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CRACKING PROCESS

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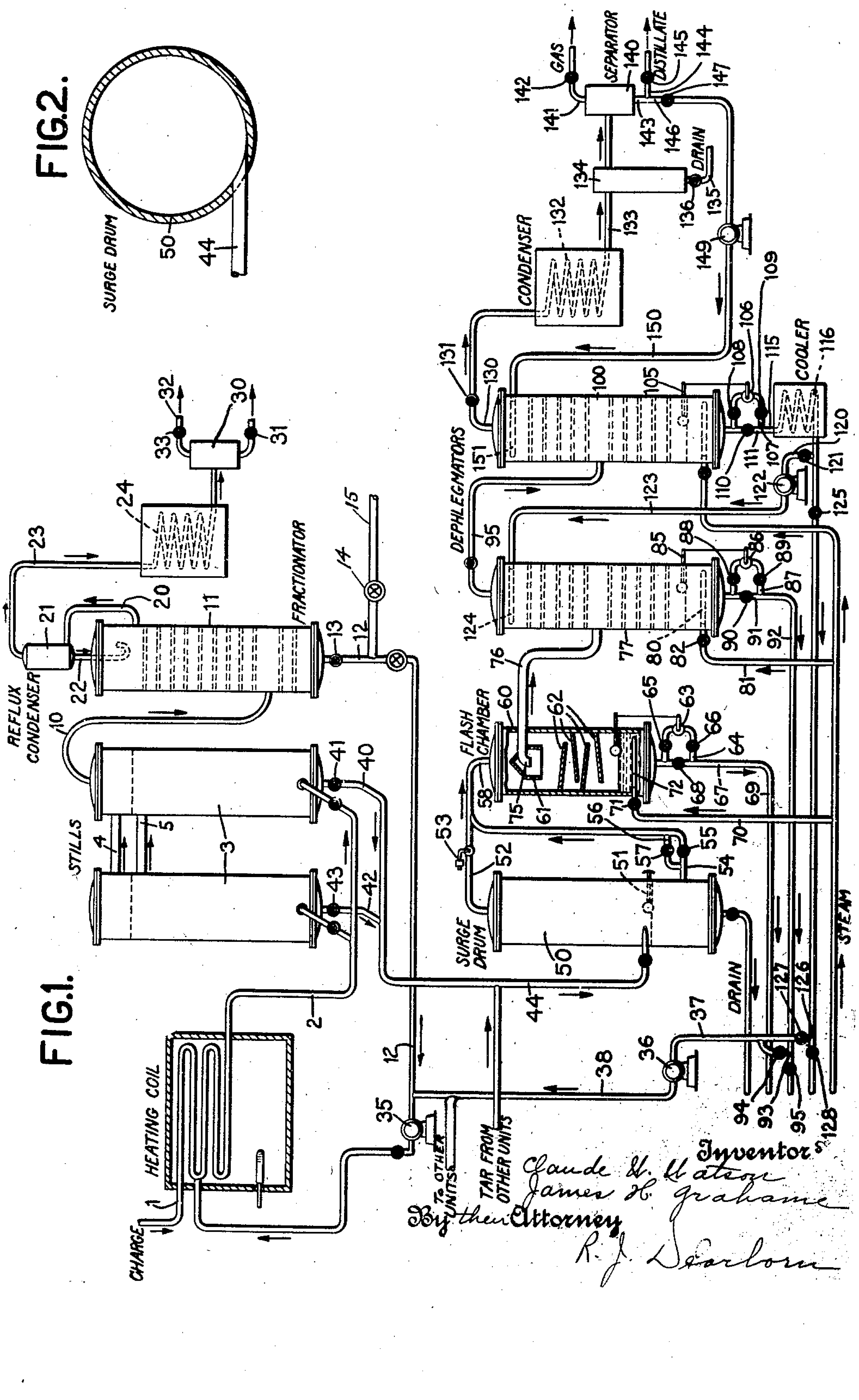

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UNITED STATES PATENT OFFICE

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CRACKING PROCESS

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The present invention relates generally to a method of converting higher boiling hydrocarbon oils into lower boiling oils usually referred to as a cracking process.

More specifically, the invention contemplates effecting uniform operating conditions for the different portions of a cracking system, thereby insuring uniform products.

