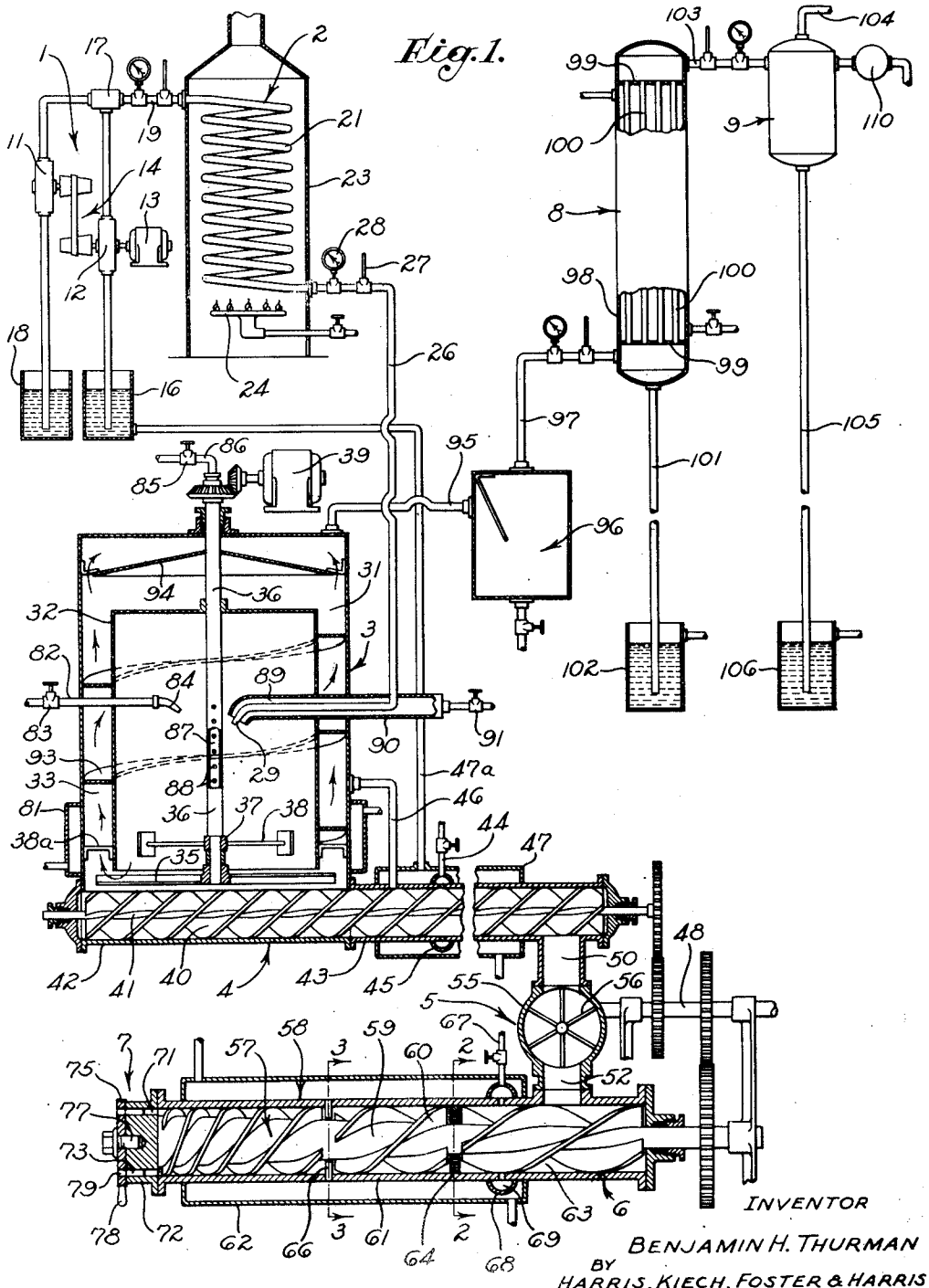
June 10, 1941. B. H. THURMAN 2,245,536

PROCESS OF MAKING, REMOVING, AND PROCESSING SOAP AND THE LIKE

Original Filed Sept. 26, 1935 2 Sheets-Sheet 1

Fig. 1.



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Fig. 4.

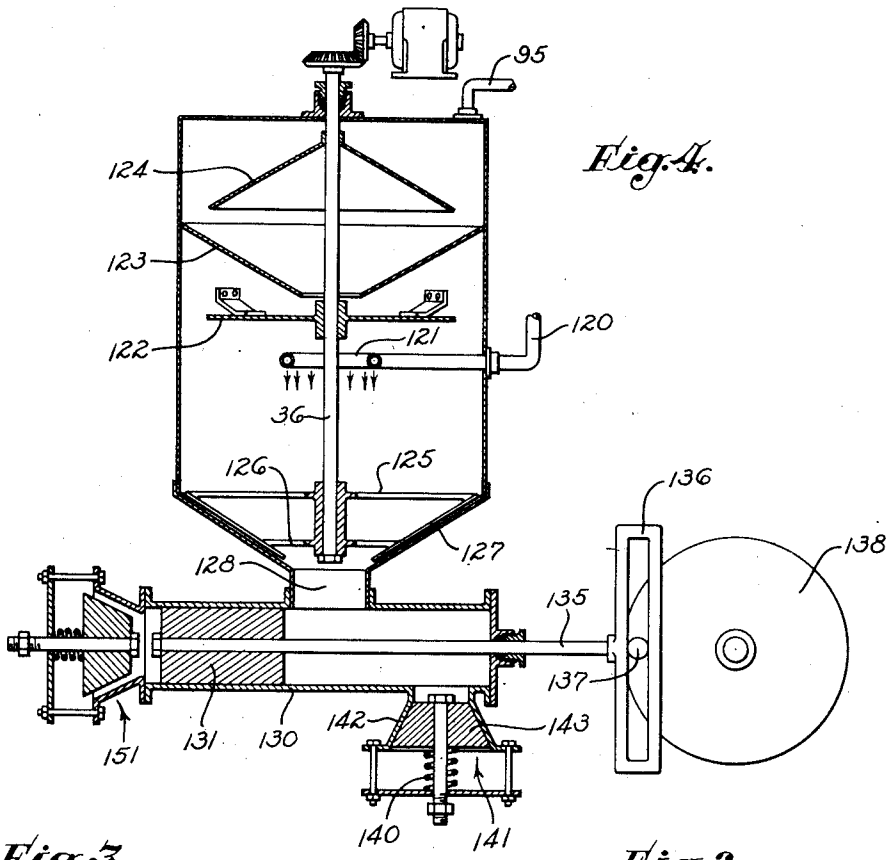


Fig. 3.

