

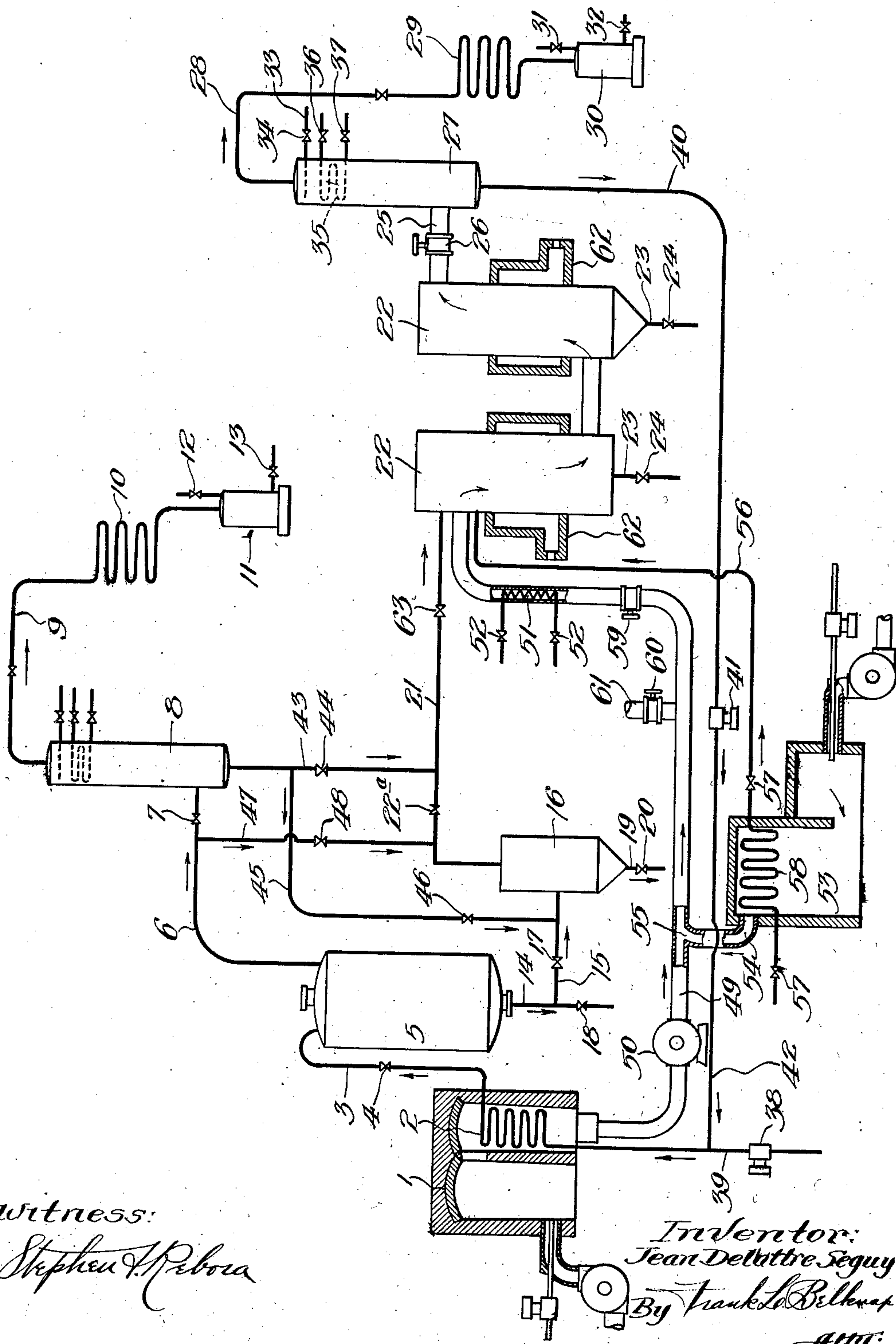
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PROCESS OF CRACKING HYDROCARBON OIL

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Witness:

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PROCESS OF CRACKING HYDROCARBON OIL

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The invention relates to the treatment of the vapors produced by previous cracking and more particularly to the treatment of vapors produced by liquid-vapor phase cracking process of the well known coil and chamber type.

