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METHOD AND APPARATUS FOR CONTINUOUS REFINING AND SIMULTANEOUS DEODORIZING RAW FATS AND OILS BY DISTILLING FREE ALIPHATIC ACIDS THEREFROM

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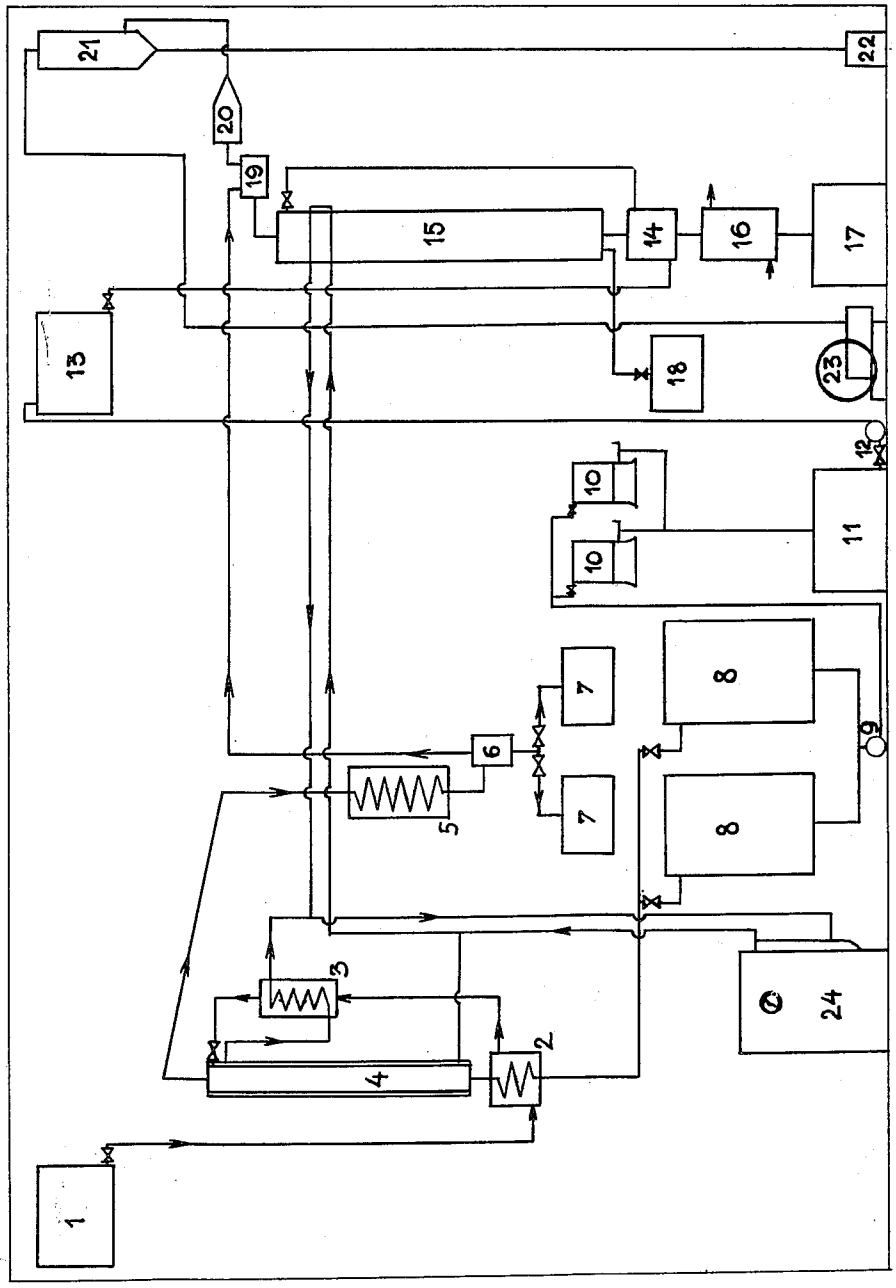


FIG. 1.

