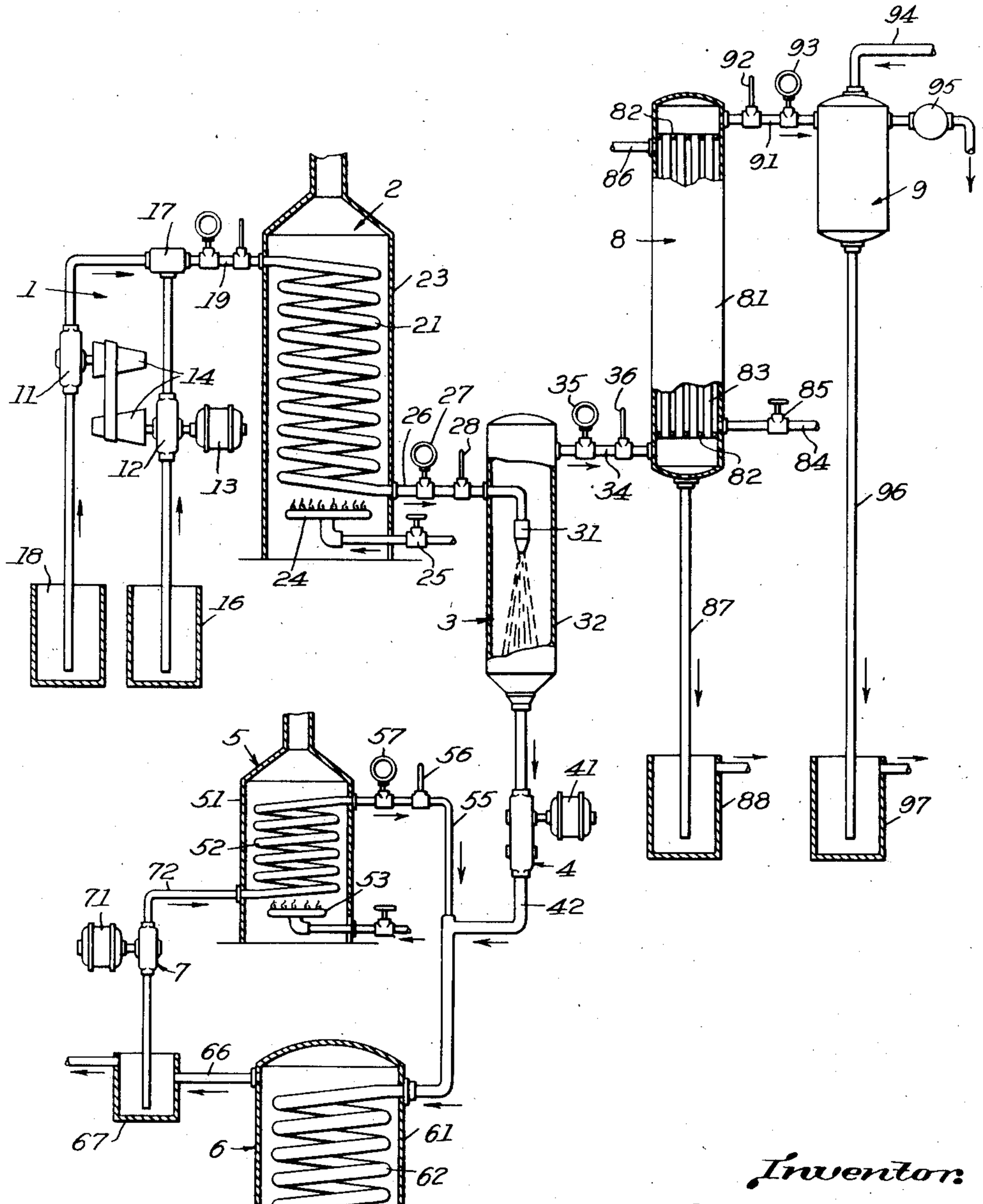
July 12, 1938. B. CLAYTON 2,123,647

APPARATUS FOR PRODUCING SOAP HAVING A DEFINITE WATER CONTENT

Original Filed June 16, 1934



Inventor:

BENJAMIN CLAYTON

By Ford W. Harris

Attorney.