In most cracking processes there is developed in certain parts of the system, such as the conversion zone or stills, a body of residual oil which collects therein and must be withdrawn from time to time, or continuously, to permit a more or less continuous operation of the system. Due to the fact that most of the known cracking processes employ superatmospheric pressures and elevated temperatures which, for example, may range respectively between 150 and 600 pounds per square inch and 750° and 950° F. in the conversion zone, it will readily be understood that such residual oil as collects in the conversion zone may contain a small percentage of relatively light components and a larger percentage of intermediate components, and a quite large percentage of heavy components. Accordingly, it is quite desirable to remove from the higher pressure zone this residual oil, generally known as tar or pressure bottoms, and to expand it into a zone or a plurality of zones of lower pressure, thereby permitting the lighter constituents to flash off or vaporize. Such vapors may be fractionally condensed into desired distillates while the heavier constituents may be withdrawn from the lower pressure zone in unvaporized form.

Such a reduced pressure zone as mentioned above is often referred to as tar stripping means or simply a tar stripper. The stripping of the hot tar from the high pressure conversion zone by way of vaporizing or flashing off the lighter components is effected largely, if not completely, by its own contained heat, although at times assistance in the distillation has been had by the introduction of steam into the primary distillation chambers of the tar stripper.

In most cracking processes where hot pressure tar is drawn from a pressure conversion zone and delivered to a tar stripper operating under reduced pressure, the delivery is effected by manually opening a valve at periodic intervals to permit a portion of the body of tar collected in the conversion zone to be transferred under the pressure differential between the two zones. After a sufficient quantity of the tar has been removed the valve is again closed. Preferably the tar will be thus withdrawn periodically and during withdrawal the valve may be opened wide, permitting a volume of the tar to issue from the conversion zone at high velocity and thus preventing the formation or deposition of carbon or coke in its passage to the tar stripper, which would of course result in stoppages of the transfer lines. Were the tar permitted to issue continuously it would of necessity be in a fine stream at comparatively low velocity, which would tend to permit the formation of coke and carbon with resultant stoppage of the passages.

It has been found, however, to be of considerable advantage, not only from the standpoint of the stripper itself but from the standpoint of the cracking unit as a whole, to maintain a substantially constant condition in the tar stripping zone. This can only be accomplished by delivery of a regulated stream of tar into the distilling zone of the tar stripper so that a regulated pressure may be maintained within the latter. Obviously, no constant condition within the distilling zone of the tar stripper could exist if the tar is delivered directly from the higher pressure conversion zone periodically or in so-called "shots".

While the employment of a single tar stripper in conjunction with a plurality of cracking units, ranging, for example, from four to twelve such units, serves to increase the frequency of the "shots" and thus to smooth out the operation of the stripper, this does not satisfactorily avoid the objectionable variations of pressure.

The present invention overcomes the difficulties in the way of pressure variations which would be normally caused by the periodic delivery of "shots" of tar to the tar stripper. This is accomplished by providing means for absorbing the shocks incident to the withdrawal of "shots" of tar, thereby effecting a regular and steady delivery of the product to the distillation chambers of the tar stripper.

Other features and advantages of the invention directed primarily to the general improvement of methods and apparatus for the auto-distillation of tar and the fractionation of the vapors will be evident from the following detailed description taken in conjunction with the accompanying drawing in which Figure 1 illustrates diagrammatically a preferred form of apparatus for practicing the present invention, and Figure 2 is a cross-sectional view through the surge drum.

Referring to the drawing, any suitable form of cracking system may be employed, although a system of the type commonly termed "coil and drum" is regarded as preferable and has been illustrated. A suitable charging stock may, for example, be fed to a heating coil 1 wherein a superatmospheric pressure is maintained, so that the oil is highly heated in transit therethrough and is then conducted through a pipe 2 to one or more of a plurality of stills 3 comprising a conversion zone. Any desired number of stills may be employed, two being shown. The stills may be connected near their tops by communicating pipes 4 and 5 to provide for the passage of the vapors and liquid from one still to another.

The oil undergoing treatment is subjected to conversion conditions in the stills 3, which may be in the nature of maintaining a superatmospheric pressure therein of, say, 150 to 600 pounds per square inch while maintaining an elevated temperature of the order of, say, 750° to 900° F. Under these conditions a portion of the oil, consisting mainly of the products of conversion, is vaporized while a portion, being mainly the residual components, remains unvaporized and collects in a body within the bottoms of the stills 3.

