Dec. 6, 1938. S. TIJMSTRA 2,139,392

EXTRACTION PROCESS

Filed May 27, 1935 2 Sheets-Sheet 1

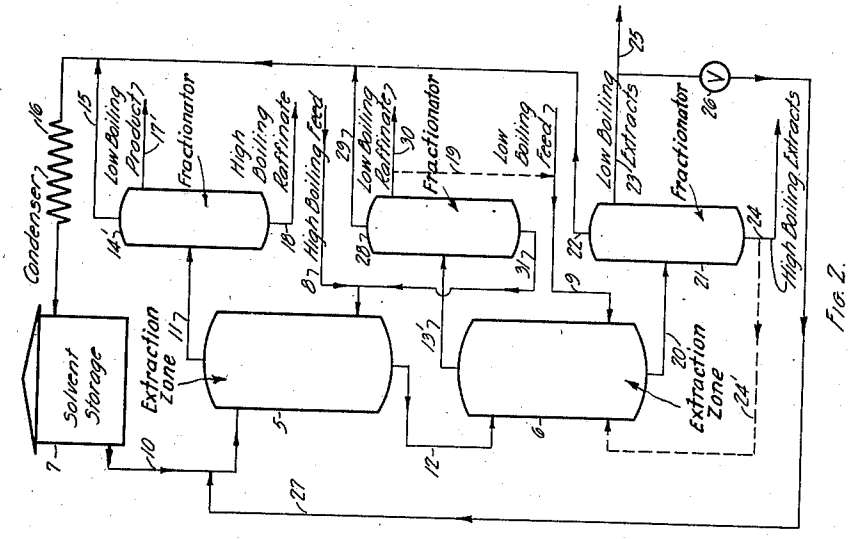

FIG. 2.

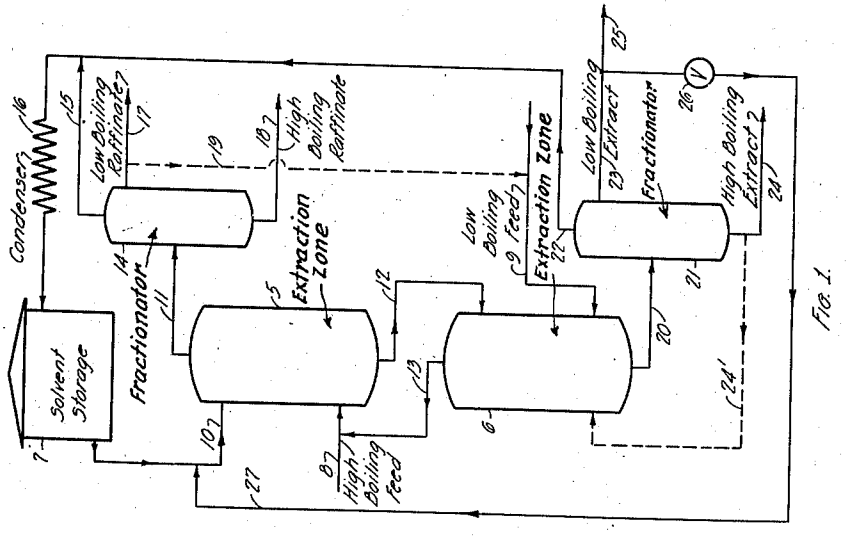

FIG. 1.

Inventor: Sijbren Tijmstra

By his Attorney:

