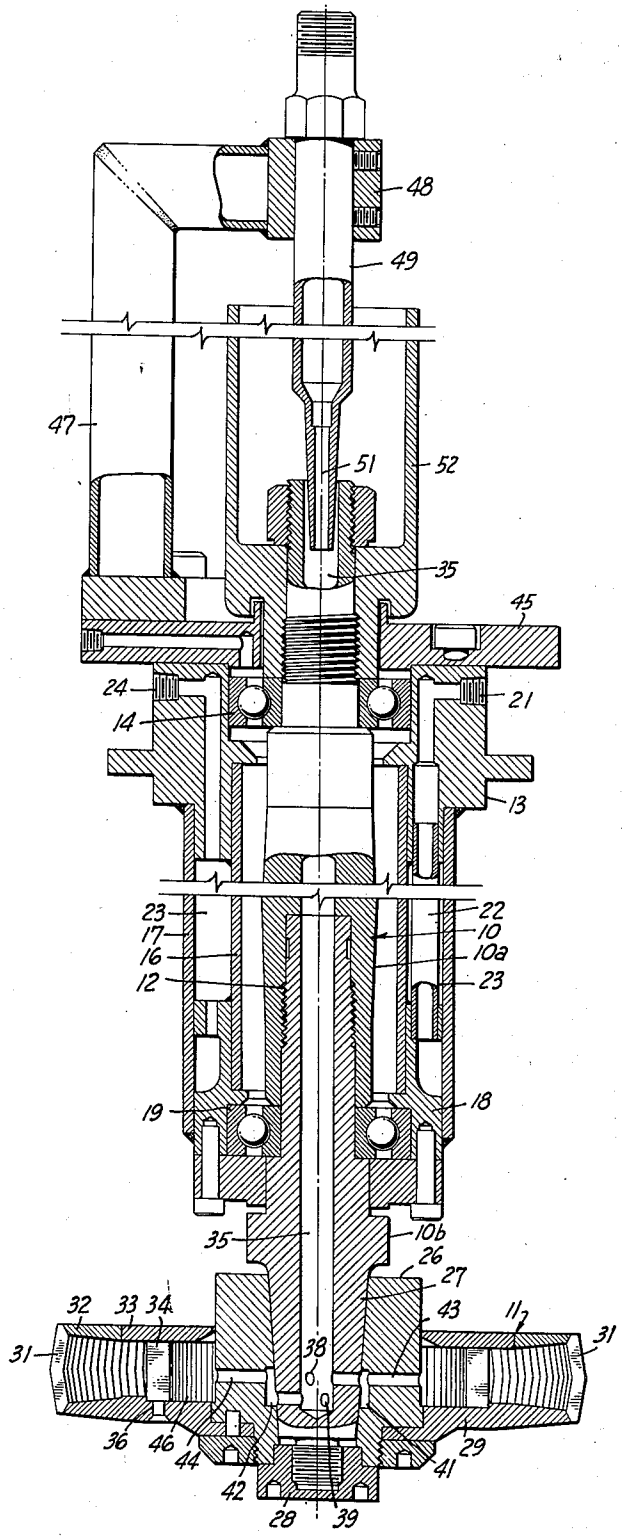
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CENTRIFUGAL ATOMIZER

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CENTRIFUGAL ATOMIZER

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This invention relates generally to centrifugal atomizer devices and methods such as are employed for spray drying equipment.

Centrifugal atomizers such as are suitable for use with spray driers commonly make use of a rotating shaft which extends into the drying or desiccating chamber, and which carries an atomizing head. Provision is made for supplying the feed material to the atomizer head at a continuous rate, and within the head the material is discharged outwardly and is acted upon by means insuring mechanical atomization, such as a plurality of circumferentially spaced atomizing bars.

Due particularly to the relatively high speed of operation involved, and to the elevated temperature of the surrounding drying gas, centrifugal atomizers have been subject to operating difficulties which have necessitated considerable expense for maintenance and repair. One part of the atomizer which in particular has given difficulty is the means employed for introducing the feed material into the head. In one type of atomizer which has been used commercially, the shaft is bored for introduction of the feed material, and the feed is introduced into that end portion of the shaft which is normally exterior to the desiccating chamber. Fluid communication with an external feed pipe is established through a stationary fitting which has sealed engagement with the shaft. Provision of this character for introducing the feed material has proven troublesome and expensive to maintain, due particularly to the difficulty in maintaining a sealed relation between the shaft and the associated stationary fitting, at the relatively high speeds of rotation employed.

