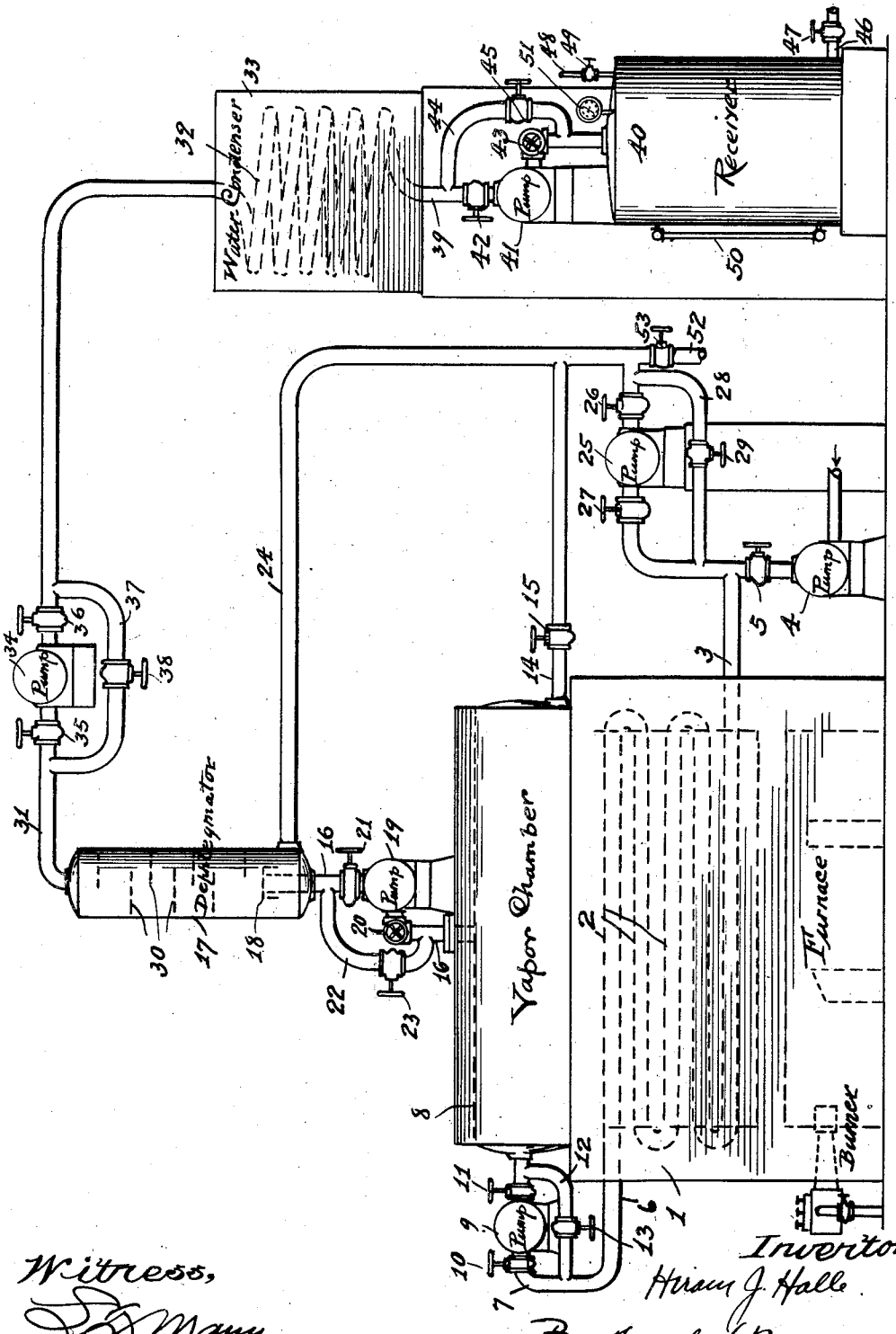
April 5, 1932. H. J. HALLE 1,852,748

PROCESS AND APPARATUS FOR TREATING HYDROCARBONS

Original Filed Sept. 1, 1920



Witness,
D. D. Mann

Inventor,
Hiram J. Halle
By Frank L. Belknap Atty.

Patented Apr. 5, 1932 1,852,748

UNITED STATES PATENT OFFICE

HIRAM J. HALLE, OF NEW YORK, N. Y., ASSIGNOR TO UNIVERSAL OIL PRODUCTS COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF SOUTH DAKOTA

PROCESS AND APPARATUS FOR TREATING HYDROCARBONS

Application filed September 1, 1920, Serial No. 407,328. Renewed October 25, 1928.

This invention relates to improvements in process for treating hydrocarbons and refers more particularly to the cracking of petroleum oil to produce therefrom gasoline or gasoline-like bodies or other light hydrocarbons.

