April 23, 1946. J. W. BODMAN 2,398,776

PROCESS FOR PRODUCING AERATED SOAP

Filed Sept. 23, 1940 2 Sheets-Sheet 1

Fig. 2

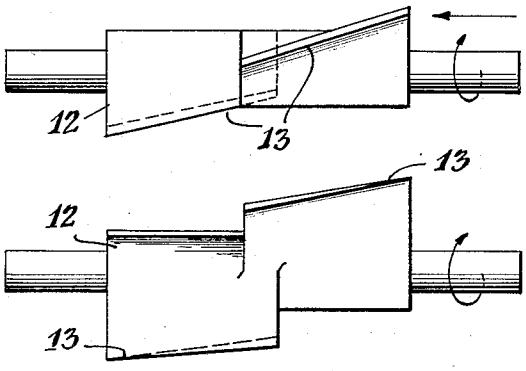

Fig. 3

Fig. 1

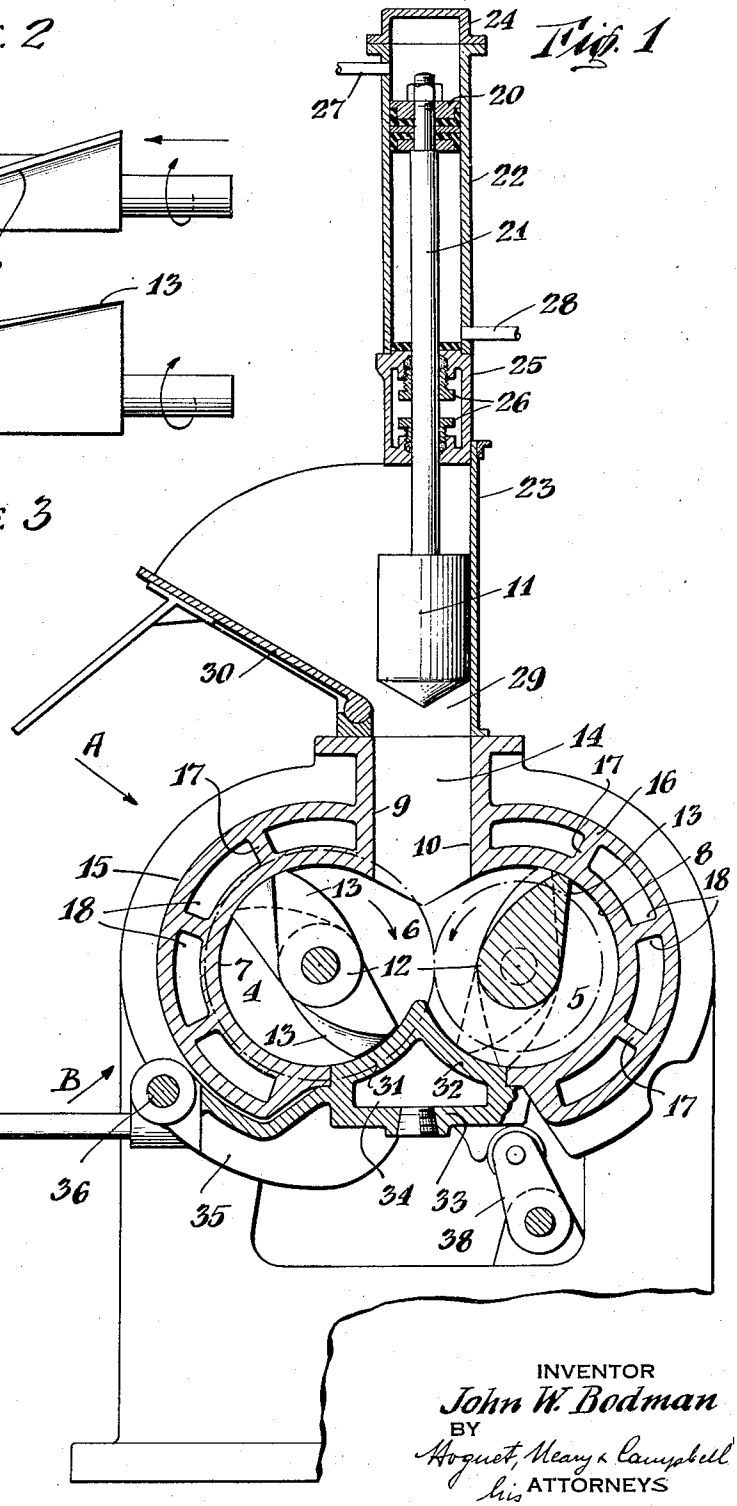

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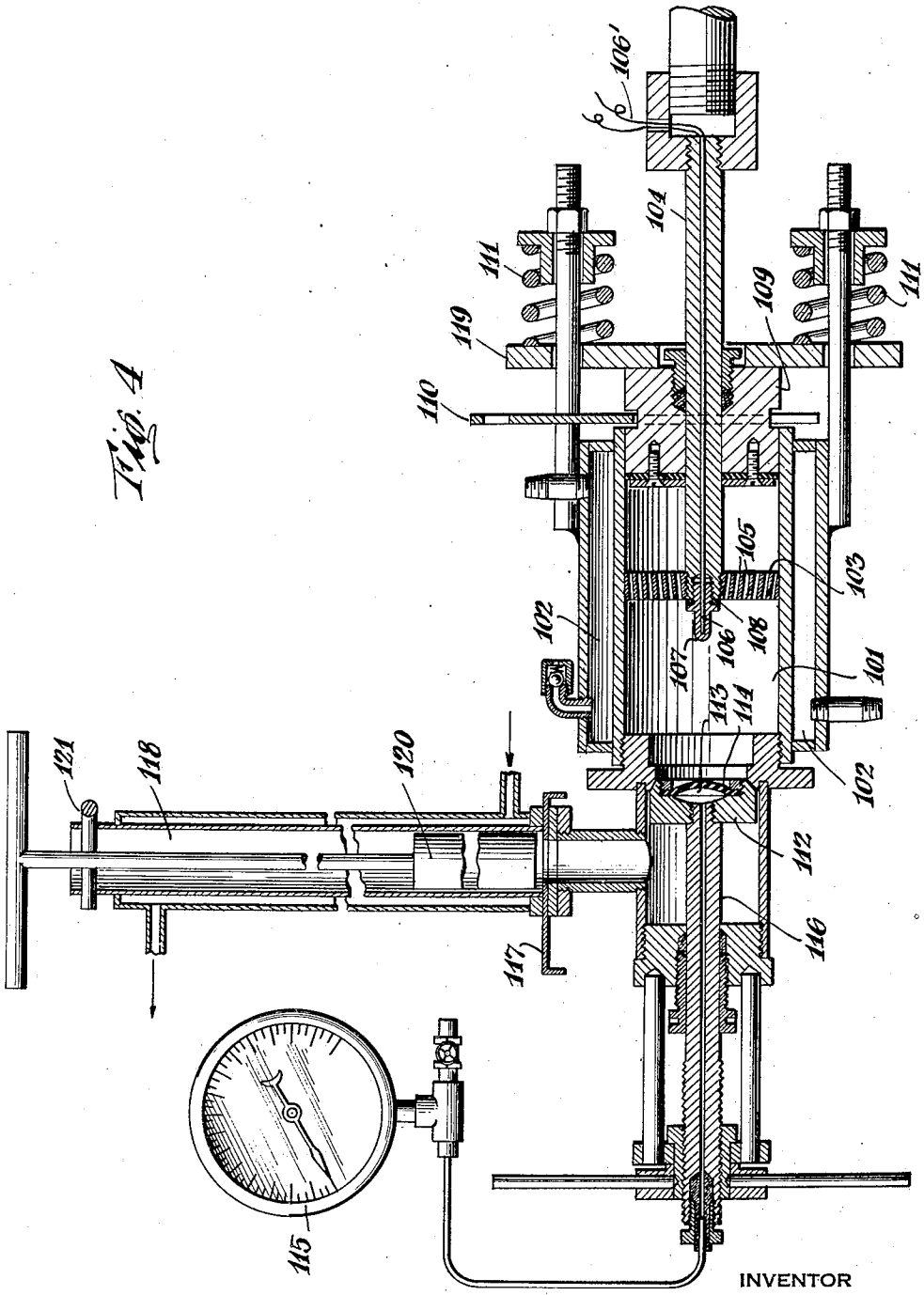
Fig. 4



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2,398,776

UNITED STATES PATENT OFFICE

2,398,776

PROCESS FOR PRODUCING AERATED SOAP

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Application September 23, 1940, Serial No. 358,006

2 Claims. (Cl. 252—134)

This invention relates to the production of aerated detergent masses suitable for laundry and toilet uses.

