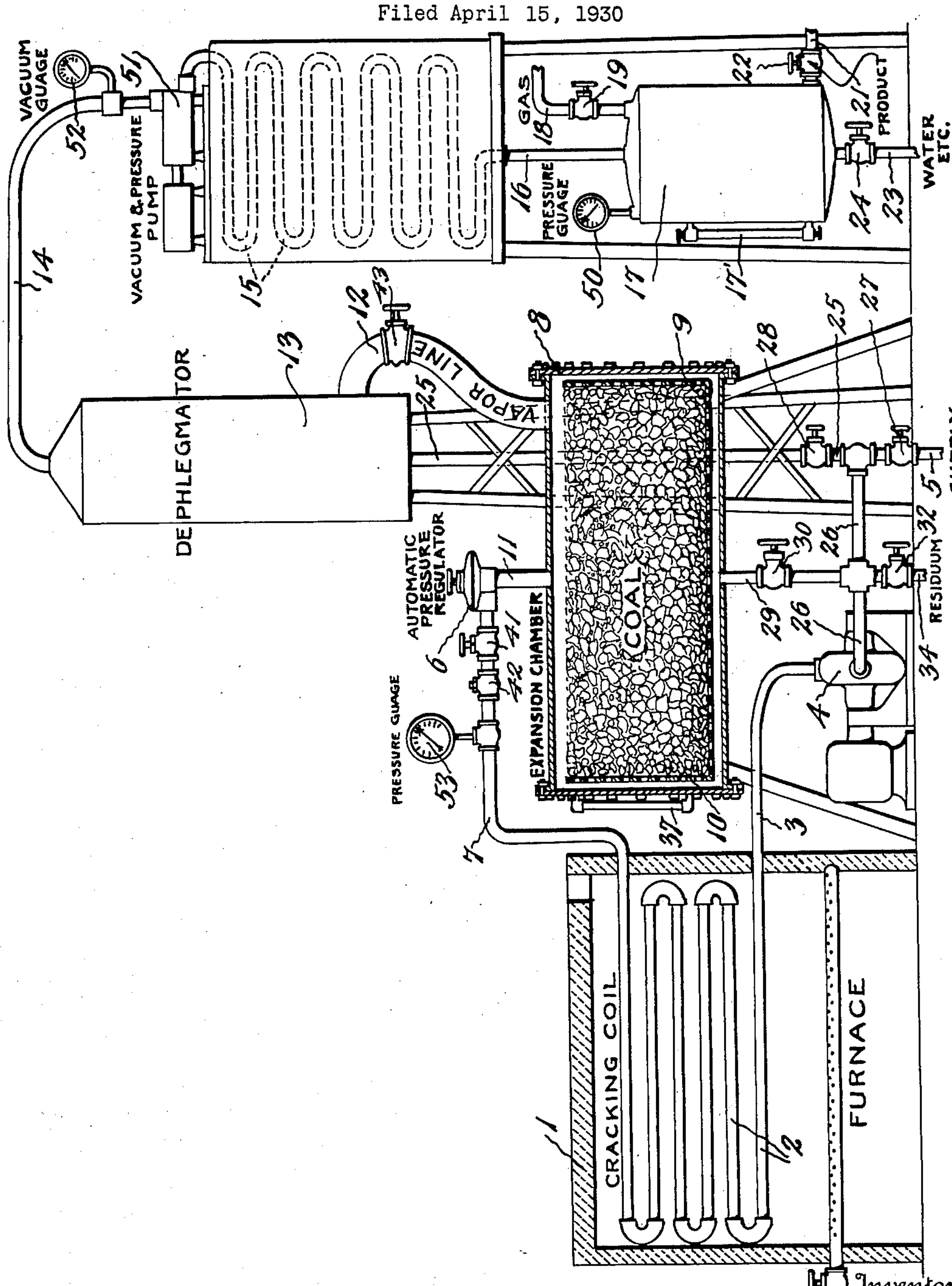
Oct. 30, 1934. R. CARTER 1,978,984

ART OF RECOVERING BLENDED FUELS

Filed April 15, 1930



Inventor

Russell Carter

By Edgar M Kitchin,

his Attorney

Patented Oct. 30, 1934

1,978,984

UNITED STATES PATENT OFFICE

1,978,984

ART OF RECOVERING BLENDED FUELS

Russell Carter, Washington, D. C.

Application April 15, 1930, Serial No. 444,480

1 Claim. (Cl. 196—56)

This invention relates to improvements in the art of recovery of hydrocarbon fuels from hydrocarbon sources, and has as its initial object improvement of the art or method as set forth in my co-pending application Serial No. 88,100, filed February 13, 1926.

