

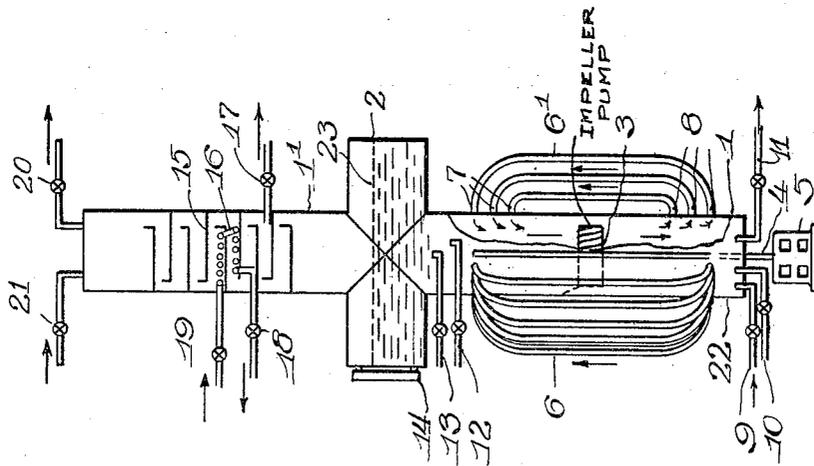
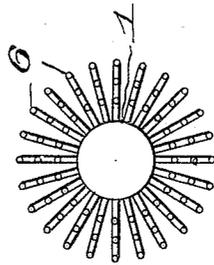
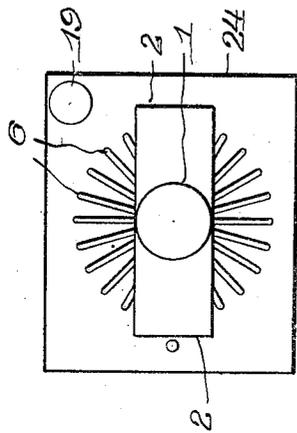
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APPARATUS AND PROCESS FOR TREATING HYDROCARBONS

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## APPARATUS AND PROCESS FOR TREATING HYDROCARBONS

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My invention comprises a method of distilling and cracking hydrocarbons while circulating in a multiple of concentric rings, and a distilling and cracking apparatus of a new and distinctive type, either as a separate unit or in combination and co-operation with a vaporizing chamber or zone and a dephlegmating section united together as integral parts of one apparatus which, in either form, has very decided advantages, both in operation and in results attained, over other types of apparatus, as will hereinafter more fully appear.

While my process is independent of the apparatus, the apparatus to be described is so peculiarly adapted to it that a previous description of the apparatus will help greatly in making clear the characteristics of the process.

In the drawings:

Figure 1 shows my apparatus in its preferred form complete with a vaporizing chamber 2 and a dephlegmating section 1' in elevation;

Fig. 2 is a plan looking from above the vaporizing chamber 2 downward showing in outline a furnace 24 for heating the tubes 6; and

Fig. 3 is a plan seen from below the heating tubes 6.

The main chamber 1 is an elongated tubular member expanding into a vaporizing chamber, section or zone 2 and continuing above it as a dephlegmating section or tower 1'. The main chamber has in it, in the center of its circulating zone, a centrifugal or other suitable type of impeller pump 3 operated through a shaft 4 by an external motor 5, or any other suitable means. The main chamber also has near its bottom valve controlled means for introducing a charging stock 9, valve controlled means for introducing a catalyst, steam, gas or a treatment agent, or a combination of two or more of them 10, and valve controlled means 11 for withdrawing solids and heavier hydrocarbons that may gravitate to the settling zone 22; also valve controlled means 12 in the upper part of the main chamber below the vaporizing chamber, section or zone for selectively withdrawing

lighter fluid hydrocarbons; and valve controlled means for introducing liquids or gases 13.

This main chamber is entirely encircled with heating and circulating tubes 6 running from the upper to the lower part of the chamber (see Fig. 1), or vice versa, placed next to each other, as shown in Fig. 3, with other encircling rows above or below, as appears in Fig. 1 at a point marked 6', said tubes being as many in number and as close together as may be mechanically expedient, and the pump being placed midway between the upper and lower openings of said tubes into said main chamber 1. These tubes are heated and the hydrocarbons in them brought to cracking temperature by any suitable means, such as a fire-box or furnace flue.

Above the main chamber 1, and in continuation of it, is the vaporizing chamber, section or zone 2, shown in Fig. 1 as an elongated drum 2 placed horizontally to the main chamber 1 with means 14 for cleaning it, which chamber, section or zone may be of any form or shape desired, provided it is in direct and open communication with the main chamber 1.

Above the vaporizing chamber, section or zone is a dephlegmating section or tower 1, a continuation of the main chamber 1 with baffles 15, valve controlled means for withdrawing kerosene, etc., 17, cooling trays or coils 16, valve controlled means for admitting 19 and withdrawing 18, cooling fluid, valve controlled means 21 for admitting cool liquid hydrocarbon to aid in dephlegmation, and valve controlled means 20 for withdrawing vapors and gases.

In operation, the charging stock is fed continuously or intermittently into the main chamber 1 through 9 and forced by the pump 3 into the lower opening 8 of the tubes and thence through them and out of their upper openings 7 into the part of the main chamber 1 above the pump which draws the fluid downward and keeps it in continuous rapid circulation. A portion of the lighter hydrocarbons, however, pass upward into the vaporizing chamber, the liquid in which by

regulating the rate of feeding at 9 is kept at a predetermined level 23.

