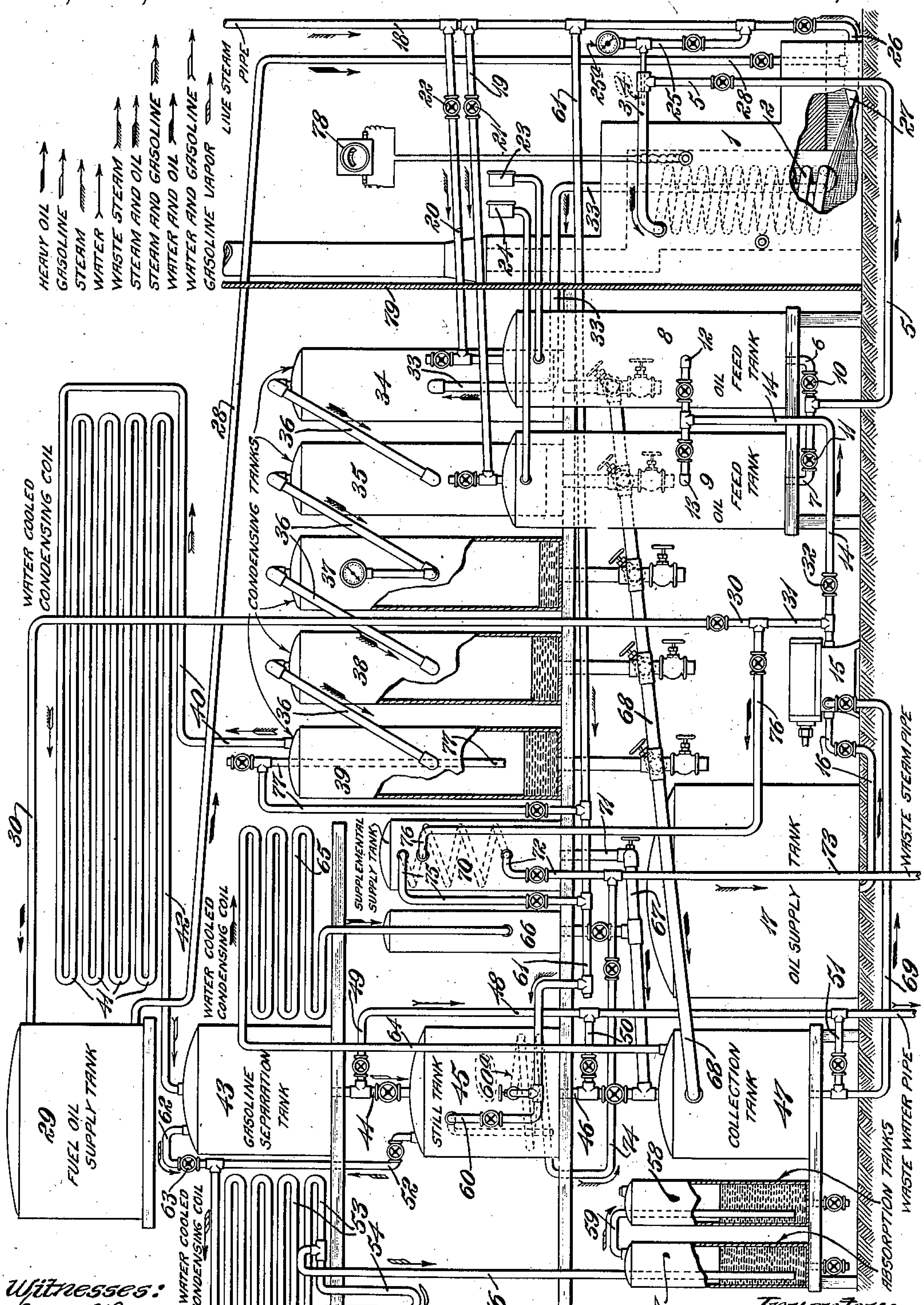
C. J. GREENSTREET.

APPARATUS FOR TREATING OIL.

APPLICATION FILED APR. 13, 1912.

1,166,982. Patented Jan. 4, 1916.



UNITED STATES PATENT OFFICE.

