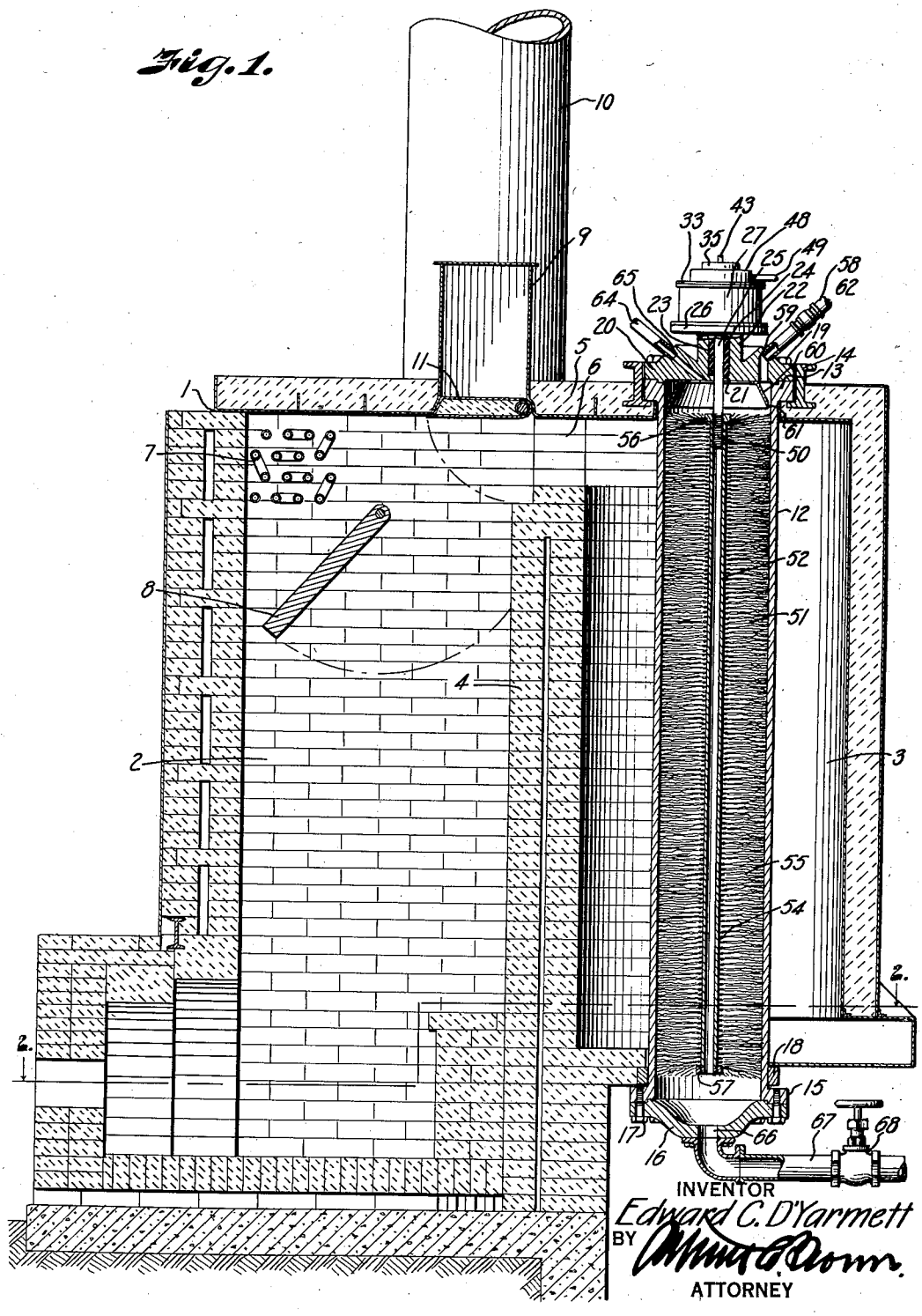
May 19, 1936. E. C. D'YARMETT 2,040,838

APPARATUS FOR CRACKING HYDROCARBON OILS

Original Filed Feb. 18, 1932 2 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

