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PROCESSING PRESSURE DISTILLATE

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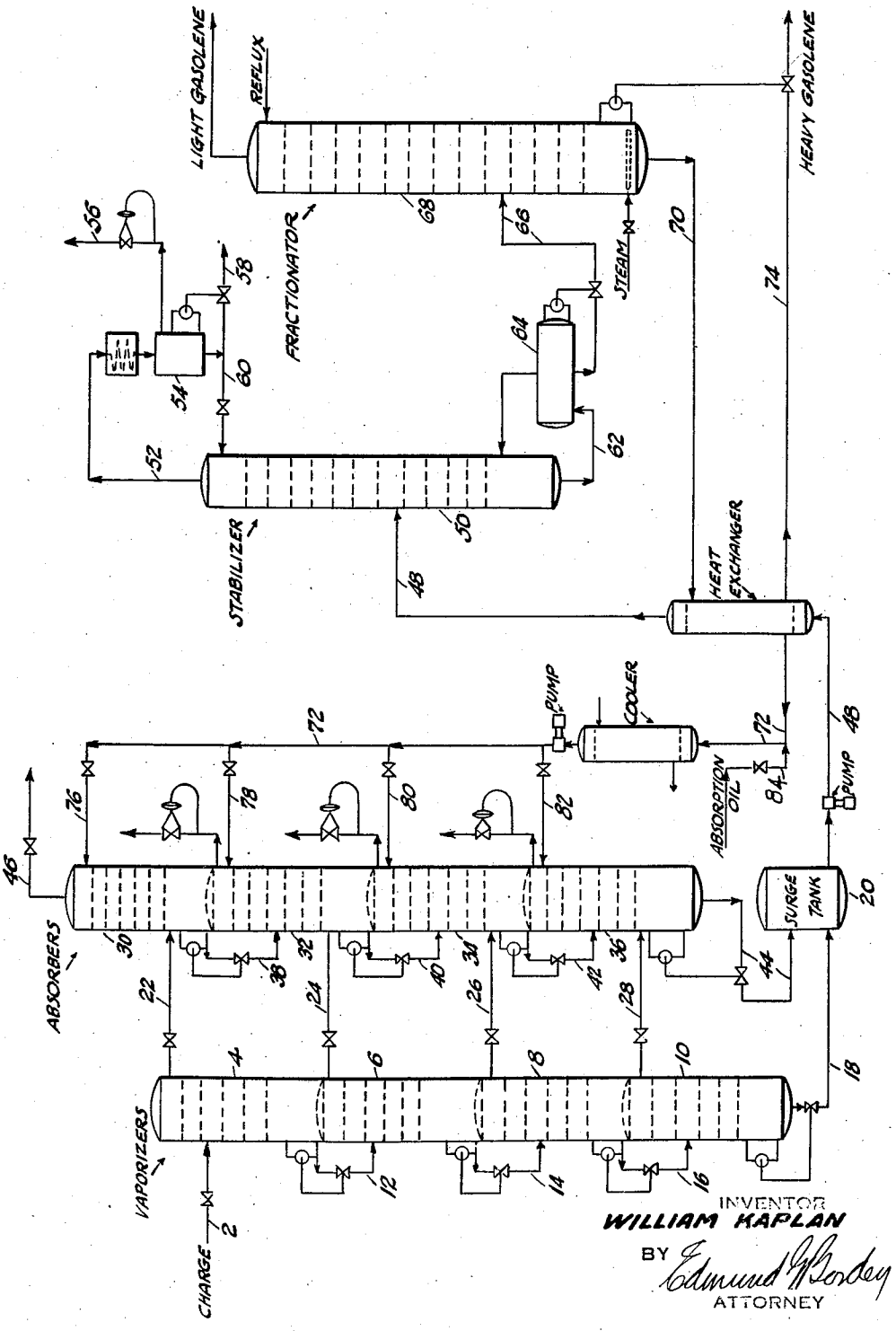

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PROCESSING PRESSURE DISTILLATE

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6 Claims. (Cl. 196—11)

This invention relates to a process for treating distillates containing low boiling constituents for the elimination of such constituents, and more particularly to a process for stabilizing pressure distillates.

