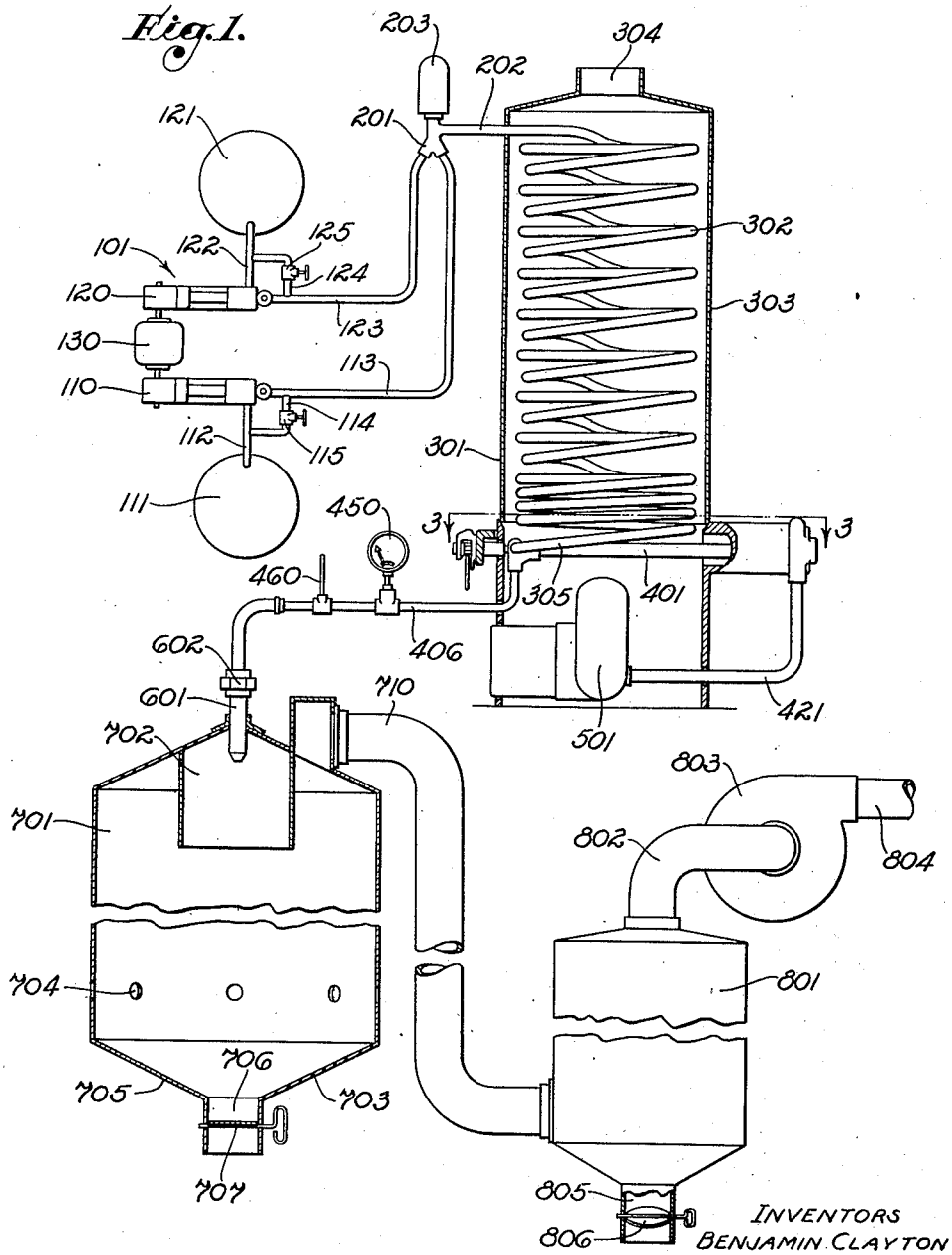
Nov. 15, 1938. B. CLAYTON ET AL 2,137,213

APPARATUS FOR PRODUCING SOAP OF LOW MOISTURE CONTENT

Original Filed April 17, 1933 2 Sheets-Sheet 1

Fig. 1.



INVENTORS
BENJAMIN CLAYTON
WALTER B. KERRICK
HENRY M. STADT
BY Fred A. Lewis
ATTORNEY.

Nov. 15, 1938. B. CLAYTON ET AL 2,137,213

APPARATUS FOR PRODUCING SOAP OF LOW MOISTURE CONTENT

Original Filed April 17, 1933 2 Sheets-Sheet 2

Fig. 2.

