

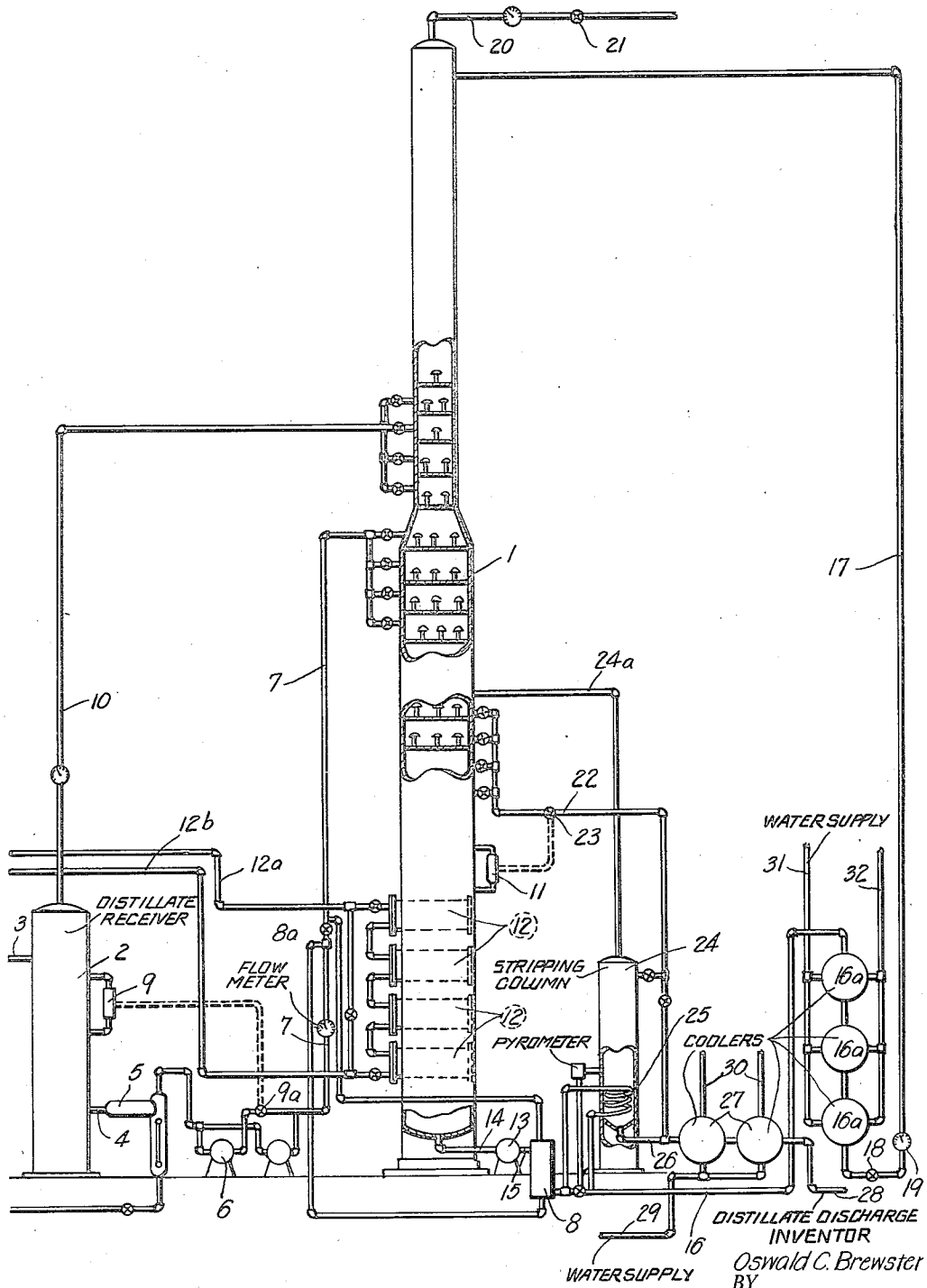
Oct. 9, 1934.

O. C. BREWSTER

1,976,212

COMBINED STABILIZATION AND ABSORPTION PROCESS

Filed Sept. 15, 1930



INVENTOR
Oswald C. Brewster
BY
Thos. C. Seefeldt
ATTORNEY

UNITED STATES PATENT OFFICE

1,976,212

COMBINED STABILIZATION AND ABSORPTION PROCESS

Oswald C. Brewster, Kansas City, Mo., assignor,
by mesne assignments, to Gasoline Products
Company, Inc., Newark, N. J., a corporation of
Delaware

Application September 15, 1930, Serial No. 481,951

10 Claims. (Cl. 196—11)

This invention relates to improvements in a combined stabilization and absorption process, and refers more particularly to a process and equipment of extremely simple nature for accomplishing simultaneously the absorption and recovery of valuable gasoline from gas containing such gasoline in vapor form, and the stabilization of the gasoline or other oil; to provide a process in which there is rejected from the oil undesirable light components which, if retained, would give an inferior product, which product would suffer undue evaporation loss on subsequent handling and storage.

