MACHINE FOR PRODUCING LAUNDRY PRODUCTS

Filed Nov. 5, 1968 3 Sheets-Sheet 1

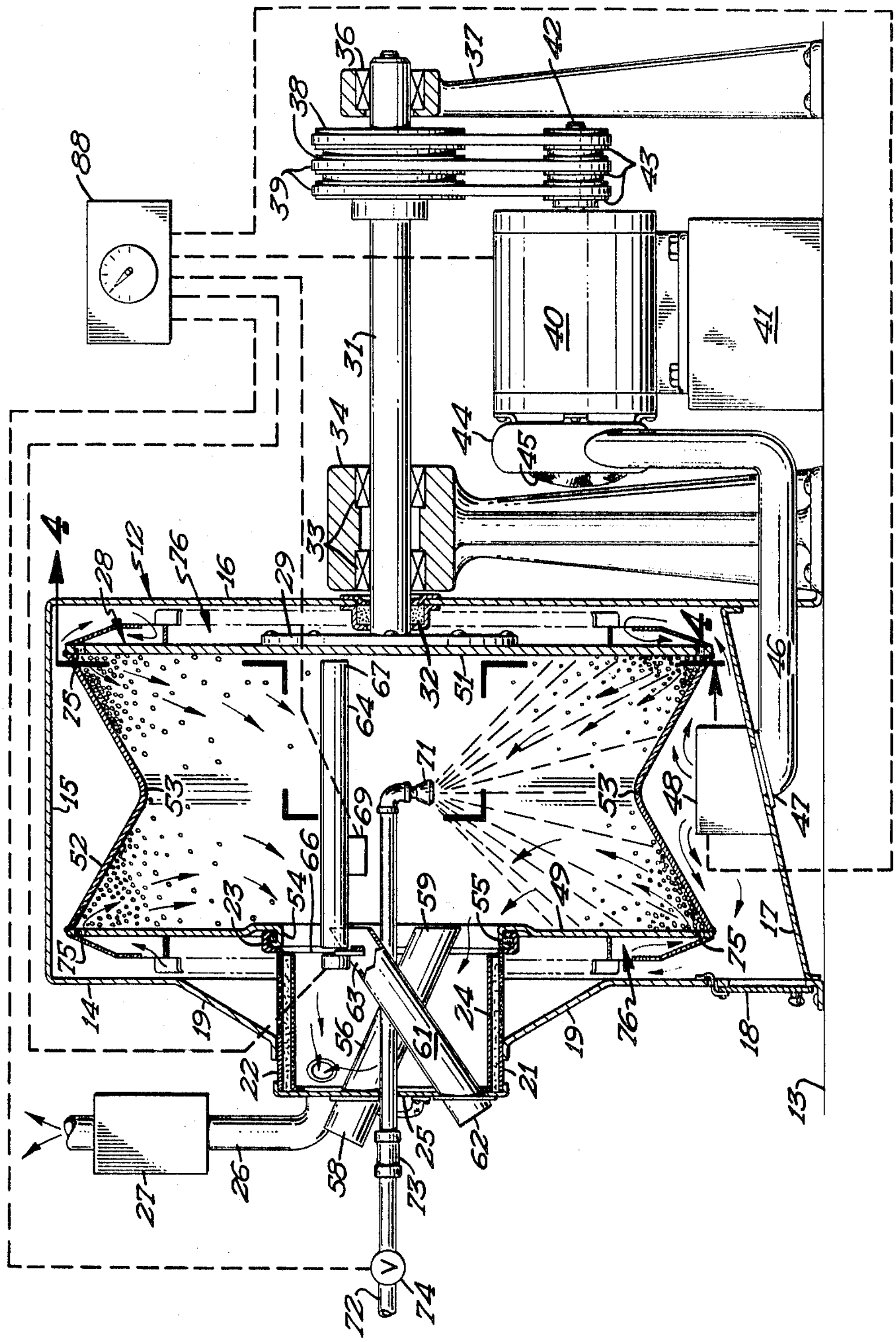

Fig 1

INVENTOR.
DONALD E. MARSHALL
BY
John J. Held, Jr.
ATTORNEYS

June 29, 1971 D. E. MARSHALL 3,588,950

MACHINE FOR PRODUCING LAUNDRY PRODUCTS

Filed Nov. 5, 1968 3 Sheets-Sheet 2

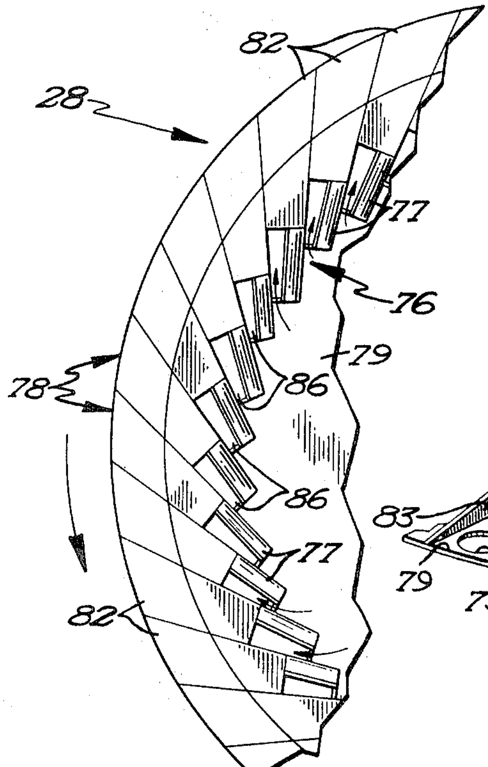

Fig 2

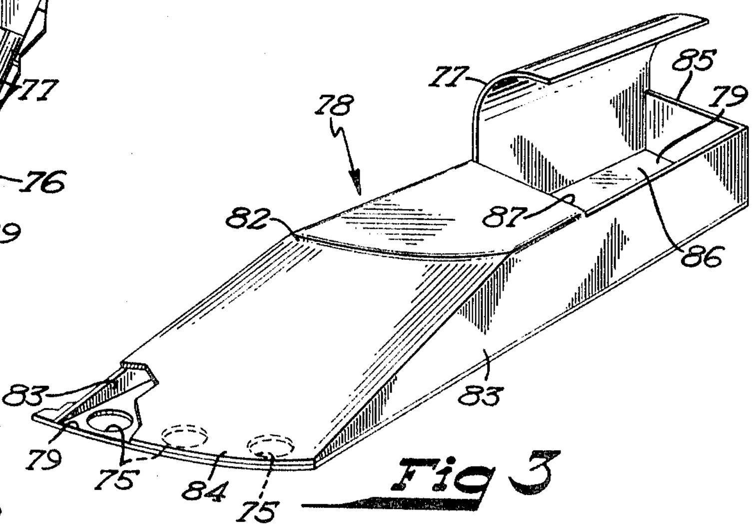

Fig 3

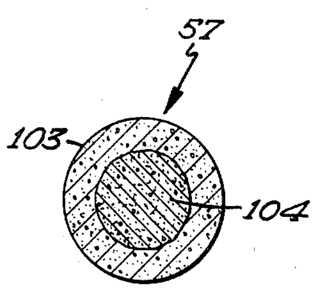

Fig 9

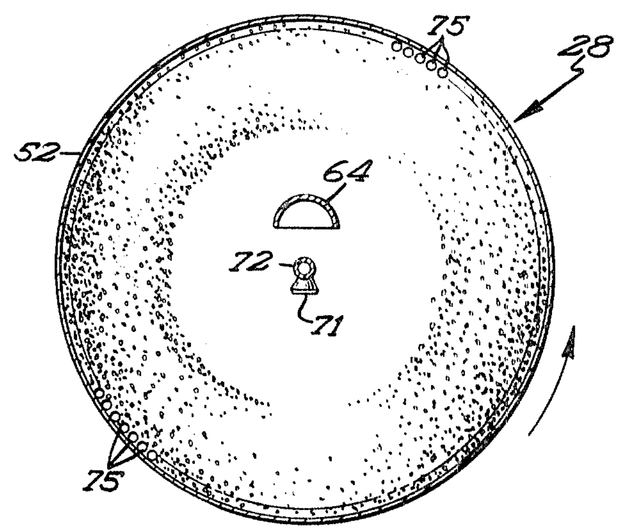

Fig 4

INVENTOR
DONALD E. MARSHALL

BY John J. Held, Jr.

ATTORNEY

MACHINE FOR PRODUCING LAUNDRY PRODUCTS

Filed Nov. 5, 1968 3 Sheets-Sheet 3

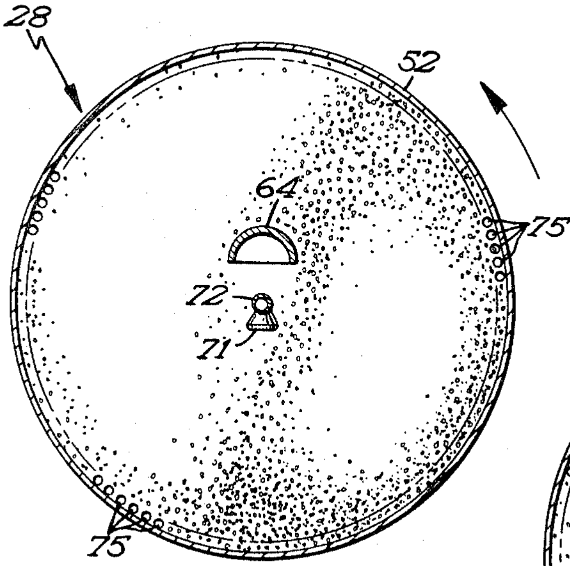

Fig 5

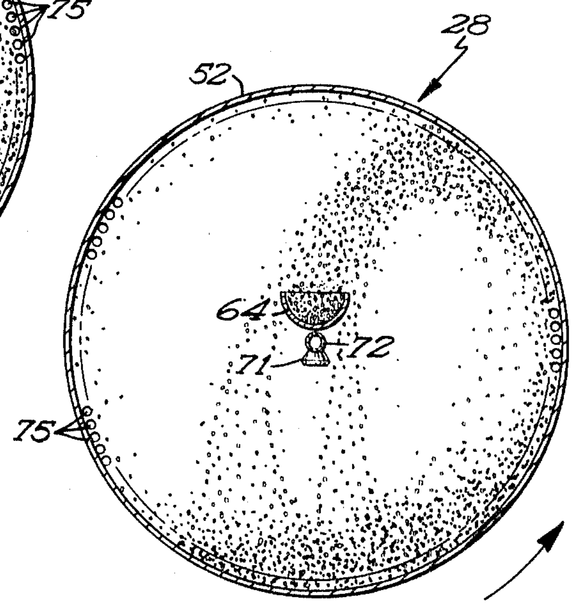

Fig 6

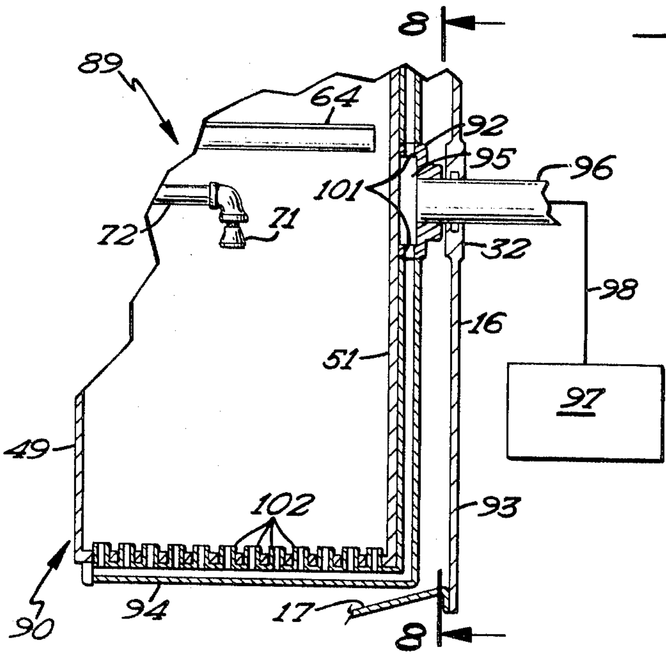

Fig 7

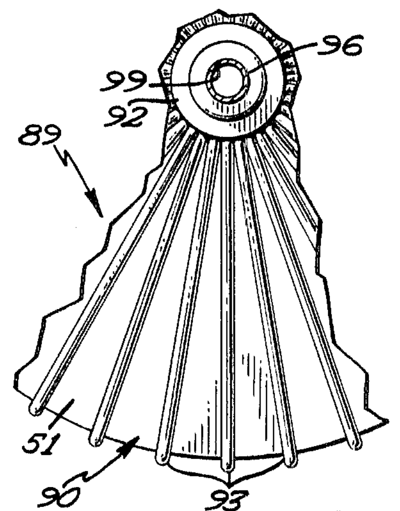

Fig 8

INVENTOR.
DONALD E. MARSHALL
BY John J. Held, Jr.
ATTORNEY

United States Patent Office

3,588,950

Patented June 29, 1971

1

3,588,950

MACHINE FOR PRODUCING LAUNDRY PRODUCTS

Donald E. Marshall, 4904 Sunnyside Road, Edina, Minn. 55424

Filed Nov. 5, 1968, Ser. No. 773,585

Int. Cl. B22d 13/00

U.S. Cl. 18—2.5 29 Claims

ABSTRACT OF THE DISCLOSURE

An improved machine and method for producing a laundry product comprising generally spherical beads formed from particles of soap, synthetic detergent, or the like. In the machine and method of this invention, the particles are formed into an annular fluidized bed of particles and gas in a rotatable chamber as a result of relatively high speed rotation of the chamber and continuous introduction of gas into the rotating chamber. Periodically the particles are tumbled in the chamber by abruptly reducing the rotational speed of the chamber. The particles may be treated in the chamber by the introduction of fluids onto the particles in the rotating chamber. The machine of the present invention also includes novel means for introducing the particles into the rotating chamber, for removing the beads from the rotating chamber, for introducing gas under pressure into the rotating chamber to fluidize the particles in the annular bed, and for recirculating the gas exhausted from the chamber back into the rotating chamber.

