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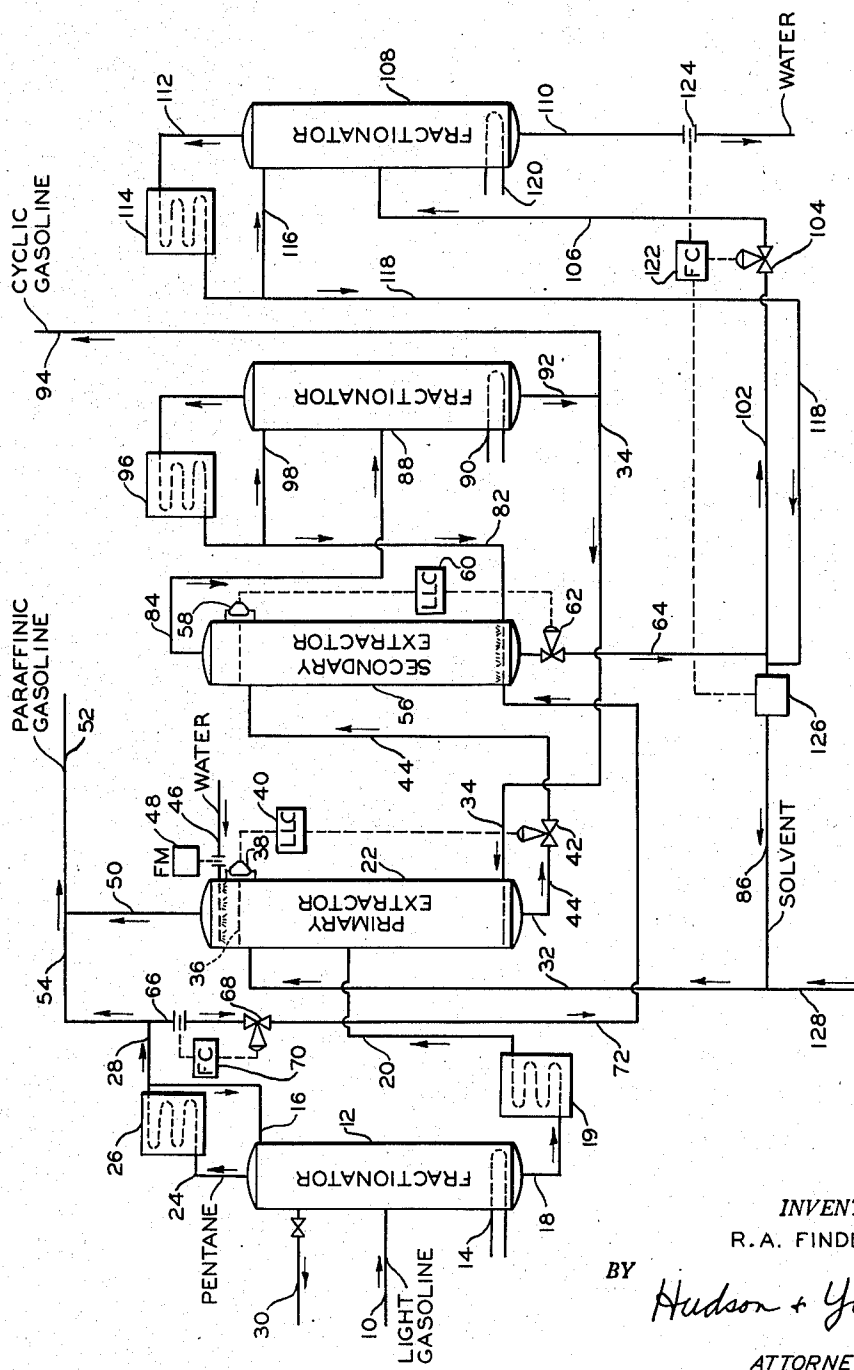
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2,656,301