Inventor
Vojtech Mares

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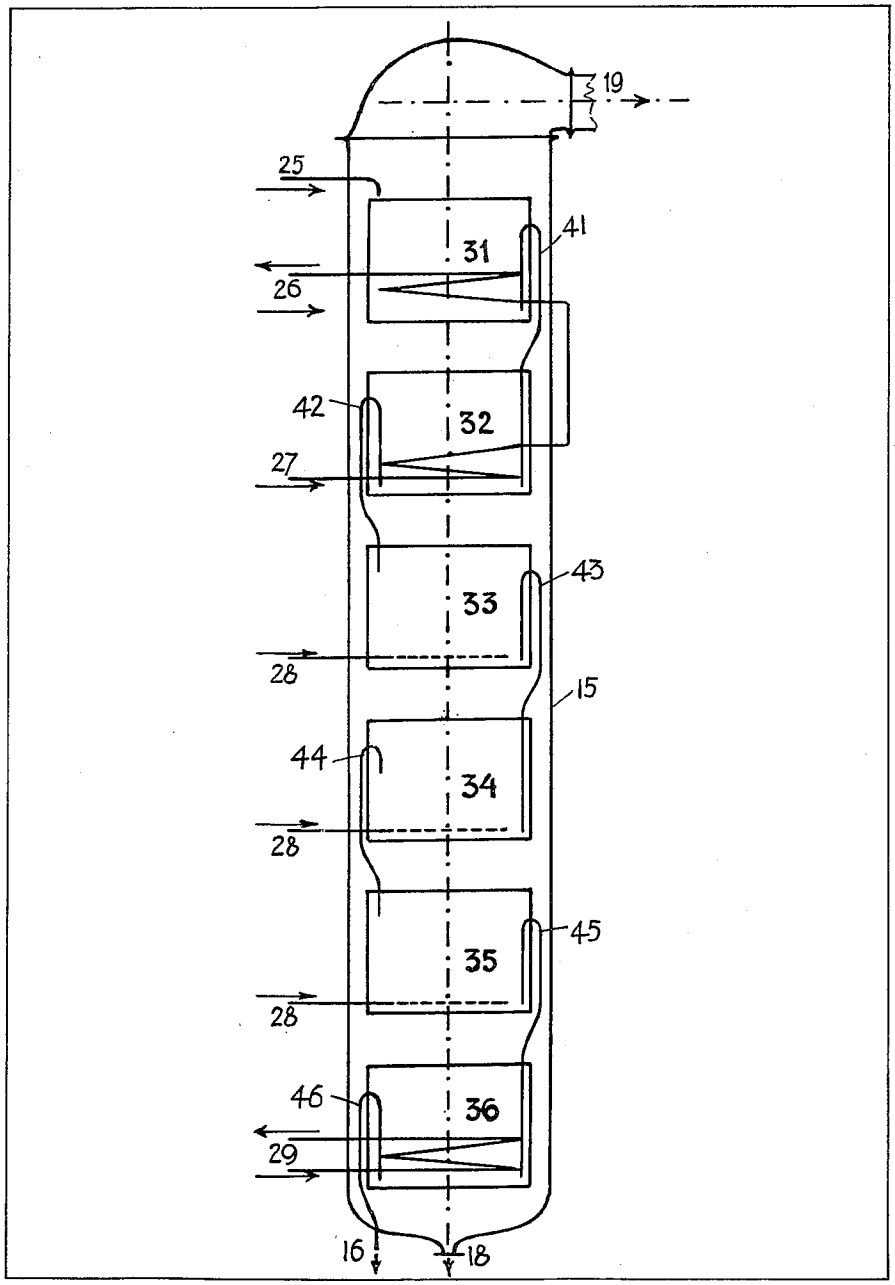


FIG. 2.

Inventor
Vojtěch Mareš
By Michael Glynn

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METHOD AND APPARATUS FOR CONTINUOUS REFINING AND SIMULTANEOUS DEODORIZING RAW FATS AND OILS BY DISTILLING FREE ALIPHATIC ACIDS THEREFROM

Vojtěch Mareš, Prague, Czechoslovakia

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For refining raw fats and oils by distilling free aliphatic acids therefrom a series of various methods has been proposed, said methods working either intermittently or continuously and using high temperatures from 200–300° C. at normal or high vacuum and saturated or superheated steam. According to one part of said methods the raw oils were deacidified only partially by distillation and the rest of free aliphatic acids was subsequently removed by neutralization with caustic. In accordance with the second part of the methods proposed the raw oils were completely deacidified by distillation down to a contents of 0.05 to 0.1 per cent of free aliphatic acids. The methods by which the raw material is only partially deacidified by distillation and then neutralized, were not suitable for refining normal oils because of extremely high working expenses and they are now made use of exclusively for refining raw oils having a high contents of free aliphatic acids, which raw oils may be refined by usual neutralization process with difficulties only. The methods, by which the raw oils were completely deacidified by distillation were not accepted by industry as considerably impairing the quality and durability of the treated oil in consequence of the high temperature employed.

