April 18, 1939. G. W. EISENLOHR 2,154,835

PROCESS OF HYDROLYZING OILS AND FATS

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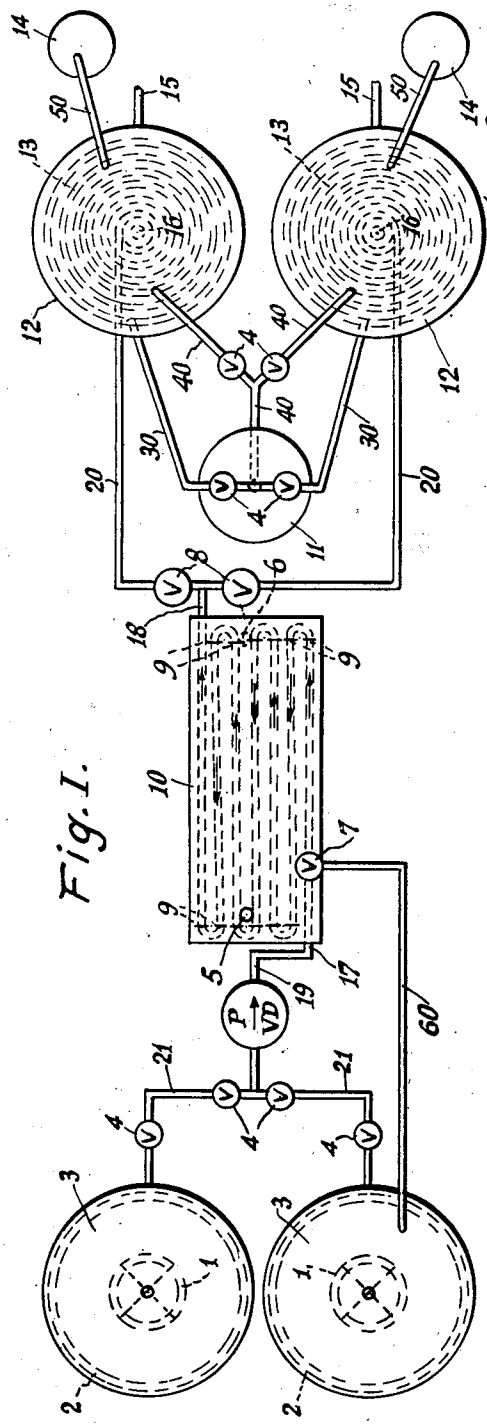


Fig. I.

