

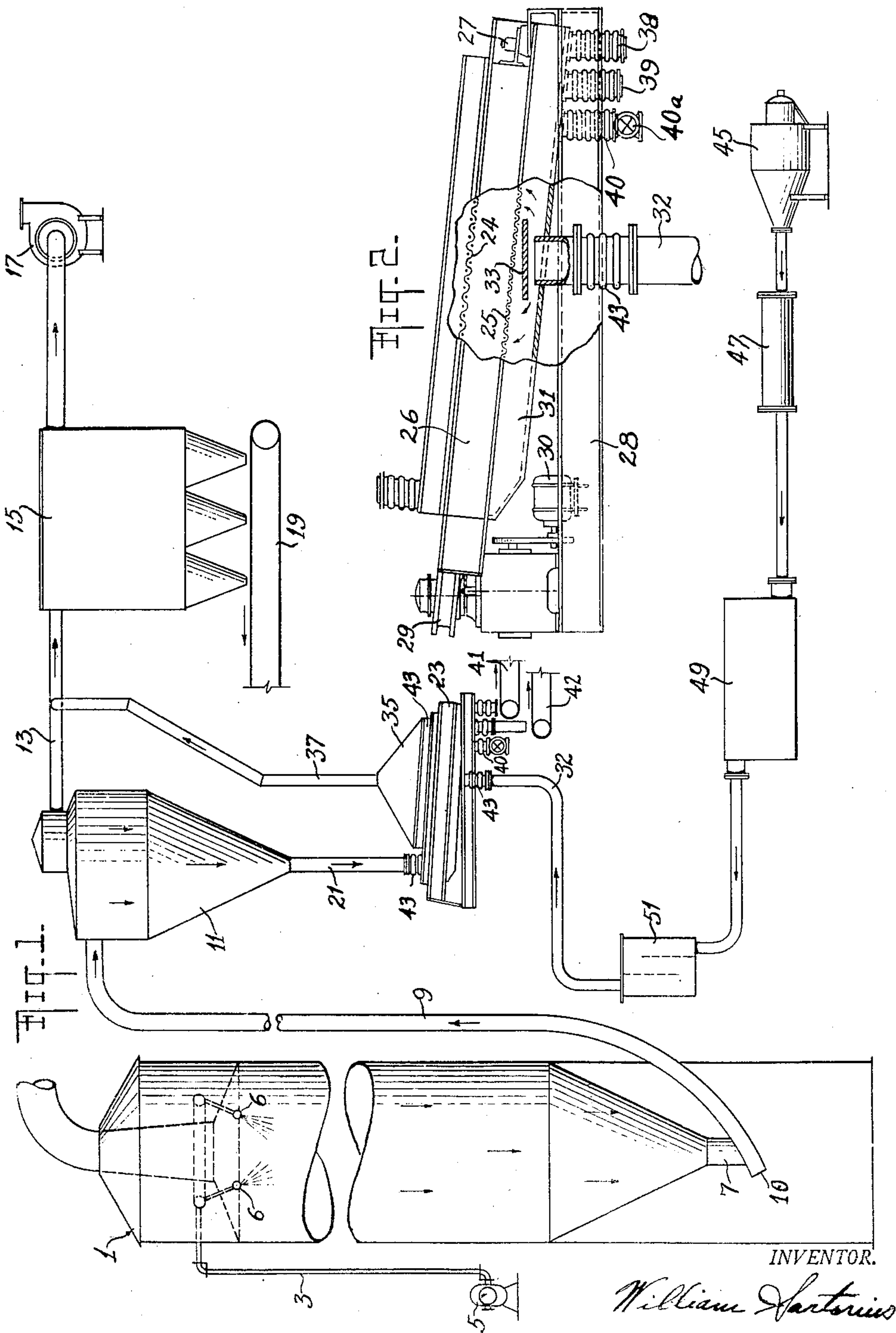
March 6, 1951

W. SARTORIUS

2,544,616

COOLING OF SPRAY-DRIED SOAP PRODUCTS

Filed Aug. 9, 1946





## UNITED STATES PATENT OFFICE

2,544,616

COOLING OF SPRAY-DRIED SOAP  
PRODUCTS

William Sartorius, Summit, N. J., assignor to Colgate-Palmolive-Peet Company, Jersey City, N. J., a corporation of Delaware