Dec. 6, 1938. S. TIJMSTRA 2,139,392

EXTRACTION PROCESS

Filed May 27, 1935 2 Sheets-Sheet 2

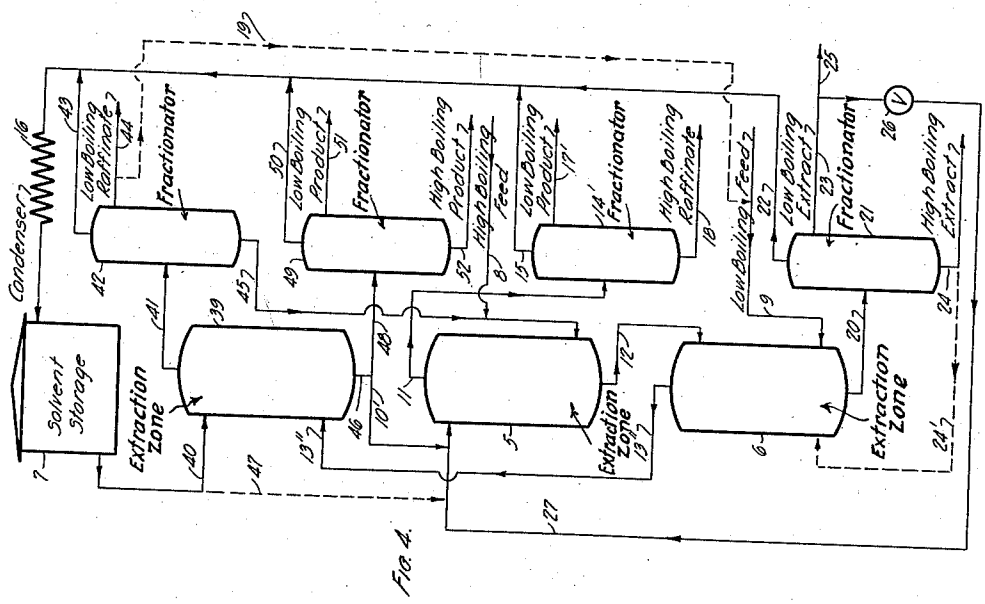

FIG. 4.

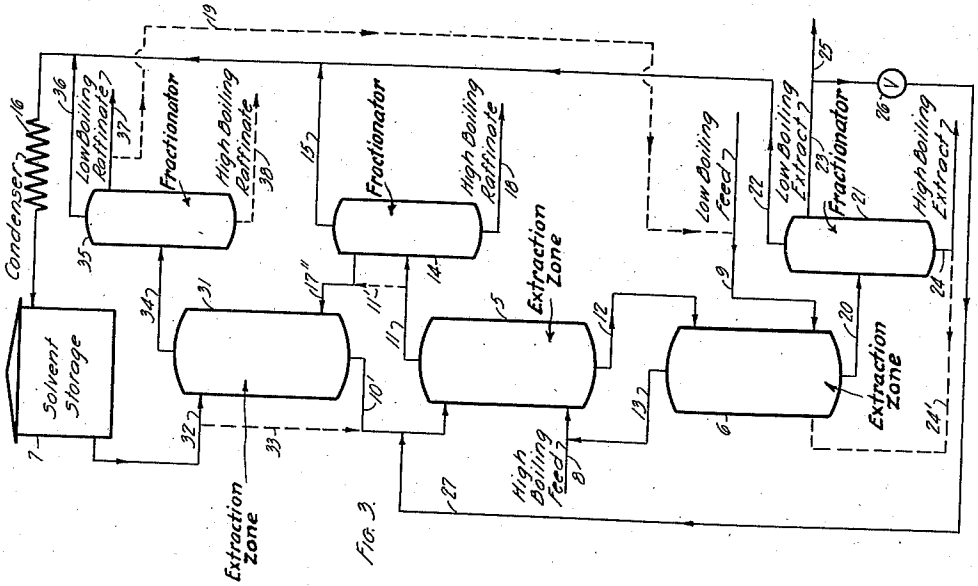

FIG. 3.

Inventor: Sijbren Tijmstra

By his Attorney:

Patented Dec. 6, 1938 2,139,392

UNITED STATES PATENT OFFICE

2,139,392

EXTRACTION PROCESS

Sijbren Tijmstra, Berkeley, Calif., assignor to Shell Development Company, San Francisco, Calif., a corporation of Delaware

Application May 27, 1935, Serial No. 23,552

11 Claims. (Cl. 196—13)

This invention relates to an improved process for the solvent extraction of liquid mixtures, and more specifically comprises an improvement thereof in which two mixtures of different boiling ranges are extracted simultaneously in a manner that the presence of the lower boiling mixture causes a more complete and efficient separation of the components of the mixture.

In the extraction of lubricating oil distillates or residues it is desired to recover paraffinic hydrocarbons which are the most stable against deterioration and which possess the most desirable temperature-viscosity characteristics. In the known processes for extracting hydrocarbon mixtures, such as cylinder oil, lubricating oil, transformer oil, spindle oil, solar oil, kerosene, gasoline, etc., a solvent having a preferential solubility for non-paraffinic components is contacted with the hydrocarbon mixture under conditions of temperature, pressure, and concentration to cause the formation of a raffinate phase, and an extract phase, which are then separated and treated to remove the solvent from the separated phase and yield the raffinate and extract portions. The paraffinic components of the mixture are thereby concentrated in the raffinate and the non-paraffinic components are concentrated in the extract. By repeatedly extracting the raffinate or the raffinate phase with a fresh solvent, or by treating it in a countercurrent treater of sufficient length or of a sufficient number of stages, an ultimate raffinate of any desired degree of purity can be produced, but the yield will often be very low because considerable amounts of the less soluble or paraffinic components are dissolved in the solvent and are removed from the extraction system as a part of the extract phase.