The single figure is a diagrammatic side elevational view of the apparatus adaptable to the process.

In connection with the explanation of the method, it will be understood that, under different conditions, the process may be modified considerably as to temperatures, pressures and methods of applying heating and cooling effects without departing from the spirit and scope of the invention.

Referring to the drawing: a bubble tower 1 is shown, consisting of a vertical, cylindrical column containing a number of bubble plates of any suitable design such as is now commonly used in the petroleum art. A usual type of distillate separator or receiving drum, such as is connected to a cracking unit of a conventional design, is shown at 2, into which flows through the line 3 a mixture of pressure distillate and gas produced by the cracking operation. The temperature of this mixture may be about 100° F. and the pressure on the separator may vary from as low as 15 pounds gauge pressure to as high as 250 pounds gauge pressure, depending on the type of cracking operation which is being employed. For an explanation of the process, I have chosen a distillate receiver connected to a typical Cross still in which the pressure is in the neighborhood of 35 pounds gauge. The liquid distillate in the drum 2 is withdrawn through the line 4 and water separator 5 by means of a pump 6, and is discharged through the line 7 to a number of optional, intermediate points of the tower 1, or this distillate charged to the tower may be first circulated through a heat exchanger 8, hereinafter further explained, by closing the valve 8a. The flow of the distillate is controlled by a liquid level control device 9, manipulating a valve 9a in the line 7 and maintaining a constant level in the drum 2. The gas in equilibrium with the distillate entering the drum separates from the distillate and flows continuously from

the drum 2 to the tower 1 through a line 10, entering the tower through one of a number of optional points as shown, such points being located somewhat higher on the tower than the point at which the feed of the liquid distillate is introduced.

A reservoir space free from bubble plates is provided in the bottom of the tower wherein liquid may be accumulated to a level determined by the liquid level control device 11. Heating elements 12 are provided in this body of liquid oil, the heating medium being any available hot oil, steam, or other heating medium, and the temperature of the oil in this reservoir is thereby maintained at a desirable point, normally in the neighborhood of 400° F. The heating medium for these heating elements is supplied through the pipe 12a and discharged through the pipe 12b. Hot oil from the bottom of this reservoir is withdrawn continuously by the pump 13 through the line 14 and is discharged through the line 15 to the heat exchanger 8, wherein the hot oil gives up some of its heat to the feed distillate. The oil then passes from the heat exchanger 8 through the pipe 16 to heat exchangers 16a wherein it is cooled to as low a temperature as is consistent with the existing available cooling water: in the particular instance being described, the oil was reduced to a temperature of 100° F. The cool oil then passes out through the line 17 provided with a control valve 18 and a flow meter 19, and discharges to the top plate of the tower 1 as shown. Residue gas leaving the system discharges from the top of the tower 1 through the line 20 provided with a control valve 21 for maintaining the pressure on the entire system at the desired point. In the present case, a gauge pressure of 35 pounds was maintained. The gas discharged through the line 20 is directed to any suitable gas disposal system: in the case being described, it was directed to a refinery fuel gas line.

Partially stabilized distillate is withdrawn continuously from one of the several optional intermediate points of the tower 1 through the line 22. The flow of liquid is controlled by the valve 23 which is actuated by the liquid level control device 11, operating to eliminate liquid from the system at such a rate as to maintain a constant level in the reservoir in the bottom of the tower.

The distillate withdrawn through the line 22 is directed to the top of the small bubble tower 24 wherein it gravitates over a series of bubble trays countercurrent to the ascending flow of vapor derived from the heating of the oil in the

bottom of the tower 24. Heat is supplied to this oil in the bottom of the tower by the heating element 25 and the heating medium may be from any available source. In the present case, a portion of the hot oil withdrawn from the bottom of the tower 1 is used for this purpose. The temperature is maintained in the tower 24 at such a point as to satisfactorily stabilize the liquid introduced to the tower. In the present case, a temperature of 196° F. was found proper for this purpose. Liquid oil is discharged from the bottom of the tower 24 through the line 26, the flow being controlled by a liquid level control device, not shown, while distilled products in the form of vapor are returned to the tower through the pipe 24a. Thus a constant level is maintained in the bottom of the tower 24 above the heating element 25. Oil discharged from the tower 24 passes through coolers 27 and thence to storage, through line 28, where it may be processed in any desirable manner for the production of gasoline. Cooling water is supplied to the coolers 27 through pipe 29, and discharged therefrom through pipes 30. In a like manner, water is supplied to the cooler 16a through the pipe 31 and discharged through the pipe 32.

