Feb. 10, 1948. M. H. ITTNER 2,435,745

FAT HYDROLYSIS

Filed May 15, 1941 3 Sheets-Sheet 1

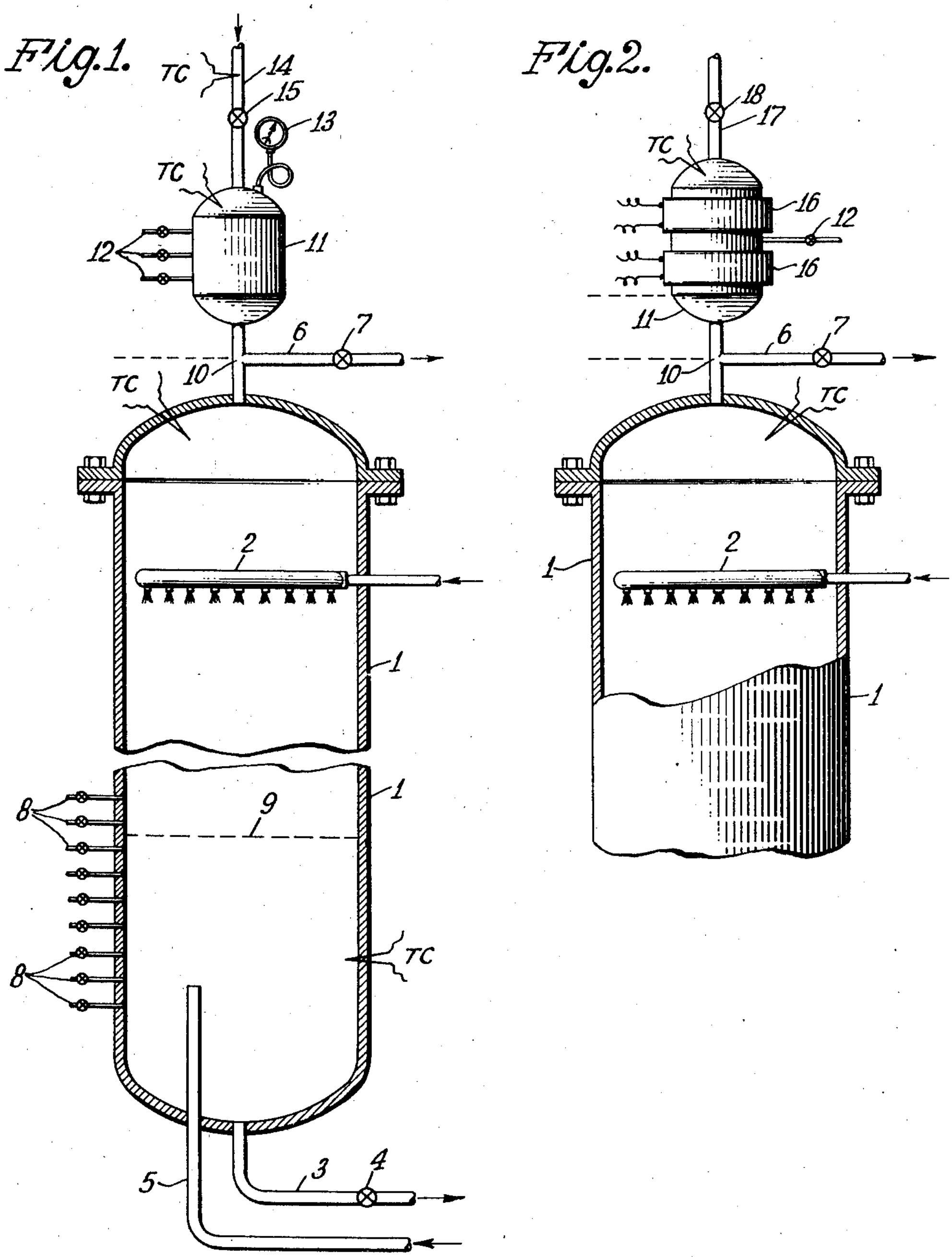

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Fig. 3.