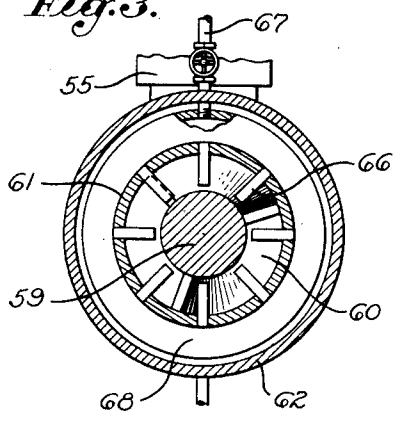
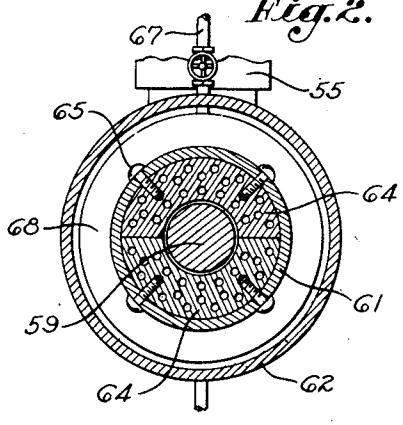


Fig. 2.



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UNITED STATES PATENT OFFICE

2,245,536

PROCESS OF MAKING, REMOVING, AND PROCESSING SOAP AND THE LIKE

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Original application September 26, 1935, Serial No. 42,348. Divided and this application May 10, 1938, Serial No. 207,140. In Canada September 14, 1936

8 Claims. (Cl. 260—418)

My invention relates to soap making and other arts in which it is desirable to form and remove particles of solid soap or other material in a low-pressure zone, often held under a high vacuum, without breaking the vacuum, while continuously recovering and removing the separated glycerine from said low-pressure zone.

The invention is particularly applicable to the manufacture and processing of soap. One method of making soap involves introduction into a heated tube of saponifying and saponifiable materials. These materials are heated in the tube during mild turbulent flow therethrough, the heating being carried to a degree determined by the desired water content of the soap to be produced and by other factors involved in soap production. Saponification takes place under these conditions of relatively high temperature, and it is usually desirable to build up considerable pressure in the tube to facilitate the desired reactions.

The friction of the materials forced through the tube tends to build up such a pressure but, in some instances, it is desirable to supplement this action by use of a restricted orifice through which the reaction products move upon being discharged from the tube. If these products are discharged into a low-pressure zone, the soap particles will drop to the lower end thereof. The conditions of temperature and pressure in the tube may be such that all of the water is vaporized before reaching the restricted orifice, in which event the steam expands after discharge from this orifice and can be readily separated from the soap. On the other hand, conditions of temperature and pressure in the tube may be such that only a portion of the water is vaporized in the tube, all or a portion of the remaining water flashing into steam upon entry into the low-pressure zone. If temperature and pressure conditions are properly regulated, soap may be formed even without vaporization of water in the tube, though the temperatures may be such that a portion of the water will flash into steam upon introduction into a low-pressure zone. Certain features of the invention, such as the soap-removal system, are of utility regardless of which of these methods is used for producing the soap. However, other features of the invention are directed particularly to methods of soap production involving vaporization of all or a part of the water in the tube.

In the event that glycerine is to be recovered, it is necessary to heat the materials in the tube to such an extent that all of the water is converted into steam therein. All or a portion of the glycerine formed by the soap-making reaction may also be vaporized in the tube. As to any unvaporized glycerine, all or a portion thereof will flash into vapor upon discharge into the low-pressure zone. The water and glycerine vapors can be withdrawn from the low-pressure zone and fractionally condensed. In this instance, the resulting soap is in the form of small anhydrous particles if insufficient heat is applied to form molten soap.

On the other hand, high pressures can be maintained in the heated tube without provision of a restricted orifice by utilization of a relatively long tube of small cross-sectional area. The frictional forces developed by flow of the materials therethrough may be made sufficient to develop the desired pressures in the tube, and conditions of pressure and temperature may be such that considerable or all of the water and even the glycerine is vaporized in some portion of the coil. When utilizing frictional forces in this pressure-building capacity, it is sometimes desirable to discharge the reaction products from the tube into a low-pressure zone from which the soap and vapors may be separately withdrawn. The reaction products discharged into this zone under such circumstances will be soap particles together with all or a portion of the water in vapor form. If the water in these reaction products is entirely in vapor form, the soap particles will be anhydrous and the reaction products may include all or a portion of the glycerine in vapor form.

In either instance, the conditions of reduced pressure and temperature are such in the low-pressure zone that soap is deposited therein, whether or not it is anhydrous, and the conveyor system of the present invention will be described with reference to the removal of this soap and any vapors formed.

It is an object of the present invention to provide a novel conveyor means for withdrawing material from a low-pressure zone without destroying the partial vacuum therein, while con-

tinuously withdrawing and recovering glycerine from the low-pressure zone.

It is another object of the present invention to provide, in such a soap-making system as discussed above, a novel method for removing soap from the low-pressure zone.

It is a further object of the invention to provide a method of removing soap particles and of processing same, as by cooling, adding water or other material thereto during flow, etc., and it is also an object of the present invention to provide a novel apparatus adapted to thus remove and process the soap.

Another object of the invention is to continuously compress soap particles withdrawn from a chamber, the compressing step being either carried to such a degree as to form a solid homogeneous mass of plastic soap, or to form a solid mass of soap particles pressed together temporarily.

It is another object of the invention to provide a novel method and apparatus for subjecting the soap to a milling or plodding action.

Other novel features of the present invention relate to the soap-forming process and apparatus, it being an object of the present invention to suitably control the temperatures in the low-pressure zone, and, in one embodiment, to supply steam to this low-pressure zone to facilitate the removal of glycerine from the soap.

