June 8, 1926. 1,588,308

L. B. CHERRY

ART OF TREATING HYDROCARBONS AND OILS

Filed Nov. 11, 1919 2 Sheets-Sheet 1

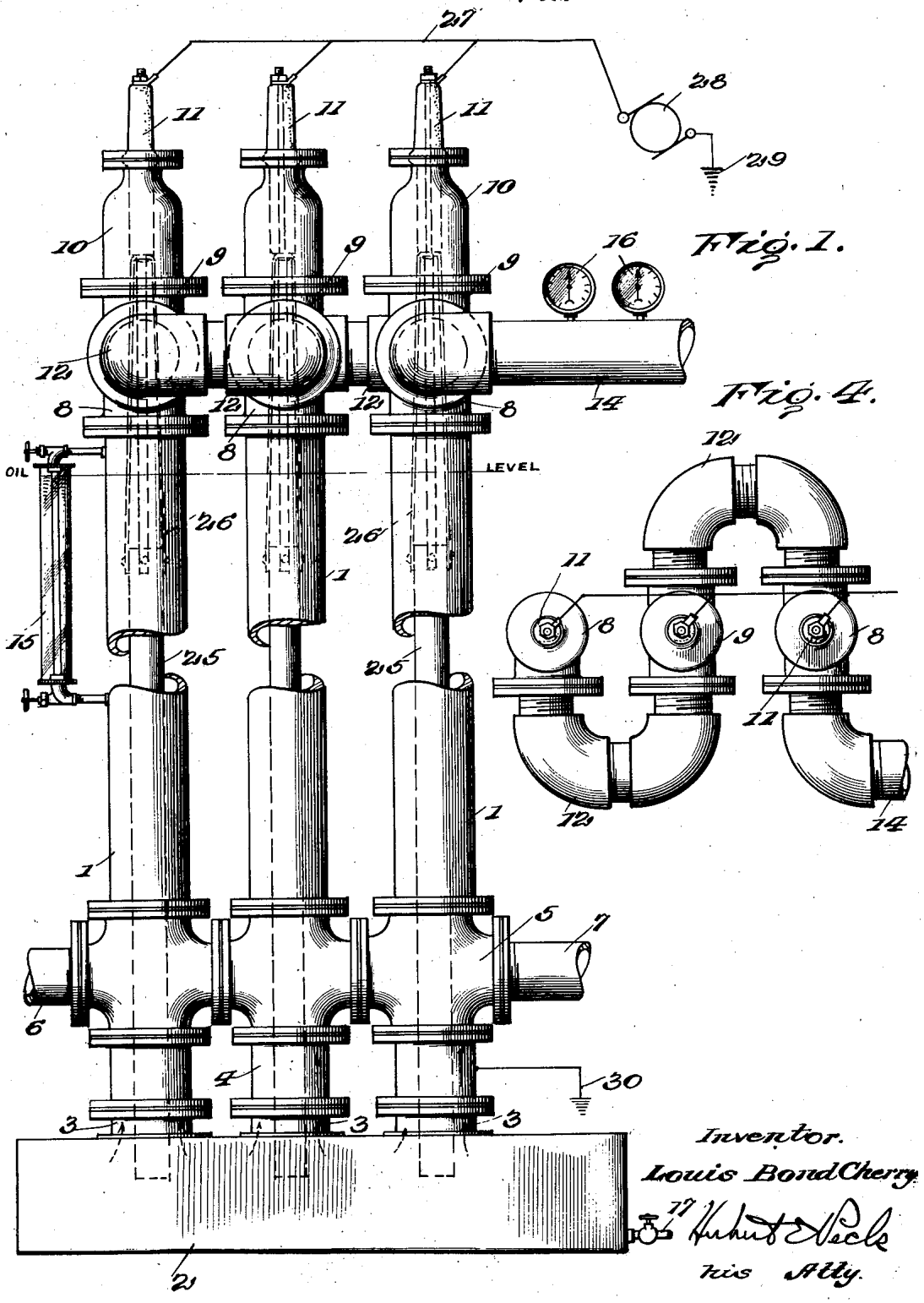

Fig. 1.

Fig. 4.

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Fig. 2.

