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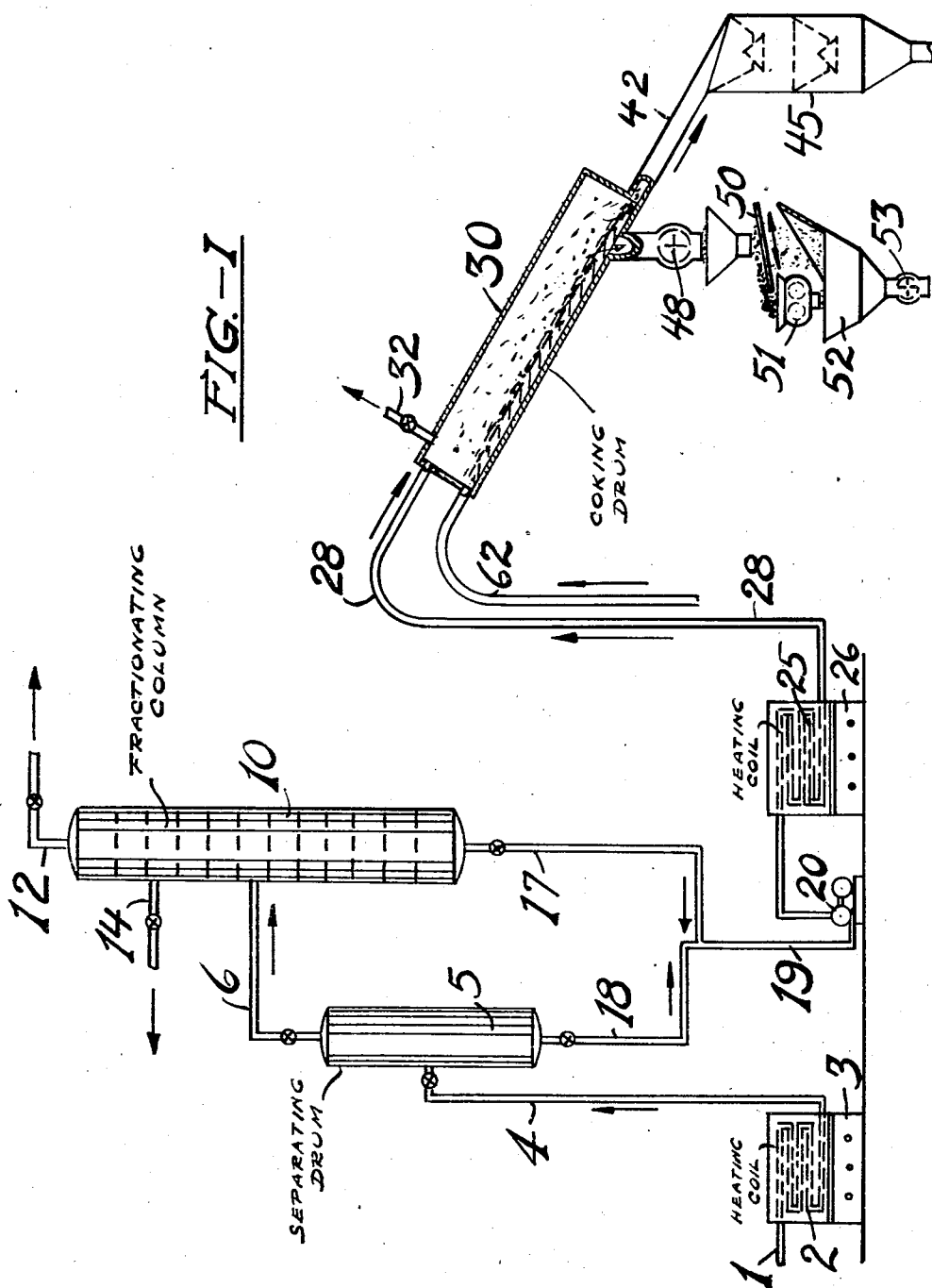
W. F. ROLLMAN