The generally spherical beads of soap, synthetic detergent or the like produced by the machine and method of this invention are relatively dense, have a relatively low moisture content and may include one or more outer layers or coatings of solidified treating fluid, with each bead containing substantially the same materials and proportion of materials as are in the other beads.

BACKGROUND OF THE INVENTION

This invention relates to an improved machine and method for producing laundry products, and more particularly, to an improved machine and method for producing a novel dense, low moisture, generally spherical bead of soap, detergent or the like. The beads of the present invention may consist of nucleus of one type of laundry material and an outer continuous layer(s) of other laundry materials.

In the past, conventional laundry products, such as the particles of soap and synthetic detergents, have been generally made in conventional spray towers. These particles have had a generally irregular shape, have been porous and have had a moisture content of above ten percent by weight. Also in the past, spherical bead products have been shaped in conventional "pill rolling" machines in which the products to be shaped are placed in the large drums or chambers and rotated therein at a relatively low rotational speed so that the products or particles are continuously tumbled in the drum.

In contrast, the machines of the present invention include a rotatable, horizontally disposed chamber in which the particles to be shaped and/or treated are rotated at a relatively high speed so that the particles form an annular bed or layer about the central longitudinal axis of the chamber and adjacent to the side wall of the chamber. Gas under pressure is continuously introduced into the rotating chamber so as to fluidize the annular bed of particles so that the particles in the bed are in a constant state of agitated motion whereby the particles are continuously contacting or striking adjacent particles and the walls of the chamber. Periodically the rotational speed of the chamber is reduced from said relatively high speed to an intermediate speed. The intermediate speed is selected so that the centrifugal force acting on the particles is less than the gravitational force acting thereon whereby the particles in the upper segment of the chamber fall away from the side wall of the chamber and are cast down upon the lower segment of the chamber and the particles therein. This tumbling compacts and hardens the surface of the particles and assists in shaping the particles.

2

The machines of the present invention have a unique fan-plenum chamber assembly which includes a plurality of fan blades mounted on each of the end walls of the chamber at points equi-spaced from each other and spaced radially inwardly from the side wall of the chamber. A plurality of holes are drilled in the end walls of the chamber adjacent to, but spaced radially inward from the side wall thereof. A plenum chamber extends radially outwardly from each of the fan blades to the peripheral edge of the chamber so that the radial outer ends of the plenum chamber overlies one or more of the holes and connects the holes with the base of the fan blades. The longitudinal axes of each of the fan blades and the plenum chambers is disposed at an acute angle with a radius of the rotating chamber, with the fan blade being positioned ahead, relative to the direction of rotation of the chamber, of the respective holes with which the fan blade is connected by the plenum chamber, whereby the plenum chambers assist in the movement of gas radially through the plenum chamber and through the holes.

The rotating chamber is positioned in a shroud and gas is introducd into the shroud from a motor driven blower. The gas in the shroud may be heated prior to its introduction into the rotating chamber and after the gas passes through the annular bed of fluidized particles and gas in the chamber, the gas is exhausted from the chamber through an aperture located adjacent the central longitudinal axis of the chamber. A portion of this exhaust gas may be recirculated back into the interior of the shroud after passing through a filter. In another embodiment of the machine of the present invention gas is introduced into the rotating chamber by means of a central manifold mounted on one of the end walls of the chamber and a plurality of radial and transverse tubes interconnecting the manifold with the chamber. The manifold is connected with a source of gas under pressure such as a rotary compressor.

The machines of the present invention also include novel means for introducing particles into the rotating chamber, for removing beads from the rotating chamber and for introducing liquid for treating the particles onto the particles in the rotating chamber.

Therefore, it is the primary object of the present invention to provide an improved machine and method for producing a laundry product comprising dense, generally spherical beads which may have a nucleus of one material and an outer layer of other materials.

Another object of the present invention is to provide an improved machine for shaping and treating particles of soap, synthetic detergent and the like wherein the particles to be shaped and treated are positioned in a rotatable chamber which is rotated at a relatively high speed so that the particles form and maintain a generally annular bed about the central axis of the chamber; wherein gas is continuously introduced under pressure into the annular bed so that the particles therein are fluidized, and wherein periodically the fluidized particles in the bed are tumbled in the rotating chamber. A related object of the present invention is to provide an improved machine of the type described wherein the speed of the rotating chamber is periodically abruptly reduced from the relatively high speed to an intermediate speed whereby a portion of the fluidized particles fall away from the upper segment of the rotating chamber and are cast down upon the lower segment of the rotating chamber. A still further related object of the present invention is to provide an improved machine of the type described wherein the rotational speed of the chamber is quickly returned to the relatively high speed after a reduction in rotational speed so that the annular bed of fluidized particles and gas is again formed.

Still another object of the present invention is to provide an improved method of shaping and treating particles of soap, synthetic detergent and the like wherein the particles are rotated in a chamber at a relatively high speed so that the particles form and maintain a generally annular bed about the rotational axis of the chamber; wherein the particles are fluidized in the annular bed by the continuous introduction of the gas under pressure into the bed; and wherein periodically the fluidized particles are tumbled in the rotating chamber. A related object of the present invention is to provide an improved method of the type described wherein the particles are tumbled in the chamber by reducing the rotational speed of the chamber from the relatively high speed to an intermediate speed whereby a large portion of the fluidized particles fall away from the side wall of the chamber and are cast down on a lower segment of the rotating chamber; and wherein the annular, fluidized bed of particles and gas is reformed again by quickly returning the chamber to the relatively high speed.

Another object of the present invention is to provide an improved laundry product of the type described which comprises a plurality of substantially spherical beads having a density greater than fifty pounds per cubic foot and a moisture content of less than five percent by weight; wherein each of the beads consists of an irregularly shaped nucleus and at least one continuous layer formed about the nucleus; and wherein each of the beads contains substantially the same materials and proportion of materials as are in the other beads so that all beads are substantially chemically identical.

These and other objects of the present invention will become apparent from the accompanying specification, claims and drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical cross-sectional view of an improved machine embodying the principles of the present invention.

FIG. 2 is a partial vertical cross-sectional view taken along lines 2—2 in FIG. 1.

FIG. 3 is a perspective view of a fan and plenum chamber utilized in the machine shown in FIG. 1.

FIG. 4 is a vertical cross-sectional view taken along lines 4—4 in FIG. 1 and showing the annular layer of fluidized particles and gas formed in the rotating chamber.

FIG. 5 is a vertical cross-sectional view taken along lines 4—4 in FIG. 1 and showing the particles in the rotating chamber being tumbled during a period in which the chamber is rotating at an intermediate speed.

FIG. 6 is a vertical cross-sectional view taken along lines 4—4 in FIG. 1 and showing the trough in position for removing beads from the rotating chamber.

FIG. 7 is a partial, vertical cross-sectional view of an improved machine, embodying the principles of the present invention, which has a modified means for introducing gas under pressure into the rotating chamber.

