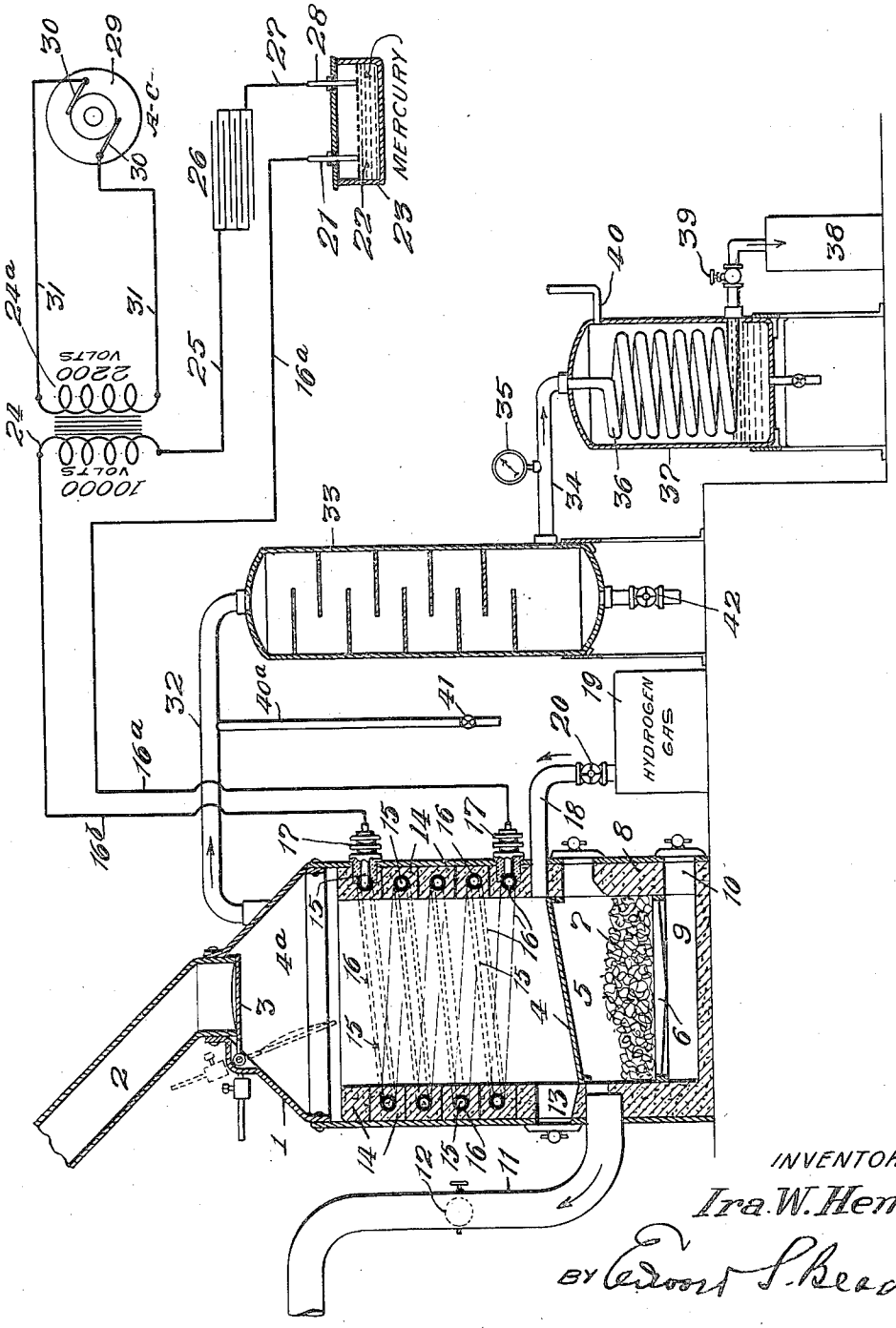
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IONIZING RETORT

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IONIZING RETORT.

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This invention relates to an ionizing retort for use in practising my new method of manufacturing gases set forth in my application Serial No. 66,129, of even date herewith, filed Nov. 2, 1925, and my new method of manufacturing benzol set forth in my application Serial No. 66,130, of even date herewith, filed Nov. 2, 1925.

The object of this present invention is to produce a partially closed ionizing retort in which hydrocarbonaceous material, commonly bituminous coal, is gasified or vaporized and in which gaseous particles of the vapor are ionized by simultaneous heat and energy of a high frequency oscillating field which is also a heating field.

In the accompanying drawing forming a part hereof and illustrating the present invention, my new retort structure is shown in vertical central elevation in conduit connection with a gas scrubber and gas condenser, both shown in vertical central elevation, the retort being electrically connected with a source of alternating current and the electrical apparatus being shown diagrammatically.