CHARLES J. GREENSTREET, OF WEBSTER GROVES, MISSOURI.

APPARATUS FOR TREATING OIL.

1,166,982. Specification of Letters Patent. Patented Jan. 4, 1916.

Application filed April 13, 1912. Serial No. 690,483.

To all whom it may concern:

Be it known that I, CHARLES J. GREENSTREET, a citizen of the United States, and a resident of the city of Webster Groves, in the county of St. Louis and State of Missouri, have invented a new and useful Apparatus for Treating Oil, of which the following is a specification.

My invention relates to an apparatus for treating crude oil, particularly heavy hydrocarbon oils, and has for its principal object, to provide for the conversion of such heavy hydrocarbon oils into lighter hydrocarbon oils.

The present invention consists in the parts and in the arrangements and combinations of parts hereinafter described and claimed.

The apparatus herein described is adapted to carry out the processes set forth in my co-pending applications, Serial Number 614,125 filed March 13, 1911; and Serial Number 696,891 filed May 13, 1912, now Patents 1,110,923 and 1,110,924, respectively, of Sept. 15, 1914.

The accompanying drawing, which forms part of this specification, is a general view of an apparatus embodying my invention.

My apparatus comprises a furnace 1 in which is located a long continuous coil of iron pipe 2. The upper end of this coil is connected by a pipe 3, atomizer 4, pipe 5 and branch pipes 6 and 7 to oil feed tanks 8 and 9. Each of the branch pipes 6 and 7 contains cut off valves 10 and 11 whereby either or both of the tanks may be placed in communication with the heating coil 2, as desired. The feed tanks 8 and 9 are likewise connected about midway of their height by valved branch pipes 12 and 13 with a pipe 14 which communicates with the delivery side of the pump 15, and the inlet side of said pump 15 communicates through a valved pipe 16 with an oil supply tank 17.

A steam pipe 18 leading from a boiler or source of steam has branch pipes 19 and 20 leading to the respective oil supply tanks 12 and 13, each of said pipes containing a control valve 21, 22; said supply tanks 12 and 13 are likewise provided with suitable pressure gages 23 and 24. Another branch pipe 25 leads from the steam pipe 18 and opens into the atomizer 4, whence it communicates through the pipe 3 with the heating coil 2; and this pipe 25 is likewise provided with a pressure gage 25ª. Another branch pipe 26 leads from the steam pipe into a suitable oil burner 27, which burner affords suitable means of heating the furnace. This oil burner is supplied with oil through a pipe 28 which communicates with a fuel oil supply tank 29, this fuel oil supply tank 29, in turn, communicates through a valved pipe 30 with a pipe 31 which communicates with the outlet pipe 14 of the pump 15 at a point between the pump and a valve 32 in said outlet pipe.

The outlet end of the heating coil 2 communicates through a pipe 33 with a condenser tank 34 about midway of the height thereof; and this condenser tank 34 communicates with a second condenser tank 35 through a pipe 36 extending from the top of the condenser tank 34 and opening into said tank 35 about midway of the height thereof. Likewise the tank 35 communicates with a third tank 37 and the third tank 37 with a fourth tank 38 and the fourth tank with a fifth tank 39, each tank in turn being connected to the next by the pipes 36 arranged as hereinbefore described.

The endmost tank 39 has a pipe 40 extending from the top thereof and communicating with a condensing coil 41 and said coil, in turn, communicates with the top of the tank 43 by means of a connecting pipe 42. This tank 43 is hereafter referred to as the gasolene separation tank.

The bottom of the gasolene tank 43 is provided with a valved pipe 44 which opens into the top of a tank 45 located immediately below the gasolene tank and hereinafter designated as a still tank; and the bottom of this still tank in turn connects through a valved pipe 46 with the top of a tank 47, hereinafter referred to as the collection tank. A pipe 48 for drawing off the waste water connects through valved branches 49, 50, and 51 with the bottoms of the gasolene separation tank, still tank and collection tank, preferably, through the pipes 44 and 46 hereinbefore mentioned.

Extending from the top of the still tank is a pipe 52 which communicates with a condensing coil 53; and the bottom of this coil is provided with a goose-neck or other suitable trap 54 in the delivery pipe 55.