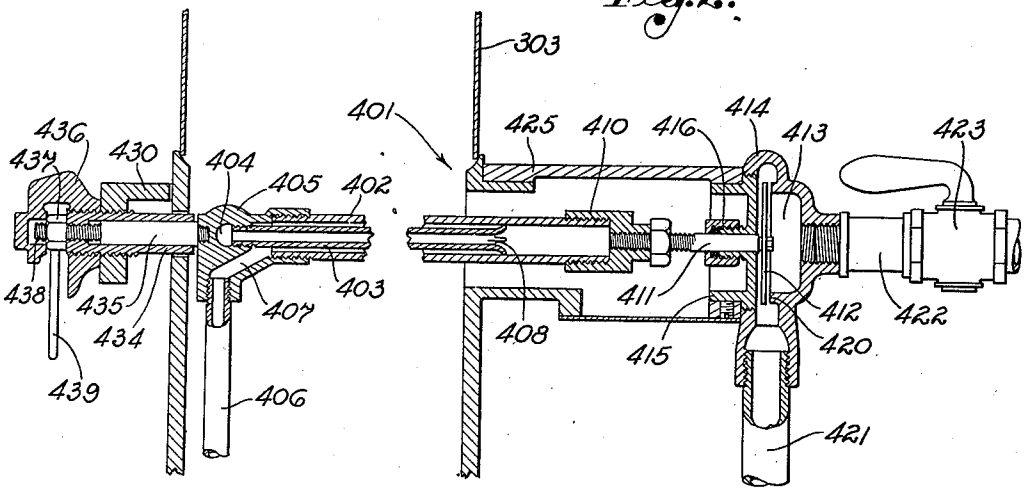


Fig. 3.

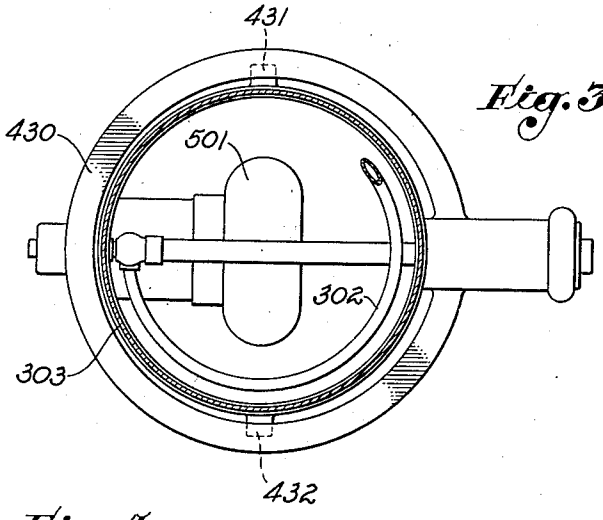
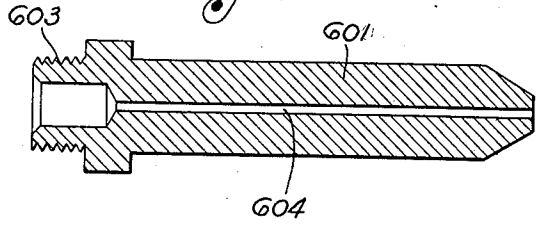


Fig. 4.



INVENTORS
BENJAMIN CLAYTON
WALTER B. KERRICK
HENRY M. STAOT
BY
ATTORNEY.

Patented Nov. 15, 1938 2,137,213

UNITED STATES PATENT OFFICE

2,137,213

APPARATUS FOR PRODUCING SOAP OF LOW MOISTURE CONTENT

Benjamin Clayton, Sugarland, Tex., and Walter B. Kerrick, Los Angeles, and Henry M. Stadt, Glendale, Calif., assignors to Refining Inc., Reno, Nev., a corporation of Nevada

Continuation of application Serial No. 733,488, July 2, 1934, which is a division of application Serial No. 666,470, April 17, 1933. This application September 12, 1935, Serial No. 40,312

10 Claims. (Cl. 87—16)

Our invention relates to an apparatus which may be used for many purposes and is particularly applicable to the manufacture of soap. For the purpose of illustrating one use to which the apparatus may be applied, we will describe its use as applied to the manufacture of soap, without intending to restrict the invention thereto, and without intending to limit the invention, the scope of which is to be determined by the claims. Soap is produced by the saponification of fats by suitable reagents. The term "fat" as used herein includes all those fats, oils, and greases which are commonly used in soap manufacture, including tallow and other animal fats, cottonseed oil, and other vegetable fats, and the fish oils.

The term "reagent" as used herein includes all those substances which are adapted to produce a saponification of fats, those most commonly employed being caustic potash or caustic soda in aqueous solution.

It is an object in this specific use of our invention to provide means by which soap can be produced by a continuous process; that is, a process by which the raw material needed for the production of soap is fed continuously into an apparatus in which the soap is formed and from which the soap is continuously delivered.