It is another object of the present invention to provide a novel method facilitating complete separation of the vapors from the soap in the low-pressure zone.

Still a further object of the invention is to provide a novel method for conserving heat in such a soap-making process.

Further objects and advantages of the invention will be evident to those skilled in the art from the following description of a typical installation.

It will be clear, however, that the embodiment to be hereinafter described in detail is selected only for illustrative purposes, and that various changes and modifications may be made without departing from the spirit of the invention.

Referring to the drawings, which are purely diagrammatic and which make no attempt to show the various elements in proportional size:

Fig. 1 illustrates a continuous soap-making system.

Figs. 2 and 3 are sectional views taken on corresponding lines of Fig. 1.

Fig. 4 illustrates a reciprocating soap-removing system.

In Fig. 1, the numeral 1 indicates a mixing apparatus, 2 is a heater, 3 is a vacuum kettle or container in which the soap is deposited, 4 is a first conveyor, 5 is a pressure seal, 6 is a second conveyor, 7 is an extruding means, 8 is a glycerine condenser, and 9 is a water condenser.

The function of the mixing apparatus 1 is to deliver to the heater 2 properly proportioned saponifying and saponifiable materials, preferably preliminarily mixed by action of the mixing apparatus to such a degree that the saponifying material is uniformly dispersed throughout the saponifiable material. The saponifiable material may be any material capable of being saponified to form soap, such, for instance, as fat. The saponifying material may be any material which will react with the saponifiable material to form soap, usually an aqueous solution of a saponifying alkali, such as caustic soda.

The mixing apparatus illustrated includes a pair of proportioning pumps respectively designated as an alkali pump 11 and a fat pump 12, the latter being driven by a suitable drive means 13. A speed-changing device 14 interconnects the pumps 11 and 12. The fat, or other saponifiable material, is taken from a fat tank 16 and pumped into a mixer 17. The caustic soda, or other saponifying material, is pumped from a tank 18 and delivered to the mixer 17. The streams of saponifying and saponifiable materials are preliminarily mixed in the mixer 17 and flow through a pipe 19 to a coil 21 of the heater 2.

The function of the heater 2 is to effect saponification of the materials under considerable heat and pressure, such temperatures preferably being utilized as will vaporize all or a portion of the water in the saponifying material. As illustrated, this heater includes an outer shell 23 surrounding a tube which is bent to form a coil 21, this coil being heated by any suitable means, such as a burner 24, supplying products of combustion which pass upward through the outer shell 23 exterior of the tubing forming the coil 21. The pumps 11 and 12 force the materials into the coil at a relatively high pressure, acting against the pressures developed in this coil. The inlet pressures on the coil may be several hundred pounds per square inch, if desired, though a pressure drop takes place in the coil so that the pressure near the discharge end of the coil may be, in some instances, from 150 to 200 pounds per square inch lower than the inlet pressure. The reaction products are delivered from the lower end of the coil 21 through a pipe 26, which may be provided with a thermometer 27 and a pressure gauge 28, these products being, in some instances, discharged into the low-pressure zone through a nozzle 29 providing a restricted orifice. In practice, I have found it desirable to employ heat insufficient to render the soap stock in the low-pressure zone molten, such, for example, as temperatures ranging from 500° F. down to, say, 450° F.

The primary function of the vacuum kettle or container 3 is to collect the soap preliminary to removal and to effect separation of the vapors. Structurally, this vacuum kettle or container provides a low-pressure zone 31 into which the reaction products are introduced. While a substantially unobstructed low-pressure zone can be utilized, I sometimes find it preferable to use an inner shell 32 positioned in this low-pressure zone to more effectively separate the soap and the vapors, though the process can be operated in some instances without such an inner shell. If used, best results are obtained if this inner shell is closed at its upper end and open at its lower end to form a hood, the diameter thereof being somewhat less than the container 3 to provide an annular space 33 through which the vapors move upward in a manner to be hereinafter described. With this construction, the reaction products are introduced into the space inside the inner shell 32, Fig. 1 illustrating the nozzle 29 discharging therein. However, as previously mentioned, it is not invariably necessary to utilize such a constricted orifice. Regardless of whether or not the nozzle 29 is utilized, it is possible by suitable manipulation to form minute solid soap particles which move downward in the low-pressure zone, collecting in the bottom of the inner shell 32 in the absence of a means for continuously removing same.

To insure delivery of this soap to the first con-

veyor 4, a suitable agitator means is provided including one or more agitator arms 35 suitably secured to a shaft 36 and moving in the zone directly beneath the lower end of the inner shell 32. A thrust bearing 37 journals the shaft 36 and is mounted on arms 38 extending inward from the inner shell 32, this inner shell being held in fixed position by spacers 38a. Suitable packing means is provided for sealing the junction of the shaft 36 and the container 3, though it is not necessary to tightly seal the junction of the shaft and the inner shell 32, a wiping joint being satisfactory. A motor 39, or other drive means, is utilized for slowly rotating the shaft 36 so that the agitator arms 35 continuously stir the soap particles in the lower end of the low-pressure zone 31. If desired, these arms may be inclined so as to pressurally force the soap downward toward the first conveyor 4.

The function of this first conveyor 4 is to move the soap particles from the low-pressure zone 31 under reduced pressure and by positive action. The preferred type of conveyor includes a screw 40 provided with helical vanes extending outwardly from a shaft 41, this screw 40 traversing the lower portion of the low-pressure zone. Preferably, though not necessarily, this screw extends horizontally so that the soap particles are drawn sidewise from the low-pressure zone 31. As shown, this screw is enclosed by aligned housings 42 and 43 providing a low-pressure passage in which the soap particles are advanced. The housing 42 may extend across the container 3, being open at its upper portion to receive the soap particles.

The soap being conveyed by the first conveyor 4 is in a highly heated condition, for example, 450° F. An important characteristic of my invention is to provide means for cooling the said soap down to a point where subsequent hydration can be effected. For that purpose, a pipe 44, suitably valved, may be communicated directly with the low-pressure passage for introducing a desirable cooling medium which may be discharged at a plurality of points around the housing 43, and structure 45 may surround this housing to provide an annular chamber communicating with the pipe 44, suitable openings being formed in this housing to deliver the cooling medium to the soap. The cooling medium is desirably water although, of course, other agents may be employed.