Referring to the drawing, 1 indicates an upright, cross sectionally cylindrical retort casing of boiler iron or other suitable material. It is provided at its upper end with a charging chute 2 the lower end of which discharges into the top of the retort. The discharge end of the chute is provided with a gas-tight forming door 3 which is closed after the retort is charged, the material with which it is charged being supported on a solid bottom 4 elevated preferably, but not necessarily, above a preheating chamber 5 that contains, in the form shown, at its bottom portion, a grate 6 for supporting fuel 7. The lower portion of the retort is provided with a doorway 8 for introduction of the fuel 7 and there is an ash pit 9 below the grate. The bottom portion of the retort is provided with an ash removal doorway 10. The preheating chamber 5 is provided, above the grate, with an upwardly and outwardly extending flue or chimney 11 shown provided with a damper 12. Above the solid supporting bottom 4, the retort is provided with a doorway 13 for removal of the residue of distillation, such as coke, asphalt, tarry oils, etc.

In accordance with this invention, the retort casing 1 is lined with fire brick 14 between the solid bottom 4 and the upper portion of the retort, wherein the top space 4^a forms a gas chamber through which the charge falls to the bottom 4 of the retort which is filled up with the charge within the space enclosed by the fire bricks.

The fire brick are formed with communicating holes in the horizontal direction through their bodies and there is located within these holes; that is, within the fire bricks, an electric secondary current circuit conductor 15 covered with asbestos 16, the so covered electric circuit wire 15 being arranged in a coil. Thus, the wire itself is insulated by its asbestos covering and the so covered wire or conductor is contained within the fire brick so that the charge does not come into contact with the covered circuit wire or conductor which is spaced apart from the interior fire brick surface of the retort by the intervening brick. The ends of the coil conductor 15 are brought into insulated support through the vertical side wall of the retort with suitable high tension insulators 17, one above the other. The under end of the conductor coil 16 leading from the under insulator 17 is, exteriorly of the retort, indicated by 16^a. The upper end of the coil conductor 16 is, exteriorly of the retort where it leads from the upper insulator 17, indicated by 16^b.

An extraneous hydrogen gas supply pipe 18 leads into the under portion of the charge containing chamber above its bottom 4 from an extraneous gas container 19 and is provided with a regulating valve 20.

The conductor 16^a is electrically connected with a copper electrode 21 in contact with the upper surface of a volume of mercury 22 in a mercury container 23 of iron.

The conductor 16^b is in electrical connection with a secondary transformer coil 24, which, when in operation, has a voltage of about 10,000. The secondary transformer coil 24 is electrically connected by a conductor 25 with an electric condenser 26 which is connected by a conductor 27 with a copper electrode 28, the bottom of which contacts with the upper surface of the mercury 22. The primary transformer coil 24^a is in electric connection with a brush 30 of

an alternating current generator. Another brush 30 is in electric connection with the primary transformer coil. The primary conductor is indicated by 31. In operation, the primary conductor coil is given a voltage of 2200. The current employed is a high frequency, oscillating current. In operation an electric arc is formed between the copper electrodes 21 and 28 at their contact with the mercury, the arc producing oscillations which effect the frequency of the current.

In operation, hydrocarbon vapor generated from the charge and accumulating in the upper space 4^a of the retort flows out of the retort through a conduit 32 which discharges downwardly into the top of a gas scrubber 33, the under portion of which is provided with a conduit 34 which has a gas pressure gauge 35 and conveys the ionized and scrubbed hydrocarbon vapor into the upper portion of a condensing coil 36 in a tank 37 provided with a water inlet pipe 40 and an escape pipe. The coil 36 discharges the scrubbed, ionized hydrocarbon vapor into a suitable receiver 38; the discharge end portion of the coil being provided with cut-off valve 39. Conduit 32, between the retort and the scrubber, is provided with a dependent pipe 40^a having a shut-off valve 41, for use in making tests of the hydrocarbon vapor generated and ionized in the retort. The foot of the scrubber is provided with a valved clean out tube 42.

While hydrogen gas and other fixed gases are not liquefied at ordinary temperatures and pressures, yet, when hydrogen gas combines with carbon to form any of the hydrocarbon series. the resultant gas can be liquefied by cooling below its particular boiling point; the question of pressure, other than atmospheric pressure, is not then involved.

The ultimate objective of my said invention whether pertaining to apparatus or to method of generating hydrocarbon vapor from hydrocarbonaceous material or to method of manufacturing benzol is the production of hydrocarbon oil from either anthracite coal or bituminous coal or from other suitable carbonaceous material. Such oils are useful in various arts and if the oil is benzol it is useful as a motor fuel.

