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SULPHATE DRIER

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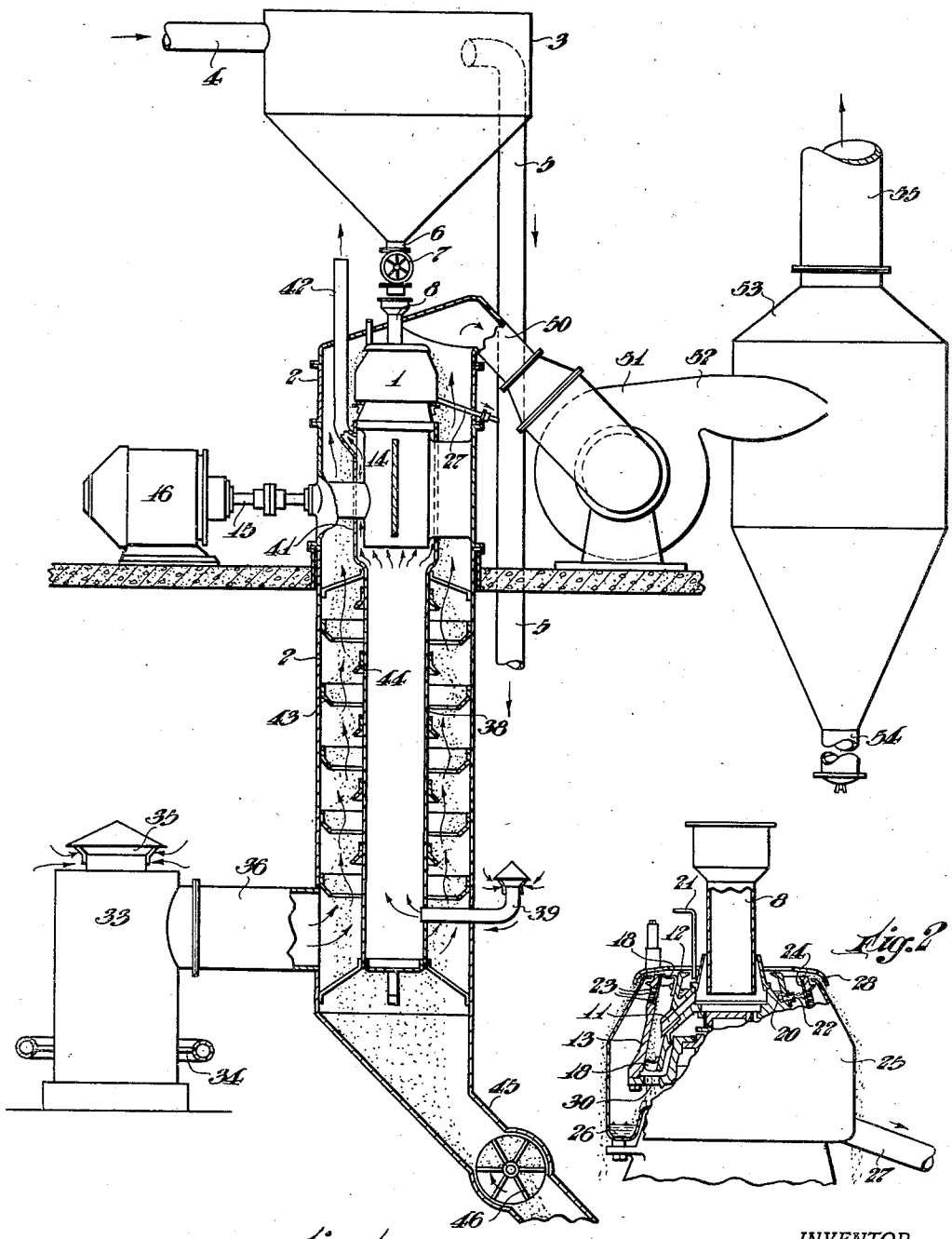


Fig. 1

Fig. 2

INVENTOR.
Joseph van Ackeren.
BY
Jesse R. Langley
ATTORNEY.

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SULPHATE DRIER

Joseph van Ackeren, O'Hara Township, Allegheny County, Pa., assignor to The Koppers Company of Delaware, a corporation of Delaware

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This invention relates to apparatus for drying materials and more particularly to the removal of moisture from wet masses of ammonium sulphate crystals such as are obtained in the removal of ammonia from coke-oven and other fuel gases by means of sulphuric acid.