Patented July 12, 1938 2,123,647

UNITED STATES PATENT OFFICE

2,123,647

APPARATUS FOR PRODUCING SOAP HAVING A DEFINITE WATER CONTENT

Benjamin Clayton, Springer, N. Mex., assignor to Refining, Inc., Reno, Nev., a corporation of Nevada

Original application June 16, 1934, Serial No. 730,971. Divided and this application October 5, 1934, Serial No. 747,455

14 Claims. (Cl. 87—16)

My invention relates to the manufacture of soap and an object of the invention is to provide an apparatus by which soap may be produced directly in a continuous process from raw material.

A further object of the invention is to provide an apparatus for producing soap continuously in which the soap is produced in solid form of any suitable shape.

A further object of the invention is to provide an apparatus for producing soap in which the moisture content of the soap produced can be accurately regulated within any desired limits.

Further objects and advantages will be made evident hereinafter.

Referring to the drawing, which is a diagrammatic view with the elements shown in elevation and partly in section, 1 is a mixing apparatus, 2 is a heater, 3 is a separating chamber, 4 is an extrusion pump, 5 is a boiler, 6 is a cooler and extruder, 7 is a water injection pump, 8 is a glycerine condenser, and 9 is a water condenser of the jet type.

The mixing apparatus consists of an alkali pump 11 and a fat pump 12, the pump 12 being driven by a suitable motor 13 and the pump 11 being driven through a speed changing gear 14 from the pump 12. The fat which it is desired to convert into soap is taken from a fat tank 16 and pumped into a mixer 17 by the pump 12. An alkali tank 18 contains an aqueous solution of a saponifying alkali such, for example, as caustic soda in water, the pump 11 taking the aqueous alkali solution or reagent from the tank 18 and pumping it into the mixer 17. The mixed fat and reagent pass through a pipe 19 to a coil 21 of the heater 2.

The heater 2 consists of an outer shell 23 in which a coil 21 is placed, and a burner 24 supplied with fuel through a fuel valve 25. Gas or oil may be used as fuel, this fuel being ignited at the burner and the hot products of combustion passing upwardly inside the shell 23 and supplying heat to the coil 21. In the coil 21 a reaction takes place between the reagent and the fat, soap, glycerine and water vapors, hereinafter termed the "reaction products", being delivered through a pipe 26, having a pressure gauge 27 and a thermometer 28 therein, to a nozzle 31 in the separating chamber 3.

The separating chamber 3 consists of a tight shell 32 inside which the nozzle 31 is carried. The nozzle consists of a metal member having a constricted orifice through which the reaction products must pass. The soap pump 4 is preferably a gear or screw pump capable of handling the hot soap precipitated in the chamber 32. This pump is driven by a motor 41 and delivers the hot soap to a pipe 42.

The boiler 5 may be of any convenient type, that shown consisting of a shell 51 in which is placed a pipe coil 52. The water in the pipe coil 52 is heated by the products of combustion from a burner 53 supplied with gas through a fuel valve 54. Steam is delivered from the boiler 5 through a pipe 55, having a thermometer 56 and a pressure gauge 57 therein, to the pipe 42.

While different forms of cooler 6 may be employed, it is desirable that one be used which tends to uniformly mix the steam delivered by the pipe 55 with soap delivered from the pipe 42 and the form shown is well adapted to accomplish this result. It consists of a tight shell 61 in which is placed a coil 62 into which the mixture of soap and steam is delivered by the pipe 42. The cooled soap leaves the coil 62 through a pipe 63. Cooling water is supplied to the cooler 6 through a pipe 64, the flow being controlled by a valve 65. Hot water is delivered from the cooler 6 through a pipe 66 to a tank 67. The cooled soap is delivered through the pipe 63 to an extrusion nozzle 68, which may have a single or several orifices of any desired shape, the soap being extruded in the form of threads or as a continuous bar 69. Devices may be incorporated in the extrusion nozzle 68 to break up the threads or bar into separate pieces of soap or the threads or bar 69 may be broken up after leaving the extrusion nozzle 68.

The water injection pump 7 may also be a screw or gear pump, being driven by a motor 71, the speed of which may be regulated to control the amount of water injected through a pipe 72 into the coil 52 of the boiler 5.