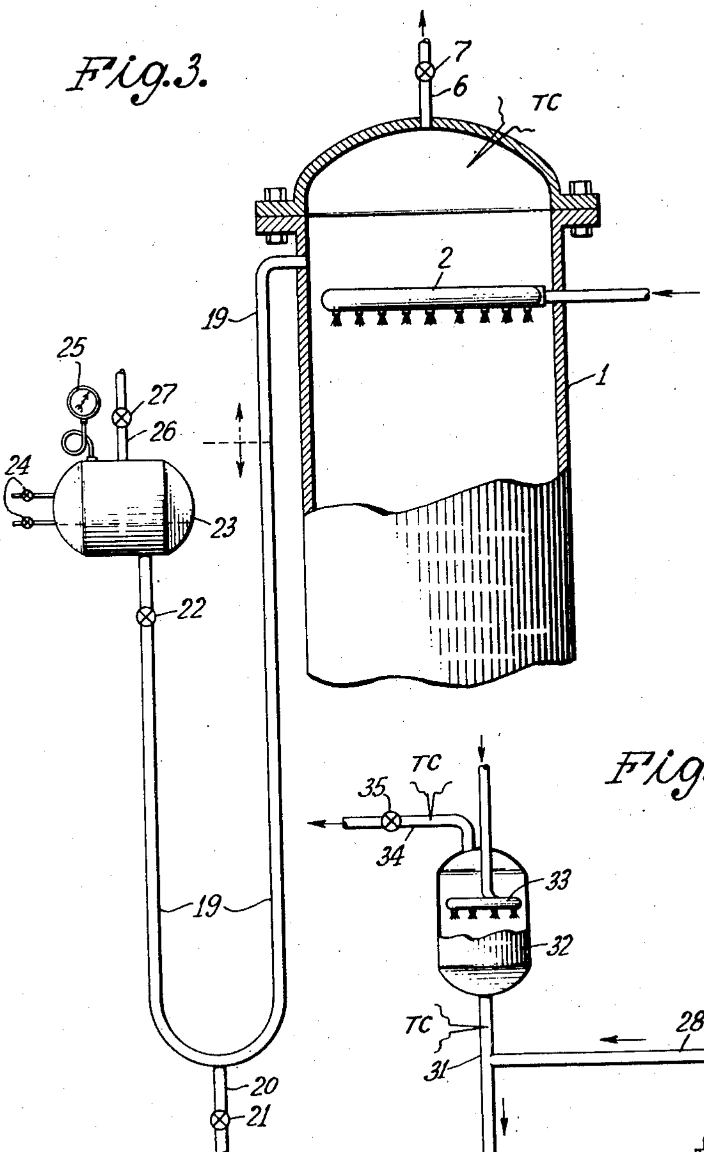

Fig. 4.

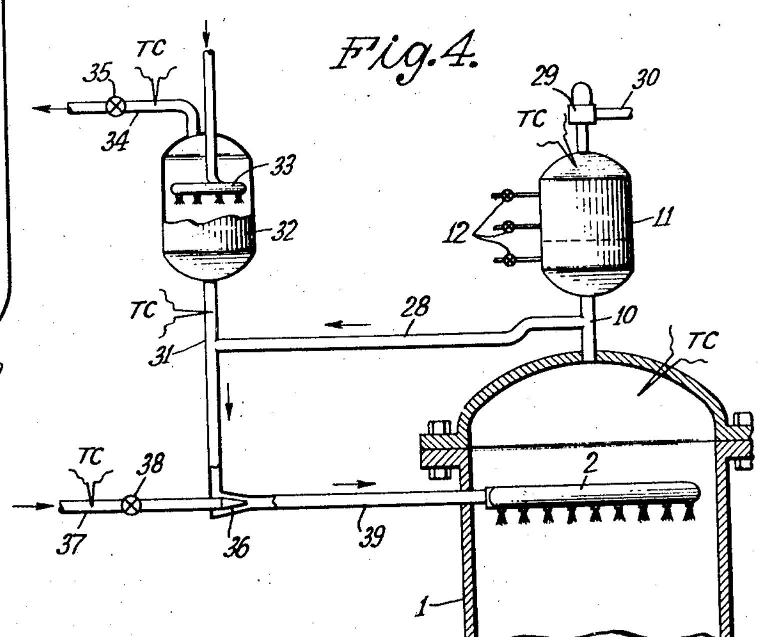

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Fig. 5.

