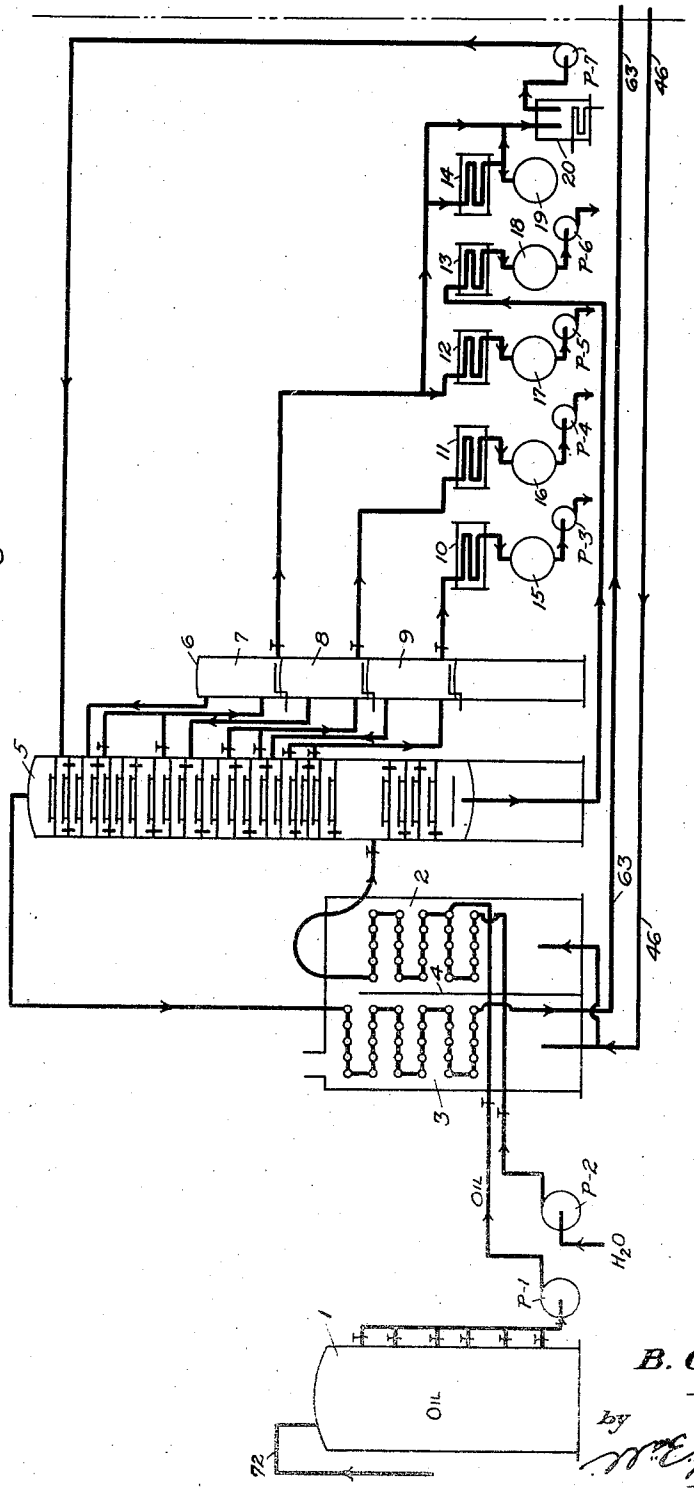
April 27, 1937. B. ORMONT 2,078,407

METHOD OF TREATING HYDROCARBONS

Filed Sept. 21, 1933 5 Sheets-Sheet 1

Fig. 1



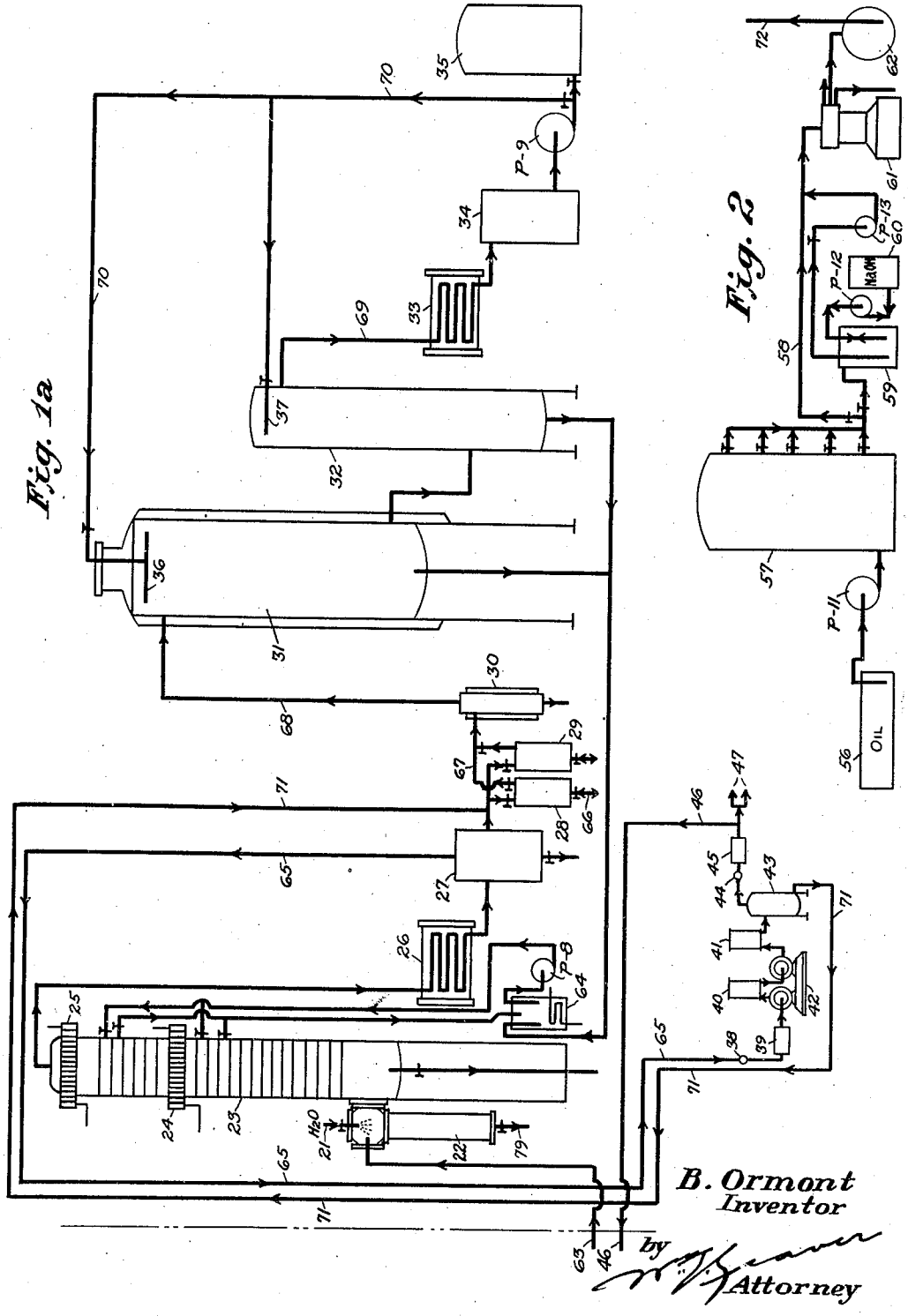
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April 27, 1937. B. ORMONT 2,078,407