If desired, other materials, such as builders, etc., may be added to the soap being conveyed by the first conveyor 4 in any desirable manner.

If water or other liquid material is thus added, the temperature of the soap is so high that the same will be vaporized and, as shown, the vapors thus formed may be returned to the low-pressure zone 31 through a pipe 46. This pipe also returns to the low-pressure zone any glycerine vapors wihch may be liberated in the low-pressure passage.

I preferably also cool the soap passing through the first conveyor 4 by providing a jacket 47 around the housing 43. Any suitable medium can be circulated through this jacket to cool the soap but I find it sometimes desirable to pre-heat the saponifiable material by forcing the same through this jacket and then through a pipe 47a to the fat tank 16. This effects considerable saving of heat and also preliminarily heats the fat or other saponifiable material in degree proportional to the temperature of the resulting soap.

Irrespective of what means are employed for effecting the cooling step, I have found it desirable in practice to cool the soap down to, say, 200° F. to 250° F. in order that water subsequently introduced, in a manner hereinafter described, to the soap being conveyed by the second conveyor may effectively hydrate the same to the desired extent, depending upon the moisture content required in the final product.

Suitable means is provided for rotating the screw 40. As shown, this means includes a countershaft 48 driven by a suitable drive means, not shown, and suitably geared to the shaft 41 of the screw 40. The direction of rotation of the screw 40 is such that the soap particles are advanced to the right, as shown in the drawings, being discharged into a chamber 50. This chamber is at subatmospheric pressure, though the pressure therein may be somewhat higher than the pressure in the low-pressure zone 31.

The function of the pressure seal 5 is to convey the soap particles from the chamber 50 to a chamber 52 which may be of the same or somewhat higher pressure. The sealing action of this device is particularly important if the pressure in the chamber 52 is higher than the pressure in the chamber 50, in which instance the device functions to conduct the soap particles without too greatly impairing the vacuum in the chamber 50. This pressure seal may be in the form of a star valve diagrammatically shown as including a casing 55 communicating with the chamber 50. A rotor 56 is adapted to turn in the casing 55 and provides outward-extending blades arranged with such clearances as to maintain the partial vacuum in the chamber 50. This rotor is preferably driven by a suitable drive means, the embodiment shown utilizing a gear connection between the rotor and the countershaft 48. The soap discharged from this star valve drops through the chamber 52 and into the second conveyor 6.

The function of the second conveyor, if used, is to further transport the soap and, if desired, to compress and process by milling or plodding these particles. Depending upon the composition of the soap particles originally produced, the water or other material added, the degree of cooling, the degree of compression developed, and the degree of milling or plodding, it is possible to obtain either one or more continuous streams of plastic bar soap, or a compact mass of individual soap particles temporarily adhering but which can be readily broken up after being discharged from the second conveyor 6. Another function which may be performed by the second conveyor 6 is to provide a moving plug of soap which assists in preventing entry of air into the low-pressure chambers of the system, thus serving as a seal to prevent loss of vacuum therein. A further function of this conveyor may be to introduce liquid or powdered builder or other added material into the soap.

Structurally, the second conveyor 6 is shown as including a rotatable member 57 and a stationary member 58. The rotatable member 57 is shown as including a shaft 59 with helical vane means 60 extending therefrom. The stationary member 58 is shown as a housing 61 communicating with the chamber 52, this housing being surrounded by a jacket 62 controlling the temperature of the soap moving therethrough. If desired, the cooling of the second conveyor may be effected by spraying water directly upon the housing 61.

If it is desired to compress the soap, the annular space 63 between the coaxially arranged stationary and movable members may be tapered as shown so as to provide a larger cross-sectional area at that end into which soap is introduced, this cross-sectional area progressively decreasing toward the end communicating with the extruding means 7. One convenient way of forming such an annular tapered space is to utilize a tapered shaft 59 with the vane means 60 extending outward therefrom and substantially across the tapered annular space 63. It is further desirable to so form the vane means 60 that the pitch thereof is greater near the inlet end than near the discharge end. Such a structure permits considerable pressing of the soap during continuous advancement thereof in the tapered annular space 63.

It is often desirable to use auxiliary means for breaking up the continuous soap body being advanced by the second conveyor 6. With certain soaps, there is a tendency for the soap to wedge between the vane means in the tapered annular space 63, thus tending to prevent the proper feed and extrusion of the soap material. So also, it is often desirable to subject the advancing soap materials to a milling or plodding action. Prevention of wedging and accomplishment of this desirable milling or plodding action are effected by utilization of one or more means for breaking upon the continuous soap plug at one or more points disposed along the second conveyor 6. For instance, the vane means 60 may be formed in sections and a perforated plate means 64 interposed therebetween, the soap being forced through the perforations by the preceding section of the vane means, and being again picked up and advanced by the succeeding section of the vane means. Fig. 2 illustrates such a perforated plate means 64 as including two semi-circular plates suitably secured in the housing 61 as by screws 65.

Figs. 1 and 3 illustrate another form of such a means for breaking up the continuous soap stream and which may be used alternately or in conjunction with the perforated plate means disclosed in Fig. 2. In this form, a series of pins or knife bars 66 may be suitably secured in the housing 61, extending inward substantially across the tapered annular space 63. These pins or knife bars 66 are positioned between adjacent sections of the vane means 60. Being stationary, they break up the stream or plug of soap being advanced along the second conveyor 6. Such perforated plates or knife bars may be disposed at one or more points along the second conveyor 6, and may also be used in conjunction with the first conveyor 4, if desired. It will, furthermore, be apparent that it is not necessary to utilize both forms of these devices, as shown respectively in Figs. 2 and 3, in conjunction with each other, for either form may be separately used to secure the desired milling and plodding effect, as well as to break up the stream or plug of soap which might otherwise tend to wedge in the tapered annular space 63. In other instances, however, such devices can be dispensed with.