Other detailed objects will in part hereinafter become apparent and in part be stated.

In the accompanying drawing, the figure is a diagrammatic showing, partly in section, of a plant well adapted for carrying out the improved art and comprehending an embodiment of the structural features of the present invention.

Referring to the drawing by numerals, 1 indicates a furnace of any approved type in which is arranged any appropriate cracking coil 2. Naturally, the coil 2 may be of any appropriate specific character according to the furnace 1. A pipe line 3 supplies fluid hydrocarbon fuel to the coil 2, and said fluid is delivered to the pipe 3 by an appropriate pump 4 taking its supply from a pipe line 5 communicating with an appropriate source of supply, not illustrated. A pipe 7 leads from the discharge end of coil 2 and discharges into the upper end of a cracking or percolating chamber 8. Arranged within the chamber 8 and spaced from the surrounding walls thereof is a support or container 9 for solid fuel indicated at 10. Fuel 10 is of the initially, that is originally, solid variety, such as coal, peat, lignite, shale, and the like. The container 9 is foraminous and may be simply an open framework, its chief function being to maintain the fuel 10 in place in substantially the form of a column within the chamber 8. A discharge nozzle 11 delivers the supply from pipe 7 to a point above the column of fuel 10, so that the hot oil is discharged down upon said column during operation. A pressure regulator valve of the automatic type, indicated at 6, is preferably interposed in the line 7 near its discharge portion 11 to insure maintenance of the requisite pressure in coil 2 notwithstanding a rarefied or vacuum condition in expansion chamber 8. A vapor line 12 leads from an upper point of chamber 8 to a cooling and settling tank 13 commonly in the art designated a dephlegmator. Leading from the upper end of the dephlegmator 13 is a vapor discharge pipe 14 which extends to a condenser 15, and the latter communicates by a pipe 16 with a receiving reservoir 17. A discharge 18 communicates with the upper portion of reservoir 17 for leading off the incondensable gases, which may be utilized as the fuel for the furnace 1, or otherwise disposed of as desired. A valve 19 controls the discharge through pipe 18. A pressure gauge 50 preferably communicates with the upper portion of reservoir 17 for indicating to the operator the need of adjustment of the valve 19. At a lower part of the reservoir 17 a discharge pipe 21 communicates therewith for the delivery of the distillate, which, when hydrocarbon fuels are being treated, is a benzol gasoline blend of distinct anti-knock properties. A valve 22 controls the discharge through pipe 21. A residuum drain-off pipe 23 communicates with the bottom of reservoir 17 and is controlled by a valve 24. An appropriate liquid gauge 17′ communicates with the receiver tank 17 to indicate the liquid level thereof. The condenser coil 15 may be any well known and commercially acceptable condenser and communicates with the discharge pipe 14 of dephlegmator 13 through a combined vacuum and pressure pump 51, which pump functions to maintain the dephlegmator, vapor line, and expansion chamber at that unbalanced pressure commonly referred to as a vacuum by which, in this instance, is meant a pressure less than atmospheric and preferably as near an actual vacuum as is practicable to be maintained in an apparatus of this kind. The line 14 preferably immediately above the pump 51 is provided with a vacuum gauge 52, while the line 7 is provided with a pressure gauge 53, the gauges 50, 52, and 53 enabling the operator to maintain all that part of the plant from the pressure regulator valve 6 to the pump 51 in a state of vacuum while the balance of the plant is maintained under pressure.

The heavier substances which fall to the bottom of the dephlegmator 13 are drained therefrom through a reflux leg 25 communicating with a pipe line 26, which in turn communicates through pump 4 with the pipe line 3. The pipe line 5 which leads from any appropriate source, such as a supply tank for petroleum or the like, is controlled by a valve 27, and communicates with the pipe 26 with which the reflux leg 25 communicates. A valve 28 is preferably interposed in the leg 25 to control discharge therefrom into pipe 26. A pipe 29 communicates with the bottom of expansion chamber 8 and with the pipe 26 to enable the pump 4 to drain chamber 8 and thus aid in maintaining vacuum therein. A valve 30 is preferably interposed in the length of pipe 29 to control communication therethrough, and a discharge pipe 31 communicates with pipe 29 and is valved at 32 for enabling discharge of residuum elsewhere than through the pump 4 when desired.