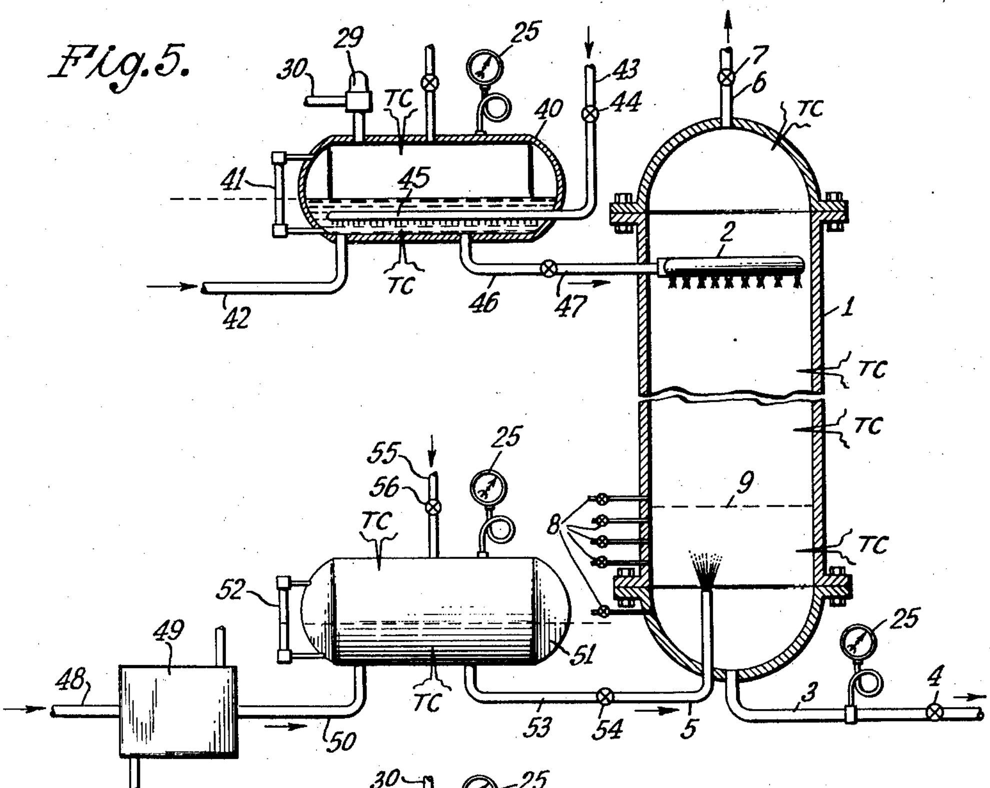
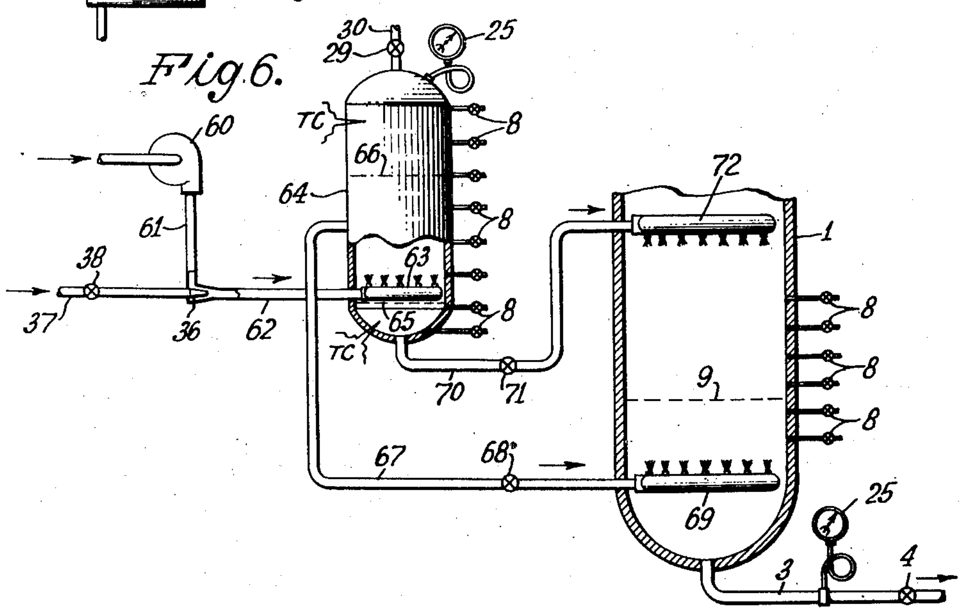


Fig. 6.



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2,435,745

UNITED STATES PATENT OFFICE

2,435,745

FAT HYDROLYSIS

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Application May 15, 1941, Serial No. 393,650

8 Claims. (Cl. 260—415)

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This invention relates to certain processes which are carried out under pressure and more particularly to the hydrolysis of fats with liquid water in autoclaves with the aid of elevated temperatures and pressures and to apparatus suitable therefor.

In the hydrolysis of fats as now carried out at comparatively high temperatures and pressures, that is, generally upwardly of about 200° C., with hot water in liquid condition, it is advantageous to maintain the pressure reaction vessel full of liquid water and fatty matter undergoing hydrolysis. The reacting liquids are forced into the vessel by suitable means, commonly with the employment of high pressure pumps. With vessels completely filled with liquid a very considerable amount of hydrostatic pressure is thus built up with great rapidity and would soon strain the vessel to the bursting pressure if proper provision were not made to guard thereagainst. It is thus necessary to provide pressure relief valves so that for each portion of liquid introduced under pressure a substantially equal volume of reacted liquid or liquids is allowed to escape through the relief valves. In this way an effort is made to maintain the desired pressure without undesired pressures being built up. Most pumps suitable for pressure work are prone to operate at at least somewhat irregular rates of delivery so that pulsating fluctuations of pressure are brought about and the effect of such pulsating irregularities in the liquid feed of a pressure vessel are hammer-like in intensity where reciprocating pumps are used and place the vessel at frequent intervals under undesirable and excessive stresses. The well-known practice of providing pumps with air-chambers filled with air in ordinary service, such as pumping water saturated with air, tends to even the flow the the pump discharge and to smooth out the pressure fluctuations. An ordinary air chamber on a pressure pump used in the hydrolysis of fats would be a very undesirable adjunct, as the air would gradually find its way into the pressure vessel and thus eventually completely lose its cushioning function. Also, at the temperatures favorable for hydrolysis, air is very destructive to fats and will cause harmful darkening and degradation of the fatty matter. It is even desirable, if not necessary practice, to subject the fat feed to special deaerating treatments to exclude every possible trace of air. If an inert gas were to be employed in an ordinary air chamber of a pump supplying degasified fat under pressure for hydrolysis the inert gas would

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soon be dissolved and entrained in the feed and its advantage would soon be lost to the process.

