June 5, 1934. I. W. HENRY 1,961,358

ELECTRIC LIGHT AND WAVE APPARATUS AND METHOD FOR TREATMENT OF HYDROCARBONS

Original Filed July 30, 1931 3 Sheets-Sheet 1

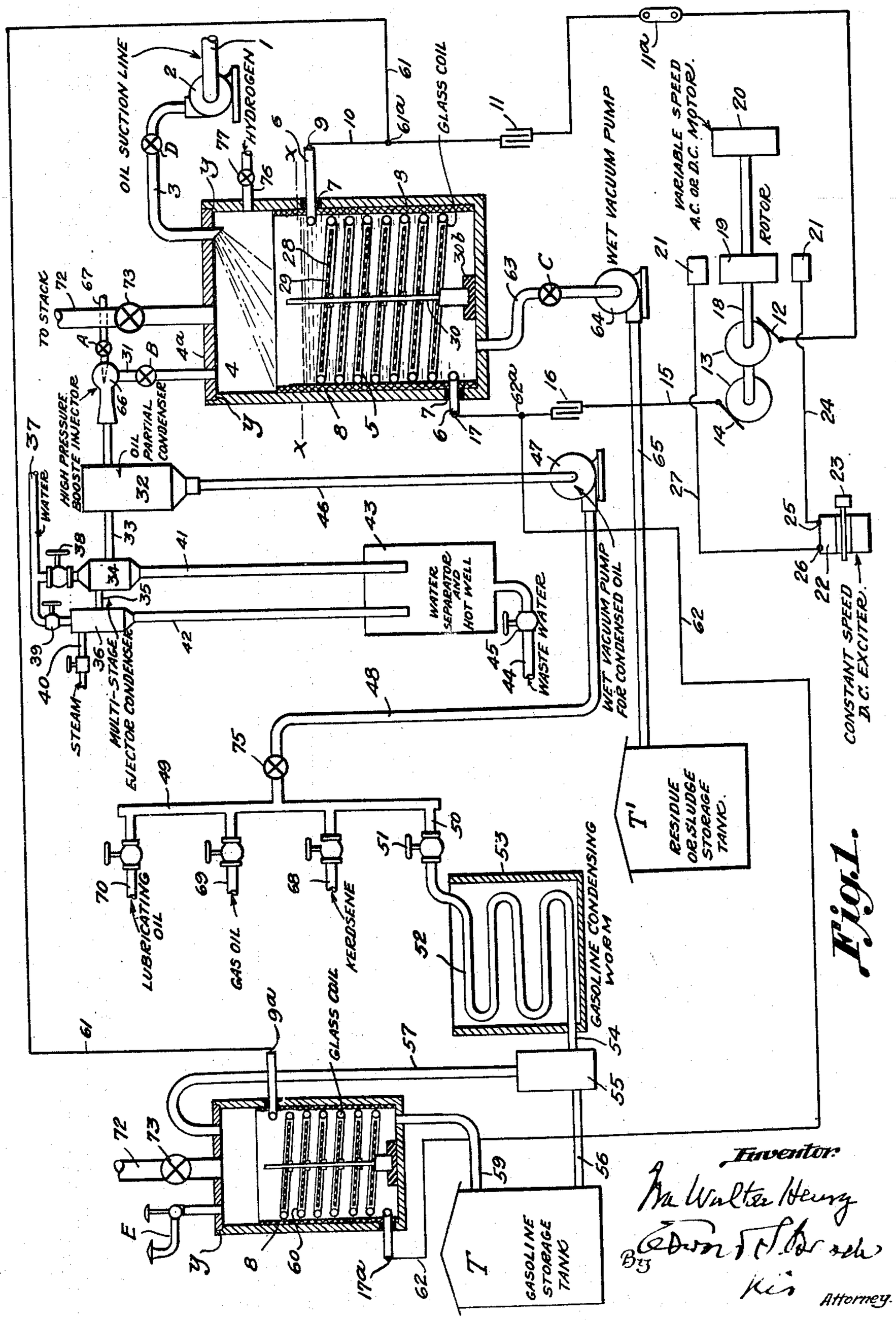

Fig. 1.

Inventor:
Irving Walter Henry
By Edmund T. Bradshaw
His Attorney.

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Original Filed July 30, 1931 3 Sheets-Sheet 2