PROCESS FOR MAKING HIGH OCTANE GASOLINE

Filed Jan. 4, 1950

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

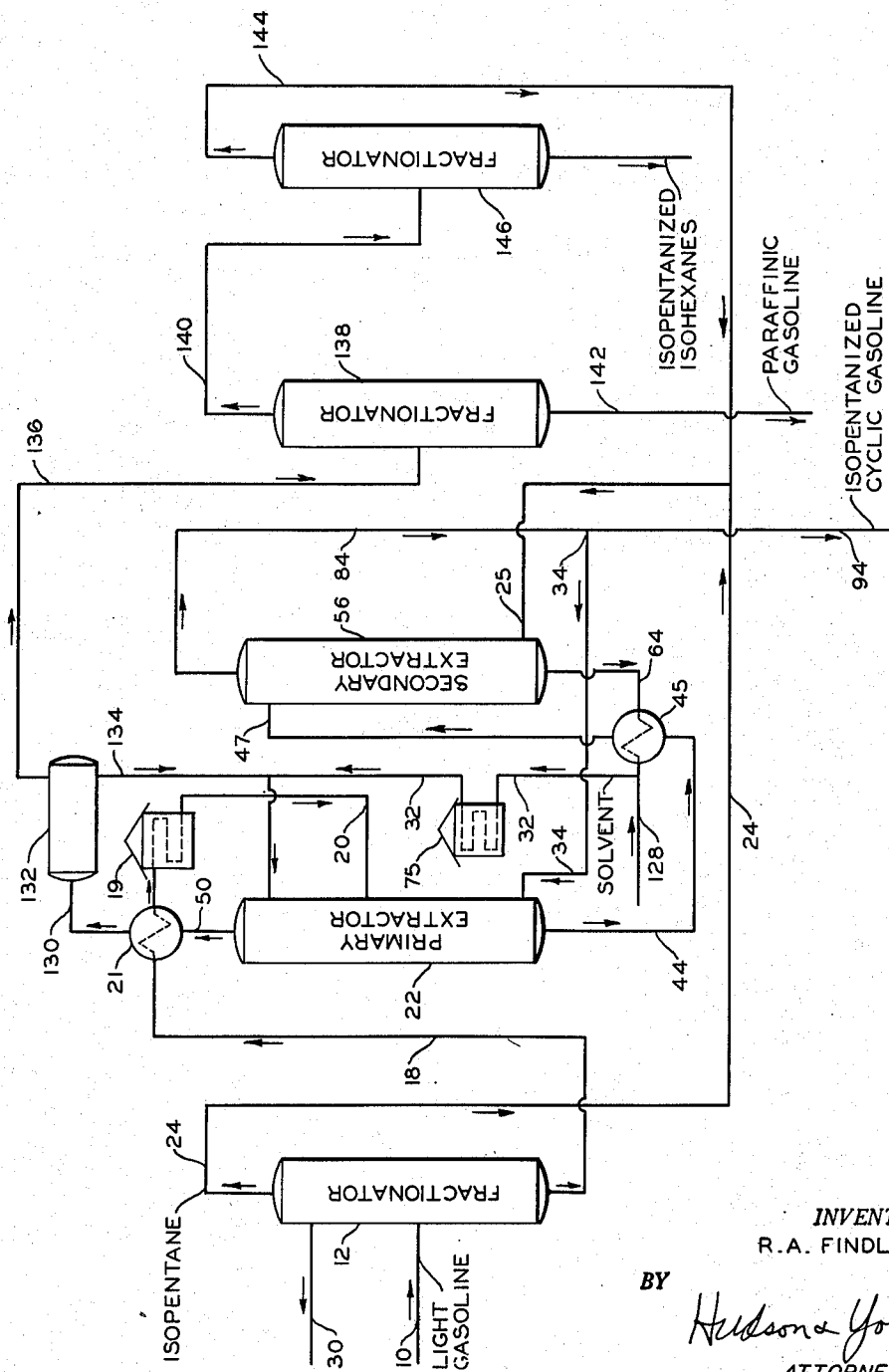


FIG. 2

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PROCESS FOR MAKING HIGH OCTANE
GASOLINE

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7 Claims. (Cl. 196—14.15)

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This invention relates to a process for the production of high octane number gasoline. Some of its specific aspects pertain to the segregation of a light gasoline into cyclic and non-cyclic components by certain combinations of fractional distillation and liquid-liquid solvent extraction. In a preferred modification an isopentanzied cyclic high octane number aviation gasoline blending component is produced.

It is of course well known and has been for a long time that the various components of natural, straight run, and cracked gasolines differ greatly in their octane numbers. In general the highly branched paraffins are of high octane number as contrasted with lower octane number for the straight chain or slightly branched paraffins. The olefins are of reasonably high octane number, some having quite high octane numbers, but are not always usable in certain types of gasoline. The cycloparaffins (naphthenes) are all of high octane number and have particularly valuable characteristics for use in aviation fuels in view of superior performance under "rich mixture" conditions. The aromatic hydrocarbons, e. g. benzene, toluene and various alkyl benzenes found in gasolines, are quite valuable for their high octane number, both in ordinary motor fuels for automobiles and in aviation gasolines. Segregation of the various higher octane number components in various ways, has been suggested, and such materials are ordinarily blended with alkylates and other synthetically produced high octane number materials to give finished aviation gasoline or extremely high octane number motor fuels for automotive use. The various aviation gasoline blends are usually finally mixed with sufficient isopentane to give a vapor pressure of about 7 pounds Reid.