It is also an object in this specific use of our invention to provide means for producing powdered soap directly from said raw materials. The term "powdered soap" is used herein to designate a soap a typical form of which consists of granules averaging about one-sixteenth of an inch in diameter or thereabouts. The size of the granules is not critical and the size of granule may be varied to suit various needs.

It is a further object in this specific use of our invention to provide means for producing soap of a low moisture content. It is not unusual for soaps to contain at least fifty per cent of water, and for many purposes soap which contains much less water is highly desirable. By our process soaps containing any desired water content can be continuously produced.

Further objects and advantages will be made evident hereinafter.

Our invention can be conveniently practiced in the apparatus disclosed in the attached drawings, in which—

Fig. 1 is a general assembly view of the apparatus, a portion of this apparatus being shown in vertical section.

Fig. 2 is an enlarged vertical section of a portion of the apparatus.

Fig. 3 is a horizontal section on a plane represented by the line 3—3 of Fig. 1.

Fig. 4 is a vertical sectional view on an enlarged scale of the nozzle.

In the form of the invention shown in the drawings we provide a mixture proportioning device 101, a mixer 201, a heater 301, a steam proportion controller 401, a fuel burner 501, a nozzle 601, an expansion chamber 701, and a dust separator 801. The mixture proportioning device 101 includes a fat pump 110 and a reagent pump 120.

The fat pump 110 and the reagent pump 120 are driven from a motor 130 so that they run at all times at proportional speeds. The fat pump 110 takes fat from a tank 111 through a pipe 112, the fat tank 111 being provided with heating means so that the fat can be preheated to any desired degree. The fat pump 110 delivers the heated fat to a pipe 113. A by-pass pipe 114 provided with a valve 115 is provided connecting the pipe 113 to the pipe 112 so that a portion of the fat may be bypassed through the valve 115 to control the rate of delivery of fat from the pump 110 to the mixer 201.

The reagent pump 120 takes reagent from the tank 121 through a pipe 122 and delivers it to a pipe 123. A by-pass pipe 124 having a valve 125 connects the pipe 123 to the pipe 122 so that reagent may be by-passed through the valve 125, the amount of reagent delivered to the pipe 123 being controlled by the valve 125.

The reagent tank 121 is provided with heating means so that the reagent may be preheated to any desired degree before being delivered to the pipe 123.

The mixer 201 may have any desired form, that shown being a simple Y-connection in which a stream of fat from the pipe 113 and a stream of reagent from the pipe 123 are mixed together and delivered to a pipe 202. For the purpose of equalizing the flow of liquid, an air chamber 203 may be provided in the pipe 202.

The pipe 202 is connected to a pipe coil 302 forming a part of the heater 301. This pipe coil is preferably of helical or spiral form and is carried inside a shell 303 connected at its upper end to a flue 304. The hot products of combustion delivered from the burner 501 pass upwardly inside the shell 303 and outwardly through the flue 304, thus heating the liquid in the coil 302.

The lower end of the coil 302 is connected through a pipe 305 with the steam proportion controller 401 which is shown in more detail in

Fig. 2. The steam proportion controller 401 consists of an outer pipe 402 and an inner pipe 403. Liquid from the pipe 305 is delivered to an opening 404 in a member 405. The inner pipe 403 is secured in the member 405 so that the interior of the pipe is in open communication with the opening 404. An outlet pipe 406 is also secured in the member 405 communicating with an opening 407. The pipe 402 is secured in the member 405 so that the interior of this pipe is in open communication with the opening 407. The other end 408 of the inner pipe 403 is open and provides an open communication with the interior of the pipe 402. The other end of the pipe 402 is connected into a member 410 which closes the end of the pipe 402 and which is threaded to receive a valve stem 411. The end of the valve stem 411 is secured to a valve disc 412 which is carried in a cavity 413 in a member 414. The member 414 has secured therein a closure member 415 through which the valve stem 411 passes, a stuffing-box 416 being provided about the valve stem 411 where it passes through the member 415.

An annular seat 420 is provided in the cavity 413 against which the valve disc 412 seats. A fuel outlet pipe 421 is secured in the member 414 in such a manner that it communicates with the space at the left of the valve disc 412 when it is seated, and a fuel inlet pipe 422 is also secured in the member 414 communicating with the space to the right of the valve disc 412 when it is seated. A fuel control valve 423 may be provided in the pipe 422.

The member 415 is secured in a member 425 which in turn is secured to the shell 303. Connected to the member 425 is a ring 430 which extends around the shell 303, being separated therefrom and resting on lugs 431 and 432 secured to the shell 303. A member 434, shown in Fig. 2, is secured in the member 430 and forms a guide for a stem 435 which projects through the shell 303 and is secured in the member 405. A member 436 is secured on the member 434 and is provided with a cavity in which a control nut 437 is placed, this control nut engaging the threaded end 438 of the stem 435. The control nut 437 is provided with a handle 439 by which it may be turned. As the nut 437 is turned, the stem 435 is moved to the right or left, depending upon the direction of rotation.