In the conversion of petroleum oils and hydrocarbons in general, for the manufacture of motor fuels, the desired motor fuel constituents are usually recovered at relatively high pressure by condensing them in contact with lower boiling constituents such as methane, ethane, propane and propylene which tend to remain absorbed to a considerable extent and render the motor fuel unstable. In view of this more or less general condition, it is the usual practice to subject the pressure distillate obtained in almost every conversion operation to a fractional distillation procedure generally referred to as stabilization. This procedure involves the rectification of the pressure distillate under conditions adapted to eliminate all of the undesired normally gaseous constituents while retaining sufficient of the C_4 hydrocarbons to give the motor fuel product the desired vapor pressure and distillation characteristics.

Conventional methods of stabilization require the use of high pressures because of the presence of relatively large proportions of low boiling constituents which otherwise could not be condensed to produce reflux with ordinary cooling water temperatures. The high pressure necessarily employed increases the temperature required at the bottom of the stabilizer and decreases the relative volatility between the C_3 and C_4 hydrocarbons, thus making it more difficult than otherwise to separate these constituents. These conditions furthermore require a high reflux ratio in order to effect a given separation.

The primary object of the present invention is to provide an improvement in the handling of hydrocarbon mixtures to facilitate the elimination of undesirable low boiling constituents.

A further object of the invention is to provide an improved process for the treatment of pressure distillates prior to their stabilization, to eliminate substantial proportion of the low boiling constituents which tend to make the stabilization difficult.

A still further object of the invention is to provide an improved process by which the capacity of present stabilizing equipment may be greatly increased.

Accordingly, the improved process of the present invention comprises the steps of passing an unstable distillate such as a pressure distillate, initially at a relatively high pressure, through a series of vaporizing zones maintained at progressively lower pressure, in each of which portions of the distillate are vaporized, passing the individual vapor fractions into separate fractionators or absorbers in which the vapors are brought into contact with an absorption oil to prevent loss of desired hydrocarbons, discharging unabsorbed gaseous constituents from the absorbers, collecting the unvaporized constituents from the vaporizing zones and the rich absorption medium from the absorbers, and subjecting the resulting mixture to stabilization in accordance with the usual procedure.

The improved process of the present invention preferably includes other features and objects which will be apparent to those skilled in the art from the following more detailed description of the invention taken in connection with the accompanying drawing in which the single figure is a diagrammatic flow sheet showing apparatus elements suitable for carrying out the improved process.

While the present invention is applicable to the treatment of various types of unstable distillates such as those produced in cracking, in the recovery of gasoline from natural gas, and in recycling operations from distillate wells, the invention will be described for purposes of illustration in connection with the treatment of pressure distillate obtained in an oil conversion operation.

Referring to the drawing, the charging stock which may be taken directly from the receiving drum of a conversion unit, is conducted at a pressure usually in excess of 200 lbs. per square inch, which may be the pressure employed in the receiving drum of the conversion unit, through a valved charging line **2**, into the first of a series of flash distilling chambers **4**, **6**, **8** and **10**. These chambers may be empty or provided with trays, and may be mounted separately or in the form of a column, as shown. If the conversion unit receiving drum pressure is at 250 lbs., a pressure of approximately 180 lbs. per square inch is maintained in the flash distilling chamber **4** and the reduction of pressure by the valve in line **2** causes the vaporization of an equilibrium mixture of light hydrocarbons. The unvaporized distillate in the chamber **4** is conducted therefrom through a float valve controlled line **12** into the chamber **6** in which a pressure of approximately 125 lbs. per square inch is maintained, and in which further vaporization of light hydrocarbons takes place. The unvaporized material in the chamber **6** is conducted through a float valve con-

trolled line 14, into the flash chamber 8 where a pressure of approximately 75 lbs. per square inch is maintained and additional distillation effected. Finally the distillate remaining unvaporized in chamber 8 is conducted through a float valve controlled line 16 into the flash distilling chamber 10 where light hydrocarbons are also vaporized because of the pressure reduction. The unvaporized distillate collected in the bottom of the chamber 10 is conducted through a float valve controlled line 18 into a surge tank 20 maintained at only slightly less than 25 lbs. per square inch. The exact pressure used in the various flash chambers will vary with the character of the entering charge; however, the usual pressure stages are such that the ratio of the quantity of gas liberated, measured at standard conditions, to the absolute pressure in each flash chamber, will be substantially constant. This ratio may advantageously increase progressively as the pressure is reduced, particularly if a substantial portion of the total lean absorption oil used is introduced into the upper portion of the low pressure absorbers, as hereinafter described.