The showing of pyrometers, gauges, flow meters, and other necessary adjuncts to the system have been eliminated in the interest of simplicity. It is understood, however, that these control accessories are installed at necessary positions on the apparatus to promote accurate and satisfactory operation.

Briefly describing the functioning of the method, the distillate in the receiver 2 contains, in addition to its gasoline content, an appreciable amount of material undesirable for gasoline, such material being too volatile to be a satisfactory component of the gasoline. Such materials are methane, ethane, propane, or corresponding hydrocarbons of other than the paraffin series.

The gas leaving the reservoir 2 through the line 10 contains appreciable quantities of material which should properly be included in a gasoline, such as butane, pentane and heavier constituents, and their isomers and corresponding hydrocarbons of other than the paraffin series. It is desirable in this operation to transfer from the distillate to the gas the undesirable constituents and to transfer from the gas to the distillate the desirable material; in other words, to free the distillate of propane and lighter material and to recover as liquid from the gas as much as possible of the butane and heavier products.

To accomplish this effect, the distillate is heated and the light material is driven off by fractional distillation. This fractional distillation is partially done by preheating the distillate in the heat exchanger 8, and is further accomplished by heat derived from its descent through the tower 1 to the outlet 22, as it passes counter-current to the ascending flow of vapor of relatively high temperature. The final elimination of undesirable products is secured in the stripping column 24. The temperature held at the bottom of the tower 24 is the vital control point in the stripping operation and is, of course, dependent on the pressure used and on the quality of product desired, which quality is, in turn, dependent on various factors in the refinery as a whole, including the character of the oil being treated, the nature of the cracking operation and the treatment the oil has received prior to its being introduced to the present system.

The quantity of material flowing through the column 1 is considerably more than that which is withdrawn from the tower through the line 22. The excess continues down the column and is progressively heated until it reaches a final temperature of 400° F., which temperature reduces this material to such an extent that it is a satisfactory absorption oil. Material from the bottom of the tower 1 is withdrawn and cooled and used as an absorption oil in the top of the column where it extracts by selective absorption the desirable components of the gas fed to the column through the line 10, as well as those in the ascending vapor from the lower part of the column thus serving as an absorption oil for the gas and as a reflux for the column. In other words, the upper portion of the column is an absorption and fractionating section, while the lower half of the column is a stripping section. Some undesirable products are also absorbed, but are subsequently removed in the lower portion of the tower. The amount of absorber oil is based on the amount of residue gas leaving the system and, dependent on conditions, may be equal to from 60 to 100 gallons of oil for each 1000 feet of residue gas, as measured at atmospheric pressure. The amount of heat applied to the system at the bottom of the tower and in the feed heat exchanger 8 is a function of the amount of absorber oil required.

The process offers great simplification over present practice, both in equipment and ease in operation. The cost of the equipment shown is approximately one half of that required for a plant of conventional design, and the operating cost and trouble is only a small fraction of that required by the conventional plant.

While it has been suggested that the distillate charged to the system is recovered from an oil cracking system, the process may be used in connection with the absorption and stabilization of any type of distillate and gas, whether they are equilibrium products or not. Gas and distillate may be derived from separate sources and introduced to the system, as well as distillates taken from cracking operations, as suggested. In other words, the oil may be light gasoline or gas from any source or various sources in the refinery or oil field, such as gas and oil recovered from natural sources.

The particular novelty in the method resides primarily in the combining of an absorption section and a stripping section in a single column and so regulating the heat input and amount of absorber oil so that an ultimate stabilized product may be withdrawn as a side stream from a zone intermediate the two sections. It is thought to be a new practice in a method such as has been described to utilize a stream taken from the bottom of the stripper section as an absorber oil, which stream is re-cycled and introduced into the top of the rectifying or absorption section of the tower or column.

Further novelty lies in the fact that the absorber oil is currently produced from the feed stock used and a portion thereof currently extracted from the system, thus there is eliminated the objectionable feature of conventional absorption systems in which it is necessary periodically to clean the absorber oil of accumulated sludge and dirt and supply inevitable loss therefrom.