As an improvement on this process, it has been proposed to treat the extract or the extract phase to remove from it certain portions of the paraffinic components, which portions may either be returned to the extraction zone or be withdrawn as a separate product. For example, the oil may be brought into contact with counterflowing streams of solvents, one of which has a greater solvent power for naphthenic or non-paraffinic oils, and the other having a greater solvent power for the paraffinic oils, as disclosed in the patent to Van Dijck No. 2,023,109. According to the said patent such solvent pairs, as liquid sulfur dioxide and propane, or bi-sulfide and methyl alcohol, are employed.

In such processes the solvent for paraffinic fractions (hereinafter designated as the auxiliary solvent) must be supplied to the system and is not itself improved by the treatment. It is, therefore, an added item in the costs of the installation and operation.

In accordance with my invention, I have found that it is possible to use as the auxiliary solvent a low boiling hydrocarbon having a paraffinic content which is sufficiently great to cause it to be at least partially immiscible with the extract phase. In such a treatment the low boiling hydrocarbon serves the function of the auxiliary solvent, in that it washes out of the oil extract phase a portion of its paraffinic constituents. At the same time this low boiling hydrocarbon mixture is itself separated into raffinate and extract portions, whereby the high boiling and low boiling hydrocarbons are simultaneously extracted. It is often desirable to operate this process at temperatures which are below those which would be employed in the absence of the low boiling hydrocarbon. In this manner the cost of providing an auxiliary solvent which is unsusceptible of improvement is eliminated, and the extraction of an additional hydrocarbon mixture is effected at substantially no extra cost.

My invention, moreover, comprises certain novel methods of contacting the solvent and the hydrocarbon mixtures of employing certain portions of the recovered products to further improve the extraction, and of further improving the purity and the yield of the various products of the system, all as more specifically described in this specification, schematically illustrated in the accompanying drawings and recited in the claims. It is understood that the drawings are, however, exemplary only because my invention may be practiced in a large number of methods, and the individual steps may be re-arranged in many ways, without departing from the spirit and scope of the invention. Furthermore, my invention may be applied to many forms of apparatus other than those suggested in the drawings.

In the drawings, Figure 1 is a schematic diagram illustrating one embodiment of my invention; Figures 2, 3 and 4 are similar diagrams illustrating modified embodiments thereof. The same numerals designate the same elements in all of the figures.

In the drawings, numerals 5 and 6 represent extraction apparatus which may be single- or multi-stage continuous countercurrent treaters, although a batch method of operation may also be employed. Moreover, 5 and 6 may be portions of the same vertical liquid contact chamber, provided with means for introducing the feed, and, when necessary, as in the methods

of Figures 2, 3 and 4, for withdrawing all or portions of one of the liquid phases at an intermediate point. Numerals 7, 8 and 9 represent sources of a selective solvent, of the high boiling oil to be extracted, and the low boiling distillate to be extracted. Pipe conduits and other apparatus will be described in the course of the explanation of the operation of the process, it being understood that the apparatus may be equipped with suitable pumps, valves, heat-exchangers, and other adjuncts which are not specifically recited.

Referring particularly to Figure 1, the high boiling oil is subjected to an extraction with a selective solvent fed to the apparatus 5 by means of a conduit 10, preferably by flowing it countercurrently to the solvent. The solvent may consist of a pure solvent, such as sulfur dioxide, $\beta\beta'$dichloroethyl ether, furfural, quinoline, phenol, nitrobenzene, etc., or of mixtures of said solvents. It is, moreover, often advantageous to employ an aromatic hydrocarbon (mono- or poly-cyclic) diluent for the selective solvent, to increase the solvent power of the solvent and to improve the composition of the raffinate phase. Such a diluent may be added separately into the apparatus 5, or mixed with the solvent outside of said apparatus, as by maintaining a properly blended solvent-diluent mixture in the tank 7.

The raffinate phase and the extract phase formed in the apparatus 5 are withdrawn through pipes 11 and 12, and are, for convenience, hereinafter designated as the first raffinate phase and the first extract phase, respectively. The latter will generally contain substantial amounts of the less soluble or paraffinic components of the oil which it is desired to recover as a part of the raffinate phase. To recover these desirable constituents this first extract phase is fed into apparatus 6 where it is contacted with a distillate having a lower boiling range than the oil which was introduced at 8. The extraction apparatus 6 may be similar to the apparatus 5 in that it may consist of a vertical chamber provided with suitable contact means, such as packing, or it may be constructed in the form of a series of alternating mixing and settling means interconnected for counterflowing the low boiling distillate from 9 and the first extract from 12.

