(No Model.)

R. H. LAIRD.

PROCESS OF AND APPARATUS FOR DEODORIZING AND REFINING CRUDE OILS.

No. 507,230. Patented Oct. 24, 1893.

Fig. 1

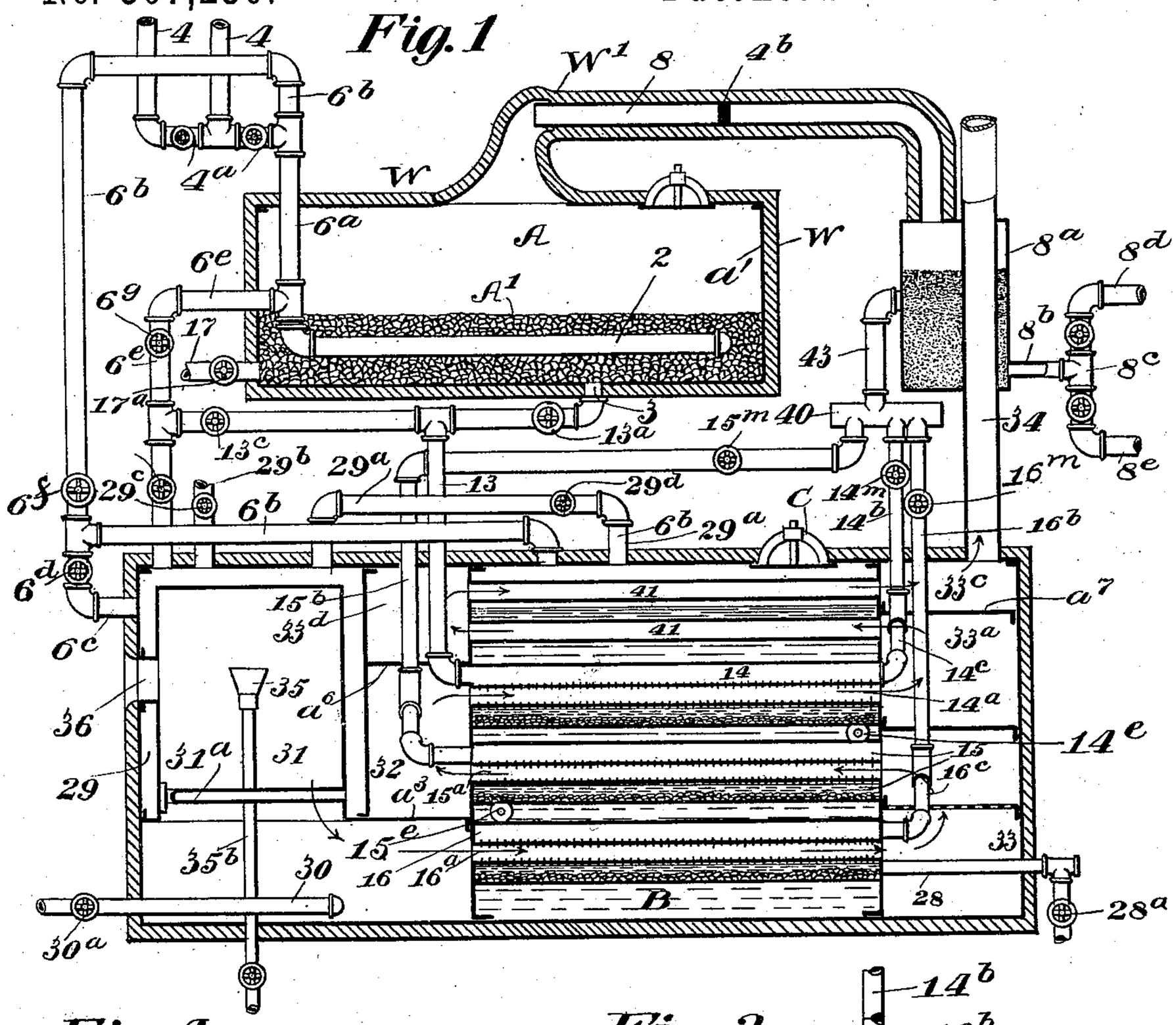


Fig. 4

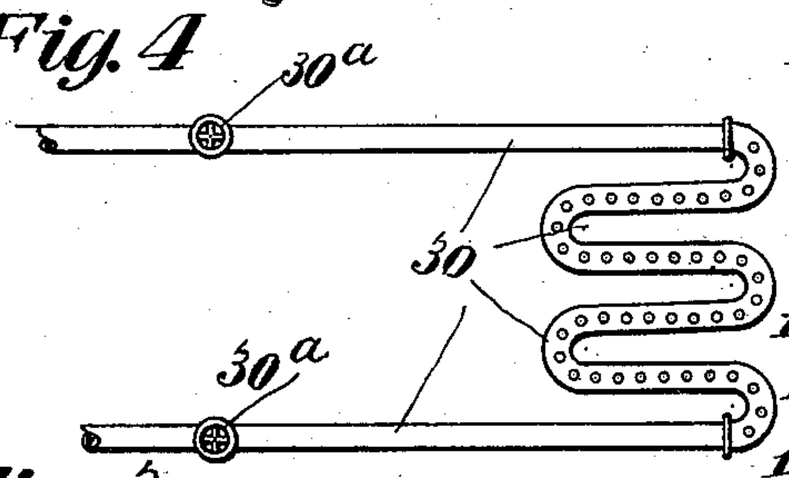