METHOD OF TREATING HYDROCARBONS

Filed Sept. 21, 1933 5 Sheets-Sheet 2



April 27, 1937. B. ORMONT 2,078,407

METHOD OF TREATING HYDROCARBONS

Filed Sept. 21, 1933 5 Sheets-Sheet 3

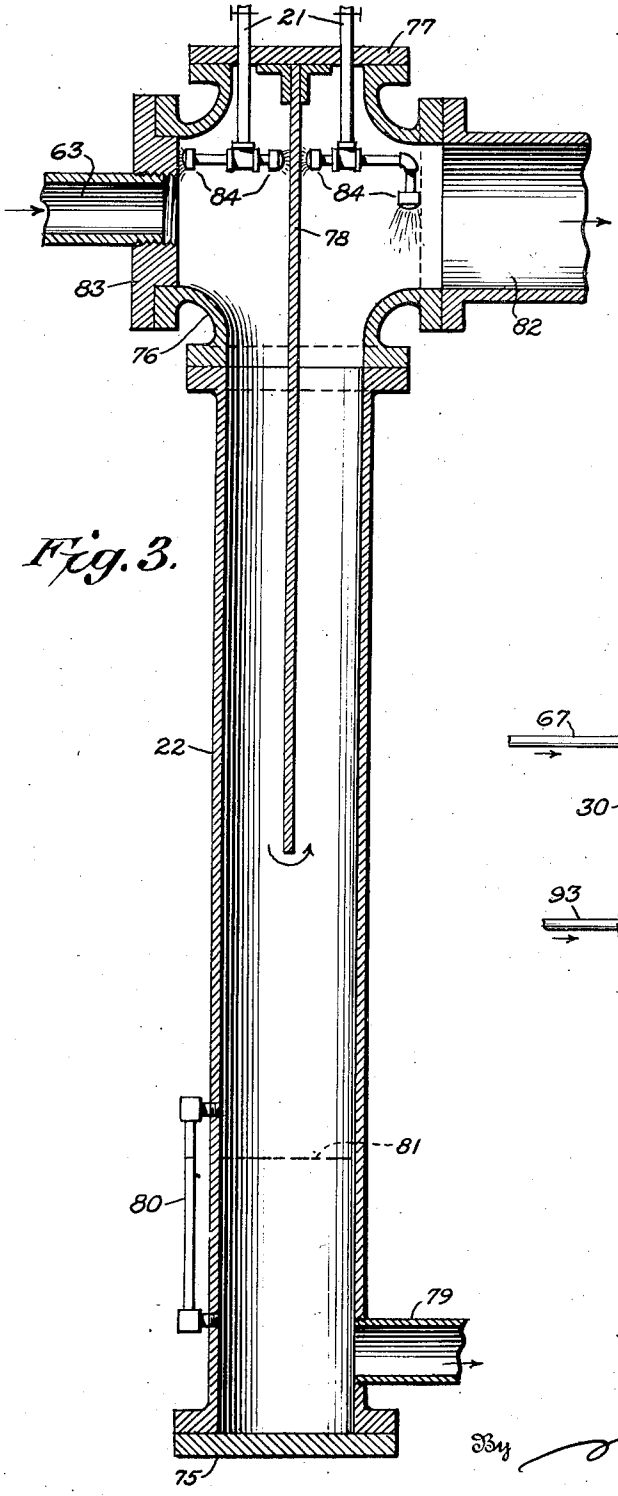


Fig. 3.

Fig. 4.

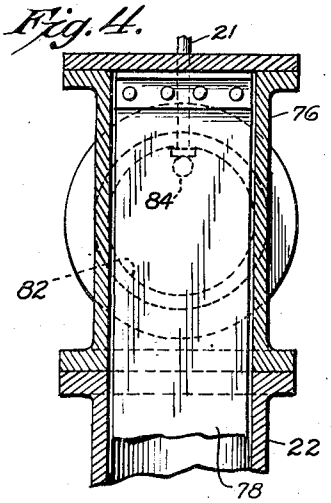
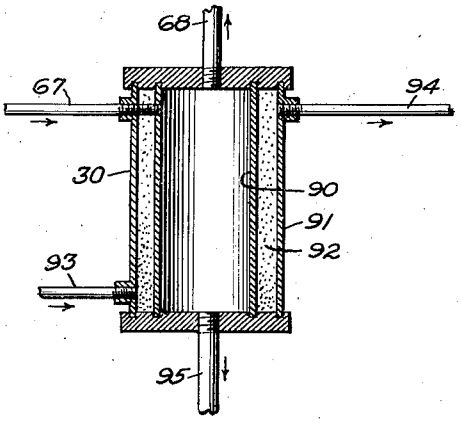


Fig. 5.