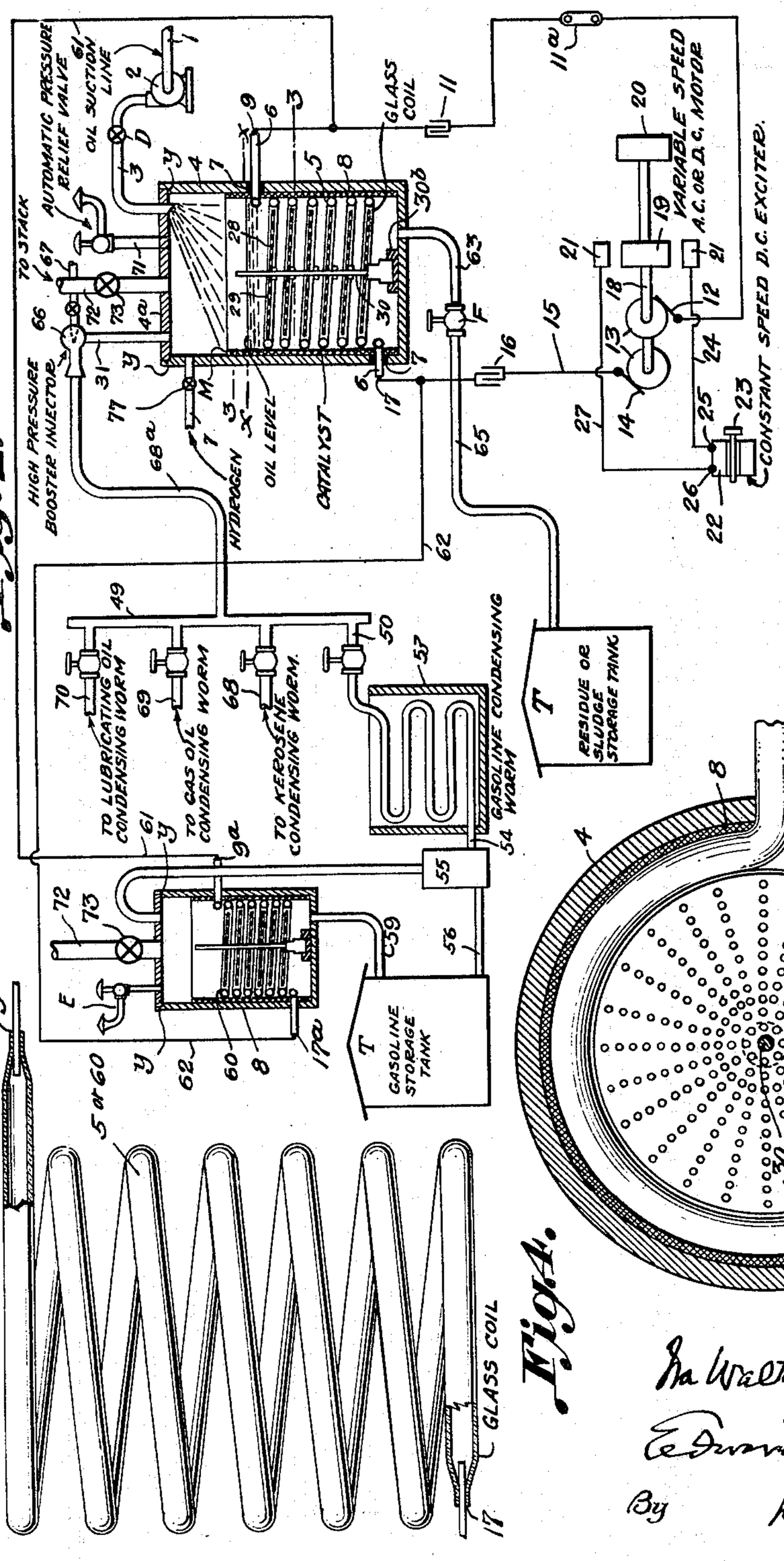

Fig. 2.

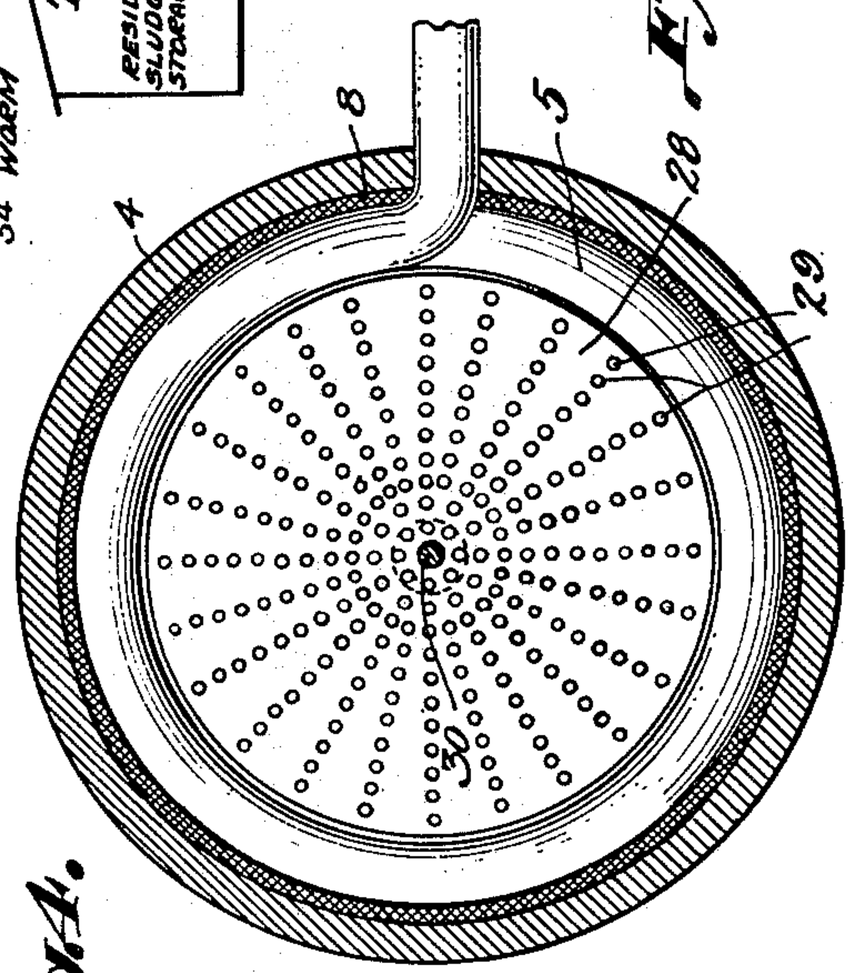

Fig. 3.

Inventor.
Ira Walton Henry
Edward S. Brooks
By his Attorney.

