Aug. 21, 1956 B. H. THURMAN 2,759,883

PROCESS FOR DEODORIZATION OF GLYCERIDE OILS

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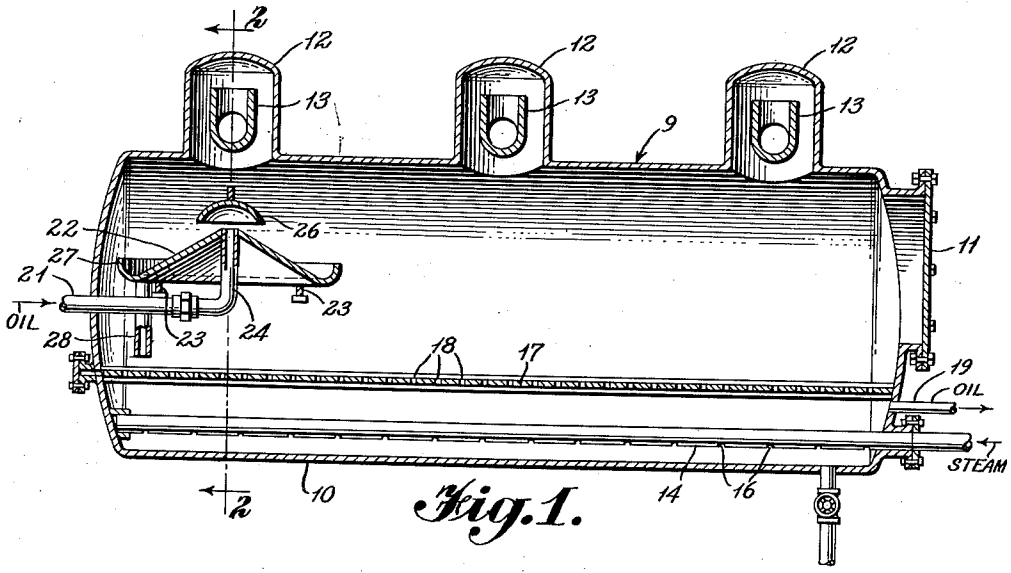

Fig. 1.

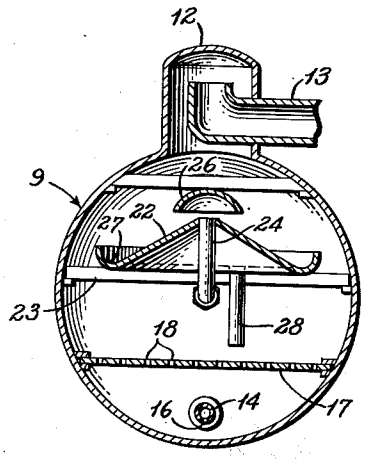

Fig. 2.

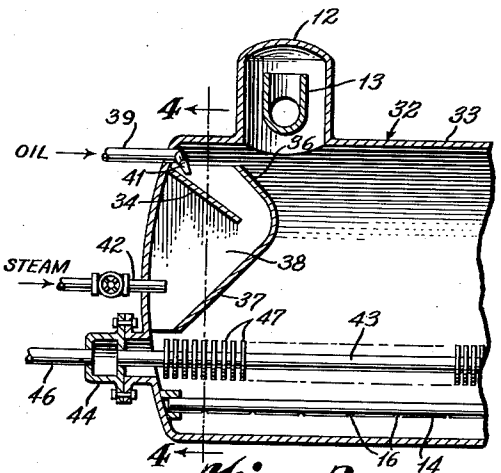

Fig. 3.

INVENTOR

Benjamin H. Thurman

BY *Bacon + Thomas*

ATTORNEYS

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Fig. 4.

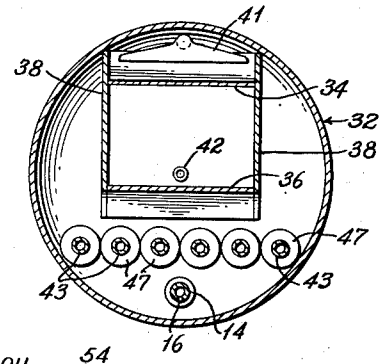


Fig. 5.