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April 27, 1937. B. ORMONT 2,078,407

METHOD OF TREATING HYDROCARBONS

Filed Sept. 21, 1933 5 Sheets-Sheet 4

Fig. 6.

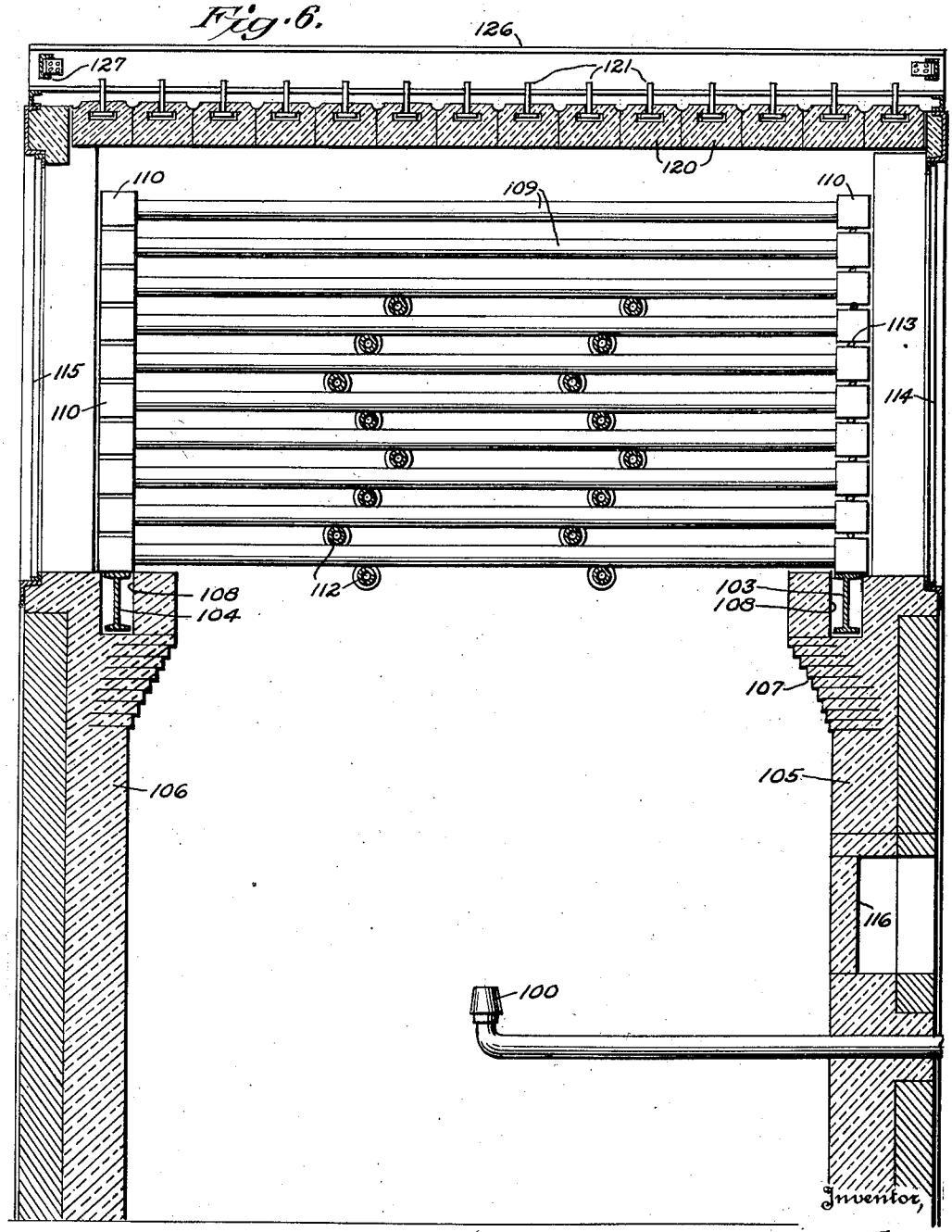
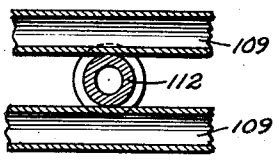


Fig. 9.



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April 27, 1937. B. ORMONT 2,078,407

METHOD OF TREATING HYDROCARBONS

Filed Sept. 21, 1933 5 Sheets-Sheet 5

Fig. 7.