Fig. 2

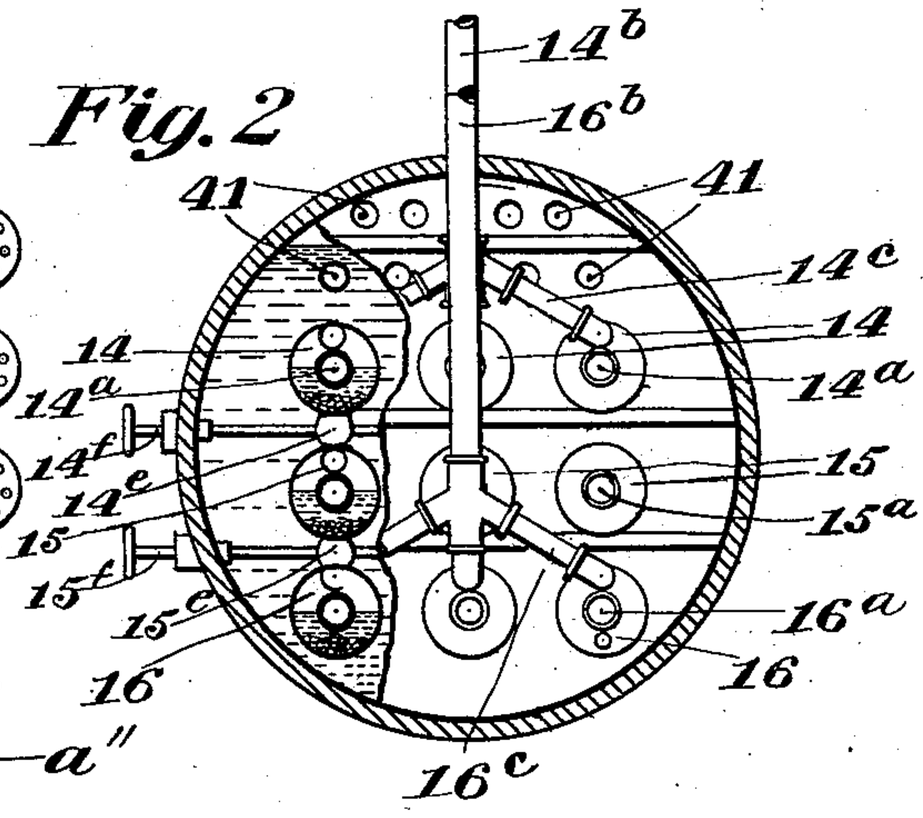
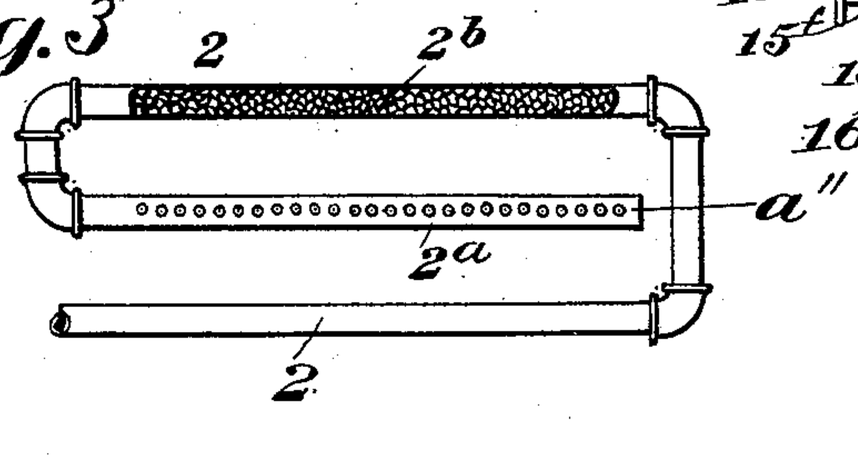


Fig. 3



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PROCESS OF AND APPARATUS FOR DEODORIZING AND REFINING CRUDE OILS.