Coal, especially bituminous coal, contains a large proportion of carbon and by my invention may be treated in such a manner as to supply a required additional amount of hydrogen gas to that normally contained in coal. By my invention, when it is restricted to the production of benzol, the benzol is produced as the main product. Heretofore benzol has been produced from coal as a by-product in the manufacture of coke, being thus produced by hydrogen already in the coal in its natural state combining with the carbon.

In my current practice, I use powdered bituminous coal the size to pass through a quarter inch screen. Coal to be powdered is customarily wet down to minimize dust and loss, and powdered coal is ordinarily more or less wet with water. The water content in the powdered coal referred to is favorable to the operation of the present method. This powdered coal is then run into the retort through its chute together with an admixture of approximately 10% of limestone of the same size as the powdered coal.

The electric current is of the alternating type and may be produced either from a commercial, alternating electric circuit or electric dynamo on the premises. The current is transformed from its primary potential of about 2200 volts to 10,000 volts; and the current is conducted through an electric arc produced by said copper electrodes in the mercury bath enclosed in its iron container. The electric arc produces oscillations which with the electric condenser secure the necessary frequency of approximately 50,000 periods a second. The circuit controlling the current is protected by the usual necessary fuses and switches for controlling the same.

Adjacent the retort, an exterior container of, broadly considered, any desired hydrocarbon vapor is provided for the introduction of the extraneous or supplemental gas in proper proportions into the charge. In case of the manufacture of benzol, I supply to the retort enough hydrogen gas to make up six atoms of hydrogen to each six atoms of carbon any hydrocarbonaceous vapor produced. In making other hydrocarbon vapors or oils, the percentage of hydrogen is varied according to the requirement of the product; but, of course, the retort may be used for any desired purpose without departure from this invention.

The use of limestone in the production of benzol is not essential but is economical and otherwise desirable.

It is not essential, but I have found it desirable to preheat the charge to be treated by means of a fire in the grate.

When and if benzol is the ultimate product and limestone is used in mixture with the coal, I preheat the charge by means of the fire in the grate to a temperature of approximately 900° F., and then when the charge has reached the desired temperature, the electric current is turned on through the secondary coil within the fire brick with the resultant effect of disintegrating or ionizing the particles of the gases generated by the heat and of putting them into a condition in which they rapdily combine with the hydrogen from the exterior source. In the meantime, the heat from the secondary coil has decomposed the gases from the limestone. The limestone acts as a flux and

tends to retard evolution of the vapor from the coal and tends to retard the outflow of the light gases generated from the limestone and thus tends to effect more complete ionization.

It has been found that limestone when intimately mixed with coal rich in hydrocarbons and having a high oxygen content commences to decompose at a temperature lower than the resinous and other matter contained in the coal, and that when this action occurs it slightly retards evolution of hydrocarbon gases given off by the coal, thus causing them to become more stable, decreasing the residue of distillation and increasing the output of benzol.

The limestone, as above indicated, facilitates the ionization. The cycle of operation, according to my experience, takes practically about fifteen minutes per long ton (2240 pounds) of coal, but varies with different grades of coal. The time is easily determined by an examination of the resultant gas taken off at said test cock. The gas obtained from the retort is passed through the scrubber to free it from free carbon, asphalt, tarry oils or other objectionable material and is finally condensed to produce the desired liquid.

Apparently the energy of the secondary high frequency heating coil 16 is exerted directly on the particles of carbon suspended in the generated gases, such carbon particles being partial conductors of the electric current; and the high frequency oscillations evidently ionize such particles and thus place them in a receptive condition for chemical combination with the introduced, free hydrogen. The heat produced from the secondary high frequency and heating electric coil installed in the fire brick would of itself heat the charge and gases, but in some locations it is more economical to preheat the charge by a fire in the grate than by use of the electric current employed in connection with the retort or otherwise. It is obvious that electric preheating of the charge could be substituted for the fire on the grate, if so desired. By heating the preheated charge by the heat emanating from the secondary coil, the ionization or change in molecular condition of the coal and limestone, or of the coal alone if the limestone is not used, is more rapidly effected. As a possible explanation of the effect of the high frequency, it is suggested that there may be a quantitative relation between the rate of vibration of the molecules of the hydrocarbons on the one hand, and, on the other hand, of the frequency of the electrical oscillations.

I find in practice that by the use of the apparatus, as illustrated and described, bituminous coal is readily and quickly converted into the liquid,—benzol (C_6H_6),—the coal, in consequence of heat and ionization, obviously evolving a hydrocarbonaceous vapor which in its ionized state combines with the admitted hydrogen into a benzol vapor, and then goes to the gas scrubber and condenser. This is one example of results that can be effected by use of the described invention.