Another arrangement which has been used in the past is to employ a fluid supply pipe separate from the shaft, but extending down alongside the shaft into the atomizer head. This arrangement necessitates an annular opening of considerable size in the upper side of the head for accommodating the feed tube. It likewise is unsatisfactory due mainly to continual recirculation of material which tends to take place through the atomizer head and the annular orifice, due to the pumping action which necessarily takes place. Recirculation of material in this fashion appears to be a contributing factor to burning of heat sensitive material, such as milk products.

It is an object of the present invention to provide an improved form of atomizer which has novel provision for introducing feed material into the atomizer head, and which in particular avoids the objectionable features of prior atomizers as outlined above.

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A further object of the invention is to provide an improved atomizer having provision for introduction of feed material through the central bore of the shaft without utilizing sealing or packing glands.

Another object of the invention is to provide a centrifugal atomizer and method which will avoid objectionable recirculation of material through the atomizer head, and which therefore will reduce objectionable burning of the material being dried.

Another object of the invention is to provide an atomizer in which induced air flow into the atomizer head is employed in a novel manner to facilitate the feeding of fluid material to be atomized.

Additional objects of the invention will appear from the following description in which the preferred embodiment has been set forth in detail in conjunction with the accompanying drawing.

The centrifugal atomizer illustrated in the drawing consists of a shaft 10 which is preferably arranged vertical as illustrated, together with an atomizing head 11 attached to the lower end of the shaft. It is desirable to form the shaft in two sections 10*a* and 10*b*, which are interfitted and secured together as by the threaded engagement 12.

The means employed for journaling the shaft includes the mounting collar 13 and the ball bearing assembly 14. The mounting collar in a commercial installation may be carried by one of the upper walls of the desiccating chamber. A pair of concentric tubes 16 and 17 have their upper ends mounted upon collar 13, and their lower ends secured to the collar 18. A ball bearing assembly 19 is carried by the collar 18, and forms a lower journal for the shaft. A passage 21 in the mounting collar 13 is adapted for connection with a water supply pipe, and communicates with a pipe 22 which extends downwardly through the space 23 between the tubes 16 and 17. Passage 24 is adapted to be connected with an outlet pipe and communicates with the upper end of the space 23.

The atomizer head 11 which is attached to the lower end of the shaft, may be any one of a number of specific types. The particular design illustrated includes a hub 26 having a tapered bore to receive the lower tapered end portion 27 of the shaft. A nut 28 serves to retain the hub in place. A lower disc 29 is carried by the hub 26, and the outer periphery of this disc forms a mounting for the circumferentially spaced atomizer bars 31. The upper ends of the bars 31 are attached to the ring 32, which is concentric with the axis of the shaft and parallel to the disc 29.

An annulus 33 is fitted within the ring 32, and carries the depending circumferentially spaced bars 34, which are attached to the disc 29 as by means of screws 36.

The means employed for introducing feed material into the atomizing head is as follows: The shaft is provided with an axial bore 35 which at its lower end communicates with the radially extending ducts 38 and 39. These ducts communicate with recesses 41 and 42 in the hub 26, whereby feed material flows outwardly through the radially extending ducts 43—44. With a symmetrical distribution of the ducts the feed material is distributed relatively uniformly about the axis of the shaft, and into the annular space 46 which surrounds the hub 26.

Near the upper end of the shaft there is a plate 45 which is attached to the mounting collar 13, and which in turn forms a mounting for the support standard 47. This standard includes a head 48 which is bored to receive the feed nozzle 49. The lower end portion 51 of the feed nozzle is dimensioned to be smaller in diameter than the corresponding diameter of the bore 35, and is positioned within the bore as illustrated. When the atomizer is in operation the nozzle 49 is connected to a source of fluid or semifluid feed material under pressure.

Suitable means is provided for driving the shaft of the atomizer. Thus a pulley 52 is shown attached to the upper end of the shaft, and is adapted to be engaged by a suitable driving belt.

Operation of my atomizer, and the features of my method, can be reviewed as follows: Normally the shaft 10 is in vertical position and the head 11 is mounted within the spray drying or desiccating chamber. Hot drying gas is continuously supplied to the desiccating chamber as is well understood by those familiar with such equipment. The shaft is driven at a peripheral speed dependent upon the material being atomized, and the drying conditions being maintained. For example when handling liquid milk products or concentrates, we have employed speeds of say 6000 R. P. M. for a 20 inch diameter atomizer head. For smaller sizes speeds of the order of from 11,000 to 15,000 R. P. M. can be employed. The liquid feed material is supplied at a substantially constant rate through the nozzle 49, and at a pressure sufficient to cause discharge of a solid jet from the lower reduced end portion 51. The feed material is delivered from the lower end of the bore 35 through the ducts 38, 39, recesses 41, 42 and ducts 43, 44 into the atomizer head, where it is finally discharged from the atomizing bars 31.

