Dec. 29, 1959 D. V. STINGLEY 2,919,232

BATCH DEODORIZER

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Fig. 2.

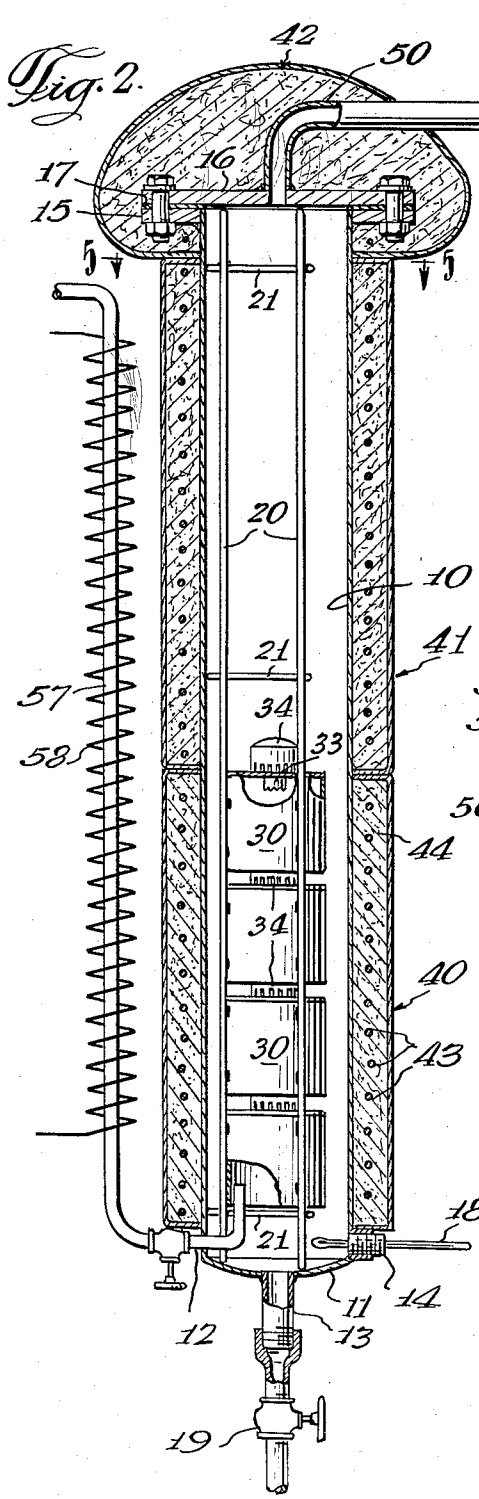


Fig. 2a.

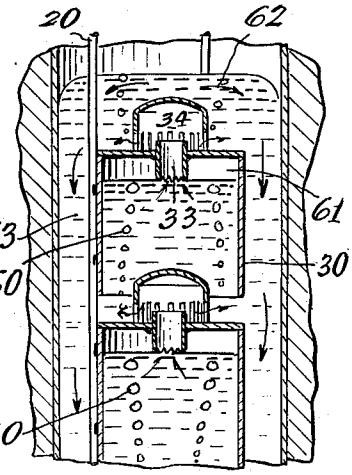
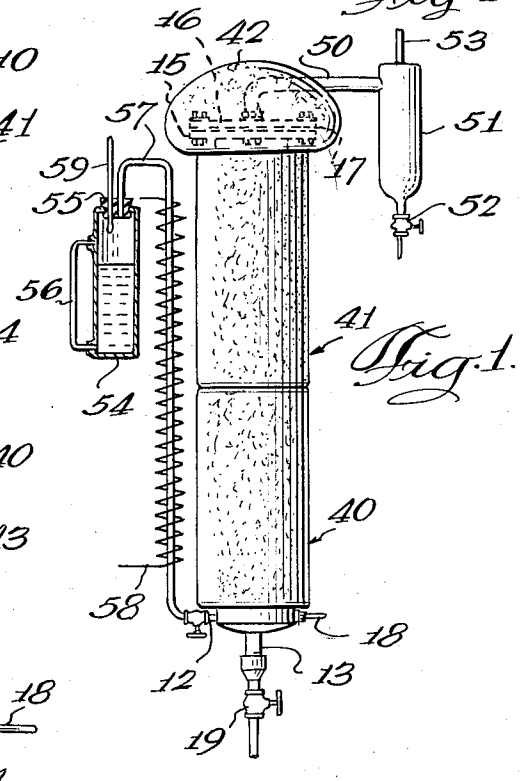


Fig. 1.