The vaporized portion may pass overhead through a vapor line 10 and be conducted to a dephlegmator or fractionator, preferably in the form of a bubble tower 11 wherein the vapors are subject to fractionation. A portion of the vapors, which may be of the nature of a gas oil, being condensed in the fractionator 11 and forming a liquid body in the bottom thereof, may be withdrawn through pipe 12 controlled by means of a valve 13. Those components that remain in the vaporous state may pass upwardly through the tower and be delivered through a vapor line 20 into a reflux condenser 21 wherein a further portion of the vapors may be condensed and knocked back through the reflux line 22 to furnish a cooling medium for the vapors passing upwardly in the fractionator 11. Any desired cooling medium may be employed in the reflux condenser, as for example the fresh charge which may be passed in indirect heat exchange with the vapors therein. The final vapor portion passing upwardly through the reflux condenser 21 and emerging from the pipe 23 is passed through a condensing coil 24 to form an ultimate distillate which may be collected in an accumulator drum 30 and delivered to any suitable storage by means of a valve-controlled pipe 31 and a fixed gas constituent which may be delivered to any suitable storage or use by means of pipe 32 controlled by valve 33.

As mentioned, a condensate which may be of the nature of gas oil is adapted to be withdrawn from a body collecting in the bottom of the fractionator 11 through the pipe 12 having the valve 13. This condensate may preferably be withdrawn by a pump 35 and returned to the heating coil 1 for further treatment, or portions or all of it may be released to suitable storage tanks through the line 15 controlled by valve 14. When the condensate is returned to the heating coil it is preferably introduced at an intermediate point where its temperature corresponds more nearly to the temperature of the oil in the coil.

It has also been mentioned that a portion of the highly heated oil undergoing treatment which remains unvaporized will connect in a body in the conversion zone or stills 3. This residual oil or pressure tar is preferably removed from the conversion zone at intermittent periods and at such times or such rate as to permit the proper conversion of the oil to take place.

For this purpose the tar may be passed from the stills through branch pipes 40 and 42, provided respectively with manually controlled valves 41 and 43, and may be discharged into a main pipe 44.

The cracking system which has been thus far described may be operated in any manner most desirable. One method of operation consists in maintaining a substantially uniform pressure from the heating coil 1 through the condensing coil 24, which, as before mentioned, may be of the order of 150 to 600 pounds, more or less, per square inch while employing such temperatures as are best suited to the conversion of the oil undergoing cracking. While only a single cracking unit embodying a single coil and battery of stills has been disclosed, it should be understood that preferably a plurality of such units, from say four to twelve, will discharge residue into the common main 44 and will pass it to the tar stripping system, which will now be described.

To insure best operating conditions of the type requiring the withdrawal of the hot pressure tar from the bottoms of the plurality of batteries of stills 3 periodically in so-called "shots", as has been briefly explained, it has been found highly desirable, in accordance with the present invention, to forcibly deliver the tar under the pressure in the stills into a region of partially reduced pressure where the shock of the "shots" may be cushioned or absorbed before the tar is delivered to the still lower pressure region where substantial vaporization of the lighter portions of the tar may take place immediately due to its own contained heat.