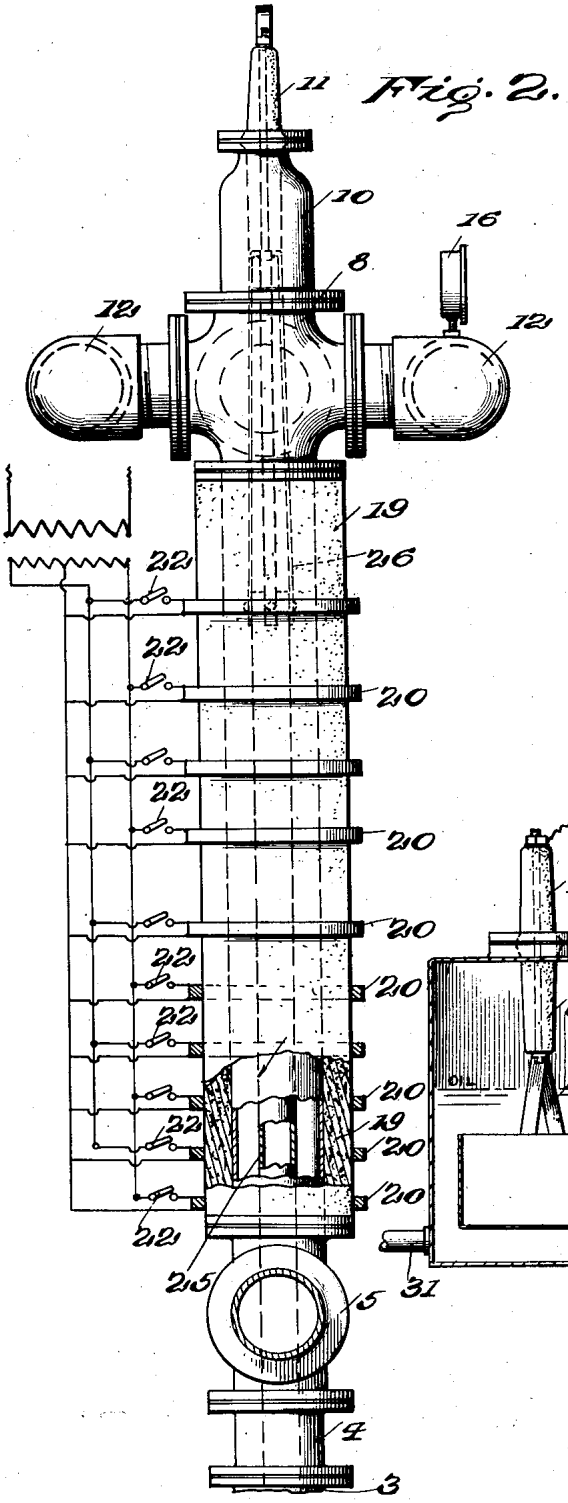
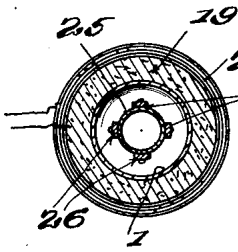


Fig. 3.



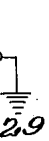


Fig. 6.

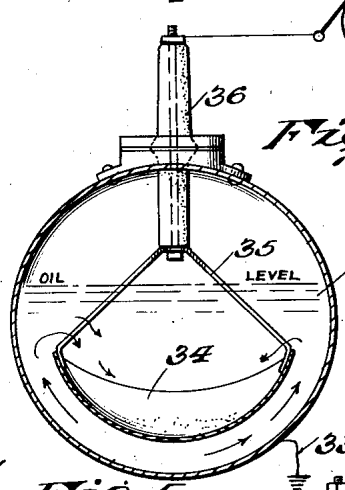
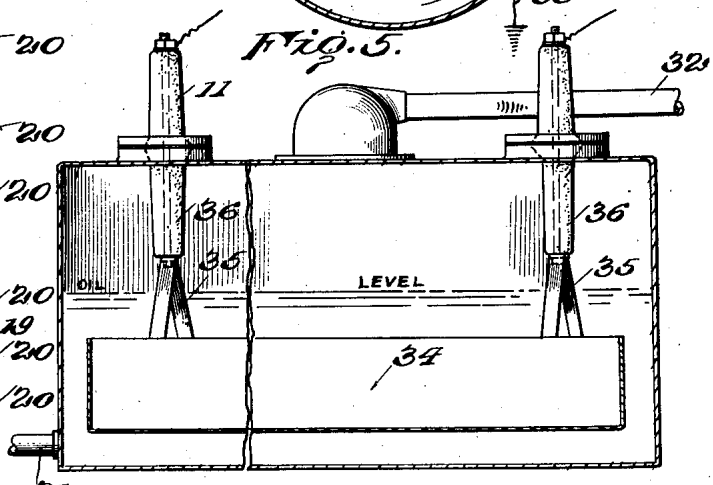


Fig. 5.