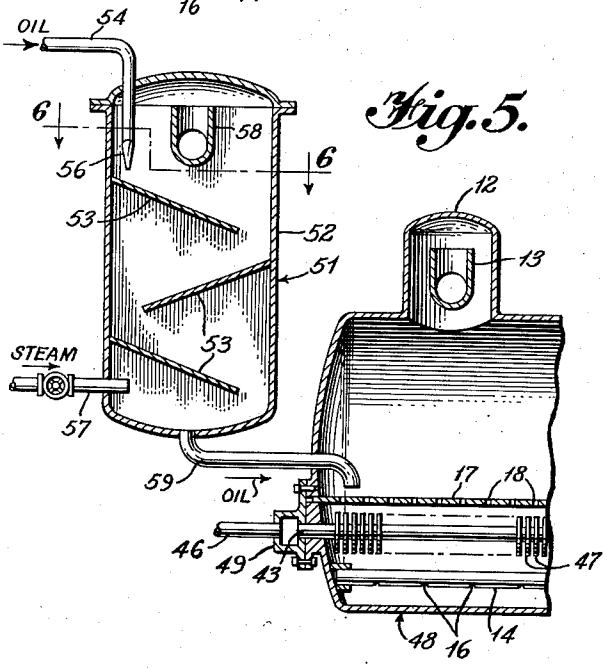


Fig. 6.

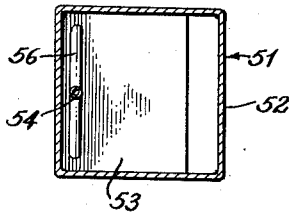
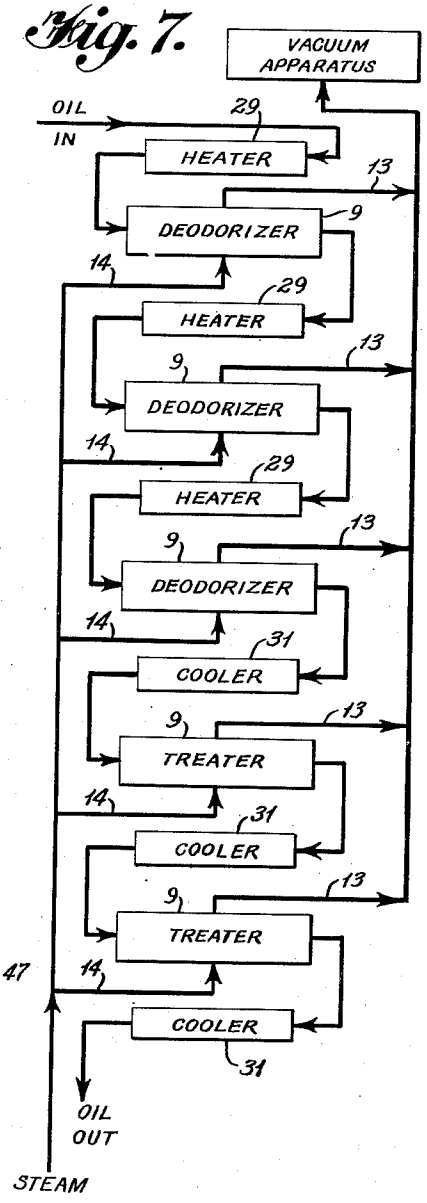


Fig. 7.



INVENTOR

Benjamin H. Thurman

BY *Bacon & Thomas*

ATTORNEYS

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PROCESS FOR DEODORIZATION OF GLYCERIDE OILS

Benjamin H. Thurman, New York, N. Y., assignor to Kraft Foods Company, Chicago, Ill., a corporation of Delaware

Application August 15, 1950, Serial No. 179,499

8 Claims. (Cl. 202—46)

This invention relates to the deodorization of glyceride oils, and more particularly, to an improved vaporizing step particularly applicable to high temperature continuous deodorization processes.