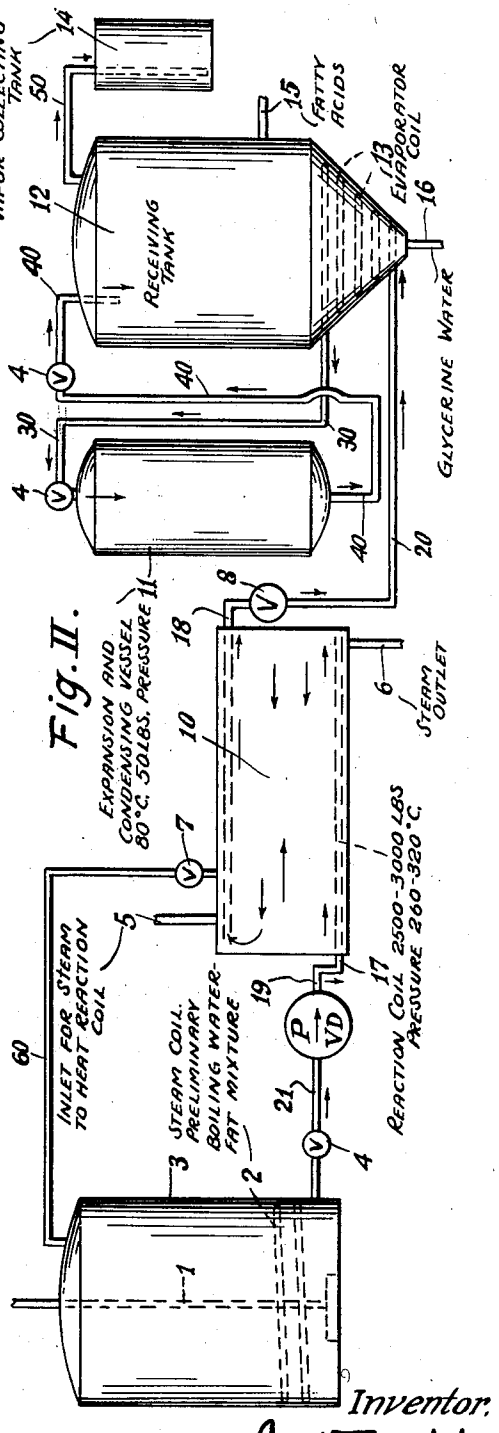


Fig. II.

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Fig. III.

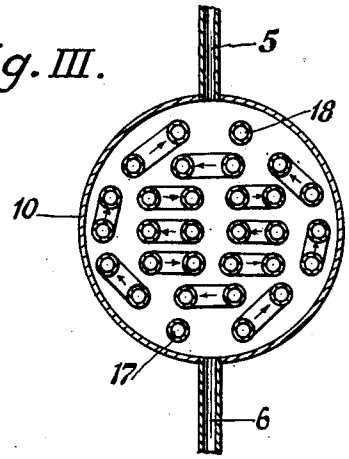
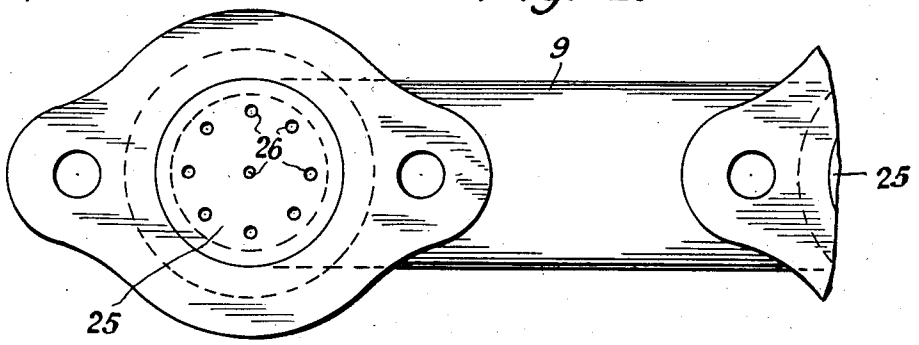


Fig. IV.



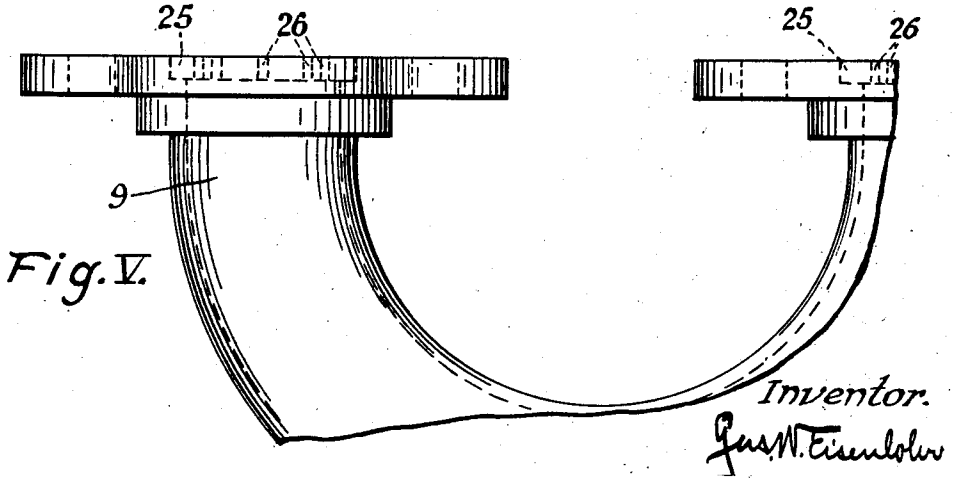


Fig. V.

