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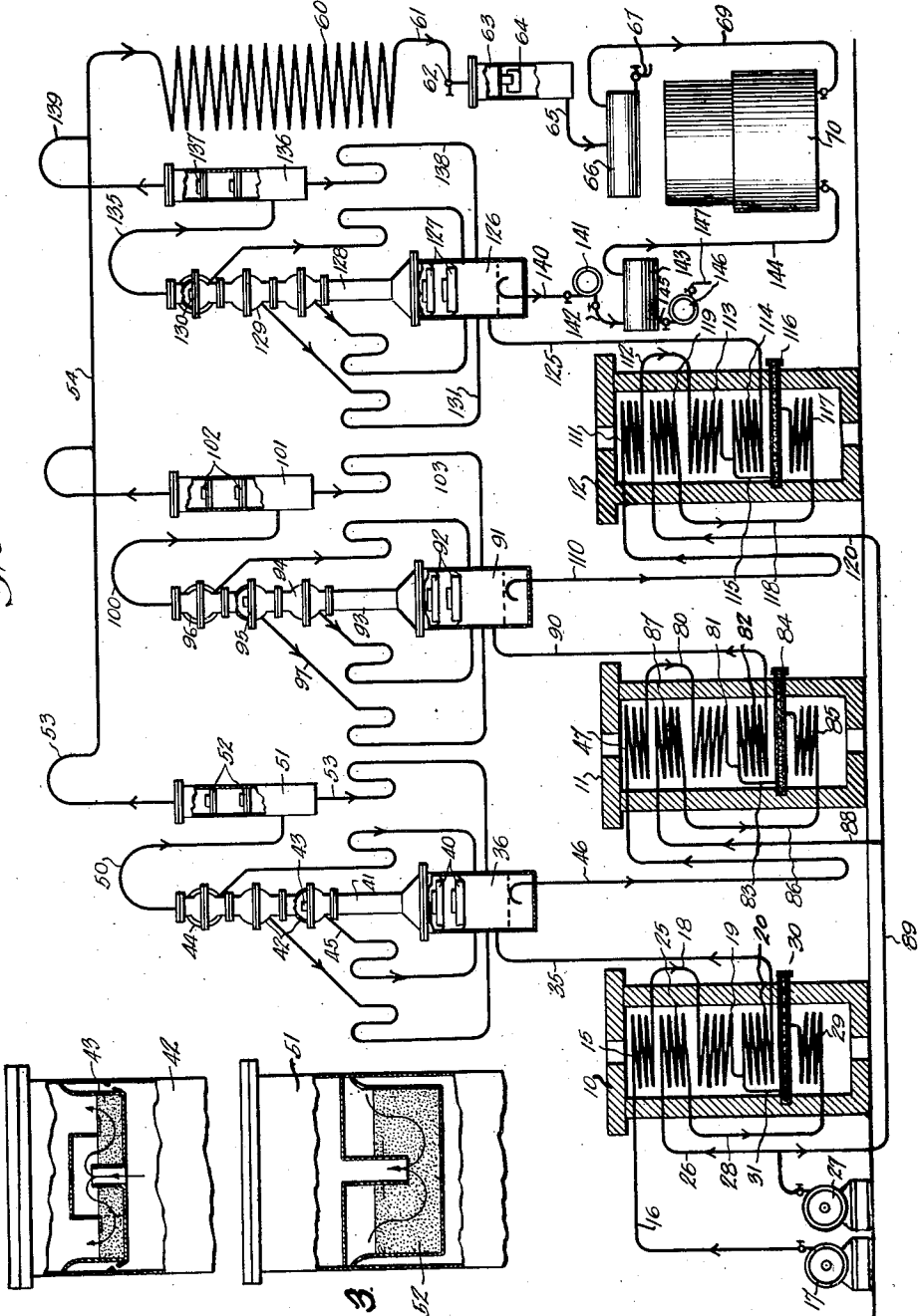
Fig. 1.

Fig. 2.

Fig. 3.

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TREATING HYDROCARBON OILS.

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The object of the invention is to provide certain new and useful improvements in treating hydrocarbon oils for the production of a water white hydrocarbon oil of the gasoline series and which is of a low boiling point and uniform in quality thus rendering it exceedingly serviceable for use as a motor fuel.

Another object is to permit of treating various hydrocarbon oils such as petroleum, fuel oil, gas oil, solar oil, pressed oil, tar oil and the like.

Another object is to render the operation continuous and thereby rendering the process exceedingly efficient, at the same time avoiding the formation of a large percentage of free carbon and uncracked oil.