Any gas or vapor released in the separating chamber 3 is withdrawn through a pipe 34 having a pressure gauge 35 and a thermometer 36 therein. The pipe 34 communicates with the bottom of the glycerine condenser 8. The glycerine condenser 8 consists of a tight shell 81 having intermediate heads 82 between which tubes 83 extend. The space between the heads 82 inside the shell 81 and around the tubes 83 is filled with cooling water delivered through a pipe 84 having a valve 85, this cooling water being removed through a pipe 86.

Any condensate produced in the glycerine condenser 8 passes downwardly through a pipe 87 to a glycerine tank 88, the pipe 87 being about thirty feet long so that as long as the lower end of the pipe is submerged in the glycerine in the

tank 88, it is possible to maintain a high degree of vacuum in the condenser 8.

Any gases or vapors which are not condensed in the glycerine condenser 8 pass through a pipe 91, having a thermometer 92 and a pressure gauge 93 therein, to the jet condenser 9. This jet condenser is supplied with cooling water from a pipe 94 and is provided with an air pump 95. Any water condensed in the jet condenser 9 is delivered through a pipe 96 to a water tank 97. The pipe 96 is about thirty feet long so that as long as the lower end is submerged in the water in the tank 97, a vacuum may be maintained in the condenser 9 if desired.

The method of operation is as follows:

The tank 16 is filled with the saponifiable fat which it is desired to convert into soap, this fat being warmed if necessary to a point at which it is liquid. The tank 18 is filled with an aqueous solution of a saponifying alkali, such, for example, as a solution of caustic soda in water. The fat is pumped into the mixer 17 by the pump 12 and the saponifying alkali is pumped into the mixer 17 by the pump 11. The variable speed gear 14 is adjusted so that the proportion of saponifying alkali supplied to the mixer 17 is only slightly in excess of that theoretically necessary to completely saponify the fat. The pumps 11 and 12 may be piston pumps but should be of such type that they can pump against several hundred pounds per square inch pressure. The mixture of saponifiable fat and saponifying alkali is delivered through the pipe 19 to the heater 2 and is heated therein by the products of combustion from the burner 24.

In the coil 21 a reaction takes place between the saponifying alkali and the saponifiable fat, and soap and glycerine are formed. Sufficient heat is supplied to the mixture in the coil 21 to raise the temperature of the reaction products passing through the pipe 26, as indicated on the thermometer 28.

The reaction products, that is to say, the soap and glycerine, with all of the water content of the mixture delivered to the coil 21, are ejected through the nozzle 31 into the separating chamber 3. The interior of the separating chamber 3 is maintained under vacuum and there is, of course, a high pressure drop as the reaction products pass through the constricted orifice of the nozzle 31.

These reaction products emerge from this constricted orifice in the form of a high velocity jet containing steam, glycerine vapor, and particles of liquid soap. The soap is thrown violently downward to the bottom of the chamber due to the velocity of the jet and in its passage through the chamber the glycerine vapor and steam escape therefrom, passing upwardly and being withdrawn through the pipe 34. Sufficient heat should be supplied by the burner 24 to enable the temperature as indicated by the thermometer 36 of the vapors passing to the glycerine condenser 8 to be maintained above the boiling point of glycerine at the absolute pressure indicated on the vacuum gauge 35.

The soap which is delivered to the bottom of the separating chamber 3 contains almost no water or glycerine. It is, however, at a sufficiently high temperature to be liquid and it is continuously withdrawn through the soap pump 4 and delivered to the pipe 42.

Since the soap delivered to the pump 4 is practically free from water, it is desirable to add water thereto to produce a commercial soap, since such soaps usually contain from 10% to 20% of water. This water content is added in the form of steam injected through the pipe 55 into the flowing stream of hot soap leaving the pump 4 through the pipe 42. The pump 4 should be capable of exerting considerable pressure since it not only takes soap from the chamber, which is under a vacuum, and extrudes it against atmospheric pressure, but it must also overcome some fluid friction in the cooler 6 and a very considerable friction in the extrusion nozzle 68. By regulating the rate of feed of the water pump 7 in proportion to the rate of feed of the fat pump 12, a soap of absolutely fixed and definite water content can be produced.

The mixture of steam and glycerine vapor passing through the pipe 34 into the glycerine condenser 8 is cooled in its upward passage through the tubes 83 to such a degree that substantially all of the glycerine content of these vapors is condensed, this glycerine condensate running downwardly through the pipe 87 to the tank 88. The steam, freed from the glycerine vapors, then passes through the pipe 91 to the water condenser 9. The supply of cooling water delivered to the glycerine condenser through the pipe 84 is so regulated that the temperature of the steam passing through the pipe 91, as indicated on the thermometer 92, is considerably below the boiling point of glycerine at the pressure indicated on the pressure gauge 93 and above the boiling point of water at that pressure.