The vapor fractions produced in the chambers 4, 6, 8 and 10 which reach the top of these chambers, are conducted respectively through vapor lines 22, 24, 26 and 28, into the lower portions of a series of absorbers 30, 32, 35 and 36, in which the individual vapor fractions are brought in contact with an absorption medium, such for example as a heavy gasoline, under conditions adapted to absorb all C_5 and heavier hydrocarbons and as much of the C_4 as desired. The absorbers 30, 32, 34 and 36 are preferably provided with the usual bubble cap contact trays, and the absorbers may be mounted separately or in a tower, as shown. The pressures maintained in the absorbers approximately correspond to those maintained in the corresponding flash distilling chambers. The rich absorption oil reaching the bottom of the absorbers 30, 32 and 34 is preferably introduced and flashed into the mid-portion of the next lower absorber, as for example through float valve controlled lines 38, 40 and 42 respectively, the rich absorption oil collected in the bottom of the absorber 36 being conducted through a float valve controlled line 44 into the surge tank 20. A small amount of absorption medium is introduced at the top of each absorber and the unabsorbed gas reaching the upper portion of each of the absorbers is discharged through a line 46 provided with a control valve set to maintain the desired pressure in the respective flash chamber and absorber.

The distillate mixture collected in the surge tank 20 and which may be substantially free of light hydrocarbons such as C_1, C_2 and C_3, but which may contain some C_3, is forced through a line 48 by means of a pump therein, heated by means of a heat exchanger in the line, and then conducted into the mid-portion of a stabilizer tower 50, in which the distillate mixture is subjected to rectification for the elimination of constituents which would render the pressure distillate unstable. The excess of C_4 and lighter hydrocarbons are conducted overhead from the stabilizer 50 through a vapor line 52, subjected to condensing conditions in a condenser therein, and the resulting condensate and gas mixture discharged into a receiving drum 54. The pressure maintained in the stabilizer 50 may vary from 150 lbs. to 200 lbs. per square inch, but may be considerably lower than that normally used for the stabilization of pressure distillate because of the relatively low content of C_3 and lower hydrocarbons in the distillate mixture handled in the stabilizer 50. In any case, the desired pressure is maintained in the stabilizer 50 by the discharge of gas from the receiver 54 through a pressure valve controlled line 56. The distillate collected in the receiver 54, which may be largely C_3 and C_4 hydrocarbons, is discharged through a float valve controlled line 58, but a regulated portion of this is preferably used as reflux in the stabilizer 50 and introduced thereinto through a valve controlled line 60.

The gasoline reaching the bottom of the stabilizer 50 is conducted through a line 62 into a reboiler 64. Excess C_4 and lighter components are stripped out of the gasoline in the lower trays of stabilizer 50 by means of reboiler 64 which is used for maintaining the desired bottoms temperature in the stabilizer. The heating medium (not shown) for reboiler 64 may be steam or hot oil.

When it is desired to utilize the heavy ends of the gasoline as absorption media, the stabilized gasoline from reboiler 64 is passed through a line 66 into fractionator 68 where a light gasoline fraction is distilled overhead and the desired heavy gasoline absorption medium is removed from the bottom. This fractionator is operated at 5 to 20 pounds gauge pressure, using steam for stripping. The heavy gasoline from the bottom of fractionator 68 may be passed through a line 70 to the heat exchanger in the line 48 to heat the distillate mixture therein, and then through a line 72, which includes a cooler and a pump for distributing the heavy gasoline to the absorbers, the excess heavy gasoline being passed through a float valve controlled line 74 to storage or to be mixed with the light gasoline. The absorption medium in the line 72 is supplied to the absorbers 30, 32, 34 and 36 respectively, from valve controlled lines 76, 78, 80 and 82, each of which discharges into the upper portion of the respective absorbers. The absorption medium may be advantageously cooled in the cooler in line 72 prior to being introduced into the absorbers.