To this end the hot tar discharged intermittently from the pressure conversion zones through pipe 44 will preferably enter a surge chamber 50 which may, if desired, be provided with a float-controlled mechanism 51 for indicating the liquid level. As shown in Figure 2, it may be advantageous to introduce the tar tangentially into the chamber by suitable tangential arrangement of the pipe 44. The inlet, furthermore, will preferably be somewhat above the normal liquid level within the chamber, although this is not essential. By virtue of this arrangement the heavy, coky particles carried along in the tar will be thrown down and permitted to settle at the bottom of the chamber, where they may be readily withdrawn. It will be apparent that due to its contained heat, a certain portion of the hot tar entering the chamber 50, which is maintained under a pressure considerably reduced, for example substantially one-half of that in the stills 3, may become vaporized, the extent of vaporization depending upon the extent of the reduction in pressure in the chamber 50. In order to avoid the building up of excessive pressures upon the formation of the vapors in this chamber, there is provided a vapor line 52 overhead having a pressure regulating valve 53 which may be set to relieve at approximately the desired maximum pressure in the surge chamber or preferably above the ordinary maximum. Where the stills are operated at, say, 400 pounds per square inch, the relief valve may well be set at about 300 pounds, with the surge drum operating at pressures fluctuating between say 75 to 250 pounds. A liquid drawoff line 54, having a valve 55 preferably manually operated with a by-pass line 56 having a valve 57 around the valve 55, may be provided from the liquid space of the chamber. This drawoff line may also be tangentially arranged, if desired, and preferably is considerably below the upper liquid level but high enough not to collect the coky deposits which settle to the bottom of the chamber. Now, while the liquid is received intermittently within the surge drum 50, so that fluctuations in pressure will necessarily arise, all the shock of the "shots" will be therein absorbed or cushioned and will not be passed along to the rest of the system. By means of the manually operated valve 55 there may be delivered from the chamber 50 a regulated stream of oil which may be at times in liquid and at times in vapor form, depending upon the pressure fluctuations in the chamber, which may be passed through a pipe 58 into a still or an expansion or flash chamber 60 wherein a pressure little above atmospheric may preferably be maintained. It is preferable that the relief valve 53 be set at a pressure materially above the maximum pressure that is ordinarily reached in the operation of the surge drum 50 so that in the normal operation of the drum the products are discharged through the line 54 and thus the valve 53 serves primarily as a safety valve and does not normally function to permit the passage of fluid except in cases of emergency. If desired, however, the valve may be set at a lower pressure such that it may normally or frequently function to permit the passage of vapors through the line 52, but ordinarily we prefer not to employ the valve in this way, since when it is set at such a pressure that it tends to act as a regulator of the pressure in the surge drum 50, it tends to negative the function of the surge drum in absorbing the effect of the intermittent introduction of material by shots or drags from the pressure stills.

Bearing in mind that the products entering the flash chamber 60 through the line 58 are very hot, it will be readily understood that a large portion of the entering liquid will immediately be vaporized. To assist in the vaporization of the lighter components by breaking up the liquid body to a certain extent, the flash chamber 60 may be provided with suitable spreading means, such as a hood 61, having a skirt, and a series of baffles 62. These serve not only to disperse the entering liquid in a relatively thin film thereover to thereby aid distillation, but the baffles may also serve to lengthen the path of the upwardly moving released vapors and provide a contacting means for the vapors and liquid thereby tending to collect and precipitate particles of heavier constituents which may have become mechanically entrained. It may be found advantageous at times to introduce steam near the bottom of the flash chamber 60 wherein a body of liquid will collect and may be maintained. For this purpose there is provided a steam pipe 70 from any suitable source and leading to a spray 72 disposed within the chamber near the bottom thereof. The pipe 70 may be provided with a suitable control valve 71. Steam, which may be superheated and introduced in this way, may assist in distilling off or stripping certain of the lighter fractions, which would otherwise be entrained in the heavy fuel oil developed or collected at the base of the chamber. The amount of liquid maintained more or less constantly in the bottom of the flash chamber 60 may be regulated by means of a float-controlled valve 63 in a line 64 having block valves 65 and 66. There may also be provided a drawoff line 67 which may have a manually controlled valve 68. Both the line 64 and the line 67 connect to a drawoff line 69 leading to any suitable form of storage. The valves 65, 66 and 68 may be adjusted in any suitable way. Preferably the valve 68 will normally be closed and the other valves opened so that the discharge of liquid from the chamber may be entirely under the control of the float-controlled valve 63. However, if desired, the valve 68 may be partly opened to permit a portion of the liquid to pass through the line 67, while a controllable portion is also passed through the line 64.

The vapors formed within the flash chamber 60 may gather in the protected area formed by the skirt portion of the spreader or hood 61 and entering an elbow 75 may be conducted through a large vapor line 76 into a dephlegmator or fractionating tower 77.

The pressure maintained in the tower 77 may ordinarily be substantially the same as that in the flash chamber 60, which, as has been stated, is preferably maintained at approximately atmospheric pressure. The pressure in the tower, however, is dependent somewhat upon the nature of the products to be developed. Thus, when the system is operating to develop certain distillates, it may be desirable to maintain it under a slight sub-atmospheric pressure, while again, for the development of a different type of distillate, it may be maintained under a slight superatmospheric pressure.