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Fig. 4.

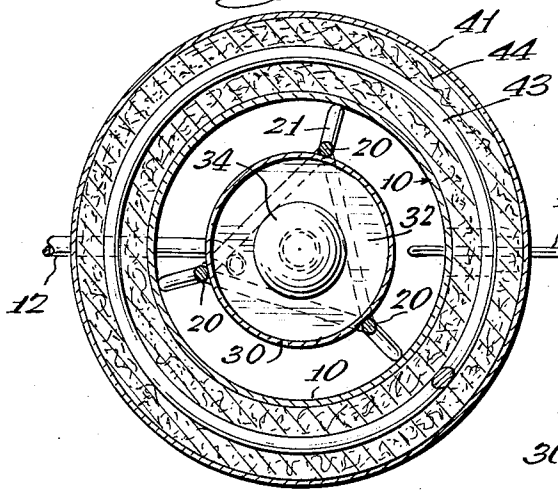


Fig. 6.

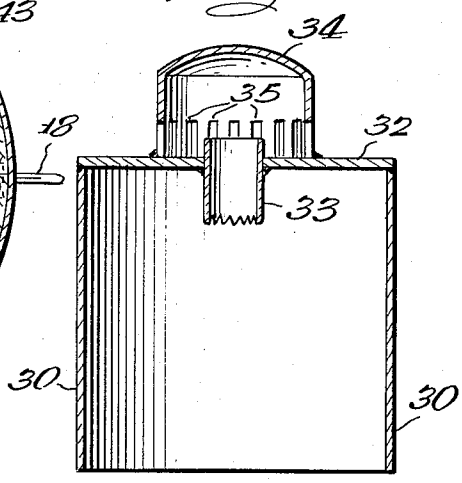
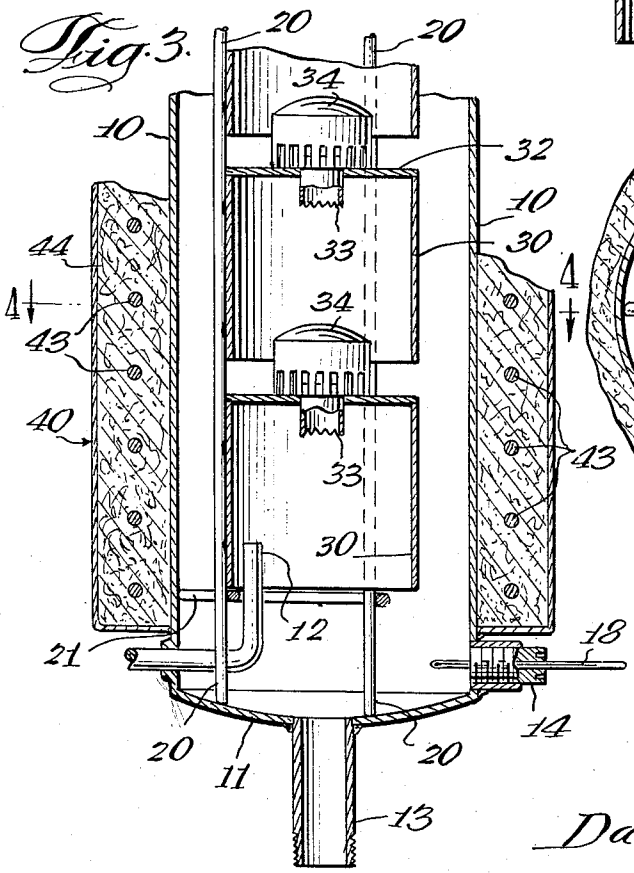


Fig. 3.