Following the cooling step effected in the first conveyor, as above-described, the temperature of the soap particles has been materially reduced by the time the soap has reached the second conveyor 6. The soap during its passage through the second conveyor may, therefore, be hydrated to the desired extent by introducing water through the pipe 67 suitably valved. This pipe may communicate directly with the soap moving in the tapered annular space 63 or may communicate with a structure 68 surrounding the housing 61 and providing a chamber 69, supplying the added material to the soap through a plurality of openings provided by the housing and disposed peripherally therearound. A very uniform mixture of soap and this added material is obtained in the second conveyor 6, regardless of whether the material is introduced at a single point or a plurality of points peripherally spaced.

Rotation of the rotatable member 57 may be effected by any suitable drive means, the embodiment illustrated including geared means interconnecting the tapered shaft 59 and the countershaft 48. Such an interconnected system is particularly advantageous in view of the fact that the first and second conveyors 4 and 6, as well as the rotor 56 of the star valve, are moved proportionately.

The function of the extruding means 7 is to exert back pressure on the soap mass and to extrude the soap either as a solid homogeneous mass in bar or filament form if the soap is of such character as to assume this form, or as a powder or compacted mass of particles temporarily adhering but which may subdivide upon extrusion, or be readily broken up after extrusion. If the soap is extruded in bar or filament form, such bars or filaments may be cut off as desired.

Structurally, this extruding means 7 may include a quick-opening valve means, such as a "Yarway" valve of the swing-gate type and, if desired, used in conjunction with a screen or perforated member forming the discharged soap into vermicelli-like filaments. The form illustrated in Fig. 1 may perform both the function of a valve and a subdividing means for the soap. As shown therein, the extruding device includes a cap 72 suitably secured to the housing 61 and defining a chamber 71. This cap provides one or more orifices 73 which communicate between the chamber 71 and a quick-opening valve plate 75. This plate may be journalled on a pin 77 retained in the cap 72, and a handle 78 may be provided for turning this valve plate to bring openings 79 thereof into or out of communication with the orifices 73. The size of the openings 79 will determine the size of the soap stream extruded therethrough. However, in some instances, it is possible to dispense with the valve plate 75, or to substitute for the extruding means 7 any suitable valve structure, either with or without a perforated means such as provided by the openings 79 to discharge a plurality of soap streams rather than a single soap stream. So also, a valve of the spring-type, such as disclosed in Fig. 4, may be substituted for the extruding means 7 without departing from the spirit of this invention.

If desired, the cap 72 may be utilized for journalling the shaft 59 of the rotatable member 57, though this is not necessary. The housing 61 serves to journal this rotatable member throughout its length. So also, the soap being compressed acts as a bearing means for the rotatable member.

In the soap-making process herein disclosed, it is often desirable to be able to regulate the temperature inside the container 3. Temperature conditions therein may be controlled by utilizing a jacket 81 surrounding all or a portion of this container, a suitable medium being circulated therethrough for regulating temperature conditions. As shown, this jacket surrounds only the lower portion of the container 3, but it will be

clear that it may be extended upward to surround substantially the entire surface thereof, if desired.

In addition, it is often desirable to introduce steam into the low-pressure zone inside the container 3. This steam serves to further control temperature conditions therein. Thus, by using high-temperature or superheated steam, it is possible to increase the temperature of the reaction products to cause liberation of additional vapors from the soap. For instance, if the glycerine has not been completely removed from the soap, additional heat can be supplied to the soap by the introduction of steam or by utilization of the jacket 81 to maintain the soap under sufficient temperature to liberate additional quantities of the glycerine. So also, the application of additional heat to the low-pressure zone prevents condensation of glycerine vapors which may have previously separated, thus preventing the condensed glycerine from returning to the soap. In addition, the steam introduced into the low-pressure zone helps to carry away the glycerine already volatilized. It also makes possible the operation of the soap-forming system at lower temperatures than would otherwise be necessary. By way of example, lower temperatures can be utilized in the reaction zone defined by the coil of the heater 2 to secure very desirable results, additional heat being supplied to the low-pressure zone through the jacket 81 or through steam introduction. In addition, the steam plays a very important part in assisting in the distillation of the glycerine by the principle of partial vapor pressures in the low-pressure zone. Thus, if steam is introduced thereinto, it is not necessary to carry as high a vacuum in the low-pressure zone as would otherwise be necessary to secure the results desired.

Fig. 1 discloses several ways of introducing steam into the low-pressure zone. One very effective way is to introduce steam through a pipe 82, the flow being controlled by a valve 83. In this instance, the steam is discharged through a nozzle 84 so directed as to impinge the steam against the reaction products discharged from the nozzle 29. In some instances, it is preferable to introduce the steam at a plurality of points in the low-pressure zone. If such a mode of injection is desired, a valve 85 may be opened, allowing the steam to move through a pipe 86 into a chamber 87 defined by the shaft 36, the steam being discharged through a plurality of orifices 88 into or adjacent the reaction products discharged into the low-pressure zone. In other instances, it is advantageous to introduce the steam through a passage 89 surrounding a portion of the pipe 26, this passage being defined between the pipe 26 and a pipe 90. A valve 91 controls the flow of steam, and it will be apparent that an annular jet of the steam is discharged around the nozzle 29. This system is particularly advantageous in uniformly distributing the steam in the reaction products discharged from the nozzle 29. It also is advantageous in that the steam heats the reaction products flowing through the pipe 26 before discharge from the nozzle 29, the steam thus heating the reaction products both before and after discharge from this nozzle. Any one of these steam-introduction systems may be used individually, or a plurality thereof may be simultaneously utilized.

The vapors which separate from the soap inside the inner shell 32 move downward with the soap, flowing beneath the lower edge of this inner shell 32 and rising in the annular space 33. I prefer to provide a helical baffle 93 in the annular space 33 so that the vapors rising in this space are guided through a helical path. In addition, a conical baffle 94 may be utilized above the inner shell 32 to further deflect the rising vapors through paths as indicated by the arrows in Fig. 1.

The vapors leave the upper end of the container 3 through a pipe 95, being conveyed to a catch-all 96 of any suitable design. Any additional solids carried upward by the vapors are separated in the catch-all, the vapors passing through a pipe 97 to the glycerine condenser 8.