The vapors entering the tower 77 are subjected therein to partial condensation or fractionation and for this purpose bubble trays, stone packing or other means of providing a tortuous course may be had within the tower. A portion of the vapors will pass upwardly while another portion, this being the heavier constituents, is condensed and knocked back the bottom of the tower. A steam spray 80 may, if desired, be placed near the bottom of the tower 77 and may be immersed in the body of heavier condensed constituents formed and collected therein or may preferably be positioned in the vapor space above the normal liquid level so that the liquid falling through the vapor space may come in contact with the steam. The supply of steam to the spray 80 may enter through a pipe 81 controlled by a valve 82.

With the vapors entering the tower at substantially its mid-point and with the steam being introduced near the bottom of the tower that portion of the tower which is below the vapor inlet constitutes what may be termed a stripping section in which the steam operates to remove the lighter constituents from the descending reflux liquid while that portion of the tower above the vapor inlet may be said to constiute the fractionating zone proper in which takes place fractionation or rectification of the overhead vapor fraction from the tower. Although superheated steam may, if desired, be employed, satisfactory results may be obtained with the use of ordinary saturated steam, the steam operating to reduce the partial pressure and enable vaporization at lower temperatures. When the steam introduced into the tower is at a temperature below that of the reflux condensate in the bottom of the tower and with the vapors entering the tower at a mid-point the latter point will ordinarily constitute the zone of highest temperature in the tower and the steam as it passes upwardly from the bottom of the tower through the several trays of the stripping section will be heated, with the result that as it reaches the point of entrance of the vapors it will approximate the temperature of the liquid in the tower at that point so that there is no danger of the steam producing any cooling effect in the upper sections of the tower. Furthermore, the steam may be used in comparatively small quantities so that its cooling effect, even in the lower sections of the tower, is negligible and in fact more than counter balanced by its effect in lowering the partial pressure.

Suitable float mechanism 85 may be employed to regulate the opening and closing of a valve 86 in a draw-off line 87, provided with block valve 88 and 89, to thereby maintain a desired body of condensate within the tower 77. A manually controlled valve 90 in a line 91 may also be provided to permit the complete drainage of the condensate from the tower or to aid in the continuous withdrawal of such condensate. Both of the lines 91 and 87 are connected to a line 92 which may lead to suitable storage or other means of further disposition of the condensate. In some instances it may be desirable to return this condensate, which may be of the nature of a heavy gas oil, to the heating coil 1 while the oil is still warm. For this purpose a connection 93 having a valve 94 may be provided from the line 92, which in turn may be blocked off beyond this connection by means of a valve 95. The condensate may thus be conducted from the line 92 by the connection 93 and a line 37 to a pump 36 which discharges into a line 38 leading to the pump 35 which, as previously explained, serves to return the condensate from the tower 11 to the heating coil 1.

The vapors passing upwardly through the tower 77 may encounter near the top of the latter a cooling medium, preferably a light distillate or gas oil taken from a source to be later explained, which may tend to knock back such heavier components as may have become mechanically entrained with the vapors or may have higher boiling points than desired. This knock-back, together with a portion of the cooling medium, will preferably gravitate toward the bottom of the chamber 77 to commingle with the body of oil at that point.

Those constituents which remain in the vapor state passing out at the top of the dephlegmator 77 may be conducted through a vapor line 95 to a further dephlegmating chamber or fractionating tower 100, which may be arranged and operated in substantially the same way as the chamber 77, with or without the introduction of steam. Preferably the pressure conditions in the tower 100 will be about the same as the pressure conditions in the tower 77, except for a minor drop due to friction losses and, as hereinbefore mentioned, this pressure will preferably be the same as that in the flash chamber 60. If desired, on the other hand, a still lower pressure, even sub-atmospheric, may be maintained within the tower 100.

The vapors in rising through the tower 100 are subjected to rectification or fractionation, an overhead vapor fraction being taken off the top of the tower through the line 130 and a condensate collecting in the bottom of the tower where there is provided a float mechanism 105 controlling a valve 106 in a draw-off line 107 having block valves 108 and 109. The body of oil may be entirely drained from the chamber 100 by means of a manually operated valve 110 in a line 111, which, with the line 107, is connected to a line 115 leading to a storage tank or other means of further disposition.