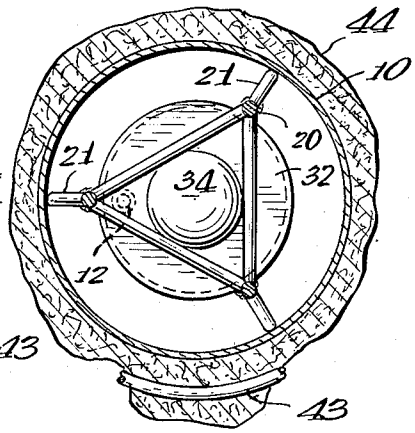


Fig. 5.

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Fig. 8.

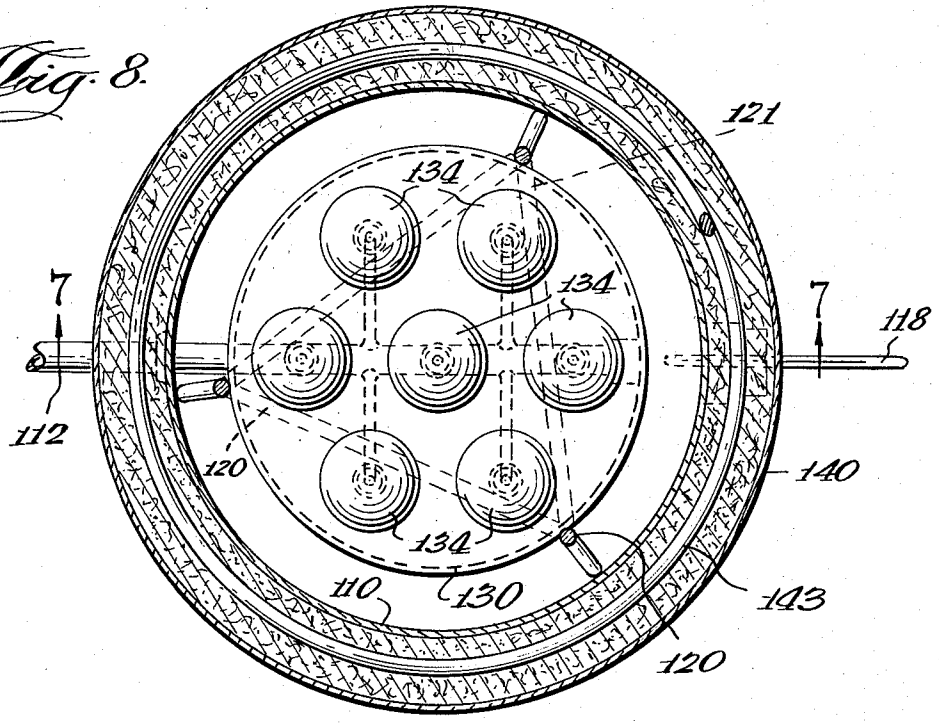
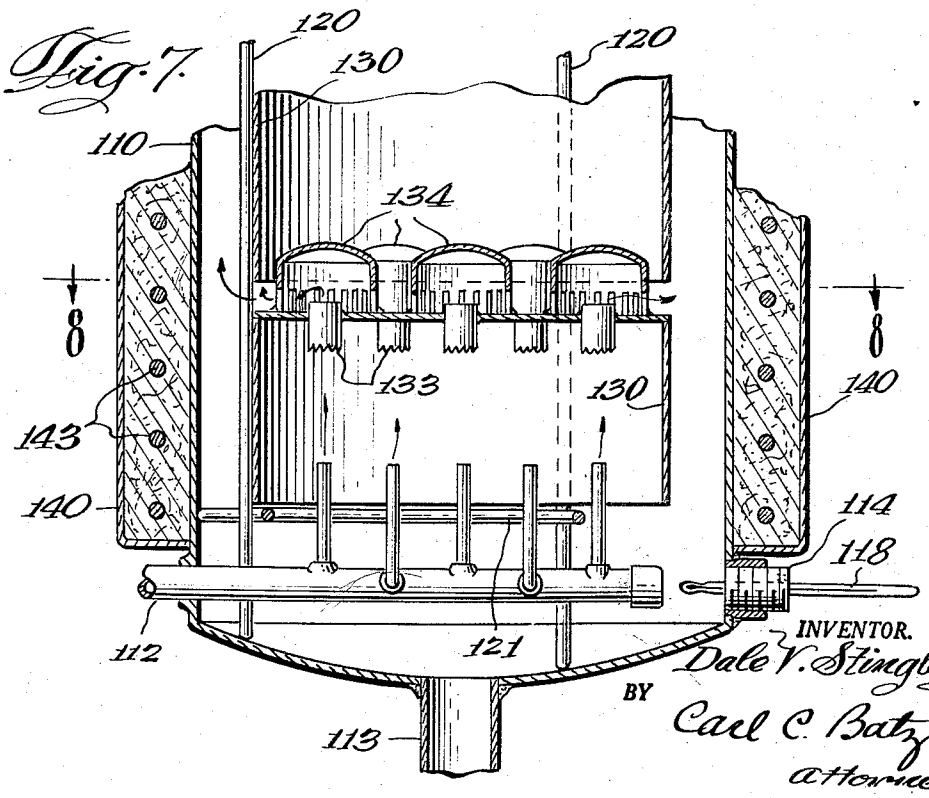