Another object is to prevent the formation of carbon in the cracking tubes and the clogging up of the apparatus as is so frequently the case in apparatus now used, and necessitating periodical stopping of the operations until the defects are remedied.

The invention consists essentially in a process whereby the hydrocarbon oil is vaporized and then free hydrogen is introduced, while cracking the oil, to form a vapor of another hydrocarbon, then distilling such vapor of another hydrocarbon to separate the vapor of high boiling point from the vapor of low boiling point, then fractionating the vapor of low boiling point and filtering the same before and after fractionating, then condensing the vapors and finally filtering the condensate to form a water white hydrocarbon oil.

The process further consists in treating the vapors of high boiling point the same as the original hydrocarbon oil, as above set forth.

In order to carry this method into effect use is made of an apparatus shown in the accompanying drawings, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a side elevation of the apparatus with parts shown in section;

Figure 2 is an enlarged sectional side elevation of one of the filters;

Figure 3 is a similar view of another filter.

The apparatus is of multi-stage form and is provided with a number of furnaces 10, 11 and 12 of any approved construction and heated in any suitable manner. In the up-

per portion of the furnace 10 is arranged an oil preheating coil 15 connected at one end by a pipe 16 with a pump 17 for forcing a hydrocarbon oil under pressure through the coil 15. The outlet end of the coil 15 is connected by a pipe 18 with an oil vaporizing coil 19 connected at its outlet end with an oil cracking coil 20 arranged below the coil 19 within the furnace 10. Between the coils 15 and 19 is arranged a water heating coil 25 connected at its inlet end by a pipe 26 with a pump 27 for circulating water through the said coil 25 to heat the same. The outlet end of this coil 25 is connected by a pipe 28 with a steam generating coil 29 arranged in the lower portion of the furnace 10. The outlet end of this coil 29 is connected with a chamber 30 mounted in the furnace 10 between the coils 20 and 29. The chamber 30 is connected by a pipe 31 with the inlet end of the oil cracking coil 20. The chamber 30 is charged with a calcium silicon alloy and the steam generated in the coil 29 in passing through the chamber 30 becomes so unstable that some oxygen and also some hydrogen is liberated. The oxygen readily combines with the permanent gases formed in the cracking reaction while the free hydrogen forms with the cracked oil in the coil 20 another vapor of a hydrocarbon and this vapor is delivered by a pipe 35 into a distilling apparatus 36. It is understood that the water delivered by the pump 27 to the coil 25 is subjected in the latter to a temperature of about 1200° F. generated into steam and superheated, and this superheated steam is then subjected to a temperature of about 1400° F. in the coil 29. The hydrogen and the oxygen of the generated steam are separated in the chamber 30 and the free hydrogen combines with the cracked oil at its entrance into the coil 20. It will be noticed that by passing the oil through the coils 15 and 19 and then through the coil 20 it is cracked in two steps, that is, it is first vaporized and superheated during its passage through the coils 15 and 19 and then cracked in the coil 20 while in a vaporized state. As both the oil vapor and the free hydrogen are in a highly heated state they readily combine to form another vapor of hydrocarbon especially as the ratio of the hydrogen supplied is not in excess of that required for the desired re-combination.

It is well known that the formation of

free carbon, in the form of coke or sludge, in the cracking tubes of the usual apparatus used for cracking oil begins to take place as the vapor produced approaches the outlet. By introducing hydrogen or even highly superheated steam at a point where the hydrocarbons have reached a complete vapor state such formation of carbon is prevented. These results are effected and controlled by the proper rate of oil and water fed and the temperature maintained within the furnace 10 and that of the cracking oil 20 and the pressure maintained. These conditions vary with different oils and with the various products desired, but by this multi-stage process the cracking action is completed at temperatures safely below the point of decomposition at which end products are formed. It will also be noticed that high furnace temperatures are unnecessary when cracking in stages.

In the upper portion of the distilling apparatus 36 are arranged filter beds 40 charged with fuller's earth or other suitable material. From the top of the distilling apparatus rises a fractionating column 41, provided with a dephlegmator 42 having filter beds 43, a water jacket 44 and reflux pipes 45 connected with the distilling apparatus 36 below the filter beds 40. The vapor entering the distilling apparatus 36 has a temperature of about 900° F. and the sensible heat of the cracked oil is sufficient to distil out the vapors of low boiling point from the vapors of high boiling point. It will be noticed that the vapor rises from the distilling apparatus 36 and passes into the fractionating column 41 and into the water-cooled dephlegmator 42 whereby the vapor of high boiling point is condensed and separated from the vapor of low boiling point and returned by the reflux pipes 45 to the distilling apparatus 36. The liquid of high boiling point accumulates in the lower portion of the distilling apparatus 36 but its level is maintained below the entrance of the pipe 35, as shown in Figure 1. The accumulated liquid of high boiling point is for further treatment delivered by a pipe 46 to a coil 47 contained in the upper portion of the furnace 11, as hereinafter more fully described. The liquid accumulated in the lower portion of the distilling apparatus 36 remains at a sufficiently high temperature to assist in distilling out continually the vapor of low boiling point from the vapors continually entering the distilling apparatus 36 by the pipe 35.