The advantages and the objects of the invention will appear from the hereinafter filed description, and therefore, need not be here recited in detail. In order to more clearly understand the invention, I have shown the accompanying drawing, which is a diagrammatic view of an apparatus suitable for carrying out the invention, but it is understood that this drawing is diagrammatic and not to scale.

Referring to the drawing, 1 designates a furnace on which is mounted a heating or cracking coil 2. The coil 2 is connected by transfer line 3 having throttle valve 4 to the insulated reaction chamber 5. From the top of the reaction chamber 5, the vapors may pass through vapor line 6, having throttle valve 7 into the lower side of dephlegmator 8. The vapors which are not condensed in the dephlegmator pass out through vapor line 9 to condenser 10 and thence to receiver 11. This receiver 11 has gas release control valve 12 and liquid discharge control valve 13.

The residue is drawn out through the lower part of the chamber 5 by draw-off pipe 14 connected to branch 15 leading to the flash chamber 16. A pressure reducing valve 17 is interposed in the line 15. The line 14 has a throttle valve 18. The residue from the flash chamber 16 is drawn out through pipe 19, having throttle valve 20. The vapors from the flash chamber 16 pass out through pipe 21, having throttle valve 22a into a series of serially connected vapor phase cracking chambers 22. I have shown two in the drawing, but more than two can be used, if desired. Chambers 22 have residue draw-offs 23 controlled with throttle valve 24. From the last chamber 22 the vapors pass through pipe 25, having throttle valve 26, into the side of dephlegmator 27. From the top of this dephlegmator, the uncondensed vapors and gases pass through line 28 and condenser coil 29 to receiver 30. This receiver 30 has gas control valve 31 and distillate control valve 32.

To the dephlegmator 27 may be directly fed through pipe 33 having control valve 34, the raw charging stock, or if desired, the temperature may be controlled by passing the raw charging stock through the closed coil 35, having valves 36 and 37 and in the latter case, the preheated oil fed to the feed pump 38 and main inlet line 39, leading to the coil 2. The reflux condensate

and the preheated raw oil, if the latter is fed directly into the dephlegmator 27, pass through line 40 and pump 41 and line 42 to the inlet feed pipe 39.

The reflux condensate from the primary dephlegmator 8 may be fed to the line 21 through the pipe 43, having control valve 44, or the reflux from the main dephlegmator 8 may be fed through the line 45, having control valve 46 into the line 15 beyond the reducing valve 17. Also, if desired, the dephlegmator 8, condenser 10 and receiver 11 may be cut out of the system and the vapors from the chamber 5 pass to the line 21 through branch 47, having control valve 48.

The arrangement is such that in one method of carrying out the invention, the gasoline vapors and lighter gases will be separated in the dephlegmator 8 from the heavier reflux and then this reflux returned through line 43 to the line 21, the valve 44 in such case being used as a pressure reducing valve and the reflux flashed into the line 21 at the same pressure as is on the chamber 16. In such case, the valve 7 will be opened and the valves 48 and 46 closed.

Another method in which the invention may be operated would be to close the valves 44 and 48 and use the valve 46 as a pressure reducing valve, whereby the reflux condensate will pass to the chamber 16. This might be desirable where the reflux condensate to flash is particularly heavy, and its heavier fractions will be removed through the line 19 with the residue. Another method of operating the invention would be to close the valves 7, 44 and 46 and pass all of the vapors through line 47, using the valve 48 as a pressure reducing valve.