It has been shown according to the present invention that the impairment of raw oil during distilling free aliphatic acids therefrom can be prevented when raw oil is for a short period exposed to high temperature, e. g. when it is first rapidly heated to a temperature of 200 to 300° C. at a high vacuum and is then rapidly cooled. By heating the raw oil to the said temperature, the majority of non-fats dissolved or finely emulsified in the starting material, will precipitate therefrom. At the same time part of free aliphatic acids will be expelled from the raw oil in another way. The non-fats present in the raw oil, cannot be removed from the oil before distilling off the free aliphatic acids, because they are dissolved and emulsified in the oil and are eliminated from the oil solution only after heating the oil to the aforesaid temperature. After a rapid partial cooling of the oil, bleaching earth is added thereto and after whitening the oil the separated particles of non-fats are filtered off together with the bleaching earth. The filtered and whitened oil is heated again to a temperature of 200 to 250° C. and is subjected to a final deacidification and to simultaneous deodorization in a special distillating column.

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This second distillation column is designed so that the oil treated therein flows continuously and gradually through a series of superposed reaction vessels which are made of a high grade material, such as of nickel or stainless steel, and in which it is at first heated to the reaction temperature and then the finely dispersed saturated or superheated steam at 250° C. is forced through the oil to entrain therewith free aliphatic acids and volatile substances, so that already neutral refined oil deacidified to 0.003 to 0.05 per cent is flowing into the lowermost vessel from which refined oil is precooled in the last vessel by means of cooling coils and flows again into a heat exchanger and into a counter-current water cooler, where it is additionally cooled. A uniform, continuous flow of oil through the individual reaction vessels is secured by a system of overflow tubes whose inlet and outlet ends are suitably arranged in the adjacent vessels or compartments so as to prevent the flowing-in oil from mixing directly with the oil flowing out of the same vessel. The system of overflow tubes according to the present invention yields a technical solution of the problem of continuous and complete deacidification and simultaneous deodorization, since the treated oil may remain in the distillation column during continuous flow through a plurality of individually separated sections until the oil is practically freed from all the free aliphatic acids and volatile substances. After flowing through the second distillation column the oil is additionally cooled and thus a final product is directly obtained, i. e. refined oil of sufficient purity for edible purposes.

The novel method of continuous refining of raw fats and oils is suitably performed in the apparatus shown in the accompanying drawings, in which

Fig. 1 is a diagrammatical illustration of the apparatus according to the present invention and

Fig. 2 is a diagrammatical sketch of the entire distillation column for simultaneous deacidification and deodorization of whitened oils.

Referring to the drawings, the raw oil is supplied from a storage tank 1 into a heat exchanger 2, where it is preheated by the oil flowing from the distillation column 4 and flows again through a preheater 3, where it is heated to a temperature of approximately 150° C. and enters into the first distillation column 4. During its flow through the resistance heating system in the distillation column 4 the oil is heated to a re-

action temperature of 200 to 300° C. The oil flowing down is encountered by counter flow steam which is directed to the bottom of the distillation column. The steam passing through the column 4 entrains therewith free aliphatic acids and volatile substances, so that the raw oil, in addition to the precipitation of the non-fats present, is at the same time partially deacidified and deodorized. Free aliphatic acids entrained with the steam pass into a cooler 5, where they are condensed and then separated from the steam in a separator 6 and collected alternatively in two recipients 7.

The oil which has flown through the first column 4 and in which the non-fats were precipitated, passes through the heat exchanger 2, where it delivers a portion of its heat to the raw oil supplied from the storage tank 1 and is directed at a temperature high than 100° C. alternatively into the two bleaching devices 8, where it is mixed with the bleaching earth and after the whitening it is supplied by means of a pump 9 to one of the two filter presses 10. In this filter press the oil is deprived of precipitated non-fats and of the added bleaching earth together with the absorbed pigments from the oil, so that a clear oil of light color is flowing from the filter press 10 into a receptacle 11 for the whitened oil, where it is accumulated. From the receptacle 11 the oil is supplied by a pump 12 into a sloping storage receiver 13 and therefrom the oil runs down by gravity over a heat exchanger 14 into a distillation and deodorization column 15, where it is simultaneously subjected to a continuous deacidification and deodorization.