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Original Filed July 30, 1931 3 Sheets-Sheet 3

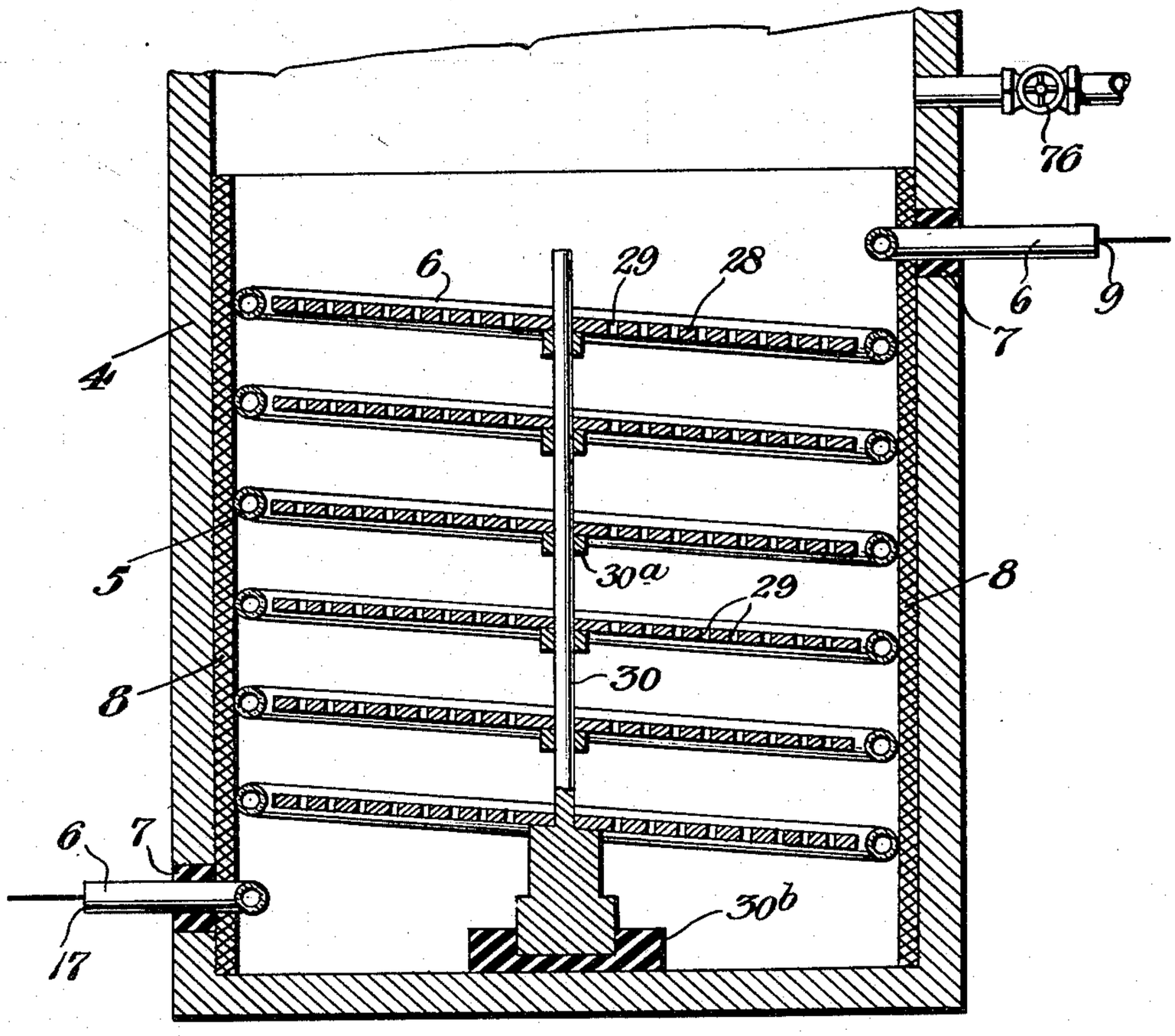

Fig. 5.

Inventor:
Ira Walton Henry
by his attorney
Edward J. Brooks

Patented June 5, 1934 1,961,358

UNITED STATES PATENT OFFICE

1,961,358

ELECTRIC LIGHT AND WAVE APPARATUS AND METHOD FOR TREATMENT OF HYDROCARBONS

Ira Walton Henry, Greenwich, Conn., assignor to Ionizing Corporation of America, New York, N. Y., a corporation of New York

Application July 30, 1931, Serial No. 554,120
Renewed August 19, 1933

6 Claims. (Cl. 204—31)

This invention relates to an electric light and wave apparatus and method for treatment of hydrocarbons, and for other uses. An important object of this invention is simultaneous dissociation and bleaching of the hydrocarbon treated.

By its use even difficultly crackable Pennsylvania crude petroleum oil may be converted readily into antiknock gasoline, for example. According to the American Petroleum Institute data, as is well-known, Pennsylvania crude petroleum while largely used for production of lubricating oils, is so resistant to efficient cracking, by methods and apparatus used prior to my ionization processes of my United States patents and corresponding patents in foreign countries, that Pennsylvania crude oil has not been used for gasoline production.

This present invention is, however, an improvement on that set forth in my pending application Serial No. 386,182, filed August, 1929, for Method and apparatus for treatment of hydrocarbons, and which is efficient for conversion of Pennsylvania crude, and crude petroleum oil from many other fields, into gasoline, as well as other petroleum and hydrocarbon oils.

This invention is also an improvement on the invention set forth in my United States Patent No. 1,709,815, of April 16, 1929, in Fig. 5 of which and the description relating to that figure, I pointed out that a radio audion or vacuum radio tube might be substituted for the current producing and cooling medium conducting coil described in that patent.

It is to be noted, however, that such radio vacuum tubes or audions are energized by rectified that is direct currents. I have found that such so energized radio receiving tubes are not efficient for conversion of some grades of crude or heavy molecular weight petroleum oils into lighter molecular weight products, such as gasoline and lubricating oils; and by the present invention, as well as by that of my said pending application, I am able efficiently to convert all grades of heavy petroleum oil known to me into desired lighter molecular weight oils.

The objects of the present invention are increased safety in use of my ionization apparatus, over use of copper on catalytic metal electromagnetice field generating coils, by use of electromagnetic field generating tubes,—preferably and best of coiled form—in which the field generating current passes wholly within the outer skin or surface of the tubes or coils which may be called self-insulating. By so doing, the following important objects and advantages are obtained.