The operation is such that normally no liquid level exists in the bore 35, and whereby a mixed phase stream of liquid and air flows from the bore 35 through the ducts 43, 44 in the hub 26. The closed hollow head has a pumping action due primarily to the fact that liquid material thrown outwardly from hub 26 entrains air and causes a continuous discharge of air together with atomized material from the periphery of the head. The air being pumped by the atomizing head flows downwardly through the bore 35 from the exterior of the desiccating chamber. This flow is restricted due to the dimensioning of the bore 35, and to the restriction of this bore by the nozzle portion 51. This flow restriction causes a subatmospheric or negative pressure to be created in the head. For the type of apparatus illustrated the negative pressure can be of such value as to draw from 5 to 10 inches of mercury, and serves to maintain an optimum balance of air and liquid in the bore 35 and the atomizer head. The solid jet of fluid material issuing from the nozzle portion 51 does not remain as such for the entire length of the bore 35. At some point intermediate the nozzle portion 51 and the lower end of the bore, the jet breaks to intermix with the stream of air. The kinetic energy imparted to the feed material issuing from the nozzle portion 51, together with the induced downward current of air, serves to carry the liquid material through the ducts in the hub 26 and the lower portion of the bore.

Care should be taken to supply the liquid feed material at a rate which will insure the pumping action described above, together with the desired flow of mixed phase material through the ducts of the hub 26. If the flow of liquid feed from the nozzle portion 51 is so great as to exceed the liquid handling capacity of the head, the lower end of the bore 35 will be flooded with liquid to provide a liquid seal serving to restrict or block flow of air into the head. Under such abnormal conditions the atomizing efficiency and capacity of the apparatus is greatly impaired. To avoid this abnormal condition, in starting the apparatus in operation it is desirable to limit the flow of liquid feed through the nozzle portion 51 until the head has been accelerated to normal operating speed, a substantial negative pressure created in the head, and a substantial flow of air induced through the bore 35. Thereafter the flow can be increased to full capacity.

The atomizer described above has a number of desirable features and characteristics. No sealed union or like connection is required between the nozzle 49 and the shaft, and thus the difficulties previously encountered with such seal connections are completely avoided. All of the air being pumped by the atomizing head flows downwardly through the bore 35 with the feed material. Therefore such air supplied to the head cannot carry with it previously atomized particles, and this serves to improve operation of the desiccator with which the atomizer is employed.

During operation of the atomizer it is desirable to continuously circulate cooling water through the space 23 between the tubes 16 and 17, thus avoiding overheating of the ball bearing assemblies, and tending to reduce the temperature of the shaft.

The atomizer described above is suitable for use with a variety of feed materials, including such products as whole milk, skim milk, milk concentrates and the like. Some feed materials may tend to cause accumulations of solid material within the shaft, thus restricting the cross-sectional flow area of the bore, and necessitating occasional shutdown of the equipment for cleaning. For example when handling a concentrate of liquid whey supersaturated with respect to lactose, it has been found that lactose crystals tend to separate from the feed by centrifugal action and accumulate as a hard crystalline mass within the bore 35. Such accumulations can be eliminated by extending the length of the nozzle portion 51 whereby its lower end terminates in proximity to the atomizer head.

We claim:

1. A centrifugal atomizer suitable for use with spray driers of the type having a drying chamber into which hot drying gas is introduced, the atomizer comprising a mounting collar for attachment to an upper wall of the drying chamber,

a vertical shaft extending through said collar, bearing means carried by the collar for journalling the shaft, a hollow centrifugal atomizing head carried by the lower end of the shaft within said chamber, said shaft being provided with a bore extending longitudinally within the same, the upper end of the bore being open to the atmosphere exterior of the chamber and the lower end of the bore being in communication with the interior of the atomizing head, and a stationary feed supply nozzle mounted above said collar and extending downwardly for a substantial distance into the bore from the upper end thereof, said nozzle serving to discharge a downwardly directed jet of feed material into said bore.

2. A centrifugal atomizer suitable for use with spray driers of the type having a drying chamber into which hot drying gas is introduced, said atomizer comprising a mounting collar for attachment to an upper wall of said drying chamber, a vertical shaft extending through said collar, bearing means carried by the collar for journaling the shaft, a hollow centrifugal atomizing head carried by the lower end of the shaft within said chamber, said shaft being provided with a bore extending longitudinally through

the same, the upper end of the bore exterior of said chamber being in communication with the atmosphere and the lower end of the bore being in communication with the interior of the atomizing head, a stationary feed nozzle at the upper end of the shaft and extending downwardly into the upper end of said bore for a substantial distance, means forming a stationary mounting for said nozzle on said collar, said bore being directly open to the atmosphere at its upper end and the upper and lower ends of the bore being in communication through the clearance about said nozzle, said nozzle serving to discharge a downwardly directed jet of feed material into said bore.

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