The function of the glycerine condenser 8 is to partially cool the vapors, usually to such an extent that only the glycerine vapor is condensed. The embodiment shown includes a tight shell 98 provided with intermediate heads 99 between which tubes 100 extend to conduct the vapors upward therethrough. The space between the heads 99 inside the shell 98 and around the tubes 100 is filled with a circulating cooling medium in the usual manner. Any condensate produced in the glycerine condenser 8 passes downward through a pipe 101 to a glycerine tank 102. This pipe is sufficiently long to permit maintenance of a high degree of vacuum in the glycerine condenser 8, the lower end of this pipe being submerged in the glycerine in the tank 102.

Any gases or vapors which are not condensed in the glycerine condenser 8 move through a pipe 103 to the water condenser 9, which may be of the jet type supplied with cooling water through a pipe 104. The water condensed therein, and the cooling water supplied thereto, move downward in a pipe 105 to a water tank 106. The pipe 105 is sufficiently long to permit maintenance of a high degree of vacuum in the water condenser 9, and the lower end of this pipe is submerged in the water in the tank 106. A suitable vacuum pump 110 is provided for maintaining the container 3 and the condensers 8 and 9 under subatmospheric pressures. Usually, it is desirable to maintain a relatively high vacuum in these portions of the apparatus, especially if glycerine is to be recovered.

The method of operation of this form of the invention is as follows:

The mixing apparatus is so adjusted as to continuously deliver determined quantities of saponifying and saponifiable materials to the heater 2. The proportion of saponifying material supplied to the mixer 17 need be only slightly in excess of the amount theoretically necessary to completely saponify the saponifiable material.

The coil 21 forms a reaction zone in which the preliminarily mixed materials react to form soap and glycerine. Depending upon temperature and pressure conditions in the coil, water or glycerine vapors may be formed therein. In fact, if the system is to be operated in a manner to recover glycerine, it is necessary, in the absence of a large amount of heat supplied to the low-pressure zone, to vaporize all of the water in the coil and usually at least a part of the glycerine. If the restricted orifice formed by the nozzle 29 is used, a portion or all of the unvaporized glycerine may be allowed to flash into vapor upon discharge into the low-pressure zone. So also, heat applied to the low-pressure zone, either externally from the jacket 81 or internally by introduction of steam into this zone, will cause formation or liberation of additional vapors.

It will be clear, however, that it is not necessary

to remove any or all of the glycerine from the soap in the event it is desired to produce a soap containing glycerine. If the glycerine is to be allowed to remain therein, the system can be operated at lower temperatures. Thus, it is possible to produce substantially anhydrous soap by vaporizing only the water, the system being so regulated that the water goes into the vapor phase either in the coil or in the low-pressure zone, or in both. If the soap is not to be substantially anhydrous, it is possible to vaporize only a part of the water in the coil or in the low-pressure zone, or in both.

As an example of forming anhydrous soap and liberating glycerine vapors without the aid of steam, the system may be operated under the following conditions, though it will be clear that this example is set forth only as illustrative of one possible set of conditions and not as limiting the invention thereto. The system may be operated with the pressure gauge **28** indicating a pressure of approximately 100 pounds per square inch (gauge), the temperature indicated by the thermometer being around 440° F. The pressure at the inlet end of the coil will be considerably higher due to the friction drop in the coil. This drop may be 100 pounds per square inch, or more in some installations. It will be understood that considerably less heat need be supplied through the walls of the tube forming the coil if the low-pressure zone is externally or internally heated, the heat supplied at this point permitting formation of water or glycerine vapors, or both, as desired. So also, addition of steam to the low-pressure zone acts, by the law of partial pressures, to permit somewhat higher pressures in this zone during glycerine-recovery operation.

If a restricted orifice, such as provided by the nozzle **29**, is utilized, the reaction products are discharged into the low-pressure zone with considerable velocity. However, this velocity drops very rapidly, and, as the velocity is reduced, the vapors readily separate from the soap particles. I find it very advantageous to utilize the inner shell **32** to insure that the vapors will travel in the same direction as the soap until they reach the lower portion of this inner shell. This facilitates the separation of the fine soap dust, preventing the vapors from carrying this finer material upward therewith, though it will be clear that this inner shell **32** may be dispensed with in some instances. It will further be clear that, when such an inner shell **32** is utilized, the pressure inside thereof may be slightly higher than the pressure in the annular space **33**. This is unobjectionable and, in some instances, is advantageous.

After passing beneath the lower edge of this inner shell **32**, the upward movement of the vapors is retarded by the helical vane means **93** which moves these vapors in a helical path, thus tending to further separate any extremely small soap particles. The catch-all **96** removes any remaining soap particles and the vapors are fractionally condensed in the condensers **8** and **9**, as previously described. It will be clear that these vapors may include only water vapor, or may include water vapor and glycerine vapor, depending upon the mode of operation of the system. If only water vapor is present, it is, of course, unnecessary to utilize two condensers.

The soap particles are continuously stirred by the agitator so that they drop into the low-pressure passage of the first conveyor **4**. It is often desirable to somewhat cool the soap particles therein, this being readily accomplished by flowing the saponifiable material or other cooling material through the jacket **47** and even by the addition of materials through the pipe **44**. This cooling is often desirable to prevent darkening or discoloring of the soap particles which tends to take place if anhydrous particles are maintained at high temperature for a prolonged time and exposed to air. Further, it is desirable to cool the soap particles before introducing additional moisture or other material thereinto through the pipe **67** in order that adequate hydration can be secured. It is not desirable, however, to cool the soap to such an extent that no vaporization whatsoever of the water takes place when it is introduced into the second conveyor through the pipe **67**. Thus, it is desirable to maintain the soap sufficiently hot so that the water which it may be desired to introduce through the pipe **67** will in part vaporize to cause an even distribution of the water, thus insuring uniform hydration of the soap. The relationship of the cooling step to the hydration step can be varied in order that a predetermined moisture content of the final product is obtainable. This cooling step also involves considerable saving in heat, the heat transfer between the saponifiable material and the soap being very effective to preliminarily heat this material in proportion to the temperature of the soap produced.

Any excess steam formed by introducing water or other liquid through the pipe **44** will rise through the pipe **46** to the low-pressure zone **31**. It will be clear, however, that the invention is not limited to the cooling of the soap at this point.