A widely used method for removing ammonia from coke oven and other fuel gases containing it comprises passing the gas into contact with sulphuric acid. The sulphuric acid reacts with the ammonia in the gas to form ammonium sulphate which is permitted to accumulate in the acid bath until it crystallizes out. The wet crystals are then removed, drained, washed and dried, usually in low-speed centrifugal driers.

It has been found, however, that this procedure alone does not produce a satisfactory grade of ammonium sulphate, further drying treatment being necessary in order to produce the thoroughly dry and substantially non-caking product known as Arcadian ammonium sulphate.

An object of my present invention is to provide improved apparatus for the recovery of dry non-caking ammonium sulphate.

A second object of my invention is to provide a novel and compact arrangement of apparatus whereby the production of a dry non-caking ammonium sulphate from a wet mass of ammonium sulphate crystals may be carried out in a single operation and with a minimum of difficulty.

My invention has for further objects such other operative advantages or results as may hereinafter be found to obtain.

My invention contemplates the provision of apparatus for drying ammonium sulphate or the like which comprises a continuously discharging high speed centrifugal drier of an efficient type mounted in a duct through which is circulated a current of heated gas such as air, gases of combustion or the like, this duct being so disposed as to effect a rapid and efficient drying of the sulphate crystals discharged from the centrifugal drier.

My invention also contemplates the provision of certain further advantageous features of design which will be more fully described hereinbelow.

In order that my invention may be fully set forth and understood, I now describe, with reference to the accompanying drawing, a preferred manner in which it is embodied and constructed. In this drawing,

Figure 1 is a view partly in elevation and partly in vertical section of apparatus for drying ammonium sulphate crystals constructed in accordance with my invention; and

Fig. 2 is a similar view on an enlarged scale of a portion of the apparatus shown in Fig. 1.

Similar reference numerals designate similar parts in each of the views of the drawing.

Referring to the drawing, there is provided a continuously discharging high speed centrifugal drier 1 mounted within a warm air or gas duct 2. Moist ammonium sulphate crystals are supplied to the drier 1 from a suitable hopper 3 having an inlet 4, an overflow conduit 5 and a discharge conduit 6 having a valve 7 leading to a charging pipe 8 located at the top of the drier 1.

Moist ammonium sulphate which passes through the charging pipe 8 into the interior of the drier 1 is discharged by centrifugal force through a plurality of downwardly sloping ports 11 mounted in a rotor 12 against a rotor 13 of larger diameter and rotating at a different speed from the speed of rotation of the rotor 12. The rotors 12 and 13 have the forms of truncated cones, their larger diameters being at the bottoms thereof and are driven through appropriate shafts and gearing located within a housing 14 and connected by a shaft 15 to an electric motor 16 or other motive device.

Attached to the outer surface of the rotor 12 are a plurality of inclined staggered scrapers 18, usually arranged in two descending spiral rows. In the upper portion of the rotor 12 there is provided a well 20 which receives water or other washing liquid from a conduit 21 and discharges the same by centrifugal action through one or more ports 22 against the upper portion of the outer rotor 13.

In the upper portion of the outer rotor 13 opposite the port or ports 22 there are located a plurality of openings 23 surmounted by a screen 24.

The rotors 12 and 13 are enclosed within a casing 25 having an annular well 26 located at the bottom thereof and which is drained by a conduit 27. The upper portion of the casing 25, which is open, extends upward to a point just short of the top of the outer rotor 13 above which is provided a deflection plate 28 of somewhat larger diameter than the top of the casing 25 and spaced a little above the rotors 12 and 13.

The wet sulphate crystals which are discharged by simple reaction through the ports 11 against the inner surface of the outer rotor 13 are gradually worked upward by the plows or scrapers 18, the separated liquid being discharged through an opening or openings 30 located in the

bottom of the outer rotor 13. As the crystals are forced upward over the screen 24 they are washed by the water or other washing liquid thrown outward from the ports 22. The washing liquid after passing outward by centrifugal action through the screen 24 and holes 23 falls under the well 26 together with the liquid passing downward through the openings 30 and passes out through the conduit 27 which may conveniently be connected to the overflow 5 from the hopper 3.