Between the coil and the trap is a pipe 56 which opens into the upper side of the delivery pipe and extends nearly to the bottom of a tank 57 which is partly filled with heavy oil and is hereinafter designated as the casing head gasolene absorption tank.

In practice, it is desirable to duplicate this casing head gasolene absorption tank as shown at 58, the communication between the two tanks being made by means of a pipe 59 which extends from the top of the first casing head gasolene absorption tank to near the bottom of the second absorption tank.

The still tank 45 has a valved steam pipe 60 opening into the lower portion thereof, this steam pipe being connected with a pipe 61 which is a branch of the main steam pipe 18. The outlet pipe 52 of the still tank has a branch pipe 62 which communicates with the top of the gasolene tank 43, this branch pipe 62 containing a valve 63.

The collection tank 47 has an outlet pipe 64 extending from the top thereof to a reverse condenser 65 whose lower portion communicates with a tank 66, the bottom of which tank communicates through a branch pipe with the pipe 67, which pipe in turn communicates with the valved pipe 46 which opens into the top of the collection tank. Opening into the lower portion of said collection tank 47 is a pipe 68 which has valved branches extending upwardly into the bottoms of the several condenser tanks 34, 35, 37, 38 and 39. The bottom of the collection tank 47 is provided with a valved pipe 69 which communicates with the inlet side of the pump 15.

A tank 70, hereinafter referred to as the supplemental supply tank, has a valved pipe 71 which communicates with the upper part of the collection tank 47. Within this tank is a heating coil ending in a valved pipe 72 which communicates with a waste steam outlet pipe 73; and likewise the heating coil 60^a in the still tank has a valved pipe 74 which communicates with the same outlet pipe. Extending from the steam pipe 61 to the upper end of the heating coil in the supplemental supply tank 70 is a valved branch pipe 75; and likewise a valved branch pipe 76 extending from the branch outlet pipe 31 of the pump opens into the upper portion of said supplemental supply tank. By this arrangement, the supplemental supply tank can be readily replenished from the source of oil supply. A branch steam pipe 77 extending from the pipe 61 extends down through the last condenser tank 39 nearly to the bottom thereof and affords a means of heating and producing pressure on the contents thereof when it is desired to remove the same from said tank.

Preferably the furnace and the pressure gages and also the pyrometers 78 are all separated by a partition 79 from the other parts of the apparatus.

The operation of the apparatus is as follows: The furnace is first heated by means of the crude oil supply from the burner tank 29 of the burner 27, where it is atomized by steam injected through the branch steam pipe 26. Meanwhile, steam from the branch pipe 25 is being injected through the atomizer 4 and forced through the apparatus under pressure from the original source of steam. During this preliminary heating, not only the temperature of the coil is raised, but the temperature of the condensing tanks is also raised. When the heating coil reaches a cherry red heat, one or both of the valves in the branch steam pipes 19 and 20 are opened to produce a pressure on the crude oil supply tanks 8 and 9 or one of them; and either or both of the valves 10 or 11 in the outlet pipes of said tanks are opened gradually to permit the oil to be forced therefrom into the atomizer. The oil thus atomized is forced under the pressure of the steam through a long heating coil, where it is gradually transformed from heavier hydrocarbons into lighter hydrocarbons. This transformation is provided for and facilitated by the high temperature, the pressure inside of said coil, the continuous smoothness of the interior of the heating coil and the uniformity of its cross sectional area and by other factors incident to the apparatus. From the heating coil, the product passes into the first condensing tank, where the more easily condensed portion of the product is condensed. The remainder of the product passes into the next tank where the more easily condensable portion is condensed and so on from tank to tank. As the operation of the apparatus continues the condenser tanks gradually become hotter, so that a portion of the product which condenses in a given tank in the early stage will distil over into the next at a later stage in the operation; and it is desirable to continue the operation until the temperature of the last condensing tank is slightly in excess of the boiling point of water. From the last condensing tank, the product passes through the condensing coil 41, which is preferably cooled by water or other artificial means; so that the resulting product which enters the gasolene tank is mostly gasolene and water.

