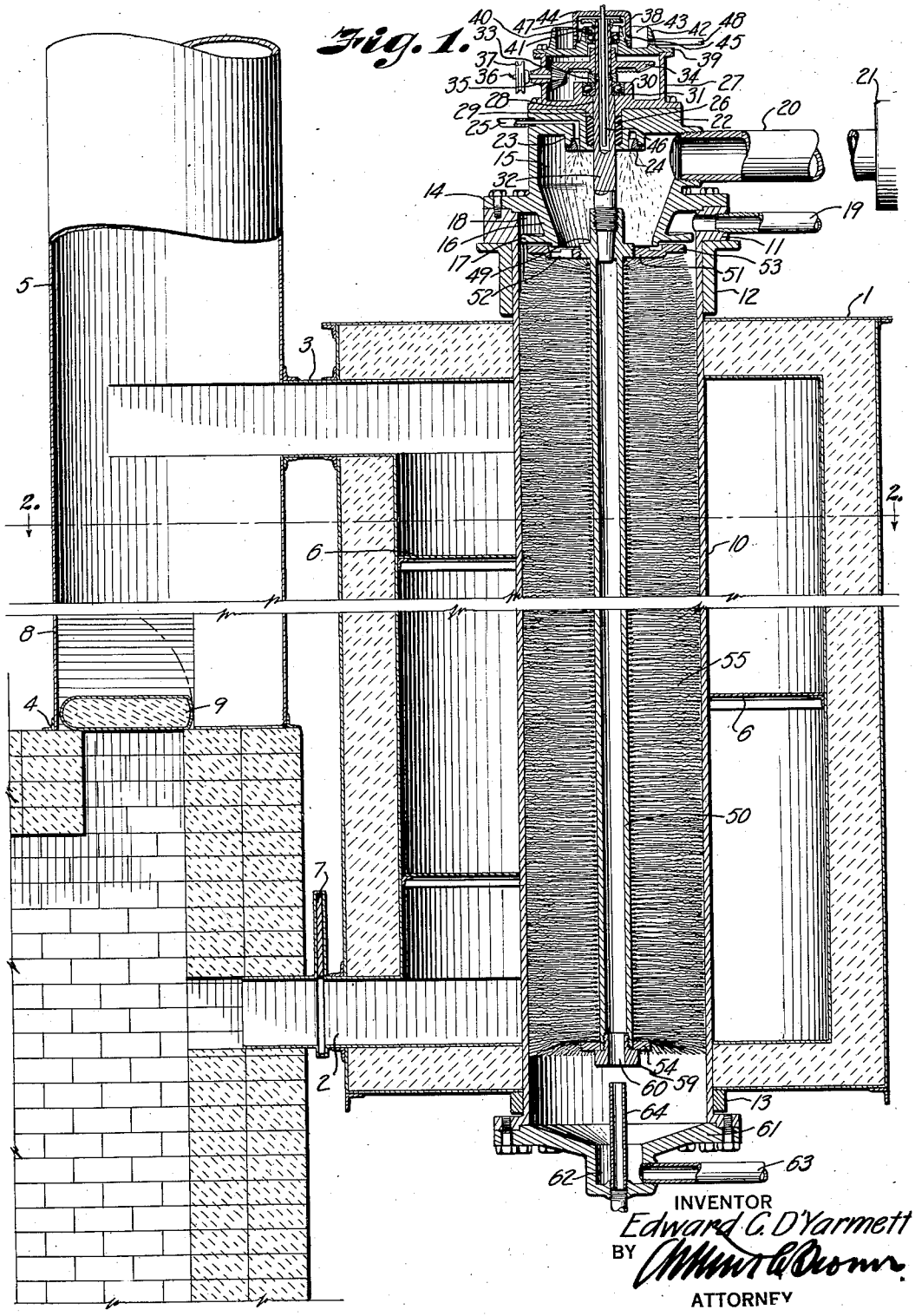
May 19, 1936. E. C. D'YARMETT 2,040,837

METHOD OF HEAT TREATING LIQUIDS

Filed Feb. 18, 1932 2 Sheets-Sheet 1

Fig. 1.



INVENTOR
Edward C. D'Yarmett
BY
ATTORNEY

May 19, 1936. E. C. D'YARMETT 2,040,837

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Fig. 2.