The low boiling distillate should be sufficiently paraffinic in nature to be partially insoluble in the first extract phase and to cause the formation of second raffinate and extract phases. Under these conditions portions of the paraffinic components of the high boiling oil which are present in the first extract phase will be dissolved in the second raffinate phase. At the same time the low boiling distillate will be separated into paraffinic and non-paraffinic portions, most of the former entering the second raffinate phase, while the latter is largely dissolved in the solvent and forms a part of the second extract phase. The second raffinate phase is withdrawn at 13 and introduced into the apparatus 5 either together with the high boiling feed, as shown, or separately. The first raffinate phase in the pipe 11, consisting of selective solvent and paraffinic concentrates or raffinates of each of the two feed mixtures may be treated in the fractionating apparatus 14 to separate it into three or more portions. The solvent is withdrawn and returned to the storage 7 through a pipe 15 and a condenser 16. Although I have shown only a single conduit for the solvent, when an aromatic diluent is employed it may often be desirable to separate the diluent from the solvent in the fractionator 14 and to provide a separate return line and a separate storage for the diluent. The low boiling and high boiling raffinates may be recovered as distillation products from the fractionating apparatus 14 and withdrawn at 17 and 18. If desired, a portion of the low boiling raffinate from 17 may be recycled through a conduit 19 and introduced to apparatus 6 together with the low boiling distillate introduced at 9. This will increase the paraffinicity of the feed mixture introduced at this point.

The second extract phase is withdrawn at 20 and fed into a fractionating apparatus 21 where it is separated into solvent, low boiling extract, and high boiling extract portions, which are withdrawn at 22, 23 and 24, respectively, the solvent being returned to the storage 7, as shown. A portion of the high boiling extract, or of a mixture of high and low boiling extracts may, if desired, be recycled to the extraction apparatus 6 as through a conduit 24', and used as a backwash, thereby further improving the purity of the extract phase in the conduit 20, i. e., reducing its content of paraffinic constituents. This feature is more fully described in the patent to van Dijck, No. 2,081,719.

It is often possible to use the low boiling extract withdrawn at 23 instead of or in conjunction with the aromatic diluent for the selective solvent. This may be effected by withdrawing at 25 only a portion of the distilled low boiling extract, and feeding the remainder through a valve 26 and pipe 27 into the apparatus 5, either together with the selective solvent in pipe 10, as shown, or separately. This low boiling extract will improve the composition of the high boiling raffinate.

When a high boiling raffinate of a high degree of purity is desired it is advantageous to employ an aromatic diluent for the selective solvent, and to exclude paraffinic diluents from the last stage or stages of the extraction process, by which is meant the stage or stages nearest the point at which the high boiling raffinate phase is withdrawn. This method of operation is illustrated in Figure 2, in which the second raffinate phase from the apparatus 6, instead of being introduced directly to the apparatus 5 is fed to a fractionator 28 to separate it into solvent, low boiling, and high boiling portions, which are withdrawn at 29, 30 and 31, respectively. The low boiling product will be somewhat more paraffinic in nature than the feed which is introduced at 9, and may be continuously withdrawn as the low boiling raffinate. If desired, a portion of it may be recycled to the feed through a conduit 19, as explained above in connection with Figure 1. The high boiling portion is introduced into the apparatus 5 with the high boiling feed at 8. The solvent from 29 is preferably returned to the storage 7, although a portion of it may be recombined with the high boiling fraction in conduit 31 and introduced into the apparatus 5 in a manner not shown in the drawing. The raffinate phase withdrawn at 11 is treated in the fractionating apparatus 14' to separate it into solvent, low boiling, and high boiling portions, which are withdrawn at 15, 17' and 18, respectively, as described above in connection with Figure 1. Since low boiling paraffinic constituents have been excluded from the apparatus 5, the distillation product recovered at 17' will be recovered in relatively small quantities and be largely aromatic,

but not to the same degree as the product which is recovered at 23. It may be withdrawn as a separate product, or blended with a small part of the product from 30 to increase its paraffinicity and then introduced into the apparatus 6 together with the low boiling feed at 9.

In either of the above described modes of operation in which a portion of the low boiling extract is recycled through the conduit 27 and used as a solvent diluent, its presence in large amounts in contact with a raffinate phase which is to yield a low boiling raffinate reduces the purity or paraffinicity of this low boiling raffinate. Thus, in the method of Figures 1 and 2, when valve 26 is opened to recycle aromatic extract the products at 17 or 30 will be less paraffinic than if valve 26 were closed. When it is desired to produce a highly paraffinic low boiling product, and yet retain the advantages of recycling the low boiling aromatic extract, recourse may be had to an auxiliary extraction zone for further extracting the low boiling extract.

