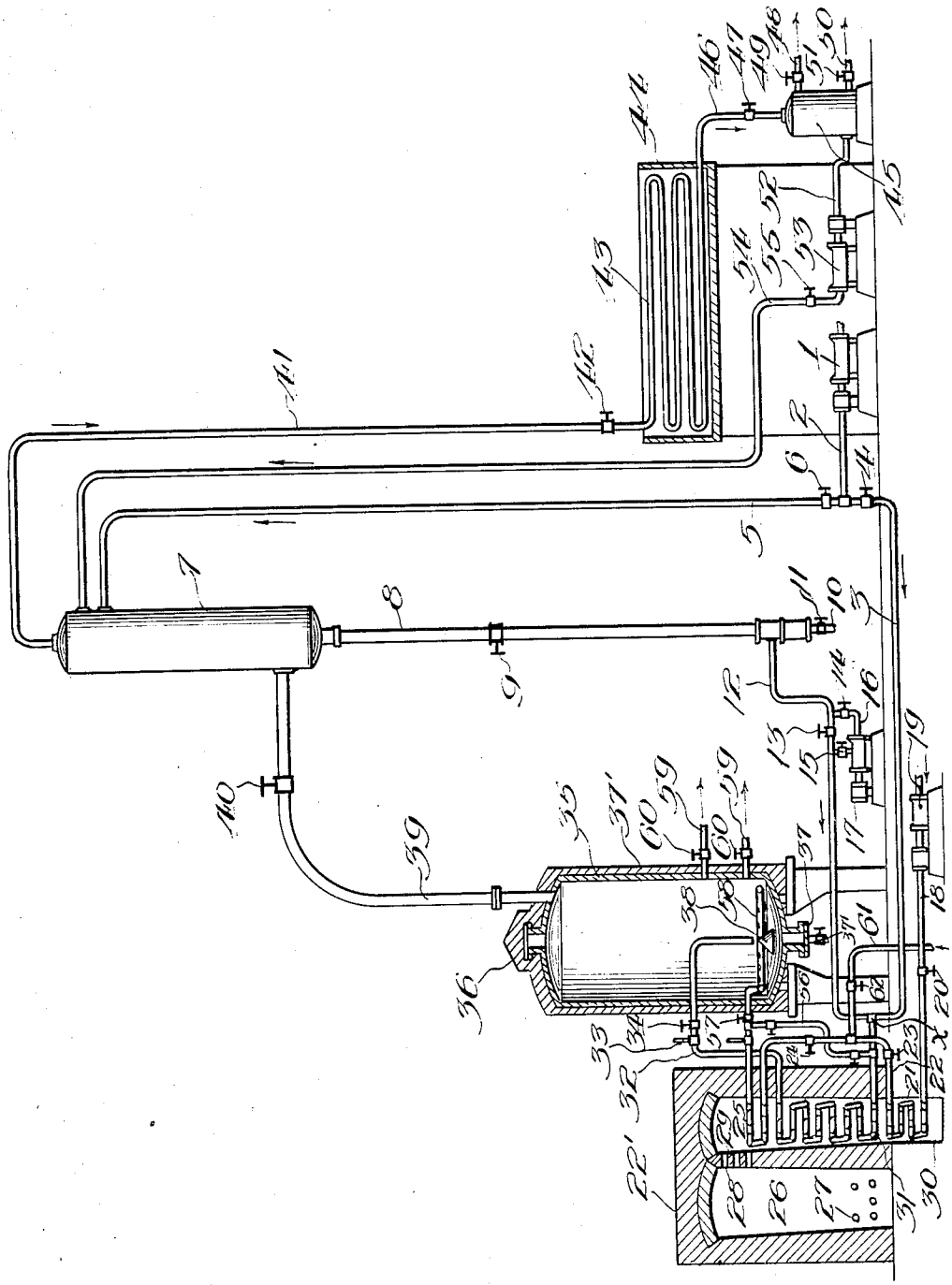
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PROCESS FOR PRODUCING OIL GAS

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PROCESS FOR PRODUCING OIL GAS

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This invention relates to improvements in process of hydrocarbon oil conversion, and refers more particularly to the treatment of relatively heavy liquid hydrocarbons under heat for the conversion thereof into oil gas suitable for commercial use.

In the particular embodiment of the present invention, the relatively heavy liquid hydrocarbon is heated to a conversion temperature in the physical presence of steam and introduced into an enlarged chamber where separation in the form of vapors and gas takes place. The vapors and gas are withdrawn and the vapors condensed as liquid distillate, the gas being drawn off to a suitable gasometer or reservoir. The unvaporized residue in the enlarged chamber, which consists of heavy liquid residue and the gradually accumulating body of carbon precipitated in the separation, may be partially converted by introducing superheated steam at a very high temperature into the body of unvaporized residue, said highly superheated steam and unvaporized residue reacting to form an oil gas.

In the drawing, the single figure is a diagrammatic side elevational view, partly in vertical section, of one form of apparatus in which the process may be carried out.