Detergent masses such as soap, aerated sufficiently to float have long been in demand commercially. Such aerated soaps have commonly been produced in a crutcher by agitating the soap while in a viscous or molten condition so as to entrap and disseminate air throughout the mass. Examination of aerated soaps made by the prior art processes discloses that the air bubbles are of all sizes and predominantly coarse and further are unevenly distributed throughout the soap bar or cake.

By the practice of my invention it is possible to produce a soap, in cake or bar form, having a characterizing dispersion of uniform cells or bubbles of a compatible gas or vapor throughout the mass, the cells or bubbles having a fineness and a uniformity or evenness of distribution never heretofore obtained.

The aerated product of my invention, particularly in a floating form, has a unique but characteristic color and appearance, making it highly desirable as compared with the prior aerated soaps available.

My product may be made from any usual laundry or toilet soap stocks. It is important, in general, that the starting stock be capable of conversion to a continuous workable state, permitting the incorporation of air or other compatible gas or vapor with the mass. This may be done by the control of heating or moisture conditions, for example. Whether such a state is molten, semi-fluid, fluid, plastic or otherwise is immaterial so long as air, for example, can be dispersed and so retained until solidification of the mass.

In the accompanying drawings I have illustrated two forms of apparatus suitable for practicing my invention. The details of the apparatus may be modified and other apparatus substituted, however, without departing from the invention, so long as the desired unique effects are reproduced.

In general, it is preferred that the apparatus be jacketed or otherwise adapted to a temperature control during the process; enclosed to permit the application of pressures suitable for the mass under treatment; and provided with a means capable of working the mass to facilitate the incorporation in the mass of the compatible gas as desired.

In the drawings, Fig. 1 is a vertical section of a conventional type of Banbury mixer. The right hand rotor is shown in Fig. 2 by a section taken in the direction of the arrow marked A along the line 6—6 of Fig. 1. Fig. 3 is a side elevation of the same rotor, the view being taken in the direction of the arrow marked B in Fig. 1.

In the drawings, Fig. 4 is another type of apparatus suitable for producing my desired product.

The apparatus illustrated in the drawings, Fig. 1, Fig. 2 and Fig. 3, comprises two parallelly-arranged chambers 4 and 5 communicating at their inner sides which open into a central chamber 6. These three inter-communicating chambers together constitute a treating chamber in which the soap stock is subjected to heat, pressure and a thorough mixing or working over. The chambers 4 and 5 are respectively formed by the cylindrical walls, indicated at 7 and 8, the upper inner ends of which terminate in the vertical walls 9 and 10 which form a mouth 14 through which the soap stock is fed into the chambers and which is adapted to be closed by a plunger 11.

The means for working over or thoroughly mixing, shearing and kneading the soap stock comprises the rotors 12 mounted axially in the chambers 4 and 5. Each of the two rotors is provided with two interrupted spiral blades 13. The details of the shape and arrangement of the spiral blades 13 and their mode of operation are set forth in the patent to Banbury No. 1,200,070, dated October 3, 1916.

In order that the temperature of the soap mass in the treating chamber may be regulated, the walls 7 and 8 are jacketed, being provided with the shell or casing sections 15 and 16 which are separated from the walls by the ribs 17. Steam or other heating medium may be introduced into the spaces 18 defined by the walls and the casing sections.

The pressure under which the soap mass is worked may be supplied by the weight of the plunger 11 which serves to close the mouth 14 when the rotors 12 are kneading and working the soap mass in the treating chamber. If the weight of the plunger is not sufficient to exert the required pressure on the soap mass, additional pressure may be supplied by steam or compressed air acting on the upper side of a piston 20 mounted on the upper end of a rod 21 secured at its lower end to the plunger 11. The piston 20 slides in a vertical cylinder 22 supported on the upper end of a hopper 23 in turn supported on the upper ends of the walls 9 and 10. The top end of the cylinder 22 is closed by a cover 24 and the lower end of the cylinder is provided with a gland box 25 in which are located the glands 26 to prevent leakage of fluid around the piston rod 21.