The expansion or cracking chamber 8, which may also be called the percolating chamber, because of the percolating action of the hot oil through the coal is preferably provided with a liquid gauge 37, and has at least one of its ends or heads detachably mounted to facilitate introduction and removal of the cage or reticulated basket 9 for the coal 10. The said basket is mounted to slide on appropriate tracks or otherwise into and out of the chamber 8, and the removable head is detached for withdrawal and replacing of the basket or container 9. As illustrated, both of the heads of the chamber 8 are shown bolted in place, and, therefore, detachably mounted.

In carrying out the art or method, according to the present invention, a supply of liquid hydrocarbon, such, for example, as petroleum, and preferably gas oil, is picked up by the pump 4, through supply pipe 5, and pipe 26, and charged through the coil 2 to the automatic pressure regulator valve 6, and the coil 2 is heated to cracking temperature. When the pressure in the coil reaches the requisite degree, as will be indicated by gauge 53, the valve 6 will automatically open and allow the oil at cracking temperature to discharge into and expand within chamber 8. Of course, a continuous supply is maintained in coil 2 by pump 4, and should there be a drop in pressure, the valve 6 will close automatically until the predetermined pressure has again been reached. The temperature of the oil within coil 2 will be maintained between 750° and 850° F., or at cracking temperature, according to the character of the oil. It should be understood, of course, that the pump 57 will have previously created a condition of vacuum in the dephlegmator, vapor line, and chamber 8, and the pump 4 will assist in maintaining the vacuum condition by drawing all liquid from chamber 8 as rapidly as it accumulates in the lower part of the chamber. The reticulated container 9 is preferably slightly less in dimensions than the container 8, to leave spaces all about the receptacle 9 to aid in preventing pocketing of released vapors and to facilitate forcible removal of coke at the completion of a batch operation. The original charging stock is heated in coil 2 preferably initially to slightly less than final working temperature, say 650°, or slightly less than cracking temperature of the particular oil being treated, and the pressure is raised by the pump 4 to the degree requisite for passing valve 6, so that the hot oil is flooded down on top of the coal or other fuel 10 and percolates through the same to the bottom of chamber 9 where it collects and is drawn off through pipe 29 and pipe 26 by pump 4, and is recycled through the coil 2 and back to the chamber 9. This recycling is continued until the coal 10 is raised to substantially the temperature of the stream of oil and then the temperature of the furnace 1 is raised to cracking temperature of the particular oil of the charging stock, say 750° to 850° or higher as may be found requisite incident to the presence of released fractions from the coal. Then the operation is continued by the cracking of the fluid discharging through nozzle 11 into chamber 8 and the liquid remaining, after releasing of vapors, will continue to percolate through the coal, picking up with it released fractions of soluble substance from the coal, and the thus combined liquids will find their way to the bottom of container 8 and may be drawn off together through pipe 29 and pipe 6 and delivered by pump 4 through coil 2 where the temperature is maintained at the cracking degree for the combined products passing through the coil. Thus, combined products progress to the nozzle 11 and crack as they enter the chamber 8, whereby commingled vapors of the products of the oil and coal are released to pass off through the vapor line. The liquids remaining after cracking, again percolate through the solids and are recycled and are thus again subjected to cracking action, and this recycling is continued until substantially all of the releasable fractions of the coal or other fuel have been either vaporized or liquefied, and either escape through the vapor line or pass out through the pipe 29. The recycling is still further continued until practically all of the lighter vapors are released by the cracking action and substantially nothing but coke remains.

During the operation, vapor from the oil and solids mingle both from the cracking of the combined liquid and from vapors of distillation arising from the solids and the percentage of benzol or content in the mingled vapors released from the solids is unusually high, higher in fact than can be attained by known processes of recovering benzol from coal, and as much higher as represented by the additional vapors released incident to the cracking operation on the liquids recovered from the coal. The vapor from the two sources mingles within chamber 8 and pass together up the vapor line 12 to the deplegmator 13 where the lighter vapors pass out the top and over through the pipe 14. The heavier vapors condense and descend as reflux through pipe 25 to pipe 26, and thence through pump 4 back to coil 2. The pump 51 has meanwhile been continuing operating to maintain the vacuum in chamber 8, vapor line 12, dephlegmator 13, and line 14. As the mingled lighter vapors reach the pump 51, they are drawn by the pump from the dephlegmator at a rate sufficient to maintain a substantial vacuum and also sufficient for charging them into the condenser coil 15, where, by drop in temperature, they are reduced to liquid, except the fixed gases which find their way to the receiver tank or reservoir 17, and are drawn off through pipe 18. When this operation has been continued until the contents of the chamber 8 is reduced to a hard coke, the batch operation can be said to have been completed, and the supply of the stream to the particular container is cut off and may be turned on to an adjacent percolating chamber, while chamber 8 is being cleared of its coke and recharged.