Heretofore the principal means employed in obtaining desired separation of components of natural, straight-run and cracked gasoline has been "super fractionation" which involves the use of a large number of fractional distillation columns and associated equipment to make very narrow boiling range cuts, so that the desired components can be separated from the less desired components. While this has found considerable success, and has been a very valuable process, it is clear that the quantity of equipment needed and the utility load, particularly in view of the numerous evaporations with subsequent condensations, is higher than might be desired. Liquid-liquid solvent extraction has been suggested, and has in a few instances been applied for obtaining specific aromatic compounds for

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special uses. However, it has not been generally found of sufficient use to warrant commercialization in treating gasolines in general, perhaps partly due to lack of solvents having the particular characteristics required for gasoline extraction and also various problems involved in obtaining the desired types of components. The present invention provides a means of obtaining superior high octane number gasoline blends suitable for motor fuel or aviation gasoline use by a novel combination of fractional distillation and liquid-liquid solvent extraction retaining some of the benefits of each and providing an over-all improvement in the process.

An object of this invention is to produce high octane number gasolines.

Another object is to segregate a light gasoline into its components according to octane number.

Yet another object is to combine fractional distillation with liquid-liquid solvent extraction to produce a high octane number aviation gasoline blending stock from natural, straight run and/or cracked gasolines.

A further object of the invention is to provide improved solvents for gasoline extractions.

A still further object of the invention is to effect a preliminary fractionation of a light gasoline into two portions, with subsequent treatment of each portion involving liquid-liquid solvent extraction to produce an ultimate blending stock of high octane number valuable for use in preparing aviation gasolines.

Yet another object is to recover an isopentanzied aviation gasoline stock directly from a liquid-liquid solvent extraction operation.

Another object of the invention is to produce an isopentane-isohexane blending stock plus an isopentanzied cyclic blending stock from an initial light gasoline whose octane number is not sufficiently high for employment of the gasoline per se in aviation fuels.

A further object of the invention is to provide a process for the treatment of gasolines involving a liquid-liquid solvent extraction step wherein ultimate hydrocarbon products are obtained free of solvent.

Yet another object is to separate gasoline into its constituents according to octane number using a relatively small amount of equipment and with a small condenser load.

Further objects and advantages of the invention will be apparent to one skilled in the art from the accompanying disclosure and discussion.

Broadly speaking, the preferred process of my

invention subjects a gasoline, preferably a light gasoline (by which I mean a gasoline having an end point not above about 350° F. and which may contain limited amounts of butane but preferably very little or no propane and lighter), which may be either a straight-run, natural, or cracked gasoline or mixtures of same, to a first fractional distillation in which at least one pentane fraction is separated from that portion of the gasoline boiling above normal pentane, i. e. is separated from cyclopentane and heavier. Said portion is essentially composed of the six-carbon-atom and higher hydrocarbons plus cyclopentane, and is generally referred to herein as a C₆+ cut. This C₆+ cut which contains all the cyclic hydrocarbons, i. e. naphthenes and aromatics, present in the initial gasoline, is next intimately contacted with a liquid solvent selected from the group consisting of aqueous methanol and aqueous acetonitrile under conditions effecting a selective solution of the cyclic hydrocarbons in the solvent leaving the non-cyclic hydrocarbons undissolved. A feature of the invention in one of its more specific aspects also includes the washing of the resulting cyclic-poor hydrocarbon phase with sufficient water to remove residual solvent therefrom, the resulting water being incorporated with the solvent in the liquid-liquid extraction step as will be discussed in detail hereinafter. From the liquid-liquid solvent extraction step there is separated a raffinate phase composed of non-cyclic hydrocarbons and an extract phase composed of cyclic hydrocarbons dissolved in the aqueous solvent. This extract phase is next intimately contacted with a portion of the formerly-separated pentane cut of the gasoline under conditions which effect removal of the dissolved hydrocarbons into a separate hydrocarbon phase producing a solvent stripped of its cyclic hydrocarbon content. From this second contacting step is separated the aqueous methanol or aqueous acetonitrile solvent which is recycled to the primary extraction stage and a hydrocarbon phase which is composed of pentane plus cyclic hydrocarbons. It will be understood of course that in the contacting steps just described the separation is not perfect, i. e. the raffinate phase from the first contacting step may still contain some cyclic hydrocarbons, and/or the extract phase therefrom may still contain some non-cyclic hydrocarbons. The degree of separation can be chosen at will in accordance with economic requirements, it being well known in the art that complete and perfect segregation of components ordinarily requires so many added contacting phases that same is not desirable and separation of say 80 to 95 per cent of the cyclic hydrocarbon content of the feed to the primary extraction zone is usually adequate. When the initial gasoline feed to the process includes olefins as in the case of cracked gasolines, the extraction steps can be adjusted and controlled in such manner that the olefins are largely obtained with the extract, or are largely obtained with the raffinate, or are partitioned between to whatever extent is desired, depending on the quantity of olefins, if any, which can be used advantageously in the cyclic blending stock to be made by the process.

