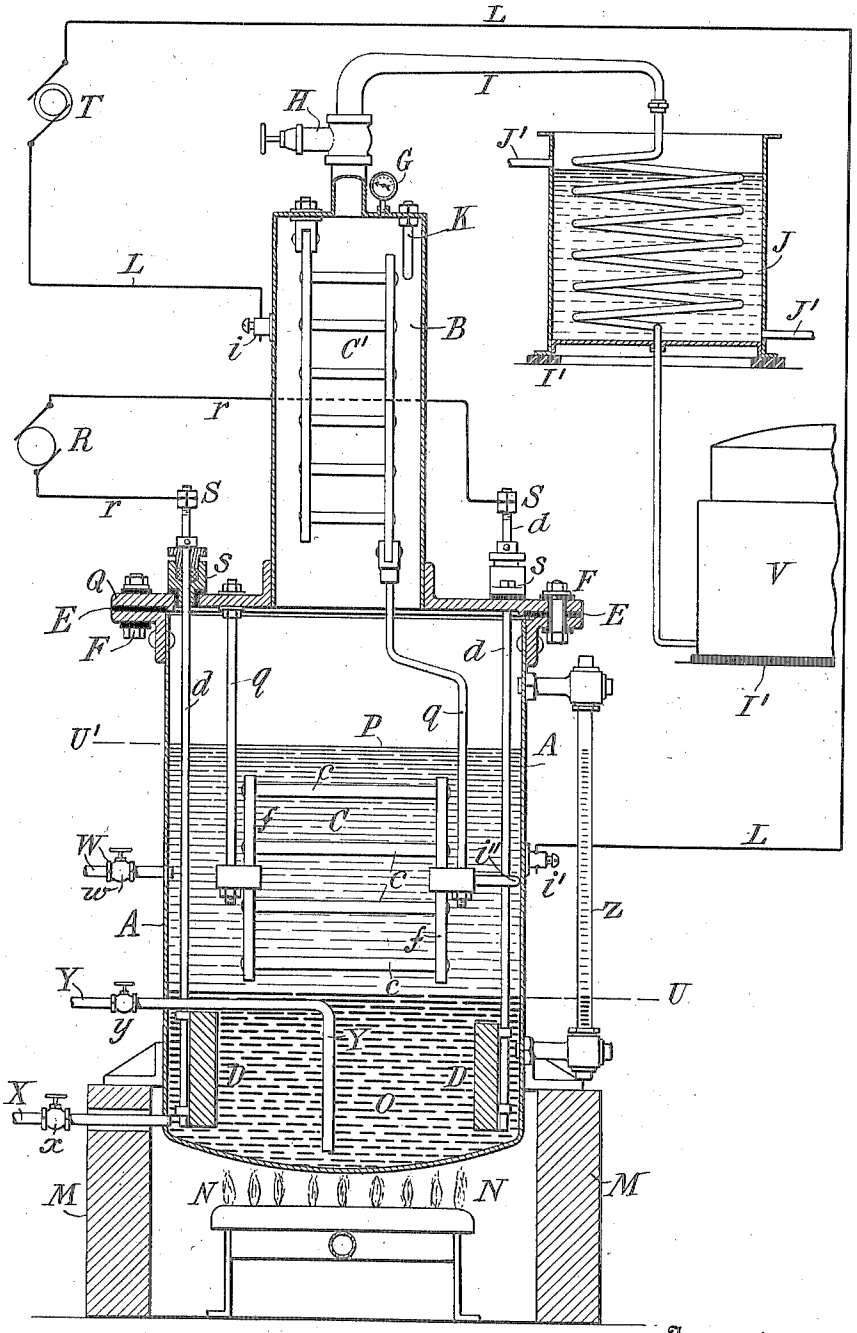
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APPARATUS FOR PRODUCING LIGHT HYDROCARBONS.

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1,345,656. Patented July 6, 1920.



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To all whom it may concern:

Be it known that I, JOHN A. YUNCK, a citizen of the United States of America, residing at South Orange, county of Essex, State of New Jersey, have invented certain new and useful Improvements in Apparatus for Producing Light Hydrocarbons, of which the following is a specification.

My invention relates to processes of producing an increased yield of the lighter hydrocarbons either from the raw product of oil wells or from the residue of manufacturing or refining operations in which the lighter constituents have been removed from the raw oil by existing processes. Thus my invention may employ either ordinary fuel oil, or kerosene as the raw material on which to operate.