The duct 27 at the upper end of the cylinder 22 admits steam or compressed air to the upper side of the piston to hold the plunger 11 down in the mouth 14 during the working of the soap mass; and the duct 28 admits steam or compressed air to the lower side of the piston to lift the plunger out of the mouth 14 on the completion of the soap treating operation. Even when no pressure is exerted on the plunger through the piston, the plunger is conveniently lifted by means of the piston.

To facilitate introducing the soap stock into the treating chamber through the mouth 14, the upper end of the latter registers with the opening 29 in the lower end of the hopper 23, the front side of which has a swinging door 30.

The treated material is discharged from the treating chamber through an opening formed in the central lower portions of the walls 7 and 8. This opening is closed by the curved wall sections 31 and 32 which form the inner lower ends of the walls 7 and 8 and which meet in a curved apex at this point. The wall sections 31 and 32 with the casing section 33 define a space which forms part of the jacket of the cylindrical chambers 4 and 5. The parts 31, 32 and 33 constitute a gate which serves to control the discharge opening of the treating chamber. For this purpose the gate is connected with an arm 35 pivoted at 36. Projecting forwardly from the arm is a counterweight 37. The gate is held in closed position by a pivoted arm 38. When the contents of the treating chamber are to be discharged, the arm 38 is swung to the right, which releases the gate and permits it to swing on its pivot 36.

The practice of the process of producing the novel soap may begin at any point in the history of the soap stock after saponification. The process may be applied equally well to settled kettle soap, or to soap made by the semi-boiling and cold-boiling processes. I set forth below for the purposes of illustration a description of the operation of the process as applied to the treatment of neat kettle soap. About 150 pounds of soap chips are introduced into the apparatus through the hopper 23 and the plunger or weight 11 is lowered into the mouth 14 leading into the treating chamber constituted by the chambers 4, 5 and 6. The weight of the plunger 11 plus the pressure exerted on the piston 20 will exert a pressure of about twenty-five pounds per square inch on the soap mass in the treating chamber, it being understood that various pressures may be employed depending on the character of the soap product desired. The steam or other heating medium circulating in the jacket of the treating chamber will heat the soap mass preferably to a temperature of from about 160 to about 225° F., thereby plasticizing it. The rotors 12 turn relatively slowly and preferably at different speeds, the left hand rotor, viewing Fig. 1, turning at about 34.2 revolutions per minute and the right hand rotor turning at about 13 revolutions per minute. Usuallly, no extra supply of air is introduced into the treating chamber beyond that which enters with the soap and that which is contained or dissolved in the soap from its previous treatment, this amount of air being usually sufficient when uniformly distributed throughout the soap mass in minute cells or bubbles to produce a floating soap. However, if desired, additional air may be added.

The rotating spiral blades 13 in conjunction with the interior surfaces of the walls 7 and 8 exert a wedging action on the soap mass, and at the point where the soap contacts with the inner surfaces of the walls 7 and 8 this wedging action becomes a shearing action. As the blades move against the soap mass the latter is not only subjected to the wedging and shearing action against the inner surfaces of the walls 7 and 8 but is also pushed axially of the blades toward the inner ends thereof which overlap somewhat, as indicated best in Fig. 3, with the result that all parts of the soap mass are constantly changing their positions and are overlapped and kneaded together. Hence all parts of the soap mass are presented to the interior surfaces of the walls 7 and 8 to receive the heat therefrom, and also whatever air is present in the soap mass is equally and uniformly distributed throughout the soap mass in microscopic cells or bubbles, by the constant and continued shifting of all portions of the soap mass.

The pressure under which the plasticized or partially melted soap mass is thus thoroughly worked and agitated apparently facilitates the process. After the working of the stock has been carried out for 15 or 20 minutes in the apparatus described the soap stock is released and the product cooled. The releasing preferably should take place into some form-imparting means, from which the solidified mass can be removed and cut up into cakes or bars. The cooling can take place within the form-imparting means.