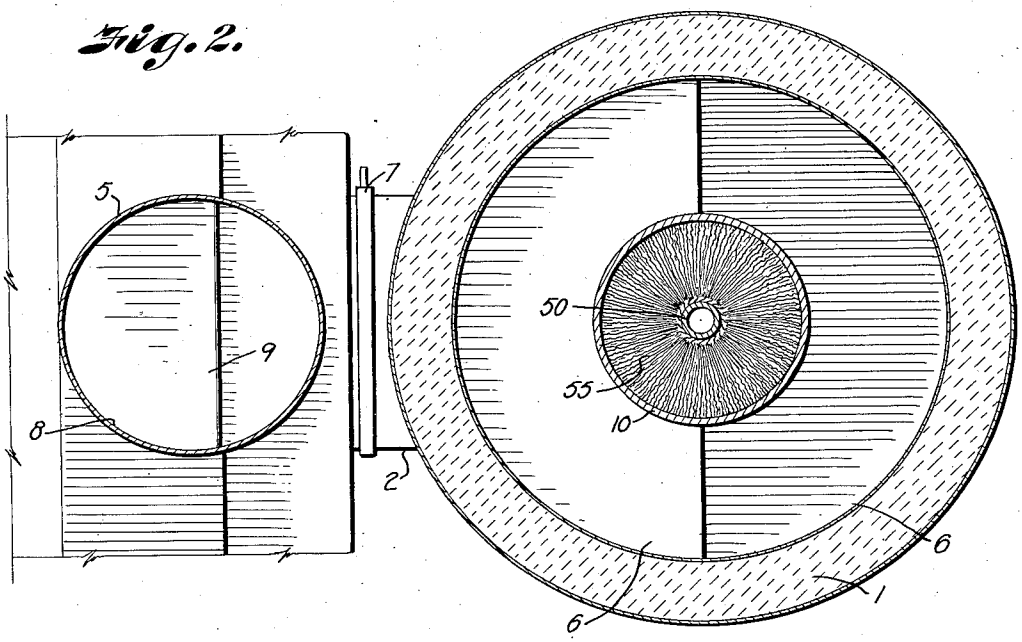


Fig. 4.

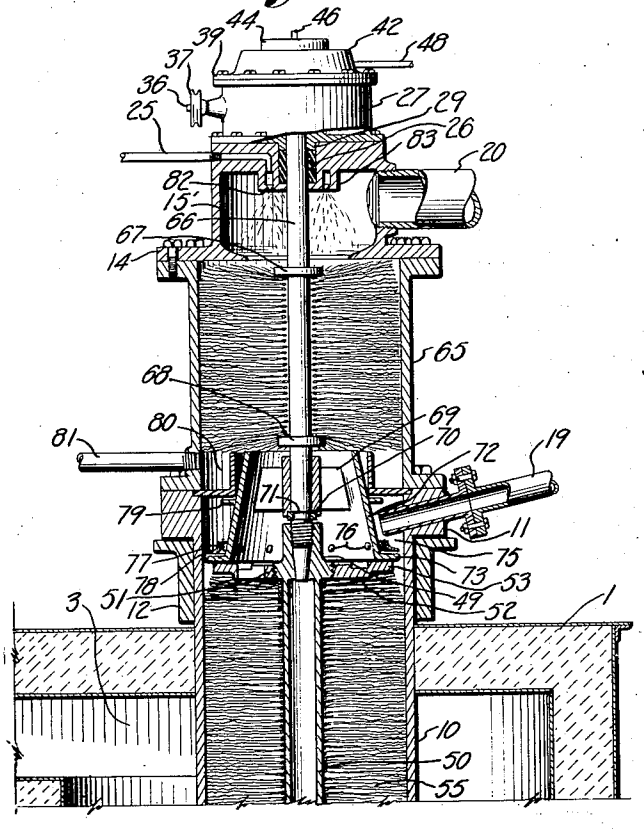
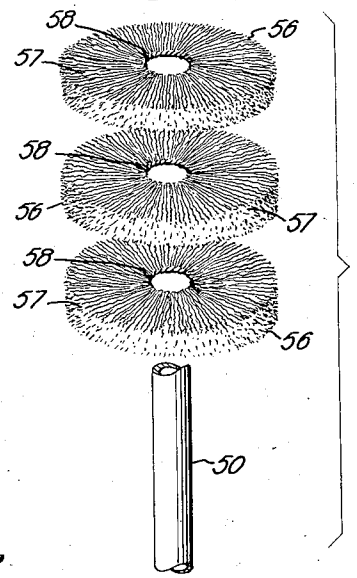


Fig. 3.