Among the objects of the invention are to provide a process in which the oil under treatment is both distilled and condensed under pressure and in such a way as to permit of relatively wide variations in pressure in different parts of the system; to provide a process of the character last referred to which permits of differential pressure as between the still vapor chamber and the primary and secondary condensers; to provide a process in which this differential pressure may be obtained by means of pumps suitably inserted in the system, or reduction valves, or a combination of valves and pumps, or equivalent; to provide a process of the character last referred to in which the differential pressure referred to may be maintained throughout the length of any given run or may be varied at different periods in a run; to provide a novel form of apparatus for carrying out the above process; and in general to provide a process and apparatus of the character referred to.

In the drawing, the single figure shows a somewhat diagrammatic side elevation of my improved apparatus.

Referring to the drawing, 1 designates the furnace in which is mounted the heating coil 2. The inlet side of the heating coil 2 is connected by feed line 3 to a charging pump 4 connected to any suitable source of oil supply. A throttle valve 5 is interposed in the line 3.

The oil while used in the liquid phase passes out of the discharge end 6 of the heating coil into transfer line 7 leading to vapor chamber 8. A pump 9 is interposed in the line 7 and at either side of the pump are throttle valves 10 and 11. The arrangement is such that the hot oil can be forced into the vapor chamber 8 under a higher pressure than that at which it leaves the heating coil. A line 12 having throttle valve 13 for by-passing pump 9 may also be provided. The vapor chamber 8 is provided with liquid residue draw-off pipe 14 controlled by throttle valve 15 leading to any suitable residue tank. Vapors pass out of the upper part of the vapor chamber 8 through pipe 16 which extends into the upper part of a vertical dephlegmator 17. The upper part of the pipe 16 is provided with a spaced cap member 18 to prevent the reflux condensate from falling back into the pipe 16. A pump 19 is interposed in line 16 and at either side of the pump are inserted throttle valves 20 and 21. The pump may be by-passed by by-pass line 22 having control valve 23. The reflux condensate may be drawn off through the return pipe 24 connected at one end to the lower part of the dephlegmator and at the other end to the feed line 3. A pump 25 is interposed in the line 24 and valves 26 and 27 are inserted at either side of the pump. The pump 25 may be by-passed by means of line 28 having control valve 29. By means of the pump 19 above referred to the vapors may be forced into the dephlegmator under a higher pressure than that in the vapor chamber 8. It will not be necessary to use the pump 25 unless the dephlegmator is under a less pressure than the heating coil as otherwise the head of oil in pipe 24 will be sufficient to return the reflux condensate to the charging line.

The dephlegmator is provided with a series of alternately disposed baffles 30 and at its upper end the dephlegmator is provided with a vapor outlet pipe 31 leading to water condenser coil 32 seated in water condenser box 33. A pump 34 is interposed in line 31 and at either side of the pump are inserted throttle valves 35 and 36. This pump 34 may be by-passed by means of a by-pass pipe 37 in which is inserted throttle valve 38. The arrangement is such that the vapors may be condensed in the water condenser coil under a higher pressure than in the dephlegmator if desired. The water condenser coil 32 is connected by pipe 39 to a receiver 40. A pump 41 having at either side throttle valves 42 and 43 is inserted in line 39 so that the receiver may be under a higher pressure than the condenser coil if desired. The pump 41 may be by-passed through line 44 having throttle

valve 45. The receiver is provided with liquid draw-off pipe 46 having throttle valve 47 and with gas outlet pipe 48 having valve 49. This receiver also has liquid level gauge 50 and pressure gauge 51. The reflux condensate may be drawn off through line 52 controlled by valve 53 to any suitable tank and retreated elsewhere if desired.

The apparatus is so constructed as to permit of a wide variation in pressure control. It will be noted that all of the pumps may be by-passed and a uniform pressure maintained throughout the entire system or that any one or more of the pumps may be cut in and the oil in that part of the apparatus relative to any given pump subjected to a higher pressure than the oil in the preceding part of the apparatus. Furthermore the pressure may be varied in different parts of the system during different periods of the operation. As for example, the heating coil and vapor chamber may be maintained under a given pressure during the first half of a run and the dephlegmator and water condenser under a higher pressure. As the run proceeds, the pressure on the dephlegmator may be made the same as the pressure on the heating coil and vapor chamber while the pressure on the water condenser coil may be maintained at a still higher pressure. Furthermore the pressure on any given part of the apparatus may be increased or decreased as the run proceeds. The foregoing are merely by way of illustrating a few of the possible ways in which the apparatus may be manipulated.