I have provided means for effectively heating the vapors in chambers 22 by passing the flue gases from furnace 1 through the flue 49 in which is interposed a fan 50, this flue leading to the first chamber 22. The arrangement is such that the flue gases come into direct contact with the vapors and superheat them. It is, of course, desirable to control and, in some cases, within relatively narrow limits, the temperature in the chambers 22. To this end, I am interposing a cooling coil 51, having valves 52, in the flue 49 to cool the gases if too hot. If the gases are not hot enough, I provide an auxiliary heater 53, having flue 54 connected, as shown at 55, to the flue 49. The arrangement of this auxiliary heater is such that the gases of combustion may enter flue 49 under the pressure of the balance of the system.

In one method of carrying out the invention,

incondensable gas and extraneous gas may be also introduced into the chambers 22 by means of the line 56, having valves 57. Preferably, this gas may be pre-heated by passing it through the heating coil 58, located in the heater 53 and the gas, introduced under sufficient pressure to enter the chambers 22, may be either inert gas, such as nitrogen or the like, or a hydrogenating gas, such as hydrogen. It may be carbon monoxide or carbon dioxide, or steam.

Another method of operating the invention may be to close the damper 59 in the flue 49 and open the damper 60 in the branch 61. In such case, the heated gas introduced through the pipe 56 may be the only means for superheating the vapors in the chambers 22.

In carrying out either of the above two last mentioned methods, the chambers 22 may be also externally heated through the furnaces 62.

Another method of carrying out the invention may be to put a catalyst, such as iron oxide or other suitable matter in the chamber 5, or the chambers 22, or in both of them. In all of the various methods above referred to, the oil may be subjected to a pressure of say 200 lbs. or more in the coil 2 and the chamber 5. The pressure in the chamber 16 and the dephlegmator 8 and the chambers 22 and the dephlegmator 27 and its associated parts may be substantially lower than the pressure in the coil—say from 100 lbs. down to atmospheric pressure. Another manner of carrying out each of the foregoing methods would be to have a pressure of say 350 lbs. on the coil 2 and chamber 5, a pressure of say 100 lbs. on the chamber 16 and dephlegmator 8 (in case the latter is not cut out of the system) while by regulating the reducing valve 63 on line 21 from 25 lbs. say to atmospheric pressure may be maintained on the chambers 22 and dephlegmator 27, or if desired, in the last mentioned case, a vacuum may be maintained in the chambers 22 by connecting a suitable vacuum pump, not shown, to the receiver 30.

In the operation of my process as above described, the vapors are dried in advance of the vapor phase cracking step by reducing the pressure thereon 50 pounds or more to an ultimate vapor phase cracking pressure of a relatively low order, such that there obtains in the vapors to be cracked a temperature-pressure relationship in which the temperature is above the saturation point for the reduced pressure. This preliminary drying of the vapors to be cracked minimizes carbon formation in the vapor phase cracking zone.

In carrying out any of the methods above described, the degree of cracking in the liquid-vapor phase part of the system, to-wit, in the coil 2 and chamber 5, may be independently controlled relative to the degree of cracking in the vapor phase cracking chambers 22. Transfer temperature in the coil 2 may be say 850° F., more or less, while the temperature in the chambers 22 may be 1000° F. more or less.

By subjecting the vapors to vapor phase cracking in the chambers 22 with the gases therein contained in the manner heretofore described, gasoline-containing relatively large percentages of anti-knock compounds may be formed. Also, other compounds may be formed, such as oxygenated compounds.

In carrying out any method of the above described process, it is desirable to have substantially complete combustion of the flue gases be-

fore they enter the chambers 25 in order to avoid combustion of the hydrocarbon vapors.

I claim as my invention:

1. In processes for converting high boiling point oils into low boiling point oils in which the high boiling point oil is subjected to pressure distillation in a pressure distillation zone, vapors and unvaporized liquid separately removed from the pressure distillation zone, the unvaporized liquid introduced while hot into a zone of lower pressure wherein substantial distillation thereof is effected by the contained heat of the oil, the improvement which comprises introducing to the unvaporized liquid oil removed from the pressure distillation zone prior to further distillation in said zone of lower pressure a lighter oil of lower temperature than said removed unvaporized liquid oil, removing vapors from said zone of lower pressure, and subjecting the same to vapor phase cracking by introducing hot gases into direct contact therewith.