Such an arrangement is illustrated in Figure 3, in which elements designated by reference characters 5 to 9, 11 to 16 and 18 to 27, inclusive, are similar to corresponding elements in Figure 1. The low boiling distillate recovered from the fractionating apparatus 14 at 17'' is fed into an extraction apparatus 31 which may be similar to the apparatus 5, and may comprise a single or a plurality of stages arranged to effect countercurrent contact between selective solvent introduced from storage 7 through a pipe 32. The conditions in the apparatus 31 are such that two phases will be formed, the extract phase being introduced into the apparatus 5 at 10' to extract the high boiling feed. It is generally most desirable to introduce all of the fresh solvent by way of the pipe conduit 32 and extraction zone 31. If, however, it is desired to employ a smaller quantity of solvent in the apparatus 31, additional solvent may be introduced through a pipe 33 directly into the apparatus 5.

The raffinate phase from the apparatus 31 is withdrawn at 34 and treated in fractionating apparatus 35 to separate it into solvent and oil portions, the former being returned to the storage 7 through a conduit 36, and the latter being withdrawn at 37 as the low boiling raffinate. This raffinate will, under these conditions, be highly paraffinic.

It is, moreover, possible to eliminate the fractionating apparatus 14, and feed the first raffinate phase from the apparatus 5 directly into the apparatus 31 through a conduit 11'. In this method the high boiling raffinate is recovered at 38 as a product of the fractionating apparatus 35.

A further modification of my process for producing a highly paraffinic low boiling product while recycling a portion of the low boiling aromatic extract is illustrated in Figure 4, in which reference characters 5 to 12, 15, 16 and 18 to 27 designate elements which are similar to those of Figure 3. In this method the low boiling paraffinic substance is excluded from the stage in which the raffinate phase containing the fully extracted high boiling raffinate phase is formed. To accomplish this, the second raffinate phase from the apparatus 6, instead of being introduced into the apparatus 5, is fed through a pipe 13'' into an auxiliary extraction apparatus 39, which may be similar to the apparatus 5, in which it is contacted, preferably in countercurrent, with solvent introduced through a pipe 40, under conditions to produce raffinate and extract phases. The former, containing the paraffinic components of both of the hydrocarbon mixtures and a small amount of solvent is withdrawn at 41 and treated in a fractioning apparatus 42 to separate its components. The solvent is withdrawn at 43 and returned to storage 7, and the low boiling raffinate is withdrawn at 44. Since substantially no low boiling extract has been introduced into the apparatus 39, this raffinate will be highly paraffinic.

The high boiling fraction contained in the phase withdrawn at 41 is recovered from the fractionating apparatus 42 at 45 and fed into the apparatus 5 together with the high boiling feed, and extracted with all or a portion of the extract phase which is withdrawn from the apparatus 39 at 46 and introduced into the apparatus 5 through a conduit 10'. Although it is generally desirable to introduce all of the solvent by way of the pipe 40 and the extraction zone 39, it may at times be advantageous to introduce additional quantities of fresh solvent directly into the apparatus 5 through a conduit 47. There being substantially no low boiling paraffinic diluent in the apparatus 5, the raffinate phase which is withdrawn at 11 will contain the high boiling fraction in a highly paraffinic condition. This raffinate phase is fed into a fractionating apparatus 14' where it is separated into solvent, low boiling, and high boiling portions, which are withdrawn at 15, 17' and 18, respectively, and disposed of as discussed above in connection with Figure 2.

If desired, all or a portion of the extract phase withdrawn at 46 may be continuously withdrawn through a pipe 48, and fractionated in the apparatus 49 into a solvent portion which is withdrawn at 50 and returned to the storage 7, a low boiling product, which is withdrawn at 51, and a high boiling product, which is recovered at 52.

The high boiling product from 52 may, if desired, be recycled into the apparatus 5 through the conduit 10', together with solvent from conduit 50 or 47, in a manner not shown in the drawings. In this manner the low boiling product, which is not sufficiently aromatic to cause the desired improvement in the distribution in the apparatus 5 may be separated at this point.

My invention may be used for the simultaneous extraction of any two hydrocarbon mixtures having different boiling ranges. The process is especially applicable for the production of lubricating or transformer oils as the high boiling raffinate, employing gasoline, keresene or a similar light distillate as the low boiling feed mixture. Such mineral oil hydrocarbons generally consist of paraffinic, naphthenic and aromatic components, the last two components being often categorically designated as naphthenic components. In the present claims I use the term "non-paraffinic" to include both of these types of hydrocarbons.

As used in the present specification and claims, I use the term "components" to designate portions of any liquid mixtures which exhibit different chemical or physical properties, and which can be separated from each other with a solvent mixture. It will be evident that by the word "component" is not meant only one chemically pure substance, but that this word covers also a mixture of substances. A component is said to be pure if it does not contain any portion of a substance which should be present only in another component. In the present specification and claims, there is no difference in meaning between the words "solution", "liquid mixture", and "liquid solution."