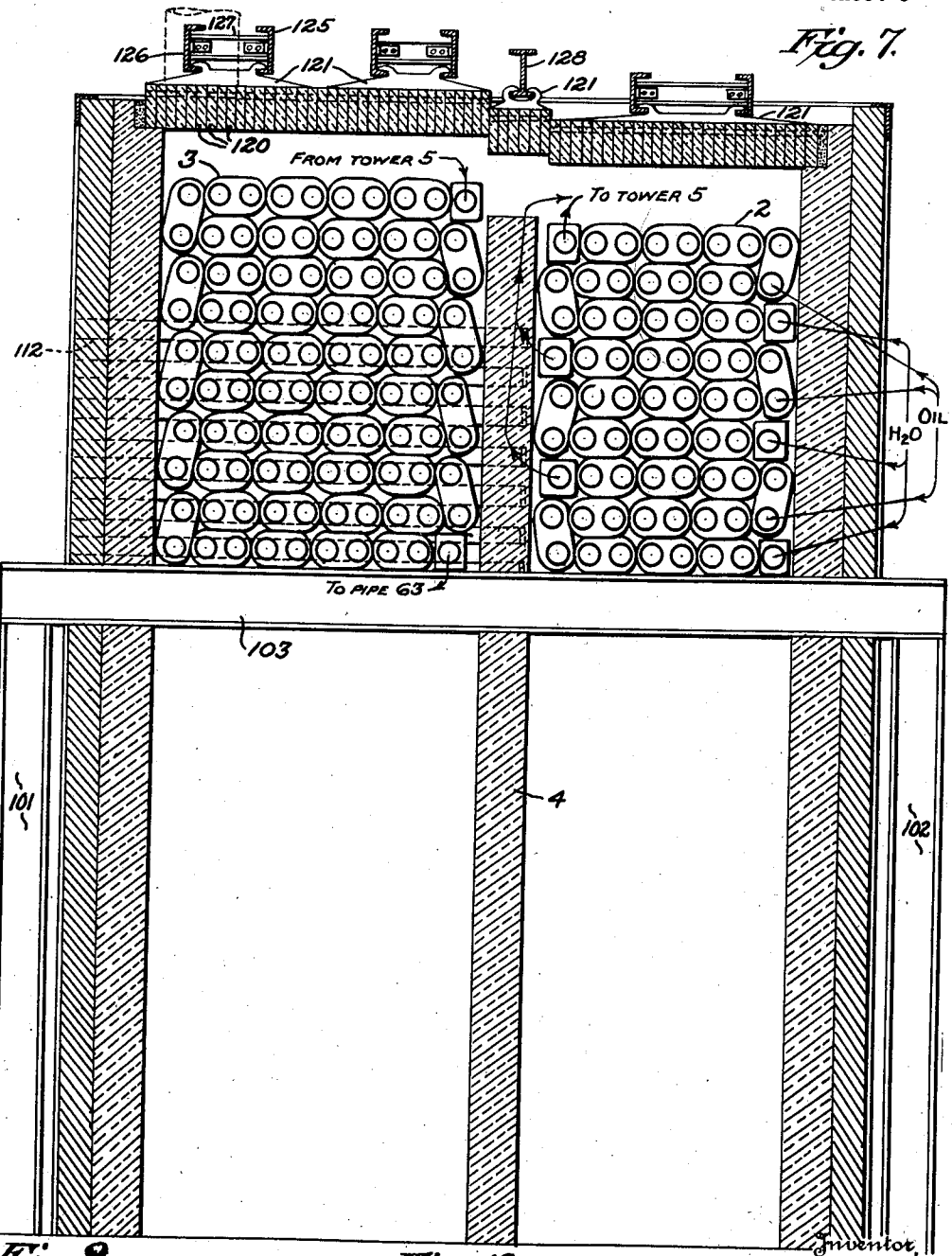


Fig. 8.

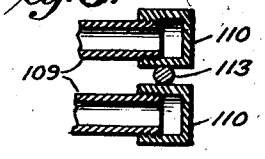


Fig. 10.



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Patented Apr. 27, 1937 2,078,407

UNITED STATES PATENT OFFICE

2,078,407

METHOD OF TREATING HYDROCARBONS

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Application September 21, 1933, Serial No. 690,477

2 Claims. (Cl. 196—63)

This invention relates to a method of producing hydrocarbons from crude and other hydrocarbon oils and has for its object to provide a process which will be more efficient in operation than those heretofore proposed.

With these and other objects in view the invention resides in the novel steps and combinations of steps constituting the process, all as will be disclosed more fully hereinafter and particularly pointed out in the claims.

Referring to the accompanying drawings forming a part of this specification in which like numerals designate like parts in all the views,—

Fig. 1 is a diagrammatic representation of that portion of the plant more particularly directed to the recovery of lubricants and similar oils according to this process;

Fig. 1*a* is a continuation of the apparatus of the plant shown in Fig. 1 and shows diagrammatically that portion of the plant particularly concerned with the recovery of the lighter hydrocarbons from the heavier;

Fig. 2 is a diagram illustrating an apparatus for use in a process for cleaning and treating oil for the removal of impurities preparatory to passing the oil to the apparatus shown in Figs. 1 and 1*a*;

Fig. 3 is a vertical sectional view in detail of the repressor;

Fig. 4 is a partial vertical sectional view of some of the parts shown in Fig. 3 but taken at 90° thereto;

Fig. 5 is a vertical sectional view in detail of the flash still **30**;

Figs. 6 and 7 are vertical sectional views, taken on intersecting planes, of the furnace containing the stills **2** and **3**;

Figs. 8 and 9 are detail sectional views illustrating supports for the tubes of a still; and

Fig. 10 is a detail elevational view of one form of furnace roof hanger.

In order that this invention may be better understood it is said that on November 30, 1926 there was granted to Bernard Ormont U. S. Letters Patent No. 1,608,664, covering a Process for producing gasoline and other hydrocarbons, and that on November 13, 1928 there was granted to him U. S. Letters Patent No. 1,691,300 for the Process of and apparatus for producing gasoline and other light hydrocarbons from heavier hydrocarbons, in each of which patents there were disclosed a process and apparatus involving primarily the use of nascent steam for vaporizing all of the hydrocarbon oil injected into the apparatus for treatment. The present invention constitutes an improvement in the art over either of said patents in that it covers, first the controlled condensation of vapors produced in a still in order to recover the lubricating oils, second the reheating in a superheater of the remaining vapors to decompose them into lighter products, and third the novel condensation of the reheated vapors in the second stage of this new process by which are fractionally recovered the lighter hydrocarbons particularly in a manner to produce a hydrocarbon which has an exceptionally high anti-knock value as a motor fuel and an octane rating far beyond any fuel so far produced, said rating being far beyond the capacity of known existing octane measuring machines.