SPECIFICATION forming part of Letters Patent No. 507,230, dated October 24, 1893.

Application filed April 20, 1892. Serial No. 429,915. (No model.)

To all whom it may concern:

Be it known that I, ROBERT H. LAIRD, a citizen of the United States, residing in the city of Toronto, county of York, Province of Ontario, Canada, have invented a certain new and useful Process of and Apparatus for Deodorizing and Refining Crude Oils; and I hereby declare that the following is a full, clear, and exact description of the same.

This invention relates to certain improvements in an apparatus for distilling oils; and the object of the invention is to construct an apparatus which consists essentially of a vaporizing chamber into which the crude oil is introduced and subjecting the crude oil while in the said vaporizing chamber to heat at a low temperature to generate therefrom what is commonly known as the alcoholic series of vapors and means for subjecting the residue of the crude oil after the alcoholic series of vapors have been obtained to the action of heat at a higher temperature than that first mentioned to obtain the vapors of the hydro carbon and the lubricating oils, and means for conducting the vapors as they are generated from the vaporizing chamber to a filter containing salt, sand and chloride of lime through which they are forced and then conducted to the condensers.

In the drawings:—Figure 1 is a vertical sectional view of the apparatus used for distilling oil. Fig. 2 is a cross sectional view of the same on line *a*—*a* Fig. 1, a portion of the left hand wall of the generator being broken away to better show the construction. Fig. 3 is a plan view of the perforated pipe within the vaporizing chamber partially in section showing it to contain fragmentary refractory materials. Fig. 4 is a plan view of the air vent within the combustion chamber.

Like numerals and letters of reference refer to like parts throughout the specification and drawings.

In the drawings, A, represents the first vaporizing chamber constructed of any material suitable for the purpose and of any suitable shape and size and provided with a covering W, of asbestus or other material having properties analogous to the properties of the asbestus. This chamber A, is fitted with a vaporizing dome 1 connected with the filter 8^a by means of a pipe 8 said pipe and dome being also provided with a covering *w'* of asbestus. Entering the first vaporizing chamber A, is a feed pipe 6^a, the lower end of which is connected to a double U-shaped pipe 2 lying upon the bottom *a'* of the said vaporizing chamber A; the shape of this pipe 2 being more clearly illustrated in Fig. 3 of the drawings. The last bend 2^a of the U-shaped pipe 2 is perforated, while the end *a''* of the said pipe is closed by a plug or other device suitable for the purpose. It might also here be stated that for the purpose of breaking up the oily globules to assist the process of distillation, the vaporizing chamber A, is partially filled with fragmentary, refractory materials A', such as broken glass, broken iron, broken granite, &c., which, can be purchased at a minimum cost, and upon which the crude oil and process of distillation will have little or no destructive action.

The feed pipe 6^a is connected with the boiler B, by means of the steam pipe 6^b; and connected to the feed pipe 6^a intermediate its juncture with the pipes 2 and 6^b are the supply pipes 4, which connect the said feed pipe 6^a and the tank containing the crude oil and solutions. As this tank may be of any suitable shape and size and can be readily conceived by the mind I do not deem it necessary to illustrate it in the drawings. After the crude oil has been placed in the aforesaid tank a solution is added to it and this mixture of crude oil and solution is then drawn from the aforesaid tank by means of the pipes 4 connected to the pipes 6^a. The steam passes from the boiler B through the pipes 6^b to the pipes 6^a where it unites with the mixture from the tank and forces the same through the pipes 6^a and through the U-shaped pipe 2, into the vaporizing chamber A. The action of the steam upon the crude oil generates the alcoholic series of vapors therefrom. The alcoholic series of vapors rising to the vaporizing dome "1" are carried from the said dome to the filter 8^a by means of the connecting pipe 8.

The filter 8^a is composed principally of sand, salt, and slaked lime, or other suitable substances and the vapors passing through this filter on their way to the condensers are

thoroughly refined and deodorized. The filter 8^a surrounds the outlet 34 to the chimney and the products of a combustion passing through the filter 8^a by means of the outlet 34 heat the filter 8^a to a temperature of about 300° Fahrenheit the components of the said filter being heated to a like temperature. The heated lime acting upon the vapors passing through the filter absorbs all or nearly all of the metallic and other impurities contained in the said vapors.