INVENTOR
Edward C. D'Yarmett
BY Arthur C. Brown
ATTORNEY

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UNITED STATES PATENT OFFICE

2,040,837

METHOD OF HEAT-TREATING LIQUIDS

Edward C. D'Yarmett, Atoka, Okla.

Application February 18, 1932, Serial No. 593,775

4 Claims. (Cl. 196—90)

My invention relates to a method of separating lighter from heavier components of liquids by distillation, and has for its principal object to effect recovery of the lighter components of liquid by heat-treating the liquid rapidly without overheating.

In accordance with ordinary practice liquids to be distilled are heated in tanks or tubes to which the heat is applied exteriorly, resulting in uneven distribution of the heat through the liquid and overheating of the part thereof exposed to the surface of the confining walls. While such unevenness of heat distribution is not a serious detriment in the treatment of some liquids, it is in others, such as hydrocarbon oils, from which close fractional cuts are desirable, and particularly in cracking operations in which overheating effects secondary cracking and the resultant deposition of free carbon on the wall of the tank or tube.

Particular objects of my invention are, therefore, to effect distribution of heat through the liquid under treatment by radiation and maximum surface contacts of the liquid, and to simultaneously effect cycling of the liquid and its evolved vapors and condensates in response to thermal forces set up as a result of differential in temperatures at various points throughout the length of the still.

For practicing my method I have provided improved apparatus, a preferred form of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a longitudinal section of an upright still embodying my invention.

Fig. 2 is a horizontal section on the line 2—2, Fig. 1.

Fig. 3 is a detail perspective view of a part of the heat-distributing and liquid-nebulizing brush.

Fig. 4 is a central longitudinal section of a part of a still of modified form, including a fractionating tower element.

Referring more in detail to the drawings:—

1 designates a heating chamber preferably of circular cross section to permit baffled flow of heating medium therethrough from an intake 2 at one end of the chamber to an outlet 3 at the opposite end thereof.

4 designates a furnace of any suitable type for supplying the heating medium and with which the inlet and outlet flues 2—3 are connected, the outlet flue 3 delivering to a stack 5. The heating chamber is preferably provided with flow directing baffles 6, and the inlet channel 2 with a damper 7 for controlling and directing the heating medium for regulating temperatures within the heating chamber. The furnace is also preferably provided with an auxiliary flue 8 leading to the stack and dampered at 9 for further heat regulation.

10 designates a tube extending centrally through the heating chamber 1 and having an upper annular flange 11 engaging a clamp 12 carried by auxiliary supports adjacent the furnace but not here illustrated.

13 designates an aligning clamp at the bottom of the heating chamber surrounding the tube 10, but not fixed thereto so as to interfere with expansion and contraction of the tube.

Fixed to the top of the tube 10 is a cover member 14 preferably comprising a chamber 15 for collection of vapors as presently described, and having at its lower end a tapered neck 16 extending into the top of the tube chamber 10 and provided with a flange 17 forming an annulus 18 from which liquid supplied from a line 19 is distributed about the top of the tube.

Opening from the side of the upper portion of the chamber 15 is a vapor outlet line 20 leading to a condenser indicated at 21, and depending from the top wall 22 of the chamber is a ring flange 23 carrying an annular nozzle 24 through which reflux liquid supplied through a line 25 may be showered through vapors rising in the chamber.

The top wall 22 and the flange 23 of the chamber 15 are channeled for passage of a shaft therethrough and the shaft passage counterbored to receive packing 26. Mounted on the top of the cover 14 is a gear box 27 having a channel 28 concentric with the channel in the top of the cover 14 and provided with a gland ring 29 for compressing the packing 26.

Within the gear box, concentric with the channel 28, is an upstanding ring 30 for confining a bearing 31 for a shaft 32 suspended on the bearing by a collar 33 and extending downwardly through the vapor space in the cover member 14 into the top of the heating chamber 10.