Application August 9, 1946, Serial No. 689,535

2 Claims. (Cl. 34-10)

1

The present invention relates to the preparation of spray-dried organic detergent products in suitable condition for packaging and more particularly to a process of cooling and transporting spray-dried soap and synthetic detergent products.

There is a large demand for detergents in granular form. The conventional method of preparing detergents in this form is by spray-drying a fluid mixture of suitable composition. This fluid mixture contains a much higher percentage of water than can be tolerated in the spray-dried product. In the case of soap, for example, the liquid mixture prior to drying usually contains between about 30% and 45% water whereas the freshly made spray-dried product contains only about 8 to 14% moisture. The removal of the excess water in the spray-drying operation necessitates the use of heated air in the spray tower in sufficient quantity and at such a temperature as to evaporate the excess water from the particles. While the evaporation of the excess moisture tends to prevent undue rise in temperature in the soap particles, in normal operation the particles are at a temperature within the range of about 170° to 195° F. at the time they are withdrawn from the bottom of the spray tower.

The spray-dried soap particles withdrawn from the spray tower are not in a suitable condition for packaging. It has been found that if spray-dried soap particles are packaged at a temperature in excess of about 95° F. there is a strong tendency for masses of particles to stick or cake together and form lumps of various sizes. These lumps are undesirable because they interfere with the free flow of the particles from the packages and because they defeat the primary purpose of forming the soap into small particles or granules, viz., to obtain rapid dissolution in water. In order to overcome the tendency to cake, the particles leaving the spray tower should be cooled to about 95° F. or lower before packaging.

The packaging apparatus, in a factory designed for large scale operation, is usually located some distance from the spray tower and on a floor higher than the product outlet from the spray tower, which necessitates conveying the particles both horizontally and vertically. A serious difficulty in conveying spray-dried organic detergents arises from the tendency of the granules to break up and produce fines. Fines are inherently produced to some extent in the spray-drying operation, but in many cases the amount is greatly increased in the handling incident to conveying and packaging the product. By

2

"fines" is meant particles of such small size that they become air-borne when the product is poured from a package. Such air-borne particles are irritating to the nasal membranes of many persons, causing sneezing, running of the eyes and nose, etc.

Although many attempts have been made to solve the problems involved in the preparation of spray-dried detergents for packaging, none of the prior art processes, so far as I am aware, has been completely satisfactory. Among the difficulties and disadvantages of prior art processes are the increase in fines during conveying, the increase in temperature of the product during conveying in types of apparatus such as screw conveyors which generate considerable friction, the increase in temperature and moisture content of the particles due to condensation thereon of moisture from the atmosphere, the building up of a deposit of the product on parts of the apparatus used in prior art processes, etc. This latter difficulty has been particularly acute where the spray-dried particles were passed through cooling apparatus of the heat exchange type, such as shell and tube coolers.

In accordance with the present invention, I provide a method of transporting or conveying spray-dried detergent particles from the product outlet of a spray tower to a packaging station and of cooling the product en route without substantially increasing the percentage of fines, without building up deposits of the product on the apparatus, and without increasing the moisture content thereof. By operating in accordance with the present invention the product is prepared for packaging substantially devoid of fines and in a condition which precludes caking in the package. Other advantages of the invention will become apparent from the following detailed description, taken in conjunction with the drawing in which:

Fig. 1 shows schematically suitable equipment for use in the process of the invention; and

Fig. 2 is a fragmentary view, partly in section, of a unit of the equipment shown in Fig. 1 on a somewhat larger scale.