In addition to the production of an increased quantity of the lighter hydrocarbon liquids known as gasolene, naphtha, petrol or the like, suitable for use as fuel in standard internal combustion engines, my invention gives added commercial value to the heavier constituents remaining by turning part or all of them into greases suitable for lubricants and other uses in the art of greater value than the ordinary residua and kerosene, now left from the existing oil cracking or refining processes of commerce.

In my invention the first of the above mentioned results is secured according to my present understanding by combining hydrogen with a certain portion of the atoms or molecules of the heavier hydrocarbons dissociated by heat under pressure and preferably in contact with solid, heated carbon bodies, and the second result is secured by oxidizing another portion of such atoms or molecules, which for any reason, do not combine with the hydrogen.

It has been heretofore proposed to accomplish the first above suggested result by cracking the hydrocarbon particles and bringing them into contact with hydrogen generated in a separate apparatus by some of the known commercial methods of making hydrogen, but in such processes great danger of fires and explosions has occurred, and moreover the hydrogen has not readily entered into the desired light hydrocarbon combinations because it was in a dead or stale condition by reason of the interval of time elapsing between its generation and its mixture with the hydrocarbon. My invention avoids these difficulties by generating the hydrogen by the electrolytic action of an electric current on water, or on an emulsion of water and oil, in a closed vessel which is either the same vessel in which the oil cracking operation is itself carried on, or in a closed vessel closely connected to the former, so that no possibility of combustion or explosion arises. Also, the hydrogen, being evolved in direct and immediate contact with the cracking oil vapors, is nascent and in the best possible condition for entering actively into the new combination desired.

One form of apparatus for carrying out my invention, and the best form of apparatus at present known to me embodying my invention, is shown in the accompanying drawing which shows a vertical central section of the same.

In the drawings A is a retort or pot which should be capable of withstanding a high pressure and temperature. It may be made of drawn steel, or of boiler plate or possibly of especially strong glass. This retort may be supported on a brickwork foundation M, or in any other convenient manner according to whether or not external heating of the retort A, is to be employed. N, N, represent gas or oil burners for such external heating. O, is a body of water, or an alkaline or other aqueous solution, which is capable of combining with the supernatent body of oil P. Immersed in the aqueous solution O are two or more electrodes D, D, of copper, silver, nickel or other suitable material which preferably are supported from the cover Q, of the retort A, by conducting strips *d*, *d*, to which external binding screws S, S, are connected so that a direct electric current may be delivered from a source of electric energy R, through circuit *r*, connected to binding screw S, S, to electrodes D, D, and so pass through the electrolyte O. Insulating sleeves *s*, *s*, extend through the cover and around the binding screws S, S, to insulate them from the cover and prevent short circuiting. In the body of oil P, is partly or wholly immersed a system of high resistance conductors C, C, forming a set of resistors. Preferably these resistors are made of carbon tubes *c*, set in copper frames *f*. These also are preferably supported entirely from cover Q, by electrically conductive rods *q*, *q*.

The cover Q, is to be bolted or otherwise fastened to retort A, as by bolts F, so as to form a gas tight joint therewith, and an insulating gasket E, is interposed so that electric current cannot flow from retort to cover or vice versa.

C′ represents another set of resistors formed of carbon tubes in circuit with conducting supports q, and located in the vapor chamber B, formed in cover Q. One or the other of these sets of resistors might be dispensed with, especially when external heating is employed. On the other hand burners N, N, may be dispensed with when resistors of sufficient heating capacity are employed. A heavy electric current is supplied to resistors C and C′ by circuit L from a source of alternating current T. One terminal of circuit L, is connected to cover Q by binding post i and the other to retort A by binding post i'. The conducting supports q are connected to cover Q as before described, and, at a point i'' between resistors C and C′, one support q is in contact with retort A, so that parallel circuits are established through resistors C and C′, which are thus connected in multiple arc with the poles of the source of alternating current T, when the cover is in place.

G, is any convenient form of pressure gage showing vapor tension in the retort. H, represents conventionally a standard form of valve which can be set to allow vapor to pass out of the retort at and above a given pressure for which it is adjusted. I, is the blow-off pipe controlled by such valve and leading to a condenser J (through which cold water may be run through connections J′, J′), and which pipe finally discharges into a gasometer or gas holder V. It is understood, of course, that with this particular arrangement of circuits the condenser, gasometer, retort and connections should rest on bases of insulating material I′ to prevent leakage of current. A thermometer or pyrometer K, may be installed in the cover for determining interior temperatures, and as a check on the accuracy of the pressure gage G.