The lightest portions of the product, which are not condensed in the condensing coil 41, pass through the pipe 62 into the condensing coil 53, and the gaseous portions emerging from the condensing coil 53 are trapped by the gooseneck 54 and forced to pass through the pipe 56 into the casing head gasolene absorption tanks 57, where they are absorbed in the heavy oil therein. The water in the gasolene separation tank being heavier than the oil, is drawn out from time to time from the bottom of the gasolene tank 43 through the waste pipe 49; and the gasolene is then passed through the pipe 44 into a still tank 45, whereupon the connection between the gasolene tank and

still tank is cut off, and the valve 63 is closed. Live steam is then injected through the branch pipe 60 into the still tank with the result of vaporizing the lighter portion of the contents of the still tank, which lighter portion passes out through the pipe 52 into the condensing coil 53. From the condensing coil the gasolene passes to the delivery pipe 55; but the lightest portion of the gasolene is trapped and escapes through the bypass 56 into the casing head gasolene tank 57 where it is absorbed by the heavy oil provided for the purpose in said tank. After this distillation the operation is continued for some time, the water in the still tank is drawn off and the remaining contents are passed into the collection tank 47. From time to time the contents of one or more of the condenser tanks is drained into this collection tank and as the temperature of the contents of the condenser tanks is high, a portion thereof will evaporate and pass through the reverse condenser whence it is returned when desired to the collection tank. When desired, the communication between the supplemental supply tank and the collection tank is opened to allow crude oil to be forced into the collection tank, the collection tank thus receives a portion of the product condensed in the condensing tanks as well as the residue of the still and a portion of crude oil. The condensing tank is placed in communication with the supply pipe of the pump either alone or simultaneously with the main-supply tank, as desired; so that the contents of said condensing tank are passed through the apparatus in the same way as the original supply of crude oil.

Obviously, the apparatus hereinbefore described may be modified without departing from my invention, and I do not wish to be restricted to the details of construction hereinbefore set forth. For instance, instead of pumping the residue from the collection tank into the oil feed tank, the residue may be pumped directly into the heating coil. So, too, when it is desired to treat viscid oils, it is desirable to have a preliminary heater between the oil feed tank and the injector or atomizer, whereby the oil is brought into condition to respond to the contemplated operation of said injector or atomizer.

What I claim as my invention and desire to secure by Letters Patent is:

1. An apparatus for treating oil which comprises a furnace, a coil of pipe therein exposed directly to the heat of said furnace, the inner surface of said coil being free from abrupt changes, a source of steam pressure and a source of oil supply communicating with the inlet end of said coil, and a condenser communicating with the outlet end of said coil, whereby the oil is forced through the coil under pressure, said furnace being adapted to heat said coil to a cherry red heat and said coil being capable of withstanding the internal pressure caused therein by such heat in the normal operation of the apparatus.

2. An apparatus for treating oil which comprises a furnace, a long helical coil of uniform cross-section therein and exposed directly to the heat of said furnace, said coil being free from obstructions and abrupt angles, an oil supply tank communicating with the inlet end of said coil, a source of steam supply communicating with said inlet end and also with said tank, and a condenser communicating with the outlet end of said coil, said furnace being adapted to heat said coil to a cherry red heat and said coil being capable of withstanding the internal pressure caused therein by such heat in the normal operation of the apparatus.

3. An apparatus for treating oil which comprises a furnace, a long continuously coiled pipe in said furnace and exposed directly to the heat thereof and free from obstructions and abrupt changes of cross-sectional area, an injector communicating with said coil on the inlet side thereof, a source of steam pressure and a source of oil supply communicating with said injector and a condenser communicating with the outlet end of said coil, said furnace being adapted to heat said coil to a cherry red heat and said coil being capable of withstanding the internal pressure caused therein by such heat in the normal operation of the apparatus.

4. An apparatus for treating oil which comprises a furnace, a coil of continuous pipe therein exposed directly to the heat thereof and having a single inlet and a single outlet, an injector communicating with said coil on the inlet side thereof, a source of steam supply and a source of oil supply communicating with said injector, a condensing tank communicating with the outlet end of said coil, a condensing coil communicating with said condensing tank, a separation tank communicating with said condensing coil, and a collection tank communicating with said condensing tank and with said separation tank, said furnace being adapted to heat said coil to a cherry red heat and said coil being capable of withstanding the internal pressure caused therein by such heat in the normal operation of the apparatus.