Generally speaking the invention comprises contacting the hot solid detergent particles withdrawn from a spray tower with air or other aeriform body under controlled conditions while the particles are being transported from the spray tower to the packaging apparatus. The air is applied under such conditions of temperature and relative humidity and in such quantity as to reduce the temperature of the particles to about 95° F. or below during the time that the product



3

is being transported from the spray-drier to the packaging apparatus without substantially increasing the moisture content. In accomplishing this cooling at least a portion of the air used has a temperature of about 70° F. or below. In a preferred form of the invention, surrounding air is used to obtain as much cooling as is practicable and the partially cooled particles are then subjected to further cooling with conditioned air of lower temperature.

When spray-dried organic detergent particles are contacted with air, their moisture content may increase, decrease or remain substantially unchanged depending upon the relative humidity of the air and the moisture content of the particles. The term "equilibrium humidity" is used herein to mean that relative humidity of air which effects neither a substantial increase nor decrease in the moisture content of spray-dried organic detergent particles with which the air is in contact. Over the range of moisture contents encountered in the present process, the equilibrium humidity is practically directly proportional to the moisture content of the soap particles, which are discharged from the spray tower with a moisture content within the range of about 8% to 14%, usually 10% to 12%. Soap particles, for example, having about 8% moisture are in equilibrium with air of 50% relative humidity, whereas soap particles having about 14% moisture are in equilibrium with air of 78% relative humidity. The relative humidity of the air used in the process of the invention to cool and transport the organic detergent particles preferably does not exceed the equilibrium humidity and advantageously is lower. By using air having a relative humidity below the equilibrium humidity, moisture is evaporated from the soap particles, thereby intensifying the cooling effect of contacting soap particles with air and permitting the use of less conditioned air, or of conditioned air of higher temperature or an intermediate combination of both while obtaining the same cooling effect of air at equilibrium humidity.

A number of difficulties arise if the relative humidity of the cooling air is higher than the equilibrium humidity. One is that the condensation of moisture from the air on the particles increases their temperature and to this extent defeats the object of contacting the particles with cold air. In some cases where the relative humidity is substantially higher than the equilibrium humidity, the temperature of the particles with which the air is contacted may actually increase even though the air is many degrees colder than the product. A second difficulty is that the deposition of moisture on the particles increases their moisture content and may make them so sticky at the surface that the tendency to cake is intensified instead of diminished. A further difficulty is that where the conditions are such that moisture is precipitated, the product not only tends to cake but also tends to deposit on the apparatus in which it is being treated and this may be so serious as to require frequent shut-downs to remove the deposited material.

During the period of contact of the soap particles with air it is essential that the particles be in a state of turbulence or agitation so as to insure intimate contact of air with the entire surface of the particles being treated. The agitation, however, should not be so intense as to cause substantial breakage of the particles and thereby increase the percentage of fines. The

4

agitation is at least partially induced by the passage of air through the mass of particles being treated. In the preferred embodiment of my invention part of the agitation is mechanically induced in a bed of soap particles through which air is passed upwardly but basically the mechanical agitation is not essential and the agitation may be produced solely by the passage of air through the bed of particles.

The velocity of air passing through the mass of soap particles may vary over a broad range, the minimum being that velocity which is just sufficient to aerate the mass and provide intimate contact between the treating air and the individual particles in the mass. A velocity within the range of about 0.5 to 3 feet per second satisfactorily aerates a mass of soap particles. While there is no theoretical upper limit to the air velocity, a practical maximum is within the range of about 30 to 50 feet per second at which velocity all the soap particles become air-borne and can be conveyed upwardly without substantial increase in fines due to turbulence and impact in transit. The fines which are present in the spray-dried product are preferably removed during or incident to the treatment with air. Much of the finest material can be removed from the product in a cyclone separator by entrainment in the air stream leaving the separator where the larger particles are thrown out and collected. Fines are also preferably removed by an air screening operation during the upward passage of air through a bed of the product.