FIG. 8 is a partial, vertical cross-sectional view taken along lines 8—8 in FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENT

An improved machine embodying the principles of the present invention is shown generally at **11**. The machine **11** includes a sheet metal shroud **12** which is secured to the floor **13** by a plurality of conventional fasteners, not shown. The shroud **12** is constructed so as to prevent the leakage of gas from the interior thereof during the operation of the machine and includes a front wall **14**, a top wall **15**, a rear wall **16** and a bottom wall **17** which slopes

forwardly, or to the left as shown in FIG. 1. A hinged clean-out door **18** is located in the front wall **14**, near the floor, and permits access to the interior of the shroud for the purpose of removing dirt, dust and the like therefrom.

The central portion **19** of the front wall **14** of the shroud **12** is flared outwardly, or in other words, projects to the left as shown in FIG. 1. A central aperture **21** is formed in the portion **19**, and a tube **22** is secured within the aperture **21** so that approximately one-third of the tube projects forwardly from the front wall **14**, and so that the right end **23** of the tube **22** extends within the shroud. A conventional, annular gas filter **24** is positioned within the tube **22** and is designed to permit gas to pass radially, with respect to the central longitudinal axis of the tube, therethrough. The righthand portion of the tube **22**, i.e., the two-thirds portion thereof positioned within the shroud, is perforated so that gas may pass from the interior of the tube into the interior of the shroud **12**. A removable cover **25** tightly closes the projecting left end of the tube **22** so as to prevent leakage of gas therefrom.

A gas exhaust conduit **26** is positioned in communication with the interior of the tube **22** so as to permit gas to be exhausted from the tube and thus from the shroud. A conventional gas filter **27** is positioned in the conduit **26** and is utilized to filter and remove any dirt, dust or like materials entrained in the exhausted gas.

A generally cylindrical, rotatable chamber **28** is mounted within the interior of the shroud **12** on the flanged end **29** of a rotatable shaft **31** and is arranged so that the central longitudinal axis of the chamber **28**, shaft **31** and the tube **22** are coaxial. The shaft **31** projects into the shroud through a conventionally sealed aperture **32** mounted in the rear wall **16** of the shroud. The dimensions of the interior of the shroud are such that when the chamber **28** is positioned within the shroud, as shown in FIG. 1, there is ample clearance between the chamber and the walls of the shroud whereby the chamber may be rotated within the shroud at relatively high speeds without danger of contact between the rotating chamber and the walls of the shroud.

Adjacent to the rear wall **16**, the shaft **31** is journaled in conventional bearings **33** carried by a pedestal support **34** which is mounted on the floor **13**. The other end **35** of the shaft **31** is journaled in a conventional bearing **36** which is carried by a second pedestal support **37** also mounted on the floor **13**. A plurality of sheaves or pulleys **38** are mounted on the shaft **23** adjacent the bearing **36**. The sheaves **38** are adapted to be driven by the V-belts **39**.

A conventional two-speed electric motor **40** is mounted on a support **41** which in turn is positioned on the floor **13**. The motor **41** is of the type which will permit the polarity of its windings to be reversed by changing the connections of the motor windings so that when the connections are reversed, the motor will act as a brake.

The output shaft **42** of the motor has a pair of sheaves or pulleys **43** mounted thereon. These sheaves **43** receive the V-belts **39** so that the motor **40** is connected with and thus selectively drives or brakes the shaft **31** and the chamber **28**.

A conventional air or gas blower **44** is also driven by the motor **40**. As shown in FIG. 1 the inlet **45** of the blower **44** communicates directly with the atmosphere, although, of course, the inlet **45** could be connected with another source of gas or air. The outlet of the blower **44** is connected by a conduit **46** with the interior of the shroud **12**. More particularly, the conduit **46** extends from the blower **44** to an inlet **47** formed in the bottom wall **17** of the shroud **12**.

As shown schematically in FIG. 1, a conventional gas heating unit, shown schematically at **48**, is positioned adjacent the inlet **47**. The purpose of the unit **48** is to heat the gas being introduced into the shroud from the blower so that the high temperature gas may be used, during at least a portion of the cycle of operation of the machine **11**, to heat the particles being shaped and treated within the chamber **28**.

The chamber **28** includes generally circular front and back end walls **49** and **51** and a continuous, annular side wall **52**. The side wall is formed so that its central portion **53** is spaced radially inwardly, relative to the end portions thereof, and so that the side wall is symmetrical about a plane passing through the center of the side wall **52** and perpendicular to the central longitudinal axis of the chamber.

An aperture **54** is formed in the front end wall **49**, with the diameter of the aperture **54** being substantially equal to the diameter of the tube **22**. The chamber **28** is positioned within the shroud **12** so that the center of the aperture **54** is aligned with the central longitudinal axis of the tube **22**. The open, right end **23** of the tube **22** and the peripheral edge of the aperture **54** may be formed, as shown, so that a conventional running gas seal **55** is provided therebetween. This arrangement of the tube and aperture **54** permits gas to flow freely from the interior of the chamber and the interior of the tube. Moreover, as noted above, gas may pass from the interior of the tube through the filter **24**, and the perforations in the tube **22** and into the interior of the shroud **12**.

A loading conduit **56** is mounted in the tube **22** and is used for introducing the soap or synthetic detergent particles **57** to be shaped and treated into the interior of the chamber **28**. The conduit **56** is positioned within the tube **22** so that one end **58** thereof extends through the cover **25**. The other end **59** of the conduit **56** is supported adjacent to, but spaced from, the periphery of the aperture **54**. The end **58** of the conduit **56** is positioned higher, relative to the ground **13**, than the other end **59** so that the particles may be gravity-fed into the interior of the chamber **28**.

An unloading conduit **61** is also mounted in the tube **22** and is used to remove the beads, i.e., the particles which have been shaped and treated in the chamber, from the chamber. Like conduit **56**, conduit **61** is positioned so that one end **62** thereof extends through the cover **25** and the other end **63** thereof is supported adjacent to, but spaced from, the periphery of the aperture **54**. The end **63** of conduit **61** is higher, relative to the ground **13**, than the end **62** so that the beads will move through the conduit **61** from the end **63** to the end **62** by gravity.

A trough **64** has its open end **65** supported by the bracket **66** and extends across the chamber **28**, with the longitudinal axis of the trough being generally parallel with, but spaced from, the central longitudinal axis of the chamber. The end **65** of the trough is positioned immediately above the other end **63** of the conduit **61**, and the end **67** of the trough is positioned adjacent to, but not in contact with, the rear wall **51** of the chamber **28**. The trough **64** is generally U shaped in cross-section, i.e., generally U shaped in a plane perpendicular to its central longitudinal axis.

A conventional electric motor **68** is also mounted on the bracket **66**, and connected with the end **65** of the trough **64** so that the trough **64** may be rotated by the motor about the central longitudinal axis of the trough from a first position, such as shown in FIG. 4, where the open side of the trough faces the upper segment of the chamber **28** to a second position, one-hundred and eighty degrees from the first position, where the open side of the trough faces the lower segment of the chamber, such as shown in FIG. 6.