In the drawings, **1** represents a supply tank containing the crude charging stock either as it comes directly from the oil well or after any desired cleaning or other treatment. This tank may serve the purpose of settling the crude oil and therefore, as shown, there is provided a plurality of outlets in various horizontal planes, each outlet provided with a valve and connected to a common pipe leading to a vaporizing still **2** of the usual single pipe coil construction such as disclosed in said prior patents, said pipe having therein a suitable pump P—**1** for insuring flow, as well as a valve between said pump and the still. This crude oil enters the still at a point above the bottom tier of coils and, in Fig. 1, is shown as entering the next to the bottom tier. The piping in the still is continuously connected, as will be understood with reference to said prior patents, wherefore it is possible for the crude oil to travel through the turns of its entering tier and flow under its pressure and the urge of gravity into the lowermost tier of piping where it will eventually enter a region of nascent steam evolved from water from any suitable source fed into the end of the bottommost tier of the still, said water being under flow regulated by any suitable valve and pump P—**2**.

That is to say, water is admitted to one end of the still and oil is admitted to said still at a point between the water entrance and the upper or vapor outlet of the still, the water and oil flowing in opposite directions in the lower piping of the still and meeting at the region of formation of nascent steam, but the flow of the water as well as that of the oil is suitably controlled as disclosed in said patents so that the oil will travel only to the region where the water is turned into steam. It is the nascency of the steam which permits the complete vaporization of all of the crude oil in the still, leaving no residue, and it has been discovered that this can be accomplished at vapor temperatures as low as 250° F.

The still **2** is preferably enclosed in the same housing with a similar single and continuous pipe still **3** which serves as a superheater for the vapors of the lighter ends of the oil, in the drawings there being shown a partition **4** between the stills and which does not extend to the upper end of the

heating chamber or furnace enclosing said stills, whereby a better heat exchange is accomplished between the two portions of the furnace. This furnace is more particularly described hereinafter.

The upper tier of the still **2** is connected by a valved pipe to a bubble tower **5** at near its bottom, said tower containing a large plurality of horizontally disposed condensing trays of any suitable type whereby the completely vaporized oil may be initially subjected to cooling temperatures to condense out the lubricating oils, leaving the vapors of the lighter hydrocarbons which may pass upwardly through the tower and through a suitable pipe connection to and through the superheater **3**. This superheater is of a construction similar to that disclosed in said prior patents in that it is a continuous pipe arranged in coils disposed in plural horizontal planes, the lowermost coil being connected to a pipe **63** leading to the apparatus of the second stage of this process and later to be described. The temperatures contemplated are such that the completely vaporized oil will pass over to the bubble tower **5** at temperatures less than 700° F., the lubricating oils will be condensed in said tower to permit the remaining vapors to pass out of the top of said tower at substantially 500° F., and the superheater will raise the temperature of these vapors to 1100–1200° F.

At suitable horizontal levels the bubble tower **5** is provided with draw-offs in the nature of piping provided with valves, each draw-off leading to a stripping tower **6** divided into a plurality of separate compartments one above the other as indicated at **7**, **8** and **9**, the uppermost compartment receiving the condensate from the upper region of the bubble tower **5** and corresponding to the lighter lubricants. The next lower compartment **8** is similarly connected to a section of the bubble tower next below that just mentioned, and therefore is adapted to receive the condensates corresponding to the medium lubricants; and in similar manner the lower compartment **9** is connected to the next lower bubble tower section to receive the heavy lubricant condensates. Any suitable heat, such as a steam coil, may be provided in the lower portion of each compartment so that should by chance any of the light hydrocarbon vapors come over with the lubricant condensates from the bubble tower, said lighter hydrocarbon vapors would be revaporized by this heat there being provided a suitable pipe connection from the top of each compartment to the bubble tower for conveying these vapors, as indicated.

Beyond the stripping tower **6** is a plurality of heat exchangers or coolers illustrated at **10**, **11**, **12**, **13** and **14**, each respectively connected to run-down tanks **15**, **16**, **17**, **18** and **19** on their outlet sides and connected on their inlet sides for receiving the condensates as formed according to the preceding disclosure.

That is to say, the cooling coils **10**, **11** and **12** are respectively connected to the compartments **9**, **8** and **7** of the stripping tower **6**, and the run-down tanks **15**, **16** and **17** associated with said coils lead to any suitable storage tanks, or to any other apparatus for further treatment as desired, said tanks having associated therewith respectively the pumps P—**3**, P—**4** and P—**5**.

The bottoms or heaviest condensates formed in the bottom of the bubble tower **5** are led, under a slight pressure and the urge of gravity, as indicated through a pipe to the coil **13** for cooling, and drain into the run-down tank **18** which likewise may be connected to any suitable storage tank, and which has associated therewith the pump P—**6** for insuring flow.

In order to control tower **5** it is necessary to pass back into the tower a portion of the lightest condensate and this is accomplished in the following manner. A portion of the condensate from compartment **7** of the stripping tower is by-passed as indicated through the cooling coil **14** in the event that cooled oil is required, or it may be passed directly as indicated in the event that hot oil is required. This by-passed oil enters receiving tank **20** where it may be further heated by means of a steam coil in the bottom thereof as shown, and is picked up by pump P—**7** and forced back into the top of tower **5**. **19** represents a tank for storage of cooled reflux oil that is required, and is connected to the coil **14** as well as to the tank **20** for variable regulation.

Referring more particularly to Fig. 1*a* there is shown a pipe **21** for admitting water in a spray into the top portion of a repressor **22**, the pipe **63** from the superheater **3** entering said repressor at a point to deliver the hot vapors at or near the water spray. Thus it will be seen that the vapors at above 1100° F. meeting the water spray will immediately produce steam and the delivery ends of the two pipes **21** and **63** are so disposed in proximity to each other that nascent steam is formed where the oil vapors enter the repressor. This water spray, being subjected to the very high temperature of the vapors, is instantaneously converted into superheated steam which reduces the temperature of said oil vapors instantaneously to whatever degree is required, depending upon the amount of water delivered. In this particular instance it is desired to keep the temperature of the vapors entering the bottom of bubble tower **23** between 600 and 700° F.

