

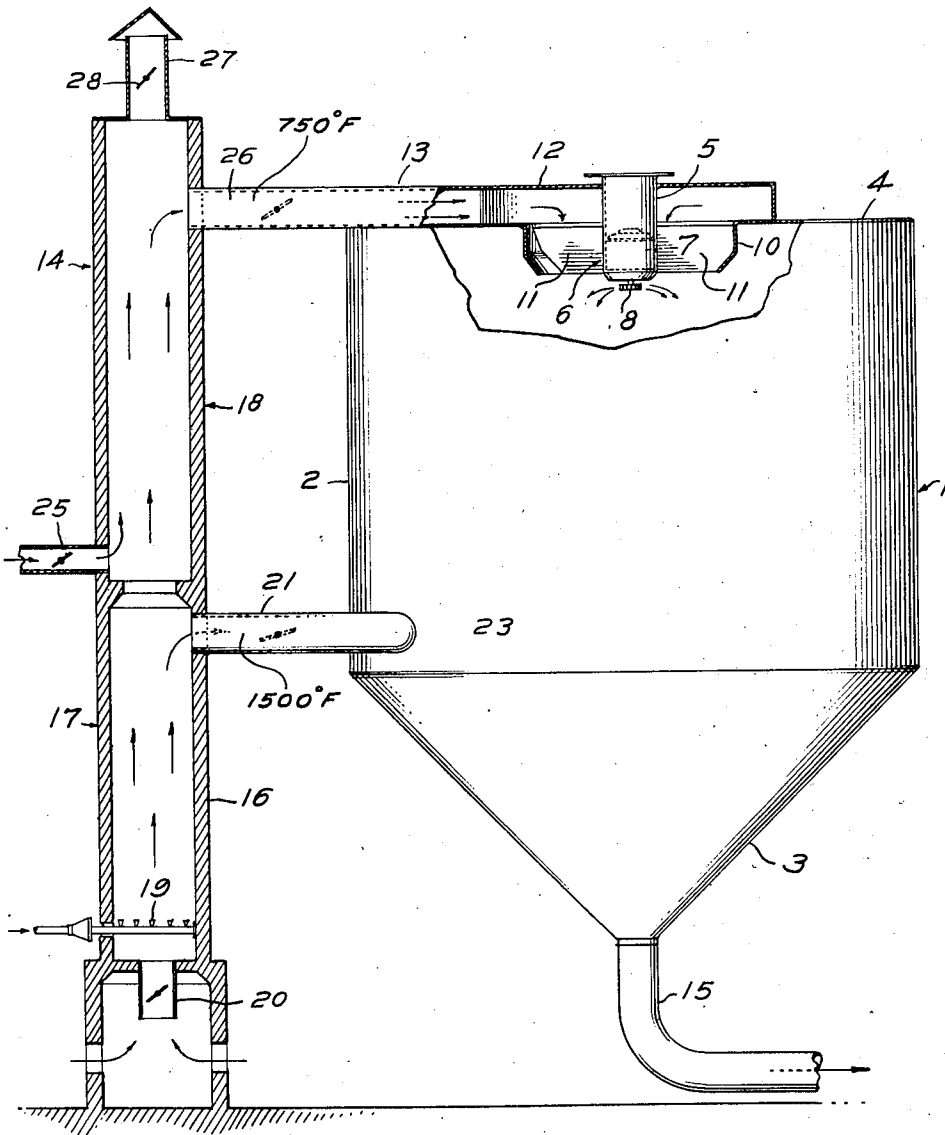
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SPRAY DRYING

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SPRAY DRYING

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1 Claim. (Cl. 159—48)

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This invention relates to a method and apparatus for spray drying and more particularly to a novel spray drying method wherein a greater drying capacity is obtained. The principal object of the invention is the provision of a combined furnace and spray drying chamber installation wherein a greater amount of fuel can be burned in the furnace, and a correspondingly greater amount of heat can be introduced and utilized in the spray drying chamber, without increasing materially the volume of the exhaust gas that must be handled by the cyclone separators and the exhaust fan. A further object is the provision of a spray drying installation wherein a substantially higher average inlet gas temperature can be employed without damage to the spray machine. Still further objects will become apparent from the following detailed description of a preferred embodiment of the invention.

A conventional spray drier that is now in wide commercial use consists generally of a vertical cylindrical drying chamber having a motor driven spray machine mounted at the top thereof. Hot gases in the form of products of combustion are generated by a gas-burning furnace and are admitted to the spray drying chamber through a flue which surrounds the spray machine. Usually a set of gas-directing vanes is placed in this flue so that the entering gases follow a vertical spiral path, the solution or slurry to be spray dried being discharged laterally into this spiral gas stream.

In installations of this type the temperature of the hot gases must ordinarily be restricted to about 750° F., or thereabouts, since the use of hotter gases increases greatly the danger of damaging the flues and the spray machine. This relatively low inlet gas temperature limits the quantity of liquid that can be evaporated in the spray drying chamber, and consequently limits the amount of product that can be produced in equipment of any given size. Ordinarily the mixture of gases and spray dried material issuing from the spray drying chamber is passed into a set of cyclone separators, where the solid material is separated from the gases, after which the gases pass through a blower or fan and are discharged to the atmosphere. In order to increase the capacity of the spray drying equipment a correspondingly increased volume of gases must be handled in the drying chamber, the cyclone separators and in the blower; in other words, the gas volume of the entire installation must be increased.