The object of the refractory fragmentary materials in the vaporizing chamber A and other parts of the apparatus is to atomize and distribute the oily globules over as large a surface as possible. The fragmentary materials also act to a certain extent as absorbents of the sulphurous impurities contained in the crude oil, while the remaining impurities combine with the solution and form a precipitate.

The U-shaped pipe 2 contains fragmentary refractory material 2^b arranged in such a manner as to break the density of the mixture when passing therethrough. It might also be stated that this fragmentary refractory material 2^b is immovably arranged in the U-shaped pipe 2 to prevent the mixture in its passage through the said pipe forcing it (the refractory material), into the end a'' to clog the said pipe and prevent a free passage therethrough. The steam when first admitted into the vaporizing chamber A is of a temperature of about 212°, and its admission at this temperature is continued to the said vaporizing chamber A until all of the alcoholic series of vapors have been obtained from the crude oil contained therein, after which the temperature of the steam is increased or is superheated by any of the usual methods now employed, and again admitted to the vaporizing chamber by means of the aforesaid connections. This superheated steam acting on the residue in the vaporizing chamber A, generates therefrom the oleic vapors of heavier gravity which rising to the dome "1" are conducted to the filter (8^a) by means of the connecting pipe 8 where they are purified and deodorized and then conducted to their respective condensers.

It might here be stated that the filter 8^a is provided with an exhaust pipe 8^b fitted with a T-branch 8^c to which are connected two pipes 8^d and 8^e respectively, each of which is provided with any of the usual form of valves. The alcoholic series of vapors after passing through the filter 8^a are conducted from the said filter by means of the exhaust pipe 8^b, T-branch 8^c and connection 8^d, to their condenser, the valve in the pipe 8^d being opened to permit of their passage therethrough and the valve in the pipe 8^e being closed for the opposite reason. After the alcoholic series of vapors have passed through the filter 8^a and connections to their respective condenser, the valve in the pipe 8^d is closed and the valve in the pipe 8^e is opened so that when the superheated steam is admitted to the vaporizing chamber A and the oleic vapors are passing through the filter 8^a they may pass uninterrupted in their course through the exhaust 8^b and connections 8^c and 8^e to their respective condenser. As these condensers are old and well known I do not consider it at all necessary to illustrate them in the drawings or enter into a detailed description thereof.

By conducting the oleic vapors as they are generated through the filter 8^a they are purified and refined before reaching the condensers, and the necessity of re-converting the condensed oil in the condensers into vapors for filtering purposes is avoided.

Instead of introducing superheated steam into the vaporizing chamber A to obtain the oleic vapors of heavier gravity supplemental heat may be applied to the external surface of the vaporizing chamber A in any manner suitable to the purpose, the temperature of the supplemental heat at no time being such as to burn or otherwise destroy the said oleic vapors as they are generated. When all the oleic vapors possible have been obtained from the crude oil within the vaporizing chamber A, the residue is drawn off from the said chamber by means of a pipe 13 which feeds the residue to the cylinders 14 surrounding the upper row of flues 14^a of the boiler B. The cylinder 14 and the other cylinders which are hereinafter described, and which surround the remaining flues of the boiler B each contain fragmentary refractory material similar to that contained in the pipe 2. The cylinders 14 are connected to and are in circulation with the cylinders 15 surrounding the row of flues 15^a next below the row of flues 14^a, and said cylinders 15 are connected to and in circulation with the cylinders 16 surrounding the row of flues 16^a next below the row of flues 15^a and so on to the lowermost row of flues of the boiler, if there happen to be more than three rows of flues. Thus it will be seen that the flames and heated products of combustion from the fire box, in passing through the flues 16^a, 15^a and 14^a as indicated by the arrows in Fig. 1 impart to each of the chambers 16, 15 and 14 a gradually reduced heat from the lower to the uppermost chamber.

As before stated the residue when drawn off from the vaporizing chamber A is fed to the row of cylinders 14 heated to a temperature greater than the temperature of the heat applied to the vaporizing chamber A, during which period the oleic vapors of the next heavier gravity are obtained. As the oleic vapors are generated within the cylinders 14 they are conducted by means of a pipe 14^b to a common branch pipe 40 and from the branch 40 to the filter 8^a and are then conducted from the filter 8^a to their respective condensers. To cut on or off the oleic vapors from the cylinder 14 to the common branch pipe 40, the pipe 14^b is fitted with a valve

14^m which is opened only during the passage of the vapors from the cylinder 14 to the filter 8^a.