My new field generating tubes,—preferably coiled,—although conducting a non-rectified electric current, such as an alternating or pulsating current, may be touched by the hands or tools of workmen without injury. Copper or catalytic metal tubes or coils, on the other hand, offer electric resistance and have to be carefully insulated, and also constantly cooled to keep the electrical resistance and loss of power and also to prevent their softening or melting; and any one directly or indirectly contacting with them may be shocked, burned, or otherwise injured. The hydrocarbon treated, whatever it may be, is simultaneously disintegrated or ionized and bleached by the electric waves and by the light rays which effectively dispel impurities and effect a lighter colored product that is more pure by reason of the bleaching.

My new tubes or coils are transparent. They are made of ordinary lead glass, pyrex glass, quartz or the like. When the current is on, they are electric light-ray and electric wave emitting tubes or coils. They are preferably partially vacuumized and in any event have their respective ends hermetically sealed on end portions of conductors or electrodes with which they form the current conveying circuit. The electric oscillations or pulsations within the coils are visible to the naked eye where the coils are observable, as for example at the projecting ends of the coils, as shown in the accompanying drawings. Thus an attendant may visually observe the condition of the oscillations or pulsations in the tubes, the frequencies of which are regulable by regulation of an oscillating or pulsating current with which the circuit is connected.

The current flows or travels along the inner surface of the glass in these partially vacuumized tubes probably as a high tension current travels on the skin of an ordinary porcelain petticoat insulator, or, if the tubes are filled with a gas, through the gas as a conductor.

When a high voltage current of from one thousand to ten thousand volts is applied to the circuit, depending on the length of the coil turns

from sealed end to sealed end, the oscillating or pulsating current passes through the self-insulated coil. If the tubes or coils are charged with a gas, such as hydrogen or neon or mercury vapor a colored light will be emitted with a characteristic electric wave length; in such case the current will pass through the gas as a conductor, but it will still be wholly within the outer surface of the tube or coil. I have found in practice that different frequencies in the electromagnetic fields are required for the best results, depending on the grades and qualities of the hydrocarbons treated; and, for the petroleum crude oils I have treated, I have varied the oscillations from about sixty to about ten thousand or more per second.

The electric waves from the oscillations or pulsations within the outer surface of the tubes or coils generate a non-sparking, electromagnetic wave field transversely of the axis of the coil, cross-axially in all directions and throughout the length of the coil.

It is in such a field that the hydrocarbon starting material is initially vaporized, being ionized as it appears to me. The vapor is then passed to a condenser from which a stream of hydrocarbon liquid flows. Light weight vapors escaping from this liquid and main stream of liquid is then re-cycled through a second, similarly generated electromagnetic field and therein and thereby liquefied. This two step treatment of heavy, petroleum oil, also set forth in my said pending application, results in a superior quality of anti-knock gasoline; or of lubricating oil, depending on the frequencies established in the electromagnetic fields and power applied.

According to the data of the American Petroleum Institute, average anti-knock gasoline has an octane test of about seventy-two per cent, but the best anti-knock gasoline heretofore made by apparatus other than those embodying my said invention tested about octane seventy-four per cent. These tests are of gasoline made by ordinary cracking processes treated with chemical compounds. Gasoline produced by the present invention may be made to respond to these octane tests by regulation of field oscillations or pulsations; and this invention has for one of its objects and advantages the production of an anti-knock gasoline responding to the octane seventy-four per cent test and higher; and also responding to a Baumé sixty to fifty degree gravity test, or better.

According to the American Petroleum Institute data the ideal anti-knock gasoline is characterized by octane 74%; gravity Baumé 60 to 50 degrees.

By the present invention I obtain such a product even from Pennsylvania, practically semi-crackable, crude oil. The reason for this result seems to be that whereas the other cracking process employs a temperature of about 800 Fahrenheit and a high pressure,—and such great heat and the pressure drive off essential constituents of the crude oil which should be retained in order to produce an anti-knock gasoline,—I, by my invention, use only low temperature and no pressure, and by so doing retain and finally liquefy the constituents that are otherwise driven off.

For these reasons and others, I prefer the practically non-pressure apparatus herein described; but whether the partially vacuumized apparatus or the pressure apparatus set forth is used, my new step of recovering and liquefying the fugitive, light weight vapors arising from the main stream of condensed gasoline, and which heretofore have gone directly into the condensate, seems to ionize the mysterious waxy constituent, and also carbon in the vapor, and otherwise to convert the constituents in part and in whole into a non-knocking gasoline even at less than at atmospheric pressure and at negligible field temperatures—temperatures less than that required to soften ordinary lead glass, for example.

To avoid vapor lock in high-speed internal combustion engines the development of which is characterized by increasingly higher speeds, it has been ascertained by scientific tests that gasoline having a gravity of about Baumé 60% is better than gasoline having a gravity of Baumé 70% or higher; and that 72% and higher octane gasoline is slower burning and does not vaporize so rapidly as the higher A. P. I. gasoline, in the overheated manifolds of an engine. All really anti-knock,—knock eliminating,—gasoline has a gravity of from sixty to fifty per cent Baumé, according to the American Petroleum Institute tests and data; by this invention, I obtain gasoline of the requisite gravity for anti-knock effects, my gasoline product testing also at octane 74%; and being produced at temperature varying from about 75° to about 400° Fahrenheit, according to the character of the oil treated; and the temperature being adjusted by regulation of the field generating, non-rectified current used.

I have not found it necessary to remove the catalysts from the apparatus now shown, but use of a catalyst is not essential so far as my experience goes in the use of my new electric light and wave tubes.

It is to be said that in my use of the glass coils set forth I have invariably used the high frequency alternating electric current circuit set forth and claimed in my said pending application, except that the glass coils have been substituted for the catalytic metal coils therein shown.

In the present application, I show the low pressure apparatus of said application with my new glass coils substituted for the metallic coils, the glass coils being electric wave and light emitting portions of the circuit, and forming a new kind of circuit, whether the coils are merely vacuumized or are charged with a gas effective of a colored light and corresponding wave length.

