July 18, 1950 O. T. PIEPER 2,515,665

SPRAY DRYING DEVICE

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Fig. 1

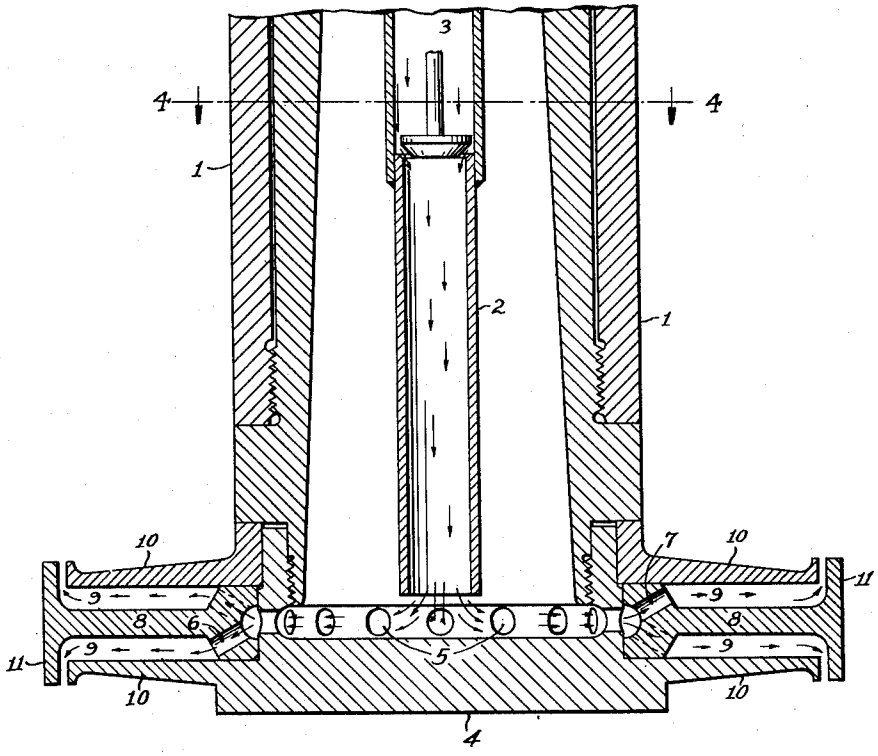


Fig. 3

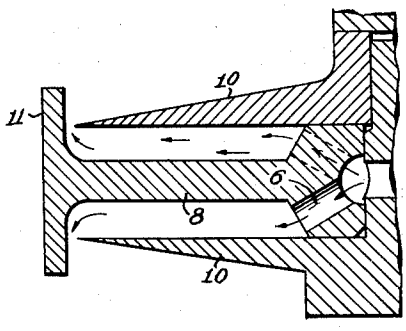
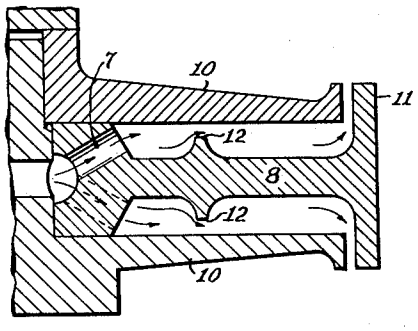