In my copending applications, Serial No. 744,846, filed April 30, 1947, now abandoned, Serial No. 57,114, filed October 28, 1948 and Serial No. 103,059, filed July 5, 1949, now U. S. Patent Nos. 2,621,197 and 2,621,196, respectively, which issued Dec. 4, 1954, I have disclosed processes of continuously deodorizing glyceride oils by passing the oil through a plurality of vaporizing and steam treating stages in which different oil temperatures are maintained in the various stages. In each of the vaporizing and steam treating stages the oil is maintained in a shallow body, steam is passed upwardly through the oil and a high vacuum is maintained above the oil. The passage of steam upwardly through the shallow body of oil tends to cause intense splashing and surging of the oil and a baffle structure is positioned above the shallow body of oil to not only prevent the splashing referred to but to first cause more intimate mixing of the oil and steam, and then effective separation of the steam and vapors from the oil. Efficient deodorization is obtained and higher temperatures and shorter time of treatment of the oil can be employed. It is possible to produce non-reverting oils from even such difficultly deodorizable oils as soyabean oil.

In accordance with the present invention, it has been found that a combination of two different types of vaporizing procedures in each stage of the continuous process results in even more efficient deodorization. That is to say, it has been found that first filming the oil over surfaces exposed to the high vacuum enables a considerable portion of the vaporizable impurities to be rapidly released from the oil so that the amount of vaporization required during the passage of steam upwardly through the shallow baths referred to above is reduced and that the total time of treatment required in each stage of the process is correspondingly reduced. The present process therefore contemplates first flowing a thin film of the oil downwardly over surfaces while the film of oil is exposed to the high vacuum and thereafter collecting the oil into a shallow bath while still under the high vacuum and passing steam upwardly through the oil.

It is therefore an object of the present invention to provide an improved deodorization step having particular utility in a continuous deodorization process involving a plurality of deodorizing stages.

Another object of the invention is to provide an improved deodorization step in which the oil at elevated temperatures is first exposed in the form of a thin film to a high vacuum and is then collected in a shallow bath while still under a high vacuum and steam passed upwardly through the shallow bath.

A further object of the invention is to provide improved apparatus for carrying out a deodorizing step in a continuous process involving a plurality of deodorizing stages.

Other objects and advantages of the invention will appear in the following detailed description thereof in which reference is made to the accompanying drawing, of which:

Fig. 1 is a vertical section through a deodorizing chamber in accordance with the present invention;

Fig. 2 is a vertical section taken on the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary vertical section of a modified type of deodorizing chamber;

Fig. 4 is a vertical section taken on the line 4—4 of Fig. 3;

Fig. 5 is a view similar to Fig. 3 showing a modified apparatus;

Fig. 6 is a horizontal section taken on the line 6—6 of Fig. 5; and

Fig. 7 is a schematic diagram illustrating a process in which the deodorizing step of the present invention is particularly useful.

Referring more particularly to the drawings, the vaporizing chamber of Fig. 1 may include a housing **10** provided with a manhole **11** at one end thereof and with a plurality of domes **12** extending upwardly from the casing **10**. The domes **12** in conjunction with vapor discharge pipes **13** entering through the sides of the domes and having portions extending upwardly toward the tops of the domes constitute entrainment traps. The pipes **13** are connected to a vacuum system such that steam and vapors withdrawn from the casing **10** at relatively high velocity are caused to make rapid changes in direction so as to throw out any liquid material entrained therein.

The chamber of Fig. 1 may also be provided with a steam pipe **14** positioned in the lower portion thereof and extending longitudinally of the chamber. Steam pipe **14** may be provided with a plurality of small perforations **16** preferably directed downwardly, as shown in Fig. 2. The chamber of Figs. 1 and 2 is also preferably provided with a baffle structure **17** preferably in the form of a screen made of a thin metal plate having a plurality of perforations **18** extending therethrough. The size of the perforations **18** in the screen **17** as well as the size of the perforations **16** in the pipe **14** are greatly exaggerated in the drawings, as such perforations are preferably of small size, those in the steam pipe being much smaller than those in the screen. The oil level in the vaporizing chamber is preferably maintained by an overflow pipe **19** positioned just below the baffle **17**. The oil depth maintained by the over flow pipe **19** in the absence of the introduction of steam through the pipe **14** will usually range from about 10 to 20 inches, depending upon the size of the deodorizing chamber employed, oil depths in the lower portion of this range being preferred.

