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METHOD FOR TREATING FATTY MATERIALS

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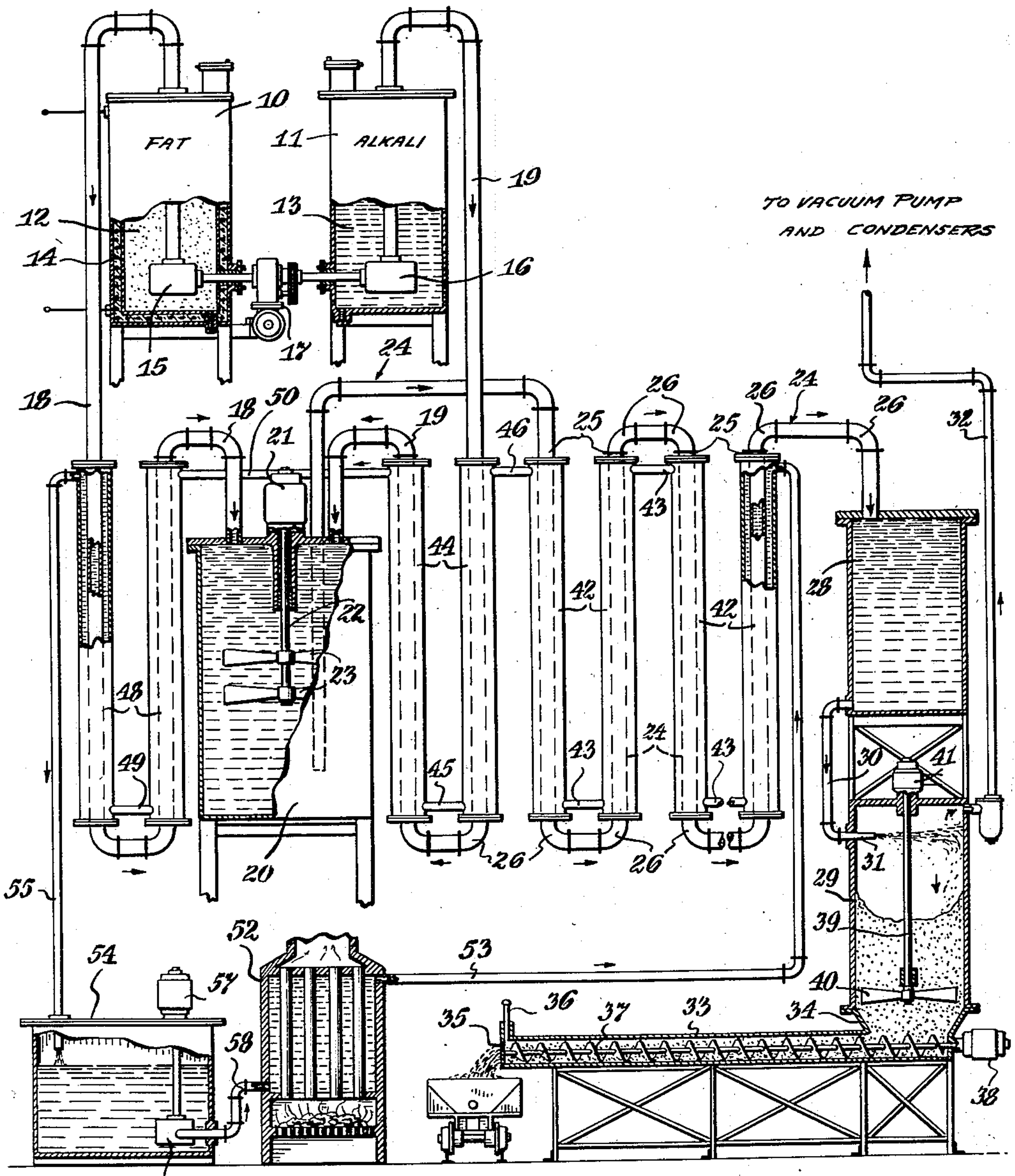

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METHOD FOR TREATING FATTY MATERIAL

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This invention relates to a novel apparatus and process for treating fatty materials and in one of its aspects is directed to a novel apparatus and process for saponifying fatty substances. In its more specific phase the invention is particularly concerned with a novel process and apparatus for continuously saponifying fatty materials under high pressure and at high temperature conditions.