The washed and partially dried crystals are forced upward over the upper edge of the rotor 13 and discharge outwardly over the top of the casing 25 under the deflector 28.

The crystals then fall down through the duct 2 where they are subjected to a rising current of heated air or a mixture of air and products of combustion supplied from a heater 33 having a plurality of burners 34 or other heating means, an intake 35 and an offtake 36 connected to the lower portion of the duct 2.

Preferably, there is provided within the interior of the lower portion of the duct 2 below the housing 14 a cylindrical air duct 38 having an air inlet 39 located at the lower portion thereof and having an upper portion 41 surrounding and spaced from the housing 14. The upper portion 41 of the duct 38 is provided with a stack 42 for discharging heated air.

It will be understood that, due to the fact that the duct 38 is surrounded by heated air or products of combustion from the heater 33, a thermosiphonic action is set up which causes cold air to be drawn in through the inlet 39 and to pass upward through the duct 38, the extension 41 and out through the stack 42. This circulation of air offers a protection for the gears and other mechanism located in the housing 14 against the relatively high temperature of the gases in the duct 2.

For the purpose of promoting contact between the descending flow of ammonium sulphate crystals and a rising current of hot gases, I provide a plurality of downwardly sloping baffles 43 and 44 which may be conveniently attached to the walls of the ducts 2 and 38, respectively.

The bottom of the duct 2 is preferably somewhat restricted to provide a discharge conduit 45 having a star wheel 46 or other suitable and sufficiently gas-tight mechanism for removing the ammonium sulphate crystals from the same.

The upper portion of the duct 2 communicates with a conduit 50 that in turn communicates with the intake side of a fan or blower 51, the latter in turn communicating through a conduit 52 with a suitable separator 53, preferably of the cyclone type as shown. The separator 53 is provided with a boot 54 for removing crystals of ammonium sulphate separated from the gases passing therethrough and with an outlet 55 for the gases and need not be described in further detail.

Due to the fact that the centrifugal drier 1 is of very compact design and discharges continuously at or near its upper periphery the location of the same within the duct 2 is of special advantage as the arrangement thus provides for substantially continuous and thorough dehydration of the sulphate crystals in a single operation with a minimum of apparatus.

Moreover, no handling of the sulphate between the point at which it is delivered to the centrifugal drier and the point at which it is recovered in non-caking ammonium crystals is required. This is highly advantageous due to the more or less acid and caking character of the sulphate between these points.

It will be obvious to those skilled in the art that the apparatus of my invention is susceptible to considerable modification and is therefore not limited to the details of the particular device shown and described hereinabove by way of example, but may variously be embodied within the scope of the claims hereinafter made.

I claim as my invention:

1. Apparatus for recovering dry and substantially non-caking ammonium sulphate from moist masses of crystals thereof which comprises a substantially continuously discharging high speed centrifugal drier, an outer duct enclosing said drier and adapted for passage therethrough of dried crystals from said centrifugal drier, driving mechanism for said drier at least partly disposed within said outer duct, and an inner cooling duct within said outer duct and enclosing that portion of said driving mechanism located within said outer duct for passage of cooling gas therethrough to cool the driving mechanism, means for passing hot gases through said outer duct and means independent of the driving mechanism and the centrifugal drier for effecting a circulation of cooling gas through the cooling duct.

2. Apparatus for recovering dry and substantially non-caking ammonium sulphate from moist masses of crystals thereof which comprises, in combination, a substantially continuously discharging high speed centrifugal drier, a hot gas duct surrounding said drier and adapted for passage therethrough of dried crystals from said drier, driving mechanism for said drier at least partly disposed within said outer duct, means for supplying hot gases to said duct, means for removing substantially dry ammonium sulphate crystals from said duct at a point below said drier, a fan for drawing hot gases through said duct, an inner cooling duct within said hot gas duct and separating the driving mechanism from the outer duct for circulating cooling gas therethrough and over the driving mechanism, and a cooling gas inlet and outlet for said inner cooling duct for effecting the circulation of cooling gas therethrough by levitation of the gas upwardly due to the indirect heating of the cooling gas by the hot gas flow through the outer cooling duct.

JOSEPH VAN ACKEREN.