It has been proposed to employ a cushioning chamber of saturated steam within or directly connected to the upper part of the hydrolysis pressure vessel.

It is an object of this invention to furnish an improved, novel and effective cushion against pulsating pressure fluctuations in introducing liquids into pressure vessels.

It is an object to provide a method of supplying liquids in non-pulsating flow to high pressure vessels.

It is also an object of the invention to effect certain economies in the process of hydrolysis both due directly to the cushioning method employed and indirectly to other advantages that are inherent in the process.

It is an object of the invention to provide improved and more economical methods of heating the materials to be subjected to hydrolysis and to provide improved and economical methods for introducing and contacting the reacting materials.

Other objects will become apparent as the process is more fully disclosed and described.

Fig. 1 represents diagrammatically the upper and lower parts of an autoclave, partly cut away, suitable for the practice of the process.

Fig. 2 represents a modified arrangement of the upper part of an autoclave, also partly cut away, suitable for carrying out the process.

Fig. 3 represents the upper part of an autoclave, partly cut away, in conjunction with another modification of the apparatus of the invention suitable for carrying out the invention.

Fig. 4 represents a sectional view of the upper part of an autoclave, partly cut away, with apparatus connected thereto providing a modified means of carrying out the invention.

Fig. 5 represents the upper and lower parts of an autoclave with apparatus connected thereto suitable for carrying out the invention.

Fig. 6 represents the lower part of an autoclave with modified means suitable for carrying out the invention.

The apparatus illustrated in Fig. 1 may be more particularly described as follows: An autoclave or pressure vessel 1 suitable for carrying out countercurrent hydrolysis of fats with water with the aid of heat and pressure is provided with a device 2 for distributing the wash water employed for extracting glycerine set free from the fatty acids produced in the process. A runoff pipe 3 connected with the bottom of the autoclave is provided with a suitable relief valve 4 for removal of the aqueous glycerine solution produced by the process. An inlet pipe 5 is provided for introduction of the fat into the lower portion of the pressure vessel 1. A runoff pipe 6 provided with a suitable relief valve 7 is connected with the upper part of the pressure vessel 1 for removal of fatty acids produced in the process. Tell-tale cocks 8 are provided so as to facilitate the location of the interface 9 between the aqueous glycerine solution in the lower part of autoclave 1 and the fatty matter thereabove.

The fatty acid outlet is through a T 10 connecting with runoff pipe 6. T 10 is also connected with small pressure vessel 11 located above it. Pressure vessel 11 is provided with suitable tell-tale cocks 12 for determining the presence of liquid or vapor within pressure vessel 11. Pressure vessel 11 may be provided with a pressure gage 13. Pressure vessel 11 is connected to a source of high pressure steam by means of pipe 14 and regulating valve 15. Thermocouples TC are provided as shown and for such locations as may have different or varying temperatures which it may be desirable to determine.

The autoclave partially represented in Fig. 2 differs from that of Fig. 1 mainly in the fact that the small pressure vessel 11 of Fig. 2 is provided with one or more suitable heating elements 16, electric or of other kind, for applying controlled, additional heat to vessel 11 and its contents. The upper part of pressure vessel 11 is supplied with suitable pipe connection 17 and valve 18 for adding steam to or removing it from vessel 11. Thermocouples TC may be provided as and where needed, or desired.

An autoclave 1 is partially represented in Fig. 3 which has connected to it a side tube 19. The side tube 19 is represented as connected to the side of the pressure vessel near the top but may be advantageously attached thereto at other positions, as for example near the bottom or at some intermediate side position. Tube 19 may be advantageously extended downwardly and then upwardly so as to form a U-tube. Tube 19 may be provided near its lowest part with connection 20 and valve 21 attached thereto, and with valve 22 which may be used to control the passage of fluids through tube 19 to or from pressure tank 23. Pressure tank 23 is provided with suitable tell-tale cocks 24, or other means, for determining and controlling the interface between two different layers of fluids within tank 23 which is also provided with pressure gage 25 and connection 26 and valve 27.

Where tell-tale cocks are used in the apparatus of the invention, they may also serve other purposes, as for example the withdrawal of samples or for the withdrawal or addition of other material as desired. Additional cocks, not shown, may be employed where and as desired.

Fig. 4 represents the upper part of pressure vessel 1 connected through T 10 with pipe 28 and pressure vessel 11 which latter is provided with tell-tale cocks 12 and in its upper part with hand controlled or automatic valve 29 and connection 30. Pipe 28 is provided with a drop so that as it extends outwardly from T 10, it also extends downwardly to the point where it connects with vertical pipe 31. Pipe 31 connects upwardly with pressure vessel 32 which is provided with a suitable water distributer 33 and outlet pipe 34 and control valve 35. The lower end of pipe 31 connects with injector 36 which is also connected through valve 38 to high pressure steam supply pipe 37. The discharge from injector 36 is through pipe 39 to distributor 2 in autoclave 1.