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Patented June 8, 1926. 1,588,308

UNITED STATES PATENT OFFICE.

LOUIS BOND CHERRY, OF KANSAS CITY, MISSOURI, ASSIGNOR, BY MESNE ASSIGNMENTS, TO C. AND C. DEVELOPING COMPANY, OF KANSAS CITY, MISSOURI, A CORPORATION OF ARIZONA.

ART OF TREATING HYDROCARBONS AND OILS.

Application filed November 11, 1919. Serial No. 337,182.

This invention relates to certain improvements in the art of treating hydrocarbons; and the objects and nature of the invention will be readily understood by those skilled in the art in the light of the following explanation of the accompanying drawings illustrating what I now believe to be the preferred mechanical expression or embodiment of my invention from among other forms, constructions and arrangements within the spirit and scope thereof, and of the preferred steps to be followed in carrying out my invention.

An object of the invention is to provide a method and means to reduce to the minimum deposit of carbon on the still surfaces during the process of "cracking" hydrocarbon oils and other distillates.

A further object of the invention is to improve the methods and means employed in the production of gasoline and the like from heavy oils and distillates.

With these and other objects in view my invention consists in certain novel features in construction and in arrangements and combinations, and in certain steps to be followed in the practice of the invention, as more fully and particularly set forth and specified hereinafter.

Referring to the accompanying drawings:—

Fig. 1 is a side elevation more or less diagrammatically illustrating a still of my invention, the heating coils and insulation not being shown, certain parts being broken away, and the direct electric current circuit being digrammatically indicated.

Fig. 2 is an end elevation showing the insulation and heating coils, certain parts being broken away.

Fig. 3 is a cross section through one of the still units.

Fig. 4 is a top plan.

Figs. 5 and 6 are a longitudinal view and a cross section of another form of still.

The still of the type of Fig. 1, of the drawings comprises a series of units which can be increased or descreased, as required in each instance.

In the example illustrated, each unit comprises an upright elongated metal tube or barrel 1 and fittings at its upper and lower ends whereby the lower ends of the units are coupled together and to the base of the still and whereby the upper ends of the units are coupled together and connected for the discharge of vaporized products.

In this instance, the base of the still is formed by a horizontally disposed settling tank or chamber 2 arranged longitudinally of the row of units and from which said units rise vertically. This settling tank has a top opening for each unit; each opening can, if so desired, be surrounded by an upwardly extending flanged coupling neck 3, rigid with the tank. Each unit is mounted on and extends upwardly from a neck 3, if so desired through the medium of a two-way flanged union 4, and a four-way flanged union 5; said unions being united with each other and the barrel 1 and neck 3, so that the barrel, unions and neck are in alinement with their interiors forming a continuous passage from the barrel into the tank.

The flanged side openings of the unions 5 of the adjacent units of the still are in alinement and adjacent openings are coupled together so that the lower portions of the units are in direct lateral communication through said unions.

The oil to be treated can be forced into the still through pipe 6 entering the side opening of one four way union 5, while if so desired, condensate from the condenser can be returned to the still through pipe 7, entering the side opening of the opposite end union 5 of the row.

On the flanged upper ends of the end barrels 1 of the still are coupled three-way unions 8, and on the upper end of the intermediate barrel 1 is coupled a four-way union 9, so that these unions are in alinement longitudinally of the still and each union forms an upward continuation of its barrel 1. The top outlet or neck of each union 8, 9, is closed by a cap or pot head 10 coupled thereto, each formed to longitudinally receive and support an insulator 11, as more fully described hereinafter.

The upper portions of the units of the still are connected together in any suitable manner and by any suitable means so that the interiors of the units above the oil level are in free direct communication.