A pipe 406 conducts liquid to the nozzle 601 and is provided with a pressure gage 450 and a thermometer 460. The nozzle 601 is secured to the pipe 406 in such a manner that it can be easily removed as by means of a pipe union 602. The nozzle 601 is shown in Fig. 4 and consists of a cylindrical member threaded at 603 for connection to the pipe 406 and is provided with a small opening 604 through which the liquids are caused to pass at high velocity and with a considerable pressure drop. The nozzle 601 projects into a space 702 inside the expansion chamber 701 which is provided with an outer shell 703 and with openings 704 near the bottom thereof. The bottom of the shell 703 is preferably conical as shown at 705 and terminates in an outlet opening 706 closed by a gate 707. The upper end of the space 702 is connected through a conduit 710 with a dust collector 801. Any form of centrifugal dust separator may be used as a dust collector 801, that shown being provided with an air outlet 802 to which a suction blower 803 is connected, this blower discharging air through a conduit 804. The lower end of the dust collector is provided with an outlet 805 having a gate 806 therein.

The fuel burner 501 may be of any desired form suited to burn gas, oil, or other fuel of liquid or semi-liquid character. This fuel is delivered to the burner 501 through the pipe 421, the amount of fuel so delivered being controlled by the valve disc 412.

The operation of the above-described apparatus will be better understood if the function of the various parts is first explained.

The function of the proportioning device 101 and mixer 201 is primarily to deliver a properly proportioned mixture of fat and reagent to the heater 301 by placing sufficient pressure on the mixture to force it to flow through the heater 301 and the nozzle 601. This function is in part performed by the pumps 110 and 120 which force the fat and reagent to flow against this pressure. Although the two pumps 110 and 120 are employed in the apparatus shown, one (110) pumping fat and the other (120) pumping reagent, it is obvious that the reagent could be mixed in proper proportion with the fat in the tank 111 by installing a mechanical mixer therein and the mixture pumped by the pump 110. The pump 120 and the mixer 201 could then be omitted. The use of two pumps 110 and 120 and the mixer 201 is, however, an excellent way to insure that a properly proportioned mixture of fat and reagent is delivered to the heater 301.

The function of the mixer 201 is merely to provide a means for uniting the fat and reagent. This function is accomplished by bringing together a stream of fat and a stream of reagent. No auxiliary means is shown for dispersing the reagent in the fat and no such means is necessary although various types of mechanical or jet mixers might be employed.

Using the apparatus as shown, the function of the proportioning device 101 is to supply fat and reagent in measured quantities which bear such proportion to each other that complete saponification is insured. This function is performed by delivering into the mixer 201 for each gallon of fat delivered thereto a definite quantity of reagent. Other means for providing the proper proportioning of the fat and reagent could obviously be employed.

The function of the heater 301 is to heat the mixture of fat and reagent flowing therein. In the apparatus shown a pipe coil 302 externally heated by combustion products from the burner 501 is employed. It is not essential that the heater should be in the form of a coil, although this is a convenient form of heater to use. It is also not essential that the heater should be heated directly by combustion products since the heater might be immersed in steam or hot oil. It is, however, essential that the heating should be capable of automatic control, as hereinafter explained.

The function of the steam proportion controller 401 is to control the proportion of water in the finished soap, this function being performed by automatically regulating the proportion of steam in the mixture delivered to the nozzle 601. The steam proportion controller may be adjusted by the operator to vary the proportion of the steam.

The steam proportion controller 401 controls the position of the valve disc 412 by the expansion and contraction of the outer tube 402. As the tube 402 expands it tends to seat the valve disc 412 on the seat 420 and thus shut off the

flow of fuel from the pipe 422 to the pipe 421 and thus supply less fuel to the burner 501. As the tube 402 contracts it tends to pull the valve disc 412 away from the seat 420 and thus allow more fuel to flow to the burner 501.

The expansion of the tube 402 depends upon its mean temperature which depends upon the rate at which the tube absorbs heat from the flue gases, the rate of conduction of the heat through the wall of the tube, and the rate at which heat is absorbed from the inner wall of said tube.

With the apparatus in operation the rate at which the tube absorbs heat does not vary directly with the amount of fuel burned since the temperature of the combustion products delivered from the burner is fairly constant regardless of whether the burner is receiving fuel at its full capacity or at half capacity. The rate of heat absorption at the outer surface of the tube while no means constant does not increase directly in proportion to the amount of fuel being burned and for small changes in the amount of fuel burned may be regarded as constant.