Thermocouples TC may be provided and placed in any part of the apparatus of the invention where it may be desirable to obtain readings or records of varying temperatures at given points, or significant differences in temperature which may occur between different points within the apparatus.

The apparatus shown in Fig. 5 represents a high pressure vessel 1, in section and partly cut away with novel means for heating and supplying the water and fat to be subjected to countercurrent hydrolysis. Vessel 1 is provided with water distributer 2 and fatty acid outlet pipe 6 and controlled relief valve 7 in its upper part, and aqueous glycerine runoff pipe 3 and controlled pressure relief valve 4 near its bottom. Fat inlet pipe 5 is also supplied near the bottom. Vessel 1 is provided with tell-tale cocks 8 to determine the location of the fat-aqueous glycerine interface 9, and with thermocouples TC at different locations to give the temperature of the contents at these locations. A hot water pressure supply tank 40, provided with level indicator 41, is placed advantageously near the upper part of vessel 1. Tank 40 may be supplied with water under pressure through pipe 42 which may be heated as desired by a supply of high pressure steam from pipe 43 regulated by means of valve 44 and perforated coil 45 located in the lower part of vessel 40 beneath the surface of a water layer maintained in tank 40. The water heated in tank 40 may be supplied, as desired, to distributor 2 by means of pipe 46 and control valve 47. The upper part of tank 40 will, in normal operation, be filled with steam under pressure. Thermocouples TC are provided to indicate the temperature of the water layer in tank 40 and of the steam above it. It is preferable to maintain the temperature and pressure of the steam in tank 40 sufficiently higher than the temperature and pressure of the fatty acids in the upper part of vessel 1 to impel water to flow through pipe 46. Tank 40 also has a pressure gage 25 and a suitable steam relief valve 29 connecting with pipe 30. The equipment attached to the lower part of vessel 1 provides a novel method of heating and supplying the fat for hydrolysis. The fat under pressure is supplied through pipe 48 and is heated in heater 49 and passes by pipe 50 into pressure tank 51 located preferably near the bottom of autoclave 1 and connected therewith by hot fat supply pipes 53 and 55 and supply control valve 54. Pressure tank 51 serves as a come and go reservoir of hot fat which is supplied in a steady stream, or as desired, to vessel 1 through and by means of control valve 54. Tank 51 is provided with a pressure gage 25 and a nitrogen supply pipe 55 and control valve 56 to the supply of nitrogen or other substantially inert gas maintained in the upper part of tank 51 at a sufficiently higher pressure than is maintained in vessel 1 to impel fat to flow through pipe 53. Tank 51 is also provided with thermocouples for indicating the temperature of its contents.

The apparatus shown in Fig. 6 illustrates the lower part of an autoclave for countercurrent hydrolysis of fats. The fat supply, which may be somewhat preheated is brought to pump 60 which forces it through pipe 61 to injector 36 which is connected through valve 38 to high pressure steam supply pipe 37. The fat is impelled by steam injector 36 through pipe 62 where it becomes heated to the desired temperature and through distributer 63 into pressure tank 64 which serves as a come and go reservoir for hot fat. Part of the steam used for injecting and heating the fat becomes condensed to liquid water upon transferring its latent heat to the fat. The water thus condensed settles in the bottom of tank 64 beneath the fat-water interface 65, and excess steam rises through the fat and collects above the steam-fat interface 66 and may be drawn off as desired through controlled relief valve 29 and pipe 30. Water containing some glycerine is conducted from the bottom of tank 64 through pipe 70 and control valve 71 to a water distributer 72 located preferably intermediate between interface 9 and water distributer 2 near the top of vessel 1, at a place where the concentration of the countercurrently falling glycerine washings are not greatly different from the concentration of glycerine in the water entering through distributer 72. Pipe 67 connects with the fatty phase within tank 64 so that a supply of hot fat may be permitted to enter vessel 1 continuously, or as desired, with non-pulsating flow, by the operation of valve 68 and be distributed through distributer 69 preferably substantially beneath the fat-water interface 9 and well above outlet pipe 3.