As shown in Fig. 2 of the drawings each of the cylinders 14 is connected to the pipe 14^b by means of branch pipes 14^c, and each of the cylinders 15 and 16 are connected to their respective pipes 15^b and 16^b in a similar manner by the branch pipes 15^c and 16^c respectively. After the oleic vapors have been obtained from the crude oil contained in the cylinder 14 the residue is drawn off from said cylinder into the cylinder 15 by means of a coupling pipe 14^d entering the bottom of one end of the cylinder 14 and the top of the same end of the cylinder 15. A valve 14^e is provided in pipe 14^d, which valve is provided with a stem 14^f extending through the wall of the generator as seen in Fig. 2 and provided at its outer end with a hand wheel adapted to be turned for operating the said valve.

The temperature of the heat applied to the cylinder 15 is much greater than that applied to the cylinder 14, and the oleic vapors generated in the cylinder 15 are of a heavier gravity than those generated in the cylinder 14. The oleic vapors are conducted from the cylinder 15 to the pipe 15^b by means of the pipe connections 15^c and then to the branch 40 by means of the pipe 15^b, from which they are conducted to the filter 8^a. The branch connections 15^c of the pipe 15^b enter the cylinders 15 at the top of the ends opposite to the ends entered by the branch connections 14^c. The pipe 15^b is fitted with a valve 15^m similar to the valve 14^m and for the same reason. When all the oleic vapors possible have been obtained from the crude oil within the cylinder 15 the residue is drawn off from said cylinder into the cylinder 16 by means of a coupling pipe 15^d similar to the coupling pipe 14^d connecting said cylinders 15 and 16 in the same manner as the pipe 14^d connects the cylinders 14 and 15. A valve 15^e operated by a rod 15^f is provided in the coupling pipe 15^d, the construction being a repetition of that previously described for withdrawing the residue from chamber 14.

The oleic vapors are conducted from the cylinder 16 to the filter 8^a by means of a pipe 16^b and branch pipe 40 and are conducted from said filter to their condenser, the pipe 16^b being fitted with a valve 16^m. The heat, it might here be stated, applied to the cylinder 16 is of a much higher temperature than the heat applied to the cylinder 15. Consequently the vapors generated in the cylinder 16 are of a much heavier gravity than those generated in the cylinder 15. The heat applied to the residue within the cylinder 16 is usually of such a temperature as to convert all of the oleic substances into vapor, and that portion of the residue within the cylinder 16 that is not convertible into vapor is considered as refuse and drawn off from the cylinder 16 by means of the pipe 28.

Within the boiler B and above the tier of cylinders 14 and flues 14^a are two tiers or rows of flues 41 which preferably pass through the steam area of the boiler for the purpose of superheating the steam within the said boiler. The steam jacket 29 may also be employed for the purpose of superheating the steam from the boiler B. To accomplish this the valve 29^d in the pipe 29^a is closed to cut off the supply of water from the boiler B and the steam jacket 29 is rendered perfectly dry by the heat from the burner 35. The valve 6^f in the steam pipe 6^b between its connections with the pipe 6^c and the pipe 6^a is closed, and the valve 6^d in the pipe 6^c is opened thus opening the passage from the boiler B into the steam jacket 29. The steam passes through the boiler B into the steam jacket 29 and is there superheated and then passes from the steam jacket 29 to the pipe 6^a by means of the pipe 6^e. From the foregoing description will be gathered one method of introducing superheated steam into the vaporizing chamber A, but as many of the ordinary methods of producing superheated steam and applying it to the said chamber may be employed I do not confine myself to this particular construction. A pipe 13^b connects the pipe 6^e with the pipe 13, and the pipe 6^e is provided with a valve 6^g intermediate its juncture with the pipe 13^b and the pipe 6^a. The pipe 13^b is also provided with a valve 13^c intermediate its juncture with the pipe 6^e and the pipe 13. While the steam is passing from the steam jacket 29 through the pipe 6^e to the vaporizing chamber A, the valve 6^g is opened to permit of its free passage therethrough, and the valve 13^c in the pipe 13^b is closed. When it is necessary to direct the superheated steam from steam jacket 29 to the cylinder 14, the valve 6^g in the pipe 6^e is closed, and the valve 13^c in the pipe 13^b is opened. The steam passes from the steam jacket 29 through the pipes 6^e, and 13^b, and 13 to the cylinder 14 where its action upon the residue contained in said cylinder generates the oleic vapors therefrom. The superheated steam in the cylinder 14 is augmented by the products of combustion passing through the flues 14^a, and it is by this means that the temperature of the heat applied to the cylinder 14 is greater than the heat applied to the vaporizing chamber A.

If desirable an independent connection may be made from the pipe 13 with each of the cylinders 15 and 16, but this is hardly necessary as the steam can find a direct passage through the end couplings 14^d and 15^d without losing any of its latent heat, as the products of combustion while passing through the flues 14^a and 15^a will enable it to retain its temperature.