Fig. 7.



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United States Patent Office 2,919,232 Patented Dec. 29, 1959

2,919,232

BATCH DEODORIZER

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Application May 27, 1957, Serial No. 661,792

5 Claims. (Cl. 202—46)

This invention relates to a method and apparatus for removing volatile materials from liquids and particularly from fats and oils. The invention is particularly related to methods and apparatus for the batch deodorization of fats and oils.

Deodorization of fats and oils generally involves removal of free fatty acids and aldehydes and other volatile materials and the destruction of peroxides therein contained resulting in the production of materials which are more nearly odorless and tasteless.

It is therefore an object of the present invention to provide an efficient process for the deodorization of various fats and oils such as animal, marine, and vegetable fats and oils, and rearranged, hydrogenated, blended, or otherwise processed fats and oils. It is also an object to provide apparatus for carrying out an efficient batch deodorization of fats and oils. It is another object to provide an apparatus which can be operated automatically thereby effecting a savings in labor required for the deodorization process. It is also an object to provide a method and apparatus by which the time required for deodorization can be materially reduced. It is a particular object to provide an apparatus wherein there is an efficient contact of the fats and oils with the stripping vapors to thereby remove the volatile materials more effectively from such fats and oils. Further objects and advantages of the invention will be apparent as the specification proceeds.

The invention can be described by reference to the accompanying drawings in which:

Fig. 1 is a perspective view of the batch deodorizer of the present invention.

Fig. 2 is a vertical cross-sectional view of the deodorizer.

Fig. 2*a* is a vertical cross-sectional view showing oil and a stripping medium in the deodorizer during the deodorization process.

Fig. 3 is an enlarged sectional view of the lower portion of the deodorizer showing in greater detail the relationship of the various elements of the apparatus.

Fig. 4 is a horizontal cross-sectional view of the deodorizer taken along view line 4—4 of Fig. 3.

Fig. 5 is a horizontal cross-sectional view of the column taken at line 5—5 of Fig. 2. This drawing shows in detail the position of the cage rods about the contact unit and shows also the relationship of the cage rod spacers to the cage rods and to the other elements of the deodorizer.

Fig. 6 is an enlarged cross-sectional view of an individual contact unit and bubble cap.

Fig. 7 is a vertical cross-sectional view of an enlarged and modified form of the invention wherein each contact unit is provided with several bubble caps and wherein also there is a multiple steam inlet.

Fig. 8 is a cross-sectional view of the modified deodorizer taken along view line 8—8 of Fig. 7.