The operation of the process as performed in the apparatus of Fig. 1 may be as follows: Fat to be hydrolyzed, suitably heated, preferably while in contact with water, is forced into the lower part of vessel 1 through pipe 5. It is very desirable that the fat be discharged into the aqueous glycerine solution maintained in the lower part of pressure vessel 1, well below the water-fat interface 9, in such a way that the hot fat will become broken up into fine globules and become saturated with water extracted from the aqueous glycerine solution, thus increasing the percentage of glycerine in this solution at the same time setting up some countercurrent hydrolysis as the fat globules rise through the water layer. It is also desirable to cause the fat to enter sufficiently above the outlet pipe 3 so that the incoming fat will not become emulsified near the bottom of vessel 1 with the glycerine solution which ordinarily is being discharged simultaneously through pipe 3 and valve 4. Water, suitably heated, is forced into the upper part of vessel 1 through a suitable distributer 2 so as to be finely dispersed and to offer large surface contact between the water droplets thus formed and the fatty matter from which the glycerine is to be extracted by the countercurrent action of descending water and rising fatty matter. The interface 9 between aqueous glycerine solution and fatty matter is preferably maintained at a substantially constant level by the proportion of fat and water employed and by the relative proportions of fatty acids and aqueous glycerine solution released by valves 7 and 4 respectively. The operation of valves 7 and 4 may be automatically controlled so as to maintain a proper pressure within the apparatus. The pressure maintained within the apparatus should be such that the water in the aqueous glycerine solution and dissolved in the fatty layer will remain in liquid condition and not be converted into steam within the aqueous glycerine layer or within the fatty layer at the temperatures maintained therein, either of which would interfere seriously with good countercurrent washing by the formation of emulsions in the zone for countercurrent washing, or by actually depleting the effective wash water and the dissolved water, both of which are essential to efficient countercurrent hydrolysis. The fatty acids passing through T 10 are in contact at or near this point with steam in substantial pressure equilibrium with the contents of vessel 1. Steam from a source having a pressure always somewhat higher than the pressure maintained in vessel 1 is permitted to enter vessel 11 through pipe 14 and control valve 15 preferably in amounts just about sufficient to prevent fatty acids from entering and remaining in vessel 11 while at the same time avoiding the necessity of providing any large excess of such steam. Any excess steam thus present in vessel 11 at any time may be permitted to escape together with outgoing fatty acids through pipe 6 and controlled pressure relief valve 7. Other means than valve 7, and separate therefrom, may be provided for escape of the excess superheated steam.

The high pressure steam entering through pipe 14 and valve 15 is released to a somewhat lower pressure on passing through valve 15 and is therefore superheated. Operation of the process will be greatly facilitated by observing from time to time simultaneous temperature readings of the high pressure steam in pipe 14, the superheated steam in vessel 11, and the fatty acids saturated with dissolved water in the upper part of vessel 1. With these data constantly available, it will be easy to so control valve 15 that the superheated steam in vessel 11 shall always have a slightly higher temperature than the outgoing fatty acids. The degree of this excess temperature is limited on the low side, only by the delicacy of available control instruments, a small fraction of a degree of excess temperature being all that is required, inasmuch as it is all the excess necessary to maintain a volume of superheated steam and to retain the liquids within vessel 1 in a liquid condition and to prevent any formation of vapor within the liquid layers in vessel 1 which would interfere with countercurrent hydrolysis. It may thus be seen, that with regulation that may readily be provided, it will be comparatively easy to avoid the necessity of supplying any large amount of steam through valve 15, and that the amount of excess steam allowed to escape through valve 7 with the fatty acids may be kept down close to none at all.

The apparatus of Fig. 2 may be operated as described for that of Fig. 1 but may also be operated without the aid of an outside source of high pressure steam by employing the heating elements 16 around vessel 11. In countercurrent hydrolysis, it is essential for smooth operation that the temperatures of the liquids within the pressure vessel shall be at least slightly below the temperature of saturated steam at the corresponding pressures, or conversely, that these liquids at whatever temperatures they may have shall be subjected to at least some excess pressure over the pressure corresponding to the pressure of saturated steam at their temperatures. In this way any excess pressure employed, however small, will prevent the harmful formation of vapor within the liquid layers, the avoidance of which is essential to the smooth operation of countercurrent hydrolysis. It can now be seen that, unless an unnecessarily large excess pressure is employed in vessel 1, the application of a moderate amount of excess heat to vessel 11, applied with the aid of heating elements 16, will result in the formation of steam by the vaporization of a small portion of the dissolved water in that portion of the fatty acids resulting from the process which may enter vessel 11, and that this steam will be superheated. The formation of this steam will drive the fatty acid-steam interface downward toward T 10. If, now, heat be applied continuously to vessel 11 in amounts so controlled that the temperature of the steam in the upper part of vessel 11 will be at all times slightly higher than the temperature of saturated steam at the pressure employed in the upper part of vessel 1, a superheated steam phase with a desirable cushioning effect against pulsating pressure fluctuations will be maintained in vessel 11 while the liquid layers within vessel 1 will remain in the liquid state.

The modified apparatus shown in Fig. 3 illustrates part of the features of the invention. The upper part of autoclave 1 is shown partly in section, partly cut away. It is provided with water distributer 2 and fatty acids outlet pipe 6 and regulating pressure relief valve 7. Pipe 19 connects vessel 1 with vessel 23, valve 22 being open during operation. The lower part of tank 23 is filled with water and so also is the connecting portion of pipe 19 and in fact the greater part of pipe 19. A certain amount of fatty matter will fill that portion of pipe 19 nearest to vessel 1, taking a position in one leg of U-tube 19 above the water therein contained. In beginning operations with this equipment valve 22 may be closed and tank 23 filled with water. Nitrogen or other substantially inert gas under pressure may then be run into tank 23 through valve 27 and pipe 26 on opening valve 22 while at the same time about two-thirds to three-quarters of the water content is permitted to flow out of pipe 19 through valve 22. The inert gas may be added to a pressure about equal to that in vessel 1, after valve 22 has been opened, and tank 23 with its content of inert gas will serve as an efficient cushion to tank 1 protecting it against stresses due to pulsating pressures. During the operation of this equipment, the interface in pipe 19 between water and fatty matter will move down and up with the pulsating increasing or decreasing pressures.