Inventor.

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UNITED STATES PATENT OFFICE

2,154,835

PROCESS OF HYDROLYZING OILS AND FATS

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Application November 24, 1936, Serial No. 112,531

6 Claims. (Cl. 260—415)

This invention relates to the hydrolysis of oils and fats and particularly to a process or processes for hydrolyzing oils and fats and to a machine for carrying on said process.

The saponification or hydrolysis processes and mechanical devices used in working said processes at the present time are classified by Lewkowitsch in his "Chemical Technology and Analysis of Oils, Fats and Waxes", sixth edition, volume 3, page 216, as follows:

(1) Aqueous saponification.
(2) Saponification with the assistance of bases.
(3) Sulphuric acid saponification. Acid saponification.
(4) The mixed process.
(5) Saponification by means of sulpho-compounds.

The processes above referred to are all well known in the manufacture of stearic acid, stearine candles, soaps and glycerin. In all of these processes the batch method is employed, that is to say a certain definite quantity of oil or fat is saponified or hydrolyzed in a single batch or operation. Likewise, in practically all of the processes at this time commonly employed in the hydrolysis of oils and fats certain chemicals or reagents are used. Thus, in the saponification by means of sulpho compounds, commonly known as the Twitchell process, or in modifications thereof, fat and water are treated with a Twitchell reagent or modified reagent, (commonly called a saponifier) and sulphuric acid and boiled with open steam for upwards to thirty hours. This process is usually carried on in a wooden tub. The material darkens during the process the fatty acids therein undergoing discoloration. On completion of the hydrolysis the reagent and the sulphuric acid go into the sweet water or glycerine water and must be treated by lime neutralization and filtration to get rid of the reagent and the sulphuric acid. It has been found in practice that where a chemical reagent is omitted as in some of the digester or autoclave methods, the results are unsatisfactory due to additional length of time necessary to produce a satisfactory or practical hydrolysis or splitting. In addition, even where aqueous saponification is carried on by the digester or autoclave method, without the use of any saponifiers, reagents or other chemical auxiliaries, the method necessarily confines itself to a batch or to a quantity limited to the size of a practical digester or autoclave.

The present process dispenses with all chemical reagents entirely, the process depending for its results on physical as opposed to any chemical means, the purpose of the process being to exert high pressure on a mixture of water and a relatively small amount of fat indirectly heated to a high temperature as against exerting pressure on a mass in an autoclave where the mass is directly heated by either high pressure or superheated steam in the presence of a catalytic agent.

Although processes for the hydrolization of fats have been proposed heretofore as disclosed by Patent 11,766, these prior methods do not find commercial application at the present time for several reasons, chiefly because of the time involved, the undesirable properties imparted to the product obtained, and the operating conditions as to temperature and pressure together with lack of uniformity in these conditions with results varying from incomplete hydrolization to destruction of the resultant products.

This invention has as an object an improved method for the continuous hydrolyzing of fats which results in complete hydrolization in markedly less time than the methods previously proposed and without the discoloration of the product and other disadvantages attending the prior practice. Other objects will appear hereinafter.

The above and other objects are accomplished by the invention hereinafter described in connection with the accompanying drawings on which the preferred operating conditions are indicated and in which,

Fig. I is a plan view of the entire machine.

Fig. II is a side elevational view of the entire machine.

Fig. III is a cross-sectional view of the reaction coil and shell enclosing same.

Fig. IV is a top view showing the return L's of the reaction coil and the position of the resistance units.

Fig. V is a side elevational view of the return L's of the reaction coil.