Steam passing upwardly through the shallow body of oil causes intense agitation of the oil below the baffle **17** and a considerable portion of the oil is carried upwardly through the perforations **18** in the baffle **17**. Small bubbles of foam are thereby produced and a substantial layer of foam collects on the upper surfaces of the baffle **17**. The steam contained within the bubbles is in intimate contact with the films of oil forming the walls of the bubbles such that vaporizable materials escape from the liquid films into the steam. As additional foam is produced adjacent the center portion of the baffle **17**, as viewed in Fig. 2, the foam flows laterally on top of the baffle. The bubbles constantly break to liberate steam and vapors from the oil and the oil thus separated from the vapors and steam flows downwardly through perforations **18** adjacent the sides of the screen into the body of oil below the baffle **17**. A constant lateral circulation of oil is therefore produced such that all of the oil is

substantially uniformly and repeatedly treated with steam.

Oil enters the vaporizing chamber through the pipe **21** and is first caused to flow downwardly in the form of a film over the upper surface of a conical member **22** supported within the chamber by cross-members **23** secured to the casing **10**. That is to say, the pipe **21** may be connected to an upwardly extending pipe section **24** so that the oil entering through the pipe **21** is directed against a cap member **26** positioned above the conical member **22** and thereby directed downwardly as a film on the upper surfaces of the conical member 22. The conical member **22** may be provided with an upwardly turned rim **27** for collecting the oil which may be delivered downwardly through a pipe **28**, to the upper surface of one end of the baffle **17**. The oil flowing down the upper surface of the conical member 22 in the form of a film is exposed to the high vacuum in the vaporizing chamber and a substantial portion of the vaporizable materials are immediately released and withdrawn through the pipes **13** to the vacuum system. The oil delivered to the top of the screen **17** is therefore partially denuded of vaporizable materials but further vaporization of such materials is effected in the shallow bath of oil by steam treatment under vacuum as above described. The oil progresses gradually along the length of the vaporizing chamber while being repeatedly contacted with steam and forced upwardly through the apertures **18** in the baffle **17**.

A complete process which may employ a plurality of the vaporizing chambers **9** of Figs. 1 and 2 is diagrammatically illustrated in Fig. 7. Five chambers **9** of the type illustrated in Fig. 2 may, for example, be employed although the number of such chambers may vary depending upon the precise deodorizing schedule followed and the amount of oil passed through the process. In the specific system shown in Fig. 7 the oil to be treated is first passed through a heater **29**, then through a vaporizing chamber **9**, through another heater **29**, through another vaporizing chamber **9**, etc. In the preferred process, the temperature of the oil is increased in each of the heaters **29** which may be any suitable type of indirect heat exchange devices in which the oil may be heated without danger of local overheating. For example, the thin fin tube heaters of the applications above referred to may be employed. After being passed through a plurality of vaporizing steps at progressively increasing temperatures the oil may then be passed through a plurality of vaporizing steps at progressively lowering temperatures. That is to say, the oil may then be passed through coolers **31** before each of the next vaporizing chambers in the system. Steam may be introduced into each of such vaporizing chambers through pipes **14** as above described and vapors and steam may be withdrawn from each of the deodorizing chambers through pipes **13** as also above described. As stated above, the number of vaporizing steps may be varied and also the schedule of temperatures and times of treatment may be varied depending upon the oil being treated and the extent of deodorization desired as well as the amount of oil which it is desired to pass through the system.

As a specific example illustrated in Fig. 7, the oil may be heated to a deodorizing temperature in the lower portion of the deodorization range in the first heater **29** and thereafter heated to higher temperatures in the subsequent heaters **29**. An example of such temperatures particularly applicable to soyabean oil may be 400 to 450° F. in the first heater, 470 to 510° F. in the second heater and 540 to 600° F. in the third heater. The oil may then be cooled in the first cooler **31** to a temperature between 400 and 425° F. and cooled in the second cooler **31** to a temperature between 325 and 350° F., the final cooler being employed to reduce the temperature of the oil to 90 to 100° F. so that it can be exposed to the atmosphere without damage to the oil.