By the present invention, an increase in the drying capacity of the equipment is obtained

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without increasing the volume of the exhaust gas through the cyclones and fan. This is done by introducing a portion of the hot gases at a higher temperature into the lower part of the spray drying chamber where they are out of contact with the spray machine. Gases having any desired temperature above about 750° F., or above the temperature limitation imposed by danger of damaging the spray machine, may be used.

In accordance with another feature of the invention, two gas streams of different temperatures are withdrawn from the same furnace by the use of secondary air or other diluting gases. In this arrangement a second flue or duct extends between a side outlet in the furnace and the lower part of the spray drying chamber. An inlet for secondary air is provided in the furnace above or beyond this hot gas outlet, so that the remaining gases in the furnace can be cooled to the desired temperature on the order of 750° F. at which they can be used for introduction at the top of the spray drying chamber.

The invention will be further described with reference to the accompanying drawing in which the single figure is a diagrammatic representation of a specific embodiment thereof. Referring to this drawing, the spray drying chamber indicated generally by reference numeral 1 is made up of a cylindrical side wall 2, a conical bottom portion 3 and a generally flat top 4 in which a central well structure 5 is mounted. A spray machine 6, consisting of an electric motor 7 driving a vaned spray wheel 8 of conventional design is mounted in the cylinder 5. An outer vertical duct 10 containing gas directing vanes 11 may surround the central well structure 5. A generally cylindrical gas flue 12, open at its bottom, also surrounds the central well 5 and provides communication between the interior of the spray drying chamber and a gas duct 13 leading to the top of the furnace 14. The conical bottom 3 of the spray drying chamber terminates in a gas outlet pipe 15 which leads to a set of cyclone separators and then to an exhaust blower or fan, these being of conventional design.

The furnace 14 consists generally of a preferably brick lined cylinder 16 which may be divided into a lower primary combustion zone 17 and an upper dilution zone 18. Gas burners 19 are provided near the bottom of the combustion zone together with an inlet 20 for the introduction of primary air. A hot gas outlet 21, which is preferably lined with firebrick or other heat-resistant material, connects the primary combustion zone 17 with a lower portion 23 of the spray drying

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chamber. It will be understood that the location of the pipe 21 with respect to the spray drying chamber is not necessarily at the exact level shown on the drawing, but may be at any level below that of the spray wheel 8.

Above the hot gas outlet pipe 21 the furnace 14 is provided with an inlet 25 for secondary air. Inasmuch as the secondary air is used for the purpose of diluting and thereby cooling the gases in this portion of the furnace, it will be understood that a non-combustible gas other than air may also be used for this purpose if desired; thus, for example, a portion of the exhaust gases from the main blower may be recirculated to the inlet 25. Above the level of the secondary air inlet 25, a gas outlet pipe 26 is located, this pipe connecting the dilution zone 18 with the duct 13 that leads to the top of the spray drying chamber. A suitable stack 27, controlled by a damper 28, may be provided at the top of the furnace if desired. All of the air inlet and gas outlet pipes leading to and from the furnace are provided with dampers, so that the quantities of gases passing there-through may be regulated to obtain optimum conditions within the spray drying chamber.

The operation of the combined furnace and spray drier is apparent from the foregoing description. Hydrocarbon gas or other fuel is burned in the burners 19 by the primary air introduced through the inlet pipe 20. The resulting hot gases pass upwardly through the furnace 14 and a portion thereof is withdrawn from the combustion zone 17 through the pipe 21 at a temperature, for example, of 1000-2000° F., preferably about 1500° F., and introduced into the lower portion 23 of the spray drying chamber. The remainder of the hot gases within the furnace 14 are diluted and cooled by secondary air or other gas introduced through the inlet 25, whereby the temperature is reduced to 750° F. or lower. Gases having this temperature are withdrawn from the dilution zone 18 through the outlet 26 and pass through pipe 13 and distributing flue 12 into the top of the spray drying chamber, where they form a rotating gas blanket into which the material to be dried is sprayed by the spray wheel 8. The resulting mixture passes downwardly through the chamber while additional hot gas is introduced at a lower level through the pipe 21 at a temperature well above 750° F. and preferably at 1000-1500° F.

As a result of the introduction of drying gases at two different levels in the spray drying chamber by the procedure described, a number of operating advantages may be obtained. The parti-

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cles of liquid material thrown off by the spray wheel 8 first encounter a smaller flow of gas, which may also be at lower temperature, than in the case of prior operating conditions. Under these circumstances they will travel a greater distance from the atomizing wheel before they become solidified or set by drying, and therefore dried particles of improved sphericity are obtained. Furthermore, as has been explained, the evaporating capacity of the spray drier is greatly increased; by employing a ratio of hot gas at 1500° F. (introduced through the pipe 21) to cool gas at 750° F. (introduced through the pipe 13), such that an average inlet temperature of 1100° F. is obtained, a total of 67% more water can be evaporated than when all of the gas is introduced at 750° F. through the pipe 13. This improvement in evaporation is obtained with the same outlet temperature (about 230° F.) in pipe 15 and with the same volume of drying gases in the cyclone separators and exhaust fan.

What I claim is:

A method of spray drying which comprises burning a hydrocarbon fuel with primary air to form a body of primary combustion gases having a temperature above 1000° F., withdrawing a portion of said primary combustion gases and diluting the remainder with cooler gas to form a body of hot secondary combustion gas having a temperature not higher than about 750° F., introducing a stream of said hot secondary combustion gas downwardly into the top of a chamber while dispersing therein a spray of liquid material to be dried and passing the resulting mixture downwardly through said chamber and introducing therein the withdrawn portion of said primary combustion gases at a level below that at which said liquid material was introduced.

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