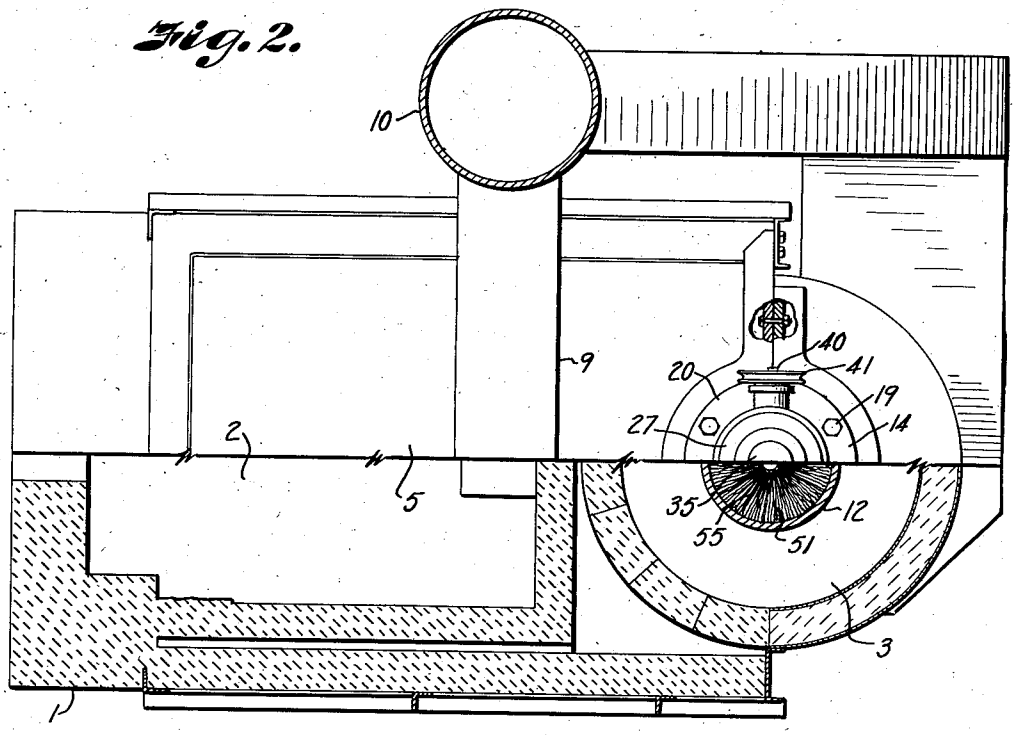


Fig. 3.

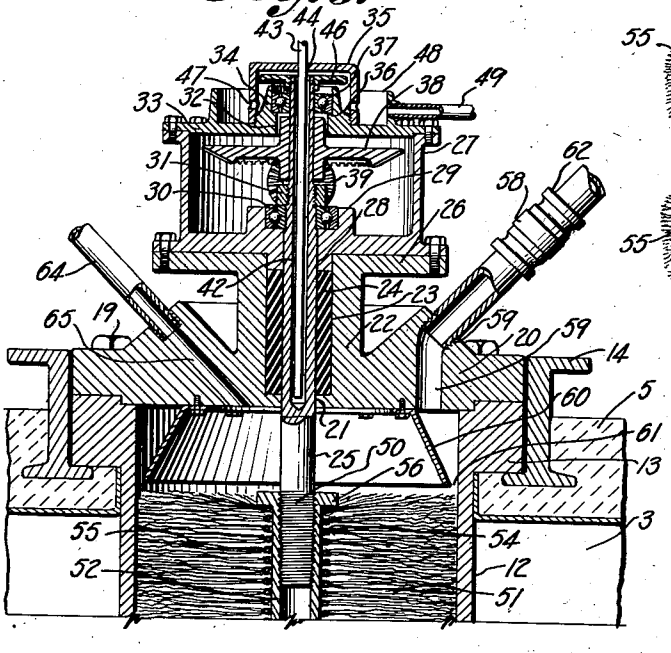
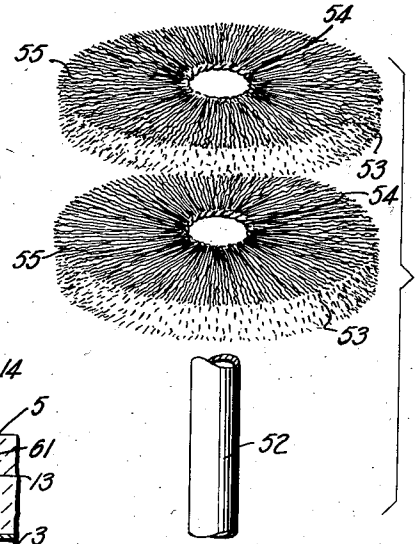


Fig. 4.