In the vaporizing chamber, section or zone, the vapors separate out and pass to the dephlegmating section or tower for cooling and separation. Condensate is not withdrawn or refluxed as when an independent dephlegmator or separator is used, but it at once gravitationally returns to the main body of hydrocarbon liquid, thus conserving heat that would otherwise be lost in transit.

I have found that continuous cycling in the manner described prevents carbon deposits, hastens cracking and results in the production in a single operation of a larger proportion of gasoline than is obtainable by other means. I also find that the introduction of a catalyst, steam, gas or a treating agent, or, in some instances, of a combination of two or more of them, is very advantageous.

It will be noted that a distinctive characteristic of my apparatus as described is the forceful circulation of hydrocarbons from one end of a common chamber through a plurality of concurrent approximately semi-circular tubes back to the other end of the common chamber where hydrocarbons from the several tubes are commingled and in the main pumped to the other end and again circulated and this repeatedly. This method of circulation is an essential feature of my process which ordinarily also includes the other subsequent methods of treatment already described.

I claim:

1. A new and improved apparatus for producing low-boiling point hydrocarbons from higher-boiling-point hydrocarbons comprising a main tubular chamber encircled in whole or in part by a plurality of substantially concentric tubes opening out of said main chamber near one end and extending to an opening into said main chamber near the other end, a centrifugal or other impeller pump or other suitable means of inducing controlled circulation through said tubes and chamber placed intermediate the entrances to and exits from said tubes in said main chamber, means of producing and maintaining temperature, means of introducing charging stock to said main chamber, means of introducing a catalyst, steam, gas or a treatment agent or a combination of two or more of them, a section in the main chamber below the tubes where solids may settle and heavy hydrocarbons may gather, means of withdrawing solids and heavy hydrocarbons, a vaporizing section, zone or chamber in or as an extension of or addition to the main chamber so situated as to be relatively free of circulation, a dephlegmating and separating section, zone or tower in or as an extension of or addition to the main chamber, with the said main chamber, vaporizing section, zone or chamber and dephlegmating and separating section, zone or tower in such rela-

tion to each other that they will be in communication each with the others, and that condensate will gravitationally return to the main body of liquid hydrocarbons without being withdrawn from the apparatus.

2. The process of producing low-boiling-point hydrocarbons from higher-boiling-point hydrocarbons under conditions of temperature and pressure conducive to cracking which consists in circulating an undivided column of hydrocarbon of substantially uniform cross-sectional area throughout the length of the column, dividing the column at one end thereof into a plurality of smaller columns and maintaining the circulation through said smaller columns and back to the main column and there discharging and commingling the hydrocarbon liquid of the smaller columns with the main column to repeatedly continue the circulation, and in maintaining above the zone of circulation a non-circulating body of hydrocarbon presenting an exposed surface to induce vaporization, said exposed surface being of substantially greater area than the cross sectional area of the main column, and in directly discharging the vapors into a dephlegmating section disposed immediately above the vaporizing zone and in position to provide for the gravitational return of condensate directly to the liquid surface of the hydrocarbon in the vaporizing zone without the liquid being withdrawn from the apparatus.

3. A new and improved apparatus for distilling and cracking hydrocarbons consisting of a main tubular chamber of substantially uniform cross-sectional area from end to end, encircled in whole or in part by a plurality of substantially concentric tubes opening out of said main chamber near its upper end and extending to and opening into said main chamber near its lower end, means for producing and maintaining temperatures in said tubes and chamber conducive to cracking, and a vaporizing chamber superposed upon and opening directly into the main chamber above the entrances of the concentric tubes, said vaporizing chamber being laterally enlarged to provide for a surface exposure of liquid hydrocarbon of greater area than the cross sectional area of the main chamber.

4. A new and improved apparatus for distilling and cracking hydrocarbons consisting of a main tubular chamber of vertically elongated formation and of substantially uniform cross-sectional area from end to end, encircled in whole or in part by a plurality of substantially concentric tubes opening out of said main chamber near its upper end and extending to and opening into said main chamber near its lower end, means for producing and maintaining temperatures in said tubes and chamber conducive to cracking, and a vaporizing chamber superposed upon

and opening directly into the main chamber above the entrances of the concentric tubes, said vaporizing chamber being laterally enlarged to provide for a surface exposure of liquid hydrocarbon of greater area than the cross sectional area of the main chamber.

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5. A new and improved apparatus for distilling and cracking hydrocarbons consisting of a main tubular chamber of vertically elongated formation and of substantially uniform cross-sectional area from end to end, encircled in whole or in part by a plurality of substantially concentric tubes opening out of said main chamber near its upper end and extending to and opening into said main chamber near its lower end, means for producing and maintaining temperatures in said tubes and chamber conducive to cracking, a vaporizing chamber superposed upon and opening directly into the main chamber above the entrances of the concentric tubes, said vaporizing chamber being laterally enlarged to provide for a surface exposure of liquid hydrocarbon of greater area than the cross sectional area of the main chamber, and a dephlegmator section of vertically elongated formation and superposed upon and opening directly into the vaporizing chamber and adapted to gravitationally discharge condensate directly to the surface of the liquid in the vaporizing chamber.

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