The rate at which the heat is conducted through the wall of the tube 402 is also fairly constant. The expansion and contraction of the tube 402 is mainly affected by the amount of heat transferred from the inner wall of the tube, and this is mainly dependent on the amount of water that has been turned into steam before the mixture of soap and water enters the tube 402. If no steam has been previously formed, the heat transfer is very high; if all the water has been transformed into steam, the heat transfer is very low.

By turning the handle 439 the member 405 can be moved to the right or left, which regulates the closing of the valve disc 412 on the seat 420 for a given expansion of the tube 402. If the handle is turned in one direction, the mean temperature of the tube 402 must be greater to move the valve disc 412 against the seat 420 than if it is turned in the other. The operator is thus able to insure the valve disc 412 interrupting the flow of fuel to the burner 501 at either a large or a small expansion of the tube 402. Since this expansion is dependent on the amount of steam carried in the soap, the operator by turning the handle 439 in one direction can insure the valve disc seating with no steam in the soap, and by turning the handle 439 in the other direction can insure the valve disc seating only when all the water has been turned into steam.

Since the position of the valve disc 412 controls the amount of fuel passing to the burner 501, it also controls the volume of the products of combustion and heat units carried therein and thus controls the amount of heat delivered to the coil 302. If at any instant the proportion of steam in the soap mixture passing through the tube 402 falls, the tube contracts, thus moving the disc 412 to the left and increasing the flow of fuel to the burner and applying more heat to the coil 302 until a balance is again obtained.

The device shown in Fig. 2 is a very efficient one for insuring that the soap flowing through the tube 402 to the nozzle 601 shall contain a definite proportion of steam. It will be obvious to one familiar with the properties of steam that as long as the soap contains any saturated steam and any free water, the soap will remain at the temperature of saturated steam at the pressure under which it is held. In other words, the proportion of steam can vary from a mere trace to a quantity representing nearly one hundred per cent of the water without any change in the temperature of the soap.

In actual operation the tube 402 expands and contracts to insure a proper proportion of steam in the soap flowing therethrough even though there is no change in temperature of the soap, this expansion and contraction being caused by a change in the rate of heat transfer from the inner wall of the tube 402 to the soap flowing therein. This change in heat transfer is due to a larger or smaller proportion of steam in the soap.

It will be seen that the ordinary form of thermostat which responds to changes of temperature only could not be used to control the proportion of steam, since as long as both water and saturated steam are present in the soap at a given pressure, the temperature cannot change regardless of the proportion of steam.

The function of the nozzle 601 is primarily to stabilize the rate of steam formation in the soap, which is accomplished by making considerable pressure drop in the soap passing through the constricted orifice 604. This orifice should be made of such size that with the pumps 110 and 120 running at normal speed and the apparatus adjusted to vaporize at least ten per cent of the water in the mixture flowing through the coil 302, the drop in pressure at the nozzle 601 is greater than the drop in pressure in the coil 302.

The drop in pressure in the nozzle 601 depends upon the rate of flow of the mixture of soap and steam therethrough. This rate of flow in turn depends upon the volume of mixed soap and steam which so passes. At 100 pounds per square inch gage pressure, saturated steam has a volume 237 times that of water at 39° F. It is therefore obvious that the vaporization of a relatively small part of the water carried in the soap enormously increases the volume of the soap and steam, which in turn enormously increases the velocity of the mixture of soap and steam flowing through the opening 604. The pressure drop in the constricted opening 604 increases much faster than the velocity of the mixture passing therethrough and probably nearly as the square of this velocity.

Any increase therefore in steam formation in the coil 302, which is fed with water at a constant rate, increases the velocity in the constricted opening 604 and increases the pressure necessary to produce this velocity; that is, the pressure in the tube 302. The water in the tube having been at the temperature of saturated steam at the pressure prevailing therein, it is obvious that any increase in this pressure checks steam formation since steam will not form at the higher pressure until the temperature of the entire mixture is raised to the temperature of saturated steam at the higher pressure.

Conversely, if the amount of steam formed falls off for any reason, the velocity of the mixture flowing through the constricted opening 604 also falls, the pressure in the heater falls, and this increases the steam formation and restores the balance.

In practice, with a certain setting of the steam proportion controller 401, the pressure shown by the gage 450 is quite constant, the nozzle 601 serving to regulate the rate of steam formation so that the pressure remains nearly constant.

The nozzle 601 can be readily disconnected from the pipe 406 and one having a larger or smaller opening 604 can be substituted if desired. The opening 604 in the nozzle 601 should be of such size that in the operation of the apparatus a considerable drop in pressure on the soap oc-

curs as it passes therethrough, and the proper size of this opening can be readily determined by trial, the smaller the opening **604**, the higher the pressure necessary to drive the mixture through the opening **604**.

The nozzle **601** also acts as a jet director causing the mixture of soap and steam to emerge into the space **702** at considerable velocity. The jet expands as it leaves the nozzle, blowing the mass of soap apart into small particles which settle slowly through the space **702**.