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UNITED STATES PATENT OFFICE

2,040,838

APPARATUS FOR CRACKING HYDROCARBON OILS

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Original application February 18, 1932, Serial No. 593,775. Divided and this application March 28, 1932, Serial No. 601,509

8 Claims. (Cl. 196—104)

My invention relates to the art of separating lighter from heavier components of liquids, particularly hydrocarbon oil, by distillation, and has for its principal object to provide simple and effective apparatus for practice of the method disclosed and claimed in my co-pending application, Serial No. 593,775, of which this application is a division.

As in my co-pending application this invention contemplates agitation of the oil in a heating chamber to nebulize the oil, transfer of heat from the wall of the heating chamber uniformly throughout cross-sectional areas of the heating chamber by conduction through the bristles of a brush having contact with the inner surface of the chamber wall, and employment of centrifugal force to stratify fluid content of the chamber and permit heating of the lighter components of the fluid while in the form of mist near the center of the chamber, as well as of the heavier portions near the wall of the chamber.

Also, as in accordance with the method disclosed in my co-pending application, the invention contemplates providing maximum heating surface to contact with the liquid and vapor content of the chamber so that cracking may occur in both liquid and vapor phase under favorable conditions of heat and pressure.

It is an object of my invention to adapt the apparatus for combining lean components of the cracked oil with gas rich in hydrogen to effect a higher yield of saturated vapor and prevent deposition of free carbon which might interfere with the operation of the apparatus, and to facilitate combination of lean components of the cracked vapors with supplied rich gases through catalysis as presently described.

In accomplishing these and other objects of the invention I have provided improved details of structure, the preferred form of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a central vertical section of an assembled furnace and oil treating apparatus constructed according to my invention.

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

Fig. 3 is an enlarged central vertical section of the upper portion of the cracking tube and power unit.

Fig. 4 is an enlarged detail perspective of portions of the brush element of the treating apparatus in disassembled relation.

Referring more in detail to the drawings:

1 designates a furnace, including vertical combustion and heating chambers 2—3, separated by a bridge wall 4 spaced from the top 5 of the furnace to form a horizontal connecting throat 6. Any suitable fuel may be employed, and a coil 7 may be mounted in the furnace chamber for preheating gas for combining with vapors of the oil under treatment or for auxiliary heating purposes.

A damper 8 is provided for controlling normal flow of products of combustion through the combustion chamber 2 so as to direct more or less of the hot combustion gases over the coils 7 as may be required before passing through the throat 6 into the heating chamber 3 and out through duct 9 to stack 10. A damper 11 is provided for directing flow of the gases directly from the combustion chamber into the stack when desired.

Extending centrally through the heating chamber 3 is a tube 12 having a top flange 13 retained in a clamp 14 set into the top wall of the furnace to suspend the tube centrally within the chamber 3. The tube 12 extends through the bottom of the chamber wall and is provided with a lower flange 15 to which a bottom head 16 is attached by bolts or the like 17, the lower end of the chamber being anchored to the bottom of the furnace by a clamp 18 attached to the furnace structure by means not shown.

Seated on the top of the tube flange 13, within the clamp 14, and anchored to the flange by bolts 19, is a covering head 20, having a central bore 21 and an upstanding boss 22 provided with a recess 23 concentric with the bore 21 to receive packing 24 for a brush supporting and actuating shaft 25, which extends through the bore 21 and packing 24 to above the annular flange 26 on the top of the boss 22. Seated on the flange 26 is a motor housing 27 having a gland 28 at its lower end within the packing recess 23 of boss 22, and provided with an upstanding central flange 29 forming a cup for an anti-friction bearing 30, one member of which is attached to the shaft 25, and the other fixed within the bearing cup. A collar 31 threaded to the shaft rotatably supports the shaft on the anti-friction bearing. The shaft extends above the collar 31 through an aperture 32 in the bottom of the housing cover 33 and through the interior of a collar 34 on said cover member into a dome 35 threaded onto the collar 34.