Referring more in detail to the drawing, 1 designates a charging pump, which discharges relatively heavy liquid charging stock through the pipe 2, where said stream may pass through the charging line 3, which may be controlled by valve 4, or charging line 5, which may be controlled by valve 6. The purpose of dividing this stream or allowing the charging stock to be passed either through the pipes 3 or 5 is to allow for a portion or all of the charging stock to be introduced directly to the heating zone or to the dephlegmator. Pipe 5 introduces the charging stock directly into the top of the dephlegmator designated 7, which is provided with reflux return leg 8, which leg may be controlled by valve 9. A drain 10, which may be controlled by valve 11, may be connected to the base of the reflux return leg 8. Said reflux return leg may be connected with the line 12, which may be controlled by the valve 13, returning the reflux to the point marked X, where the stream of reflux condensate mixes with the stream of charging stock being introduced through the line 3. Where it is desired, the valve 13 may be closed and valves 14 and 15 in by-pass 16 opened, thus allowing a mechanical pressure to be placed upon the reflux by means of the pump 17 interposed in the by-pass 16. It is understood, of course, that the use of a pump is optional.

Referring now to some of the features of the present invention, water may be introduced through the line 18 under pressure applied by the pump 19. A valve 20 may be interposed in line 18 for controlling the flow of water therethrough, said line 18 discharging the water into the lower bank of a heating coil 21 positioned in the lower portion of a side-fired furnace designated as a whole 22′. The heating coil 21 may take the form of superposed rows of freely communicating tubing, forming a continuous passageway, of say three to five inches in diameter, more or less. The water in its passage through the coil 21 is subjected to a very high temperature and is preferably converted into steam, which passes out through the transfer line 22, which may be controlled by valves 23 and 24, and upwardly until it reaches the coil 25, which is placed in the upper part of the furnace in the zone of hottest heat. The heating coil 25 is very similar to coil 21. The furnace 22′ comprises the combustion chamber 26, which may be heated by means of the burners 27, or the like, the gases of combustion passing through the ports 28 into the tube chamber 29, where said combustion gases flow downwardly countercurrent to the upward flow of material in the coils, the spent gases of combustion being withdrawn at the point 30, discharging to a suitable stack, not shown.

The liquid hydrocarbon material to be introduced to the heating zone for heating may consist, as before described, of reflux condensate and charging stock, or raw oil, as desired. Beyond the point X, the hydrocarbon material may be introduced to the coil 31, which takes the form of superposed

rows of freely communicating continuous tubing, through which the charging material passes upwardly. During its passage through the heating coil 31, the hydrocarbon fuel is heated to a gasifying temperature and is transferred by means of transfer line 32, in which may be interposed the pyrometer 33 and throttle valve 34, to the expansion chamber 35. This expansion chamber may take the form, as shown, of a vertically disposed enlarged chamber, or it may be disposed in any plane desired. Upper and lower manhole plates 36 and 37 are preferably provided to assist in cleaning, and the chamber itself is preferably externally unheated, although it is heavily insulated, as shown at 37'. The heated hydrocarbon fuel from the heating coil 31 is preferably discharged over a cone-shaped deflector 38, although, of course, the use of this cone-shaped deflector is optional. The transfer line 32 is shown as introducing the oil at a point adjacent the lower portion of the chamber 35. It is understood, of course, that the heated oil may be discharged at any point intermediate the height of the chamber or into the top thereof. Separation of lighter fractions in the form of vapors and gas will take place within the chamber 35, said vapors and gas being discharged through the vapor outlet pipe 39, in which may be interposed the valve 40, said line 39 discharging the vapors into the dephlegmator 7, preferably at a point adjacent the lower end thereof. The vapors in their upward passage through the dephlegmator are subjected to the baffling effect of baffles placed therein, as is usual in dephlegmators of this type, and may be also subjected to the cooling effect of raw charging stock introduced through the line 5, or other cooling mediums, as shall be hereinafter explained.

The vapors still remaining uncondensed after passage through the dephlegmator may be discharged through the vapor outlet line 41, which may be controlled by the valve 42 communicating with the condenser coil 43, which may be mounted in condenser box 44. The condensible vapors condensed in the coil 43 are collected in the receiver 45 after passing through the pipe 46, which may be controlled by the valve 47. The receiver 45 may be equipped if desired with the oil gas outlet pipe 48, which may be controlled by valve 49, and with the liquid draw-off line storage on one side, as designated at 50, which may be in turn controlled by valve 51. A regulated portion of the distillate collected in the receiver 45 may be used as a cooling medium in the dephlegmator, as hereinbefore described, being recycled through the line 52, and having a pressure placed thereon by means of the pump 53. The exhaust side of the pump discharges the distillate under pressure into the charging line 54 to the dephlegmator, which may be controlled by valve 55.