The function of the expansion chamber **701** is to allow the jet to expand and the steam to escape from the soap. The steam is constantly withdrawn by the blower **803** passing through the dust separator **801** in which any fine particles of soap carried by the steam are removed. Air which enters the expansion chamber **701** through the openings **704** is, of course, also removed by the blower **803**. If desired, the openings **704** may be closed and a partial vacuum established in the space **702** by the blower **801**, but as a matter of convenience it is probably better to allow air to enter the space **702** through the openings **704** so that the space **702** is at substantially atmospheric pressure.

The larger soap particles of course settle in the bottom of the expansion chamber **701**, being withdrawn from time to time through the opening **706** by withdrawing the gate **707**. The finer particles are separated in the dust collector **801**, being withdrawn from time to time through the opening **805** by withdrawing the gate **806**.

The operation of the process can be better understood if we describe the operation of a plant capable of converting about a gallon per minute of fat into soap. Such a plant would have a coil **302** about 400 feet long and consisting of pipe having an internal diameter of about one-half inch. Operating with a certain mixture of animal tallow, soy bean, and coconut oil, the fat is heated in the tank **111** to a temperature well in excess of that necessary to render it sufficiently fluid to pump readily. A reagent solution of caustic soda in water is prepared in the tank **121**, this solution having a specific gravity of 37° degrees Baumé. The valve **115** is set to allow one gallon of fat per minute to pass into the pipe **113** and the valve **125** is set to allow sufficient reagent to pass into the pipe **123** to completely saponify the fat. A chemist skilled in the art can determine the exact proportion, which depends upon the nature of the fat. In the case being considered the valve **125** is set to allow about one-half gallon per minute of reagent to pass into the pipe **123**.

A nozzle **601** is selected which will force a pressure of from 200 to 250 pounds per square inch (gage) to be indicated on the gage **450**. The temperature indicated by the thermometer **460** will be the saturated steam temperature for the pressure indicated by the gage **450**, or, in the case above considered, about 400° F. If dry soap is desired, the apparatus can be adjusted so that all the water in the soap is vaporized before the soap enters the nozzle **601**, and so that the steam produced by this vaporization is slightly superheated.

It is possible by considerably superheating the steam to produce a soap containing less than 2% of water.

Operating with the thermometer **460** indicating the temperature of saturated steam at the pressure indicated by the gage **450**, the moisture content of the powdered soap delivered at the opening **706** may be regulated by adjusting the steam proportion controller **401** by turning the handle **439**.

If the handle is turned to pull the valve disc **412** away from the seat **420**, the average temperature of the tube **402** must be raised to force the valve disc **412** against the seat **420**.

The temperature of the soap flowing through the tube **402** will not be changed from the temperature of saturated steam at the pressure indicated by the gage **450** as long as this pressure is not changed and both water and saturated steam are present in the soap.

By moving the handle **439** to pull the valve disc **412** away from the seat **420**, more fuel is allowed to flow to the burner **501** and more heat is applied to the coil **302**. This causes more steam to be vaporized and increases the amount of saturated steam in the soap in the tube **302**. The heat transfer from the interior of the tube **402** to the soap falls and the mean temperature of the tube **402** rises, thus expanding the tube, moving the valve disc **412** toward the seat **420**, and reducing the flow of fuel to the burner. A balance is almost instantly established with the soap at a slightly higher pressure indicated on the gage **450** due to the additional friction in the opening **604** which is due to the greater volume of steam and a slightly higher temperature indicated on the thermometer **460**, this higher temperature being, of course, due to the higher vaporization point of the water at the higher temperature.

In practice the proportion of saturated steam in the soap emerging from the nozzle **601** into the chamber **702** can be regulated by the operator by adjusting the steam proportioning device **401** so that all or none of the water originally added to the reagent appears as steam or any portion therebetween.

This enables the operator to accurately control the water content of the powdered soap delivered through the openings **706** and **805** from merely a trace to an amount nearly equal to the total water content of the original reagent solution. The soap is produced due to the action of the jet as it emerges from the nozzle **601** in the form of irregular shaped granules having a variable size of which the largest are not as large as a grain of rice. The granules can be reduced to flake form by passing them through a pair of rolls or can be readily pressed into cakes.

If it is desired to add to the soap inert material such as various detergents, they can be uniformly mixed with the fat or reagent in the tanks **111** or **121** and will appear uniformly distributed in the final product.

In the actual operation of the apparatus above described in the manner above described, soap having a moisture content of about two per cent was produced at the rate of about five hundred pounds an hour, the total time required from the time the mixture left the mixer **201** to the time the finished soap emerged from the nozzle **601** being less than six minutes.