In the particular example illustrated, I

show this free direct communication between the upper portions of the units established through the unions 8, 9, by means of flexible return pipe bends arranged to permit independent expansion and contraction of the various units without causing leakage in or damage to the connections between the upper ends of the units. For instance, I show laterally or horizontally arranged U-pipes 12 coupled into the side necks or outlets of the unions 8 and into the opposite or front and rear side necks or outlets of the union 9 so that one return bend is located in front of the union 9 and an end union 8 while the other return bend is located at the rear of the other union 8 and the union 9, in the particular three unit still that I happen to illustrate in the drawings for purposes of explanation without intending to so limit my invention. As at present advised by experience, I prefer to make each return bend of two pipe elbows united by threaded nipples and also united to the unions 8, 9, by threaded nipples so that what are in effect swivel connections are established between the units permitting difference in expansion between the units without causing such loosening of joints as to result in excessive leakage.

The vapors are taken off from the upper portion of the still through any suitable offtake pipe 14 leading to the condenser (not shown). This offtake pipe can be coupled to one of the end unions 8 if so desired. Also if so desired, similar unions can be employed to make up the series 8, 9, and outlets or necks not receiving return bends or the vapor offtake 14 can be capped or otherwise closed.

The oil supply through pipe 6 should be regulated to maintain the oil level in the still approximately as indicated in Fig. 1, with the barrels 1 full of oil almost up to the row of unions 8, 9, and an oil level indicator 15 is preferably provided so that the operators will always be advised as to the level of the oil in the still.

The vapor offtake pipe can be provided with suitable temperature and pressure indicating instruments 16 to visibly disclose the temperature and pressure of the vapor space within the pipe.

The settling tank 2, can be provided with any suitable valved blow-off or discharge 17 through which carbon and sediment can be removed from the tank when desired.

Any suitable means are provided whereby the necessary vaporizing and oil cracking temperature can be maintained in the oil containing portions of the still. I prefer to apply this temperature through the medium of the metal barrels 1 and to employ means to maintain said barrels at approximately a red heat, if that be necessary to attain the results I seek. I can thus maintain the desired temperature of the oil in the barrels, by exteriorly arranging coils of good conducting wire on the barrels and connecting said coils into the proper alternating current power circuit so as to heat the barrels by induction, as explained and claimed in my patent application S. No. 80,707, filed Feb. 26, 1916, but I do not wish to limit my present invention to any particular means for or manner of producing or maintaining "cracking" temperature in the liquid containing portions of the apparatus.

In the present example, I show each barrel 1 provided with an exterior insulating covering 19, and on the exterior of this covering I arrange a longitudinal series of separate form wound coils 20 of good conducting material, to constitute the primary coils through which the barrel is heated by induction by reason of the magnetic relation between the metal barrels and exterior coils.

The terminals of each coil on a barrel are connected through a suitable switching apparatus 22, with the alternating current power circuit so that a greater or less number of coils can be thrown into the circuit to increase or decrease the temperature of the oil as working conditions may require.

In order to provide an electric terminal opposing the barrel 1 (of each unit) which is utilized to constitute the other terminal, and also for the purpose of maintaining a certain circulation of oil in the still, I arrange metal tubes 25 longitudinally of and within the units. Each tube is open at both ends and its internal passageway is unobstructed. One tube is provided for each unit, each tube being centrally-concentrically arranged within its unit and being sufficiently smaller in diameter than the barrel of the unit to provide an annular passageway exteriorly of the tube and approximately throughout the full length of the unit. Each tube at its lower end depends from its unit into the settling tank while the upper end of the tube is arranged below the oil level in the still so that the tubes are completely submerged in the oil. Each tube 25 is suspended in its unit from the insulator 11 of the unit, through the medium of conducting wires or metal strips 26, and these conducting wires are fixed to the tubes of the still and in electrical connection therewith. Said conducting wires 26 are electrically connected through the insulators and with a high voltage direct current feed wire 27 preferably forming the positive lead from any suitable source 28 of high voltage direct current, the opposite or negative lead of which is grounded at 29. The barrels 1 of the still are also grounded at 30, hence during the operation of the still there is a flow of high voltage direct current from the tubes 25 through the oil to the barrels 1 of the still.

The tubes 25 form and constitute anodes,

and the still barrels 1 form and constitute cathodes, in the particular example illustrated although I do not wish to so limit my invention.