The hydrocarbon phase obtained from the secondary extraction step described above contains cyclic hydrocarbons removed from the C₆+ cut in the primary extraction step, and these hydrocarbons make up the high octane number cyclic blending stock which is a product of the process.

In certain specific embodiments of my invention this hydrocarbon phase is first subjected to a fractional distillation to remove pentane therefrom (in the present specification and claims the unmodified word "pentane" refers broadly to isopentane, normal pentane, or both). In other specific embodiments of my invention, the initial fractional distillation of the gasoline is carried out in such a way as to produce an isopentane concentrate which is used as the pentane fraction employed to wash out of the aqueous solvent in the secondary extraction step the cyclic hydrocarbon content thereof, and the resulting hydrocarbon phase in itself constitutes an isopentane cyclic hydrocarbon concentrate suitable without further fractional distillation for use as a high octane number blending component of aviation gasoline. Further aspects of different specific embodiments of the invention will be disclosed and explained in detail hereinbelow in conjunction with the description of the drawings.

In the drawings, Figure 1 is a schematic flow diagram of apparatus elements and flow of materials therethrough suitable for practicing one specific embodiment of the invention. Figure 2 is likewise a schematic flow diagram, showing another specific embodiment of the invention. It will be appreciated that the drawing is diagrammatic in nature, and while a few valves and controls considered a part of the invention are shown, numerous auxiliary items of equipment, such as heat exchangers, condensers, valves, and the like, will be necessary but can readily be supplied by one skilled in the art having been given the present disclosure.

In Figure 1 a gasoline which, if the final blending stocks are used in automotive motor fuels may have an end point of about 400° F. but which if the final blending stocks are to be used in aviation gasolines should have a lower end point such as about 325 or 350° F., is passed from storage or other source not shown via line 10 into fractional distillation unit 12. While this is shown as a single column, it may in some instances be desirable to carry out this fractional distillation in two or more separate columns with associated equipment in a manner which will be understood by those skilled in the art. Fractionator 12 is supplied with an internal heater 14 or external reboiler at the bottom, and reflux is supplied to the top of same from line 16. This initial fractionation is effected so as to take off as a bottoms product a C₆+ cut which should also contain any cyclopentane present in the feed. This bottoms product is removed via line 18 and is passed via line 20 into a primary extraction vessel 22, first passing through a heater 19 if required. A C₅ cut, which may if desired contain any butane present in the gasoline feed, is taken off overhead from fractionator 12 through line 24, condensed in condenser 26, and recovered via line 28, a portion being returned to the top of the column 12 as reflux through line 16. This pentane cut should contain at least the isopentane content of the gasoline introduced into the process through line 10, and may also contain the normal pentane content thereof. In some instances it may be desired to separate the normal pentane separately, which may be done by recovering it through line 30 either as a side cut from a single fractionator 12, or by the use of an auxiliary fractionator as desired. The further use of the pentane cut in line 28 will be described hereinbelow.

Primary extractor 22 is shown as a single verti-

cal contact column, which is filled with packing, bubble trays or other liquid-liquid contacting devices known to the art. However, extractor 22 may take any of the known forms for effecting intimate contact between two partially immiscible liquids in a countercurrent fashion. The C_6+ hydrocarbon cut obtained from the bottom of fractionator 12 is introduced into extractor 22 near the midpoint as shown, preferably through fine orifices or spray nozzles, while the solvent, either aqueous methanol or aqueous acetonitrile, is introduced into same at a higher point fairly near the top, from line 32. The aqueous solvent is maintained in extractor 22 as the continuous phase while the hydrocarbon is the dispersed phase. Into the bottom of extractor 22 is introduced from line 34 through spray nozzles or the like a portion of the cyclic hydrocarbons obtained as extract, this portion serving as stripping liquid, reflux, backwash, or enriching liquid, these terms being used synonymously herein, to provide an extract of required purity. In the top extractor 22 a hydrocarbon phase is maintained, the interface 36 between this hydrocarbon phase and the solvent phase being maintained at a constant level by float 38 connected with liquid level control 40 which actuates a motor valve 42 in the liquid outlet line 44 from the bottom of extractor 22. Into the top of extractor 22 is introduced a small amount of water through line 46. The quantity of this water is metered by flow meter 48, and can be controlled automatically at a predetermined rate if desired. Thus-introduced water is caused to contact the hydrocarbon phase intimately and removes therefrom by solution the very small amount of solvent which remains dissolved in the hydrocarbon phase, plus any which still is carried therein in suspension. The resulting water containing dissolved solvent flows downwardly in extractor 22 and joins the solvent phase therein. The resulting washed raffinate is recovered from the top of extractor 22 via line 50. This is a cyclic-poor C_6+ hydrocarbon material of relatively low octane number, although the particular octane number depends largely on the proportion of branched chain to straight chain and slightly branched chain hydrocarbons therein. This material is recovered as a product of the process through line 52, and may be joined by means of line 54 by a portion of the pentane cut obtained from fractionator 12 in line 28. The resulting cyclic-poor material can be used per se for any desired use, blended into ordinary motor fuel if the octane number is not too low, or may be subjected to non-catalytic or catalytic reforming operations to improve its octane number. In the event the pentane cut which is later used in the secondary extractor 56 to be described is isopentane, the raffinate from extractor 22 will contain some isopentane which may be recovered by fractional distillation as shown in detail in Figure 2 described hereinafter.

