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DISTILLATION OF CRUDE PETROLEUM

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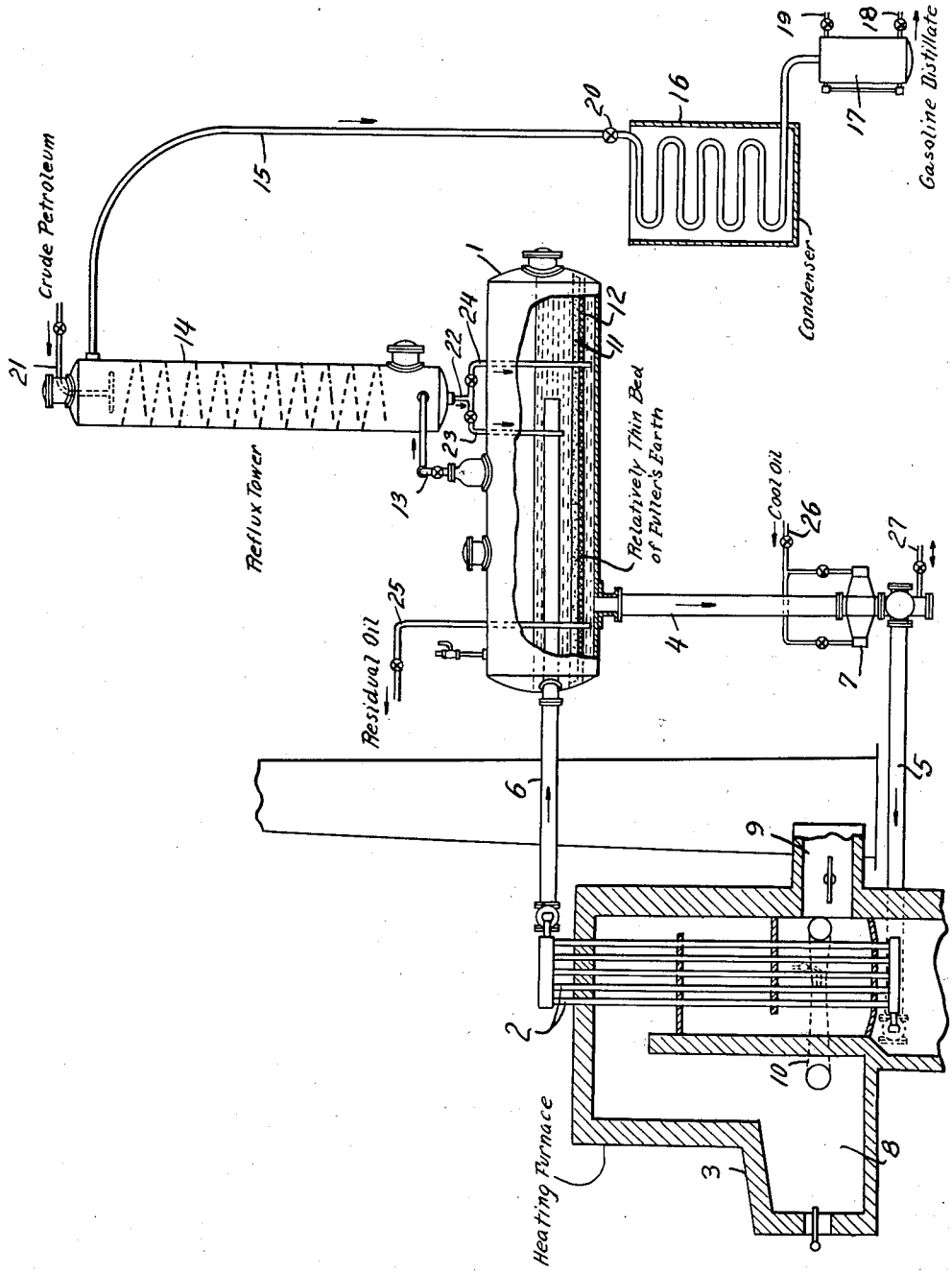

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DISTILLATION OF CRUDE PETROLEUM.

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This invention relates to improvements in the production of gasoline from crude petroleum. The invention provides an improved method of distilling crude petroleum whereby, in a single operation, its natural gasoline content is recovered together with an additional amount of gasoline produced by mild cracking.