Although these steps of releasing and cooling can be carried out in any preferred manner, I shall disclose a specific operation in connection with my process. For example, on the completion of the process the rotors may be shut down and the pressure on the soap mass in the treating chamber relieved, either by lifting the plunger 11 or by opening the gate. I prefer, however, to release the pressure on the chamber before opening the gate in this particular operation. The treated soap mass is discharged by throwing the arm 38 to the right and then moving the counterweight 37 upwardly, which causes the gate to swing downwardly, discharging the soap into a container. Due to the differential in temperature between that at which the operation is carried out, and room temperature, there is an immediate cooling of the discharged soap mass. If desired, there may be a preliminary cooling by passing a cooling medium through the jacket surrounding the mixer. The solidified soap mass may then be cut up into cakes and bars in much the same manner as framed or milled soap is cut up into cakes and bars. The cutting of the soap mass into cakes and bars and the pressing of the cakes and bars into the ultimate finished product does not substantially affect the specific gravity of the soap and thus the floating characteristics.

Instead of carrying out my process as a batch operation, as hereinbefore described, I may continuously practice my process. For example, in the type of apparatus described above, the soap stock, either fluid or solid, may be introduced at one end of the treating chamber and withdrawn from the other end continuously. The apparatus disclosed in the Pease Patent No. 2,048,286 may also be utilized to practice my process continuously.

Fig. 4 discloses another suitable apparatus. This apparatus comprises a cylindrical soap chamber 101 having a heating jacket 102 connected to a hot water steam supply whose temperature can be varied or held constant at any desired value, whereby the temperature of a soap mass charged into the chamber may be readily

controlled. Agitation of the soap mass is provided by the reciprocating movement of a disc-shaped piston 103 connected to a hydraulically actuated tubular piston rod 104. The piston 103 may be formed with a plurality of perforations 105, to provide a path through which the soap may flow as the piston is reciprocated. Perforations in the piston rod head of approximately $\frac{3}{32}$ inch in diameter have been used successfully. The perforations are preferably formed at an angle of approximately 12° from the perpendicular to the face of the piston so that the soap is prevented from retracing its path exactly through the piston. The piston 103 may be replaced, if desired, by another having different or more suitable perforations for working a given composition.

The temperature of a soap mass in the soap chamber 101 may be measured by means of a thermocouple 106, the junction of which is carried by a thin walled metal tip 107 extending into the soap and thermally and electrically insulated from the piston 103 by suitable means such as bushing 108. The thermocouple leads 106' extend out through the rod 104 to suitable measuring apparatus whereby readings may be taken indicating the average temperature of the soap.

In order that the capacity of the soap chamber 101 may remain substantially constant, the end of the chamber through which the piston rod 104 extends, is closed by means of a closely fitting cylindrical plunger 109 which is adapted to move longitudinally of the soap chamber as required to compensate for the change in available space as the piston rod 104 goes in and out. Excessive movement of the plunger 109 is prevented by check plate 110 and coil springs 111.

The opposite end of the chamber is closed by means of a valve plug 112 provided with means for measuring the pressure exerted upon the soap by the forward stroke of the piston 103. The plug 112 is formed with an oil space 113 separated from the soap by means of a flexible diaphragm 114 fitted to the face of the plug whereby the pressure on the oil may be considered equal to the pressure on the soap. As a result, the soap pressures may be read by means of a suitable pressure gauge 115 connected to the oil space 113 by means of a tubular supporting shaft 116.

When the treatment of the soap has been completed, the sliding gate 117 to a water cooled mold 118 is opened and valve plug 112 is moved so as to permit passage of the soap from the chamber into the mold. The soap may be extruded from the chamber in any convenient manner such as by coupling the piston 103 with the plunger 109 after removing the check plate 110 and pressure plate 119. The mold 118 is preferably fitted with a weighted plunger 120 which rises as the soap is extruded into the mold while maintaining some slight pressure downward on the soap. The extent to which the plunger 120 can rise in the mold is determined by a stop 121, which is used in order to predetermine the size of the bar and to hold the same under a positive pressure during the initial period of cooling. When the extruded soap has been cooled, the mold is detached and the solidified bar removed.

If the chamber 101 of the apparatus of Fig. 4 is charged with the soap to be treated or tested, is heated by means of hot water circulating in the jacket and the perforated piston is reciprocated, the consistency of the soap mass is found to change as the temperature rises. These changes are observed by the pressure developed on the forward stroke of the piston through the soap mass. I have successfully utilized this apparatus with the piston 103 reciprocating at 8.6 strokes per minute.