The apparatus illustrated in Fig. 4 embraces certain important novel features which also permit of a novel method of carrying out hydrolysis. The fatty acids resulting from the hydrolysis passing out of the top of autoclave 1 and through T 10 and pipe 28 reach vertical pipe 31 and work upwardly therein to pressure tank 32 which is maintained full of liquid, and thence outwardly through pipe 34 and controlled pressure relief valve 35. In passing upwardly in tank 32 the hot fatty acids come into direct heat exchange relationship with a flow of water supplied through water distributer 33, thus heating the water with heat absorbed from the hot fatty acids. The outgoing fatty acids lose, in this way, the greater part of their dissolved water which is thus added to the water supplied through distributer 33, and any remaining undissolved water separates from the outgoing fatty acids between distributer 33 and outlet pipe 34. The undissolved water in tank 32 works downwardly through pipe 31 to steam-water injector 36 where it comes into intimate, direct contact with high pressure steam supplied through pipe 37 and valve 38. The action of injector 36 produces a strong flow of liquors through pipe 39 to and through distributer 2 bringing the

temperature of the water and fatty matter discharged through distributer 2 up close to the temperature of saturated steam at the pressure maintained in the upper part of vessel 1. This current results also in circulating a certain amount of fatty acids from the upper part of vessel 1 through T 10 and pipes 28 and 31, injector 36, pipe 39 and distributer 2 back into the upper part of vessel 1. In this way the water and fatty acids are almost emulsified and the water is dispersed into a very fine state of subdivision, and on entering vessel 1 is so thoroughly distributed that it contributes at once, and thereafter, the highest degree of efficiency to the washing action of the wash water falling countercurrently downward through the rising fat. An incipient degree of emulsification, or an approach thereto, is not harmful in this part of the apparatus or to this stage of the process where the hydrolysis is already substantially complete. At the temperature and pressure of the operation, fatty matter and undissolved water, even though partly emulsified separate rapidly from one another when removed from an emulsifying influence, and the fatty acids entering tank 32 from pipe 31 are substantially free from emulsification and are almost free from any but dissolved water and the countercurrently flowing water which is passing downwardly through pipe 31. If, for example, a pressure of about 500 pounds per square inch is maintained in vessel 1 and a temperature very slightly lower than the temperature of saturated water vapor at that pressure, and steam is supplied through pipe 37 to valve 38 at 600 pounds per square inch, or somewhat higher, the contact between steam, and water and fatty acids in injector 36 and pipe 39 will heat the water and circulating fatty acids substantially to the temperature of the hot expanded steam. During this operation a certain amount of the hot steam in giving up its latent heat to heat the water and circulating fatty acids will be condensed, thus adding to the total amount of hot water sent to distributer 2. The amount of water thus condensed from the steam is a direct function of the pressure, temperature and amount of steam employed, and of the fresh water added through distributer 33 so that it becomes a matter of adjustment of these controllable factors to determine the total amount of water passing through distributer 2, and to control it at will. Injector 36 may be a single stage or a multi-stage injector. It is desirable to supply an additional pressure tank 11 above T 10. With the method of operation here shown, it is advantageous to inject a slight excess of steam through injector 36 which will pass as such through distributer 2 and rise through T 10 into tank 11. The amount of steam passing thus into tank 11 need not be at all large and this excess steam, which will be very slightly superheated over the temperature maintained in the top of vessel 1, may be suitably released through valve 29 and connection 30 and be utilized elsewhere in the process or for other purposes. The drop in pipe 28 from T 10 to pipe 31 is so that steam will flow only towards tank 11, and liquid water towards pipe 31. Thermocouples in the high pressure steam line 37, in the fatty acids in pipes 34 and 31, and in the upper part of vessels 1 and 11, and elsewhere, permit of easy adjustment, and are conducive to the smooth running of the process and permit the operation of countercurrent hydrolysis within a narrow range of temperature without any danger of untoward variations in either temperature or pressure.

The apparatus of Figs. 5 and 6 provide novel means and methods for supplying hot water and hot fat to vessel 1 substantially without pulsations or pressure variations. Auxiliary water and fat reservoirs 40, 51 and 64 with their contents of hot water or hot fat are maintained at pressures sufficiently above the pressure within vessel 1 to impel the water and fat to flow into the autoclave. The hot water and hot fat are released as desired in substantially non-fluctuating flows through inlet control valves 47, 54, 68 and 71. These reservoir tanks are themselves provided with cushioning means which though having practically no direct influence on changes in pressure in vessel 1, do nevertheless have a salutary influence on the pressure within the auxiliary reservoir tanks.