The drawing illustrates schematically a conveying and cooling system adapted to carry out the preferred embodiment of the invention. In the drawing, reference character 1 represents a spray tower, which may be of concurrent or countercurrent type, into the upper part of which a heated liquid soap composition is introduced through soap lines 3 by means of a pump 5. The soap solution is broken up into droplets by means of any suitable device such as the spray nozzles 6. The droplets are solidified and dried to a moisture content of about 8% to 14% during their fall through the tower to the product outlet 7.

The product outlet 7 connects with a pneumatic lift or conveyor 9 which is open at the intake end 10 to permit the influx of air. The conduit 9 leads into a cyclone separator 11 which is connected through the exhaust line 13 with a bag house 15. A suction fan 17 places the entire system from the intake 10 to the inlet of the fan under a negative pressure sufficient to produce a velocity of air in the conveyor 9 of about 30 to 50 feet per second. In the cyclone separator 11 all except the finest soap particles are separated from the air and these fines which are entrained in the outgoing air stream are filtered from the air in the bag house 15. A conveyor 19 is provided to convey the fines separated in the bag house to a storage bin adjacent to the crutchers in which the soap solution is prepared. The fines are blended in proper proportions with kettle soap, builders, etc., to prepare the liquid soap mixture of predetermined desired composition for spraying in the tower 1.

The separated particles are removed from the cyclone 11 through an outlet 21 which also forms the inlet to a cooling and classifying device 23. A preferred form, as shown more fully in Fig. 2, comprises a sloping perforated bed having an upper coarse screen 24 and a lower fine screen 25 both of which are mounted in a framework 26.



5

The framework 26 is supported at each side of the lower end on a bearing 27 which permits both sliding and oscillating movement between the framework 26 and the bed 28 of the machine on which the bearings 27 are mounted. The upper end of the framework 26 is mounted in an eccentric device 29, driven by a motor 30. When the motor is operating, the upper end of the framework 26 is given a rotary motion in its own plane about the axis of rotation of the eccentric while the lower end slides along and oscillates about the bearings 27. The mechanical features of this type of shaking screen, which are known to the art, form no part of the present invention and any other suitable device having a sloping perforated bed can be used instead of the device illustrated.

Below the screen 25 is an air chamber 31 having a cold air supply line 32 and a baffle 33 for distributing the air entering the chamber from the line 32 substantially uniformly over the entire area of the screen 25. Above the screens 24 and 25 a hood 35 is provided which has a conduit 37 connecting it with the exhaust line 13. At the lower end of the screens 24 and 25 and the air chamber 31, respectively, are a tailings outlet 38, a product outlet 39, and a fines outlet 40 from which the fines may be returned for re-use as described above. A conveyor 41 is provided for transporting the tailings from the outlet 38 to a reworking station (not shown). Conveyor 42 transports the product of desired size range to a packaging station (not shown). All connections between fixed parts, such as the product outlet 21, the supply line 32, the hood 35, etc., and the moving parts of the device 23 are made by flexible connectors 43.

A cooling system is provided for conditioning the air introduced into the device 23 through the supply line 32. The system illustrated comprises a blower 45, a water cooler 47 to remove at least most of the heat of compression, an air refrigerator 49, which may be a fin-tube cooler into which a refrigerant gas such as Freon, SO<sub>2</sub>, NH<sub>3</sub>, etc. may be evaporated, and a mist separator 51 which connects with the cold air supply line 32.