In operating the apparatus to produce gasolene and other light or low boiling point hydrocarbons from crude oil or its heavy or high boiling point distillates, the oil (or distillates) is more or less continuously forced through pipe 6 to maintain the oil level in the still approximately at the line indicated with the tubes 25 completely submerged. The coils 20 on the barrels 1 are energized by alternating current, as hereinbefore described, to maintain the necessary or desired oil cracking temperature in said barrels. Direct current of the necessary high voltage is kept flowing from any suitable source 28 through lead 27, conducting strips 26, to the anode-forming tubes 25 from which a constant radial flow of current is maintained through the hot oil to the cathode-forming barrels 1 and from thence to ground. The oil at the exteriors of the tubes 25 is highly heated by the action of the coils on the barrels 1 and hence said oil and the vapor generated by the heat rapidly rise, maintaining the oil under constant rapid upward flow or circulation at the exteriors of the tubes 25. This rapid upward flow in the barrels 1, sets up and maintains a return flow down through the tubes 25 and into the settling tank 2, the oil entering the tubes through their submerged upper ends and entering the tank from the depending lower ends of the tubes. The tank is common to all of the barrels and tubes, and an upward flow from the top of the tank is maintained into the lower ends of the barrels below the supply of fresh oil entering the communicating unions 5 through pipe 6.

The joint or cooperating action of the heat and direct current on the oil results in the separation and precipitation of carbon and the rapid circulation of the oil past the surfaces of the anode and cathode is for the purpose of preventing deposit of the carbon on such surfaces and to cause the oil, by reason of its rapid movement, to convey the free carbon to the settling tank where the carbon has opportunity to precipitate by gravity owing to the relative quiet body of oil in said tank.

The oil vaporizing and cracking heat from the surfaces of the barrels 1 has a tendency to attract the free carbon toward and cause its deposit on the cathode, the inner surfaces of the barrels 1, but the direct current flowing from the anodes, the tubes 25, sets up what might be termed a counter ionization, and tends to counteract the tendency of the free carbon to move toward and deposit on the surfaces of the barrels, and while this action is going on, the flow of the oil is sufficiently rapid to carry off the carbon before it has a chance to be deposited on the surfaces of either the anodes or the cathodes. Hydrogen is electro positive and carbon electro negative when crude oil or other liquid hydrocarbon is ionized by the passage therethrough of a direct electric current of the necessary high voltage. When such hydrocarbon is thus ionized or broken up or separated into its elements or radicals, hydrogen is attracted toward the cathode, and carbon is attracted toward the anode and tends to travel across the ascending column of oil (in this instance) and deposit on the anode. However, this travel toward the anode is in this instance, retarded by the action of the heat from the cathode, and the high velocity of the ascending oil prevents the carbon from completing its journey to and deposit on the anode surface, and the free carbon is carried off through the open upper end of the tube 25. The direct current flow and the temperature of the oil in the still, are so regulated, that the vapors rising in the top of the still and drawn off through offtake 14, will condense in any suitable condenser to produce low boiling point or light products such as gasolene. The voltage required in each instance, will depend to a certain extent on the distance between the anode and cathode, but will be upwards, approximately, of forty thousand volts. Those skilled in the art will understand the various methods and means that can be employed to produce and control the high voltage direct current required, and hence I have not deemed it necessary to diagram and illustrate such systems and means as might be adopted.

It will be understood from the foregoing explanation, that I do not propose to conduct sufficient current through the hot high resistance oil in the still, to accomplish complete decomposition of the oil. Ionization by the heat and current is carried only to the stage necessary to bring about the breaking up and re-arrangement of molecules that will release the desired percentage of free carbon and result in the production of the product sought.

The still of the type of Fig. 1 is composed of pipe and fittings that are standard and easily obtainable on the market and this still is of peculiar advantage and highly efficient for certain purposes, but I do not wish to limit the broad features of my invention to a still of such type, nor in fact to any particular still structure or means for heating the oil nor to any particular means for maintaining the desired circulation of the oil.

My invention is adaptable to furnace heated stills whether of the vertical or horizontal types, and whether of the high or low pressure types.

For instance, in Figs. 5 and 6, I show a

furnace heated still 38, of the horizontal boiler type. The crude oil or heavy distillate is forced into this still to approximately maintain the oil level indicated, through supply pipe 31. The vapors are drawn off from the top of the still and conveyed to the condenser through offtake pipe 32. The shell of the still forms the cathode and is connected to ground at 33. The anode is formed by a metal pan-like element 34 suspended in the still by the metal conducting strips 35 from the porcelain insulators 36 extending through the top of the still. The strips 35 are electrically connected with the positive lead from any suitable source of direct current, the negative lead of which is grounded as explained in connection with the still type of Fig. 1. The source in the arrangement of Fig. 1 is preferably of the type that converts alternating power current into direct current of the desired high voltage, and the same is true of the apparatus of Figs. 5 and 6.