Fixed to the shaft 32 above the collar 33 is a bevel gear wheel 34 meshing with a pinion 35 on a shaft 36 extending to the exterior of the gear box and provided with a driving element, such as a pulley 37.

The shaft 32 extends above the bevel gear wheel 34 through a collar 38 of a cover plate 39 on the gear box and is provided with a bearing member 40 cooperative with a bearing member 41 in the collar. Rising from the plate 39 is a ring flange 42 forming a chamber 43 about the shaft, and covering the end of the shaft is an inverted cup 44 having lateral apertures 45 within the annular chamber formed by the ring 42.

The upper end of the shaft 32 is channeled, and extending through the cup 44 into said channel is a tube 46 for supplying cooling liquid to the shaft. Fixed to the top of the shaft within the cup 44 is a deflector plate 47 for deflecting liquid discharged from the channel of the shaft 32 laterally to the wall of the cup 44. 48 designates an outlet line for the cooling liquid.

The lower end of the shaft 32 is preferably tapered and suspended from the shaft, preferably by means of a collar 49, threaded onto the lower end of the shaft 32, is a hollow shaft 50 of a length to extend substantially through the heating tube 10 but spaced from the end thereof for a purpose presently mentioned.

The collar 49 is flanged to provide a stop ring 51 having spokes 52 carrying a balance ring 53, and the opposite end of the shaft 50 is provided with a ring 54 similar to the ring 51 but slidable on the shaft. Mounted on the shaft between the rings 51 and 54 is a brush 55 preferably consisting of a plurality of units 56 (Fig. 3), each preferably consisting of a plurality of relatively fine bristles 57 of heat-conductive material, radiating from a center ring 58 of twisted wire and crimped at their outer portions to provide extensive surface area. The units 56 are compressed on the shaft by threading the plug 59 onto the free end of the shaft to hold the bristles of the several units in close relation and form a compact brush body in which the bristles are in close assembly but afford space for the passage of vapors and mist generated from the liquid under treatment therethrough.

The brush 55 is of a diameter to fit snugly within the heating tube but for rotation with the ends of the bristles in contact with the wall of the tube, whereby heat applied exteriorly to the tube will be conducted substantially uniformly in cross sectional areas throughout the tube chamber.

The ring 54 is adjustable on the lower end of the shaft 50 by means of a plug 59 having a channel 60 therethrough for passage of steam or other heating medium into the shaft, if desired.

The lower end of the tube 10 is closed by a base plate 61 having a tapered inner surface leading to a cup 62 having an outlet line 63 for withdrawing residue from the chamber formed in the bottom of the tube 10 below the brush. 64 designates a nozzle opening through the bottom of the cup concentrically with the shaft 50 for delivery of steam or other auxiliary heating fluid to the interior of the tube 10, the nozzle 64 terminating above the normal liquid residue level in the bottom of the tube.

In the form of apparatus illustrated in Fig. 4, a fractionating tower section 65 is interposed between the top of the heating tube and a vapor chamber 15' substantially identical with the chamber 15 shown in Fig. 1, except for omission of the oil distributing annulus at its lower end.

Mounted on the vapor chamber 15' is a gear box 27, and suspended from gearing in the box through the fractionating chamber is a driving shaft 66 having a collar 67 thereon within the upper portion of the fractionating chamber. Threaded onto the shaft within the lower portion of the fractionating chamber is a collar 68 cooperative with the collar 67 for retaining the brush on the shaft 66. Mounted on the shaft 66, by means of a spider 69 on the shaft and a clamp ring 70 seated in an annular groove 71 in the shaft, is a frusto conical collar 72 having a flange 73 at its lower end of a diameter to provide an annular space 75 within the upper end of the heating tube for delivery of charging stock from a supply pipe 19 to the tube adjacent the wall thereof.

Mounted above the flange 73 and spaced from the side wall of the collar, by bolts 76 and spacers 77, is a distributing ring 78 whereby oil delivered against the side wall of the cup is distributed substantially uniformly around the tube. A ring 79 on the periphery of the collar 72 serves to prevent splashing of the oil upwardly into the fractionating chamber.