The soap produced was of very high quality, the high temperature and pressure combined with the thorough mixture of the ingredients due to the turbulent flow in the coil **302** having produced a complete reaction between the reagent and the fat.

We have also found that by our process fats, such as certain kinds of vegetable oils, which are extremely difficult to saponify by ordinary soap boiling processes, can be quickly, cheaply, and completely saponified.

It is entirely obvious that our apparatus is applicable to many other uses than that described above, being particularly adapted to provide

BEST AVAILABLE COPY

means by which many substances may be treated chemically by suitable reagents.

This application is a continuation of our application Serial 733,488, filed July 2, 1934, which is a division of our application Serial 666,470, filed April 17, 1933, now issued as Patent No. 1,968,526 of July 31, 1934 which in turn is a continuation in part of our application Serial 568,278, filed October 12, 1931.

We claim as our invention:

1. An apparatus for producing soap, which comprises: a heater; means for delivering a dispersion, consisting of a saponifying material in aqueous solution carried in a saponifiable material, to said heater; means for supplying heat to said dispersion while in said heater in sufficient amounts to cause a rapid reaction in said dispersion and thus form soap and steam in said heater; means for controlling the heat supplied to said dispersion while in said heater in response to the amount of steam present in said heater; walls forming an expansion chamber into which said soap is delivered while in a heated condition; and means for withdrawing vapor from said chamber at a sufficient rate to maintain a partial vacuum on said chamber.

2. An apparatus for producing soap, which comprises: a heater; means for delivering a dispersion, consisting of a saponifying material in aqueous solution carried in a saponifiable material, to said heater; heating means for supplying heat to said dispersion while in said heater in sufficient amounts to vaporize at least a portion of the water to form steam and to cause a rapid reaction in said dispersion and thus form soap; walls forming an expansion chamber into which said soap is delivered while in a heated condition; a nozzle through which said soap is delivered in finely divided form into said expansion chamber; means for withdrawing vapor from said chamber at a sufficient rate to maintain a partial vacuum on said chamber; means responsive to the amount of steam formed in said heater; and means operatively connecting said last-named means and said heating means to regulate the amount of heat supplied to said heater and thus regulate the moisture content of the soap by controlling the amount of vapor separating from the soap in said expansion chamber.

3. In combination in an apparatus for making soap from a saponifiable material by reaction with a saponifying material: means for forming a mixture of said materials; a heater providing relatively long and narrow passage means through which said mixture moves, said heater including a heating means for heating said mixture to a degree sufficient to vaporize at least a portion of the water in the saponified products; means for maintaining substantially constant the proportion of said water which is vaporized in said heater to form a stream of reaction products including soap and steam, said means including a steam proportion control means responsive to the amount of water vapor formed in said heater, and means for operatively connecting said heating means and said steam proportion control means; and walls forming a chamber into which said reaction products are discharged and in which steam separates from the soap.

4. In combination in an apparatus for promoting chemical reactions between two liquid substances which upon reaction will produce reaction products which contain water: means for mixing proportioned streams of said substances in liquid state and while out of contact with the atmosphere and at superatmospheric pressure, said means including a mixing means providing a mixing chamber, two conduits communicating therewith, two high-pressure pumps respectively delivering streams of said substances at high pressure respectively through said conduits, and means for varying the relative quantities of said substances moving from said conduits into said mixing chamber; walls defining an elongated passage directly communicating with said mixing chamber and conducting therefrom the mixture as fast as formed, said pumps forcing said mixture through said elongated passage by the impelling pressure applied to the separate streams, the pressure on said mixture progressively decreasing during its flow through said elongated passage; heating means for progressively applying heat to said mixture during flow through said elongated passage to progressively heat said mixture under decreasing pressure conditions and form said reaction products in which a portion of said water is in the form of steam; and means responsive to the amount of steam formed in said elongated passage for controlling said heating means to maintain constant the proportion of said water which is vaporized.

5. A combination as defined in claim 4 in which said means responsive to the amount of steam includes an expansible tube means forming a part of said elongated passage and being heated externally by said heating means and cooled internally by the reaction products flowing therethrough whereby the mean temperature of said expansible tube means varies with the amount of heat absorbed by said reaction products from the inner wall thereof and thus varies with the amount of steam present in the reaction products, said means also including means responsive to the expansion and contraction of said tube means for controlling said heating means.