The neutral fat or oil to be hydrolyzed or split is placed in supply tank 3 together with the proper amount of water. It is understood that the quantity of water is not fixed, but at least equal parts or more of water should be used. For instance, in case of tallow, if a high split or hydrolyzation is to be obtained, two parts of water to one of fat can be used. The mixture is then agitated by means of turbine mixers 1 and is heated by means of heating coils 2 located in the supply tank. However, it is to be under-

stood that I do not confine myself to turbine mixers, the essential point being that an intimate mixture of the fat and water be created. For instance, I have found that a slow boiling with a steam coil produces enough agitation to insure good mixing. In short, any mechanical means of producing a good mixture of the proper proportions of fat and water can be made use of. However, in any case air should be excluded as much as possible in the supply tank or in preparing the mixture. The water used should preferably be distilled. From the supply tank or tanks this mixture of fat and water is pumped by means of an hydraulic or any other kind of pressure pump, (P—VD) or by any other mechanical means from the supply tank through the line **21** and through the pressure line **19** at **17** to the reaction coil (Fig. III) enclosed in the cylindrical shell **10** (Figs. I, II and III), the reaction coil being surrounded by superheated steam which enters the shell at **5** and has its outlet at **6**. By this means the mixture in the reaction coil is maintained at a substantially uniform temperature throughout the length of the coil. This shell need not at any time be under more than a nominal pressure of say, 10 to 20 pounds. The steam is superheated by any of the well known methods to from 300 to 350° C. so as to maintain a temperature of from 260° to 320° C. on the inside of reaction coil. While I have designated superheated steam it is obvious that any heat may be used to bring the mixture in the reaction coil to the desired temperature such as a hot oil bath, hot air, or any other heat interchange system or means. The pressure in the said reaction coil is built up by means of resistance units **9** (for detail see Fig. IV, **25** and **26**) which tend to maintain a pressure of from 2500 to 3500 pounds on the heated fat to be split. This pressure is further regulated by means of the pressure regulating valves **8**. From the pressure or reaction coil the mixture, which is now a fatty acid and a glycerin solution commonly called "sweet water", is forced through the outlet of the pressure line leading from the reaction coil to an evaporator coil **13** located in the conical bottom of receiving tanks **12**. Some heat transfer occurs to and through the tubes or pipes constituting the evaporator coil, concentrating the sweet water which has separated out in the conical bottoms **12** and correspondingly cooling the fatty acid and sweet water mixture inside the coil **13**. This transferred heat also has a tendency to break up any emulsion which may still persist at this stage, i. e. when the mixture goes into the receiving tanks after passing through the expansion and condensing vessel **11**. From the coil **13** the fatty acid and sweet water mixture is forced through a pipe **30** to and through a condenser shown as **11** in Figs. I and II, which is maintained at a temperature so as to cool the mixture to approximately 80° C. The pressure is released to approximately 50 pounds in the condensing vessel **11** and is fully released in the receiving tank **12** into which the mixture of fatty acids and sweet water is then forced through pipe line **40**. The release of the pressure in this flash condenser tank **11** causes part of the water to be instantly transformed into steam. By regulating the temperautre of the cooling water the amount of condensate is controlled, thus regulating the concentration of glycerin in the water. The sweet water is then conveniently drawn off through outlet **16** from the bottom of the conical receivers **12** and the fatty acids are removed through outlet **15**. There are also connected to the closed receivers **12**, by means of pipe **50**, conveniently located in the covers of said receiving tanks, the vapor collecting tanks **14**. These vapor collecting tanks are ordinary open tanks containing water, and kept practically full at all times. The connecting pipes **50** are so arranged that the escaping vapors bubbling up through the sweet water and fatty acids pass through these pipes and into the vapor collecting tanks, thus eliminating losses in the glycerin recovery carried off by and in the escaping vapors to the vapor collecting tank.

A pipe line **60** is connected with the reaction coil (A—A) this pipe line leading back to supply tank **3**. A safety valve **7** is placed in the line **60** to relieve excess pressure in the reaction coil, the mixture in the reaction coil in such event flowing back into the supply tank.