In the operation of this apparatus the spray-dried product, as it enters the pneumatic conveyor 9, is at an elevated temperature, usually of the order of about 170° to 195° F. Air is drawn into the conveyor from the surrounding atmosphere by the suction fan 17 and given a sufficient velocity to pick up and carry the soap particles. A velocity within the range of about 30 to 50 feet per second is satisfactory. Below about 30 feet per second some of the larger particles are not air-borne and above about 50 feet per second the amount of breakage of the product which produces objectionable fines increases substantially. The velocity can be readily controlled by a damper in the inlet 10 of the conduit 9. The period of contact of the soap particles with the air in the conveyor 9 is of the order of seconds only, the maximum contact time being fixed by the length of the conduit 9 and the minimum requisite air velocity to carry the tower output. Under good operating conditions, the temperature of the soap particles is lowered within about 25° to 30° F. of the temperature of the air entering the inlet 10. Thus, if the ambient air has a temperature of about 70° F., and a relative humidity of about 60%, for example, the hot product leaving the spray tower is cooled to about 95° F. in the air conveyor but if the air is about 95° F.

6

with a relative humidity of about 70% the soap particles leave the cyclone separator at about 120° to 125° F. In the industrial areas of the United States there are many days during the year when the temperature is substantially above 70° F. and on such days the product leaving the separator 11 is further cooled in the device 23 in order to bring it down to the required temperature of 95° F. or below. The particles are introduced into the device 23 at the upper end of screen 24 which screens out the oversize particles or tailings, e. g., it may be a 12 to 20 mesh screen, and these particles are discharged through the tailings outlet 38. The major portion of the product passes through screen 24 onto screen 25 where it is contacted with the air flowing upwardly therethrough. This air, in passing through the units of the conditioning system, is cooled to a temperature of about 70° F. preferably somewhat below 70° F. and even to as low a temperature as about 35° to 40° F., as desired, although it is preferred that the cooling surface in the refrigerator 49 be above 32° F. to prevent accumulation of frost. The relative humidity of this air is also controlled in passing through the conditioning system so that when it comes in contact with the soap particles on the screen 25 there is no substantial deposition of moisture on the particles or any parts of the apparatus and the relative humidity may be sufficiently low that some evaporation of moisture from the soap particles takes place. This is advantageous since the evaporation of moisture withdraws heat from the soap and supplements the cooling obtained by contact with the colder air. The particles of soap on the screens 24 and 25 are in a state of turbulence induced in part by the vibration or shaking of the screens on which they rest and in part by the flow of air therethrough at such a velocity as to aerate the soap bed. The air velocity is preferably sufficiently high that particles finer than about 150 to 200 mesh are blown out of the soap mass and carried away through the conduit 37 to the bag house 15. Ordinarily a velocity within the range of about 1 to 10 feet per second suffices, depending upon the particle size at which the cut is made, the desired completeness of removal and to some extent upon the soap composition and spraying conditions which affect the density of the product. In this way the product not only is cooled to a temperature of 95° F. or lower in passing through the device 23 but the fines are also removed and the spray-dried product is prepared in very satisfactory condition for immediate packing. Any fines that go through the screen 25 are removed through outlet 40 which is provided with a star wheel or other air lock device 40A.

The present invention provides an efficient, flexible process for preparing spray-dried organic detergents of proper temperature and desired particle size for packaging. When the ambient air is about 70° F. or lower, the product is sufficiently cooled in the air conveying step and the principal advantage of the supplemental treatment with the upwardly flowing air stream is to remove fines. At ambient air temperatures within the range of about 70° to 80° F., ambient air, unless its relative humidity is substantially higher than equilibrium humidity, may be used in the supplemental treatment to complete the cooling to 95° F. or lower and also to remove the fines. When the ambient air is above about 80° F., the air used in the supplemental



treatment is artificially cooled and/or dehumidified sufficiently to lower the temperature of the partially cooled product to 95° F. or lower. The period of contact of a detergent particle with the air during the supplemental treatment is a function of the size of the screen and its slope, and while the output of the tower is a major factor in the design of the screen, the minimum requisite contact time under the worst contemplated operating conditions must also be considered. Two or more screening devices such as 23 may be used in series and/or parallel, as desired, if a single unit would be too large.