I claim as my invention:

1. A process of concentrating the paraffinic component of a high boiling mineral oil containing paraffinic and non-paraffinic components comprising the steps of extracting said oil with a selective solvent for non-paraffinic components in a first extraction zone under conditions producing first raffinate and extract phases, separating the first extract phase from the first raffinate phase, contacting the first extract phase in a second extraction zone with a low boiling mineral oil distillate containing paraffinic and nonparaffinic components under conditions causing the formation of a second raffinate phase comprising paraffinic components of the said oil and of the low boiling distillate, and a second extract phase comprising non-paraffinic components of the said oil and of the low boiling distillate, separating the second extract phase from the second raffinate phase, returning at least a portion of the second raffinate phase to the first extraction zone, separating from the second extract phase a non-paraffinic low boiling extract, introducing at least a portion of said separated low boiling extract into the first extraction zone, withdrawing the first raffinate phase from the first extraction zone, and separating from said first raffinate phase a fraction containing the paraffinic component of the high boiling oil in concentrated form.

2. A process of concentrating the paraffinic component of a high boiling mineral oil containing paraffinic and non-paraffinic components comprising the steps of extracting said oil in countercurrent with a selective solvent for non-paraffinic components, in a first extraction zone under conditions producing first raffinate and extract phases, separating the first extract phase from the first raffinate phase, contacting the first extract phase in a second extraction zone with a low boiling mineral oil distillate containing paraffinic and non-paraffinic components under conditions causing the formation of a second raffinate phase comprising paraffinic components of the said oil and of the low boiling distillate, and a second extract phase comprising non-paraffinic components of the said oil and of the low boiling distillate, separating the second extract phase from the second raffinate phase, returning at least a portion of the second raffinate phase to the first extraction zone, separating from the second extract phase a non-paraffinic low boiling extract, introducing at least a portion of said separated low-boiling extract into the first extraction zone near the point of introduction of the solvent, withdrawing the first raffinate phase from the first extraction zone, and separating from said first raffinate phase a fraction containing the paraffinic component of the high boiling oil in concentrated form.

3. A process of separating mineral oil fractions containing paraffinic and non-paraffinic components into two portions, respectively, more paraffinic and less paraffinic than the original fractions, comprising the steps of counterflowing a selective solvent and a low boiling mineral oil distillate adapted to form separate layers when in contact with each other, said selective solvent having a greater solvent power for non-paraffinic hydrocarbons than for paraffinic hydrocarbons, and the low boiling distillate containing paraffinic and non-paraffinic components, bringing a separate body of a high boiling mineral oil containing both paraffinic and non-paraffinic hydrocarbons into contact with the counterflowing solvent and low boiling distillate, thereby producing raffinate and extract phases, withdrawing said extract phase and separating from it a non-paraffinic low boiling extract, introducing at least a portion of said separated low boiling extract into the stream of said selective solvent at a point to flow countercurrently to said high boiling mineral oil, withdrawing the raffinate phase, and separating from it a fraction containing the paraffinic component of the high boiling fraction in a concentrated form.

4. A process of separating mineral oil fractions containing paraffinic and non-paraffinic components into two portions, respectively, more paraffinic and less paraffinic than the original fractions, comprising the steps of extracting a high boiling mineral oil in a first extraction zone by flowing it countercurrently to a selective solvent having a greater solvent power for non-paraffinic hydrocarbons than for paraffinic hydrocarbons, thereby producing first extract and raffinate phases, separating the first raffinate and extract phases, flowing said first extract phase in a second extraction zone countercurrently to a low boiling mineral oil distillate containing paraffinic and non-paraffinic components under conditions causing the formation of a second raffinate phase comprising paraffinic components of the oil and of the low boiling distillate, and a second extract phase comprising non-paraffinic components of the oil and of the low boiling distillate, returning at least a portion of the second raffinate phase to the first extraction zone near the point of introduction of the said oil, withdrawing the second extract phase from the second extraction zone and separating from it an extract comprising the non-paraffinic component of the low boiling distillate in concentrated form, introducing at least a portion of said separated low boiling extract into the first extraction zone near the point of introduction of the solvent, withdrawing first raffinate phase from the first extraction zone and separating from it a fraction containing the paraffinic component of the high boiling oil in a concentrated form.