One way to effect the cooling previously described as being furnished near the top of the tower 77 involves a suitable disposition of a part or all of this condensate. For this purpose a pipe connection 120 may be made to the line 115 in the vicinity of the tower 100. It may be controlled by a valve 121 and is connected to the suction side of a pump 122. Any suitable cooling means 116 may be provided between the line 115 and connection 120 through which the condensate may pass enroute from the tower 100 to the tower 77. By closing or partially closing a valve 125 in the line 115, opening or partially opening the valve 121, and thereupon starting the pump 122, a portion or all of the condensate which is withdrawn from the bottom of the tower 100 may be passed through a line 123 and delivered in a spray or mist through a suitable spraying device 124 situated within the tower 77 near its top. Any portion of the condensate which may be passed through the valve 125 may either be sent to storage or may be merged with the condensate from the tower 77 and returned to the heating coil 1. For this purpose a connection 126 controlled by a valve 127 is provided to enable passage of the condensate from the line 115 into the line 37. A valve 128 may serve to close off the line 115 beyond the connection 126 whenever desired. If all of the condensate is returned to the heating coil, it may be desirable to eliminate the cooler 116 or provide a by-pass around the latter.

The vapors passing upwardly through the tower 100 pass counter-current to and in direct contact with a cooling medium or reflux such as a naphtha, which here again, as in the tower 77, may tend to knock back such heavier component portions as may have become entrained with the vapors or as may have higher boiling points than desired. The thus cleansed vapors may pass out at the top of the tower 100 and through a vapor line 130, provided, if desired, with a valve 131 to a condenser 132. Such vapors passing overhead may include a majority of the condensable light distillate vapor, a certain amount of uncondensable gas and some water vapors. The main portion of these vapors passing through the condenser 132 are therein reduced to a liquid distillate and water and are delivered through a pipe 133 into water-trapping means 134 where a separation is effected between the water content and the distillate. The water may be drained off by means of a line 135 having a valve 136. The distillate and gas passing into a separator 140 may therein be separated, the gas being conducted from the separator to any suitable gas storage or other means of further disposition by the pipe 141 having a valve 142, while an ultimate distillate delivered to the bottom of the separator 140 may be withdrawn through a pipe 143 connecting with a pipe 144 having a valve 145 which may lead to a storage tank or other means of further disposition.

The pipe 143 may also be connected to a pipe 146, having a valve 147, which leads to a connection on the suction side of a pump 149. By this means the distillate from the separator 140 may be diverted through the suction of pump 149 by closing or partially closing the valve 145 and opening or partially opening the valve 147. When the pump 149 is then set in motion, it may deliver such portion of the distillate as is desirable through a line 150 into suitable spraying means 151 situated within the chamber 100 near its top thereby furnishing the cooling medium or reflux, the purpose of which has been hereinbefore set forth.

The condensate evolved in the chamber 100, which may be of the nature of a comparatively light gas oil, may provide an excellent charging stock for a vapor phase cracking operation. While its value as a liquid phase cracking stock may not be so great, it is quite satisfactory when blended with the other gas oils developed in the towers 11 and 77. In case it cannot be at once charged to a vapor phase process, it may be preferable to commingle it with the heavier condensates from the chambers 11 and 77 and return it to the heating coil 1, as has been explained. If this mode of operation is adopted, it may be found desirable to bypass the tower 100 by means of a connection from the vapor line 95 delivering the vapor from chamber 77 directly to the condenser coil 132, while a reflux or cooling medium may be returned from the separator 140 to the top of the chamber 77. Thus, only a single gas oil fraction would be developed in the tar stripper portion of the system.