When the soap particles reach the discharge end of the first conveyor **4**, they drop into the chamber **50** and enter the spaces between the blades of the rotor **56** of the star valve. A sufficient number of blades is provided so that an effective seal is maintained at all times regardless of the position of the rotor. It will be clear, however, that the chamber **50** will be under subatmospheric pressure, though the pressure therein may be somewhat higher than the pressure in the low-pressure zone **31** due both to the pumping action of the screw **40** and the material introduced into the soap through the pipe **44**.

The particles of soap drop from the star valve into the chamber **52** and thence into the second conveyor **6**. The system may be so operated that a material pressure differential exists between the chambers **50** and **52**, or it may be operated in such way that these chambers are at substantially the same subatmospheric pressure.

The second conveyor **6** may serve to transport the soap without compression, though it is usually desirable to utilize a system which compresses or compacts the soap during passage therethrough. Depending upon the degree of compression, the degree of cooling, and the materials added, the soap may be extruded from the extruding means **7** either as a compact mass or stream of plastic soap or as a compressed, compacted mass of temporarily adhering soap particles which either separate upon extrusion or which can be readily broken up. The term "compressed mass" of soap is herein-utilized to cover all such forms. In any instance, the resulting soap product can be used as produced, or may be run through a series of plodders or through milling rolls, being pressed and stamped into finished cakes of soap.

If used, the means for breaking up the soap

stream, such as illustrated in Figs. 2 and 3, serve the very desirable function of subjecting the soap to a milling or plodding action during movement by the conveyor means. They also tend to prevent clogging of the conveyor system through wedging of the soap mass in the tapered annular space 63. It will be clear that, while I have disclosed such means only in conjunction with the second conveyor 6, similar means may be applied to the first conveyor 4, if desired.

One of the important functions which may be performed by the second conveyor 6 is to provide a seal or plug of soap to prevent air leaking back through the second conveyor 6 to the star valve. The tapered annular space 63, as well as the constricted opening or openings of the extruding device, assist in building up a back pressure which so compacts the soap as to form such an effective seal or plug. It will be understood, however, that this sealing action is supplementary to the sealing action of the star valve, and that, in some instances, it is possible to utilize the star valve with or without the second conveyor 6 for preventing entry of air into the chamber 50 and the low-pressure zone 31 in such quantity as to impair the partial vacuum which it is desired to maintain therein.

If desired, the successive cooling and hydration steps, respectively, may be performed during the passage of the soap particles in the first conveyor. Powdered or liquid builders may be introduced in any desired manner. As stated, the soap may be additionally cooled through the conveyor 6 by circulating a cooling medium through the jacket 62.

It will further be apparent that pressure on the soap progressively rises, either in infinitesimal steps along the conveying system or in finite steps, such, for instance, as when a material pressure differential exists on opposite sides of the star valve.

The degree of vacuum maintained in the low-pressure zone 31 and the amount of heat supplied to the heater 2 will depend upon the product to be produced, and will depend upon whether or not the glycerine is to be recovered by condensation or is to be allowed to remain in the soap. Regardless of the moisture or glycerine content of the soap, however, the conveying system permits continuous removal of the soap particles from the low-pressure zone 31 without breaking the vacuum. This is true even through sufficient heat is supplied to the container 3 through the jacket 81, or through steam introduction, to maintain the soap in the low-pressure zone 31 in liquid or semi-liquid condition. While it is not always essential to circulate a heating medium through this jacket 81 or to add steam to the low-pressure zone, these expedients serve to regulate the temperature in the container 3 and are useful both in preliminarily heating the container when the apparatus is first put into operation and in supplying additional heat to the low-pressure zone during continuous operation to assist in liberating glycerine from the soap in the bottom of the low-pressure zone 31.

One of the features of this invention is that the soap particles are moved sidewise from the low-pressure zone, though vertical or inclined removal can, in some instances, be utilized. While it is usually preferable to operate the conveyor system hereinbefore described continuously, this system can be intermittently operated to intermittently remove the soap particles from the low-pressure zone.

An alternative system of removing the soap sidewise from the low-pressure zone and an alternative construction of the vacuum kettle or container 3 are illustrated in Fig. 4. Here the reaction products flow through a pipe 120 from the heating coil and are discharged through a suitable orifice means shown as including an annular ring 121 provided with downward-extending perforations.

The vapors move upward through a tortuous path determined by baffles 122, 123, and 124, being discharged through pipe 95 previously described. The baffle 122 is suitably supported in spaced relationship with the container 3 and may serve as a journal for the shaft 36. The baffle 123 extends inward and downward but terminates short of the shaft 36 to provide an annular space in which the vapors may move upward. The baffle 124 is of conical form and may be stationary or movable, the latter embodiment being illustrated. Movement through this tortuous path tends to separate the smaller soap particles from the vapors. In addition, the baffles provide a means for retarding the upward flow of the vapors.

The soap particles drop to the lower end of the container 3 and are stirred by an agitator shown as including upper and lower agitator arms 125 and 126. An agitator arm 127 preferably turns directly above the conical bottom of the container 3 and insures movement of the soap into a throat 128 of the container.

Reciprocating means is provided for withdrawing the soap particles without breaking the vacuum in the low-pressure zone 31. This system provides a cylinder 130 in which a piston 131 is reciprocated by any suitable means, such as a piston rod 135 attached to a cross-head 136. A pin 137 carried on a rotatable disc 138 fits into the cross-head 136 to effect reciprocation thereof. However, a suitable crank means or other reciprocating mechanism may be substituted.

As the piston 131 moves to the left in the cylinder 130, a partial vacuum is created in the right-hand end thereof so that, when the piston uncovers the throat 128, the soap particles may drop into this cylinder. As the piston 131 moves to the right and covers the throat 128, the pressure in the right-hand end of the cylinder 130 progressively increases. If sufficient soap has been introduced into the cylinder 130, this soap will be compressed by this rightward movement of the piston 131. When the pressure becomes sufficiently great to overcome the action of a spring 140 normally closing a valve means 141, this valve means opens and allows the soap to be extruded. As disclosed, this valve means may include a conical seat 142 adapted to receive a conical plug 143 normally seated by action of the spring 140 and by any pressure differential during the time the pressure inside the right-hand end of the cylinder 130 is below atmospheric.