On referring to Figs. 2 and 3 of the drawings it will

be seen that the deodorizer has a cylindrical section of stainless steel pipe or shell **10** which is closed at its bottom end by a head **11** provided with a central drain and inlet pipe **13**. In the lower section of the tubular or cylindrical column or shell **10** there is provided a stripping steam inlet **12**. Also at the lower portion of the cylindrical shell **10** there is provided a thermometer well **14** through which a thermometer **18** may be inserted and thereby the temperature of the materials deodorized may be measured. At the upper portion of the cylindrical shell **10** is a flange **15** to which there is affixed a reducing flange **16** which is in turn provided with an exhaust tube **50** connecting with a vacuum supply and fatty acid and steam condensers. In order to afford a sealed union between the flanges **15** and **16** there is provided a gasket **17** which may be formed of any suitable material, such as a plastic consisting of tetrachloroethylene polymers. It is desirable that the interior walls of the shell and all connecting fittings be smooth and polished in order that there be no interference with the circulation of oils and vapors within the deodorizer.

Heat is supplied to the deodorizer by any suitable means such as the heating mantles shown in the principal embodiment of the invention as shown in the drawings. Referring particularly to Figs. 1 and 2, the heating mantle **40** surrounds the lower portion of the tubular column in which the oil circulates through the liquid and stripping media contact devices or units during the deodorization process. In order to prevent condensation of the stripping steam and volatile materials distilled from the fats and oils, a second or central heating mantle **41** is provided about the upper portion of the deodorizer. The central heating mantle **41** generally surrounds the deodorizer column in that portion between the top of the series of contact units and the flange **15**. A third or upper mantle **42** is provided about the upper flange and the proximate portions of the exhaust tubing to prevent condensation and return of fatty acids to the deodorizer chamber. Each of the heating mantles shown in the drawings contains electric heating elements **43** and insulating materials **44**. The heat input is desirably controlled by means of thermostatic control elements situated between each heating element and the cylindrical shell **10** or they may be provided within the chamber in contact with the flow of oil. It is of course apparent that other means of supplying heat may be used and is within the scope of the present invention. Of these alternate heating means the most common would be the conventional steam jacket or other jackets provided with other heat transfer media such as a mixture of diphenyl and diphenyl oxide.

The series of inverted cylindrical contact units are arranged inside the vertical cylindrical shell **10** and occupy the lower portion of the shell as is shown in Fig. 2. The individual contact units shown particularly in Figs. 5 and 6, are supported by and welded to the vertically situated cage rods **20**. In order to provide stability and support of the contact units, it is desirable that there be at least three cage rods although there may be many more depending upon the size and weight of the contact unit installation. The cage rods **20** are held in position in the upper portion of the cylindrical shell **10** by means of cage rod spacers **21**. The cage rods **20** are affixed to the rod spacers **21** by tack welding or other convenient means. In the lower portion of the cylindrical shell **10** the cage rods are affixed preferably by tack welding to the skirt **30** of the contact unit.

The contact units or devices as shown in Fig. 6 are of smaller diameter than the cylindrical pipe **10** in order to provide an annular space between the periphery of the trays and the inside of the column wall **10**. The annular

space about the series of units is illustrated in Fig. 4 and extends between the skirt **30** and the column **10**. Referring particularly now to Fig. 6, the contact unit comprises a skirt **30** at the top of which is welded a plate **32** which completely seals the top of the contact unit except for their riser **33** which is a short section of pipe extending below the plate **32** and which may also extend slightly above the plate **32**. The riser **33** perforates the center of the plate **32** and is designed to lead oil and steam from within the inverted skirt **30** to a space beneath the bubble cap **34**. The bubble cap **34** rests upon the top of plate **32** over the upper opening of the riser **33**, and is provided with slots **35** whereby the rising vapors and oil may escape to the sides of the bubble cap **34**. The upper portion of the bubble cap **34** extends into the area enclosed by the skirts of the contact unit immediately above it.