The solvent phase from primary extractor 22 is passed via line 44 and motor valve 42 into secondary extractor 56 near the top thereof. This extractor is similar to extractor 22 as described above. Here again the aqueous methanol or acetonitrile solvent is maintained as the continuous phase and the hydrocarbon is the dispersed phase. A hydrocarbon-solvent interface is maintained near the top of secondary extractor 56 by means of float 58, liquid level control 60 and motor valve 62 interposed in the bottom effluent line 64 of extractor 56. Into the bottom of secondary extractor 56 is introduced a pentane cut

which is a portion of that obtained in line 28 from fractionator 12, this material being passed into the bottom of extractor 56 via line 66, motor valve 68 controlled by flow controller 70, and line 72. Into the bottom of extractor 56 is also introduced recycled pentane cut via line 82. The pentane material introduced into the bottom of secondary extractor 56 may be termed a secondary solvent, as its function is to remove from the aqueous methanol or acetonitrile solvent the dissolved cyclic hydrocarbons. These cyclic hydrocarbons plus pentane wash material or secondary solvent are recovered as a hydrocarbon phase from the top of secondary extractor 56 through line 84, while the aqueous solvent which has been stripped of its cyclic hydrocarbon content but which still contains some dissolved pentane material is recovered from the bottom of secondary extractor 56 via motor valve 62 and line 64 and is in large part recycled via line 86 and line 32 to the primary extractor 22 for reuse therein.

In the event the pentane cut employed as washing liquid in secondary extractor 56 is normal pentane or is mixed isopentane and normal pentane, it is ordinarily desirable to separate same from the recovered cyclic hydrocarbons present in admixture therewith in stream 84. Accordingly, in such case this material is passed to a fractionator 88 provided with kettle heater 90. From fractionator 88 the cyclic hydrocarbons recovered by the solvent extraction procedure herein described are recovered as kettle product via line 92, and the net make of this extract material is produced as a high octane number blending stock and passed via line 94 to storage, blending, or direct use as desired. A portion of this stock is passed via line 34 back to the bottom of primary extractor 22 as backwash liquid therein to improve the purity of the extract. The overhead from fractionator 88 is composed of the pentane cut plus the small amount of solvent, i. e. methanol or acetonitrile, which is present dissolved in the hydrocarbon phase recovered from the top of extractor 56 via line 84. The solvent material in question forms a low-boiling azeotrope with pentanes which is recovered in the overhead product therewith. This overhead product is condensed in condenser 96, a portion is passed via line 98 as reflux to the top of fractionator 88 and the remainder is returned via line 82 to the bottom of secondary extractor 56 for reuse therein as washing liquid or "secondary solvent." When the pentane cut obtained from fractionator 12 and used as secondary solvent or washing liquid in secondary extractor 56 is isopentane, fractionator 88 will usually be dispensed with.

The water content of the methanol or acetonitrile employed in primary extractor 22 is maintained at optimum values in the process of my invention as will now be described. A portion of the aqueous solvent phase recovered from the bottom of secondary extractor 56 via line 64 is diverted to line 102 and passed via motor valve 104 and line 106 into a fractionator 108, from the bottom of which water is recovered via line 110 and from the top of which the water-free or water-poor solvent is recovered via line 112, passed through condenser 114, a portion returned to the top of column 108 as reflux via line 116, and the balance passed via line 118 back to admixture with the solvent being recycled via line 86 to the primary extractor 22. Make-up solvent is added to the system from line 128. The fractionator 108 is provided with a kettle heater such as an internal heater 120. Flow controller 122 is

set so that a constant quantity of water is to be withdrawn from the process through line 110, as detected at orifice 124. This quantity is set to be essentially equal to the quantity of water introduced into the top of the primary extractor 22 through line 46 as metered by flow meter 48. A continuous specific gravity recorder-controller 126 is interposed in line 86, or arranged to sample and measure continuously a portion of the material passing through line 86 or a sample thereof in known manner. This controller 126 is set to over-ride the response of flow controller 122 to orifice 124 so as to change the setting of motor valve 104 when necessary to maintain the specific gravity of the solvent in line 86 within a selected range, this gravity being directly related to the water content of this stream. In this manner the water content of the solvent in primary extractor 22 is maintained at the desired value. Suitable values in the case of methyl alcohol are 5 to 20 weight per cent water, preferably 9 to 12 per cent, based on total water-methanol solvent. In the case of acetonitrile, water contents of 3 to 15 weight per cent, preferably 5 to 10 per cent, are preferred.