Although the invention has been described in considerable detail in connection with a preferred embodiment, those skilled in the art will realize that modifications and variations can be made without departing from the principle of the invention. Thus, instead of introducing the partially cooled product directly into the cooling and classifying device 23 from the product outlet 21, a conveyor might be interposed in order to obtain a more advantageous location of the pieces of apparatus. The air going through the screen 25, instead of going directly to the exhaust duct 13, may be introduced into the conveyor 9 to take advantage of its lower temperature or it may be recirculated with only a portion of the recirculating stream being bled off to the exhaust duct while a comparable amount of cold air is fed into the stream. A vibrating screen is not at all essential to the process of the invention and other types of apparatus in which granular detergent particles may be brought into intimate contact with a cold stream under turbulent conditions can be used in place of the device illustrated. The temperature at or below which the soap product may be packaged without objectional caking may vary a few degrees either side of 95° F. depending upon the soap stock (the oils) used in making the kettle soap, the builder content, etc., and where the temperature is specified as about 95° F. this range of temperatures is intended. Similarly the temperature at or below which particles of synthetic organic detergents, including the sulphate and sulphonate types, may be packaged without caking depends upon the chemical composition of the particular detergent and the added ingredients, if any, with which it is mixed. Regardless of the temperature required in a particular case, the spray-dried organic detergent particles can be cooled to or below that temperature by the process of the invention. The range of about 70° F. or lower, the range of about 70° F. to 80° F., and the range of about 80° F. and higher are indicative of the temperatures which may be used in the process and are not critical. The temperatures and relative humidities of the two air streams flowing through the air conveyor 9 and the cooling device 23, respectively, can be varied over a considerable range, provided however that the relative humidity of the conditioned air flowing through device 23 is not so high as to substan-

tially increase the moisture content of the product by condensation of moisture thereon.

I claim:

1. The process of cooling spray-dried soap particles having a temperature of about 170° to 195° F. which comprises conveying such hot soap particles from the outlet of a spray tower to an air separating device with an upwardly flowing current of ambient air having a temperature above about 80° F., thereby substantially cooling said hot soap particles but not to the desired temperature of about 95° F., separating the partially cooled particles from the air current in said air separating device and introducing them onto an agitated bed, and passing a current of air of a temperature of about 70° F. or below and a relative humidity not greater than the equilibrium humidity upwardly through the particles of soap on said bed at a velocity within the range of about 1 to 10 feet per second while the particles are maintained in a state of agitation, to complete the cooling of the particles to the desired temperature.

2. The process which comprises partially cooling hot solid spray-dried soap particles at a temperature of at least about 170° F. by contact for a few seconds with ambient air at a temperature above about 80° F. while flowing upwardly at a rate of about 30 to 50 feet per second, separating the partially cooled particles from said air, and completing the cooling to about 95° F. or below by contacting said separated particles in a turbulently moving mass with a stream of conditioned air at a temperature of about 70° F. or below flowing upwardly through said mass at a velocity within the range of about 1 to 10 feet per second.

WILLIAM SARTORIUS.

#### REFERENCES CITED

The following references are of record in the file of this patent:

#### UNITED STATES PATENTS

Number	Name	Date
1,567,031	Buensod	Dec. 29, 1925
1,581,664	Schwantes	Apr. 20, 1926
1,912,910	Neuman et al.	June 6, 1933
1,942,418	Forté	Jan. 9, 1934
1,971,566	Hutton	Aug. 28, 1934
2,094,786	Flint	Oct. 5, 1937
2,245,881	Vissac	June 17, 1941
2,320,755	Smith	June 1, 1943
2,335,732	Bowen	Nov. 30, 1943
2,346,500	Moore	Apr. 11, 1944
2,387,458	Mojonnier	Oct. 23, 1945

#### OTHER REFERENCES

"Drying and Processing of Materials by Means of Conditioned Air," published by Carrier Engineering Corporation. Copyright 1929, pages 59 and 181 relied on. Also note page 177.