As an example of my process utilizing the piston treating apparatus of Fig. 4, the apparatus is charged with soap chips made from a kettle soap of an 80% tallow and 20% cocoanut oil formula. These chips contain approximately 30% water. They are thoroughly worked in the apparatus for about 15 minutes at a static pressure of about 20 pounds gauge, and at a temperature of 160° F. The mass is then released to a mold and cooled. The resulting soap bar upon examination is found to have a specific gravity of about 0.71 and a whiteness and opacity so superior to that of known aerated soaps as to be unique. A microscopic examination showed that the air bubbles were unusually minute and uniform in size and, furthermore, that they appeared to be uniformly distributed throughout the mass, characteristics not found in any other aerated soaps.

As another example, I charge the piston apparatus with a similar soap stock in chip form and thoroughly work the mass for 20 minutes, at a temperature of 140° F. and under a static pressure of about 20 pounds gauge to aerate it. The specific gravity of the bar produced is 0.83 and is found also to have a unique air distribution, giving it the characterizing whiteness and opacity.

I have also aerated a similar soap stock in my piston apparatus utilizing temperatures of 140° F. and a static pressure of about 60 pounds gauge. Under these conditions the specific gravity of the soap bar was found to be 0.82 and it had acquired the characterizing microscopic air cells and uniformity of distribution typical of the product produced by my process.

As a result of the present disclosure, other apparatus for practicing the invention, as well as obvious changes in the processing steps, will become apparent to those skilled in the art. For this reason, the apparatus described, as well as the processes in which they are used, are for the purpose of illustration only and should not be considered as imposing limitations on the broader aspects of my invention.

In treating a soap stock in a solid chipped form according to the process of the present invention, sufficient air usually enters the mixing zone with the charge to impart floating properties to the final soap product. However, if the soap stock charged is of such a nature as to not include sufficient air to impart the desired aerated properties on subsequent processing, additional air may be introduced into the mass to be treated prior to or during the processing. The specific gravity of the product may be controlled over a wide range by suitably adjusting the temperature and pressure conditions during processing so as to insure the dispersion and retention of the desired proportion of air, for example, in the final product. A degree of aeration such that the volume of the air cells or bubbles will equal 35% or more of the volume of the soap product may be obtained. A floating soap or other detergent mass produced by the present invention may have a specific gravity of from about 0.50 to about 0.98.

Satisfactory soaps may be produced at temperatures ranging from about 140° F. to about 225° F. with a soap stock of the illustrative type used by way of example. The foregoing temperatures, of course, would be modified depending upon the de-

tergent component used, the moisture content, and the presence of other ingredients, the important factor being that the mass during processing should be in a workable state somewhat similar, at least, to the molten or semi-fluid to fluid state of ordinary soap stocks at temperatures of 160° F. to 180° F., for example.

The temperature to produce a desired viscosity in soap is, in general, inversely proportional to the moisture content. As a rule, I am able to aerate within a somewhat lower range of temperatures than has heretofore been possible. This may be because of the intense working under pressure which is a major feature of my process. The lower limit of temperature which may be used for the pressure aeration of soap will depend in part on the effectiveness of the apparatus used in accomplishing the working action described, and in part on other factors, such as the tendency of the dispersed gas bubbles or cells upon release to move within the mass and to coalesce into larger bubbles or voids and the manner in which the mass under treatment will coalesce to form a coherent aerated bar after working at the lower temperatures.

I appreciate, of course, that the type or condition of the charging stock may have an important bearing on the commercial aspects of the process. It will be understood, however, that the state or condition of the charging stock in the practice of my process is not important from the standpoint of my invention in that, for example, it may be fluid, molten, or solid, continuous or comminuted. The important factor is the condition of the mass during treatment as described herein.