As so far described the apparatus is sufficient for carrying on intermittent operations. To render the operation continuous the oil may be pumped in through pipe W, controlled by valve w, and the electrolite through pipe X, controlled by valve x. Accumulated grease and solid residues and non-volatile residua may be driven out from the retort through siphon pipe Y, controlled by valve y, and extending nearly to the lowest point in the retort. The level or levels of fluid contents can be seen in gage glass Z, and the supply regulated accordingly.

The new and improved process according to which the above described apparatus operates (and which could be carried on by other arrangements of the parts described) is the following:

The principal raw material is heavy hydrocarbon oil as produced in the oil fields, or kerosene or other modified form of the natural oils, represented at P.

The purpose is to crack or break up the particles of this heavy oil and, by separating those with the lighter hydrogen constituents, or by combining with the vaporized or dissociated particles additional portions of hydrogen to produce a vapor or vapors of lighter hydrocarbons, which vapor or vapors can be condensed into gasolene or naphtha or similar fluid product capable of use in standard internal combustion engines.

The general theory of operation is to accomplish this purpose by bringing the vapor of the heavy oil used as raw material into contact, under considerable pressure, with nascent hydrogen given off at the negative electrode D, and into contact with the highly heated carbon resistors C and C′. The action of the heated carbon of the resistors, as well as of the external heating apparatus, cracks the oil vapor molecules or particles into constituent parts, and so liberates the lighter hydrocarbon constituents. The nascent hydrogen, which is the main product evolved by the electrolysis of the water, combines with the heavier constituents thus released from the oil by the cracking process and this combination forms additional light hydrocarbon products which combine with and enrich those evolved by the ordinary "cracking" and distilling action of the heat. Incidentally, the oxygen also liberated by electrolysis of the water and emitted from the positive electrode combines with the heavier constituents released by cracking the oil and this combination in its turn forms greases useful for lubrication and other purposes in the arts. These, together with the unevaporated heavy oils, if any, are driven out by internal pressure through pipe Y, when valve y is opened.

Whether or not the above theory is correct in all details the practical result of my invention when operated on kerosene is the evolution of large bodies of light hydrocarbon vapors which, when passed through the condenser J, form a hydrocarbon liquid of the average density of about 62 Baumé.

The purpose of combining the water with the oil in the form of an emulsion (which results as soon as agitation by ebullition takes place) is to produce an intimate mixture of the two, particle with particle, so that the hydrogen evolved from each aqueous particle of the emulsion or mixture may freely and promptly unite with the adjacent oily particles of the emulsion, while in the full vigor of its nascent condition. This

action is obviously more efficient than that of a solid stream of hydrogen on a separate integral body of liquid or vaporized pure oil would be, although the latter would be within the broader phases of my invention, if the hydrogen were produced according to the general method here described.

The details of operation would vary with different raw materials and with different conditions existing and results sought. I will give one example as illustrating the general principles involved.

I fill the lower portion of the retort A with an aqueous solution of sodium carbonate in the proportion of one pound of the carbonate for every four gallons of water, the total quantity of this solution O, being sufficient to submerge electrodes D, D. I then introduce enough kerosene or fuel oil P, to submerge resistors C, the levels of the respective bodies of liquid O and P being indicated by lines U, U'. I then pass an alternating current of about 500 amperes and 5 volts through resistors C and C' and set valve H to blow off at 100 pounds pressure to the square inch. If the cost of current is too high, the above given quantity of current may be cut down and vaporization of the oil partly or wholly effected by heat from gas burner N, N. At the same time I pass a current through electrolyte O, of from 1 volt and 100 amperes, to 10 volts and 10 amperes, according to the condition of the emulsion. At the beginning the pure aqueous solution of sodium carbonate would be a good conductor and a low voltage would suffice so that the larger amperage could be employed. As the oil and alkali and water begin to boil and mix to form an emulsion the internal resistance of the fluid will increase and the voltage must be raised and this would usually be concomitant with a reduction of the amperage. The cross section of the resistors C and C' would be so designed that before or by the time the vapors and gases generated by the combined heating actions rose to 100 pounds pressure, the resistors C and C' would be red hot or nearly so and their cracking action upon the oil and vapor would be most effective. The direct current through the alkaline solution, or emulsion O, would evolve considerable volumes of free nascent hydrogen which would be forced into intimate contact with the so dissociated hydrocarbon constituents by the vapor pressure and would tend to form new hydrocarbon vapors of different densities at different levels in the upper half of the retort, and when the automatic valve H opened, these vapors would ultimately flow out separately or in a general mixture through valve H, into condenser J, reaching gasometer V, in the shape of gasolene, naphtha or the like liquids. The operator would watch gage glass Z and maintain the proper proportions of oil and electrolyte by adjusting valves w and x. At intervals valve y in the blow off pipe Y would be opened and the internal vapor pressure would drive out the greases and other heavy residues from the bottom of the retort. After the apparatus reaches the normal temperature of operation the water will boil rapidly on introduction to the retort and pass through the emulsion stage with the oil and some of it will pass off as steam to be condensed with the other products of the operation. The hot carbon resistors will also dissociate the steam into hydrogen and oxygen.