Fig. 2



INVENTOR
Oliver T. Pieper
BY Pennie, Edmonds, Morton and Barrows
ATTORNEYS

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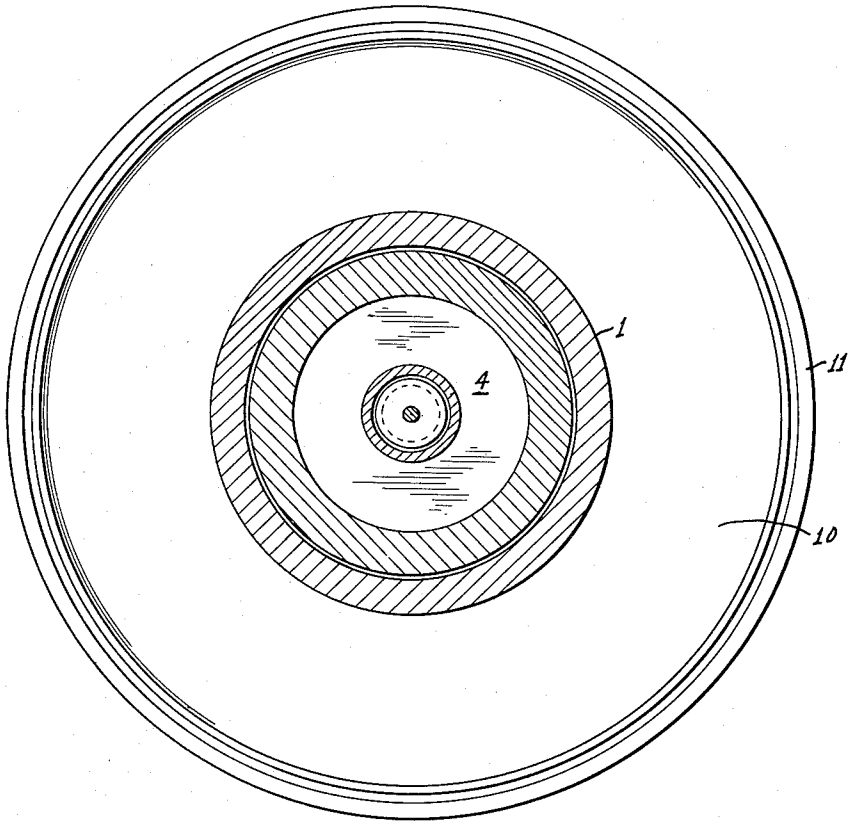
FIG. 4



INVENTOR
Oliver T. Pieper
BY
Dennis, Edmonds, Morton and Brown
ATTORNEYS

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UNITED STATES PATENT OFFICE

2,515,665

SPRAY DRYING DEVICE

Oliver T. Pieper, Edgewood Hills, Del., assignor to American Dyewood Company, Chester, Pa., a corporation of Pennsylvania

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8 Claims. (Cl. 299—63)

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This invention relates to spray drying and particularly to improvements in apparatus for separating material in a dry condition from liquids containing such material.

Spray drying, in which a liquid is distributed into a current of heated gas such for example as combustion products, with or without added air, for the purpose of rapidly evaporating the liquid and obtaining a dry product, has been practised for many years with various types of apparatus. The most modern and effective apparatus utilizes a whirling disc or "wheel" to which the liquid is fed and from which it is distributed by centrifugal force applied by the rapid rotation of the wheel. In such apparatus, the problem of obtaining proper distribution of the liquid from the wheel has never been completely solved. Improper distribution of the liquid from the wheel has resulted in failure to evaporate all of the liquid in portions of the material, and deposits of partially evaporated material are built up on the walls of the evaporation chamber. This in turn necessitates frequent stoppage of the apparatus for cleaning and additional expense due to cleaning and to the loss of material which is not recovered in the desired form. Improper distribution of the liquid from the wheel has also resulted in atomization of the liquid leaving the spray head, so that a mist of liquid globules is formed. Although such globules dry quickly and do not adhere to the walls of the drying chamber, they dry to form particles of very small size, which are objectionable, e. g., in soap powders where they cause discomfort to the user. These and other disadvantages of the known types of apparatus have limited the application of spray drying, which in many cases has proved to be uneconomical.

It is an object of the present invention to provide an improved spray drying head in which proper distribution of the liquid is maintained and the disadvantages mentioned are avoided.

Another object of this invention is the provision of a spray drying head which is so designed that when rotated at high speeds (e. g., 5000–15,000 R. P. M.) it distributes into the drying chamber a substantially uniform sheet of liquid which is depressed in the form of an umbrella by the stream of hot gas entering the drying chamber. For further information concerning the details of a complete spray drying apparatus in which the spray drying head of this invention may be installed, reference is made to my prior patent applications, Serial Nos. 581,476 and 581,477, filed March 7, 1945, now Patent 2,478,779.