Seated on a shoulder 36 on the inner surface of the collar 34 is an anti-friction bearing 37, one member of which is attached to the shaft to assist in rotatably aligning the shaft.

Fixed on the shaft 25 within the housing 27 is

a beveled gear wheel 38 meshing with a pinion 39 on a shaft 40 (Fig. 2) rotatable from any source of power through transmission indicated by the belt wheel 41.

The upper end of the shaft 25 is provided with a central channel 42 for circulation of cooling fluid supplied thereto from a pipe 43 extended into the channel through an aperture 44 in the dome 35 threaded onto the collar 34 of the cover plate 33.

Water delivered to the channel 42 is deflected laterally from the top of the dome 35 onto a spreading plate 46 to drop between the side wall of the cup and the collar 34 for outlet through apertures 47 in the cup into the annular space between the cap and an upstanding flange 48 on the cover plate 33, to be drawn off through a line 49.

The shaft 25 terminates within the upper portion of the tube 12 in a threaded end 50. A brush 51, suspended from the shaft 25 and extending to near the bottom of the tube, preferably consists of a hollow core 52 threaded onto the lower end of the shaft 25 and a plurality of brush sections 53, each consisting of a central wire ring 54 and radiating bristles 55 of heat conductive material fitted over the core and held in compact relation between a flange 56 on the upper end of the core 52 and a nut 57 on the lower end of the core. The bristles 55 are preferably crimped at their outer ends to provide substantial surface areas and coated with antimony or other material capable of acting as a catalyzer for components of the cracked oil and the rich gas supplied for combination with unsaturates of the oil; or the bristles may be made of material capable of acting as such a catalyzer, but having the heating conductivity required for the practice of the process.

Oil for treatment in the tube 12 is supplied from a line 58 through an opening 59 in the cover member 20 onto a deflecting ring 60 suspended from the cover member and terminating at its lower edge in slightly spaced relation with the wall of the tube to provide a narrow annular port 61 through which the oil is dropped onto the upper end of the brush adjacent the tube wall, the line 58 being provided with a check valve, indicated at 62, for preventing back flow of liquid and vapors when the tube is being operated under high pressures.

Combining gas may be supplied from a line 64 through the channel 65 in the cover member 20 to the interior of the deflecting ring 60.

The bottom head 16 of the tube 12 is cupped to cooperate with the lower portion of the tube in forming a collection chamber for vapors evolved in the tube, and has a central outlet port 66 communicating with a line 67 through which the vapors and any remaining liquid are drawn off from the tube, the line 67 being provided with a valve 68 for regulating pressures in the tube.

Assuming the apparatus to be constructed and assembled as described, hot gases from the furnace flowing over the bridge wall circulate about the treating tube while in down flow to the outlet from the tube, and heat from the wall of the tube is conducted through the bristles of the brush to the interior of the tube so that cross sectional areas of the tube chamber are heated to substantially uniform temperatures, the temperatures at spaced vertical points varying downwardly from the upper inlet to the lower outlet of the heating chamber, but temperatures of the cross sectional areas of the chamber being held substantially uniform.

Liquid charging stock delivered onto the top of the brush is agitated by the brush and centrifuged during its downward travel through the brush to nebulize the oil, the liquid content being thrown to the wall of the tube where it is again picked up by the bristles for reagitation so that substantially immediately after the liquid oil enters the tube it is transformed into a mist.