It will further be noticed that the vapors of low boiling point are decolorized and deodorized in their passage through the filter beds 43 in the dephlegmator 42, and these vapors pass from the upper end of the dephlegmator 42 by way of a gooseneck 50 into a filter 51 containing filter beds 52 charged with fuller's earth to further decolorize and

deodorize the vapors of low boiling point. Any liquid of condensation in the filter 51 passes by way of a reflux pipe 53 to the distilling apparatus 36 while the thoroughly decolorized and deodorized vapor of low boiling point passes from the top of the filter 51 by way of a gooseneck 53 into a gas main 54 connected with a condenser 60 in which the vapor is condensed. The resultant condensate flows by its own gravity through a pipe 61, having a pressure relief valve 62, into a filter 63 containing a filter bed 64 to further clarify the condensate. The finished water white or motor fuel flows from the filter 64 by way of a pipe 65 into a tank 66 provided with a valved outlet 67 for drawing off the motor fuel as required. The permanent gases entering the tank 66 with the water white motor fuel pass by way of a pipe 69 into a gasometer 70 of usual construction.

The above described arrangement forms the first stage of the treatment, and the second stage begins with the delivery of the liquid of high boiling point into the coil 47 contained in the second furnace 11, as previously mentioned. The coil 47 is connected by a pipe 80 with a preliminary cracking coil 81 connected with the cracking coil 82 and into the entrance of this coil passes free hydrogen by way of a pipe 83 leading from a chamber 84 similar to the chamber 30 in the furnace 10. The chamber 84 is supplied with water vapor from a coil 85 connected by a pipe 86 with a coil 87 connected by a pipe 88 with a pipe 89 connected with the pump 27. It is understood that the arrangement of the water and oil pipe coils in the furnace 11 is the same as above described in reference to the coils in the furnace 10 and the operation is the same so that further description is not deemed necessary, it being understood that the new vapor formed in the coil 82 is delivered by a pipe 90 to a distilling apparatus 91 similar to the distilling apparatus 36 and likewise containing filter beds 92. The distilling apparatus 91 is provided on the top with a fractionating column 93 on which is mounted a dephlegmator 94 having a filter bed 95, a water jacket 96 and reflux pipes 97 leading back to the distilling apparatus 91. The action in the distilling apparatus 91, the fractionating column 93 and the dephlegmator 94 is the same as above described, that is, the new vapor is separated into vapor of low boiling point and vapor of high boiling point, of which the former passes by way of a gooseneck 100 into a filter 101 similar to the filter 51 and likewise containing filter beds 102. A reflux pipe 103 connects the bottom of the filter 101 with the distilling apparatus 91 and the upper end of the filter 101 is connected by a gooseneck 104 with the gas main 54 to conduct the

vapor of low boiling point from the filter 101 to the gas main 54 to be condensed in the condenser 60. The vapor of high boiling point in the distilling apparatus 91 is condensed and accumulates in the bottom of the distilling apparatus 91 from which it passes by way of a pipe 110 into a coil 111 arranged in the upper portion of the furnace 12.