By an apparatus of this description it is possible to obtain from the crude oil all of the oleic vapors from the lightest to the heaviest gravity until nothing of commercial value is left to the crude oil originally introduced into

the vaporizing chamber A. For cleansing purposes the vaporizing chamber A is provided with an exhaust pipe 17 fitted with a valve 17^a and the pipes 4, 8, and 13 are each provided respectively, with a valve 4^a, 4^b, and 13^a. When it is found necessary to cleanse the vaporizing chamber A, the valves 4^a, 4^b, and 13^a in the pipes respectively 4, 8, and 13 are closed and the valve 17^a in the exhaust pipe 17 is opened. Steam from the boiler B at a high pressure is introduced into the chamber A by means of the pipe 6^b and the sediment is blown off through the pipe 17 which may lead to the ground or to a tank placed to receive said sediment.

In place of using the pipe 29^a to feed the steam jacket 29, I may if I so desire provide the steam jacket 29 with a feed pipe 29^b fitted with a valve 29^c. Located within the fire-box 31 of the furnace of the boiler is an air duct 30 in the form of a perforated worm shaped pipe provided with valves 30^a to regulate the current of air to the combustion chambers.

It will be noticed by reference to Fig. 1 of the drawings that the fire box 31 is supplied with a draft of air by means of a vent located at the front of the furnace and above the burner 35. The air enters the fire box 31 through a perforated opening in the vent 36 located at the front of the furnace and burner 35 assisting the combustion of the fuel and passes downward through said fire box to the bottom where the auxiliary draft supplied by the perforated worm shaped pipe 30 unites with the said products of combustion and they then pass through the lowermost tier of flues 16^a. The auxiliary draft from the worm shaped pipe 30 assists a secondary combustion which takes place in the combustion chamber 33, boiler flues 16^a and 15^a and combustion chamber 32. The perforated worm shaped pipe 30 as before stated is provided with valves 30^a so that the temperature of the heat applied during the vaporization of the crude oil can be properly regulated and the oleic vapors generated during the distillation will be prevented from burning; that is, in obtaining the vapors of different gravities the heat must be increased so gradually that such increased heat will not burn or otherwise destroy the vapors.

Within the fire box 31 at or near its middle is a burner 35 of any suitable design to consume the oleic vapors fed to it from the cylinder 16 to which it is shown connected by means of the pipe 35^b. This burner 35 is the means employed for heating the boiler B and steam jacket 29, and the products of combustion from the burner 35 while passing through the flues 16^a, 15^a, and 14^a supply heat to the cylinders, 16, 15, and 14. I may, however, if I find it desirable, in place of using the burner 35 fire up in the usual manner, and for this purpose I have provided the fire-box 31 with hollow grate bars 31^a in circulation with the water area of the steam jacket 29. To allow of contraction and expansion of the grate bars in the fire-box each grate bar is rigidly connected at one end to the shell of the steam jacket 29, while the other end is loosely mounted on a support. The products of combustion pass from the fire box 31 through the lowermost series of flues 16^a to the combustion chamber 33 from which they are conducted to the combustion chamber 32 by means of the flues 15^a. The products of combustion are conducted from the combustion chamber 32 to a third combustion chamber 33^a by means of the flues 14^a, from whence they are directed through the lowermost tier of the flues 41 to the combustion chamber 33^d and then through the uppermost row of flues 41 to the combustion chamber 33^c from whence they are conducted by the outlet pipe 34. Entering the oil chambers 14, 15, and 16, respectively, from the flues 14^a, 15^a and 16^a are copper pins 42 arranged at regular intervals to provide a means for conducting the heat to said cylinders from said flues and by means of which little or no heat is lost. The combustion chambers 33 and 33^a are located at the back end of the boiler B and are separated from each other by means of a partition a'. A similar partition a^3 separates the combustion chamber 32 from the fire box 31, and similar partitions a^6 and a^7 separate the combustion chambers 32 and 33^d and the combustion chambers 33^a and 33^c. From a construction of this kind it will be readily understood that the products of combustion containing the greatest amount of latent heat will pass through the lowermost tier of flues 16^a and that during their transit therethrough a certain portion of the latent heat is absorbed into the cylinders 16 and boiler B, thus supplying the greatest amount of heat to the said cylinders. As the cylinders 16 and boiler B have absorbed a certain percentage of the heat of the products of combustion during the passage of the said products through the flues 16^a it cannot be expected that the cylinders 15 surrounding the flues 15^a will be heated to the same temperature as the cylinders 16 surrounding the flues 16^a and the same in regard to the cylinders 14 surrounding the flues 14^a when in comparison with the cylinders 15 surrounding the flues 15^a.