My invention may be used with high pressure apparatus if desired.

In the accompanying drawings forming a part thereof and illustrating apparatus embodying the present invention,

Figure 1 is a view partly in vertical sectional elevation and partly in diagram of my new electric light and electric wave emitting coil apparatus embodying this invention in a highly vacuumized or practically non-pressure apparatus;

Fig. 2 is a view similar to that shown in Fig. 1, but embodying the invention in a pressure apparatus;

Fig. 3 is a cross-sectional view at line 3—3 of Fig. 1 and shows removable catalytic members comprising a plurality of transverse catalytic baffle plates in the electromagnetic field;

Fig. 4 is a view of one of my new electric light and electric wave emitting coils removed, and showing a conductor end or electrode hermetically sealed in each end of the oil, which is of glass or the like.

Fig. 5 is a vertical central section of a vaporizer or still showing baffle plates of catalytic metal inclined in planes of coil turns with dotted lines

indicating induced dissociating, electric coupling currents through coil turns and baffle plates.

It is noted that the partial vacuum apparatus shown in the drawings is of the barometric type and capable of producing a partial vacuum of from about twenty-seven inches to twenty-eight inches of mercury.

In drawings (Fig. 1), an oil or pre-cracked oil vapor supply pipe 1 leads to the intake side of a charging pump 2 which discharges through a pipe 3 into the upper part of the chamber of a vaporizer 4. If preferred, the starting material of crude oil, raw or pre-cracked gasoline, for example, may be fed into the vaporizer 4 by gravity, in some cases, but the use of a feed pump, the speed of which may be varied from negligible head to high pressure of the starting material fed, is desirable as explained below.

The lower portion of the chamber of the vaporizer, 4, which may be called a receiver, or a container, or a still, is provided with an interior, tubular, elongated field generating coil 5, of electric light ray and wave emitting material, which extends upwardly from near the vaporizer bottom to the line x—x which in some cases may be considered as an oil level; for example, in batch treatment of oil. The coil ends 6 extend outwardly through the side wall of the vaporizer. The end portions of the glass or like coil 5 pass back through a collar 7 in the vaporizer wall. The coil is preferably spaced from the vaporizer wall by an asbestos or other suitable cushioning packing 8 between the coil and the side wall of the converter.

An alternating high or low frequency electric current, depending on the character of the material treated, is used to energize the coil for the production, within and transversely of the coil, and throughout the length of the coil, of a high or low frequency, oscillating, non-discharging and consequently non-sparking electromagnetic field of electric light rays and waves. The energy of this field is also exterior to the coil and through the converter wall as it is also through the material of the coil, the supplementary catalytic members mentioned below, the starting material and the vapors thereof. The oscillations in this field are of enormous velocity whether they are of a high, a low or any intermediate frequency.

Said field is effective to dissociate hydrocarbonaceous starting material into hydrogen and electrified carbon particles, these products of dissociation having a movement corresponding to that of the field in which they are generated.

One end of coil 5 is hermetically sealed at 9, on the end of a conductor or electrode 10 provided with a condenser 11 and a switch 11ª. Conductor 10 is in electric connection with the brush 12 of one of the two alternating electric current generating rings 13, the other ring 13 being provided with a brush 14 from which a conductor 15, provided with a condenser 16, leads into sealed connection at 17 with the other end portion of the coil 5. This end portion of conductor 15 forms an electrode. The hermetically sealed connections of the coil ends, at 9 and 17, with the conductor ends are exterior of the condenser. Fig. 5 shows the sealed coil and conductor ends or electrodes.

The generator rings 13 are on a shaft 18 carrying a rotor 19 and driven by an adjustable speed, electric motor 20; the rotor revolving between field pieces 21, provided each with a coil not shown, all as usual; but, in accordance with a features of this invention, and for effecting a constant frequency of adjusted oscillations in the high frequency, oscillating, non-discharging and non-sparking electro-magnetic field through coil 5, and consequently for treatment of the starting material in the vaporizing chamber in such a field possessing constant frequency of oscillations adjusted to the natural period of the starting material under conversion, I now provide for the alternating current circuit, as also set forth in my application Serial No. 386,182, a constant speed, direct current exciter 22 driven through a power application member 23 with which the exciter is provided. Prior to my invention such an exciter has been mounted on the shaft 18, but I remove it from the shaft and drive it independently of the shaft end of the adjustable speed motor 20. This permits the exciter 22 to be driven at constant speed, while the adjustable speed motor 20 may have its speed adjusted for varying the frequency of the cycles and of oscillations in the electromagnetic field; this is, adjusted at the will of the operator to vary the frequency according to the particular quality or character of the material under treatment. One of the field piece structures 21 for rotor 19 is in connection through a conductor 24 with the direct current exciter, at 25; and, at 26, the exciter is in electric connection with a conductor 27 which is in connection with the other field piece structure 21. This special circuit apparatus is of substantial economic importance reducing the cost of the electricity otherwise obtained.

The practical effect and advantage of the arrangement just described, due to the separately and constantly maintained speed of the exciter, is also to maintain electric current strength in all the oscillations of the adjusted electromagnetic field, and consequently to maintain constant frequency of oscillations and constant uniformity of treatment of the starting material and of its evolved vapor, in said field, and constant uniformity of quality of the vapor of dissociation and recombination, for each particular grade of material treated. Uniformity of the vapor results in uniformity of the quality of the hydrocarbon liquid into which the vapor is condensed.

The starting material forms a working load in the electromagnetic field, and the constant oscillations in the field selected for each different kind or grade of material are advantageous in treating different grades of crude petroleum and other hydrocarbonaceous starting material, depending upon their carbon content.

In dissociating different grades or types of crude petroleum or gas oil or pre-cracked gasoline, I change the frequency of the oscillations to suit the so-called natural period of the oil or other starting material. The change in the frequency of the oscillations may be one involving a greater or less frequency than that assumed to be a normal frequency.