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These and other objects are accomplished in accordance with the invention by constructing a spray drying head comprising a primary flange having a vertical circumferential baffle and a secondary or auxiliary flange placed in such relationship to the primary flange as to provide an annular space between them through which the liquid to be spray dried is thrown by centrifugal force. In accordance with this invention I have discovered that it is essential that the outer circumferential face of the auxiliary flange should not extend above the adjacent inner vertical face of the vertical circumferential baffle in order to provide a spray drying head which will produce a product containing a desirably low proportion of "fines" or dust-like products and which will reduce to a minimum the formation of deposits on the walls of the drying chamber.

The accompanying drawings illustrate in diagrammatic form particular embodiments of the spray drying head of this invention. Referring to the drawings:

Fig. 1 represents in section an elevation of a circular spray drying head having an external diameter of about 6 inches;

Fig. 2 represents a modification of the primary flange by providing an intermediate baffle to assist in providing a uniform sheet of liquid leaving the spraying device;

Fig. 3 represents a modification of the secondary or auxiliary flange, shown in relationship to the primary flange; and

Fig. 4 represents a sectional view taken on line 4—4 of Fig. 1.

Referring to Fig. 1, the numeral 1 represents a rotatably mounted chamber to which the liquid to be spray dried is fed through the stationary pipe 2 containing a control valve 3 to regulate the rate of liquid feed to the spray head 4. A series of radially directed holes 5 is provided at the base of the chamber 1. The liquid being dried is thrown by centrifugal force through these holes 5, then through the radial passages 6 and 7 in the primary flange 8, and then through the annular spaces 9 located between the primary flange 8 and the auxiliary flanges 10. The auxiliary flanges 10 are spaced in such relationship to the vertical circumferential baffle 11 on the flange 8 so as to direct the liquid thrown through the annular spaces 9 against the baffle 11. The liquid flows along the vertical face of the baffle 11 and is thence thrown in the form of a uniform sheet from the edge thereof.

In an apparatus of the type shown in Fig. 1, applicant has found that the passages 6 and 7

should preferably be staggered (as shown) and should be at least 16 in number, in order to provide a liquid sheet having the greatest uniformity. The number of passages 6 and 7 should not be so great, however, as to result in excessive weakening of the apparatus, and the passages should be of sufficient diameter to prevent their clogging. The number and size of the passages 6 and 7 will depend upon the capacity desired for the apparatus, upon the materials used in its manufacture, upon the liquid being spray dried, and upon other factors, and may be determined by simple experiments.

Referring to Fig. 2, an intermediate baffle 12 has been provided on the flange 8, to assist in the production of a more uniform sheet of liquid leaving the spray head and thus result in a reduction in the content of dust in the final product.

Fig. 3 shows a modification of the auxiliary flange 10 which has been found to be useful in the preparation of a spray dried product of desirable properties. Preferably, however, the inner face of the vertical baffle 11 should extend 0.000–0.125 inch beyond the adjacent face of the flange 10. Generally, the distance between the inner face of the vertical baffle 11 and the outer edge of the flange 10 should not be greater than about ⅛", depending upon the rate of feed of the liquid to the spray head, upon the particular liquid being spray dried, etc.

With a spray head of the type described installed in a suitable drying chamber, I have efficiently spray dried many materials (e. g., extracts of quebracho, wattle, dividivi, logwood, fustic, licorice, and coffee, and solutions of a wide variety of detergents) to produce a free-flowing, uniform product of high bulk density containing a minimum proportion of products of extremely small particle size.

I claim:

1. A spray drying device for distributing liquid into a drying chamber, comprising a rotatably mounted shaft having a head secured thereto for rotation therewith, and means for conducting liquid to said head, said head comprising an outwardly-extending primary flange and two outwardly-extending auxiliary flanges all mounted for rotation with the head, the primary flange having smooth substantially planar upper and lower faces and the auxiliary flanges having smooth substantially planar faces spaced from the respective upper and lower faces of the primary flange to provide upper and lower annular chambers, said primary flange having transversely-extending upper and lower baffles positioned beyond the outer peripheries of the auxiliary flanges, said baffles extending from said smooth faces of the primary flange transversely at least as far as the outer extremities of the auxiliary flanges, whereby liquid conducted to the head is thrown by centrifugal force through the upper and lower annular chambers against the upper and lower baffles and along said baffles into the drying chamber in the form of a substantially uniform sheet.