The shaft 66 has a threaded and preferably tapered lower end from which the brush shaft is suspended by means of a cap 49 as described in connection with the preferred form of the invention.

For taking an additional cut from the fractionating chamber, I provide a trap 80 in the bottom of the chamber around the cup 69 through which condensate may be withdrawn through a line 81, if desired. If no additional cut is desired, the line 81 is closed and condensate returned to the heating tube over the edge of the trap.

Vapors rising through the fractionating tower into the collection chamber 15' are withdrawn through the vapor line 20 and may, if desired, be knocked back by reflux liquid supplied from line 25 through a nozzle 82 in the bottom of a cup 83 depending from the top of the collection chamber.

In practicing my method with the apparatus described, liquid to be distilled, supplied to the top of the heating tube adjacent the wall thereof, contacts the revolving brush and is, by the brush, broken up into a mist by mechanical stirring action of the brush. The brush, revolving in contact with the wall of the heating tube, conducts heat from said wall inwardly to the center shaft so that the temperature within the tube is substantially uniform throughout cross sectional areas thereof and the liquid and mist thereof heated substantially uniformly throughout such cross sectional areas.

Although the liquid may be preheated before delivery to the still tube, it enters the still at a comparatively low temperature, and, passing down the tube, is progressively heated so that lower boiling point vapors are progressively generated during passage of the liquid downwardly through the tube. The vapors of different boiling points mingle during their upward travel through the tube, the vapors of higher boiling point generated at lower elevations in the tube contacting the bristles of lower temperature in their upward travel, to be condensed and returned to the liquid stream for retravel down the wall of the heating tube and revaporization, thereby setting up progressive fractionation within the heated vessel through thermal cycling. Rotation of the brush sets up centrifugal force tending to throw the heavier vapors, mist and liquid to the wall of the tube for initial heating and to assist in circulation of the mist.

In the simple form of the invention, vapors generated in the heating tube may be withdrawn from the top of the tube for condensation, or, if desired, may be passed through a fractionating tower such as illustrated in Fig. 4 of the drawings, wherein vapors rising in the tower first contact a cooler area and are knocked back for withdrawal of the condensate, the lighter vapors only rising to the vapor outlet.

While in the foregoing description I have referred to the brush as composed of bristles, it is apparent that any other mechanical device for

effecting the distribution of the heat and nebulization of the oil would come within the scope of the invention, and, while I have described the invention for simple distillation, it is apparent that the same method can be employed under higher heat or with pressure for cracking hydrocarbon oils; adaptation of the method and apparatus for cracking being, however, particularly disclosed in a co-pending application.

What I claim and desire to secure by Letters Patent is:

1. The method of distillation including impelling liquid stock to the periphery of the chamber of a treating vessel, converting the liquid to mist at the periphery of the chamber, conducting heat through closely related transverse zones in the chamber, vaporizing the mist by the conducted heat, and removing vapors from the treating chamber.

2. The method of distillation including delivering charging stock to the chamber of a treating vessel, heating the vessel to progressively higher temperatures in the direction of flow of the stock, impelling stock in liquid form, together with condensate of lower boiling point fractions of the stock to the periphery of the chamber, converting the liquid to mist at the periphery of the chamber, conducting heat through closely related transverse zones in the chamber, vaporizing the mist by the conducted heat, and removing vapors from the chamber.

3. The method of distillation including delivering charging stock to the chamber of a treating vessel, creating transverse zones of gradually increasing temperature within the chamber by conduction of heat through said zones, impelling charging stock in liquid form and condensate of lower boiling point components of the stock to the periphery of the chamber, converting the liquid to mist, converting the mist to vapor by heat transfer within the separate zones, and removing vapors from zones of progressively higher temperature through zones of progressively lower temperature.

4. The method of distillation including delivery of charging stock to the chamber of a vessel circular in cross section, heating the wall of the vessel progressively in the direction of travel of charging stock through the vessel, conducting heat along definite radial lines from the wall of the vessel to the center of the chamber, impelling charging stock and condensate of lower boiling point components of the stock to the periphery of the chamber by centrifugal force, converting the liquid to mist, converting the mist to vapor by heat transfer in zones defined by the radial lines of heat conduction, and removing vapors formed in the respective zones through zones of lower temperature.

EDWARD C. D'YARMETT.