The boiler B is fitted with the usual manhole doors *c*, for cleaning or other purposes, while the necessary connections are properly made between the several parts composing the apparatus.

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

1. The herein described process of distilling oil, which consists in first introducing the crude oil to be treated into a vaporizer, then introducing steam at a temperature of substantially 212° to said vaporizer whereby the alcoholic series of vapors are generated, then withdrawing said vapors, then introducing

superheated steam to said vaporizer whereby the oleic series of vapors are generated and then withdrawing said vapors, substantially as set forth.

2. In an apparatus for distilling oil, the combination with a boiler, a series of flues therein, a tubular oil chamber surrounding each of several of said flues, an inlet and an outlet for each of said oil chambers, a pipe affording communication between the steam space of the boiler and the inlet of said oil chambers, a receptacle outside the boiler, and a pipe communicating between said receptacle and said oil chambers, substantially as set forth.

3. In an apparatus for refining oil the combination of a boiler, a flue formed therein, a tubular oil chamber surrounding said flue, said chamber having an inlet and an outlet, a pipe affording communication between the steam space of the boiler and the inlet of said oil chamber, and a packing of refractory material within the oil chamber adapted to break the density of the crude oil substantially as described.

4. In an apparatus for distilling oil the combination of a receptacle, an inlet and an outlet to said receptacle, a boiler, a series of flues therein, a tubular oil chamber surrounding each of several of said flues a pipe communicating between said receptacle and said oil chambers, an inlet and an outlet to each of said oil chambers, a filter and pipes communicating between the filter and the receptacle and the oil chambers, substantially as described.

5. An apparatus for distilling oil consisting of a receptacle for the oil to be treated provided with an outlet, a condenser, a pipe connecting said condenser with the outlet of the receptacle, a perforated oil inlet pipe arranged in said receptacle and having an internal packing of refractory material, substantially as set forth.

6. In an apparatus for distilling oil, the combination with a receptacle for the oil to be treated, a perforated oil inlet pipe arranged in said receptacle and having an internal packing of refractory material, a boiler, a pipe connecting said oil-inlet pipe with the steam space of the boiler, a condenser, and a pipe connecting said receptacle with the condenser, substantially as set forth.

7. In an apparatus for distilling oil the combination of a receptacle for the oil to be treated, a dome to said receptacle, a substantially U-shaped perforated pipe within said receptacle, a boiler, a pipe connecting said U-shaped pipe with the steam space of said boiler, an inlet for the oil to said U-shaped pipe, a filter, a pipe forming a communication between said dome and said filter, a series of flues within said boiler, a tubular oil chamber surrounding each of several of said flues, means for feeding the oil from the said receptacle to the said oil chambers, means for heating said oil chambers and means for conducting away the oleic vapors as they are generated, substantially as described.

8. In an apparatus for distilling oil consisting of a shell or casing having partitions forming a central water space or boiler therein and fire spaces or combustion chambers at the ends thereof, a series of flues passing through said water space and affording communication between the combustion chambers, partitions in said combustion chambers between the ends of alternate pairs of flues whereby a zig-zag passage is formed for the products of combustion through said water space, a tubular oil chamber surrounding each of several of said flues, an inlet and an outlet to each of said oil chambers, pipes affording communication between the inlets and outlets of alternate pairs of said oil chambers whereby a zig-zag passage for the oil is formed through said boiler, valves in said pipes, and a pipe connecting the steam space of said boiler with the inlet of said oil chambers, substantially as described.

9. In an apparatus for distilling oil consisting of a shell or casing having partitions forming a central water space or boiler therein and fire spaces or combustion chambers at the ends thereof, a series of flues passing through said water space and affording communication between the combustion chambers, partitions in said combustion chambers between the ends of alternate pairs of flues whereby a zig-zag passage is formed for the products of combustion through said water space, a tubular oil chamber surrounding each of several of said flues, an inlet and an outlet to each of said oil chambers, pipes affording communication between the inlets and outlets of alternate pairs of said oil chambers whereby a zig-zag passage for the oil is formed through said boiler, valves in said pipes, a pipe connecting the steam space of said boiler with the inlet of said oil chambers, and a packing of refractory material in each of said oil chambers, substantially as described.