The whitened oil flows into the second distillation column 15 (Fig. 2) through a tube 25 and passes into the first reaction vessel 31. During the filling of this vessel 31 the oil is preheated by a coil 26 and after reaching a given level within the vessel it begins to overflow automatically through the tube 41 into the second reaction vessel 32, where it is heated by a coil 27 to the reaction temperature. After reaching the predetermined level in the vessel 32 the oil begins to overflow through a tube 42 into a third reaction vessel 33, where steam finely dispersed by the perforated coil 28 is forced through the layer of oil heated to a temperature of 200 to 250° C., the steam entraining therewith free aliphatic acids and volatile substances. After reaching the predetermined level in the vessel 33 the oil begins to overflow automatically through the tube 43 into the next reaction vessel 34, where the process is repeated again until the oil automatically runs down through the tube 44 into the vessel 35, where the process is again repeated until the oil is automatically delivered through the tube 45 into the vessel 36, wherein it is entirely free from odor and flavor and wherein it is precooled by the coil 29 with cold water streaming therethrough. After reaching a predetermined level in the vessel 36 the oil begins to overflow through the tube 46 from the column 15 into the through-current cooler 16 over the heat exchanger 14, where it delivers a portion of its heat to the whitened oil prior to its entry into the second distillation column 15. After passing the cooler 16 the refined oil is accumulated in the receiver 17.

Distilled-off aliphatic acids leave the individual reaction vessels located in the column 15 and are condensed on the cooling jacket of the column, over which they flow into a recipient 18, where they are accumulated. The non-condensed volatile substances and steam escape through the top of the column over a separator 19 into a barometric condenser 21. By means of an air pump 23 and of a steam ejector 20 the desired high vacuum is obtained in the distillation column 4 and in the second distillation column 15, as well as in the respective recipients. The desired temperatures in the two columns 4 and 15 are maintained by a separate heating system 24, where the heat exchanging substance is heated by a gas or crude oil burner.

In the following a specific example of the novel continuous method of refining and deodorizing raw fats and oils in an apparatus according to the present invention, as set forth above, will be described:

In an apparatus, having an output of 20 tons in 24 hours, there are treated 20,000 kilograms of raw soya-bean oil having a contents of 3 per cent of free aliphatic acids. At a temperature of approximately 80° C. the raw oil flows continuously down by its own gravity from the storage tank 1 through the heat exchanger 2, where it is preheated to a temperature of approximately 150° C., after which it passes through the preheater 3, where it is heated to about 220° C. and enters through the top into the distillation column 4 in which a high vacuum (low absolute pressure) of approximately 5 cm. Hg is maintained by means of a steam ejector 20. In the distillation column the oil flows rapidly through the resistance heating insert the oil being heated approximately to 200° C. After a rapid passage through the distillation column the oil flows through the heat exchanger, where it is precooled to approximately 200° C. and is collected under reduced pressure alternatively in one member of the couple of bleaching devices 8, where it is cooled to a temperature of 110° C. When about 5 tons of oil have been accumulated in the bleaching device the latter is closed and the oil directed into the second member of the couple of the bleaching device 8. Meanwhile after the addition of 50 kilograms of bleaching earth the contents of the first mentioned member has been whitened and the oil and bleaching earth mixture are supplied by means of the pump 9 to the filter press 10, where the eliminated non-fats and bleaching earth are filtered off. Clear filtered oil is accumulated in the receptacle 11 and hence it is pumped over into the sloping storage receiver 13.

In the meantime the oil in the distillation column has been under the influence of high temperature and stream freed from about 1 per cent of free aliphatic acids which were entrained by the stream from the column into the cooler 5, where the aliphatic acids are condensed and collected over the separator 6 in one of the two recipients 7. After passing through the distillation column 4 and through the bleaching arrangement about 19,500 kilograms of whitened oil and approximately 210 kilograms of distillated acids with a contents of about 95 per cent of free aliphatic acids are obtained from the above mentioned 20,000 kilograms of raw oil. From the sloping storage receiver 13 the whitened oil flows out continuously over the heat exchanger 14 in a direct stream into the second distillation column 15, where it successively flows by means of overflow tubes through a series of superposed vessels 31 to 36, where it gradually heated from about 100° C. to 230° C. and at this temperature steam is forced therethrough with the successive

vessels, the steam entraining therewith the rest of free aliphatic acids and the volatile substances, so that entirely neutral and deodorized oil is already flowing into the last vessel. In this last vessel the oil is precooled and after passing through the heat exchanger 14 and through the next cooler 16 it is accumulated in the storage receiver 17. Free aliphatic acids volatilizing from the individual vessels are accumulated on the cooling walls in the column over which walls they flow in condensed state into the recipient 18.