Similarly, when the piston 131 is moved to the right from its position shown, a partial vaccum will be created in the left-hand end of the cylinder 130 so that, when the piston uncovers the throat 128, soap particles will drop into this cylinder. Subsequently leftward movement of this piston will cover the throat 128 and increase the pressure in the left-hand end of the cylinder 130 until such time as the soap is extruded from a valve 151, similar to the valve 141 previously described. Both valves tightly seat when the pressure within the cylinder 130 decreases, thus permitting the development of subatmospheric

pressures in the cylinder 130 so that the flow of soap thereinto is not impeded. If desired, the degree of vacuum developed in the cylinder 130 may be higher than that present in the low-pressure zone 31, in which event the soap particles will be forcibly drawn into the cylinder 130 as the throat 128 is uncovered.

If desired, the solid soap particles alternately discharged through the valves 141 and 151 may be conducted to a conveyor system, such as shown in Fig. 1, for cooling and hydration to secure a soap of desired moisture content. Use of only one of the conveyors is ordinarily sufficient, though the complete conveyor system can be utilized if desired.

Various changes and modifications may be made without departing from the spirit of the invention hereinbefore described with reference to two illustrative embodiments.

This application is a division of my application Serial No. 42,348, filed September 26, 1935.

I claim as my invention:

1. A process of removing volatile material from a product including both volatile and non-volatile materials, which process includes the steps of: introducing a stream of said product into a vapor-separating chamber while at a temperature above the boiling point of said volatile material at the pressure existing in said vapor-separating chamber and while reducing the pressure thereon whereby vapors of said volatile material separate from the non-volatile material in this chamber; continuously removing the separated vapors from said vapor-separating chamber in such manner as to maintain a partial vacuum therein while collecting said non-volatile material in said chamber in comminuted condition; and removing the comminuted non-volatile material from said chamber in such manner as not to impair said partial vacuum and without interruption to the concurrent removal of vapors from said vapor-separating chamber.

2. A process of removing volatile material from a product including both volatile and non-volatile materials, which process includes the steps of: introducing a stream of said product into a vapor-separating chamber while at a temperature above the boiling point of said volatile material at the pressure existing in said vapor-separating chamber whereby vapors of said volatile material separate from the non-volatile material in this chamber; continuously removing the separated vapors from said vapor-separating chamber while collecting said non-volatile material in said chamber in comminuted condition; delivering the comminuted non-volatile material from said chamber to a passage; advancing said comminuted material along said passage; extruding said comminuted material from said passage through one or more orifices; and cooling said comminuted material during advancement along said passage.

3. A process for continuously producing soap from a saponifiable material by reaction therewith of a saponifying material, which comprises: continuously mixing streams of the saponifiable material and the saponifying material; continuously advancing a stream of the resulting reaction products containing soap and volatile material through a conduit to a vapor-separating chamber while at a temperature which is above the boiling point of the volatile material measured at the pressure existing in said vapor-separating chamber; introducing said stream of the resulting reaction products into said vapor-separating chamber which is maintained at a reduced pressure lower than the pressure existing in said conduit to permit the volatile material to separate from the soap in said vapor-separating chamber and leave a soap in comminuted condition; continuously removing the separated vapors from said vapor-separating chamber at such rate as to maintain said reduced pressure; and continuously removing the comminuted soap from said vapor-separating chamber without interruption to the concurrent removal of the vapors from said vapor-separating chamber.

4. A process for producing soap and removing volatile material therefrom, which process includes the steps of: saponifying proportioned quantities of a saponifiable material and a saponifying material to produce reaction products including soap and volatile material; introducing a stream of the reaction products into a vapor-separating chamber while at a temperature above the boiling point of said volatile material at the pressure existing in said vapor-separating chamber whereby vapors separate from the soap in said chamber; maintaining such thermodynamic conditions in the zone of saponification and in the vapor-separating chamber as to produce a comminuted soap which tends to continuously collect in said chamber; continuously withdrawing the separated vapors from said vapor-separating chamber; and substantially continuously withdrawing the comminuted soap from said vapor-separating chamber while sealing said vapor-separating chamber against the entrance of air at the point of withdrawal of the soap and without interruption to the concurrent removal of the vapors from said vapor-separating chamber.

5. A process for producing soap and removing volatile material therefrom, which process includes the steps of: saponifying proportioned quantities of a saponifiable material and a saponifying material to produce reaction products including soap and volatile material; introducing a stream of the reaction products into a vapor-separating chamber while at a temperature above the boiling point of said volatile material at the pressure existing in said vapor-separating chamber whereby vapors separate from the soap in said chamber, said soap collecting in said vapor-separating chamber in comminuted condition; continuously removing vapor from said vapor-separating chamber; removing soap from said vapor-separating chamber without interruption to the concurrent removal of the vapors therefrom; adding moisture to the soap thus withdrawn from said vapor-separating chamber; and compressing the comminuted soap after said moisture has been added thereto to form a compressed soap mass.

6. A process as defined in claim 5, including the steps of subjecting said compressed soap mass to a milling action and thereafter extruding the soap mass.

7. A process for producing soap and removing volatile material therefrom, which process includes the steps of: saponifying proportioned quantities of a saponifiable material and a saponifying material to produce reaction products including soap and volatile material; introducing a stream of the reaction products into a vapor-separating chamber while at a temperature above the boiling point of said volatile material at the pressure existing in said vapor-separating chamber whereby vapors separate from the soap in said chamber; maintaining such thermodynamic conditions in the zone of saponification and in

the vapor-separating chamber as to produce a comminuted soap which tends to continuously collect in said chamber; continuously withdrawing the separated vapors from the vapor-separating chamber in such manner as to produce a partial vacuum therein; and removing the comminuted soap from said vapor-separating chamber without impairing the partial vacuum therein and without interruption to the concurrent removal of the vapors from said vapor-separating chamber.

8. A process as defined in claim 7 in which the withdrawal of said soap from said vapor-separating chamber is effected by moving this soap into a low-pressure passage, forcibly advancing the soap along this low-pressure passage, and compressing the soap during its forward advancement to form a compressed soap mass which prevents entrance of air into said low-pressure passage.

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