In all cases, according to one feature of this invention based on my discovery of its practical efficiency, the crude petroleum of other hydrocarbonaceous starting material treated for production of hydrocarbon fluid is first dissociated into a vapor by the action of the electromagnetic field in the vaporizer chamber; the hydrogen and electrified carbon particles of the vapor then recombining into a purified vapor. Both dissociation and recombination occur in the electromagnetic field and without addition of oxygen or of hydrogen from any source extraneous to the hydrocarbonaceous starting material itself.

This object, feature and economic advantage of the invention constitute an extremely impor-

tant new departure from all comparable prior practice in which additional hydrogen from some extraneous source of hydrogen and oxygen have been introduced into the converter chamber and the electromagnetic field during the dissociation.

The qualitative results arising from exclusion of oxygen and of hydrogen from an extraneous source are very marked in the ultimate products whether they are of high or low molecular weights. When hydrogen from an extraneous source is used on a working scale, either hydrogen gas has to be manufactured in large quantities for supplying the converter and electromagnetic field; or else, the additional hydrogen has to be supplied by dissociation of water at a high temperature sufficient to produce a supply of superheated steam from the converter and electromagnetic field, the latter being raised to a sufficiently high heat to dissociate the aqueous volume introduced in the presence of a catalyst into hydrogen and oxygen. Obviously, dissociation of the aqueous volume used for the additional of extraneous hydrogen supply necessarily involves supplying the converter not only with hydrogen, but also with oxygen. The oxygen does not enter into combination with the hydrocarbonaceous vapor and though some of it may be burned up in high temperature work; the oxygen actively oxidizing oxidizable surfaces with which it may come into contact, and especially attacking the surface of the metallic catalytic elements described below or other catalytic metal in the field. In the present case of the electric light and wave emitting coils, the use of catalysts is in some cases apparently unnecessary.

In the form shown in Fig. 1 the supply pipe 3 communicates with the vaporizer chamber through the converter cover 4ª which is suitably fixed in place at *y*.

The vaporizer chamber is shown provided, within the electric light ray and wave emitting coil 5, and within the electromagnetic field, with removable catalytic elements in the form of a plurality of removable, transverse, horizontal, spaced apart, perforated nickel or other catalytic metal plates 28 which are frequently perforated at 29, being supported on a vertical stepped post 30 provided with spaced shoulders 30ª for the centrally holed plates. The plates are spaced apart one above the other. Each is in an approximate plane of a coil turn, in an electrically coupled relation to a coil turn. The effect of this coupling is a vast multiplicity of induced currents, some of which are indicated by *a*, through the coil turns and plates. The perforated plates permit a somewhat slowed down escape of the vapor purified between the plates which, as baffles, retard the vapor escape and produce what may be metaphorically called a cooking of the vapor in the field oscillations combined with the induced currents due to the electric coupling of the coil turns and catalytic plates. This I find to be of high importance in that it dispels all waxy constituents and results in the so-called Premium gasoline referred to by the Bureau of Mines; and at the same time, the oscillating or pulsating electric light rays have a powerful bleaching effect on the hydrocarbonaceous material under treatment, producing a purified, anti-knock gasoline; or, if desired, a purified lubricating oil of the smoothest working character. In a word, this feature of my invention, apart from the bleaching effect due to the electric light, is of great advantage in stills having metal coils as in my said patents and pending, application Serial No. 386,182, the baffle plates may be supported in any desired practical manner. The glass coil is preferably mounted in the still chamber both for direct bleaching effects and safety to the coil. Considered as an ionizing and catalyzing means, this feature unites in cooperation, an oscillating or pulsating electromagnetic field of any desired equal frequency; the ionizing power of which is enormously increased by the immense number of induced coil and baffle plates coupling circuits above, between and below the plates; the oil or vapor being held in retarded flow by the baffle plates of catalytic metal.

When the oscillating, non-discharging, non-sparking electromagnetic field is established, and oil or vapor is introduced into the field, by the feed pump, if that is continuously operated, the oil or vapor is jetted or sprayed into the upper portion of the vaporizing chamber from the discharge end of the feed pipe, upon and between the members of the catalytic elements and into the electromagnetic field. The jetting or spraying action is favorable to the almost instantly occurring subsequent dissociation. If desired, the initial oil or pre-cracked gasoline or vapor supply may be preheated by any suitable kind of preheater.

By the natural period of the different kinds or types of the starting material and evolved vapors is meant, as usual in physics, the inherent amplitude of vibrations peculiar to each different type of petroleum starting material in which there are a great many varying qualities.

It is during the dissociation that different impurities, often including sulphur as in Texan and other oils and vapors, are released from the starting material, collecting on the vaporizer walls and bottom, and on the walls of the members of the catalytic elements when and if the latter are used.

The dissociated hydrogen and electrified carbon particles of the recombination constitute a purified hydrocarbon vapor which passes out of the upper part of the vaporizing chamber, in a purified and also in an expanding condition, through an eduction pipe 31 that discharges the vapor into a partial condenser 32 having two discharge ports. An upper port is provided with a pipe 33 that delivers into a multi-stage ejector condenser member 34 which is in communication through a pipe 35 with an associated chambered multi-stage ejector condenser 36. The tops of both members 34 and 36, are in connection with the water supply pipe 37; member 34 being connected with pipe 37 through a valve 38 and member 36 communicating with pipe 37 through a valve 39. The member 36 is provided with a valved steam intake pipe 40. The chambered member 34 has a bottom discharge pipe 41 and member 34 has a bottom discharge pipe 42. Both pipes 41 and 42 discharge downwardly into a water separator and hot well tank 43 provided with a waste water discharge pipe 44 having a valve 45.

The partial condenser 32 has a discharge pipe 46 from its under portion to a wet vacuum pump 47 for condenser oil from the partial condenser 32, and pump 47 delivers through an eduction pipe 48 to a fractionating manifold 49 having a gasoline delivery pipe 50 provided with a valve 51 through which the gasoline flows into a condensing worm 52 in the gasoline condensing tank 53.