The anode 34 is in the form of an open-top pan or receptacle arranged in the lower portion of the still and extending approximately throughout the length thereof and longitudinally parallel with the lower portion or bottom of the still. The bottom of the pan-forming anode is transversely curved to correspond with the curvature of the bottom of the still and so as to be approximately concentric therewith and form a narrow oil space between the bottom of the still and the bottom of the pan-forming anode. The direct current flows radially across this space through the oil from the anode 34 to the hot bottom surface of the still that forms the cathode and functions as hereinbefore described in connection with the still type of Fig. 1. The oil being highly heated through the bottom of the still, rapidly ascends in the narrow space between the anode and still bottom, carrying the free liberated carbon upwardly so rapidly that it does not have opportunity to deposit on the metal surfaces, as in the type of Fig. 1. The rapid upward movement of the oil is such as to maintain a circulation in the still that brings about a relative slow movement in the body of oil in and above the pan-forming anode, whereby the free carbon precipitates by gravity above the pan and settles therein and is retained thereby. The term "cracking" is usually employed by refiners of crude oil in referring to methods whereby crude oils and heavy distillates are subjected to sufficiently high temperatures to change the molecular structures thereof and produce various hydrocarbon products having different boiling points.

It is evident that various changes, modifications and variations might be resorted to without departing from the spirit and scope of my invention and hence I do not wish to limit myself to the exact disclosures hereof.

Desiring to protect my invention in the broadest manner legally possible, what I claim is:—

1. In the treatment of oils and the like, subjecting the oil to cracking temperature at a cathode while subjecting the oil to an ionizing electric current flowing therethrough from an anode to said cathode.

2. In the treatment of oils and the like, causing rapid circulation of the oil between an anode and a cathode while subjecting the oil to cracking influences and to an ionizing electric current.

3. In the treatment of oils and the like, subjecting the oil to the ionizing influence of an electric current while the oil is rapidly circulating in a direction transverse to the flow of current therethrough and while the oil is being subjected to a cracking temperature.

4. In the treatment of oils and the like, causing the oil to circulate in a circuit including a relatively narrow space between an anode and a cathode and a settling space or chamber, and subjecting the oil while flowing through said narrow space to the ionizing action of a direct electric current passing through the oil transverse to the direction of flow of the oil.

5. In the art of cracking oils and the like, directing an ionizing electric current flow through the oil while heating the oil to cracking temperature in a direction opposite to the current flow from anode to cathode.

6. In the art of decomposing or breaking down liquid hydrocarbons, subjecting the liquid to electrical influences to prevent carbon deposit on adjacent surfaces, while the liquid is being decomposed or broken down by action other than that resulting from said electrical influences.

7. In the art of decomposing or breaking down liquid hydrocarbons with a resulting release of free carbon, subjecting the liquid to decomposing influences and while carbon is being thus released subjecting the liquid to electrical influences to prevent adhesion of the carbon to adjacent surfaces.

8. In the art of breaking down or cracking liquid hydrocarbons, subjecting the liquid to cracking or breaking down influences and to an ionizing electric current and causing the liquid to travel rapidly while under said influences, to carry off free carbon and to return more slowly for settling.

9. In the treatment of hydrocarbon oils, subjecting the oil in liquid form to a cracking temperature at a heated surface whereby carbon is released from said oil and simultaneously causing an electric current to flow through said oil to said surface to pre-

vent said carbon from depositing thereon.

10. In the treatment of hydrocarbon oils, heating the oil to a cracking temperature while causing the same to circulate between an anode disposed therein and a cathode, and simultaneously subjecting said circulating oil to the action of an electric current to prevent carbon deposit upon heated surfaces.

11. In the cracking of hydrocarbon oils, flowing the oil in a stream longitudinally of an electrode disposed therein, heating said flowing stream of oil to a cracking temperature at a heated surface whereby carbon is liberated from said oil, and simultaneously subjecting said stream to an electric field whose one terminal is said electrode to cause said liberated carbon to migrate away from said heated surface.

12. In the art of cracking hydrocarbon oils, heating the oil to a cracking temperature while in a container, and simultaneously producing an electric field from a point in said container and within the oil to the walls of said container to cause carbon particles liberated from the oil by said heating to migrate away from said walls.