Continuous processes for the manufacture of soaps have heretofore been proposed. They generally have consisted of mixing a fatty material and alkali at an elevated temperature, thereafter this mix, which has been partially converted into soap is pumped through direct-fire heated reaction coils of relatively great length. From these coils the saponified material together with the reaction by-products are released through a nozzle into a vaporizing chamber where the saponified material falls to the bottom of the chamber and the glycerine, water and any other by-products present are flashed off. These processes have a number of disadvantages, some of which are as follows:

(a) The yield of glycerine is very poor, especially when compared with the maximum potential yield. This is in all probabilities due to the decomposition or oxidation of the glycerine caused by localized overheating of the saponified mass.

(b) The efficiency is low because the coefficient of heat transfer from the hot direct-fire burner gases to the zone of reaction is low and consequently it is necessary to maintain these gases at relatively high temperatures thereby causing local overheating and requiring high fuel consumption.

This local overheating not only decreases the glycerine yield but also causes burnouts of the reacting pipes, necessitating periodic shut-downs of the system with the consequent loss of time and cost in repairing and/or replacing of the burned-out parts.

(c) The operational hazards are high, the reactions conduits are long and correct proportioning of reacting materials is difficult. These are due chiefly to the poor heat transfer characteristics of direct-fire apparatus necessitating the use of long reaction conduits; extremely high pressures are required to force the mass through the conduit, and the conduit because of its length makes it practically impossible properly to use free fatty acids which develop extremely viscous soap masses incapable of being forced through long conduits.

One of the objects of this invention is to provide a novel apparatus and process for the continuous saponification of fatty substances and by which a high yield of glycerine is obtained.

Another object of the invention is to operate the reaction conduits in the continuous manfuacture of soap at substantially lower and more uniform temperatures, thus increasing the life of the conduits and minimizing shut-downs as well as replacement and repairing of parts.

Another object of the invention is to shorten materially the reaction conduit in the continuous production of soap.

Another object of the invention is to provide a continuous saponification apparatus in which free fatty acids, as well as fats, may be satisfactorily treated.

These as well as other objects and advantages are secured by following the teachings of the present invention which includes the hereinafter specifically described process of drawing from separate sources of supply predetermined quantities of fatty material and saponifying agent by means of a pumping system which may be accurately controlled to vary the ratio, when desired, of these materials drawn from these sources of supply. These materials are forced out of the pumping system and on the discharged side thereof they are intermingled and passed through a reaction conduit heated by a flowing liquid stream of a hot heat transfer medium which is pumped or in some other manner positively moved over said conduit. Under these conditions the coefficient of heat transfer from the heat transfer medium to the conduit is of a very high order, and therefore the heat transfer medium may be maintained at a temperature only slightly higher than the maximum temperature to be attained by the mass which is to be saponified. This results in a greatly enhanced yield of glycerine, because local overheating, with the consequent decomposition or oxidation of glycerine, is avoided. The heat transfer medium is preferably one which is non-metallic, and will not carbonize or appreciably decompose when used for this purpose. Although diphenyl oxide may be employed, I prefer to use the salt mixture known as "HTS" and comprising a mixture of the following salts in the proportions indicated: $NaNO_2$—40%, $NaNO_3$—7%, KNO_3—53%. Moreover, the mass to be saponified may be elevated to a sufficiently high temperature in a relatively short length of conduit and the pressure required to force this mass therethrough is greatly reduced.