In order to provide an apparatus of the type of the present invention which has a larger capacity, the embodiment of Figs. 1 and 2 may be modified as shown in Figs. 7 and 8. In Fig. 7 the cylindrical shell **10** is generally larger than that of the smaller embodiment of Fig. 2. In this embodiment the contact unit again has a lid **132**, but in this modified version the lid **132** is perforated by a multiplicity of risers **133**, each of which extends downward and also is covered by a bubble cap **134**. As in the case of the smaller embodiment each of the bubble caps has a series of slots **135** surrounding the lower portion of the cap whereby oil and vapors may escape from the bubble cap and into the area enclosed by the skirt of the next higher unit. Fig. 8 is a vertical cross-sectional view taken along the view line **8—8** and portrays the relationship of the bubble caps **134**. In the enlarged modification of the apparatus it is also desirable to provide a multiplicity of stripping steam inlets **112** in order to assure a uniform flow of steam upward to the entire series of contact units.

The deodorizer is provided with a conventional condenser in the vacuum supply system. The condenser **51** shown in Figs. 1 and 2 has an outlet valve **52** and a pipe **53** connecting with the vacuum source. Stripping steam or other media passes through exhaust tube **50** into the condenser **51**, together with volatile materials removed from the liquid in the deodorizer.

Steam, the preferred stripping media, can be supplied to the stripping media inlet **12** by the vaporization of water under reduced pressure at temperatures near room temperature. The vaporization can be accomplished in a water vapor generator **54** which may be a section of stainless steel pipe (see Fig. 1). The upper end of the water vapor generator **54** in the embodiment shown in Fig. 1 is not restricted and is fitted with a large rubber stopper **55** which affords blow-out protection in the event of vacuum failure. A sight gauge **56** for following the volume of water consumed is connected to the vapor generator by means of pressure tubing. Where required the lower end of the water vapor generator may be heated by any suitable means such as a hot water or steam jacket or an electric heating mantle. The water vapors generated are passed to the stripping steam inlet **12** by means of a tubing **57** which is desirably heated by suitable means such as by the electric heating tape **58** which is illustrated in both Figs. 1 and 2. As shown in Fig. 1 the water vapor generator can be provided with a thermometer **59** by which the temperature of the vaporizing water can be measured. It is, of course, apparent that this particular source of steam is not essential to the apparatus and that any other convenient source of stripping media can be used. In apparatus of larger capacity any convenient source of steam, etc., may be used.

In the operation of the batch deodorizer it is desirable to preheat the apparatus to approximately the temperatures at which the deodorizing process is operated. The vegetable oil or fat to be deodorized is then heated beyond its melting point or to approximately 120° F. and is introduced into the preheated deodorizer. In the principal embodiment shown in the drawings a vacuum is drawn within the deodorizer and the melted fat or oils are drawn up through the inlet pipe. The inlet pipe is then closed by means of a valve and the introduction of vapor is begun. In other modifications of the invention other inlets for fats and oils may be provided.

In the apparatus of the drawings it has been found desirable to volatilize pure water at approximately 100° F. under the same vacuum as is maintained within the deodorizer chamber. These rather cool vapors are drawn into the inlet pipe **12** in the lower portion of the deodorizer shell **10**. In order to avoid cooling the melted oils with the water vapor it has also been found desirable to preheat the vapors by means of a heating strip **58** or mantle which is provided about the steam inlet pipe. As steam or heated water vapors are introduced into the bottom of the tower it will be seen that upon contact with the oil they will rapidly obtain the temperature of the oil which we preferably maintain within the range of about 425 to 430° F., but which may be any temperature suitable for deodorization. As shown in Fig. 2*a* the steam upon being introduced into the area enclosed by the skirt **30** or the lowest unit rises as bubbles **60** within the tray through the oil and forms a head **61** under plate **32** and above the bottom of the riser **33**. As more vapor collects under the plate **32** some of it escapes through the riser **33** and as it passes through the riser to the bubble cap **34** it forces oil along with it. As the steam is passed through the slots **35** the large bubbles of steam and masses of liquid oil are broken up with considerable agitation, and the contact of the steam and oil is thereby increased. Upon being discharged from the slots **35** of the lowest unit, the steam and oil rises through the second unit to form a second head and then through the riser **33** and into the cap **34** and through the slots **35** of the next higher unit, etc. throughout the series of contact units. Upon being discharged from the uppermost bubble cap, the steam rises together with vaporized fatty acids and volatile impurities which are all drawn through the discharge tube **50** to a fatty acid and moisture condensers **51**. A vacuum is continuously maintained by means of connections **53** with a vacuum system connected with the discharge tube **50** of the condensers. As the steam passes through the series of contact units it entraps and forces upward a considerable amount of oil or fat. Also as the fat and oil and steam pass through the bubble caps there is a considerable agitation of the oil and a significantly increased contact of oil and steam. As the oil is discharged from the top of any unit most of that oil proceeds upward through the next unit above while a minor portion of the oil is discharged to the side at the top of each unit. Oil is therefore circulating at all times about the group of units. The greatest flow of oil will be throughout the annular space from the top of the series of contact units as indicated by arrows **62** and **63** to the bottom of the lowest unit and thence upward through the units.