2. A spray drying device as defined in claim 1 in which the primary flange has a plurality of generally radially-extending passages therethrough communicating with said annular chambers, and the body of the head has a plurality of holes through which liquid introduced through the liquid conducting means may flow to said passages and to the annular chambers.

3. A spray drying device as defined in claim 1 in which the primary flange has an upper and a lower annular baffling face spaced inwardly of said outer baffles.

4. A spray drying device for distributing liquid into a drying chamber, comprising a rotatably mounted shaft having a head secured thereto for rotation therewith, and means for conducting liquid to said head, said head comprising a primary flange substantially perpendicular to said shaft and mounted for rotation therewith, said flange having a hub portion with upper and lower faces, an intermediate portion of less thickness than said hub portion having smooth substantially planar upper and lower faces and a baffle at its periphery extending substantially perpendicularly above and below the intermediate portion, an upper and a lower auxiliary flange mounted for rotation with the shaft and having smooth substantially planar faces contiguous to the respective upper and lower faces of the hub portion of the primary flange over part of their extents and substantially parallel but spaced from the respective upper and lower faces of the intermediate portion of the primary flange over the remainder of their extents to provide upper and lower annular chambers between the primary flange and the upper and lower auxiliary flanges and between the hub and the baffle of the primary flange, said baffle being positioned beyond the outer peripheries of the upper and lower auxiliary flanges and extending from the intermediate portion of the primary flange above and below perpendicularly at least as far as the outer extremities of the upper and lower auxiliary flanges, respectively, and a plurality of passageways for conducting liquid through said hub from the liquid conducting means to the upper and lower annular chambers, whereby liquid conducted to the head is thrown by centrifugal force through the upper and the lower annular chambers against the baffle and along the baffle into the drying chamber in the form of a substantially uniform sheet.

5. A spray drying device as defined in claim 4 in which said passageways extend alternately around the periphery of said hub portion to the upper and the lower annular chambers.

6. A spray drying device for distributing liquid into a drying chamber, comprising a rotatably mounted shaft having a head secured thereto for rotation therewith, and means for conducting liquid to said head, said head comprising an outwardly-extending primary flange and an outwardly-extending auxiliary flange, both mounted for rotation with the head, said flanges having smooth substantially planar annular opposing faces spaced apart to form an annular chamber between them, said primary flange having a transversely-extending baffle positioned beyond but adjacent the outer periphery of said auxiliary flange, said baffle extending from the smooth face of said primary flange transversely at least as far as the outer extremity of the auxiliary flange, whereby liquid conducted to the head is thrown by centrifugal force through said annular chamber against said baffle and along said baffle into the drying chamber in the form of a substantially uniform sheet.

7. A spray drying device as defined in claim 6 in which the primary flange has a plurality of generally radially-extending passages therethrough communicating with the annular chamber, and the body of the head has a plurality of holes through which liquid introduced through the liquid conducting means may flow to said passages and to the annular chamber.

8. A spray drying device for distributing liquid into a drying chamber, comprising a rotatably mounted shaft having a head secured thereto for rotation therewith, and means for conducting liquid to said head, said head comprising an outwardly-extending primary flange and an outwardly-extending auxiliary flange both mounted for rotation with said head, said flanges having smooth substantially planar opposing faces spaced apart to form an annular chamber between them, said primary flange and said auxiliary flange each having a second face at the outer periphery of the respective first-mentioned faces extending transversely thereof and spaced relative to each other to provide a discharge channel communicating with the drying chamber, the second face of the primary flange being mounted beyond the second face of the auxiliary flange and extending transversely from the first face of the

primary flange at least as far as the outer extremity of the second face of the auxiliary flange, whereby liquid conducted to the head is thrown by centrifugal force through said annular chamber against the second face of the primary flange and through said channel into the drying chamber in the form of a substantially uniform sheet.

OLIVER T. PIEPER.

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