10. In an apparatus for distilling oil the combination of a receptacle for the oil to be treated, a dome to said receptacle, a substantially U-shaped perforated pipe within said receptacle, a boiler, a pipe connecting said U-shaped pipe with the steam space of said boiler, an inlet for the oil to said U-shaped pipe, a filter, a pipe forming a communication between said dome and said filter, a series of flues within said boiler, a tubular oil chamber surrounding each of several of said flues, means for feeding the oil from the said receptacle to the said oil chambers, means for heating said oil chambers and means for conducting away the oleic vapors as they are generated, a filter and a pipe for conducting the oleic vapors from the respective oil chambers of the boiler, substantially as described.

11. In an apparatus for distilling oil á receptacle for the oil to be treated, a dome to

the said receptacle, an inlet for said receptacle, a boiler, a pipe connecting the inlet of the receptacle with the steam space of said boiler, a filter, a pipe communicating between said dome and said filter, said filter containing sand, salt, and slaked lime and means for supplying heat to said filter, substantially as described.

12. An apparatus for distilling oil consisting of a vaporizer for the oil having an inlet and an outlet, a shell or casing having partitions forming a central water space or boiler therein and a combustion chamber at each end thereof, a series of flues passing through said water space and affording communication between said combustion chambers, partitions in said combustion chambers between the ends of alternate pairs of flues, whereby a zig zag passage is formed for the products of combustion through said boiler, oil chambers each provided with an inlet and an outlet, said chambers surrounding the respective flues of the series, pipes affording communication between the respective inlets and outlets of said oil chambers whereby a zig zag oil passage is formed through said boiler, valves in said pipes, a pipe affording communication between the steam space of the boiler and the inlet of said vaporizer a pipe affording communication between the outlet of said vaporizer and one end of said zig zag oil passage in the boiler, a valve in said pipe, a condenser, and pipes affording communication between the outlet of each of the respective oil chambers in the boiler and of said vaporizer and said condenser, substantially as set forth.

13. An apparatus for distilling oil, consisting of a vaporizer having an inlet and an outlet, a shell or casing having partitions forming a central water space or boiler therein, combustion chambers at each end thereof and a fire box or chamber at one end thereof, a series of flues passing through said boiler and affording communication between said combustion chambers, partitions in said combustion chambers between the ends of alternate pairs of flues whereby a zig zag passage is formed for the products of combustion through said boiler, oil chambers each provided with an inlet and an outlet, said chambers surrounding the respective flues of the series, pipes affording communication between the respective inlets and outlets of the said oil chambers whereby a zig zag oil passage is formed through said boiler, valves controlling said pipes, a pipe affording communication between the outlet of said vaporizer and one end of said zig zag oil passage in the boiler, a valve in said pipe, a condenser, and pipes affording communication between the outlet of each of the respective oil chambers in the boiler and of said vaporizer and said condenser, substantially as set forth.

14. An apparatus for distilling oil, consisting of a vaporizer having an inlet and an outlet, a shell or casing comprising a water chamber or boiler and a superheater, a pipe affording communication between the steam space of the boiler and the inlet of said vaporizer, a pipe affording communication between said superheater and the inlet of said vaporizer a condenser, and a pipe affording communication between said condenser and the outlet of said vaporizer, substantially as set forth.

15. An apparatus for distilling oil consisting of a vaporizer having an inlet and an outlet, a shell or casing having partitions forming a water chamber or boiler and a fire chamber therein, said partitions being arranged to form a close chamber surrounding said fire chamber, said close chamber serving as a superheater, a pipe affording communication between the steam space of the boiler and the said superheater, a pipe affording communication between the said superheater and the inlet of the vaporizer, a pipe affording communication between the steam space of the boiler and the inlet of said vaporizer, a condenser, and a pipe affording communication between the outlet of said vaporizer and said condenser, substantially as set forth.

16. An apparatus for distilling oil consisting of a boiler having a flue formed therein and a tubular oil chamber surrounding said flue, said chamber having an inlet and an outlet a pipe affording communication between the steam space of the boiler and the inlet of said oil chamber, a condenser, and a pipe affording communication between the outlet of said oil chamber and said condenser, substantially as set forth.

17. An apparatus for distilling oil consisting of a vaporizer for the oil having an inlet and an outlet, a boiler having a flue and a tubular oil chamber surrounding said flue, said chamber having an inlet and an outlet, a pipe affording communication between the steam space of the boiler and the inlet of said vaporizer, a pipe affording communication between the inlet of said oil chamber and the outlet of said vaporizer, a pipe affording communication between the steam space of the boiler and the inlet of said oil chamber therein, a condenser, and a pipe affording communication between the respective outlets of said vaporizer and oil chamber, and said condenser, substantially as set forth.

Toronto, April 5, 1892.

ROBERT H. LAIRD.

In presence of—
CHAS. H. RICKER,
JOHN GALT.