The temperature of the oil can be measured at the bottom of the cylinder immediately inside the thermometer well **14**. It has been found desirable in the operation of this apparatus to maintain the oil temperature at approximately 430° F. In order to maintain this oil temperature it has been necessary to maintain the temperature at the outer surface of the cylinder **10** within the range of about 475 to 550° F. In order to maintain such temperatures heating mantles are placed about the cylinder **10**. We have found it desirable to use three separately controllable heating mantles to control the temperature in the lower portion of the cylinder within the range of about 460 to 475° F. The lower portion of the cylinder requires a much greater amount of heat than the upper portion of the cylinder since it is the portion wherein the oil circulates. It is also necessary to

heat the upper portion of the cylinder, that is, that portion of the cylinder above the series of trays, to approximately 430° F. in order to avoid condensation of vapors and volatile materials. We have also found it desirable to provide a third heating element 42 which surrounds the upper flanges and exhaust tubing in order to prevent condensation in this portion of the apparatus.

It has been found that in this apparatus, as in other deodorization apparatus, a longer time is required for the deodorization of vegetable oils than is required for the deodorization of animal fats. The present apparatus will satisfactorily deodorize vegetable oils in 15 to 20 pound batches in approximately two to three hours. A 15 to 20 pound batch of lard can be deodorized satisfactorily in approximately two hours.

At the completion of the deodorization it has been found desirable to permit the apparatus to be cooled to just above the melting point of the fat or oil before the fat or oil is withdrawn from the apparatus in order to minimize oxidation of the deodorized product. In the present apparatus such a cooling period may be about 1 hour. Oxidation may also be prevented and the product withdrawn immediately after deodorization if the apparatus is fitted with an outlet provided with a heat exchanger so that hot deodorized oils can be cooled prior to exposure to the air.

In a particular embodiment of the novel apparatus wherein the cylinder shell 10 measured 40 inches in length and was of corresponding diameter, etc. and which contained a series of four contact units, a batch of 20 pounds of lard was deodorized in two hours. During this two hour period 400 cc. of distilled water was vaporized and passed through the deodorizer. It may therefore be calculated that 200 g. of steam were passed through the deodorizer per hour. In this particular run a vacuum of .3 inch pressure was maintained in the column. The water vapors were preheated to approximately the temperature of the oil before being passed through the inlet pipe into the lower bubble tray. After the two hour deodorization period was completed, the apparatus was allowed to cool for approximately one hour. The melted lard was then withdrawn and analyzed and was found to contain less than .02% fatty acids and was found to be a very satisfactorily deodorized product.

It will be apparent to the skilled in the art that the present invention is subject to many variations and modifications, all of which are within the skill of the art and within the spirit and scope of the present invention.