The above temperatures are particularly suitable for a difficult oil to deodorize such as soyabean oil and will produce a non-reverting edible soyabean oil when the time of treatment in each chamber **9** is between approximately 10 and 20 minutes with a time in each heater or cooler of approximately 5 minutes so that the oil is at a temperature above 400° F. for a time between approximately 1 to 2 hours. For more easily deodorized oils the temperatures and time of treatment may be reduced, for example, the highest temperature reached may be in the neighborhood of 475 to 525° F. The number of chambers employed for deodorization at progressively higher temperatures may be varied and the number of chambers **9** employed during the cooling sequence may be correspondingly varied. In fact, it is entirely possible to initially raise the temperature of the oil in the first heater 29 to the highest temperature employed in the process and then progressively decrease the temperature employed in the remaining chambers **9** although it is preferred to employ at least one intermediate vaporizing step before reaching the highest temperature. In any event, the temperature of the oil should be decreased to approximately 320 to 350° F. before steam treatment of the oil is discontinued and it should be cooled to a temperature in the neighborhood of 90 to 100° F. before being discharged from the process into contact with the air. The vacuum employed will usually range between 1.5 and 5 mm. of mercury with a preferred range between 1.5 and 3 mm. of mercury. At the high vacuum and high temperatures mentioned, a relatively large amount of materials are vaporized from the oil and such materials may be condensed and recovered in the form of valuable by-products.

The modified treating chamber **32** shown in Figs. 3 and 4 is provided with a casing **33** which may be generally similar to the casing **10** of the chamber **9** of Figs. 1 and 2. A different type of structure for providing a film of oil exposed to the vacuum is, however, illustrated and may include an inclined plate member **34** extending laterally across one end of the deodorizing chamber in the upper portion thereof and a curved plate member **36** partially surrounding the plate member **34** and providing a lower portion **37**. The plate members **34** and **36** may be supported by side walls **38** shown more clearly in Fig. 4 secured to the end wall of the casing **33**. Oil enters the deodorizing chamber **32** through a pipe **39** which may be provided with a distributing nozzle **41** spreading the oil in the form of a film upon the upper surface of the plate member **34**. The oil flows down the plate member **34** on to the lower portion **37** of the plate member **36**. This oil is largely protected from contact with steam and vapors in the main portion of the vaporizing chamber **32** by reason of the curved plate member **36** and side walls **38** and is therefore not subject to contamination by absorbing vapors liberated from the oil in the remaining portion of the chamber. A small amount of steam which is free from vaporized impurities may be introduced through the pipe **42** so as to contact the film of oil on the members **34** and **36** and such steam carrying vapors liberated from the oil film may be discharged from the chamber through one of the domes **12** and vapor discharge pipes **13**.

The vaporizing chamber **32** of Figs. 3 and 4 may be employed in a system such as shown in Fig. 7 in which the heaters **29** and coolers **31** are omitted. That is to say, the chamber **32** may be provided with a plurality of pipes **43** extending longitudinally through the lower portion of the vaporizing chamber so as to be in contact with the oil therein. These pipes may be connected to a suitable header **44** into which a suitable heating or cooling medium may be introduced through a pipe **46**, it being understood that the other end of the pipe (not shown) will likewise be connected to a suitable header provided with a pipe for discharging heating or cooling medium. The pipes **43** may each be provided with a plurality of fins **47** positioned relatively close together so as to transmit heat from the pipes **43** to the oil or vice

versa, depending upon whether the oil is being heated or cooled. By positioning the fins **47** on each of the pipes close together and also positioning the respective pipes **43** sufficiently close together that the fins of the respective pipes are substantially in contact with each other, the fins **47** may take the place of the baffle **17** of Figs. 1 and 2 so that the baffle **17** may be omitted. In employing the vaporizing chambers **32** of Figs. 3 and 4 the oil will ordinarily be initially heated to a temperature within the deodorizing range in an external heater, for example, a heater similar to the first heater **29** of Fig. 7 although all of the heating may be done in the chambers **32**. Thereafter the temperature of the oil may be increased or decreased as described above without employing heaters or coolers between the various vaporizing chambers. That is to say, an appropriate heating medium may be passed through the pipes **43** to increase the temperature of the oil progressively through a portion of the process and then a suitable cooling medium may be passed through the pipes **43** of the succeeding vaporizing chambers to progressively cool the oil. Ordinarily a final cooler **31** will be employed to reduce the temperature of the oil from approximately 325 to 350° F. down to 90 to 100° F. although again, a chamber **32** can be employed for this purpose.