In the jet condenser 9 the steam is condensed due to the introduction of cooling water through the pipe 94, the condensed water being delivered through the pipe 96 to the tank 97. Any air or uncondensed vapor or gas which would tend to accumulate in the jet condenser 9 is continuously withdrawn by the air pump 95.

In practice the degree of vacuum carried in the separating chamber 3 may be regulated by suitable manipulation of the condensers 8 and 9 and the air pump 95. The degree of vacuum maintained depends somewhat upon the temperature of the jet leaving the nozzle 31. The higher this temperature, the higher the absolute pressure can be carried in the separating chamber 3. This pressure must be sufficiently low to promote a rapid vaporization of the glycerine, this vaporization being promoted by the fact that the chamber also contains steam, thus reducing the partial pressure of the glycerine vapors due to the law of partial pressures.

In practice the apparatus operates continuously, the tanks 16 and 18 being replenished from time to time and the glycerine and water delivered to the tanks 97 and 88 being withdrawn as they accumulate. The soap 69 extruded from the pipe 61 has a definite and constant water content. The glycerine recovered, being a distillate, is in very pure form and has a high commercial value.

If desired, the temperature in the separating chamber 3 can be lowered sufficiently so that all or a portion of the glycerine is not vaporized and is carried over as a liquid in the soap removed by the pump 4. The same effect can, of course, be obtained by increasing the absolute pressure in the separating chamber. All that is necessary to permit the glycerine to be carried over into the soap with a substantial dehydration of the soap passing to the pump 4, is to hold the temperature in the separating chamber 3 above the boiling point of water at the pressure maintained there-

in, but below the boiling point of glycerine under that pressure.

This application is a division of my application Serial No. 730,971, filed June 16, 1934, now Patent No. 2,037,006, granted April 14, 1936, for Process for producing soap having a definite water content.

I claim as my invention:

1. In combination in an apparatus for continuously producing soap: walls forming a passage closed from the atmosphere and providing a first portion comprising an elongated reaction zone, a second portion comprising an enlarged separating zone and a third portion comprising a discharge zone; pump means for continuously introducing into first portion of said passage proportioned quantities of saponifiable and saponifying materials whereby a mixture thereof flows continuously through said reaction zone with progressively decreasing pressure; means for heating said reaction zone to form reaction products including soap and vapor which reaction products are continuously introduced into said separating zone; means for withdrawing said vapor from said separating zone at such rate as to maintain a vacuum therein, thus separating said vapor from said reaction products to leave soap; extrusion means at the end of said passage for extruding a stream of soap delivered thereto through said discharge zone; and pump means for continuously withdrawing soap from said enlarged separating zone while retaining same in said passage and thus out of contact with the atmosphere and against the vacuum in said separating zone without impairing said vacuum, said pump means developing sufficient superatmospheric pressure to extrude a stream of said soap through said extrusion means after flow along said discharge zone.

2. A combination as defined in claim 1 in which said pump means comprises a screw pump positioned in at least a portion of said discharge zone.

3. In combination in an apparatus for continuously producing and processing soap: walls defining a separating zone; means for continuously delivering to said separating zone a stream of hot reaction products including vapor and soap; pump means for continuously withdrawing vapor from said separating chamber at such rate as to maintain a partial vacuum therein; walls defining a discharge passage closed from the atmosphere and communicating with said separating zone; pump means for continuously withdrawing hot soap from said separating zone at a rate substantially corresponding to the rate said soap is delivered thereto in said reaction products and for moving said soap thus withdrawn along said discharge passage as a stream and without exposure thereof to the atmosphere; extrusion means receiving the stream of soap flowing in said discharge passage for extruding same, said pump means acting against said partial vacuum in said separating chamber and increasing the pressure on said soap to a value sufficient to extrude same through said extrusion means; and means for cooling said stream of soap during its flow through said discharge passage.