About 19,270 kilograms of refined oil and 220 kilograms of distilled aliphatic acids with a contents of approximately 90 per cent of free aliphatic acids are produced from 19,500 kilograms of whitened oil after flowing through the distillation column 15. The final yields from 20,000 kilograms of raw soya-bean oil with a contents of 2 per cent of free aliphatic acids is thus 19,270 kilograms of refined oil and 430 kilograms of distilled aliphatic acids with a contents of 92%.

The novel method of continuous refining of raw fats and oils shows in contrast to previously employed refining methods the following considerable advantages:

1. The whole operation with the exception of the whitening of oils is continuous, so that the apparatus is very efficient in view of the small attendance it requires.

2. A considerable preservation of heat is obtained, since after the oil has first been heated purpose of precipitation of non-fats and for a partial deacidification, the heat of the oil is utilized for the next bleaching operation and after the second heating of the oil its heat is utilized simultaneously for a complete deacidification and deodorization.

3. All the free aliphatic acids which are present in the raw oil are obtained in distilled state and in a concentration of 95 to 98 per cent.

4. The yield of refined oil is substantially increased over the previously used method of neutralization with an average acidity of raw oils of 3 per cent the increase of yield is 2 to 3 per cent.

5. The refined oil obtained is of light color, of faultless quality and of long lifetime.

6. The novel method of continuous raffination provides a substantial reduction of working expenses over the previously used neutralization processes even when treating raw oils with a small contents of free aliphatic acids. When using the novel method the difficult separation of oil emulsions and separation of waste by centrifuging which may be necessary besides another likewise difficult treatment of waste soap to waste aliphatic acids, may be dispensed with.

I claim:

1. A method of continuously refining and simultaneously deodorizing raw fatty materials of the class consisting of fats and oils containing non-fatty matter and free aliphatic acids, which comprises heating said raw fatty material to a temperature of 200° to 300° C. under vacuum until all non-fatty matter is substantially precipitated and a major proportion of free aliphatic acids volatilized; partially and rapidly cooling said fatty material; adding an adsorptive earth thereto; filtering off said adsorptive earth; and subjecting said fatty material to distillation under vacuum at a temperature of 200° to 250° C. in the presence of steam to remove substantially all the residual free aliphatic acids from said fatty material.

2. A method of continuously refining and simultaneously deodorizing raw fatty materials of the class consisting of fats and oils containing non-fatty matter and free aliphatic acids, which comprises heating said raw fatty material to a temperature of 200° to 300° C. under vacuum and in the presence of steam until all non-fatty matter is substantially precipitated and a major proportion of free aliphatic acids volatilized; partially and rapidly cooling said fatty material; adding a bleaching earth thereto; filtering off said bleaching earth; and subjecting said fatty material to distillation under vacuum at a temperature of 200° to 250° C. in the presence of steam to remove substantially all the residual free aliphatic acids from said fatty material.

3. A method of continuously refining and simultaneously deodorizing raw fatty materials of the class consisting of fats and oils containing non-fatty matter and free aliphatic acids, which comprises heating said raw fatty material to a temperature of 200° to 300° C. under vacuum and in the presence of a counter-current flow of steam until all non-fatty matter is substantially precipitated and a major proportion of free aliphatic acids volatilized; partially and rapid cooling said fatty material; adding a bleaching earth thereto; filtering off said bleaching earth; and subjecting said fatty material to distillation under vacuum at a temperature of 200° to 250° C. in the presence of steam to remove substantially all the residual free aliphatic acids from said fatty material.

4. A method of continuously refining and simultaneously deodorizing a raw fatty material of the class consisting of fats and oils containing non-fatty matter and free aliphatic acids, which comprises rapidly heating said fatty material to a temperature of 200° to 300° C. under vacuum and in the presence of steam for a short time period; partially and rapidly cooling said fatty material; adding a bleaching earth thereto; filtering off said bleaching earth and recovering the bleached fatty material; preheating said bleached fatty material; subjecting said preheated fatty material to steam distillation under vacuum to remove free aliphatic acids and other volatile substances therefrom; and recovering a refined and deodorized fatty material.