5. An apparatus for treating oil which comprises a furnace, a coil of continuous pipe therein exposed directly to the heat thereof and having a single inlet and a single outlet, an injector communicating with said coil on the inlet side thereof, a source of steam supply and a source of oil supply communicating with said injector, condens-

ing tanks communicating serially with the outlet end of said coil, a condensing coil communicating with said condensing tanks, a separation tank communicating with said condensing coil, a collection tank communicating with said condensing tanks and with said separation tank, and a communication between the source of steam supply and the last of the condensing tanks, said furnace being adapted to heat said coil to a cherry red heat and said coil being capable of withstanding the internal pressure caused therein by such heat in the normal operation of the apparatus.

6. An apparatus for treating oil which comprises a furnace, a continuous coil of pipe of uniform cross-section therein arranged and adapted to be heated to a red heat and having a single inlet and a single outlet, an injector communicating with said coil on the inlet side thereof, an oil supply tank communicating with said injector, a source of steam supply communicating with said injector and with said supply tank, a condensing tank communicating with the outlet end of said coil, a condensing coil communicating with said condensing tank, a separation tank communicating with said condensing coil, and a collection tank communicating with said condensing tank and with said separation tank.

7. An apparatus for treating oil which comprises a furnace, a coil of continuous pipe therein arranged and adapted to be heated to a red heat, an injector communicating with said coil on the inlet side thereof, a source of steam supply and a source of oil supply communicating with said injector, condensing tanks communicating serially with the outlet end of said coil, a condensing coil communicating with said condensing tanks, a separation tank communicating with said condensing coil, a still tank arranged for said separator tank to drain into, a collection tank arranged for said still tank to drain into, a heavy oil tank, a second condenser coil communicating with said separator tank and said still tank, a delivery pipe for said second condenser coil, and a trap in said delivery pipe, said delivery pipe having an escape pipe between said coil and said trap and adapted to convey the lightest hydrocarbons into said heavy oil tank.

8. An apparatus for treating oil which comprises a furnace, a coil of continuous pipe therein, an injector communicating with said coil on the inlet side thereof, a source of steam supply and a source of oil supply communicating with said injector, condensing tanks communicating serially with the outlet end of said coil, a condensing coil communicating with said condensing tanks, a separation tank communicating with said condensing coil, a still tank arranged for said separator tank to drain into, a collection tank arranged for said still tank to drain into, draw-off pipes for all of said tanks, a heavy oil tank, a second condenser coil having a delivery pipe and a trap in said delivery pipe, and an escape pipe between said coil and said trap and adapted to convey the lightest hydrocarbons into said heavy oil tank.

9. An apparatus for treating oil which comprises a furnace, a heating coil therein, an oil feed tank, means for forcing oil from said feed tank into said coil, a source of steam supply communicating with said heating coil, a number of condensing tanks serially connected to the outlet end of said coil, a condensing coil connected to said condensers, a gasolene separation tank communicating with said coil, a still tank communicating with said gasolene tank, a collection tank communicating with said still tank, and an outlet pipe leading from said condensing tanks to said collection tank.

10. An apparatus for treating oil which comprises a furnace, a heating coil therein, means for forcing oil into said coil, a source of steam supply communicating with said heating coil, a number of condensers serially connected to the outlet end of said coil, a condensing coil connected to said condensers, a gasolene separation tank communicating with said coil, a still tank communicating with said gasolene tank, a collection tank communicating with said still tank, and an outlet pipe leading from said condensing tanks to said collection tank, and a reverse condenser for said collection tank.

11. An apparatus for treating oil which comprises a furnace, a long heating coil of small and uniform section therein, said coil being free from obstructions and abrupt angles and exposed directly to the heat of the furnace, means for forcing oil into said coil, a source of steam supply communicating with said heating coil, a number of condensers serially connected to the outlet end of said coil, a condensing coil connected to said condensers, a gasolene separation tank communicating with said coil, a still tank communicating with said gasolene tank, a collection tank communicating with said still tank, and an outlet pipe leading from said condensers to said collection tank, and a pump arranged to return oil from the collection tank to the heating coil.