13. A still for the treatment of oils and the like, constructed and arranged to cause the continuous circulation of the oil in a circuit under the influence of heat, said circuit including a settling space or chamber and a relatively narrow passage, an anode and a cathode being arranged along opposite sides of said passage, and means to cause a flow of high voltage direct electric current through the oil flowing through said passage and from the anode to the cathode.

14. A still for the treatment of oils and the like, provided with an anode and a cathode forming a relatively narrow passageway through which the oil is caused to rapidly circulate, said still providing a return passage and settling space, and means for causing an ionizing electric current flow from the anode to the cathode and transversely through the rapidly flowing oil in said passageway.

15. Apparatus for the treatment of oils and the like, constructed and arranged to cause circulation of the oil in an endless circuit under the influence of heat, means for heating the oil to cause said circulation, and means for maintaining an ionizing flow of electric current through the oil while thus circulating.

16. Apparatus for the treatment of oils and the like, comprising means for containing and circulating the oil, means for applying heat to the oil to crack the oil and maintain said circulation, and means for maintaining a high voltage direct current flow through the oil while circulating.

17. A still for the treatment of oils and the like, said still provided with an anode arranged with respect to a wall of the still through which the oil is heated to provide a relatively narrow passageway for the upflow of the oil, said wall forming a cathode, and means for causing a flow of electric current from said anode to said cathode and through the upward flowing oil in said passageway.

18. A still for cracking oils and the like, comprising an oil-flow-directing anode arranged in the still and normally submerged in the oil being treated, means for heating the oil through a wall of the still adjacent to and spaced from said anode, and means for causing a high voltage direct electric current to flow from said anode to said wall and through the intervening body of oil.

19. A still for cracking oils and the like, comprising a settling tank, barrels rising therefrom and opening thereinto and connected at their upper ends for off flow of vapor, means for heating the oil through said barrels, open-end anode-forming tubes arranged longitudinally within said barrels to receive oil therefrom through their upper ends and to discharge oil through their lower ends into said tank, said tubes forming oil passages within the barrels extending upwardly from the tank at the exteriors of the tubes, and means for causing flow of electric current from the tubes to the barrels and through the oil surrounding the tubes.

20. Apparatus for cracking oils embodying means for causing the hot oil to circulate, in combination with means for establishing an electric field within the heated circulating oil to cause migration of solid matter within the oil transversely of the direction of oil flow.

21. In apparatus for the production of lighter oils from heavy oils, means for heating the heavy oil to a cracking temperature through a wall in contact with said heavy oil, in combination with means for establishing an electric field in said hot heavy oil to cause migration of heavy particles in the oil to prevent deposit thereof on said wall.

22. Apparatus for the production of light oils from relatively heavy oils, comprising a heavy oil container embodying means to maintain oil circulation therein by gravity, and means for heating a wall of said container to maintain said oil circulation and subject the heavy oil to cracking temperature, in combination with means to maintain an electric field in said circulating hot oil to cause migration of free carbon in said oil and prevent deposit thereof on said heated wall.

23. Apparatus for cracking hydrocarbon oils, comprising a container for the oil to be cracked, and means for heating the container to subject the oil to a cracking temperature, in combination with means to main-

tain an electric field in said oil between the wall of the container and a point within the oil therein to cause carbon migration in the oil in a direction away from said wall.

24. Apparatus for cracking liquid hydrocarbon oils, comprising a container for such oils, and means for heating a wall of such container to subject the oil to cracking temperature, in combination with means to maintain an electric field within the oil with such wall forming a cathode of said field.

25. Apparatus for cracking liquid hydrocarbon oils, comprising a still, and means for heating a wall thereof to subject the oil therein to cracking conditions, said still embodying means whereby said oil under the heat from said wall is caused to circulate along said wall, and a settling chamber into and from which said hot circulating oil is caused to flow, in combination with means for maintaining an electric field within said hot circulating oil, said wall forming the cathode of said field to prevent deposit on said wall.

26. An oil still provided with a settling chamber and embodying means providing for oil circulation within the still and to and from said chamber, said still provided with heating means to subject the oil to cracking conditions and to promote oil circulation, and electrical means to set up conditions within the still that will counteract the tendency of free carbon carried by the oil to deposit on hot still walls.

27. Apparatus for cracking liquid hydrocarbons comprising a still having a metal wall along which the liquid flows, means to heat said wall to promote liquid circulation and establish liquid cracking conditions, in combination with means for setting up electrical conditions to counteract any tendency of free carbon carried by the liquid to deposit on said wall.

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