The present system furnishes a method by which the gas from the stabilizing operation is freed of its desirable products by absorption at

relatively low pressures rather than by rectification at high pressures as is the usual practice.

I claim as my invention:

1. A stabilization and absorption system comprising a column having an absorption section, a stripping section and an intermediate section, means for introducing the feed materials into said intermediate section, withdrawal means for the ultimate product at an intermediate point in the stripper section, means for withdrawing an absorber oil from the bottom of the stripping section and a return line for recycling the absorber oil to the top of the absorption section.

2. In a stabilization and absorption apparatus, a column comprising absorption and stripping sections and an intermediate section, separate means for introducing gases and liquids into said intermediate section, a heater in the stripping section, an absorber oil withdrawal line at the bottom of the stripper section, discharging into said absorption section, a pump in said withdrawal line, and a stabilized product withdrawal line intermediate the stripper section.

3. A stabilization and absorption system comprising a column having an absorption section, a stripping section and an intermediate section, means for introducing the feed materials into said intermediate section, withdrawal means for the ultimate product at an intermediate point in the stripper section, an auxiliary column having a heater therein, means for directing the ultimate product to said auxiliary column, a liquid drawoff from said auxiliary column, and a vapor line connecting the auxiliary column with the first mentioned column.

4. The process which comprises subjecting hydrocarbon liquids and gases to a combined fractionation and absorption step in which the gases pass upwardly in countercurrent contact with liquid absorber oil and reflux condensate, and the liquids pass downwardly against a rising stream of vapors, separately segregating residue gases and liquid free from light gases, diverting a portion of said liquid last mentioned as a desired product, stripping light fractions from another portion of said liquid leaving reduced liquid material, utilizing liquid material so obtained as said absorber oil and passing vaporized light fractions resulting from said stripping step upwardly in countercurrent contact with said liquid absorber oil and reflux condensate.

5. A stabilization and absorption process for hydrocarbons comprising the steps of introducing unstabilized hydrocarbons into an intermediate point in a combined absorption and stripping zone, drawing off from the bottom of said zone, and cooling, the unvaporized portion of the introduced hydrocarbons, passing vaporized constituents through the absorption portion of said zone, utilizing withdrawn and cooled liquid as absorber oil in the absorption portion of said zone and withdrawing a stabilized product from an intermediate point of the stripping portion of this zone.

6. A stabilization and absorption process for treating hydrocarbons comprising the steps of introducing unstabilized hydrocarbons into an intermediate point in a combined absorption and stripping zone, drawing off from the bottom of said zone, and cooling, the unvaporized portion of the introduced hydrocarbons and utilizing it as an absorber oil in the absorption portion of said zone, withdrawing the stabilized products from an intermediate point of the stripping section of said zone, reheating the stabilized products in a separate zone wherein a controlled temperature is maintained, returning evaporated portions from said separate zone to the first mentioned zone at a point above the point of withdrawal of liquid from said first mentioned zone, and withdrawing the final stabilized liquid products from said separate zone.

7. A process for separating unstabilized hydrocarbon liquid into gaseous and liquid components, which comprises introducing said liquid into an intermediate section in a zone wherein gases and vapors pass upwardly in countercurrent contact with downwardly flowing liquid absorber oil, removing residue gases from an upper point in said zone, collecting liquid oil at a lower point in said zone, removing a portion of said liquid oil as a desired product, stripping lighter constituents from the other portion of said liquid oil to leave a reduced liquid material satisfactory for use as absorber oil, and introducing reduced liquid material so obtained into an upper level in said zone as a source of said downwardly flowing absorber oil.

8. A process according to claim 7 wherein the first mentioned portion of the collected oil is subsequently stripped of its lighter fractions by re-boiling and the resulting vapors are introduced into said absorption zone in contact with said absorber oil.

9. A stabilization and absorption process for separating unstabilized hydrocarbon liquid into gaseous and liquid components, which comprises introducing said liquid into an intermediate section in a zone wherein gases and vapors pass upwardly in countercurrent contact with downwardly flowing liquid absorber oil introduced at an upper level in said zone, removing residue gases from an upper point in said zone, removing liquid oil from a lower point in said zone as a desired product, stripping lighter constituents from other liquid collected in said zone below the point of introduction of said absorber oil, to leave a reduced liquid material satisfactory for use as absorber oil, and utilizing reduced liquid material so obtained as said absorber oil first mentioned.

10. A process according to claim 9 wherein the liquid oil removed from said lower point in said zone is subsequently stripped of its lighter fractions by re-boiling and the resulting vapors are introduced into said zone in contact with said absorber oil.

OSWALD C. BREWSTER.