Instead of using the heavy gasoline from the fractionator 68 as absorption media in the absorbers, other suitable absorption oil may be utiilzed, and where such other oil includes constituents of higher boiling point than gasoline, the entire gasoline production of the process may be distilled overhead in the fractionator 68, while the absorption medium is recovered in the lower portion of the fractionating tower and recycled to the absorbers. Absorption media from an outside source may be introduced into the line 72 through a valved line 84. The high boiling absorption oil may be recovered in a different manner by providing a still in the line 48 to separate the pressure distillate as a vapor which would then be stabilized in the tower 50, as described, and the entire stabilized product withdrawn to storage from the line 66.

While, in describing the invention in connection with the foregoing example, certain specific pressures have been mentioned for the vaporizing chambers and the corresponding absorbers, it is to be understood that the process may be carried out at greatly different pressures. For example, the distillate recovered in a recycling operation (including any absorption oil) may have an initial pressure of from 700 to 2000 lbs. per square inch. The pressure reduction in the series of

flash distilling chambers therefore may be regulated to properly fit into the remainder of the process, so that the pressure obtained in the chamber 10 and absorber 36 may be somewhat lower than that to be utilized in the stabilizer 50 or in any series of fractionating columns which may be used for the recovery of a number of hydrocarbon fractions. Likewise, the temperatures in the vaporizing chambers may vary to some extent but will usually not be higher than approximately 100° to 150° F. in the chamber 4, and considerably lower in the chamber 10. The temperatures maintained in the absorbers may be accurately controlled by regulating the temperature of the absorption medium used therein.

The quantity of absorption medium introduced into the different absorbers may vary considerably, the greatest amount preferably being introduced into the first absorber 30. It will be noted that this absorption medium, together with its absorbed constituents, is flashed into the lower pressure absorber 32 and brought in contact with vapors from the line 24. This procedure carried out in the series of absorbers, promotes the selective elimination of light gases such as ethane and methane. The C_3 and C_4 hydrocarbons, for example, conducted into the absorber 32 from the line 24, will tend to replace C_1 and C_2 hydrocarbons which may be present in the absorption medium introduced through the line 38 or present in the absorption oil in the upper part of the absorber 32. With certain types of hydrocarbon mixtures, it may be found that only relatively small proportions of absorption oil will need to be introduced through the lines 78, 80 and 82.

The advantages resulting from removing a large proportion of the C_1, C_2 and C_3 from the pressure distillate prior to its stabilization, is apparent from the fact that a lower reflux rate will be required in the stabilizer. The proportion of constituents taken overhead will obviously be reduced, and it is therefore possible to considerably increase the capacity of given equipment by the use of the improved process of the present invention. Because of the smaller proportion of the light constituents referred to, the stabilizer can be operated at considerably lower pressures and temperatures than normal, and a lower vapor load will be imposed upon the reboiler and lower section of the stabilizer in order to supply the heat for carrying out the fractionation. The use of a lower bottom temperature decreases the liquid expansion and reduces the volume of liquid flowing down through the trays. This effect may be appreciable when the operating bottom temperature is reduced from above 310° to below 290° F. which is the temperature range in which the expansion of the butanes is greatest.

From the foregoing description of the invention, it will be apparent to those skilled in the art that various modifications may be made in the procedure, without departing from the spirit of the invention.

Having described the invention in its preferred form, what is claimed as new is:

1. In the stabilization of unstable distillates, the improvement which comprises subjecting the distillate to successive vaporization steps in a series of zones of progressively decreasing pressure to produce a vapor fraction in each zone, passing the vapor fraction from each zone to a separate absorption zone of approximately the pressure of the distilling zone in which the fraction was produced, introducing a lean absorption oil into the upper portion of each absorption zone, producing a rich absorption medium in each absorption zone containing recovered desirable constituents, passing the rich absorption medium from each absorption zone except the last into the next lower pressure absorption zone in contact with the vapor fraction introduced thereinto, and withdrawing rich absorption oil containing the desirable constituents recovered in the absorption zones from the absorption zone of lowest pressure.