In the event that any of the heavier oils should have the tendency to condense at this reduction in temperature, the nascency of the steam will substantially prohibit such condensation and therefore keep all of the oils in the vapor form. There is no reason that can be assigned to the resultant vapor condition of all of the oils entering the bubble tower **23** except this nascency of the steam, and therefore it is submitted that it is the nascent condition of the steam which is responsible for preventing any premature condensation while the vapors are passing from pipe **63** to said tower. The repressor **22** is provided with a suitable valved outlet for the water, and is more fully disclosed in detail hereinafter.

The second bubble tower **23** receives the vapors from the quencher at substantially its bottom and at a temperature not exceeding 700° F. and at near the top of the tower there is provided a condenser generally indicated at **24**, and at the very top of the tower is a second condenser **25**, each condenser as shown receiving suitable medium for cooling purposes. The portion of the tower just below the condenser **24** has a drawoff tap leading to a reflux accumulator tank **64** similar to tank **20** and provided with a heating coil in its bottom and a pump P—**8** for drawing the reflux oil condensate and passing it back to the tower at the points indicated for temperature control.

The gases, light vapors, and steam pass out of the top of the tower **23** and are conducted to a condenser **26** connected to a receiving tank **27** where the gases, light oils, and water are separated. That is to say, the water can be drawn off of tank **27** at the bottom thereof, while the

gases pass from the extreme upper portion thereof and are led through the pipe 65 to a compressor presently to be described. The light hydrocarbons at this stage represent motor fuels and similar lighter hydrocarbons of high octane value for blending and other purposes.

At this point the light products are found to be colored and have an odor which is not agreeable, and in order to remove the color and odor without destroying the anti-knock qualities the products are passed to tank 28 which has at its bottom a connection 66 by means of which water under pressure can enter said tank, thereby forcing the light oils upwardly into a pipe 67 leading to a flash still 30, more fully described hereinafter.

This still is heated by means of a steam jacket or other suitable means to a temperature not exceeding 350 to 400° F. for the purpose of reconverting the liquids back into the vapor form. These vapors then pass through a pipe 68 to any suitable apparatus for removing the odor and color and making the product marketable. Such an apparatus is shown in Fig. 1a as comprising a polymerizing tower 31 connected near its bottom with an after tower 32 tapped near its top by pipe 69 leading to a condenser 33 associated with a receiving tank 34 from which the liquid passes to a pump P—9 and storage tank 35. For cleaning and refluxing purposes a by-pass 70 leads a porton of the finished product back to the polymerizing tower 31 and after tower 32, in both of which the liquid is delivered as a spray in the usual manner as from nozzles 36 and 37. The condensates from the bottoms of 31 and 32 are passed back to the reflux accumulating tank 64 and then fed back into bubble tower 23 as reflux oil to be recovered.

Tank 28 has a duplicate in tank 29 and is connected in parallel therewith as clearly indicated. This parallel arrangement is provided so that when water in tank 28 is forcing the liquid over to the flash still 30, water may be drawn off the bottom of tank 29 to permit said tank to fill with oil from 27, and vice versa. Suitable valves will be provided as shown for controlling the correct flow of condensates and water as will be readily understood.

The uncondensed gases and vapors reaching the receiving tank 27 pass from the top thereof through pipe 65 to the spray tank 39, their pressure being controlled by pressure valve 38.

They then pass into compressor 42 which is of the two-stage type, and in the first stage the liquid and gases are compressed to 100 pounds and then they are cooled in cooler 40 after which they enter the second or high stage of the compressor where they are compressed to 300 to 350 pounds and then cooled in 41 and passed to the receiving tank 43. The compression of the gases and vapors results in the condensation of additional amounts of liquids which collect at the bottom of 43 and are forced by the gas pressure through pipe 71 into receiving tanks 28 and 29 where they join the condensates from 27. The uncondensed gases pass from the top of 43 through a pressure controlling valve 44 into an equalizing tank 45 from which they are led through pipes 46, 47, etc. to various points in the plant for use as fuel, pipe 46 leading as indicated to the burners in stills 2 and 3.

When using crank case drainings or similar oils for charging stock in this process, it may be necessary to remove impurities such as colloidal carbon, water, etc., before starting the process and this may be satisfactorily accomplished in the apparatus indicated in Fig. 2. Such oil is preferably dumped into receiver tank 56 from which it is forced by pump P—11 into the settling tank 57 which is similar to tank 1 hereinafter mentioned in that it is provided with valved taps at different horizontal levels for drawing off the upper portions of the oil, which clear first.

In the event that the oil by settling has become sufficiently clarified of its impurities to be available for use in the process, it is passed through pipe 58 to a centrifuge 61 where the water and other liquids are separated from it, after which it then enters tank 62 from which it is drawn and passed through pipe 72 to the storage supply tank 1.

In the event that settling alone does not clarify the oil sufficiently, it is passed to a tank 59 where it is mixed with a solution of caustic soda. The caustic solution is preferably a 10% solution and is prepared in any suitable manner either directly in tank 60 or it is prepared elsewhere and led thereto, the pump P—12 serving to deliver it into tank 59 where it mixes with the oil. This mixing can be accomplished by alternate opposite operations of said pump as indicated by the arrows, and the temperature of the mix may be made from 110° F. to 200° F. After being mixed and allowed to settle, the oil is drawn from tank 59 by means of the pump P—13 and passed to the centrifuge 61 where the sludge, water and caustic solution are removed and the clean oil passed to tank 62 as before stated. If found necessary the mixture after settling may be decanted and retreated with caustic soda and again heated before final settling and centrifuging.

The repressor 22 particularly illustrated in Figs. 3 and 4 preferably comprises a cylindrical chamber, conveniently a section of pipe, closed at its bottom as by a plate 75 and having at its top a cross generally indicated by the numeral 76. The upper opening of this cross is closed by a plate 77 carrying therethrough two valved pipes such as 21. To the under surface of this plate 77 there is suitably secured the upper end of a partition member or baffle 78 depending centrally substantially half way down the pipe casing 22, said baffle being of a width as clearly shown to closely fit the inner surface of said casing. A draw-off connection 79 for liquid is located at the lower extremity of the casing and there is provided a sight gauge 80 to indicate the level of the liquid in the lower portion of said casing. The connection 79 may be provided with an intermittently operating valve of any suitable type automatically actuated to open at fixed intervals of time or in accordance with the level of the liquid in said casing, the liquid level preferably restricted to a position registrable on the gauge 80. The dashed line 81 indicates the approximate upper lever permitted.