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METHOD OF COKING

Filed Oct. 1, 1940

2 Sheets-Sheet 1



Walter F. Rollman Inventor  
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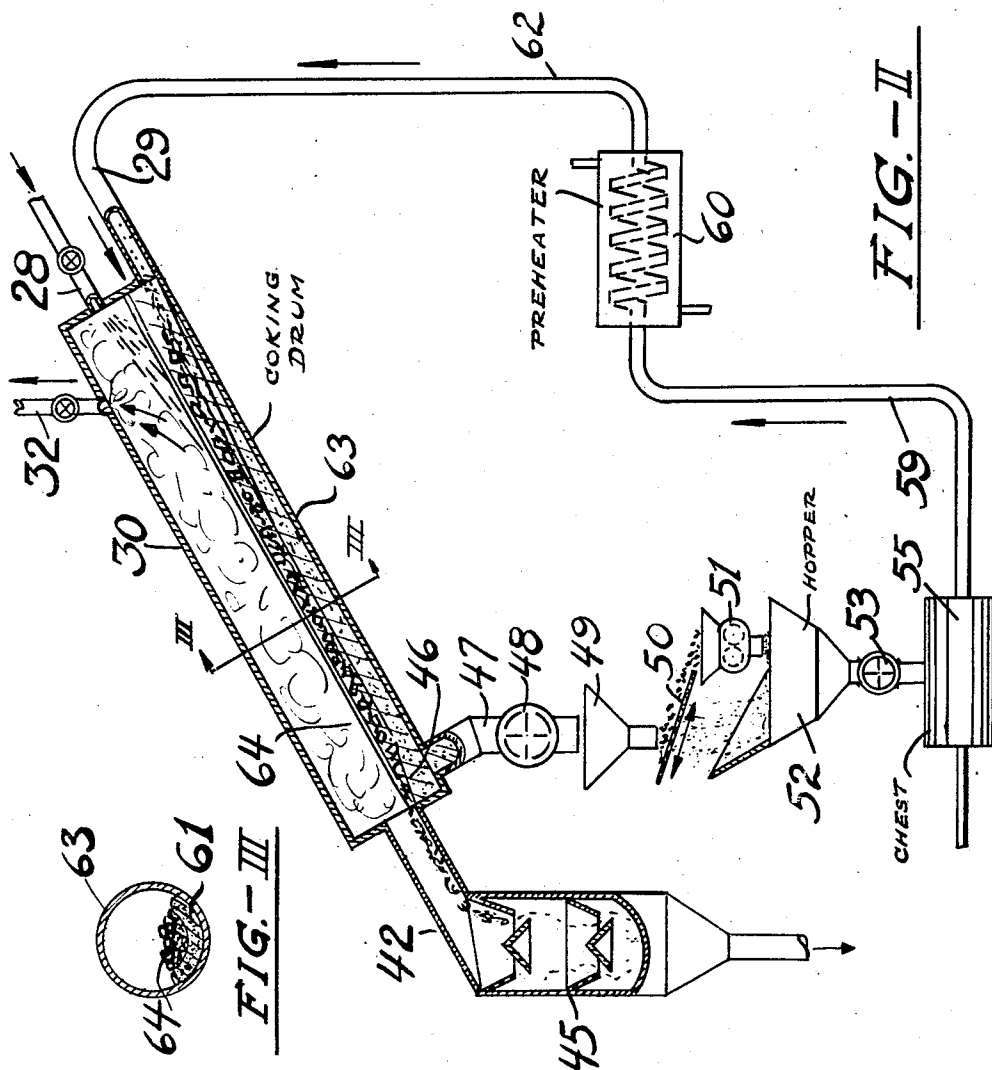
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## METHOD OF COKING

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## UNITED STATES PATENT OFFICE

2,336,639

## METHOD OF COKING

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Standard Oil Development Company, a corporation of Delaware

Application October 1, 1940, Serial No. 359,191

5 Claims. (Cl. 196—69)

The present invention relates to improvements in the art of refining petroleum oil. More particularly, it appertains to improvements in the so-called "coking" of heavy petroleum oil residuum or crude petroleum oil, from which the lower boiling constituents, say those boiling up to 900° to 950° F. have been removed by distillation, wherein the residual oil is converted to solid coke and hydrocarbons of lower boiling range than the original residual oil. As is known to those familiar with the art of refining petroleum oil, ordinarily the first step in the treatment of crude oil is to subject it to heat to distill the more volatile fractions, that is to say, the constituents boiling up to 950° F. or thereabouts. The material which remains in the crude still is called "reduced crude." This material cannot be vaporized at any reasonable temperature. Therefore, it is common practice in the oil industry to subject such a reduced crude to a thermal treatment which will convert a major portion of the reduced crude to lower boiling fractions, including gas oil, which fractions may be readily vaporized. One method of thus treating the reduced crude to prepare it for further treatment is to subject it to a viscosity reducing operation where the products formed are gasoline, naphtha, normally gaseous hydrocarbons, gas oil, and a heavy tarry material. Another method of treating the reduced crude for the purpose stated, is to subject it to the above-mentioned coking operation, usually conducted at temperatures in the range of 850° F. to perhaps 1100° F., and under superatmospheric pressure, that is to say, a gauge pressure of 2 to 3 atmospheres or more is maintained within the coking zone. In this process, together with the naphthas, gasoline, normally gaseous hydrocarbons and gas oil produced, a solid coke is also formed.