The products of combustion of any suitable fuel used on the grate of the preheating apparatus go to the air through the chimney or flue 11. The door for the ash removing doorway 10 is ordinarily provided with an air admission opening and damper, as usual in furnace construction. Even if an electric current heater were substituted for the preheating means illustrated, it would be ordinarily unnecessary and non-economical to consume such electric heater current as a source of heat auxiliary to that produced by the high frequency oscillating field of the secondary current conductor 15. In practice, however, the preheating apparatus, whatever its form, may be used continuously during the heating of the material to be distilled.

It would seem that the high frequency, oscillating field effects disassociation of molecules in the gaseous vapor given off by the material in its heated condition and changes the polarity of the electrons. Considering the effects of said high frequency oscillating field which is also a heating field, by light of the electron theory, it may be that the positive electrons change their polarity in the electric field in which they vibrate and are attracted into chemical combination with electrons in the hydrocarbon gas introduced from its extraneous source into the material within the retort chamber.

What I claim is:

1. An ionizing retort for distillation of hydrocarbonaceous or other suitable material having a solid bottom; thereabove a charge receiving chamber, a charge supplying means, means for gas-tightly sealing the charge supplying means, and a gas eduction port; the retort having adjacent its bottom a doorway for removal of the residue of distillation; and the retort having above its bottom a fire brick wall containing a secondary transformer coil in combination with a primary transformer coil; an electric current condenser and a mercury bath container; the secondary transformer coil circuit conductors being severally connected with an electrode in contact with the mercury bath.

2. In the combination set forth in claim 1, means for preheating the retort bottom and charge.

3. In the combination set forth in claim 1, an exterior gas container in conduit connection with the receiving chamber of the retort.

4. In the combination set forth in claim 1,

a gas scrubber in conduit connection with the gas escape port of the retort, and a valved conduit for reception of the gas generated in the retort and for use in testing same.

5. An ionizing retort for distillation of hydrocarbonaceous or other suitable material having a solid bottom; thereabove a charge receiving chamber, a charge supplying means, and gas eduction port; the retort having adjacent its bottom, a doorway for removal of the residue of distillation; and the retort having above its bottom a fire brick wall containing a secondary transformer coil the terminals of which are connected with alternating current supply means.

6. An ionizing retort for distillation and ionization of distillable and ionizable material, the retort including an intake for the material to be distilled and ionized, an outlet for the products of such distillation and ionization; and apparatus for creating within the restort a high frequency oscillating electric and heating field effective for distillation and ionization.

7. The combination of a retort for treatment of material with apparatus for creating and maintaining in the retort chamber, during a retorting operation, a high frequency, oscillating and electric heating field, effective of physico-chemical changes in constituents of the material treated.

8. In apparatus for distilling hydrocarbonaceous material and ionizing the gaseous product of distillation, the combination of a retort having an inlet for the material, an outlet for gaseous products of distillation and a secondary electric conductor; a transformer electrically connected with said conductor; a source of alternating current electricity for the transformer; an electric current condenser one side of which is electrically connected with the secondary coil of the transformer and the other side of which is connected with current frequency creating means; said current frequency creating means electrically connected with the secondary current conductor; a scrubber in conduit connection with the retort for reception of ionized gaseous products of distillation; and, in conduit connection with the scrubber, a gas condensing apparatus.

9. In apparatus for distilling hydrocarbonaceous material and ionizing the gaseous product of distillation, the combination of a retort having an inlet for the material, an outlet for gaseous products of distillation and a secondary electric conductor; a source of alternating current electricity for the transformer; an electric current condenser one side of which is electrically connected with the secondary coil of the transformer and the other side of which is connected with current frequency creating means; said current frequency creating means electrically connected with a secondary current conductor; a scrubber in conduit connection with the retort for reception of ionized gaseous products of distillation; and, in conduit connection with the scrubber, a gas condensing apparatus; and means for preheating a charge in the retort.

10. In apparatus for distilling hydrocarbonaceous material and ionizing the gaseous product of distillation, the combination of a retort having an inlet for the material, an outlet for gaseous products of distillation and a secondary electric conductor; a source of alternating current electricity for the transformer; an electric current condenser one side of which is electrically connected with the secondary coil of the transformer and the other side of which is connected with current frequency creating means; said current frequency creating means electrically connected with a secondary current conductor; a scrubber in conduit connection with the retort for reception of ionized gaseous products of distillation; and, in conduit connection with the scrubber, a gas condensing apparatus; the transformer being connected with said source of alternating current electricity by a conductor of a primary current of about 2000 volts, the transformer being effective to transform the primary current into a secondary current of about 10,000 volts for said secondary conductor, and said current frequency creating means being operative to effect a frequency of amout 50,000 periods a second.

Signed at New York city, in the county of New York and State of New York.

IRA W. HENRY.