2. A hydrocarbon oil cracking process which comprises heating the oil to cracking temperature under pressure and separating the same into vapors and unvaporized oil, flash distilling the unvaporized oil in a flashing zone by pressure reduction, introducing to said flashing zone to be vaporized therein a hydrocarbon oil of lower boiling point than said unvaporized oil, removing from the flashing zone the commingled flashed vapors and vapors evolved from the lower boiling oil and subjecting the same to a gasoline-producing vapor phase cracking operation by introducing hot gases into direct contact therewith, and condensing the resultant gasoline vapors as a product of the process.

3. The process of cracking a mineral oil charging stock which comprises vaporizing the oil under a substantial superatmospheric pressure, drying the oil after it has expanded into vapor by suddenly reducing the pressure thereon not less than 50 pounds per square inch to the extent required to bring the temperature above the saturation point for the reduced pressure, then heating the oil vapors under the reduced pressure to a cracking temperature and cracking the vapors, and then cooling and fractionating the vapors.

4. The process of cracking a mineral oil charging stock which comprises heating the oil and thereby vaporizing it under a substantial superatmospheric pressure, allowing the vapors to expand beyond the heating zone and removing heavy fractions, then drying the oil vapors by reducing the pressure thereon not less than 50 pounds per square inch to the extent required to bring the temperature above the saturation point for the reduced pressure, then heating the oil vapors under the reduced pressure to a cracking temperature and cracking the vapors, and then cooling and fractionating the vapors.

5. A process of cracking mineral oil charging stock which comprises heating the oil to a cracking temperature while flowing through a heating coil under a relatively high superatmospheric pressure, effecting an initial separation of vapors in a primary vaporizing zone maintained under approximately the same pressure as the heating coil, effecting a secondary separation of vapors in a secondary zone maintained under a superatmospheric pressure lower than that maintained on the heating coil, uniting the vapors separated from the oil in said primary and secondary zones and reducing the pressure on the combined vapors at least 50 pounds below the pressure at which any of the vapors were generated, then subjecting

the combined vapors to vapor phase cracking at the reduced pressure and subjecting the vapor phase cracked vapors to fractionation and condensation.

5 6. A process for cracking mineral oil charging stock which comprises heating the oil to a crack-
ing temperature while maintained under a rela-
tively high superatmospheric pressure, effecting
an initial separation of vapors from unvaporized
10 oil under a comparatively high superatmospheric
pressure, thereafter effecting a further separation
of vapors from unvaporized oil under a relatively
lower superatmospheric pressure, reducing the
pressure on the vapors at least 50 pounds below
15 the pressure at which any of the vapors were
generated, and subjecting the same to a vapor
phase cracking treatment, and finally cooling and
fractionating the vapor phase cracked vapors.

20 7. The process of cracking a mineral oil charg-
ing stock which comprises vaporizing the oil
under a substantial superatmospheric pressure,
drying the oil after it has expanded into vapor by

suddenly reducing the pressure thereon not less
than 50 pounds per square inch and to a reduced
pressure such that the temperature of the vapors
is above the saturation point for the reduced pres-
sure, then heating the oil vapors under the re-
duced pressure to a cracking temperature and
cracking the vapors, and then cooling and frac-
tionating the vapors.

8. The process of cracking a mineral oil charg-
ing stock which comprises vaporizing the oil under
a substantial superatmospheric pressure, drying
the oil after it has expanded into vapor by sud-
denly reducing the pressure thereon not less than
50 pounds per square inch and to a reduced pres-
sure of the relatively low order of 25 pounds per
square inch or less whereby to bring the tem-
perature of the vapors above the saturation point
for the reduced pressure, then heating the oil
vapors under the reduced pressure to a cracking
temperature and cracking the vapors, and then
cooling and fractionating the vapors.

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