2. The process of stabilizing distillates produced at relatively high pressures which contain substantial proportions of low boiling undesirable constituents, which comprises subjecting the distillate to flash distillation in a series of zones maintained at progressively lower pressures, separating a vapor fraction from the distillate in each zone and passing such fractions into separate absorption zones in contact with an absorption medium adapted to recover desirable constituents from the vapors, said absorption zones being separate from said flash zones and being maintained at progressively lower pressures in the direction of the progressively lower pressures of said flash zones, passing rich absorption medium from each absorption zone except the last into the absorption zone of next lower pressure, collecting the rich absorption media from the absorption zones together with the unvaporized portion of the distillate from said flash distilling zones, and rectifying the resulting mixture at a high pressure to produce a distillate substantially free of undesired low boiling constituents.

3. In a process for stabilizing distillates produced at relatively high pressures and which contain undesirable relatively low boiling point constituents and at the same time avoiding substantial loss of desirable constituents from such distillates, the improvement which comprises passing the unstable distillate at a relatively high pressure into and through a series of flash distilling zones of progressively lower pressure in each of which a vapor fraction is produced containing desirable and undesirable constituents, passing each of the said fractions into a separate absorber of a series of absorbers in contact with an absorption medium to recover the desirable constituents from each vapor fraction, the absorbers being separate from the distilling zones, introducing a lean absorption oil into the upper portion of each absorber, and passing rich absorption medium from the absorber receiving vapor from the distilling zone of highest pressure through the other absorbers in the series in contact with the vapors therein.

4. The process of refining pressure distillates produced at relatively high pressures and which contain substantial proportions of low boiling constituents tending to make such distillates unstable, which comprises passing the pressure distillate into the first of a series of flash distilling zones maintained at progressively lower pressures, passing unvaporized distillate from each zone into the next succeeding lower pressure zone, producing a vapor fraction from the distillate in each zone and conducting such fractions into separate absorption zones in contact with an absorption medium therein, the absorption zones being separate from the distilling zones, maintaining the absorption zone for each vapor fraction at approximately the pressure maintained in the distilling zone in which the vapor fraction was produced, passing rich absorption medium from each absorption zone except the last into

the absorption zone of immediately lower pressure and contacting it with the vapor fraction introduced thereinto, thereafter contacting each vapor fraction with lean absorption oil, and carrying out the absorption operations in said absorption zones so as to recover desirable constituents from said vapor fractions.

5. In a process for stabilizing distillates produced at relatively high pressures and which contain undesirable relatively low boiling point constituents and at the same time avoiding substantial loss of desirable constituents from such distillates, the improvement which comprises passing the unstable distillate at a relatively high pressure into and through a series of flash distilling zones of progressively lower pressure in each of which a vapor fraction is produced containing desirable and undesirable constituents, passing each of the said fractions into a separate absorber of a series of absorbers in contact with an absorption medium to recover the desirable constituents from each vapor fraction, the absorbers being separate from the distilling zones, passing rich absorption medium from the absorber receiving vapor from the distilling zone of highest pressure through the other absorbers in the series in contact with the vapors therein, mixing the rich absorption medium from the last absorber of the series with the unvaporized portion of the distillate from the last flash-distilling zone, and subjecting the mixture to rectification in a tower to produce a high boiling bottoms fraction, and utilizing said high boiling bottoms fraction as absorption media in said absorbers.

6. In the stabilization of unstable distillates, the improvement which comprises subjecting the distillate to successive vaporization steps in a series of zones of progressively decreasing pressure to produce a vapor fraction in each zone, passing the vapor fraction from each zone to a separate absorption zone of approximately the pressure of the distilling zone in which the fraction was produced, producing a rich absorption oil containing the recovered desirable constituents in each absorption zone, passing the rich absorption oil from each absorption zone except the last into the next lower pressure absorption zone, and passing the vapor fraction introduced thereinto first in contact with said rich absorption oil and then in contact with a lean absorption oil, and withdrawing rich absorption oil containing the desirable constituents recovered in the absorption zones from the absorption zone of lowest pressure.

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