The vaporizing chamber **48** of Figs. 5 and 6 may be similar to the vaporizing chambers of Figs. 3 and 4 in that it is provided with a plurality of pipes **43** having fins **47**. The pipes **43** may be connected to a header **49** at one end of the vaporizing chamber and to a similar header (not shown) at the other end of the vaporizing chamber, a pipe **46** being employed to introduce the heating or cooling medium into the header **49**. The vaporizing chamber **48** is shown as also being provided with a baffle **17** which may be of the same type as that described with reference to Figs. 1 and 2. The heating pipes **43** of Fig. 5, however, have the fins **47** of the respective pipes substantially in contact in the same manner as shown in Fig. 4 so that the effects of both the fins **47** and the perforations **18** in the baffle **17** may be employed to produce improved contact between the oil and steam and separation of the steam and vapors from the oil.

The vaporizing chamber **48** of Figs. 5 and 6 is shown as being provided with an external chamber **51** for subjecting films of oil to the vacuum. The chamber **51** may have a closed casing **52** which may be rectangular in horizontal section, as shown in Fig. 6, and may be further provided with a plurality of internal inclined plate members **53** extending alternately from opposite sides of the chamber **51**. Oil may enter the chamber **51** through a pipe **54** provided with a distributing nozzle **56** which spreads the oil in the form of a film on the upper plate member **53** such that the oil flows down over the respective plate members **53** in the form of a thin film. A small amount of steam may be introduced into the lower portion of the chamber **51** through a pipe **57** and vapors and steam may be withdrawn from the chamber **51** through a vapor discharge pipe **58** which may be similar to the vapor discharge pipes **13**. The oil may flow from the chamber **51** through a pipe **59** into the vaporizing chamber **48** so as to be discharged at one end of the upper surface of the baffle **17**.

Thus in all of the modifications above described, the oil in each vaporizing step is first filmed over a surface so as to be exposed to a high vacuum in the form of a thin film, and is then subjected to treatment with steam in a shallow pool. As stated above, a relatively large portion of the vaporizable impurities are immediately released from the oil, thus reducing the amount of time required for vaporizing in the main portions of the vaporizing chambers wherein steam is passed upwardly through a shallow body of oil maintained under a high vacuum. It has been found impracticable to attempt to remove all of the vaporizable materials required for effective deodorization while the oil is in the form of a thin film upon a supporting surface and although all of the vaporizable materials which it is necessary to remove to produce effective deodorization may be removed by passing steam upwardly through shallow bodies of the oil under the conditions described above, it has been found that the total time required to remove a sufficient amount of vaporizable materials at a given temperature is substantially reduced, or conversely, the temperature required for a given time of treatment is substantially reduced by a combination of the two types of vaporization operations. By alternately filming the oil over surfaces and treating with steam in a baffled shallow pool, a better quality deodorized oil is produced. The oil is heat sensitive and damage to the oil, for example by cracking and polymerization, is decreased both by a permissible decrease in temperature and by a decreased time of treatment at such temperature.

I claim:

1. In a process of deodorizing glyceride oils, the steps which comprise, heating said oil to a deodorizing temperature, flowing said oil in the form of a thin film over a surface while said film is exposed to a high vacuum to vaporize a portion of the vaporizable materials contained in said oil, collecting the oil from said film in a shallow pool of said oil, maintaining said high vacuum above said pool while passing steam upwardly through said pool whereby said steam causes oil to be carried upwardly, and obstructing substantially the entire path of said oil and steam adjacent the surface of said pool by a baffle structure having a plurality of openings therethrough for effecting increased contact between said oil and steam and separation of steam and vapors of additional vaporizable material from said oil.

2. In a process of deodorizing glyceride oils, the steps which comprise, heating said oil to a deodorizing temperature, flowing said oil in the form of a thin film over a surface while said film is exposed to a high vacuum to vaporize a portion of the vaporizable materials contained in said oil, collecting the oil from said film in a shallow pool of said oil, maintaining said high vacuum above said pool while passing steam upwardly through said pool whereby said steam causes oil to be carried upwardly, and subdividing the path of said steam and oil being carried upwardly thereby into a plurality of paths of restricted area adjacent the surface of said pool to produce increased contact between said steam and oil and effect separation of steam and vapors of additional vaporizable materials from said oil.