The hydrolyzation or splitting occurs practically instantaneously in the pressure coil (for detail see cross-section view Fig. III) where the mixture of fat and water are subjected to from 2500 to 3500 pounds pressure and from 260° to 320° C. of indirect heat. While I have specified desired pressures and temperatures, it is understood that considerable variations are permissible although I have found best results within those herein specified. The resistance units **9** are inserted in the pressure coil after the manner of orifice plates, and are stainless steel discs **25** which contain small diameter perforations **26**, for instance 1/64 inch in diameter (see detail drawing Fig. IV). However, I do not wish to be limited to these perforated discs as to the manner in which the pressure is built up, as this can be accomplished in a variety of ways, such as alternate pressure baffles in the reaction coil or by the use of small diameter tubing to form the reaction coil or by any means which tends to retard or resist the free flow of the mixture through the pipes constituting the reaction coil. I have provided conventional gate valves **4** in the pipes or lines **21**, **30** and **40** to regulate or shut off the flow. Similar valves may be inserted in other lines as desired.

The present process consists essentially of subjecting a constantly flowing stream of a suitable mixture of fat and water to high temperatures and pressures effecting practically instant and complete hydrolyzation or splitting into fatty acids and glycerin. The water and fat remain in a liquid state due to the pressure applied on the mixture up to the point of its entering the evaporator coil **13** and the condenser **11**. In the condenser as the pressure is relieved, the steam and glycerin are condensed and recovered and the final separation between the fatty acids and the sweet water occurs as above described in receivers **12**.

The process and apparatus produce fatty acids as light as the original oil, fat or tallow used in the mixture, the result being accomplished by excluding air at all stages in the process and operations and particularly in the supply tanks, condenser and receiving tanks.

Having described my invention what I claim as new and desire to secure by United States Letters Patent is:

1. A process which comprises hydrolyzing instantaneously a continuously flowing stream of fatty material which comprises continuously forcing under at least 2500 pounds pressure through a reaction coil a mixture comprising

water and a hydrolyzable fatty material in substantial amount but in amount substantially less than the amount of water, heating the coil by indirect heating means to a temperature which maintains the material flowing therethrough at a substantially uniform temperature in the range of 260 to 320° C., continuously flowing the hydrolyzed material from the reaction coil, condensing said material, and separating the fatty acids from the glycerin water.

2. A process for hydrolyzing fatty material which comprises preliminarily boiling a mixture comprising water and a hydrolizable fatty material in substantial amount but in amount substantially less than the amount of water, passing the mixture under at least 2500 pounds pressure through a reaction coil, maintaining the material in the coil at a temperature of range 260 to 320° C., passing the liquid mixture from the reaction coil to an expansion and condensing vessel, releasing the pressure in said condensing vessel, and passing the mixture from said vessel to a receiving tank, and separating the fatty acids from the glycerin water.

3. A process for hydrolyzing fatty material which comprises preliminarily boiling under conditions excluding air a mixture comprising water and a hydrolizable fatty material in substantial amount but in amount substantially less than the amount of water, passing the mixture under at least 2500 pounds pressure through a reaction coil, maintaining the material in the coil throughout its length at substantially uniform temperature within the range of 260 to 320° C., passing the liquid mixture from the reaction coil to a condensing vessel with exclusion of air, releasing the pressure in said condensing vessel to transform a portion of the water into steam, the fluid mixture flowing continuously from said reaction coil into said vessel, passing the mixture from said vessel to a receiving tank with exclusion of air, and separating the fatty acids from the glycerin water.

4. The process set forth in claim 3 in which said mixture contains about one part of fat and two parts of water.

5. A process for hydrolyzing fatty material, the steps which comprise passing a mixture comprising water and said material under at least 2500 pounds pressure through a reaction coil in which the mixture throughout the length of the coil is maintained through indirect heat at a substantially uniform temperature within the range of 260 to 320° C. by contacting the conduit forming the coil with heating vapor which flows through and fills the spaces between the separate coils of the reaction coil and which flows previously heated from an inlet to a separate outlet through a confined space surrounding the coil, passing the liquid mixture from the reaction coil to a condensing vessel and there releasing the pressure to transform a portion of the water into steam, the fluid mixture flowing continuously from said reaction coil into said vessel, and passing the mixture from said vessel to a receiving tank, and separating the fatty acids from the glycerin water.

6. The process set forth in claim 5 in which the pressure in said condensing vessel is released to approximately 50 pounds and the temperature of the vessel is maintained at approximately 80° C.

GUSTAV W. EISENLOHR.