My invention pertains to the problem of coking a heavy residual petroleum oil, and I provide means wherein the coke may be intermittently or continuously removed from the coking zone.

One object of my invention is to convert continuously heavy residual petroleum oils into fractions having a relatively lower boiling range than the original material and, at the same time, to produce a hard coke of which a major portion is in the form of relatively large lumps.

A further object of my invention is to treat heavy residual petroleum oils in a drum which is preferably horizontally or obliquely disposed under conditions such that the oil is converted to fractions boiling within the gasoline, naphtha and gas oil ranges and solid coke, while causing

a moving or stationary layer of ground solid material to contact the inner surface of the drum thus providing a shield against the deposition of coke formed in the process on the said inner surface of the coking drum.

Another object of my invention is to coke a residual heavy petroleum oil intermittently in a drum lined with coke, the operation being periodically discontinued to remove formed coke.

Other and further objects of my invention will appear presently from the following detailed description.

To the accomplishment of the foregoing and related ends, I provide in a preferred modification a process and a suitable apparatus therefor, in which heavy residual hydrocarbon oils heated to coking temperatures are discharged into a drum disposed at an angle with respect to the horizontal in which a moving stream of hot ground coke is present on the inner lower surface of the drum, which layer of ground coke prevents the oil from contacting the inner surface of the drum and depositing coke formed in the process on the said inner surface, but rather forms on the surface of the ground added coke and is caused to flow toward the discharge end of the drum from which it is eventually withdrawn.

My invention will be best understood by reference to the accompanying drawings in which,

Fig. I is a diagrammatic layout depicting suitable apparatus in which my invention may be carried into effect;

Fig. II is a partial vertical sectional view showing in detail, the form and arrangement of the coking drum and its immediate accessory apparatus;

Fig. III is a section taken through the line III—III of Fig. II.

Throughout the several views, similar reference characters refer to similar parts.

In carrying out my process, a reduced crude petroleum oil is introduced into the system shown in Fig. I through line 1 and then discharged into a coil 2 disposed in a furnace setting 3 where it is heated to a temperature sufficient to volatilize the lower molecular weight compounds such as the hydrocarbons boiling below about 800° F., whereupon it is discharged into line 4, thence discharged into a drum 5 from which the vapors are taken off overhead through transfer line 6 and discharged into a fractionating column 10. The hydrocarbons boiling in the gasoline range and below that, are withdrawn through the fractionating column 10 through line 12, and these hydrocarbons may be fractionated to give desired

products, in equipment not shown. A light gas oil fraction which may be further treated, such as by catalytic cracking to form gasoline or which may be refined for use as a domestic heating oil is withdrawn through line 14. The higher boiling fractions including heavy gas oil are withdrawn from the fractionating tower through line 17 and a confluence of the latter fraction is caused in line 19 with high boiling oil withdrawn through the bottom of drum 5 through line 18. The oil in line 19 is discharged into a pump 20, thereafter discharged into a second coil 25 disposed in a furnace setting 26 where the oil is heated to a temperature in the range of from 850° F. to 1100° F. and sufficient pressure is developed by means of pump 20 so that when the heated oil withdrawn from the coil 25 is discharged through line 28 into coking drum 30, it will be under superatmospheric pressure, such as a pressure of from 2 to 3 atmospheres gauge pressure. Under the conditions of temperature and pressure stated, a portion of the liquid oil discharged into the drum 30 is vaporized and the vapors are withdrawn through line 32. A solid coke is also formed. The vapor fractions in line 32 contain hydrocarbons boiling in the gasoline, naphtha and gas oil ranges, together with normally gaseous hydrocarbons, and these fractions may be conducted to suitable fractionating equipment to recover desired products which may then be suitably treated to produce stabilized gasoline or other desired products.