The embodiment of the invention illustrated in Figure 2 will now be described. Wherever possible, the same reference numerals have been used in Figures 1 and 2 to indicate like pieces of equipment and flow lines. A gasoline, which preferably has been debutanized and cut to an end point of 350° F., is introduced via line 19 into fractionator 12. Normal pentane is removed through line 30. Isopentane is recovered as overhead product through line 24 and is passed via line 25 into the bottom of secondary extractor 56 as wash liquid or "secondary solvent" therein. The secondary extractor is preferably operated at a temperature within the range of 85 to 100° F. The C₆+ cut, which also includes cyclopentane present in the gasoline, is recovered as bottoms from fractionator 12 via line 18, passed through heat exchanger 21 and heater 19, and introduced via line 20 into primary extractor 22 at a temperature within the neighborhood of 150 to 170° F. Extractor 22 preferably gives about 20 theoretical stages of liquid-liquid extraction. Make-up solvent is added to the system through line 128. The circulating solvent, which is aqueous methanol or aqueous acetonitrile, is heated in heater 75 and introduced via line 32 into the top of primary extractor 22. Reflux liquid, which is a portion of the cyclic hydrocarbon extract obtained by the solvent extraction, is passed via line 34 into the bottom of primary extractor 22 for enriching the solvent therein with cyclic hydrocarbons thus improving the purity of the latter recovered as extract product. The cyclic-hydrocarbon-enriched solvent is withdrawn from the bottom of primary extractor 22 and passed via line 44, heat exchanger 45 for cooling, and line 47 into a high point of secondary extractor 56 for removal of cyclic hydrocarbons therefrom by intimate contact of the solvent phase with the isopentane introduced into the bottom of secondary extractor 56 through line 25 as hereinabove described. Secondary extractor 56 preferably gives about 20 theoretical stages of liquid-liquid extraction. From the bottom of secondary extractor 56 the aqueous solvent is withdrawn through line 64 and passed via heat exchanger 45, line 32, and heater 75 into primary extractor 22 for reuse therein.

It is to be understood that various valves, condensers, fractionator kettle heaters and the like

shown in Figure 1 will also be used very similarly in Figure 2, but have been omitted for the sake of simplicity in the drawing and brevity of description.

The hydrocarbon phase recovered from the top of secondary extractor 56 is composed of part of the isopentane introduced into the bottom thereof from line 25, plus essentially all of the cyclic hydrocarbons extracted from the C₆+ cut in primary extractor 22 which have been removed from solution in the aqueous solvent by entry into the hydrocarbon phase in secondary extractor 56. This phase is recovered as overhead from secondary extractor 56 via line 84, part being returned to primary extractor 22 via line 34 as reflux as described, and the remainder being recovered via line 94 for use per se as a high octane number isopentane cyclic hydrocarbon concentrate aviation gasoline blending stock.

The raffinate phase from primary extractor 22 contains not only the non-cyclic C₆ and heavier hydrocarbons originally contained in the gasoline and which remain undissolved in the solvent in primary extractor 22, but also include appreciable amounts of isopentane which has been carried into primary extractor 22 in solution in recycled aqueous solvent introduced into primary extractor 22 through line 34 from secondary extractor 56. The raffinate phase referred to is recovered via line 50, passed through heat exchanger 21, then passed through line 130 into settler 132, where it is allowed to settle at a temperature of 85 to 100° F. Methanol or acetonitrile solvent settled out in settler 132 is returned via lines 134 and 32 into primary extractor 22. Hydrocarbon phase is removed from the top of settler 132 via line 136 and passed into a fractionator 138. In this fractionator 138 a separation is made between the isohexanes and lighter, which of course includes the isopentane in the stream, as an overhead fraction obtained through line 140, and the heavier hexanes and higher boiling hydrocarbons which are obtained as kettle products via line 142. A suitable cut point between the isohexanes taken off overhead in fractionator 138 and remaining hexanes and heavier taken off as bottoms in fractionator 138 is about 150° F. at atmospheric pressure. The material in line 142 is a paraffinic gasoline, containing all of the C₆+ components of the original gasoline feed introduced to the process through line 19 except the isohexanes and the cyclic hydrocarbons. This paraffinic gasoline recovered through line 142 may be blended into ordinary motor fuel or may be subjected to catalytic or non-catalytic reforming or other treatments to improve the octane number thereof or convert same to more valuable materials, depending primarily on the proportion of relatively high octane number branched chain hydrocarbons present therein.