6. In combination in an apparatus for promoting chemical reactions between two liquid substances which upon reaction will produce reaction products which contain water: means for mixing proportioned streams of said substances in liquid state and while out of contact with the atmosphere and at superatmospheric pressure, said means including a mixing means providing a mixing chamber, two conduits communicating therewith, two high-pressure pumps respectively delivering streams of said substances at high pressure respectively through said conduits, and means for varying the relative quantities of said substances moving from said conduits into said mixing chamber; walls defining an elongated passage directly communicating with said mixing zone and conducting therefrom the mixture as fast as formed, said pumps forcing said mixture through said elongated passage by the impelling pressure applied to the separate streams, the pressure on said mixture progressively decreasing during its flow through said elongated passage; heating means for progressively applying heat to said mixture during flow through said elongated passage to progressively heat said mixture under decreasing pressure conditions and form said reaction products in which a portion of said water is in the form of steam; means responsive to the amount of steam formed in said elongated passage for controlling said heating means to maintain constant the proportion of said water which is vaporized; walls defining a vapor-separating chamber; and means delivering the reaction products from said elongated passage directly into said vapor-separating

chamber to separate steam from the reaction products.

7. In combination in an apparatus for promoting chemical reactions between two liquid substances which upon reaction will produce reaction products which contain water: means for mixing proportioned streams of said substances in liquid state and while out of contact with the atmosphere and at superatmospheric pressure, said means including a mixing means providing a mixing chamber, two conduits communicating therewith, two high-pressure pumps respectively delivering streams of said substances at high pressure respectively through said conduits, and means for varying the relative quantities of said substances moving from said conduits into said mixing chamber; walls defining an elongated passage directly communicating with said mixing zone and conducting therefrom the mixture as fast as formed, said pumps forcing said mixture through said elongated passage by the impelling pressure applied to the separate streams, the pressure on said mixture progressively decreasing during its flow through said elongated passage; heating means for progressively applying heat to said mixture during flow through said elongated passage to progressively heat said mixture under decreasing pressure conditions and form said reaction products in which a portion of said water is in the form of steam; means responsive to the amount of steam formed in said elongated passage for controlling said heating means to maintain constant the proportion of said water which is vaporized; walls defining a vapor-separating chamber; means delivering the reaction products from said elongated passage directly into said vapor-separating chamber to separate steam from the reaction products; and pump means for forcibly withdrawing the separated steam from said vapor-separating chamber at such rate as to maintain a subatmospheric pressure therein.

8. In combination, an apparatus for continuously producing soap from saponifying and saponifiable materials and separating vaporizable materials from the soap which comprises receptacles for saponifiable and saponifying materials, mixing means, separate conduits for connecting the said receptacle with said mixing means, high pressure pumping means for rapidly advancing streams of said saponifiable and saponifying materials to said mixing device through said conduits, whereby to effect rapid and intimate admixture of said materials while in stream flow, a heating device communicating with the mixing device through which the mixture is advanced under pressure with sufficient rapidity to prevent local overheating, means for supplying heat to said heating device to raise the temperature of said mixture sufficient to form vapors in said device at said pressure and to vaporize said vaporizable materials when said pressure is released to produce soap of the desired moisture content, an evaporating chamber, means for connecting the heating device to said evaporating chamber, said means having a constantly open discharge member whereby said mixture is constantly and uniformly discharged in said evaporating chamber to liberate the vaporizable materials to deposit the said soap in said chamber in a continuous manner.

9. A saponifying apparatus comprising, in combination, receptacles for containing saponifiable and saponifying materials, mixing means, separate conduits for connecting said receptacles with said mixing means, high pressure pumping means for rapidly advancing streams of said saponifiable and saponifying materials to said mixing device through said conduits, whereby to effect rapid and intimate admixture of said materials while in stream flow, a heating device communicating with the mixing device through which the mixture is advanced under pressure with sufficient rapidity to prevent local overheating, means for supplying heat to said heating device to raise the temperature of said mixture sufficiently high to vaporize said vaporizable materials when released into a vacuum chamber, a vacuum chamber, means for connecting the heating device to said vacuum chamber, said means having a constantly open discharge member whereby said mixture is constantly and uniformly discharged in said vacuum chamber to liberate said vaporizable materials in a continuous manner.

10. In combination, an apparatus for continuously reacting two substances with each other comprising receptacles for receiving said substances, mixing means, separate conduits for connecting said receptacles with said mixing means, high pressure pumping means for rapidly advancing streams of said substances to said mixing device through said conduits, whereby to effect rapid and intimate admixture thereof while in stream flow, a heating device communicating with said mixing device through which the mixture is advanced under pressure with sufficient rapidity to prevent local overheating, means for supplying heat to said heating device to raise the temperature of said mixture sufficient to form vapors in said device at said pressure and to vaporize said vaporizable materials when said pressure is released, an evaporating chamber maintained under vacuum, means for connecting the heating device with said evaporating chamber, said means having a constantly open discharge member whereby said mixture is constantly and uniformly discharged in said evaporating chamber to liberate the vaporizable materials thereof continuously as said mixture is introduced to said evaporating chamber.

BENJAMIN CLAYTON.
WALTER B. KERRICK.
HENRY M. STADT.