A conventional electrical vibrator unit, shown schematically at **69**, is connected with the trough **64** and is utilized to vibrate the trough **64** so as to assure that the beads caught therein, as hereinafter described, are moved along the trough from the end **67** toward the end **65**. As noted above, the trough **64** is positioned so that its end **65** is positioned above and adjacent to the end **63** of the conduit **61**. When the beads caught in the trough are moved toward the open end **65**, as a result of the operation of the unit **69**, they fall into the conduit **61**, and thus are removed from the machine **11**. The vibrator unit **69** may be of the

type manufactured and sold by the Syntron Division of FMC Corporation, Homer City, Pa.

A conventional spray nozzle **71** is positioned within the chamber **28**, adjacent the center thereof, and may be used to spray fluids onto the particles in the lower segment of the chamber. The nozzle **71** is connected with and supported by a pipe **72** which extends from the chamber **28** through the tube **22** and cover **25**. The pipe may be connected to one or more sources of pressurized fluid, not shown. A conventional pipe coupling **73** is used in the pipe **72** to facilitate removal of the cover **25**. A conventional, electrically controlled valve **74** is positioned in the pipe **72** and controls flow through the pipe.

A plurality of relatively small diameter holes **75** are drilled in the front and rear walls **49** and **51** of the chamber **28** adjacent to, but spaced radially inwardly from, the side wall **52**. The holes **75** are equi-spaced about a circle having as its center the central longitudinal axis of the chamber. The holes are arranged with respect to the side wall **52** so that when the gas under pressure is introduced into the chamber **28** through the holes, as hereinafter described, a generally annular "fluidized" bed or layer of particles and gas is formed in the chamber **28**, during rotation of the chamber.

A unique fan-plenum chamber assembly **76** is utilized to force gas, under pressure, into the interior of the chamber **28** through the holes **75**. This assembly **76**, shown best in FIGS. 2 and 3, consists of a plurality of curved fan blades **77** and plenum chambers **78** which are mounted on the exterior faces **79** of both the front and rear walls **49** and **51**. Since the assemblies **76** mounted on the walls **49** and **51** are identical, only the assembly **76** on the wall **51** will be described in detail.

As shown in FIGS. 2 and 3, the plenum chambers **78** are wider at their radial outer ends, i.e., the ends adjacent to the periphery of the wall **51**, than at their radial inner ends, i.e., the ends adjacent to the center of the wall **51**. The longitudinal center lines of the chambers **78** are disposed at an acute angle, e.g., 20°–30°, with respect to a radius of the wall **51**, with the inner ends of each chamber **78** leading the outer end thereof in the direction of rotation of the chamber **28**, this direction of rotation being indicated by the arrow **81** in FIG. 2.

All the fan blades and plenum chambers are structurally and functionally identical and, as best shown in FIG. 3, each chamber **78** includes a top panel **82** spaced from and parallel with the exterior face **79** of the end wall **51** of the chamber **28**. The outer radial edge of the top panel **82** overlies and is congruent with the underlying peripheral arc of the end wall **51** so that the top panel overlies a number of the holes **75**. While in FIG. 3, the top panel **82** is shown overlying or covering three holes **75**, the specific number of holes covered by a top panel **82** is not critical so long as proper fluidization is obtained in chamber **28**.

A pair of side panels **83** extend between the exterior face **79** and the side edges of the top panel **82**. As shown in FIG. 2, the side panels **83** converge together at their radially inner ends, i.e., the inner ends of the side panels are spaced closer together than the outer ends thereof, so that each chamber **78** has a generally frusto-conical shape. An outer end panel **84** extends between the exterior face **79**, the outer edge of the top panel **82** and between the radially outer ends of the side panels **83** so as to completely close the radially outer end of the chamber **78**, except, of course, for the holes **75** enclosed within the chamber **78**. An inner end panel **85** extends between the radially inner ends of the side panels **83** and the face **79** of wall **51**. An opening **86** is defined in the top of the chamber **78** between the radial inner end **87** of the top panel **82**, the inner end panel **85** and the side panels **83**.

The curved fan blade **77** projects beyond the plane of the top panel **82**, is integrally formed with the trailing side panel **82**, relative to the direction of rotation of the chamber **28**, and extends along the side of the opening **86**. The axial height of the blades **77**, relative to the chamber **78**, is determined by the gas capacity or volume of flow desired.

The fan blades **77** are utilized during rotation of the chamber **28** to forcibly direct the gas in the shroud **12** into the plenum chambers **78** and hence, under pressure, through the holes **75** into the chamber **28**. The design of the plenum chambers **78**, including the angular disposition of the plenum chambers **78**, relative to a radius of the end wall **51**, assists in forcing gas through the plenum chambers **78** and into the chamber **28** during rotation of the chamber in a manner similar to that of a conventional centrifugal blower or fan.

The operation of the motor **68**, the vibrator unit **64**, the motor **40**, the unit **48** and the valve **74** is controlled by a conventional timing mechanism **88**. The timing mechanism **88** employs an electric motor which sequentially operates a plurality of switches in a preselected sequence. Such timing mechanisms are old and well known in the art and for this reason, further description thereof has not been included herein.

A machine **89**, partially shown in FIGS. 7 and 8, is structurally and functionally similar to machine **11** except that the machine **89** includes an alternate means for introducing fluidizing gas into the rotating chamber **90**. The detailed description of the machine **89** has been limited to the parts thereof which are different from the corresponding parts in machine **11** and the same reference numerals have been used to indicate common parts in machines **11** and **89**.

Chamber **90** is structurally similar to chamber **28**, except that its side wall **91** is straight, as distinguished from the curved side wall **52**. For this reason, a further detailed description of the chamber **90** is not included herein.

Chamber **90** utilizes a manifold **92** and a plurality of radial and transverse pipes **93** and **94**, respectively, to accomplish the same function as is accomplished by the fan-plenum chamber assembly **76** used in connection with chamber **28**. The manifold **92** is centrally mounted on the end wall **51** and interconnects the end **95** of the shaft **96** and the end wall **51** of the chamber **90**. The shaft **96**, supported and driven in a manner similar to shaft **31**, is similar to shaft **31** except that the shaft **96** includes a central passage, not shown. The manifold **92** is connected with the outlet of a rotary compressor, shown schematically at **97**, by means of a conduit **98** which, in turn, is in communication with the central passage in the shaft **96**. The shaft **96** performs the dual function of supporting the chamber **90** for rotation as well as supplying gas to the manifold **92**.

Each of the radial pipes **93** is connected at one end, through a metered orifice **101**, with the manifold **92**. As best shown in FIG. 8, the pipes **93** are equi-spaced around the circumference of the manifold **92**, and extend radially outwardly, adjacent to the end wall **51**, from the manifold so that the outer ends thereof project beyond the periphery of the chamber **90**, i.e., just beyond the side wall **91**. Each pipe **93** is connected at its radial outer end with an end of a transverse pipe **94** which extends axially, adjacent to the outer surface of and across the side wall **91**. The other end of the transverse pipe **94** is closed.

Each of the transverse pipes **94** has a plurality of tubes **102** connected thereto which extend radially inwardly, relative to the central longitudinal axis of the chamber **90**, through the side wall **91** of the chamber **90** into the interior of the chamber so that the open, inner ends of the tubes **102** project slightly beyond the inner surface of the side wall **91**. As shown in FIGS. 7 and 8, the tubes **102** and the inner ends thereof are spaced closely together so that the pressurized gas emitted from the ends of the tubes **102** is capable of creating and maintaining a bed of fluidizing particles and gas in the chamber **90**.