The multitude of bristles provides a maximum surface area for distributing heat units into the mist and vapor, and, being in contact with the wall of the tube, conducts the wall heat uniformly to the center of the tube. The oil is delivered to the top of the rotating brush which breaks the oil into a mist, which, as it absorbs heat from the brush wires and hot wall of the tube, will change into a vapor or remain in a mist until sufficient heat has been applied to cause the desired cracking. By controlling the temperature of the furnace and the rate of feed so that the outlet temperature of the fluid, both liquid and vapor, is sufficient to cause the desired cracking of the particular oil, the cracking operation may be controlled so as to prevent secondary cracking and the forming of coke. Furthermore, it is known to the art of cracking, that the resultant materials from liquid and vapor phase cracking differ somewhat, and by regulating the outlet valve any desired pressure may be built up in the tube and the mist thus kept from vaporizing until it has absorbed sufficient heat to cause cracking in the liquid phase or the liquid and vapor phase cracking may be carried on simultaneously.

Gases, when supplied for combining with unsaturated components of the oil within the tube, are delivered to the vapor space at the top of the tube for mingling with the vapors, and, passing downwardly through the tube contact with the hot brush wires (which may be coated with or made up of suitable material to cause catalytic action), and the rotation of the brush causes the combining gas and the cracked vapors to mix and commingle, thereby facilitating the combining operation.

It is apparent that the apparatus may be adjusted for treatment of charging stocks at the most advantageous temperatures and pressures by regulation of the furnace and of the valves on the tube inlet and outlet lines.

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

1. Apparatus of the character described including an upright vessel circular in cross section, a brush rotatable within the vessel including bristles radiating from about the center of the vessel to contact with the wall of the vessel throughout a vaporizing space within the vessel, whereby liquid charging stock is transformed to mist within the vessel in response to rotative travel of the bristles in contact with the liquid, means for delivering liquid charging stock to the vessel, means for heating contents of the vessel, and means for drawing off vapors from the vessel.

2. Apparatus of the character described including an upright vessel circular in cross section, a rotatable shaft within and concentric of the vessel, brush members mounted on the shaft, each including a horizontal series of bristles surrounding the shaft and having contact with the wall of the vessel, means for heating the brushes, means for supplying charging stock to the vessel, and means for drawing off vapors from the vessel.

3. Apparatus of the character described including an upright vessel circular in cross section,

a rotatable shaft within and concentric of the vessel, brush members mounted on the shaft, each including a horizontal series of bristles of heat conductive material surrounding the shaft and having contact with the wall of the vessel, means for heating the brushes, means for supplying charging stock to the vessel, and means for drawing off vapors from the vessel.

4. Apparatus of the character described including an upright vessel circular in cross section, a rotatable shaft within and concentric of the vessel, a plurality of horizontal series of heat conductive bristles mounted on and surrounding the shaft and having wiping contact with the wall of the vessel, means for heating the bristles, means for supplying charging stock to the vessel, and means for drawing off vapors from the vessel.

5. Apparatus of the character described including an upright vessel circular in cross section, a rotatable shaft within and concentric of the vessel, a plurality of superimposed brush members, each including a center ring mounted on the shaft and a set of bristles radiating from the ring to contact with the wall of the vessel, means for heating the wall of the vessel, means for supplying charging stock to the vessel, and means for drawing off vapors from the vessel.

6. Apparatus of the character described including an upright vessel circular in cross section, a rotatable shaft within and concentric of the vessel, a series of brush members mounted on the shaft, including radial bristles having contact with the wall of the vessel and substantially filling the vessel, means for delivering charging stock to one end of the vessel for contact with said bristles, means for heating the wall of the vessel, and means for drawing off vapors evolved from said stock by heat transfer from the vessel wall and bristles from the opposite end of the vessel.

7. Apparatus of the character described including an upright vessel circular in cross section, a rotatable shaft within and concentric of the vessel, brush members mounted on the shaft, each including a horizontal series of bristles surrounding the shaft and having contact with the wall of the vessel, means for heating the brushes, means for supplying charging stock to the vessel, means for drawing off vapors from the vessel, and means on the end of the shaft for retaining the brushes on the shaft.

8. Apparatus of the character described including an upright vessel circular in cross section, a rotatable shaft within and concentric of the vessel, brush members mounted on the shaft, each including a horizontal series of bristles surrounding the shaft and having contact with the wall of the vessel, means for heating the brush members, means for supplying charging stock to the vessel, and means for drawing off vapors from the chamber, the end brush members being spaced from the ends of the chamber to provide collection spaces in the ends of the vessel.

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