12. An apparatus for treating oil which comprises a furnace, a coil of continuous pipe therein, an injector communicating with said coil on the inlet side thereof, a source of steam supply and a source of oil supply communicating with said injector, a condensing tank communicating with the outlet end of said coil, a condensing coil communicating with said condensing tank, a separation tank communicating with said

condensing coil, a collection tank communicating with said condensing tank and with said separation tank, and a pump whose inlet side is connected to said collection tank and whose delivery side is connected to said source of oil supply.

13. An apparatus for treating oil which comprises a furnace, a coil of continuous pipe therein, an injector communicating with said coil on the inlet side thereof, a source of steam supply and a source of oil supply communicating with said injector, a condensing tank communicating with the outlet end of said coil, a condensing coil communicating with said condensing tank, a separation tank communicating with said condensing coil, a collection tank communicating with said condensing tank and with said separation tank, and a reverse condenser for said collection tank.

14. An apparatus for treating oil which comprises a furnace, a coil of continuous pipe therein, an injector communicating with said coil on the inlet side thereof, a source of steam supply and a source of oil supply communicating with said injector, condensing tanks communicating serially with the outlet end of said coil, a condensing coil communicating with said condensing tanks, a separation tank communicating with said condensing coil and having delivery and draw-off pipes, a still tank arranged for said separator tank to drain into and means for heating said still tank, a collection tank arranged for said still tank to drain into, and a condenser for said still tank, said still tank having an outlet pipe at the upper part thereof communicating with said condenser, a delivery pipe for said condenser and a trap in said delivery pipe, and an escape pipe between said coil and said trap and adapted to convey the lightest hydrocarbons into heavy oil receptacles provided therefor.

15. An apparatus for treating oil which comprises a furnace, a coil of continuous pipe therein, an injector communicating with said coil on the inlet side thereof, a source of steam supply and a source of oil supply communicating with said injector, a condensing tank communicating with the outlet end of said coil, a condensing coil communicating with said condensing tank, a separation tank communicating with said condensing coil, a still tank arranged for said separator tank to drain into, a collection tank arranged for said still tank to drain into, heavy oil receptacles, a condenser coil having a delivery pipe, a trap in said delivery pipe, an escape pipe leading from said delivery pipe between said coil and said trap and opening into said heavy oil receptacles.

16. An apparatus for treating oil which comprises a furnace, a coil of continuous pipe therein, an injector communicating with said coil on the inlet side thereof, a source of steam supply and a source of oil supply communicating with said injector, a condensing tank communicating with the outlet end of said coil, a condensing coil communicating with said condensing tank, a separation tank communicating with said condensing coil, and a still tank arranged for said separator tank to drain into, a collection tank arranged for said still tank to drain into, a second condensing coil communicating with said still tank and having a delivery pipe and a trap in said delivery pipe, and an escape pipe between said coil and said trap and adapted to convey the lightest hydrocarbons into heavy oil receptacles provided therefor.

17. An apparatus for treating oil which comprises a furnace, a coil of continuous pipe therein, an injector communicating with said coil on the inlet side thereof, an oil supply tank, an oil feed tank communicating with said injector and a source of steam supply communicating with said injector and with said feed tank, condensing tanks communicating serially with the outlet end of said coil, a condensing coil communicating with said condensing tanks, a separation tank communicating with said condensing coil and having delivery and draw-off pipes, a still tank arranged for said separator tank to drain into and having a condenser in communication with the upper part thereof, a collection tank arranged for said still tank and said condensing tanks to drain into, and having communication with said oil supply tank, said condenser having a delivery pipe and a trap in said delivery pipe, and an escape pipe between said trap and said coil arranged to deliver the lightest hydrocarbons, and a pump whose inlet side communicates with said collection tank and whose delivery side communicates with said oil tank.

Signed at St. Louis, Missouri, this 11th day of April, 1912.

CHARLES J. GREENSTREET.

Witnesses:
ALBERT H. CROISSANT,
M. A. SHELTON.