chamber; supplying sufficient air to support combustion sufficient to produce heat in the vaporizing chamber to vaporize the remaining fuel; expelling the resultant gases from the vaporizing chamber; and supplying air to the gases to complete the combustion.

8. The method of burning fuel which consists in spraying liquid fuel by means of air into a vaporizing chamber; supplying sufficient air to support combustion sufficient to produce heat in the vaporizing chamber to vaporize the remaining fuel; expelling the resultant gases from the vaporizing chamber; and supplying heated air to the gases to complete the combustion.

9. The method of burning fuel which consists in spraying liquid fuel by means of air into a vaporizing chamber; supplying sufficient air to support combustion sufficient to produce heat in the vaporizing chamber to vaporize the remaining fuel; expelling the resultant gases from the vaporizing chamber; and supplying air of low velocity and large volume to complete the combustion.

10. In a burner, the combination of a vaporizing chamber; means for introducing fuel and air to the chamber with the air deficient for combustion; a mixing chamber into which the resultant gases from the vaporizing chamber are discharged; means for introducing air to the mixing chamber; and a flame nozzle leading from the mixing chamber.

11. In a burner, the combination of a vaporizing chamber; means for spraying fuel into the vaporizing chamber comprising an air jet and a fuel jet; means for supplying air to the vaporizing chamber in quantities deficient for combustion; a mixing chamber into which the resultant gases are discharged; means for introducing air to the mixing chamber; and a flame nozzle leading from the mixing chamber.

12. In a burner, the combination of a vaporizing chamber; means for spraying fuel into said vaporizing chamber comprising a fuel jet and an air jet; means for supplying additional air to the vaporizing chamber but in quantities insufficient to consume the fuel; a mixing chamber into which the resultant gases are expelled; means for supplying air to complete combustion to the mixing chamber; and a flame nozzle leading from the mixing chamber.

13. In a burner, the combination of a vaporizing chamber; means for spraying fuel and air into said vaporizing chamber comprising a fuel jet and an air jet; means for introducing an additional supply of air to the vaporizing chamber, said means introducing said air adjacent to the walls of the chamber; a mixing chamber into which the resultant gases are expelled; means for supplying air to the mixing chamber; and a flame nozzle leading from the mixing chamber.

14. In a burner, the combination of a vaporizing chamber; means for spraying fuel into the vaporizing chamber comprising a fuel jet and an air jet; a cup-shaped baffle within the vaporizing chamber, the wall of the cup-shaped baffle being spaced from the walls of the vaporizing chamber; means for delivering air between the baffle and the walls of the vaporizing chamber in quantities insufficient to consume the fuel in the vaporizing chamber; a mixing chamber into which the resultant gases are discharged; means for supplying air to the mixing chamber; and a flame nozzle leading from the mixing chamber.

15. In a burner, the combination of a vaporizing chamber; means for introducing fuel and air to the vaporizing chamber with the air deficient for combustion; a mixing chamber around the vaporizing chamber into which the resultant gases are discharged; means for introducing air to the mixing chamber, said means directing the air into contact with the walls of the vaporizing chamber; and a flame nozzle leading from the mixing chamber.

16. In a burner, the combination of a vaporizing chamber; means for introducing fuel and air to the vaporizing chamber with the air deficient for combustion; a mixing chamber surrounding the vaporizing chamber into which the resultant gases are discharged; an air chamber surrounding the mixing chamber and discharging to the mixing chamber; and a flame nozzle leading from the mixing chamber.

17. In a burner, the combination of a vaporizing chamber; means for delivering fuel and air to the chamber with the air deficient to complete combustion; a mixing chamber into which the resultant gases are discharged; an air chamber surrounding the mixing chamber; a baffle lip extending from the air chamber forming the outer wall of the mixing chamber; a baffle between the lip and the wall of the air chamber; and a deflecting plate over the baffle plate forming between said lip and the baffle plate a flame nozzle.

18. In a burner, the combination of a vaporizing chamber; air and fuel jets leading to the vaporizing chamber; a mixing chamber into which the resultant gases are dis-

charged; an air conduit leading to the mixing chamber; and a rotary fan delivering air to the air conduit.

19. In a burner, the combination of a vaporizing chamber; air and fuel jets leading to the vaporizing chamber; a mixing chamber into which the resultant gases are discharged; an air conduit leading to the mixing chamber; a rotary fan delivering air to the air conduit; pumps for delivering air and fuel to the jets; and a common motor for actuating said pumps and fan.

In testimony whereof I have hereunto set my hand.

ROBERT F. METCALFE.