The third stage is now reached and the liquid passing through the coil 111 passes by way of a pipe 112 into and through a preliminary cracking coil 113 connected with a cracking coil 114 supplied with free hydrogen through a pipe 115 connected with a chamber 116 similar to the chambers 30 and 84 previously described. The chamber 116 is connected with a decomposing coil 117 connected by a pipe 118 with a coil 119 connected by a water supply pipe 120 with the pipes 89 and 26 connected with the pump 27. The action relative to the oil and water in the coil contained in the furnace 12 is the same as above described relative to the furnaces 10 and 11 so that further description of the same is not deemed necessary, it being sufficient to state that the vapor of hydrocarbon formed in the coil 114 passes from the latter by way of a pipe 125 into a distilling apparatus 126 similar to the distilling apparatus 36 and 91. The distilling apparatus 126 contains filter beds 127 and is connected at the top with a fractionating column 128 surmounted by a dephlegmator 129 containing a filter bed 130. Reflux pipes 131 connect the dephlegmator with the distilling apparatus 126. The operation in the distilling apparatus and its connected parts is the same as above described, that is, the entering new vapor of hydrocarbon is separated into a vapor of low boiling point and vapor of high boiling point, of which the vapor of low boiling point is conducted by way of a gooseneck 135 into a filter 136 containing filter beds 137. The lower end of the filter 136 is connected by a reflux pipe 138 with the distilling apparatus 126 to return any liquid of condensation from the filter 136 to the distilling apparatus 126. The top of the filter 136 is connected by a gooseneck 139 with the gas main 54 to conduct the vapor of low boiling point to the condenser 60. The vapor of high boiling point accumulating in the bottom of the distilling apparatus 126 is conducted by a valved pipe 140 into a condensation trap 141 connected by a valved pipe 142 with a separating tank 143 from which the permanent gas is conducted by a pipe 144 into the gasometer 70 while the liquid in the separating tank is conducted by a valved pipe 145 to a trap 146 having a valved outlet 147. It is understood that the operation of the third stage is the same as above described relative to the first and second stages so that further description of the same is not deemed necessary.

Although I have shown and described but three stages, it is evident that for treating some oils two stages may be sufficient while for treating other oils more than three stages the same as above described may be needed, and hence I do not limit myself to the number of stages shown and described.

It will be noticed that the working pressure throughout the entire system is equalized or in balance up to the pressure relief valve 62 and the trap 141 and that the product as it leaves the cracking coil 20, 82 or 114 in the several stages is in a vapor state and readily flows upward to the distilling apparatus 36, 91 or 126. The height of a column of liquid in each of the pipes 46 or 110 is sufficient to provide a head to overcome the pressure of the next stage. By the arrangement described the condensate of high boiling point is compelled to flow or travel from the distilling apparatus 36 through the pipe 46 into the coil 47 of the second stage. Herein the cracking action is repeated and the vapor is passed to the distilling apparatus 91 while the condensate of high boiling point passes by way of the pipe 110 to the coil 111 of the third stage, from which the new vapor flows by way of the pipe 125 to the distilling apparatus 126 thus completing the cycle as described above.

The distilling apparatus 36, 91 and 126 may be heated by the waste heat from the furnaces 10, 11 and 12 or other suitable means. The dephlegmators 42, 94 and 129 are water-cooled and the temperature of the vapors of low boiling point passing out of the fractionating columns 41, 93 and 128 are regulated down to the temperature of the cut desired.

It is well known that the distillate from a cracked oil can be made water white by redistillation in the presence of fuller's earth. In this process it has been found by tests that the product can be made water white by suspending filter beds arranged in suitable trays located so that only the heated vapors from the stills pass through the filter beds, as will be readily understood by reference to Figures 2 and 3. By this arrangement renewal of the filtering beds is avoided and the filtering process becomes practically continuous with the result that the product is in an exceedingly clarified state. It will be noticed that by the arrangement described a simple, progressive and continuous system of filtration by easy stages is had whereby the product is thoroughly decolorized and deodorized thereby producing a water white motor fuel.

It will further be noticed that by the process described a progressive cracking and distilling is had uninterruptedly in multi-stages under required conditions.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:—

1. A method of treating hydrocarbon oils, which comprises providing a plurality of furnaces each containing oil-heating coils for the purpose of subjecting the oil passing therethrough to gradually increasing exterior temperatures whereby the oil is treated progressively to the temperature of vaporization, introducing free hydrogen into the oil in the coils of each furnace at the point where the oil has reached the vaporization state, said hydrogen being of a temperature of approximately 1400° F., whereby vapors of new hydrocarbons are thus formed, passing the vapors thus produced from each furnace into separate distillation columns, condensing the vapors of high boiling point, fractionating out the vapors of low boiling point in each column, and passing the con-

densate of high boiling point from each column to a second furnace for repeating the above steps.

2. The process of treating hydrocarbon oils which consists of passing the oil through a furnace having a series of coils of gradually increasing temperature which will raise gradually the temperature of the oil until it has reached the vapor point at approximately 500° F., introducing into the oil vapor free hydrogen at a temperature of approximately 1400° F. to form the vapor of another hydrocarbon, passing the new formed hydrocarbon vapors to a distilling column, condensing the vapors of high boiling point, fractionating out the vapors of low boiling point by the heat of the condensate, and passing the condensate from the vapors of high boiling point to a second furnace for repeating the above steps.

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