By following this method the mass to be saponified is raised to the requisite elevated temperature even before saponification is completed so that the reaction may proceed satisfactorily and so that the mass may be maintained in such a condition of fluidity that it may readily be forced through the conduits. In order to assure complete saponification, this mass, after it leaves the heated conduits, may enter a holding chamber where the reaction goes to completion. Thereafter the completely saponified mass may be discharged from the holding chamber into a vacuum chamber to flash off the volatile constituents, and the resultant substantially anhydrous soap separated therefrom is discharged from this chamber.

In practicing this invention, the starting materials which may be used include any suitable fatty material and a saponifying agent. The fatty materials which may be employed, include any suitable oils, fats or waxes or combinations of the same which have heretofore been employed as soap stock, these substances being well known and need not be specifically enumerated herein. There also may be employed, instead of the oils, fats and waxes, any of the higher fatty acids or mixtures of such acids, the metallic derivatives of which are soap. The saponifying agents include the caustic alkalies such as NaOH, KOH and the like. If soaps other than alkali-metal soaps are desired, the oxides or hydroxides of the desired metals may be used as saponifying agents.

Instead of saponifying fatty materials, this invention may be employed for other purposes, examples of which are fat splitting and the production of degraded glycerides employing fats and glycerine.

The invention comprises the several steps and relation of one or more steps with respect to each of the others, and the apparatus embodying the features of construction, combination of elements and arrangement of parts which are adapted to effect such steps. All are exemplified in the following detailed disclosure, and the scope of the invention will be indicated in the claims.

Referring to the drawing, the single figure is a view in side elevation partly in cross section and partly diagrammatically of an apparatus embodying the invention.

According to the invention, there are provided a plurality of tanks 10 and 11 respectively containing fatty material 12 to be saponified and an aqueous solution 13 of an alkali such as NaOH. The solution 13 may be of any desired concentration. The tank 10 containing the fatty material 12 therein may have coupled therewith a heating device for rendering and maintaining said fatty material molten in the event the fatty material is solid or semi-solid at room temperature. For this purpose there is provided a resistor 14 adapted to be energized by a suitable source of E. M. F. The molten fatty material 12 and the aqueous alkali solution 13 are drawn out of the respective tanks 10 and 11 in appropriately proportioned quantities by pumps 15 and 16. The pumps 15 and 16 may be interconnected by a variable speed drive 17 to vary and control positively the ratio of output from these pumps. Any type of proportioning pumps which are adapted to have the ratio of pumped material varied and to maintain a positive output control may be used.

Connected to the discharge sides of the pumps 15 and 16 are the respective conduits 18 and 19. The conduits 18 and 19 are of appropriate length, their discharge ends terminate in openings at the top of a mixing chamber 20 and conduct the fatty material 12 and the aqueous alkali 13 to the mixing chamber in the course of the preheating of these components as they pass therethrough. Mounted on the top of said mixing chamber 20 is an electric motor 21 having a drive shaft 22 extending into said chamber 20. The shaft 22 has a plurality of vertically spaced mixing blades 23 keyed to the shaft 22.

A conduit 24 of appropriate length has one end thereof connected to mixing chamber 20 at an outlet opening therein near the bottom thereof, and its other end is connected to the top of a retention chamber 28 at an inlet opening therein at the top thereof. The conduit 24 may consist of a plurality of straight pipe lengths or sections 25 arranged vertically or horizontally and connected to each other by elbows 26.

Located below the retention chamber 28 is a vacuum tank 29. A conduit 30 has one end thereof connected to chamber 28 at the discharge opening in the side thereof and near the bottom of said chamber. The other end of conduit 28 extends through the inlet opening in the side of tank 29 and near the top thereof, and terminates in a nozzle 31 having a restricted opening through which the material emanating therefrom is at super-atmospheric pressure and is atomized or broken up into a number of streams of small particles.