This application is a continuation-in-part of my prior pending applications Serial No. 240,037 filed November 12, 1938, and Serial No. 311,584 filed December 29, 1939.

The apparatus may be and should be provided with efficient heat insulating material at all parts where heat radiation losses may otherwise be substantial or harmful.

Although the invention has been described and illustrated with reference to specific means and operations, the invention is not limited to the specific means and operations referred to which are only illustrative of the invention described hereinabove and defined in the following claims.

I claim:

1. In the process of hydrolyzing fats by causing liquid fatty matter and liquid water to flow countercurrently in direct contact in an autoclave under suitable high temperature and pressure to form an aqueous glycerine solution in the lower part of the autoclave and fatty matter thereabove, the method of heating water for said countercurrent hydrolysis and dispersing it in said fatty matter which comprises intimately contacting water with steam to heat said water, and utilizing pressure of said steam to impel a flow of said heated water at least largely in liquid form into said fatty matter at a plurality of points near the top of the autoclave, said hot water being at a temperature and pressure sufficiently higher than the temperature and pressure of the fatty matter to effect dispersion of said water in said fatty matter with the aid of uncondensed steam.

2. In the process of hydrolyzing fats with water, to fatty acids and glycerine with the aid of heat and pressure and countercurrent washing of glycerine from the resulting fatty matter with the aid of hot water, the method of dispersing said water to facilitate said washing which comprises mixing the water with a portion of said fatty acids and forcing the mixture of fatty acids and water under pressure with the aid of direct steam into said fatty matter at a plurality of points, the proportion of fatty acids to water being sufficient to aid the dispersion of said water in said fatty matter.

3. In the process of hydrolyzing fats by causing fatty matter and water to flow countercurrently in direct contact in an autoclave under high temperature and pressure, the method of supplying heated fats for said countercurrent flow which comprises maintaining a quantity of hot fatty matter in direct contact with substantially inert gas, maintaining the pressure of said inert gas substantially higher than the pressure in said autoclave, utilizing the pressure of said inert gas to impel hot fatty matter to flow into said autoclave, and controlling the flow of said hot fatty matter into the autoclave.

4. In the process of hydrolyzing fats by causing fatty matter and water to flow countercurrently in direct contact in an autoclave under high temperature and pressure, the method which comprises heating fatty matter before it is forced into said autoclave at least substantially up to temperature for said countercurrent hydrolysis by direct contact with an excess of steam at a temperature and pressure higher than the temperature and pressure in said autoclave, segregating excess steam from said heated fatty matter, and utilizing the pressure of said excess steam to force a flow of said heated fatty matter into said autoclave.

5. In the process of hydrolyzing fats by causing fatty matter and water to flow countercurrently in direct contact in an autoclave under high temperature and pressure, the method which comprises heating fatty matter before it is forced into said autoclave at least substantially up to temperature for said countercurrent hydrolysis by direct contact with an excess of steam at a temperature and pressure higher than the temperature and pressure in said autoclave, segregating excess steam from said heated fatty matter, permitting undissolved hot water condensed from said steam together with any glycerine derived from said fatty matter dissolved therein to settle from fatty matter thus heated, and utilizing the pressure of the segregated steam to force fatty matter thus heated and segregated into the autoclave where it is subjected to said countercurrent hydrolysis.

6. In the process of hydrolyzing fats by causing fatty matter and water to flow countercurrently in direct contact in an autoclave under high temperature and pressure, the method which comprises heating fatty matter before it is forced into said autoclave at least substantially up to temperature for said countercurrent hydrolysis by direct contact with an excess of steam at a temperature and pressure higher than the temperature and pressure in said autoclave, segregating excess steam from said heated fatty matter, permitting undissolved hot water condensed from said steam together with any glycerine derived from said fatty matter dissolved therein to settle from the heated fatty matter, forcing hot water into said autoclave near the top thereof, forcing said heated fatty matter into said autoclave near the bottom thereof and forcing said settled water and glycerine into said autoclave between the places of introducing said water and fatty matter.

7. In the countercurrent process of hydrolyzing fats with water to fatty acids and glycerine at elevated temperature and pressure, the method which comprises contacting hot fatty acids produced in the countercurrent process with water at lower temperature to effect cooling of the fatty acids and heating of the water by direct heat exchange, supplying additional heat to said water by direct steam, and contacting said heated water by countercurrent flow with fatty material to be hydrolyzed.

8. The method of hydrolyzing fats which comprises intimately contacting fatty material with water by countercurrent flow in an autoclave at elevated temperature and pressure to form fatty acids and glycerine, withdrawing fatty acids from the upper part of said autoclave, withdrawing glycerine from the lower part of said autoclave, subjecting the fatty acids formed while still under

pressure to partial cooling by direct contact and mixing with water having a lower temperature whereby the water is heated and the fatty acids are cooled, supplying additional heat to said water by injecting steam at a higher temperature and pressure into contact therewith, and dispersing said heated water and injected steam into fatty material in said autoclave for countercurrent flow with fatty material to be hydrolyzed.

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