5. A method of continuously refining and simultaneously deodorizing a raw fatty material of the class consisting of fats and oils containing non-fatty matter and free aliphatic acids, which comprises rapidly heating said fatty material to a temperature of 200° to 300° C. under vacuum and in the presence of steam for a short time period; partially and rapidly cooling said fatty material; adding a bleaching earth thereto; filtering off said bleaching earth and recovering the bleached fatty material; preheating said bleached fatty material to 200° to 250° C.; subjecting said preheated fatty material to steam distillation under vacuum to remove free aliphatic acids and other volatile substances therefrom; and recovering a refined and deodorized fatty material.

6. A method of continuously refining and simultaneously deodorizing raw fatty materials of the class consisting of fats and oils containing non-fatty matter and free aliphatic acids, which comprises heating said raw fatty material to a temperature of 200° to 300° C. under vacuum until all non-fatty matter is substantially precipitated and a major proportion of free aliphatic acids volatilized; partially and rapidly

cooling said fatty material; adding an adsorptive earth thereto; filtering off said adsorptive earth; and subjecting said fatty material to distillation under vacuum at a temperature of 200° to 250° C. in the presence of super-heated steam to remove substantially all the residual free aliphatic acids from said fatty material.

7. A method of continuously refining and simultaneously deodorizing raw fatty materials of the class consisting of fats and oils containing non-fatty matter and free aliphatic acids, which comprises heating said raw fatty material to a temperature of 200° to 300° C. under vacuum until all non-fatty matter is substantially precipitated and a major proportion of free aliphatic acids volatilized; partially and rapidly cooling said fatty material; adding an adsorptive earth thereto; filtering off said adsorptive earth; and subjecting said fatty material to distillation under vacuum at a temperature of 200° to 250° C. in the presence of saturated steam to remove substantially all the residual free aliphatic acids from said fatty material.

8. A method of continuously refining and simultaneously deodorizing raw fatty materials of the class consisting of fats and oils containing non-fatty matter and free aliphatic acids, which comprises preheating said fatty material; further heating said preheated fatty material to a temperature of 200° to 300° C. under vacuum until the non-fatty matter is substantially precipitated and a major proportion of free aliphatic acids volatilized; partially and rapidly cooling said fatty materials; adding an adsorptive earth thereto; filtering off said adsorptive earth; and subjecting said fatty material to distillation under vacuum at a temperature of 200° to 250° C. in the presence of steam to remove substantially all of the residual free aliphatic acids from said fatty material.

9. A method of continuously refining and simultaneously deodorizing raw fatty materials of the class consisting of fats and oils containing non-fatty matter and free aliphatic acids, which comprises preheating said fatty material; further heating said preheated fatty material to a temperature of 200° to 300° C. under vacuum until the non-fatty matter is substantially precipitated and a major proportion of free aliphatic acids volatilized; partially and rapidly cooling said fatty material; adding an adsorptive earth thereto; filtering off said adsorptive earth; preheating said bleached fatty material; and subjecting said preheated fatty material to distillation under vacuum at a temperature of 200° to 250° C. in the presence of steam to remove substantially all of the residual free aliphatic acids from said fatty material.

10. A method of continuously refining and simultaneously deodorizing raw fatty materials of the class consisting of fats and oils containing non-fatty matter and free aliphatic acids, which comprises preheating said fatty material to a temperature below 200° C.; further heating said pre-heated fatty material to a temperature of 200° to 300° C. under vacuum until the non-fatty matter is substantially precipitated and a major proportion of free aliphatic acids volatilized; partially and rapidly cooling said fatty material; adding an adsorptive earth thereto; filtering off said adsorptive earth; preheating said bleached fatty material; and subjecting said preheated fatty material to distillation under vacuum at a temperature of 200° to 250° C. in the presence of steam to remove substantially all of the residual free aliphatic acids from said fatty material.

11. An apparatus for continuously refining and simultaneously deodorizing raw fatty materials comprising a first distillation column; a second distillation column including individual reaction chambers superimposed upon each other, and a plurality of siphon tubes each connecting two consecutive superimposed reaction chambers whereby the fatty material flows by gravity from each of said reaction chambers into the next following one; and a bleaching device interposed between said distillation columns.

VOJTĚCH MAREŠ.

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