This material is projected against a side of the vacuum tank 29 at such velocity that in the case of soap, the glycerine, water vapor and other by-products become separated from the soap particles which drop to the bottom of the vacuum tank 29 and the by-products, in the vapor phase, pass out of the tank 29 and into the conduct 32 where they are recovered. The tank 29 has an open lower end communicating with a horizontally disposed hollow conveyor and cooling tube 33, terminating at one end in a hopper 34 located directly under the bottom of tank 29 and demountably secured thereto and terminating at its other end in a screen discharge orifice 35 which may be closed by a slide gate 36. A conveyor screw 37 is located in a conveyor tube 33 and is driven by an electric motor 38. A drive shaft 39 extends through the top of tank 29, has keyed thereon one or more paddle blades 40, and is driven by motor 41 supported on top of tank 29.

Jackets 42 surround the sections 25 of conduits 24 and are connected to each other by short pipes 43. Jackets 44 surround sections of conduit 19, are connected to each other by short pipe 45 and to the end jacket 42 closest thereto by pipe 46. Jackets 48 surround sections of conduit 18 and are connected to each other by short pipe 49. The jackets 44 and 48 are connected to each other by short pipe 50. A heater 52 has a pipe 53 extending out of the side thereof near its top. The heater 52 may be direct fired as shown for heating the contents therein. This pipe 53 communicates with said heater 52 and the end jacket 42. A receiving chamber 54 has an opening in the top thereof through which extends a discharge pipe 55 connected to the end jacket 48.

A pump 56 is located in chamber 54 and is driven by motor 57 mounted on the top of chamber 54. A discharge pipe 58 is connected to the discharge side of pump 56, extends through the side of chamber 54 and terminates in the side of heater 52 and near the bottom thereof. The conduits 18, 19 and 24 as well as the respective jackets therefor may all be arranged one above the other horizontally rather than vertically as shown. One of the significant aspects of this invention is the heating medium employed.

According to this invention, the heating medium preferred is one which is sufficiently fluid at about 500° F. that it may be pumped, will not decompose at temperatures below about 1000° F., is non-metallic and will not appreciably corrode the conduits at these elevated temperatures. Among others, diphenyl oxide may be used, but I prefer to employ what is generally known as "HTS" which is a mixture of salts consisting of approximately 40% $NaNO_2$, 7% $NaNO_3$ and 53% KNO_3. "HTS" melts at about 290° F. and will not appreciably decompose below 1000° F.

The "HTS" which is normally solid is rendered molten in the heater **52** which may be direct-fired by coal, fuel oil, gas or any other appropriate heating means. It is preferable that it be heated by a fluid heating medium through one or more burners whose operation may be controlled automatically by an automatic thermostatic device, not shown, so that the temperature of the "HTS" as it leaves the heater **52** will always be within the desired limits, which in the example hereinafter specifically described will be between 650° and 700° F.

In the embodiment of the invention, specifically described as an illustrative example, the conduits, jackets, mixers and chambers may be composed of steel, thus eliminating the necessity of using alloy metals. The conduit **24** may be less than two hundred feet long and this dimension may be as low as one hundred and fifty feet. The conduits **18** and **19** may be less than fifty feet each in length and the portions thereof located within the jackets **44** and **48** may be about thirty feet each in length. These conduits **18**, **19** and **24** may have an inside diameter of one-half inch and the inside diameter of the jackets may be two inches.

In operation a quantity of fatty material **12**, in liquid, semi-solid or solid state is placed in the tank **10** and an aqueous alkali solution **13** is placed in tank **11**. For the purposes of illustration, the fatty material **12** may be cocoanut oil and the alkali solution **13** may be a 50% aqueous solution of caustic soda. The pumps **15** and **16** may be set to deliver continuously five and one-half pounds of the soda solution **13** and fourteen pounds of the cocoanut oil **12** per minute. The cocoanut oil flows through the preheated conduit **18** and the soda solution flows through the preheated conduit **19** wherein their temperatures are elevated to between about 400° and 500° F.

From these conduits **18** and **19** the cocoanut oil and the soda solution which are now elevated to between about 400° and 500° F. flow into the mixing chamber **20** where intermingling and reaction between the cocoanut oil and soda solution first takes place. These substances **12** and **13**, now at elevated temperature, are continuously agitated and mixed while in and passing through the mixing chamber in order to intimately and uniformly distribute the soda solution throughout the cocoanut oil.