As a feature of the invention, a regulated portion of the water, which has been heated to a very high temperature in the heating coil 25 and has been converted into highly superheated steam, may be mixed with the charging material being introduced to the heating coil 31, by returning a regulated portion thereof to the line 56, which may be controlled by suitable valves, as shown, said steam preferably mixing with the charging material at a point nearer the furnace than the point marked X, where the reflux condensate and fresh charging stock are mixed.

As a further feature of the invention, valve 57 may be so controlled as to admit a regulated portion of the highly super heated steam into the lower interior of the expansion chamber 35, discharging through the spray or rose 58. For some operations, it is desirable to discharge the highly superheated steam through the spray 58 simultaneously with the introduction of the steam at the point marked X. The expansion chamber 35 may be provided with the usual liquid residue draw-off lines 59, controlled by valves 60, and if desired, with a drain 37' on the plate 37, as shown.

Describing now the operation of the present process, charging stock is introduced under pressure applied by the pump 1 either directly to the dephlegmator 7 or to the heating coil 31, or the stream may be split, as heretofore described. It is, of course, understood that it may be desirable to divert the cold charging stock through a heat interchanger, which may be installed, for instance, in the vapor line 41. Just prior to entrance of the hydrocarbon material into the heating coil 31, superheated steam returned by means of the line 56 is mixed therewith, and the mixture subjected to further heat in the heating coil 31, discharging through the transfer line 32 into the reaction chamber 35. Steam from a boiler plant may be introduced through the line 61, which may be controlled by valves 62, if it is not desirable to heat water in the lower coils 21. It is understood, of course, that the superheated steam may be introduced at any point in the height of the coil 31, or at numerous points in the height thereof, if found desirable.

The highly heated mixture of hydrocarbon material and superheated steam, upon being introduced through the transfer line 32 into the interior of the chamber 35, will expand and the vapors and gas released therefrom pass through the vapor outlet 39 and are treated as heretofore explained, and the carbon precipitated in the lower portion of the expansion chamber, together with the small proportion of liquid residue which remains unvaporized. A portion of the superheated steam from the coil 25 may be intro-

duced through the rose 58 in the lower portion of the reaction chamber penetrating the heavy carbon, liquid oil, or coke accumulating in the bottom part of this chamber.

A substantial amount of oil gas will be made as the mixture of oil and superheated steam are heated in the coil 31 and an additional amount of oil gas will be made by blowing the superheated steam through the carbon body and into the bottom of the chamber 35.

In the dephlegmator 7, the heavier vapors are condensed by contact with the cooling mediums heretofore described, while the lighter ends and non-condensable gas, or those sufficiently treated, will pass through the line 41, condensing in the condenser 43, and collecting in receiver 45. Such water vapors as are not utilized in making oil gas are also condensed in the condenser 43 and separated from the liquid collecting in receiver 45. The oil gas is separated from condensed liquids in receiver 45 and is removed through pipe 48. It is understood that the process of the present invention is adapted to operate continuously except for periodic shutdowns to clean the oil gasifying chamber 35.

The apparatus may be maintained under a pressure of from three to several hundred pounds gauge uniformly held throughout the apparatus, or differential pressures may be employed, if desired, as is well known in this art. With the present invention, all the oil with the exception of the lighter ends taken from the top of the dephlegmator can be recycled through the system until said oil is ultimately converted into its lighter constituents or non-condensable gas. The pressure maintained during the operation of the process depends to a large extent upon the temperature used, character of oil treated, and products desired. It is to be noted that the steam is brought up to its disassociating temperature in the presence of oil vapors, which is in the neighborhood of 1300° F. The various tubes in the furnace are preferably calorized. The temperature of the highly heated mixture passing through the transfer line 32 may be from 1200 to 1500° F., more or less.

It is to be, of course, particularly noted that substantially all the oil which is fed into the system and is not converted on a single pass through the system into either light ends or non-condensable gas, is caused to recycle through the system, being returned by the reflux leg 8, as many times as is necessary to effect the complete breaking up of the charging oil into non-condensable gas. The positioning of the coil 25 at the point where the combustion gases are hottest causes a high superheating of the steam therein, and at the same time protects the oil heating coil 31 from the direct rays of the radiant heat, as well as the high temperature of the combustion gases.

It is the intention of the present invention to produce substantial quantities of oil gas and relatively minimum quantities of distillate. In other words, the production of the distillate is merely an incident to the process of producing the oil gas, the major percentage of the oil which has not been converted into gas being recycled for further treatment, as explained.

I claim as my invention:

A process for producing oil gas, which comprises passing heavy hydrocarbon oil in a restricted stream and in admixture with superheated steam through a heating zone and heating the same therein to a decomposition temperature between 1200° F. to 1500° F., discharging the heated mixture into an enlarged separating zone and separating the vapor and gas from carbonaceous residue therein, dephlegmating said vapor and gas in a manner to separate the greater portion of the vapors from the gas by scrubbing the same with fresh oil being supplied to said heating zone, and repeatedly recycling the resultant reflux condensate through said heating zone in admixture with additional quantities of steam until the same has been substantially decomposed into gas.

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