4. In combination in an apparatus for continuously producing and processing soap: walls defining a separating zone; means for continuously delivering to said separating zone a stream of hot reaction products including vapor and soap; pump means for continuously withdrawing vapor from said separating chamber at such rate as to maintain a partial vacuum therein; walls defining a discharge passage closed from the atmosphere and communicating with said separating zone; pump means for continuously withdrawing hot soap from said separating zone at a rate substantially corresponding to the rate said soap is delivered thereto in said reaction products and for moving said soap thus withdrawn along said discharge passage as a stream and without exposure thereof to the atmosphere; extrusion means receiving the stream of soap flowing in said discharge passage for extruding same, said pump means acting against said partial vacuum in said separating chamber and increasing the pressure on said soap to a value sufficient to extrude same through said extrusion means; walls defining a discharge passage closed from the atmosphere and communicating with said separating zone; pump means for continuously withdrawing hot soap from said separating zone at a rate substantially corresponding to the rate said soap is delivered thereto in said reaction products and for moving said soap thus withdrawn along said discharge passage as a stream and without exposure thereof to the atmosphere; extrusion means receiving the stream of soap flowing in said discharge passage for extruding same, said pump means acting against said partial vacuum in said separating chamber and increasing the pressure on said soap to a value sufficient to extrude same through said extrusion means; means for continuously adding moisture to said soap during continuous advancement through said discharge passage before it reaches said extrusion means; and means for cooling said soap during continuous advancement in said discharge passage and before it reaches said extrusion means.

5. In combination in an apparatus for continuously producing and processing soap: walls defining a separating zone; means for continuously delivering to said separating zone a stream of hot reaction products including vapor and soap; pump means for continuously withdrawing vapor from said separating chamber at such rate as to maintain a partial vacuum therein; walls defining a discharge passage closed from the atmosphere and communicating with said separating zone; a screw pump for continuously withdrawing hot soap from said separating zone at a rate substantially corresponding to the rate said soap is delivered thereto in said reaction products and for moving said soap thus withdrawn along said discharge passage as a stream and without exposure thereof to the atmosphere; extrusion means receiving the stream of soap flowing in said discharge passage for extruding same, said screw pump acting against said partial vacuum in said separating chamber and increasing the pressure on said soap to a value sufficient to extrude same through said extrusion means; and means for cooling said stream of soap during its flow through said discharge passage.

6. In combination in an apparatus for producing soap: walls defining a passage closed from the atmosphere; means for continuously introducing proportioned streams of saponifying and saponifiable materials into one end of said passage; means for heating the resulting mixture of said reacting materials during flow through said passage to form reaction products including soap and vapors; means communicating with said passage for continuously removing said vapor from the stream moving through said passage and during continued advancing movement of the balance of said soap and vapors along said passage; pump means intaking from the other end of said passage for continuously withdrawing the soap therefrom against the action of said means for removing said vapors.

7. In combination in an apparatus for producing soap: walls defining a passage closed from the atmosphere; means for continuously introducing proportioned streams of saponifying and saponifiable materials into one end of said passage; means for heating the resulting mixture of said reacting materials during flow through said passage to form reaction products including soap and vapors; means communicating with said passage continuously removing said vapor from

the stream moving through said passage and during continued advancing movement of the balance of said soap and vapors along said passage; pump means intaking from the other end of said passage for continuously withdrawing the total soap products therefrom against the action of said means for removing said vapor and increasing the pressure on said soap products to a value sufficient to extrude same; and extrusion means communicating with the discharge of said pump means for extruding the soap products.

8. In combination in an apparatus for continuously producing soap: means for reacting under heat and pressure proportioned quantities of saponifiable and saponifying materials to produce reaction products including vapor and soap; means for separating said vapor from said reaction products to leave soap sufficiently hot to be substantially molten, said means including walls defining a separating zone continuously receiving a stream of said reaction products; pump means for withdrawing said vapor from said separating zone at such rate as to maintain a partial vacuum therein; walls defining a discharge passage closed from the atmosphere; an extrusion means communicating with said discharge passage; pump means for continuously withdrawing said substantially molten soap from said separating zone at a rate corresponding to the rate at which said soap is delivered thereto in said reaction products, said pump means withdrawing said soap against the partial vacuum in said separating zone without impairing said partial vacuum and developing sufficient pressure to move said soap as a stream along said discharge passage and through said extrusion means; and means for cooling said soap from its substantially molten condition as it flows in said discharge passage and thus while out of contact with the atmosphere.