The agitation and mixing of these components is accomplished by the mixing blades **23** which are continuously rotated by the drive motor **21**. From the mixing chamber, the mix of cocoanut oil, soda solution and all products of reaction thus far produced flow through the heated conduit **24** where the temperature of the mix is elevated to its maximum of between about 525° to 550° F. and reaction between the components progresses and the mix therein flows into the retention and final reaction chamber **28** where the reaction goes to completion in the course of the travel of the mix therethrough. From the retention chamber **28**, the substantially completely saponified fatty material together with the by-products of reaction flow through the pipe **30**, through the restricted opening in nozzle **31** and into the vacuum tank **29**. These products are forced through the nozzle in fine streams of fine particles at such velocity that they impinge against a side wall of the chamber **29** to further break up these particles and release any by-products such as water and glycerine which may have been entrapped in the soap particles. The by-products are drawn off of the chamber **29** through the pipe **32** and are recovered and the anhydrous soap particles fall to the bottom of the tank **29**. These soap particles at the bottom of tank **29** are constantly maintained in the state of agitation by the continuously rotating motor driven paddle **40** further to free the soap from the by-products and to prevent packing and the screw conveyor **37** is constantly rotated to continuously feed the soap out of the bottom of the tank **29**, through the chute **33** where the soap is cooled and out of the discharge end **35** thereof and into a receiver or packaging means therefor. The pumps **15** and **16** provide all the force necessary to maintain a continuous flow of the reactants from the tanks **10** and **11** to the tank **29**.

The heating of the conduits **18**, **19** and **24** is accomplished by a constant and continuous flow of molten "HTS." This heating medium, the "HTS" is rendered in the molten state in the heater **52** where it is heated to a temperature of between about 650° and 700° F. From the heater **52** the molten "HTS" flows through pipe **53** and into and through the series connected jackets **42** in a direction counter-current to the direction of travel of the mix through the conduit **24**. From the jackets **42**, the "HTS" flows through jackets **44** and **48**, the discharge pipe **55** and into the reservoir **54** in this order. The heating circuit is closed and completed by the pipe **58** on the discharge side of pump **56** and on the inlet side of the heater **52**. The single pump **56** maintains a continuous flow of this molten "HTS" in this circuit. In this illustration, the temperature of the "HTS" in the jackets **42** is about 650° F. and in the jackets **44** and **48** is about 550° F.

Because of the rapid heat transfer of the molten "HTS" to the materials within the conduits, the length of the conduits **18**, **19** and **24** may be exceptionally low as shown and because of this characteristic, the pressure drop between the pumps **15** and **16** and the nozzle **31** may be very low and as low as fifty pounds per square inch which is less than half the pressure drop between the pumps and nozzle of other continuous processes heretofore proposed.

Since certain changes in carrying out the above process and in the construction set forth, which embody the invention, may be made without departing from its scope, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A process for the continuous manufacture of soap comprising moving a fatty material and a saponifying agent in predetermined quantities from separate sources of supply, mixing said fatty material and saponifying agent, moving said mix

through a reaction conduit, holding chamber and into a reduced pressure chamber in the aforesaid sequence and supplying heat to said reaction conduit by moving thereover a heat transfer medium comprising approximately 40% $NaNO_2$, 7% $NaNO_3$ and 53% KNO_3 and maintaining said heat transfer medium at a temperature above 290° F. and below 1000° F.

2. A process for the continuous manufacture of soap comprising moving a fatty material and a saponifying agent in predetermined quantities through separate conduits from separate sources of supply to a mixing chamber, mixing said fatty material and saponifying agent, moving said mix through a reaction conduit, holding chamber, and into a reduced pressure chamber in the order named, supplying heat to all of said conduits by moving thereover in liquid form a heat transfer medium maintained at a temperature between about 550° F. and 650° F., said medium comprising approximately 40% $NaNO_2$, 7% $NaNO_3$ and 53% KNO_3.

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