The overhead from fractionator 138 is carried via line 140 to a fractionator 146, wherein excess isopentane is taken off overhead via line 144 and returned to admixture in line 25 with isopentane recovered directly from fractionator 12 via line 24. The admixed isopentane is introduced into the bottom of the secondary extractor 56 for reuse therein as washing liquid. The kettle product of fractionator 146 is termed an isopentane isohexane fraction, has a very high octane number and high volatility, and is employed as a blending stock for preparing aviation gasolines.

From the foregoing it will be seen that in the embodiment of this invention illustrated in Fig-

ure 2, two valuable aviation fuel blending stocks are prepared, viz. an isopentanzied cyclic gasoline enriched in aromatics and naphthenes, and an isopentanzied isohexane stock rich in high octane number paraffins of high volatility. As an example of stream compositions obtainable in carrying out the process of Figure 2, the data presented in Table I are provided. It will be appreciated that these are merely in general illustrative, and that the exact quantities of materials to be obtained in the various streams will vary considerably depending on temperatures, flow rates, character and proportion of the various types of hydrocarbons, extraction efficiencies of the particular equipment used, and the like. In Tables II and III are listed corresponding equipment and condenser load requirements, respectively, and these are also compared with equipment and condenser loads for (a) extraction effected without use of an isopentane secondary solvent requiring the dissolved hydrocarbons to be distilled out from solvent and raffinate phases and (b) equivalent separation of feed components by fractional distillation alone. Here again, of course, the exact values will vary depending on the particular separation to be made. The advantages of my invention are obvious from these data.

While specific and preferred embodiments of the invention have been described herein, it will be appreciated that other variations may be made in the apparatus and process without departing from the spirit and scope of the invention.

TABLE I

Gallons/hour	Feed to primary extractor	Raffinate phase	Total solvent feed to primary extractor	Make-up solvent	Extract phase	Isopentanes secondary solvent fractionated from gasoline	Reflux gasoline	Isopentanzied cyclic gasoline	Paraffinic gasoline	Isopentanzied isohexanes	Recycle isopentane secondary solvent
Gasoline.....	23,700	16,700	-----	-----	42,600	-----	35,600	7,000	12,530	4,170	-----
Solvent.....	-----	17	206,027	10	206,060	-----	50	10	-----	-----	17
Isopentane.....	-----	9,000	9,000	-----	5,090	5,390	5,090	1,000	-----	4,390	4,610
	23,700	25,717	215,027	10	253,750	5,390	40,740	8,010	12,530	8,560	4,627

TABLE II

Summary of equipment

[Gallons per hour condensed]

Fig. 2	Extraction				Superfractionation	
	Using Secondary Solvent		No Secondary Solvent			
	Number	Size	Number	Size	Number	Size
Extractors:						
Primary.....	3	13 ft. by 80 ft.	2	12 ft. by 80 ft.		
Secondary.....	3	do.....	None			
Fractionators:						
Deisohexanizer.....	2	11 ft. by 35 trays ..	2	11 ft. by 35 trays ..	2	12 ft. by 35 trays.
Deisopentanizer.....	1	5 ft. by 35 trays ..	None		1	12 ft. by 50 trays.
Solvent stripper.....	None		1	11 ft. by 25 trays ..	2	8 ft. by 30 trays.
			1	7 ft. by 25 trays ..	2	10 ft. by 30 trays.
					1	5 ft. by 40 trays.
					2	5½ ft. by 30 trays.
					2	6½ ft. by 30 trays.
					1	8 ft. by 30 trays.
					2	12 ft. by 35 trays.
Total.....	9 vessels.....		6 vessels.....		15 vessels.	

TABLE III

Summary of condenser load

[Gallons per hour condensed]

Fig. 2	Extraction		Superfractionation
	Using secondary solvent	No secondary solvent	
Extractors.....	None	None	-----
Extract stripper.....	None	63,900	-----
Raffinate stripper.....	None	25,050	-----
Deisohexanizer.....	73,170	56,970	-----
Deisopentanizer.....	9,210	None	-----
Total.....	82,380	145,920	197,900

I claim:

1. A process for the production of a high octane number aviation fuel blending stock from a light gasoline which comprises subjecting a light gasoline to fractional distillation to separate same into at least one pentane cut and a heavier cut containing any cyclopentane present in the said light gasoline together with C₆ and heavier hydrocarbons referred to hereinafter as a C₆+ cut, subjecting said C₆+ cut to liquid-liquid solvent extraction with a solvent selected from the group consisting of aqueous methanol and aqueous acetonitrile under conditions selectively dissolving in said solvent cyclic hydrocarbons present in said cut, separating from said liquid-liquid solvent extraction a cyclic-poor raffinate phase and a cyclic-rich extract phase, subjecting said extract phase in a second step

to liquid-liquid contacting with a hydrocarbon washing liquid at least partially composed of said pentane cut under conditions forming a cyclic-poor solvent phase and a cyclic-rich hydrocarbon phase, and recycling said solvent phase to the first named liquid-liquid solvent extraction step as solvent therefor, at least the cyclic hydrocarbon content of said last named cyclic-rich hydrocarbon phase from said second liquid-liquid contacting step comprising the aforesaid high octane number aviation fuel blending component product of the process.