It is advantageous to carry on the fractionation of the vapors evolved in the tar stripping operation in a plurality of towers with removal of the several reflux condensates collected in the towers because in such a method of operation the cooling necessary to obtain the final gasoline or naphtha or other light distillate desired may be apportioned between the towers and the amount of reflux that ultimately reaches the bottom of the first tower, that is tower 77, is less than if only one tower were used. Thus in case only one tower is employed it is ordinarily necessary to introduce steam into the bottom of the tower in order to insure that the gas oil cut shall be free from gasoline or naphtha constituents, the best method of operating being to introduce the vapors from the flash chamber 60 into a fractionating tower at a mid-point therein and introduce saturated steam into the bottom of the tower. But in case two towers, as shown in Figure 1, are employed it is ordinarily unnecessary to introduce steam into the first tower, that is tower 77, since it is not usually required to pump back all of the reflux condensate obtained from the bottom of tower 100 (the excess being removed from the fractionating zone and being either pumped back to the heating coil 1 or conducted to another cracking system or otherwise disposed of) and, due to the reduced quantity of reflux conducted to the tower 77 the temperature therein is sufficient to insure that the reflux condensate drawn off the bottom will be substantially free of gasoline or naphtha constituents. The reflux condensate collecting in the tower 100, however, may contain gasoline or naphtha constituents unless steam be introduced to the tower and consequently steam may be introduced into the bottom of the tower to thereby lower the partial pressure and effect the removal of the gasoline or naphtha constituents from the reflux condensate. The steam need not be superheated and it is quite satisfactory to use steam the temperature of which is below that of the fluids in the bottom of the tower. The amount of steam thus introduced may be relatively small, satisfactory results having been obtained by the use of an amount of steam approximating one per cent by weight of the reflux condensate withdrawn from the bottom of the tower. As a rule it is not necessary to employ more than five or ten per cent of steam.

Although the surge drum operation herein set forth is most useful in cases where the removal of pressure tar from the cracking stills is carried on intermittently by taking periodic shots or drags from the stills it may also be employed to advantage in cases where the withdrawal of residue is continuous.

When it is desired to employ a sub-atmospheric pressure in stripping the tar or residue a vacuum pump may be provided to take suction on the gas line 141 and pumps may also be provided to take suction on the lines 67, 92, 111 and 145 to facilitate the withdrawal of residue from the flash chamber 60, the withdrawal of condensates from the towers 77 and 100 and the removal of distillate from the receiver 140, respectively.

The description of the various features of the invention and their relation to each other have been set forth in such detail that no summary of operation will be required for a full understanding. While certain specific forms of apparatus and definite operating conditions have been mentioned in the foregoing sections, it will be understood that many variations or modifications may be made without departing from the spirit of the invention. It is not desired to be limited in the interpretation of its scope other than by reference to the appended claims.

What we claim is:

1. In the conversion of higher boiling hydrocarbons into lower boiling ones, the process that comprises heating said oil in a stream of restricted cross section to a cracking temperature under superatmospheric pressure, separating the heated oil into vapors and residual liquid, passing said vapors to a fractionating zone, withdrawing condensed portions of the vapors from the fractionating zone and returning same to an intermediate point in said stream, expanding said residual liquid into a flash chamber maintained at a pressure lower than that of the cracking operation to subject said residual liquid to distillation, subjecting evolved vapors to fractionation in a primary fractionating zone to form a heavy condensate and a vapor fraction, subjecting said vapor fraction to further fractionation in a secondary fractionating zone to form an intermediate condensate and a light vapor fraction, condensing said light vapor fraction to form a final light distillate, introducing steam into said intermediate condensate to strip light components therefrom, conducting the stripped intermediate condensate to the primary fractionating zone to serve as a reflux therefor, and returning the heavy condensate to the intermediate point in said stream.

2. In the conversion of higher boiling hydrocarbons into lower boiling ones. the

process that comprises heating said oil in a stream of restricted cross section to a cracking temperature under superatmospheric pressure, separating the heated oil into vapors and residual liquid, passing said vapors to a fractionating zone, withdrawing condensed portions of the vapors from the fractionating zone and returning same to an intermediate point in said stream, expanding said residual liquid into a flash chamber maintained at a pressure lower than that of the cracking operation to subject said residual liquid to distillation, subjecting evolved vapors to fractionation in a primary fractionating zone to form a heavy condensate and a vapor fraction, introducing steam into said heavy condensate to strip lighter components therefrom, subjecting said vapor fraction to further fractionation in a secondary fractionating zone to form an intermediate condensate and a light vapor fraction, condensing said light vapor fraction to form a final light distillate, introducing steam into said intermediate condensate to strip light components therefrom, conducting the stripped intermediate condensate to the primary fractionating zone to serve as a reflux therefor, and returning the stripped heavy condensate to the intermediate point in said stream.

In witness whereof I have hereunto set my hand this 11th day of January, 1929.

CLAUDE W. WATSON.

In witness whereof I have hereunto set my hand this 14th day of January, 1929.

JAMES H. GRAHAME.