The cross 76 is connected on one side as by the passage 82 with the bubble tower 23 and on the opposite side of the cross there is provided a cover plate 83 provided with a threaded connection which may be the end of the pipe 63 from the superheater still 3 hereinbefore mentioned. The water pipes 21 each terminate in a plurality of nozzles such as 84 suitably disposed to furnish a controlled spray which will be in effect a curtain disposed across the passage of the vapors from pipe 63 to the bubble tower 23. Also nozzles are provided for wetting the opposite faces of the baffle 78 so that there results a plurality of

films of moving water creating wetted surfaces and areas in the cross 76 and the upper portion of the casing 22 so that the hot vapors from pipe 63 will be cooled by contact therewith while at the same time the high temperature of said vapors will create nascent steam which has been found particularly effectual in maintaining the constituents of the oil vapors in the vapor phase, whereby substantially no condensate is formed in said casing. Any condensate formed will be immediately vaporized, however, by the action of the nascent steam generated by the liquid water on the plurality of wetted surfaces.

The flash still 30 is particularly shown in Fig. 5 wherein it will be seen that the light oils from pipe 67 enter a chamber 90 having thereabout a spaced wall 91 to provide the jacket area 92 therebetween which is heated by steam or other medium entering as through the pipe 93 and leaving by way of pipe 94. Instead of the heating jacket, this flash still may have, alternatively, a heating coil therein for vaporizing the oil. Any condensate or unvaporized oil may be drawn off from the chamber 90 as through the pipe 95, the superheated vapors passing out of the chamber at the upper end through the pipe 68 to the polymerizing tower 31.

The furnace hereinbefore mentioned is particularly illustrated in Figs. 6 to 10 from which it will be seen that the stills 2 and 3 are separated as by the division wall 4, there being provided any suitable means of heating each still as for example by a fuel nozzle 100. This furnace is peculiarly constructed in a manner designed to reduce burning out to a minimum and to render repairs easy. That is to say, there is provided exteriorly on each side of the furnace a pair of channels, I beams, or other suitable structural supports such as 101 and 102 disposed vertically as shown, and across the tops there is secured a horizontally disposed I beam 103. A duplication of these supports is provided on the opposite side of the furnace to carry a horizontal similar I beam 104. The front, side, and rear walls of the furnace are then constructed of fire brick or other suitable heat resisting material, the front and rear walls 105 and 106 respectively stepped inwardly at their upper portions as indicated at 107 to provide a bricked structure around the I beams 103 and 104 to keep the heat from the burner such as 100 away from said beams. However, it is to be particularly observed that in this brick wall construction there is provided a rectangular space 108 open at its top and within and through which space completely extends the I beams 103, 104. In other words, the said I beams are of a length to extend exteriorly beyond the side walls of the furnace as clearly shown in Fig. 7, with their supporting structural members 101 and 102 likewise disposed outside of the furnace.

Each still is made of plural sections of tubing such as 109 disposed in horizontal rows with their ends interconnected by means of boxes generally indicated by the numeral 110 whereby there is produced substantially a single tube conduit for the oil and vapors in each still, with suitable connections to the rest of the plant through the boxes in accordance with the layout such as shown in Fig. 1. These plural tubes therefore create what may be termed a bank, each bank through their journals or connecting boxes 110 resting as a unit upon the upper flange of the I beams 103 and 104 so that said beams take the entire weight of each bank. Each bank may comprise a single unit of piping or it may comprise a plurality of pipe sections, there being shown three sections in the right hand half of Fig. 7. Thus the use of the customary headers is avoided. All of, or the majority of the lower courses of, the tubes in each bank may be supported intermediate their ends by tubular or other supports indicated at 112, the ends of said tubular supports being fixed in the walls of the furnace.

To provide for expansion the boxes 110 at the front of the furnace are separated vertically by a steel roller such as 113 and the boxes at the rear of the furnace are separated vertically by a steel plate of a thickness equal to the rollers 113. The purpose of this construction is to keep the rear end of the tubes of each bank relatively fixed while permitting the front ends to move under the expansion and contraction of the tubes due to application of heat, the connections between each bank to the rest of the plant being made at the rear of the furnace.

By this construction it will therefore be seen that the heat from the burner 100 may raise the temperature of the tube bank permitting the metal of the bank to expand without disrupting the structural features of the furnace or the individual still, while at the same time preserving the integrity of the bank of tubes as a whole. Further, the I beams 103 and 104 are air-cooled and therefore will be insured a life longer than that ordinarily permitted such structural members which are hung from the roof, or which are entirely encased or embedded within the furnace walls or are otherwise directly subjected to the heat of the burner. That is to say, air from outside the furnace is permitted to freely enter the rectangular spaces 108 in which is disposed each I beam, said air travelling along the web of said beam. Because said space 108 is open at its top, the natural draft of the furnace will insure such passage of air over the web of said beams, it being understood that there will be just a loose fit between the edges of the top flange of each beam and the vertical walls of the space 108 containing the beam. Should any repairs be necessary to the brick walls 105 and 106, the same can be made without disturbing the tube bank and its support. The front and rear walls of the furnace may have the usual furnace construction such as provision for doors 114 and 115 for permitting access to the tube banks, as well as an opening 116 through which access may be had to the combustion chamber. Also the tube banks may be repaired without disturbing the brickwork of the furnace. This isolation of construction is quite important due to the difference in the coefficients of heat expansion of brickwork and metal which normally is the cause of ruptures in furnace construction.