2. A process according to claim 1 wherein said pentane cut is essentially isopentane, and the isopentane content of said cyclic-rich hydrocarbon phase is retained in admixture with said cyclic hydrocarbons forming an isopentane high octane number aviation gasoline blending stock.

3. A process according to claim 2 wherein said raffinate phase is subjected to fractional distillation to separate a C_6 and heavier paraffinic gasoline as bottom product and an isopentane isohexane fraction as overhead product, and said overhead product is blended with said isopentane cyclic-rich blending stock.

4. A process according to claim 3 wherein at least a portion of the isopentane content of said isopentane isohexane cut is separated in a further fractional distillation step prior to the last said blending and is returned to said second liquid-liquid contacting step as a portion of the washing liquid therein.

5. A process according to claim 1 wherein said pentane cut comprises the total pentane content of said gasoline, said cyclic-rich hydrocarbon phase is subjected to fractional distillation to separate as an overhead fraction pentane in admixture with dissolved solvent as a low-boiling pentane-solvent azeotrope, and said overhead fraction is returned as washing liquid to said second contacting step.

6. A process according to claim 1 wherein said primary extraction zone is maintained at 150 to 170° F. and said secondary extraction zone is maintained at 85 to 100° F.

7. A process for the production of a high octane number aviation fuel blending stock from a light gasoline which comprises subjecting a light gasoline to fractional distillation to separate same into a pentane and lighter fraction and a hexane and heavier fraction, said hexane and heavier fraction also containing any cyclopentane present in said gasoline and being referred to hereinafter as a C_6+ cut, introducing said C_6+ cut into a primary extraction zone at a point intermediate the ends of said zone, introducing a solvent selected from the class consisting of aqueous methanol and aqueous acetonitrile into said zone at a point near one end thereof, maintaining liquid hydrocarbons and liquid solvent in intimate liquid-liquid contact in said zone under conditions effecting solvent extraction of cyclic hydrocarbons from said C_6+ cut, withdrawing undissolved cyclic-poor hydrocarbons from said one end of said zone as a raffinate phase, introducing water into said zone at said one end and intimately contacting same with raffinate phase to dissolve and thereby remove solvent therefrom, withdrawing from the other end of said extraction zone solvent including water introduced at said first end and having dissolved therein cyclic

hydrocarbons from said C_6+ cut, passing the thus withdrawn cyclic-rich solvent to one end of a secondary extraction zone, introducing a hydrocarbon washing liquid into the other end of said secondary extraction zone, said hydrocarbon washing liquid comprising pentanes and being at least partly the aforesaid pentane and lighter cut separated from said light gasoline by fractional distillation as aforesaid, effecting intimate liquid-liquid contact of solvent and hydrocarbons in said secondary extraction zone, withdrawing from said other end of same a cyclic-hydrocarbon-denuded solvent phase and returning a portion of same to said primary extraction zone as the solvent as described hereinabove, withdrawing from said first end of said secondary extraction zone a hydrocarbon phase comprising pentane washing liquid and recovered cyclic hydrocarbons, passing same to fractional distillation and separating same into a pentane overhead fraction and a cyclic-rich C_6 and heavier including cyclopentane fraction as a high octane number aviation gasoline blending product of the process, returning a portion of the last said cyclic-rich product to said other end of said primary extraction zone as enriching liquid therein, returning the pentane overhead from the last mentioned fractional distillation step to said other end of said secondary extraction zone as the bulk of said washing liquid, withdrawing the portion of cyclic-hydrocarbon-denuded solvent phase separated from said other end of said secondary extraction zone which is not passed to said primary extraction zone as aforesaid and subjecting same to fractional distillation to remove excess water therefrom as bottoms product and recovering a water-lean solvent as overhead, admixing said water-lean solvent with that portion of solvent phase returned to said primary extraction zone, and controlling the water content of the solvent in said primary extraction zone by controlling the water removal from the last said fractional distillation to equal the water introduced into said one end of said primary extraction zone, the quantity of solvent phase passed to said last named fractional distillation being primarily controlled in response to the quantity of water produced as bottoms product with said primary control being sufficiently over-ridden in response to the specific gravity of the total admixed solvent passing to said primary extraction zone to maintain said specific gravity within a predetermined range corresponding to an optimum range of water content.

ROBERT A. FINDLAY.

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