During the operation stated, it should be understood that the valve 27 will be adjusted as required to compensate for losses through the release of vapors and their passing out the vapor line, whereby the circulating stream will be maintained constant.

It should be understood that while I have referred to the fuel 10 as coal, and consider coal an especially appropriate illustrative example, and have also referred to petroleum or its products as the fluid initially on stream, the invention comprehends the use of a plurality of any fuels or materials adapted for being jointly cracked or distilled to effect delivery of a distillate in which the blending affords an improved commercial product.

Also, while I have referred to the hydrocarbon group of fluids as petroleum, I prefer to use straight run fuel oil, that is, fuel oil which has not been cracked, for the charging stock, and the coal utilized is preferably, but not necessarily, highly volatile bituminous. This, of course, is stated for illustration only, and not by way of limitation, since it is entirely possible to obtain valuable results when shale or other product, or even wood or other solid fuels are utilized, and when other fluids are employed, pine rich in rosin may be the solid fuel and crude turpentine the fluid for the charging stock.

When utilizing oil and coal, the combined vapors recovered as the final product is a benzol blended gasoline distillate of especially effective anti-knock properties.

It will be understood, of course, that the entire plant will be protected by such gauges and temperature indicating apparatus as are commonly employed for this purpose. For instance, the chamber 8 and the dephlegmator 13 will be provided with pyrometers or other temperature indicating apparatus to insure maintenance thereof within the allowable ranges. The vapors on reaching the dephlegmator 13 are subjected to a cooling, and preferably also a filtering action, so that the heavier substances will be thrown down and the more volatile vapors will rise through the pipe 14. Care must be exercised to see that the temperature of dephlegmator 13 does not raise too high or drop too low, and, to that end, any appropriate well known means may be utilized. The tendency is toward rising temperatures and to keep the dephlegmator sufficiently cool, cool oil may be delivered to lower portions thereof, or any other well known method may be utilized for preserving the requisite temperature of the dephlegmator. In fact, the dephlegmator 13, the condenser 15, and the reservoir 17 with cooperating parts are the same as used in many of the cracking and distilling plants in use today, and I propose to utilize the most approved methods of practicing the industrial art insofar as these structures are concerned.

It is to be observed that by the utilization of the present inventions I am able to obtain from a plurality of inferior products a plurality of superior products. For example, when using petroleum and bituminous coal, the residuum of the petroleum and the coke of the coal combine and form a hard, dry coke well adapted for use as a domestic fuel. The superiority of the gasoline in the blending of benzol with gasoline distillate affords a motor fuel of well recognized superior quality now extensively known for its anti-knock properties.

It will be observed that the structure employed and the mode of operation are quite similar to those disclosed in my above-identified, co-pending application, the essential difference inhering in the maintenance of the cracking coil and condensing coil as well as the receiver tank under pressure while the intermediate parts, essentially the expansion chamber, vapor line, and dephlegmator, are maintained with a vacuum in the sense of being maintained at a pressure below atmospheric, but as near an actual vacuum as is feasible. This area of vacuum greatly facilitates releasing and recovery of vapors, and thus expedites and enhances both the speed and effectiveness of distillate recovery.

It will be understood that while the artist has shown rather large lumps of coal or other solid fuel, finely comminuted fuel may well be used, and in instances will be preferred both for the initial economy in cost of supplies and in enhancing speed of distillation.

Also, as a matter of time saving and other economies in operation, a plant may well be organized to provide alternate expansion chambers enabling the stream to be continuous or substantially so, while the solids are treated as successive batches, and, to that end, the line 7 is valved at 41 and provided with a branch 42 which leads to the automatic pressure regulator of the adjacent expansion chamber, not illustrated. Also, the vapor line 12 is valved at 43 to enable cutting out the vapor line from expansion chamber 8 when the alternate expansion chamber and its vapor line (not illustrated) is being used. In such case also it will be entirely feasible, when shifting the stream to the second batch or second expansion chamber to drain the first expansion chamber through pipe 29 and leave the contained coke substantially dry after closing the valve 41 and before closing the valve 30.

What I claim is:—

In the art of recovering volatile values from liquid and originally solid hydrocarbon sources, the steps of heating the liquid to a sufficient extent and under pressure sufficient to maintain the liquid at cracking temperature in liquid phase, contacting the solid with the thus heated liquid in a vacuum until vapors are released and commingled from both sources incident to the heat of the liquid as the source of heat for the solid, taking off the commingled vapors in a vapor line and dephlegmator in which vacuum is maintained, and condensing the lighter vapors under super-atmospheric pressures.

RUSSELL CARTER.