The super-imposed or static pressure to which the soap mass is subjected will preferably be correlated to the temperature, the pressure usually being increased with a rise in temperature and ranging from slightly over atmospheric pressure to 100 pounds per square inch and over. Satisfactory results, however, have been obtained by maintaining a given pressure on the soap mass, say about 25 pounds per square inch, and varying the temperature according to the characterizing properties desired in the new soap. It is desirable to subject the soap mass to pressure to secure an increased working action and also to prevent escape of moisture and air from the mass. It is also desirable while the soap stock is being subjected to both heat and pressure to agitate it thoroughly by mechanical means so as to uniformly distribute any entrapped, occluded, as well as dissolved air and gases throughout the mass under treatment. This agitation is advantageously carried on in such a manner that not only are all portions of the soap mass exposed equally to the source of heat, but also all portions of the soap mass are moved relatively to each other.

I do not wish to be limited to any particular theory of operation of my process. However, it will be noted that in each of the apparatus described above as suitable for practicing my process, there is the common feature of intensely working the mass under treatment by a shearing, infolding, kneading, squeezing action. For example, the possible effect of this action on the soap in the apparatus illustrated by Figure 4 is to provide within the mass during the processing period, a tremendous number of relatively rapid or sudden increases in pressure followed by similar releases or reductions in pressure. During each increase in pressure, additional gas or air, for example, is forced into solution or otherwise intimately dispersed throughout the mass under treatment. With each following reduction or removal of pressure the gas may actually be drawn out of solution. Such released gas would be in a highly dispersed condition, and with a suitable adjustment of the working conditions, the imposed pressure and the viscosity of the mass as controlled by temperature, for example, so as to minimize upon release the recombining of the dispersed gas cells, it is understandable how a final product may be obtained in which the dispersion approaches colloidal proportions.

I have noted that if very low static pressures are utilized in my process, it is desirable to have such a working action during the processing as would tend to produce the greatest number and maximum amount of these internal positive and negative pressures on the treated mass. However, the use of material static pressures is found desirable in any event for increasing the working action.

In floating soaps, as heretofore produced, the entrapped air bubbles vary considerably in size but, in general, are relatively large and are irregularly distributed throughout the body of the soap. In the aerated or floating soap, for example, capable of being produced by the practice of the present process, on the contrary the air bubbles entrapped in the solidified mass are characteristically of a minute and uniform size and are uniformly distributed throughout the body of the soap. As a result of my process, the bubbles or cells are so small and are so evenly distributed throughout the body of the detergent mass that when the resulting solidified mass is cut up into cakes or bars, the presence of the bubbles or cells is not noticeable to the unaided eye and a unique whiteness and opaqueness is immediately apparent. The microscopic size of the bubbles or cells of aerated soap, for example, produced by my process, indicates that a predominant proportion of the bubbles may have resulted from the entrapping upon solidification of air bubbles substantially as released from solution in a colloidally dispersed form. I have found that the bubbles may be of the order of from 20 to 60 thousandths of a millimeter (.0008 inch to .00024 inch) in diameter.

The present application is a continuation, in part, of my application filed June 18, 1936, Serial No. 85,985, which in turn is a continuation of my application filed April 8, 1933, Serial No. 665,063. My application Serial No. 85,985 has issued as Patent No. 2,215,539, dated September 24, 1940.

I claim:

1. A process for producing an aerated, floating soap mass suitable for use in bar or cake form, having a compatible gas uniformly dispersed throughout the mass in the form of microscopic cells or bubbles and suitable for producing a unique whiteness and opaqueness in an uncolored soap mass, comprising working a continuous soap mass in a pressure chamber while under pressure and in the presence of a compatible gas, uniformly distributing a material proportion of said gas throughout the soap mass in the form of microscopic cells or bubbles, controlling the temperature of said mass during said working so as to approach solidification and prevent migration and coalescence of said dispersed gas cells or bubbles within the mass, forcing said soap mass from said pressure chamber into a forming means while maintaining pressure thereon and maintaining said soap mass under pressure in said forming means while further cooling said mass.

2. A process for producing an aerated, floating soap mass suitable for use in bar or cake form, having a compatible gas uniformly dispersed throughout the mass in the form of microscopic cells or bubbles and suitable for producing a unique whiteness and opaqueness in an uncolored soap mass, comprising working a continuous soap mass in a pressure chamber while under pressure and in the presence of a compatible gas, uniformly distributing a material proportion of said gas throughout the soap mass in the form of microscopic cells or bubbles, forcing said soap mass from said pressure chamber into a forming means while maintaining pressure thereon and maintaining said soap mass under pressure in said forming means while further cooling said mass.

JOHN W. BODMAN.