The roof of the furnace is peculiarly constructed to render the same easy of repair, replacement, removal and insertion. Primarily it consists of a plurality of individual fire bricks, or other suitable ceramic elements, such as 120 laid side by side, each provided in its upper portion with an inverted T slotway for receiving the T head of a hanger 121 of a shape shown particularly in Fig. 9. In other words, the hanger comprises a vertical web portion 122 with a transverse T flange 123 at its bottom and with a pair of oppositely directed hooks such as 124 formed in its upper edge, which hooks are adapted to slidably engage the bottom flanges of two channels such as 125 and 126 placed face to face and

secured as by the cross connector 127, see Fig. 7.

Where the expanse of roof is relatively great there may be provided a hanger 121 with a plurality of pairs of hooks for engaging plural pairs of channels as indicated in the left half of the roof structure of Fig. 7, or there may be provided a single broad hanger as shown in the right half of said figure. Where the section of the roof has relatively short dimension, the construction shown above the partition wall 4 of the furnace in Fig. 7 may be employed wherein the hanger, instead of having the outwardly directed hooks shown in Fig. 9, is provided with a pair of inwardly directed hooks for engagement over the edges of the bottom flange of an eye beam such as 128. The ends of such structural members such as the channels 125, 126, or the eye beam 128, are suitably supported by the walls of the furnace. By this construction fractional repairs or replacements of damaged bricks may be made without sacrificing the remainder of the roof bricks.

From the foregoing disclosure it will thus be seen that by this invention there is provided a method of treating a hydrocarbon oil which consists in heating the oil to a vaporizing temperature in still 2 insufficient to completely vaporize the same, independently heating water in the lower part of said still to produce a region of nascent steam, and conveying the unvaporized oil to said region where said oil is completely vaporized. The resultant mixture of oil vapors and steam at a temperature below 700° F. is then subjected to condensing temperatures in the bubble tower 5 to recover the heavier hydrocarbons after which the remaining oil vapors leaving said tower at substantially 500° F. are subjected to additional heating to raise the temperature thereof to 1100°–1200° F. in still 3. The superheated vapors are then led to the repressor 22 where the temperature thereof is lowered to substantially 600°–700° F. in the presence of nascent steam which latter maintains all of the constituents of said vapors in the vapor form, after which the vapors are subjected to condensing temperatures in the second bubble tower 23 to recover the lighter ends of the oil. The light oils are then led to the flash still 30 where their temperature is instantaneously raised to 350°–400° F. to insure the exceptionally anti-knock values being retained in said oils, after which the vapors are condensed and otherwise treated for marketing. Therefore it will be observed that this method includes the utilization of nascent steam at two different points or stages of the process, first to establish complete vaporization of the oil in order to permit the recovery of the heavier ends thereof, and again to hold the constituents of the remaining vapors in the vapor form while reducing their temperature for recovery of the lighter ends of said oil.

From the above disclosure it will be seen that the apparatus embodies novel features in the arrangement of parts and the construction thereof. The entire plant is closed whereby the process is conducted out of contact with the air, for in starting up, the system is filled with steam which is driven out by the following oil vapors. The furnace is made so that the tube banks constituting the stills 2 and 3 are carried solely by the horizontal I beams which in turn are supported by the vertical structural columns which latter are disposed entirely outside the furnace, wherefore air is permitted by the natural draft of the furnace to freely enter the space in the furnace walls provided for the horizontal I beam, to cool the latter. The furnace roof is made in sections, each composed of a plurality of fire bricks or the like strung upon a hanger which latter is hooked slidingly upon a supporting steel structural member, whereby fractional repairs and/or replacements of damaged roof bricks may be made without sacrificing the remainder of said bricks. Lastly the tubes of each bank are so mounted that the ends where the connections to the rest of the plant are made are fixed or relatively rigid, whereas the opposite ends are mounted upon rollers permitting free longitudinal movement of the tubes upon expansion and contraction due to heat from the furnace.

The repressor is designed to receive the vapors at a temperature of 1100° F. and immediately subject them to the constant presence of a film of moving water in order to lower the temperature of said vapors. Further the water supply is so arranged that a portion thereof may be immediately turned into steam, whereby nascent steam is created where the hot vapors make contact, with the result that the nascency of the steam is responsible for maintaining the vapors in the vapor phase though their temperature is materially reduced, and said nascency is also responsible for revaporizing any condensate which might be formed and which may be undesirable. Therefore, none of the constituents of the vapor is lost through condensation and the remainder of the process proceeds upon the full 100% of the hydrocarbons.

It is obvious that those skilled in the art may vary the steps and combinations of steps constituting this process without departing from the spirit of the invention, and therefore it is not desired to be limited to the foregoing except as may be required by the claims.

What is claimed is:—

1. The method of treating a hydrocarbon oil which consists in heating the oil to a temperature substantially no higher than 500° F. and insufficient to completely vaporize the same; independently heating water to produce a region of nascent steam; conveying the unvaporized oil to said region where said oil is completely vaporized at no increase in said temperature; subjecting the resultant mixture of oil vapors and steam to condensing temperatures to recover the heavier fractions of said oil; subjecting the remaining oil vapors to additional heating at temperatures above 900° F. to crack the same; and lowering the temperature of the reheated and cracked vapors, including subjecting said vapors to contact with a film of moving water so as to maintain said vapors in the vapor phase; and recovering the lighter fractions of said oil.

2. The method of treating a hydrocarbon oil which consists in continuously vaporizing the lighter ends of said oil out of contact with water; subjecting the unvaporized oil to the action of heat and nascent steam to completely vaporize the same; subjecting the resultant mixture of oil vapors and steam to condensing temperatures to recover the heavier ends of the oil; superheating the remaining oil vapors to raise the temperature thereof to 1100–1200° F.; lowering the temperature of the superheated vapors to 600–700° F. while holding all of the constituents of said vapors in the vapor form; and condensing said vapors to recover the lighter ends of said oil.

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