DESCRIPTION OF OPERATION

As described above, the synthetic detergent or soap particles **57** which are to be shaped and/or treated in machine **11** are introduced into the rotating chamber **28** through the conduit **56**. These particles may be the end product from a conventional spray tower utilized in the manufacture of irregularly shaped, conventional soap and detergent particles and may be conveyed directly from the bottom of the tower into the chamber **28** or from a hopper.

The rotational speed of the chamber **28** is selected so that during relatively high-speed rotation of the chamber, the particles will form and maintain a generally annular bed or layer adjacent to the side wall **52** of the chamber, as shown in FIG. 4. Moreover, because of the fan-plenum chamber assembly **76** mounted on the end walls **49** and **51** of the chamber, the gas in the interior of the shroud **12** is forced through the holes **75** formed in the end walls **49** and **51**. The number and size of the fans **77** and plenum chambers **78** are correlated with the rotational speed of the chamber **28** so that the gas being forced into the rotating chamber through the holes **75** is sufficient to form a completely fluidized bed of particles and gas. In this annular fluidized bed, the particles are in continuous agitated motion as the gas passes into and through the bed so that the particles continually strike and come into contact with each other and with the walls of the chamber **28** whereby the particles are shaped into compact, generally spherical beads. After passing through the bed, gas is exhausted from the chamber **28** through the aperture **54**. A portion of the exhausted gas is then removed from the machine through conduit **26** and the remainder of the gas is recirculated back into the interior of the shroud **12** through the filter **24**. This recirculated gas, of course, is again introduced into the chamber **28**.

To assist in the shaping of the particles, the gas introduced into the shroud **12** may be heated by the heating unit **48** to a temperature whereby the heated gas causes the particles to become somewhat plasticized. In addition, the fluidization and heating of the particles reduces the moisture content of the particles far below that of the original particles and, for example, below five percent by weight. Thus, the moisture content of the particles and resulting beads of this invention is significantly less than that of conventional soap or detergent particles.

If it is desired to treat or coat the particles in the chamber **28**, a treating or coating fluid may be introduced in the rotating chamber and sprayed onto the particles through the nozzle **71**. The timing mechanism **88** controls the flow through the valve **74**, and thus through the nozzle **71**, and therefore, if desired, the introduction of the fluid may be regulated with respect to the rotation of the chamber.

Periodically, the timing mechanism **88** causes the windings of the motor **40** to be reversed so that the motor abruptly brakes the chamber **28**, thus causing the speed of the chamber **28** to be reduced from the relatively high speed at which the particles form and maintain a generally annular bed to an intermediate speed setting for the two-speed motor **40**. This intermediate speed may just be five or ten percent less than the relatively high speed, but must be low enough so that the gravitational force acting on the particles overcomes the centrifugal force acting on the particles whereby the particles in the upper segment of the chamber fall away from the side wall **52** and are cast down upon the lower segment of the chamber and upon the particles in the bed in the lower segment of the chamber, as shown in FIG. 5. This causes additional compaction of the particles and hardens the outer surface of the particles. Moreover, during the time the speed of the chamber is below the relatively high speed, the particles are tumbled in the chamber and this also assists in shaping and hardening the particles. Almost immediately after the timing mechanism **88** has caused a reduction in the speed of the chamber **28**, the timing mechanism causes the windings of the motor **40** to be switched back to their original position so that the motor again drives the chamber **28** at the relatively high speed.

A typical cycle operation for forming and maintaining the annular bed in the chamber **28**, abruptly braking or reducing the rotational speed of the chamber to the intermediate speed and returning the speed of the chamber back to the relatively high speed, may take from 10 to 20 seconds. Approximately one-half of this cycle may be utilized for forming and maintaining the particles in the annular bed, approximately one-quarter of the cycle may be utilized for reducing the speed of the chamber from the relatively high speed to the intermediate speed and the other one-quarter of the cycle may be utilized for tumbling the particles during the time the speed of the chamber is below the relatively high speed and for returning the rotational speed of the chamber from the intermediate speed to the relatively high speed or, of course, the periods of relatively high speed operation or intermediate speed operation may be made of much longer duration.

The operation of the machine **89** shown in FIG. 7 is identical to the foregoing description of the machine **11**, except that the gas is introduced into the chamber **90** through the manifold **92** and a plurality of pipes **93** and **94**. The gas may be heated, if desired, prior to its introduction into the manifold by a conventional heater, not shown, positioned in conduit **98**. The operation of machine **89** does include the recirculation of gas.

After the particles **57** have been shaped and treated in the chamber a sufficient length of time, i.e., for a sufficient number of cycles of operation, the resulting beads appear generally as shown in FIG. 9, with the reference numerals **103** indicating the portion of the bead which was introduced into the chamber and the reference numeral **104** indicating a layer of coating material which was added to the portion **103** during the treatment of the particles in the chamber.

As noted above, the trough **64** is positioned, as shown in FIGS. 4 and 5, so that its open side is directed toward the lower segment of the chamber during the time the particles are being shaped and/or treated in the chamber **28**. When the desired number of cycles of operation have been completed, however, the timing mechanism **88** actuates the electric motor **68** and the motor rotates the trough one-hundred and eighty degrees from the position shown in FIGS. 4 and 5 to the position shown in FIG. 6 wherein the open side of the trough is directed toward the upper segment of the chamber. Thus, when the chamber **28** is next abruptly braked from the relatively high speed to the intermediate speed, a portion of the beads falling away from the upper segment of the chamber land in or are caught in the trough **64**. When the trough **64** is in the position shown in FIG. 4, the timing mechanism **88** also causes the vibrator units **69** to operate so that the beads caught in the trough **64** are moved toward the left, as shown in FIG. 1, are deposited in the conduit **61** and are thereby removed from the machine. As the operation of the machine is repeated, the chamber **28** is completely emptied of beads.

The beads produced by the machines described herein have a density of greater than fifty pounds per cubic foot and a generally specific gravity for the bead of approximately nine-tenths, with a moisture content of below five percent by weight. These beads are designed for use in automatic washers which are equipped with mechanical or hydraulic dissolvers, and in which the clothes or fabrics to be cleaned are not introduced into the washer until after the beads have been thoroughly dissolved and diluted.

The composition or makeup of the beads produced by the machines of this invention may vary. For example, a bead produced in machines of this invention may have a nucleus of potash soap protected by a continuous, outer layer of soda soap. The soda soap layer, of course, would be introduced through the nozzle **71** while the nucleus of potash soap would be introduced into the chamber through the conduit **56**. The advantage of using a bead of this type is that the active ingredients of soda soap cost approximately one-half the cost of the active ingredients of synthetic detergents. The outer layer of soda soap is to prevent the caking or absorbtion of moisture by the more active potash soap nucleus.