The following illustrative run of carrying out the process may be given. Starting with a gas oil of 32° Baumé obtained from a Kansas crude petroleum the oil may be heated to a temperature in the heating coil of 700° F., care being taken to keep the oil in the liquid phase in the heating coil to prevent precipitation of carbon in the tubes. The pressure on the heating coil may be maintained at 130 lbs. to the square inch by suitably regulating the valve 13 and closing the valves 10 and 11. This by-passes the pump 9. The pressure on the vapor chamber 8 may be maintained at 90 lbs. by closing the valve 23 and suitably regulating the valves 20 and 21. By maintaining the vapor chamber under a lower pressure than the heating coil an increased vaporization of the oil will take place at a temperature at which it was heated. The pressure on the dephlegmator may be maintained at 200 lbs. by closing the valve 38 and suitably regulating the valves 35 and 36. The pressure on the water condenser and receiver may be increased to 250 lbs. by suitably operating the pump 34 and by passing the pump 41. The pump 41 may be by-passed by closing valves 42 and 43 and opening valve 45. The pressure is controlled on the receiver and condenser coil by regulating the outlet valves 47 and 49 on the receiver. Inasmuch as the dephlegmator is under a higher pressure than the heating coil, the pump 25 may be cut out of the system by closing valves 26 and 27 and the valve 29 opened to permit the reflux condensate to pass through line 28. By means of this process from 50 to 65% of the original oil may be converted into pressure distillate of 52° Baumé and containing 35% of 58° Baumé gravity gasoline (the 35% being based on the original oil treated). By means of the increased pressure on the condenser more of the gasoline content contained in the incondensible gases will be compressed out into the receiver than would be the case where a uniform pressure is maintained.

The following modified method of carrying out the process may also be described. The pressure on the heating tubes may be maintained at 150 lbs., the pressure on the expansion or vapor chamber at 75 lbs. and the pressure on the balance of the system namely the dephlegmator, condenser coil and receiver at 150 lbs. This can be accomplished by suitably arranging pumps and by-pass lines heretofore referred to.

Another modified method of carrying out the process may be given. The pressure on the heating coil may be maintained at 150 lbs., on the vapor chamber and dephlegmator at 75 lbs., on the water condenser coil and receiver at 200 lbs. This is accomplished by suitably regulating the pumps and valves shown. In this case it will be necessary to use pump 25 in the event reflex condensate is returned to the heating coil for the reason that oil in the dephlegmator is under a lower pressure than the oil in the heating coil.

It will not be necessary for me to give other modified forms of carrying out the above process. The invention is not limited to the details heretofore described except as set forth in the appended claims.

I claim as my invention:

1. A process of cracking petroleum oil, consisting in heating oil under a predetermined pressure, passing the oil to a vapor chamber, reducing the pressure on the oil in the vapor chamber, passing the vapors to a reflux condenser, increasing the pressure on the vapors in the reflux condenser in excess of the pressure in the vapor chamber, passing the uncondensed vapors from the reflux condenser to a second condenser and maintaining the pressure of said second condenser substantially higher than the pressure in said vapor chamber.

2. A process of cracking petroleum oil, consisting in heating oil under a predetermined pressure, passing the oil to a vapor chamber, reducing the pressure on the oil in said vapor chamber, passing the vapors to a reflux condenser, passing the uncondensed vapors from the reflux condenser to a second condenser and maintaining the pressure on

said first and second condensers substantially greater than the pressure in said vapor chamber.

3. The process of cracking petroleum oil, comprising heating oil under a predetermined pressure, in passing the oil to a vapor chamber, in maintaining the pressure on the oil in the vapor chamber lower than the pressure thereon in the heating chamber, in passing the vapors from the vapor chamber into a dephlegmator, in maintaining the pressure on the vapors in the dephlegmator greater than the pressure in the vapor chamber, in condensing and collecting the vapors discharged from the dephlegmator.

4. The process of cracking petroleum oil, comprising heating oil under a predetermined pressure, in passing the oil to a vapor chamber, in maintaining the pressure on the oil in the vapor chamber less than the pressure maintained in the heating chamber, in passing the vapors from the vapor chamber into a dephlegmator, in maintaining the pressure on the vapors in the dephlegmator greater than the pressure in the vapor chamber, in condensing and collecting the vapors discharged from the dephlegmator, and in discharging reflux distillate from the dephlegmator, and in forcing said distillate into the heating coil under pressure.

5. An apparatus for cracking hydrocarbon oil, comprising a heating coil and an enlarged reaction chamber, means for supplying hydrocarbon oil under pressure to said coil, means for removing vapors from said enlarged reaction chamber, means for conveying heated oil from said coil to said chamber, under a pressure lower than the pressure maintained in said coil, and additional means associated with said means for conveying oil from said coil to said chamber for placing oil passing from said coil to said reaction chamber, under a pressure in excess of the pressure maintained on the oil in said coil.

HIRAM J. HALLE.