5. A process of separating a high boiling mineral oil containing paraffinic and non-paraffinic components into two portions, respectively, more paraffinic and less paraffinic than the original oil, comprising the steps of extracting said oil in a first extraction zone with a selective solvent having a greater solvent power for non-paraffinic hydrocarbons than for paraffinic hydrocarbons, thereby producing first raffinate and extract phases, separating the first raffinate and extract phases, contacting the first extract phase in a second extraction zone with a low boiling mineral oil distillate containing paraffinic and non-paraffinic components under conditions causing the formation of a second raffinate phase comprising paraffinic components of the said oil and of the low boiling distillate, and a second extract phase comprising said non-paraffinic components of the oil and of the low boiling distillate, separating the second extract phase from the second raffinate phase, removing from at least a portion of the second raffinate substantially all of the low boiling distillate, returning at least the high boiling oil constituent of the residual portion of said second raffinate phase to the first extraction zone, separating from the second extract phase a non-paraffinic low boiling extract, introducing at least a portion of said low boiling extract into the first extraction

zone, withdrawing the first raffinate phase from the first extraction zone, and separating from said first raffinate phase a fraction containing the paraffinic component of the high boiling oil in concentrated form.

6. A process of separating a high boiling mineral oil containing paraffinic and non-paraffinic components into two portions, respectively, more paraffinic and less paraffinic than the original oil, comprising the steps of extracting said oil in a first extraction zone in countercurrent with a selective solvent having a greater solvent power for non-paraffinic hydrocarbon than for paraffinic hydrocarbons, thereby producing first raffinate and extract phases, separating the first raffinate and extract phases, contacting the first extract phase in a second extraction zone with a low boiling mineral oil distillate containing paraffinic and non-paraffinic components under conditions causing the formation of a second raffinate phase comprising paraffinic components of the said oil and of the low boiling distillate, and a second extract phase comprising non-paraffinic components of the said oil and of the low boiling distillate, separating the second extract phase from the second raffinate phase, removing from the second raffinate substantially all of the low boiling distillate, returning at least the high boiling oil constituent of the residual portion of said second raffinate phase to the first extraction zone, separating from the second extract phase a non-paraffinic low boiling extract therefrom, introducing at least a portion of said separated low boiling extract into the first extraction zone near the point of introduction of the solvent, withdrawing the first raffinate phase from the first extraction zone, and separating from said first raffinate phase a fraction containing the paraffinic component of the high boiling oil in concentrated form.

7. A process of separating mineral oil fractions containing paraffinic and non-paraffinic components into two portions, respectively, more paraffinic and less paraffinic than the original fractions, comprising the steps of extracting a high boiling oil in a first extraction zone with a selective solvent having a greater solvent power for non-paraffinic hydrocarbons than for paraffinic hydrocarbons, thereby producing first raffinate and extract phases, separating the first raffinate and extract phases, contacting the first extract phase in a second extraction zone with a low boiling mineral oil distillate containing paraffinic and non-paraffinic components under conditions causing the formation of a second raffinate phase comprising paraffinic components of the said oil and of the low boiling distillate, and a second extract phase comprising non-paraffinic components of the said oil and of the low boiling distillate, separating the second extract and raffinate phases, separating from the second extract phase a non-paraffinic low boiling extract, introducing at least a portion of said separated low boiling extract into the first extraction zone, extracting the second raffinate phase in a third extraction zone with said selective solvent under conditions causing the formation of a third raffinate phase and a third extract phase, separating the third extract and raffinate phases, removing from the third raffinate phase substantially all of the low boiling distillate, returning at least the high boiling oil constituent of the residual portion of the third raffinate phase to the first extraction zone, withdrawing the first raffinate phase from the first extraction zone, and separating from said first raffinate phase a fraction containing the paraffinic component of the high boiling oil in concentrated form.

8. A process of separating mineral oil fractions containing paraffinic and non-paraffinic components into two portions, respectively, more paraffinic and less paraffinic than the original fractions, comprising the steps of extracting a high boiling oil in a first extraction zone in countercurrent with a selective solvent having a greater solvent power for non-paraffinic hydrocarbons than for paraffinic hydrocarbons, thereby producing first raffinate and extract phases, separating the first raffinate and extract phases, contacting the first extract phase in a second extraction zone with a low boiling mineral oil distillate containing paraffinic and non-paraffinic components under conditions causing the formation of a second raffinate phase comprising paraffinic components of the said oil and of the low boiling distillate, and a second extract phase comprising non-paraffinic components of the said oil and of the low boiling distillate, separating the second extract and raffinate phases, separating from the second extract phase a non-paraffinic low boiling extract, introducing at least a portion of said separated low boiling extract into the first extraction zone near the point of introduction of the solvent, extracting the second raffinate phase in a third extraction zone with said selective solvent under conditions causing the formation of a third raffinate phase and a third extract phase, separating the third extract and raffinate phases, removing from the third raffinate phase substantially all of the low boiling distillate, returning at least the high boiling oil constituent of the residual portion of the third raffinate phase to the first extraction zone near the point of introduction of the high boiling oil, withdrawing the first raffinate phase from the extraction zone, and separating from said first raffinate phase a fraction containing the paraffinic component of the high boiling oil in concentrated form.