For recovery of fugitive or light fixed gas, which rises from the gasoline flowing from the

condenser and for incorporation thereof as a fluid forming part of the general gasoline supply in the gasoline storage tank T, the discharge end portion 54 of the worm 52 leads into the expansion chamber of a gasoline receiver 55 above its bottom; the main portion of the gasoline flowing out of the receiver chamber through an eduction pipe 56 that discharges the main stream of gasoline into the gasoline storage tank T. But the exceedingly light and economically important fugitive or exceedingly light weight gas, expandingly and continuously rising from the main stream of the gasoline, flows upwardly through the receiver 55 and out of it through a pipe 57 into the chamber of a converter 58 in which the light weight fugitive fixed gas is converted into fluid gasoline which flows out through a pipe 59 into a place of reception which is preferably the gasoline storage tank T.

The converter 58, wherein the vapor escaping from the main gasoline stream is liquefied, is provided with a glass or like electric light and wave emitting coil 60, the same as coil 5 in vaporizer 4; the coil ends projecting through the converter walls and being each hermetically sealed on a conductor end, as shown at 9^a and 17^a. This coil 60 is in circuit through leads 61 and 62 with the conductors 10 and 15. The converter 58 is shown provided with the removable catalytic plates 28, as in the case of the vaporizer 4.

Apparatus for the purposes described may be made largely of ceramic material when economy of plant construction is desired, the coils being of glass or the like as above stated.

Substantially better results are obtained for liquefaction of the fixed gas introduced into converter 58, and subjection therein to the action of the oscillating, non-discharging and non-sparking electromagnetic field, by winding the coil 5 clockwise and the coil 60 anti-clockwise as shown, as described and claimed in my said application, Serial No. 386,182 and as herein also shown.

The alternating current generator driven at at a variable speed and in circuit, as described, with the constant speed direction current exciter produces a constant magnetic field in the generator when the generator speed is varied. The variations in the speed of the generator create variations in the frequencies without changing either the strength of the alternating field or the voltage of the exciter; and the catalytic metal pole-forming portions, if they are used, are alternately polarized, thus alternately subjecting the starting material to polarizing effects. The opposite side of each plate serves as a pole.

I have found in practice that the winding of the coils in reverse directions has a new effect on the catalytic electrically energized members that is quite different from the effect obtained when the coils are both wound in the same direction. The coils wound in reverse directions as shown are connected in series and are wound clockwise and anti-clockwise in order to vary the magnetic fields produced in the catalytic metal members, severally, and analogously to the field variations obtained by winding electromagnets in direct current work for production of north and south poles; the so oppositely wound coils effecting the opposite polarities, act and react on the catalysts and on the carbon content of the starting material under treatment. I find that this action and reaction positively intensifies the conjoint action of the catalysts and energized carbon particles and that the polarization of the catalytic material is a highly important feature of my invention, as set forth in said application Serial No. 386,182. It is herein shown because the effects obtainable are useful with the electric light and wave emitting coils when the material to be treated is of a kind difficult to vaporize or liquefy in the said fields.

The vaporizer 4 has a bottom discharge pipe 63 for carrying off impurities or sludge. It leads to the intake side of a vacuum pump 64 which discharges through its eduction pipe 65 into a sludge residue tank T'.

When and if the apparatus is to be operated for production of lubricating oil, it is desirable to put a high pressure booster ejector into operation ahead of the vacuumizing apparatus described, if that is used; or ahead of the fractionating manifold, as the case may be. Such a booster ejector is shown and includes a chambered member 66 provided at one end with a high pressure steam supply pipe 67 which delivers steam into the chamber of member 66 crosswise of the upflow of vapor of recombination from vaporizer 4 through pipe 31. This ejector member 66 is interposed, conduitwise, in the pipe 31, the discharge from member 66 being through a portion of the pipe 31. If the ejector booster member is used, the hydrocarbonaceous vapor ascending into the booster member is entrained by the high pressure steam.

When and if pressure is desired, the vacuumizing apparatus and its members may be omitted, and the apparatus constructed as shown in Fig. 2, in which a conduit 68^a connects the booster discharge end with the manifold.

To shut off the booster ejector, a valve A with which the high pressure steam supply pipe is provided, is closed. The booster ejector structure then becomes merely a portion of the conduit connection of vaporizer 4 with the partial vacuum apparatus designated by the reference numerals 32 to 48, inclusive.

The sludge discharge pipe 63 is provided with a shut-off valve C in Fig. 1 and a shut-off valve F in Fig. 2; and feed pump eduction pipe 3 is provided with a shut-off valve D in each figure. When the valve C is closed, the feed pump may be operated slowly to supply vaporizer 4 with a batch of starting material up to the level x—x, valve D being then closed. Various other valves may be supplied for convenience in adapting the apparatus to various working conditions.

The fractionating manifold 49 is provided as usual with valve take-off pipes such as 68 for kerosene; 69 for gas oil and 70 for lubricating oil. In the pressure apparatus of Fig. 2 vaporizer 4 has a relief valve 71.

Vaporizer 4 is provided with a flue 72 provided with a shut-off valve 73. The flue is used only when the converter is to be cleaned out by raising the temperature of said field and burning sludge and other impurities off interior surfaces of and within the converter chamber.