In carrying out the present invention, crude petroleum including its natural gasoline content is subjected to distillation under relatively low super-atmospheric pressures and at relatively mild cracking temperatures. The natural gasoline content of the crude petroleum is thus stripped or topped from the oil while at the same time an additional amount of gasoline formed by the mild cracking conditions to which the oil is subjected is recovered together with the natural gasoline content. To provide for uniform heating and to avoid local overheating, the oil is heated by repeated circulation at relatively high velocity through heating tubes from and to a large body maintained in a vaporizing zone from which the gasoline vapors are taken off. A bed of finely divided absorbent or filtering material is maintained within the body of oil in the vaporizing zone and extending entirely across it in the path of the oil circulating and recirculating through the heating tubes so that the circulating oil is repeatedly passed through this bed of finely divided material as it is repeatedly passed through the heating tubes. To reduce any interference with free circulation of the heavy oil circulating in the still to a minimum, this bed of finely divided absorbent or filtering material is made relatively thin. Crude petroleum is supplied to the circulating body of oil and the heavy oil remaining after separation of gasoline, including the natural gasoline content and that formed by cracking, is discharged continuously during the operation. The stripped or topped oil discharged from the still is withdrawn from beneath the bed of finely divided filtering or absorbent material, that is from the oil circulating to the heating tubes before it enters the heating tubes and after passage through the bed of finely divided material.

The vapors including the gasoline vapors separated in the vaporizing zone may be subjected to a refluxing operation for separation and return to the circulating body of oil in the still of heavier components. In one particularly advantageous method of operation, the vapors taken off from the vaporizing zone are subjected to a refluxing operation into which the crude petroleum is direcly introduced. In this method of operation, the crude petroleum is employed to cool and reflux the vapors and at the same time is preheated thereby. The lighter components of the crude petroleum including its natural gasoline content may thus be largely vaporized in the refluxing operation to escape therefrom with the gasoline vapors entering the refluxing operation from the still. To the extent that the natural gasoline content of the crude petroleum is thus separated in the refluxing operation, the heat supplied to the circulating body of oil in the still is more effectively used for cracking and likewise any possible tendency to overcracking of the natural gasoline content of the crude petroleum is eliminated. In this same respect, it is also advantageous to return reflux condensate from the refluxing operation to the body of oil in the vaporizing zone above the bed of finely divided filtering or absorbent material to promote complete separation of light components from the reflux condensate and from any admixed unvaporized crude oil. By operating in this manner, circulation of such separated light components through the heating tubes is avoided, eliminating any tendency to overcracking of such components and also providing for more effective use in the cracking of the heat supplied to the heating tubes. The reflux condensate, and any admixed crude oil, or part of the reflux condensate or of such mixture, may however be returned to the circulating body of oil beneath the bed of finely divided material, particularly if there is any tendency to sluggishness in circulation.

The invention will be further described in connection with the accompanying drawings which illustrate, in a diagrammatic and conventional manner, in elevation and partly

in section and with parts broken away, one form of apparatus adapted for the practice of the invention.

Referring to the drawings, the still illustrated comprises a bulk supply drum 1, a battery of heating tubes 2 arranged in the heating flue of a heating furnace 3, circulating connections 4, 5 and 6 including a circulating pump 7 for circulating oil from the bulk supply drum upwardly through the heating tubes and back to the bulk supply drum. The heating furnace includes the heating flue in which the heating tubes 2 are arranged, a firebox 8 connected to one end of this heating flue and a stack flue 9 connected to the other end. Part of the escaping waste heating gases may be returned and recirculated through the heating flue in admixture with fresh hot products of combustion from the firebox by means of return flue 10 which is provided with suitable forcing means. Arranged in the bulk supply drum, below the normal liquid level therein, and between the outlet to the circulating connections 4 and the inlet from the circulating connections 6, is a bed 11 of finely divided material extending entirely across the bulk supply drum. This bed is carried by suitable supporting means adapted to retain the finely divided absorbent or filtering material and to permit free passage of oil. It may be made up, for example, of one or more screens of graduated fineness arranged between perforated plates or gratings. Vapors from the bulk supply drum 1 escape through connection 13 to the lower end of the reflux tower 14, pass upwardly therethrough, and vapors remaining uncondensed escape therefrom through connection 15 to condenser 16 arranged to discharge into receiver 17. The receiver 17 is provided with an outlet 18 for the distillate product and an outlet 19 for uncondensed vapors and gases. Pressure in the system may be maintained by means of valve 20, or by suitable valves arranged beyond the condenser or receiver. Connection 21 is provided for the supply of crude petroleum to the upper end of the reflux tower 14. Reflux condensate and any admixed unvaporized crude oil flow from the lower end of the reflux tower through connection 22, either to the body of oil in the bulk supply drum above the bed 11 through connection 23 or to the body of oil in the bulk supply drum beneath the bed 11 through connection 24. Connections 23 and 24 are provided with suitable regulating valves, as illustrated, to permit direction and distribution of the oil flowing from the lower end of the reflux tower through connection 22 as desired. Connection 25 is provided for the discharge of residual oil from the still during operation; it will be noted that this connection opens into the body of oil in the bulk supply drum beneath the bed 11. Cool oil, for example part of the crude oil subjected to distillation, is supplied through connection 26 for cooling and lubricating the bearings of the circulating pump 7. An amount of crude oil in excess of that required for cooling and lubricating the pump bearings may also be introduced through this connection; for example where the amount of oil supplied to the operation exceeds that necessary to effect the desired refluxing in the tower 14. Connection 27 is provided for pumping out the still at the end of a run and for initially charging it at the beginning of a run.