9. In combination, in an apparatus for producing soap and continuously recovering glycerine: walls forming a passage closed from the atmosphere and providing a first portion comprising a reaction zone, a second portion comprising a separating zone and a third portion comprising a discharge zone; pump means for continuously introducing into first portion of said passage proportioned quantities of saponifiable and saponifying materials whereby mixture thereof flows continuously through said reaction zone; means for heating said reaction zone to form reaction products including soap and vapor which reaction products are continuously introduced into said separating zone; means for withdrawing said vapor from said separating zone at such a rate as to maintain a vacuum therein, thus promoting the separation of the vapor from said reaction products to leave soap, pump means for continuously withdrawing soap from said separating zone without breaking the vacuum maintained therein and discharging the same through said discharge zone.

10. Apparatus for separating glycerine from a soap mixture containing glycerine and soap, which comprises: a heating device, means for forcing a stream of said mixture under pressure through said heating device, means for supplying heat to said heating device to raise the temperature of said mixture at least sufficient to vaporize said glycerine when said pressure is released and to render the resultant soap in a molten condition, an evaporating chamber, sealed from the atmosphere, means for spraying the heated mixture into said chamber to liberate glycerine vapor and deposit molten soap in said chamber, means for withdrawing vapors from said chamber and maintaining pressure in said chamber low enough to vaporize said glycerine and means constructed and arranged for withdrawing said molten soap from said chamber while maintaining said chamber sealed from the atmosphere.

11. An apparatus for producing soap and recovering glycerine which comprises, in combination, means for mixing saponifiable and saponifying materials, means for advancing the said mixture as a stream, means for heating the mixture during its advancement, a vaporizing chamber communicating with said means into which the heated mixture is discharged, means for withdrawing the glycerine vapors at a rate sufficient to maintain a pressure in said vaporizing chamber low enough to vaporize said glycerine, means for condensing the withdrawn vapors, a discharge passage communicating with the vaporizing chamber and pumping means adapted to continuously withdraw the soap deposited in the vaporizing chamber without substantially impairing the vacuum maintained therein.

12. An apparatus for producing soap and recovering glycerine comprising, in combination, a conduit, means for advancing therethrough a mixture of saponifiable and saponifying materials, an evaporating chamber communicating therewith into which the mixture is discharged, means for withdrawing glycerine vapors from said evaporating chamber at a rate sufficient to maintain a pressure in said chamber low enough to promote the vaporization of said glycerine vapors, means for maintaining the heat in said evaporating chamber sufficiently high to render the soap deposited therein in a molten condition, a discharge passage, means constructed and arranged for continuously withdrawing said molten soap from said chamber and discharging the same by said discharge means without substantial impairment of the vacuum maintained in said evaporating chamber.

13. An apparatus for producing soap and recovering glycerine comprising an elongated reaction pipe, means for forcing, under pressure, a soap mixture containing glycerine through said pipe, means for heating said mixture during its advancement sufficiently high to raise the temperature of the mixture to promote the vaporization of said glycerine when the pressure is released and to render the soap in a molten condition, an evaporating chamber sealed from the atmosphere, means for spraying the heated mixture into said chamber to liberate the glycerine vapor and to deposit molten soap therein, means for withdrawing the glycerine vapors from said chamber at a rate sufficient to maintain a sufficient vacuum therein to vaporize substantially all of the glycerine in said mixture, a passageway communicating with said evaporating chamber and means constructed and arranged for forcing the molten anhydrous soap through said passageway, said means being constructed and arranged to effect the withdrawal of the soap without discontinuing the operation of the apparatus.

14. An apparatus for producing a substantially glycerine free soap comprising a heating device, means for forcing, under pressure, a soap mixture through said heating device, means for heating the device sufficiently high to raise the temperature of the mixture to vaporize the constituents thereof when the pressure is released, an evaporating chamber, sealed from the atmosphere, means for spraying the heated mixture into said chamber to liberate said vapors and to

deposit molten soap in said chamber, means for maintaining a sufficient vacuum therein to promote the vaporization of substantially all of the water and impurities in said mixture, a discharge passageway communicating with said chamber through which the resultant soap, freed from the said vapors, is discharged, and pumping means associated with said discharge means so constructed and arranged to continuously withdraw said soap from said evaporating chamber without substantially impairing the vacuum maintained therein.

BENJAMIN CLAYTON.