Reduction of current strength in the coils by reduction of the speed of the alternating current generator constitutes the practical way of obtaining a low temperature of the converter structure in whole and in part. I have found it very desirable not only for safety and convenience but also for increased quantitative and qualitative results in the distillation of some grades of crude petroleum, to operate at substantially low temperatures; for example, at from about 75 degrees Fahrenheit up to about 250 degrees Fahrenheit. Production of motor fuels and the like

at any of such low temperatures in use of electromagnetic fields has been hitherto unheard of in the art; and just as the dissociation and recombination above referred to, without addition of oxygen or hydrogen, constitutes a new departure in the art; so my present low temperature distillation by the electric light and wave emitting coils constitutes a new departure, and it has the great advantages of safety and convenience because the vaporizer and converter in their general structure are kept approximately cool, and workmen are not liable to be burned or otherwise injured by contact with the coils or vaporizer or converter walls. Moreover, my invention secures freedom from explosions and substantially increased quantitative and qualitative results.

By operating the charging pump at speed the starting material will issue as a spray into the upper portion of the chamber of converter 4. As the oily spray descends, counter-currentwise to the ascent of the generated and recombined vapors, it passes into the electromagnetic field and is immediately dissociated. Simultaneously, sulphur and other impurities are separated from the vapors of dissociation, and are best removed continuously away from the presence of the dissociating and recombining constituents of the vapors by operation of the pump 64 or by unaided, outflowing discharge through the pipe 63. The molecular weight of the starting material is reduced during dissociation and recombination by elimination of the various impurities referred to including the mysterious waxy substance above mentioned.

When the higher partial vacua are required than above indicated, and such as correspond to an absolute pressure of approximately fifteen millimeters of mercury, such vacua may be obtained by the operation of the steam jet type of booster ejector above described; but whatever degree of partial vacuum is required may be obtained by use of any other practical form of partial vacuumizing apparatus.

As in some cases it may be preferred to install a pressure system as a unit, I have shown in Fig. 2 a pressure system. In the Fig. 2 construction, the sludge discharge pipe 63 leads directly to the pipe 65 through the shut-off valve 64^a which takes the place of the wet vacuum pump 64 shown in Fig. 1. In Figs. 1, 2 and 5 I show transverse, perforated, nickel, and therefore catalytic inclined baffle plates 28, the peripheries of which are closely adjacent convolutions of the coil with the insulating mat 8 interposed between the vaporizer wall and the interiorly mounted coil. These plates are removable.

Each post 30 is supported on an insulation member 30^b on the bottom of a vaporizer.

With some grades of material or under some circumstances, hydrogenation may be desired and be beneficial as explained in my prior patents. A hydrogen intake pipe 76 is shown. It is provided with a shut-off and regulating valve 77, this hydrogen supply pipe discharging into the converter chamber for the starting material or otherwise as may be preferred. By closing valve 77 no hydrogen will be admitted.

The booster ejector 66 when used assists in propelling heavy gases through the vapor pipes commonly called vapor lines. Operation of ejector 66 effects higher vacua which increase the flowing movement of the heavy gases through the vapor lines.

By increasing the frequency of the current through the coil the function of which, as already stated, is to establish a low or high frequency, oscillating, non-discharging, non-sparking electromagnetic field of electric light ray and waves within the coil and converter chamber, a distillate of heavier molecular weight, such as lubricating oil, is obtainable.

It is a demonstrated fact that temperatures are of relatively and generally of silght importance in the described operations which are effected mainly, if not in most cases exclusively, by change of frequencies to which questions of temperature are incidental.

The upper space of the chamber of the vaporizer 4 forms an expansion chamber.

The simultaneous bleaching of the hydrocarbon while it is being disintegrated, dissociated or ionized in the field is of substantial importance with some petroleum oils and vapors as it secures a purer and smoother product of lighter color indicative of a high degree of purification.

What I claim is:

1. The herein described method of making antiknock gasoline, consisting in vaporizing petroleum oil on an electromagnetic light and wave field at a temperature of from about 75° to about 400° F., and at approximately atmospheric pressure; in condensing the vapor into gasoline and passing the gasoline as a main stream to a place of reception; in capturing light weight vapors arising from such main stream and recycling them through another electromagnetic wave field therein and thereby converting the captured vapors into gasoline; and in recovering the converted, captured vapor into gasoline.

2. The herein described electric current circuit, comprising an electric light and wave ray emitting coil; a non-rectified electric current conductor sealed in each end portion of the coil; the two conductors so sealed in the coil ends forming an electric circuit; and, in the circuit, a non-rectified current generator, a variable speed motor for driving the generator; a constant speed direct current exciter or direct current source; and leads connecting it in circuit with the rotor ring structures.

3. The herein described electric current circuit, comprising an electric light and wave emitting coil; a non-rectified electric current conductor sealed in each end portion of the coil; the two conductors so sealed in the coil ends forming a circuit; and, in the circuit, a non-rectified electric current generator; a variable speed motor for driving the generator; a constant speed direct current exciter; leads connecting it in circuit with the rotor ring structures; another non-rectified electric current circuit ends of which are severally connected with a lead from the generator; and a second coil of electric light and wave emitting material; the latter coil having each of its ends sealed on an end of said other circuit.

4. In electromagnetic field generating and still forming apparatus, the combination with a still and electromagnetic field generating and maintaining apparatus; including an electric current conducting coil; of a catalytic baffle plate mounted in the still chamber in the approximate plane of a coil turn thereby forming an electric coupling generative of a multitude of induced electric currents through the coil turn and baffle plate supplementary to the field movements, the baffle plate serving to hold material treated under the influence of both the field movements and the multiplicity of induced currents upon the coil and plate, while permitting resultant vapor to escape therefrom.

5. In the apparatus set forth in claim 4, the coil being made of translucent material emitting electric light bleaching and ionizing rays.

6. In electromagnetic field generating and still forming apparatus, the combination with a chambered vaporizer; a translucent electric light and wave emitting coil in said chamber; insulating material between the chamber wall and the coil; and, within said chamber, a plurality of spaced apart, catalytic baffle plates each in the approximate plane of a coil turn; whereby the electromagnetic field energy is augmented by a multiplicity of induced, dissociating currents through the coil turns and baffle plates, and whereby the material ionized or dissociated in the augmented field is retarded in its outflow therefrom.

IRA WALTON HENRY.