Another type of bead which could be produced is a bead having a mild caustic detergent outer layer with a nucleus of a strong caustic detergent so that when the bead is dissolved to a concentration of three-tenths percent in soft water, i.e., water having below 50 parts per million of hardness components, the solution of clothes and water would have a pH of 8.5–10. A similar type of bead could be used in hard water, i.e., water having hardness components of between 50 and 200 parts per million, so that when the bead is dissolved, to a concentration of five-tenths percent, the solution of clothes and water would have a pH of 9.5–12.0. The advantage of using the milder outer caustic layer is that it would facilitate the handling of the beads and permit, for the first time, a strong caustic solution, such as now used in the commercial laundries, to be safely used in the home.

Likewise, the beads produced in the machines of this invention could also have a nucleus of a bluing material, a fluorescent bluing dye, a clothes bleaching chemical or a rinse promoting chemical with the outer layer being a detergent product. Still another example of such beads would be a bead having an outer layer of water softening chemicals, such as metasilicate, and a nucleus of potash soap.

The variations and different combinations of nucleus and outer layer materials which may be utilized for the soap and detergent beads of the present invention, of course, is not limited to the examples given above; and it should be understood that the machines of this invention provide an economical and efficient way of producing laundry products in a dense bead form in which two or more products can be combined so that each bead contains the same chemicals and same proportion of chemicals as all other beads, within, of course, normal manufacturing tolerances.

Thus, it should be apparent from the foregoing that the invention described herein provides a unique and novel machine and method for shaping and treating laundry products which will permit those products to be economically attractively sold both to the home and commercial laundry market. In addition, the machines and method described herein permits the production of detergent products which will, for the first time, permit the home laundry market to utilize harsher chemicals and a wider variety of detergent products than could heretofore be safely commercially sold.

Also, it should be obvious to those skilled in the art that the specific machines described herein could be modified without departing from the principles of the invention. For example, the trough **64** could also be arranged so that it could be completely withdrawn from the chamber **28** when not in use, rather than be positioned such as shown in FIGS. 4 and 5.

Also, other means could be used to direct gas or air under pressure into the rotating chamber; and in connection with the shaping and treating of certain particles it may not be necessary to periodically, abruptly reduce the rotational speed of the chamber. In some instances, and particularly with a machine similar to that shown in FIGS. 7 and 8, the tumbling of the particles in the chamber may be accomplished by abruptly varying the flow and/or pressure of the gas or air introduced into the chamber. In addition, and as noted above, the size, number and angle of the plenum chambers and fan blades used in the machine **11** may be varied, depending on the particles to be shaped and/or treated and, of course, the cycle of operations can be changed.

Therefore, the preferred embodiments of the invention described herein are to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are thus intended to be embraced therein.

I claim as my invention:

1. An improved machine for shaping and treating particles of soap, detergent and the like comprising: a rotatable chamber having end walls and a side wall and being adapted to receive the particles; means for rotating the chamber about its central axis at a relatively high speed whereby the particles form and maintain a generally annular bed about said central axis and adjacent the side wall of the rotating chamber; means for continuously introducing gas under pressure into said annular bed so that the particles are fluidized in said annular bed; and means for causing the fluidized particles in said annular bed to be impinged intermittently against the walls of the rotating chamber and against the other fluidized particles in said annular bed so that the fluidized particles are intermittently tumbled in, and against the walls, of the rotating chamber.

2. The improved machine described in claim **1** which includes means for introducing particle-treating fluid into the rotating chamber so that said fluid contacts the fluidized particles in said annular bed.

3. The improved machine described in claim **1** wherein the means for causing the fluidized particles in said annular bed to impinge intermittently against the walls of the rotating chamber and the other fluidized particles in said annular bed includes means for periodically, abruptly changing the rotational speed of the rotating chamber.

4. The improved machine described in claim **3** wherein the means for changing the speed of the rotating chamber periodically, abruptly reduces the speed of the rotating chamber from said high speed to an intermediate speed.

5. The improved machine described in claim **4** wherein the central axis of the chamber is substantially horizontal; and wherein said intermediate speed is below the rotational speed needed to maintain said annular bed of particles so that when the speed of the chamber is periodically, abruptly reduced, a large portion of the fluidized particles fall away from adjacent the side wall of the rotating chamber and are cast down on the lower segment of the rotating chamber.

6. The improved machine described in claim **5** which includes means for introducing particles into the interior of the rotating chamber during rotation of the rotating chamber and means for removing particles from the rotating chamber during rotation of the rotating chamber.

7. The improved machine described in claim **5** wherein the means for changing the rotational speed of the rotating chamber quickly returns the rotating chamber to said relatively high speed after a reduction of rotational speed whereby said annular bed of fluidized particles and gas is again formed.

8. The improved machine described in claim **6** which includes means for introducing particle-treating fluid into the rotating chamber so that said fluid contacts the fluidized particles in said annular bed.

9. The improved machine described in claim **1** wherein the central axis of the chamber is horizontal.

10. The improved machine described in claim **1** wherein the means for causing the fluidized particles in said annular bed to impinge intermittently against the walls of the rotating chamber includes means for periodically introducing into the chamber a volume of gas under pressure in excess of that needed to fluidize the particles in the rotating chamber whereby the excess gas causes the fluidized particles to be intermittently impinged against the walls of the rotating chamber.

11. The improved machine described in claim **1** which includes means for introducing particles into the interior of the rotating chamber during rotation of the chamber and means for removing particles from the rotating chamber during rotation of the chamber.

12. The improved machine described in claim **1** wherein the means for introducing gas under pressure into said annular bed includes a plurality of holes formed in the rotating chamber, said holes permitting communication between the exterior of the rotating chamber and said annular bed in the rotating chamber; and means positioned without the rotating chamber for causing gas under pressure to flow through said holes into the rotating chamber.

13. The improved machine described in claim **12** wherein the means for causing gas to flow into the rotating chamber includes a plurality of fan blades mounted on the exterior face of at least one of the end walls of said rotating chamber whereby the fan blades cause gas surrounding said rotating chamber to be forced into the rotating chamber through said holes.

14. The improved machine described in claim **13** wherein said holes are formed in the end walls of the rotating chamber, adjacent to, but spaced radially inwardly from the side wall of the rotating chamber; wherein the fan blades are mounted on each of the end walls at points equi-spaced from each other and at points spaced radially inward from the side wall, with the longitudinal axis of each of the fan blades being disposed at an acute angle with respect to a radius of the rotating chamber and with the fan blades being spaced radially closer to said central axis of the rotating chamber than said holes; and wherein a plurality of plenum chambers are formed on the exterior face of the end walls of the rotating chamber and are arranged so that a plenum chamber extends from each of the fan blades to at least one of said holes whereby the plenum chamber serves to direct gas from the fan blade radially outwardly to and through said holes.

15. The improved machine described in claim **14** wherein the fan blades are positioned ahead, relative to the direction of the rotation of the rotating chamber, of the respective said holes with which the fan blades are connected by a plenum chamber so that the plenum chamber assists in the movement of gas radially through the plenum chamber and through said holes.

16. The improved machine described in claim **14** wherein a shroud is positioned so as to surround the rotating chamber; wherein gas is introduced into the interior of the shroud; and wherein gas heating means is used to heat the gas introduced into the shroud.