For cleaning, repairing or inspection the cover Q, can be removed carrying with it the resistors and electrodes. The retort body and cover are made the terminals for the heavy current, connections through the resistors being made by internal contact, because so far as known to me, no insulation for the heavy current conductors, such as would be needed if an attempt were made to pass conductors through masses of insulation set in the retort walls, will continuously withstand the heat and action of the hot vapors.

The advantages of my invention reside mainly in the fact that each hydrogen particle is evolved in immediate contact with the dissociated hydrocarbon particles with which it is to become associated in the new combination, and under conditions of heat and pressure favoring such combination, secondarily in that the cracking of the hydrocarbon is facilitated by contact with the hot carbon resistors, and thirdly, in that danger of combustion and explosion is eliminated.

Having described my invention, I claim:

1. In an apparatus for increasing the amount of light hydrocarbon fluids obtainable from a given quantity of native hydrocarbon oil or residuum the combination, with a closed retort for holding the materials, of electrical heating means located in said retort interior comprising a plurality of resistors, one of which is located in the retort space for fluids, and another in the retort space for vapors, and an electric circuit including said resistors.

2. In an apparatus for increasing the amount of light hydrocarbon fluids obtainable from a given quantity of native hydrocarbon oil or residuum the combination, with a closed retort for holding the materials having a space for containing an electrolyte and another space for containing oil, of means for passing an electric current through any electrolyte in said first mentioned space and means for heating all the retort contents.

3. In an apparatus for increasing the amount of light hydrocarbon fluids obtainable from a given quantity of native hydrocarbon oil or residuum the combination, with

a closed retort for holding the materials, of electrodes located at opposite points in the lower portion of the retort interior, a source of direct electric current and conductors connecting it with said electrodes, and means for heating the retort and contents.

4. A combination such as set out in claim 3, in which the heating means comprises a conductor of high resistance located in the retort above the level of the above mentioned electrodes and means for passing an electric current through said high resistance conductor.

5. In an apparatus for cracking fluid hydrocarbons the combination, with a closed retort having a zone for fluids and a zone for vapors, of a carbon resistor located in the fluid zone, another carbon resistor located in the vapor zone, and means for passing electric currents through both resistors.

6. In an apparatus for producing a supernormal yield of light hydrocarbon fluid from a given quantity of heavier oil the combination, with a closed retort having a lower zone for an electrolyte, an intermediate zone for the oil, and an upper zone for vapor, of means for passing an electric current through the electrolyte in the lower zone, carbon resistors in the oil and vapor zones, and means for passing electric currents through both said resistors.

7. In an apparatus for producing a supernormal quantity of light hydrocarbons from a given quantity of heavier oil the combination of means for producing an emulsion of the oil and a suitable electrolyte and means for passing an electric current through said emulsion, whereby the hydrogen so evolved by electrolysis of the conducting portions of the emulsion may immediately combine with the heavier constituents of the oil in said emulsion to synthetically form the desired lighter hydrocarbons.

8. A combination such as set out in claim 7 in which the means for forming the emulsion comprises heating apparatus capable of producing violent ebullition of both the oil and electrolyte contained in the retort.

9. In an apparatus for cracking fluid hydrocarbons the combination, with a retort of electrically conductive material having a removable cover also of conductive material, of a non-conducting gasket between retort and cover, a resistor supported solely from the cover, electrically connected thereto at one end and so located that its other end is in contact with the retort wall when the cover is fastened on, means for fastening the cover to the retort, and an electric supply circuit, one terminal of which is connected to the retort and the other to the cover.

JOHN A. YUNCK.