3. In a process of deodorizing glyceride oils, the steps which comprise, heating said oil to a deodorizing temperature, flowing said oil in the form of a thin film over a downwardly inclined surface while said film is exposed to a high vacuum to vaporize a portion of the vaporizable materials contained in said oil, collecting the oil from said film in a shallow pool of said oil, maintaining said high vacuum above said pool while passing steam upwardly through said pool whereby said steam causes oil to be carried upwardly, subdividing the path of said steam and oil being carried upwardly thereby into a plurality of paths of restricted area adjacent the surface of said pool to produce increased contact between said steam and oil and effect separation of steam and vapors of additional vaporizable materials from said oil, and exchanging heat between said oil and a heat exchange medium in indirect heat exchange relation with said oil while said oil and steam is subdivided into said plurality of paths.

4. In a process of deodorizing glyceride oils, the steps which comprise, heating said oil to a deodorizing temperature, flowing said oil in the form of a thin film over a surface while said firm is exposed to a high vacuum to vaporize a portion of the vaporizable materials contained in said oil, collecting the oil from said film in a shallow pool of said oil, maintaining said high vacuum above said pool while passing steam upwardly through said pool whereby said steam causes oil to be carried upwardly, subdividing the path of said steam and oil being carried

upwardly thereby into a plurality of paths of restricted area adjacent the surface of said pool to produce increased contact between said steam and oil and effect separation of steam and vapors of additional vaporizable materials from said oil, and heating said oil by indirect heat exchange with a heating medium while said oil and steam is subdivided into said plurality of paths.

5. In a process of deodorizing glyceride oils, the steps which comprise, heating said oil to a deodorizing temperature, flowing said oil in the form of a thin film over a surface while said film is exposed to a high vacuum to vaporize a portion of the vaporizable materials contained in said oil, collecting the oil from said film in a shallow pool of said oil, maintaining said high vacuum above said pool while passing steam upwardly through said pool whereby said steam causes oil to be carried upwardly, subdividing the path of said steam and oil being carried upwardly thereby into a plurality of paths of restricted area adjacent the surface of said pool to produce increased contact between said steam and oil and effect separation of steam and vapors of additional vaporizable materials from said oil, and cooling said oil by indirect heat exchange with a cooling medium while said oil and steam is subdivided into said plurality of paths.

6. In a process of deodorizing glyceride oils, the steps which comprise, heating said oil to a deodorizing temperature, flowing said oil in the form of a thin film over a surface while said film is exposed to a high vacuum to vaporize a portion of the vaporizable materials contained in said oil, collecting the oil from said film in a shallow pool of said oil, maintaining said high vacuum above said pool while passing steam upwardly through said pool whereby said steam causes oil to be carried upwardly, subdividing the path of said steam and oil being carried upwardly thereby into a plurality of paths of restricted area adjacent the surface of said pool to produce increased contact between said steam and oil and effect separation of steam and vapors of additional vaporizable materials from said oil, and varying the temperature of said oil in said shallow pool during passage of steam upwardly therethrough by indirect heat exchange with a heat exchange medium.

7. In a process of deodorizing glyceride oils, the steps which comprise, heating said oil to a deodorizing temperature, flowing said oil in the form of a thin film over a surface while said film is exposed to a high vacuum to vaporize a portion of the vaporizable materials contained in said oil, collecting the oil from said film in a shallow pool of said oil, maintaining said high vacuum above said pool while passing steam upwardly through said pool whereby said steam causes oil to be carried upwardly, subdividing the path of said steam and oil being carried upwardly thereby into a plurality of paths of restricted area adjacent the surface of said pool to produce increased contact between said steam and oil and effect separation of steam and vapors of additional vaporizable materials from said oil, and heating said oil in said shallow pool during passage of steam upwardly therethrough by indirect heat exchange with a heating medium.

8. In a process of deodorizing glyceride oils, the steps which comprise, heating said oil to a deodorizing temperature, flowing said oil in the form of a thin film over a surface while said film is exposed to high vacuum to vaporize a portion of the vaporizable materials contained in said oil, collecting the oil from said film in a shallow pool of said oil, maintaining said high vacuum above said pool while passing steam upwardly through said pool whereby said steam causes oil to be carried upwardly, subdividing the path of said steam and oil being carried upwardly thereby into a plurality of paths of restricted area adjacent the surface of said pool to produce increased contact between said steam and oil and effect separation of steam and vapors of additional vaporizable materials from said oil, and cooling said oil in said shallow pool during passage of steam upwardly therethrough by indirect heat exchange with a cooling medium.

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