Referring now to the coking drum, and its accessory apparatus shown in detail in Figure II, it will be observed that the coking drum as shown is inclined downwardly from right to left, so that the coke formed may flow by gravity along the lower inner surface of the drum. In order to prevent the coke formed in the process from clinging or adhering to the surface of the drum, a ground coke, which is preheated to a temperature of from 850° F. to 1100° F., is continuously discharged through the conduit 62 into the drum 30 in a manner hereinafter more fully explained. This coke settles at the underside of the inclined drum and flows concurrently with the liquid oil fed to the drum through line 28. The presence of the hot added coke prevents oil or droplets of oil from filtering through to the inner wall of the drum because of the rapid vaporization and coking of the oil under the conditions employed, and the coke formed in the process flows with the added coke toward the lower discharge end of the drum. The coke formed in the process is deposited upon the ground coke added to the process, and the made coke will normally consist of large lumps of hard coke. This coke passes downwardly and is eventually discharged into the outlet 42 and thence into a receiver 45. The ground added coke, on the other hand, passes through an opening 46 in the lowermost end of the drum 30, thence into a conduit 47, thence through a star feeder 48, thence through a funnel shaped conduit 49 onto a reciprocating screen 50 where the coke fines are separated from the remainder of the material and withdrawn through the bottom of the screen into hopper 52. The coarse material is fed from the top of screen 50 into grinder 51, and then passes in ground condition into hopper 52. From hopper 52 the coke is fed through star feeder 53 into dispersion chest 55, to which chest is also fed a gasiform substance such as steam, methane, ethane, propane, vaporized light naphthas, or some other gas, whereupon a dispersion of coke in the gas-

eous medium is formed. The dispersion or suspension of coke in the gaseous medium is withdrawn through line 59, forced through preheater 60 where it is heated to about the same temperature as the oil fed to the drum 30, and then is conducted through transfer pipe 62 into an extension 29 of drum 30 and thereafter the dispersion is discharged into drum 30 where the coke settles out along the lower side of the drum 30 to form a layer 61. (See Figure III.)

Referring to Figure III, the reference character 63 represents the wall of the drum, 61 represents the layer of ground coke which extends along the underside of the drum, which layer may be several inches thick at its deepest point, while reference character 64 refers to the mass of coke which is formed in the coking operation and which is eventually recovered in relatively large aggregates or lumps of hard coke.

It is pointed out that my process may be operated intermittently, that is to say, I may use a horizontal drum which I may line with a paste made from powdered coke and a small quantity of pitch or other binder of such consistency that when baked the coke will remain in position on the walls in the form of an easily crushable solid. Coke formed from the coking operation in the drum may be removed in one piece by removing the end plate or plates which act as closure members for the drum, and causing the formed coke to be removed from the drum by a hydraulic ram or the like. It is obvious that this process is intermittent and that the coking operation would necessarily have to be discontinued during the process of removing the coke.

To recapitulate, my present invention relates to an intermittent or continuous method of coking heavy residual petroleum oils in a process wherein the coking is performed in a drum, the inner walls of which are protected by a layer of powdered coke during the coking operation, thus preventing coke formed in the process from adhering to the walls of the coking vessel or drum. I have observed that heavy oil or pitch does not readily penetrate a layer of inert or powdered material and that only a short time is required for the conversion to coke of an oil heated to coking temperatures.

I further wish to point out that instead of using coke, I may use other material, such as clay, bauxite, sawdust, and the like, as the added ground material 61.

Many modifications of my invention will occur to those who are skilled in this particular art.

What I claim is:

1. The method of converting a reduced petroleum crude oil into hydrocarbon fractions boiling below about 800° F., which comprises heating the said petroleum oil, removing vapors from the heated oil, recovering a liquid portion, further heating the liquid portion to a coking temperature, discharging the liquid portion into an unheated inclined drum containing in the lowermost portion thereof a continuous moving but undisturbed layer of ground adsorbent material, and recovering a solid coke formed from the oil discharged in the drum together with vaporized hydrocarbon fractions.

2. The method set forth in claim 1, in which the adsorbent material is ground coke.

3. The method set forth in claim 1, in which the adsorbent material is ground coke and the oil in the coking drum is maintained at a temperature within the range of from 850° F. to 1150°

F., and under a pressure of from 1 to 3 atmospheres.

4. The process set forth in claim 1, in which the process is continuous and in which the ground material is heated to a temperature of from 950° 5 F. to 1100° F.

5. The method of treating a reduced petroleum crude oil to form predominantly gas oil and solid coke continuously, which comprises heating the reduced crude oil to a temperature from about 750° F. to 825° F., conducting the heated oil to a separation zone to separate a vapor from a liquid fraction, heating said liquid fraction to a tem-

perature of within the range of about 950° F. to 1100° F., discharging the heated oil to an unheated inclined coking drum having a substantially cylindrical form, feeding a continuous undisturbed stream of moving highly heated ground coke along the lowermost portion of the coking drum upon which the oil fed to the drum is deposited and converted into vapors and solid coke, the latter depositing upon the said moving stream of ground solid material contained within the drum.

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