I claim:

1. Apparatus for removing volatile substances from liquids comprising a vertically positioned shell, means communicating with the upper portion of said shell for the production and maintenance of a vacuum within said shell, means for introducing liquids into said shell, means for introducing a stripping medium into the lower portion of said shell, a plurality of vertically positioned liquid and stripping medium contact devices disposed within said shell, each of said contact devices being of a smaller diameter than the inside diameter of said tubular shell whereby an annular space is formed between the periphery of said contact devices and the interior wall of said shell, each of said contact devices being generally cylindrical in shape and open on the bottom end and closed on the upper end except for an aperture through which said stripping medium and said liquid may pass into the space above said contact device, an aperture in the upper end of said contact device, a riser tube communicating with said aperture and extending downwardly into the hollow space within said contact device whereby said stripping medium and liquid may rise through said contact device, a bubble cap positioned over said aperture and said riser tube whereby the upward flow of liquid and stripping medium through said contact device is interrupted and the contact thereof is increased, said bubble cap being generally hemispherical in shape and having narrow openings on the lower side thereof to permit egress of liquid and stripping medium in close mutual contact, means for withdrawing the stripping medium and volatile substances from the upper part of said shell, and means for the withdrawal of liquids from said shell.

2. Apparatus for removing volatile substances from a liquid comprising a column, means for introducing a liquid to be stripped of volatile substances into said column, means for introducing a stripping medium into the lower portion of said column, a plurality of vertically spaced stripping medium and liquid contact devices in the column so constructed and arranged that said stripping medium and said liquid pass upwardly therethrough in mutual contact, said contact devices being of lesser diameter than the inside diameter of said column whereby an annular space wherein liquid may flow freely is formed between said contact devices and said column said contact device being open on the bottom end whereby the space partially enclosed by said contact device freely communicates with the annular space surrounding said contact device, means communicating with the upper portion of said column for producing and maintaining a vacuum within said column, means for withdrawing the stripping medium and volatile substances from the upper part of said column, and means for the withdrawal of liquids.

3. Apparatus for removing volatile substances from liquids comprising a vertically positioned tubular shell, means communicating with the upper portion of said shell for the production and maintenance of a vacuum within said shell, means for introducing liquids into said shell, means for introducing a stripping medium into the lower portion of said shell, a plurality of vertically spaced units disposed within said shell, each of said units being of smaller diameter than the inside diameter of said tubular shell whereby an annular space is formed between the periphery of said units and the interior wall of said shell each of said units being generally cylindrical in shape, being open on the bottom end whereby the space partially enclosed by said unit freely communicates with the annular space surrounding said unit and being closed on the upper side except for an aperture through which said stripping medium and said liquid pass into the space above the unit, and tubular risers extending downwardly from the aperture of said unit whereby said stripping medium and liquid rise through said unit in intimate contact.

4. An apparatus for removing volatile substances from fats and oils comprising a vertically positioned tubular column, said column communicating in the upper portion thereof with a vacuum supply, means for introducing vapors into the lower portion of said column, means for introducing fats and oils into said column, a plurality of vertically spaced cylindrical units disposed within said column, said cylindrical units being of lesser diameter than said tubular column, said units having no closure on the lower sides thereof and being closed at their upper end except for riser tubes inserted in the upper end thereof, said riser tubes extending downwardly into the space below the upper closure of said units, bubble caps positioned over each riser tube, slots in the sides of said bubble caps whereby liquids and vapors are permitted to flow from said bubble cap, said cylindrical units being of lesser diameter than said tubular shell whereby oil may flow from the top of said series of units downwardly through the annular space within said tubular shell and surrounding said series of units.

5. The method of stripping volatile materials from liquids comprising charging a batch of liquid into a column having a plurality of spaced liquid-vapor contact devices disposed therein, said liquid substantially covering said plurality of liquid-vapor contact devices, passing a continuous flow of vapor into the lower portion of said column whereby said vapors and said liquid are

caused to flow upward through said plurality of liquid-vapor contact devices, said vapors collecting and forming a head beneath the upper closure of each of said liquid-vapor contact devices and said vapors flowing from said head with entrained liquids through a riser tube which projects downwardly from the upper closure of each of said contact devices whereby liquid flowing from the upper most liquid-vapor contact device flows to the side and down through an annular space surrounding said plurality of liquid-vapor contact devices and is continually recycled through said contact devices whereby

said liquid is continually contacted with vapors and the volatile materials of the liquid are stripped from said liquid and pass upwards and outwards through an exhaust system at the upper portion of said column.

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