17. The improved machine described in claim **16** wherein the gas fluidizing said annular bed of particles flows from said annular bed into the interior of the shroud through an aperture formed in at least one of the end walls of the rotating chamber, adjacent said central axis of the rotating chamber, so that at least a portion of the gas may be recirculated and reintroduced into the annular bed; wherein means are positioned adjacent the rotating chamber to filter the gas being recirculated; and wherein means are used to control selectively the operation of the gas heating means.

18. The improved machine described in claim **12** wherein the means for introducing gas under pressure into said annular bed includes: a manifold positioned adjacent said central axis of the rotating chamber; a gas rotary compressor having its outlet connected with the manifold; a plurality of generally L-shaped conduits, each conduit having one of its ends blocked and the other of its ends connected with the manifold, having a first section thereof extending from the manifold to the periphery of the rotating chamber and having a second section thereof extending adjacent to the side wall of the rotating chamber, substantially parallel to said central axis of the rotating chamber; metering orifices associated with each of the conduits; a plurality of short tubes connected with the second sections of the conduits and extending radially inwardly therefrom through the side wall of the rotating chamber so that the radially inner open ends of the tubes are spaced adjacent to, but radially inwardly from, the inner surface of the side wall of the rotating chamber whereby gas under pressure is emitted from the inner open ends of the tubes into said annular bed.

19. The improved machine described in claim **18** wherein the first sections of the conduits extend radially along the exterior face of one of the end walls of the rotating chamber.

20. The improved machine described in claim **1** wherein a stationary shroud is positioned so as to surround the rotating chamber; wherein gas is introduced into the interior of the shroud; and wherein gas heating means is used to heat the gas introduced into the shroud.

21. The improved machine described in claim **20** wherein the gas fluidizing said annular bed of particles flows from said annular bed into the interior of the shroud through an aperture formed in at least one of the end walls of the rotating chamber adjacent said central axis of the chamber so that at least a portion of the gas may be recirculated and reintroduced into said annular bed; and wherein filter means are positioned adjacent the rotating chamber to filter the gas being recirculated.

22. The improved machine described in claim **2** wherein the means for introducing fluid into the rotating chamber includes a relatively stationary nozzle positioned within the rotating chamber and a conduit connecting the nozzle with a source of fluid under pressure, the central longitudinal axis of the conduit being, at least in part, parallel with said central axis of the rotating chamber.

23. The improved machine described in claim **5** wherein the side wall of the rotating chamber is curved and is symmetrical about a plane extending through the center of the side wall and perpendicular to said central axis of the rotating chamber.

24. The improved machine described in claim **23** wherein the central portion of the side wall of the rotating chamber is spaced radially inwardly, relative to the end portions of the side wall.

25. The improved machine described in claim **6** wherein the means for removing the particles from the rotating chamber includes a trough having a generally U-shaped cross section, in a plane perpendicular to the central longitudinal axis of the trough; with the trough being positioned in the rotating chamber adjacent to said central axis of the chamber.

26. The improved machine described in claim **25** wherein said central longitudinal axis of the trough is substantially parallel to said central longitudinal axis of the rotating chamber.

27. The improved machine described in claim **26** wherein the trough is mounted within the rotating chamber so that it may be positioned selectively either in a first position in which the trough faces the upper segment of the rotating chamber whereby when the rotational speed of the chamber is periodically abruptly reduced, at least a portion of the particles falling away from the side wall of the rotating chamber are caught in the trough, or in a second position in which the trough is rotated approximately 180° from said first position.

28. The improved machine described in claim **26** wherein one end of the trough extends through an aperture formed in one of the end walls of the rotating chamber; and wherein means are included for vibrating the trough whereby the vibration of the trough assists in moving the particles caught in the trough along the trough toward the one end thereof.

29. The improved machine described in claim **15** which includes means for introducing particles into the interior of the rotating chamber during rotation of the chamber; wherein said central axis of the rotating chamber is substantially horizontal; wherein the means for causing the fluidized particles in said annular bed to impinge intermittently against the walls of the rotating chamber includes means for periodically, abruptly reducing the speed of the rotating chamber from a high speed to an intermediate speed, said intermediate speed being below the rotational speed needed to maintain said annular bed of fluidized particles so that when the speed of the chamber is periodically, abruptly reduced a large portion of the fluidized particles fall away from adjacent the side wall of the rotating chamber and are cast down on the lower segment of the rotating chamber; wherein the means for changing the rotational speed of the rotating chamber quickly returns the rotating chamber to said relatively high speed after reduction of rotational speed whereby said annular bed of fluidized particles and gas is again formed; wherein a trough is used for removing the particles from the rotating chamber, the trough having a generally U-shaped cross section, in a plane perpendicular to the central longitudinal axis of the trough and being mounted within the rotating chamber so that it may be positioned selectively either in a first position in which the trough faces the upper segment of the rotating chamber whereby when the rotational speed of the chamber is periodically, abruptly reduced, at least a portion of the fluidized particles falling away from the side wall of the rotating chamber are caught in the trough, or in a second position in which the trough is rotated approximately 180° from said first position; wherein a shroud is positioned so as to surround the rotating chamber; wherein gas is introduced under pressure into the interior of the shroud; wherein a gas heating means is used to heat the gas introduced into the shroud; wherein means are used to control selectively the operation of the gas heating means; wherein the gas fluidizing said annular bed of particles flows from said annular bed into the interior of the shroud through an aperture formed in at least one of the end walls of the rotating chamber adjacent said central axis of the chamber so that at least a portion of the gas may be recirculated and reintroduced into said annular bed; wherein filter means are positioned adjacent the rotating chamber to filter the gas being recirculated; wherein a relatively stationary nozzle means is used to introduce fluid into the rotating chamber including a nozzle positioned within the rotating chamber and a conduit connecting the nozzle with a source of fluid under pressure, the central longitudinal axis of the conduit being, at least in part, coaxial with said central axis of the rotating chamber; and wherein the side wall of the rotating chamber is curved and is symmetrical about a plane extending through the center of the side wall and perpendicular to said central axis of the rotating chamber, with the central portion of the side wall of the rotating chamber being spaced radially inwardly, relative to the end portions of the side wall.

References Cited

UNITED STATES PATENTS

2,165,287 7/1939 McBride ----------- 241—54X

JAMES M. MEISTER, Primary Examiner

U.S. Cl. X.R.

18—2.6

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,588,950 Dated June 29, 1971

Inventor(s) D. E. Marshall

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the drawings, Sheet 1, Fig. 1, lines 2-2, directed toward chamber 28, should be inserted between the front wall 14 of the shroud 12 and the front wall 49 of the chamber 28; the reference number 11 should be generally applied to the machine; the reference number 65 should be applied to the end of the trough 64 adjacent the unloading conduit 61; the reference number 68 should be applied to the schematic box adjacent bracket 66. In the drawings, Sheet 2, Fig. 2, the reference number 81 should be applied to the arrow indicating the direction of rotation of the chamber 28. In the drawings, Sheet 3, Fig. 7, the reference number 91 should be applied to the side wall connecting front end wall 49 and back end wall 51; the reference number 93 should be instead applied to the pipe running vertically down the back end wall 51. Column 7, line 49, reference number 99 should be inserted to follow "passage".

Signed and sealed this 8th day of February 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
☆ U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334