9. A process of separating mineral oil fractions containing paraffinic and non-paraffinic components into two portions, respectively, more paraffinic and less paraffinic than the original fractions, comprising the steps of extracting a high boiling oil in a first extraction zone in countercurrent with a selective solvent having a greater solvent power for non-paraffinic hydrocarbons than for paraffinic hydrocarbons, thereby producing first raffinate and extract phases, separating the first raffinate and extract phases, contacting the first extract phase in a second extraction zone with a low boiling mineral oil distillate containing paraffinic and non-paraffinic components under conditions causing the formation of a second raffinate phase comprising paraffinic components of the said oil and of the low boiling distillate, and a second extract phase comprising non-paraffinic components of the said oil and of the low boiling distillate, separating the second extract and raffinate phases, separating from the second extract phase a non-paraffinic low boiling extract, introducing at least a portion of said separated low boiling extract into the first extraction zone near the point of introduction of the solvent, extracting the second raffinate phase in a third extraction zone with said selective solvent under conditions causing the formation of a third raffinate phase and a third extract phase, separating the third extract and raffinate phases, introducing at least a portion of the third extract phase into the first extraction zone to

extract the high boiling mineral oil, removing from the third raffinate phase substantially all of the low boiling distillate, returning at least the high boiling oil constituent of the residual portion of the third raffinate phase to the first extraction zone near the point of introduction of the high boiling oil, withdrawing the first raffinate phase from the extraction zone, and separating from said first raffinate phase a fraction containing the paraffinic component of the high boiling oil in concentrated form.

10. A process of separating mineral oil fractions containing paraffinic an non-paraffinic components into two portions, respectively, more paraffinic and less paraffinic than the original fractions comprising the steps of extracting a high boiling oil in a first extraction zone in countercurrent with a selective solvent having a greater solvent power for non-paraffinic hydrocarbons than for paraffinic hydrocarbons, thereby producing first raffinate and extract phases, separating the first raffinate and extract phases, contacting the first extract phase in a second extraction zone with a low boiling mineral oil distillate containing paraffinic and non-paraffinic components under conditions causing the formation of a second raffinate phase comprising paraffinic components of the said oil and of the low boiling distillate, and a second extract phase comprising non-paraffinic components of the said oil and of the low boiling distillate, separating the second extract and raffinate phases, returning the second raffinate phase to the first extraction zone near the point of introduction of the high boiling oil, separating from the second extract phase a non-paraffinic low boiling extract, introducing at least a portion of said extract into the first extraction zone near the point of introduction of the solvent, withdrawing the first raffinate phase from the first extraction zone, extracting at least a portion of said first raffinate phase in a third extraction zone with a selective solvent having a greater solvent power for non-paraffinic hydrocarbons than for paraffinic hydrocarbons under conditions causing the formation of third raffinate and extract phases separating the third raffinate and extract phases, introducing at least a portion of the third extract phase into the first extraction zone at a point to cause it to flow countercurrently to the high boiling mineral oil, and separating from the third raffinate phase a fraction containing a paraffinic low boiling raffinate.

11. A process of separating mineral oil fractions containing paraffinic and non-paraffinic components into two portions, respectively more paraffinic and less paraffinic than the original fractions comprising the steps of extracting a high boiling oil in a first extraction zone in countercurrent with a selective solvent having a greater solvent power for non-paraffinic hydrocarbons than for paraffinic hydrocarbons, thereby producing first raffinate and extract phases, separating the first raffinate and extract phases, contacting the first extract phase in a second extraction zone with a low boiling mineral oil distillate containing paraffinic and non-paraffinic components under conditions causing the formation of a second raffinate phase comprising paraffinic components of the said oil and of the low boiling distillate, and a second extract phase comprising non-paraffinic components of the said oil and of the low boiling distillate, separating the second extract and raffinate phases, returning the second raffinate phase to the first extraction zone near the point of introduction of the high boiling oil, separating from the second extract phase a non-paraffinic low boiling extract, introducing at least a portion of said extract into the first extraction zone near the point of introduction of the solvent, withdrawing the first raffinate from the first extraction zone, removing from said first raffinate phase a fraction containing the paraffinic component of the high boiling oil in concentrated form, and extracting at least the low boiling distillate constituent of the residual portion of the first raffinate phase in a third extraction zone with a selective solvent having a greater solvent power for non-paraffinic hydrocarbons than for paraffinic hydrocarbons under conditions causing the formation of third raffinate and extract phases separating the third raffinate and extract phases, introducing at least a portion of the third extract phase into the first extraction zone at a point to cause it to flow countercurrently to the high boiling mineral oil, and separating from the third raffinate phase a fraction containing a paraffinic low boiling raffinate.

SIJBREN TIJMSTRA.