In carrying out the invention in the apparatus illustrated, a bed of finely divided absorbent or filtering material, such as fuller's earth, or similar absorbent earths or clays, pulverized coke or calcined bauxite, is arranged on the support means 12 in the bulk supply drum 1. Fuller's earth is a particularly advantageous material for this purpose. This bed of finely divided material may consist, for example, of 15–30 mesh fuller's earth and may be about 4 to 6 inches in depth. The still is then charged with oil and brought to operating conditions of temperature and pressure. This initial charge may be of the crude oil to be subjected to distillation, or, particularly if the period required to bring the still to operating conditions of temperature and pressure is somewhat prolonged, it may be of gas oil character stock. The still is advantageously operated under pressures in the neighborhood of 50 to 60 pounds per square inch and the circulating body of oil maintained at a corresponding temperature; this temperature will vary with different crude petroleums, but for the purpose of illustration it may run in the neighborhood of 650° to 725° F. After the still is brought to operating conditions of temperature and pressure, the introduction of crude petroleum through connection 21 is begun, and the supply of crude petroleum through this connection is regulated to condense and reflux in the tower those components of the vapors entering the tower heavier than desirable as components of the distillate product. At the same time, the discharge of residual oil through connection 25 is begun. Any additional crude oil required to maintain the still charge is supplied through connection 26. The reflux condensate and admixed unvaporized crude oil from the lower part of the reflux tower 14 is returned through connection 23 to the body of oil in the bulk supply drum above the bed of finely divided filtering or absorbent material. If any tendency toward sluggish circulation through the heating tubes is noted in operation, more or less of this oil mixture may be supplied through connection 24 to the body of oil in the bulk supply drum beneath the bed of filtering or

absorbent material. The distillate product, including the natural gasoline content of the crude petroleum and that produced by the mild cracking conditions prevailing in the still, is discharged through connection 18.

The present invention makes it possible to separate the natural gasoline content from crude petroleum together with an additional amount of gasoline produced by cracking and at the same time to obtain a residual topped or stripped crude oil which is readily susceptible to further treatment in the usual way, that is the way in which topped or stripped crude oils are usually treated. No serious difficulties are encountered in such further treatment, and particularly difficulties due to any suspended solid material formed in the combined cracking and topping operation are avoided.

We claim:

1. An improved method of producing gasoline from crude petroleum, which comprises maintaining a body of oil in a vaporizing zone and maintaining a bed of finely divided absorbent or filtering material within said body and extending entirely across it, circulating oil from said body from beneath said bed of finely divided material through heating tubes and back to the body of oil above said bed of finely divided material and heating it to a mild cracking temperature therein, supplying crude petroleum to the circulating body of oil, taking off vapors including vapors of the gasoline product from said vaporizing zone, and taking off residual oil from the body of oil from beneath said bed of finely divided material.

2. An improved method of producing gasoline from crude petroleum, which comprises maintaining a body of oil in a vaporizing zone and maintaining a bed of finely divided absorbent or filtering material within said body and extending entirely across it, circulating oil from said body from beneath said bed of finely divided material through heating tubes and back to the body of oil above said bed of finely divided material and heating it to a mild cracking temperature therein, passing vapors from said vaporizing zone through a refluxing operation and taking off vapors including vapors of the gasoline product from said refluxing operation, introducing crude petroleum into the vapors in said refluxing operation, returning reflux condensate from said refluxing operation to the circulating body of oil together with admixed unvaporized portions of the crude petroleum supplied to the refluxing operation, and taking off residual oil from the body of oil from beneath said bed of finely divided material.

3. An improved method of producing gasoline from crude petroleum, which comprises maintaining a body of oil in a vaporizing zone and maintaining a bed of finely divided absorbent or filtering material within said body and extending entirely across it, circulating oil from said body from beneath said bed of finely divided material through heating tubes and back to the body of oil above said bed of finely divided material and heating it to a mild cracking temperature therein, supplying crude petroleum to the circulating body of oil, passing vapors from said vaporizing zone through a refluxing operation and taking off vapors including vapors of the gasoline product from said refluxing operation, returning reflux condensate from said refluxing operation to the body of oil above said bed of finely divided material, and taking off residual oil from the body of oil from beneath said bed of finely divided material.

In testimony whereof we affix our signatures.

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