March 5, 1935. O. J. NELSON 1,993,017

APPARATUS FOR TREATING PETROLEUM

Filed Dec. 28, 1929 3 Sheets-Sheet 1

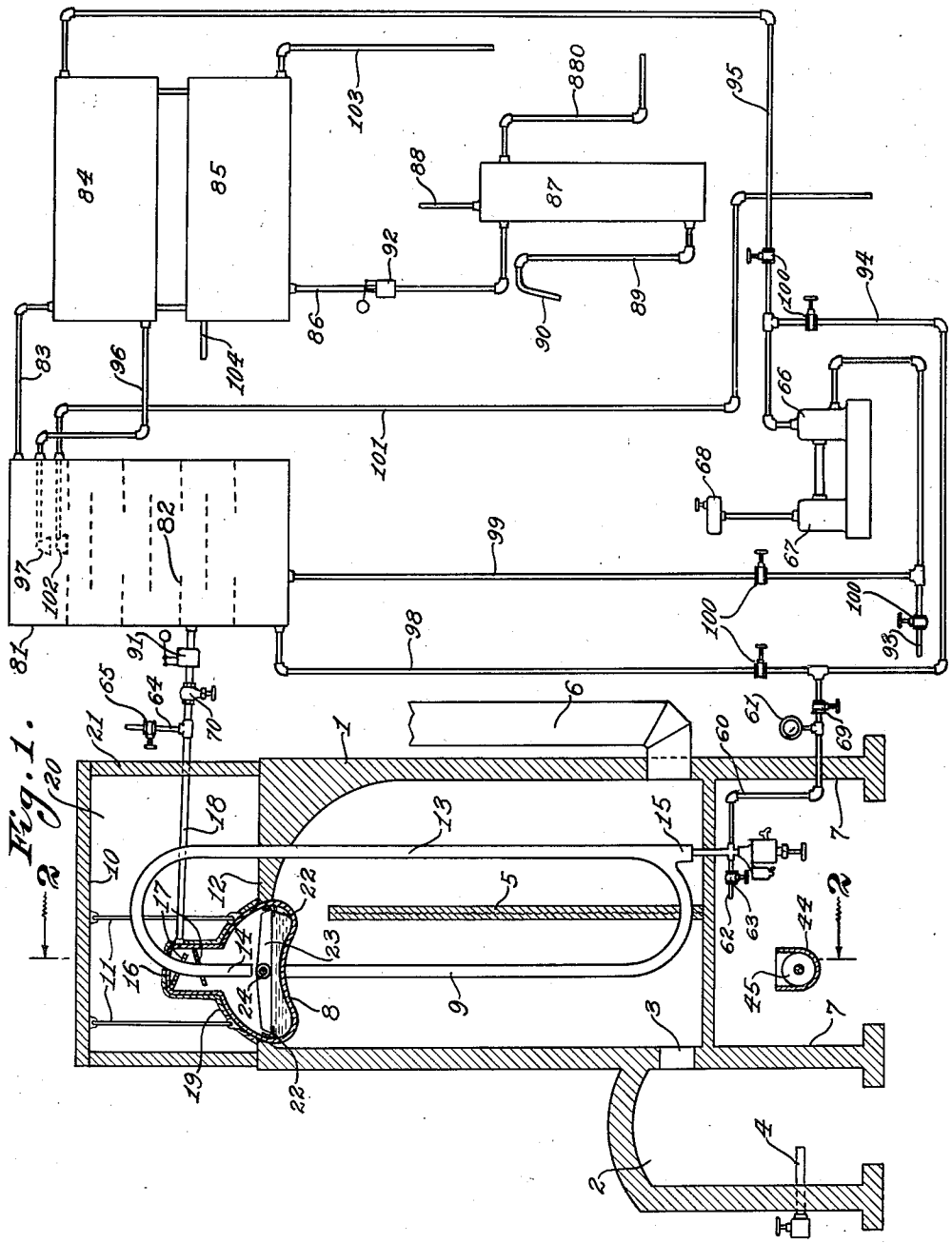


Fig. 1.

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APPARATUS FOR TREATING PETROLEUM

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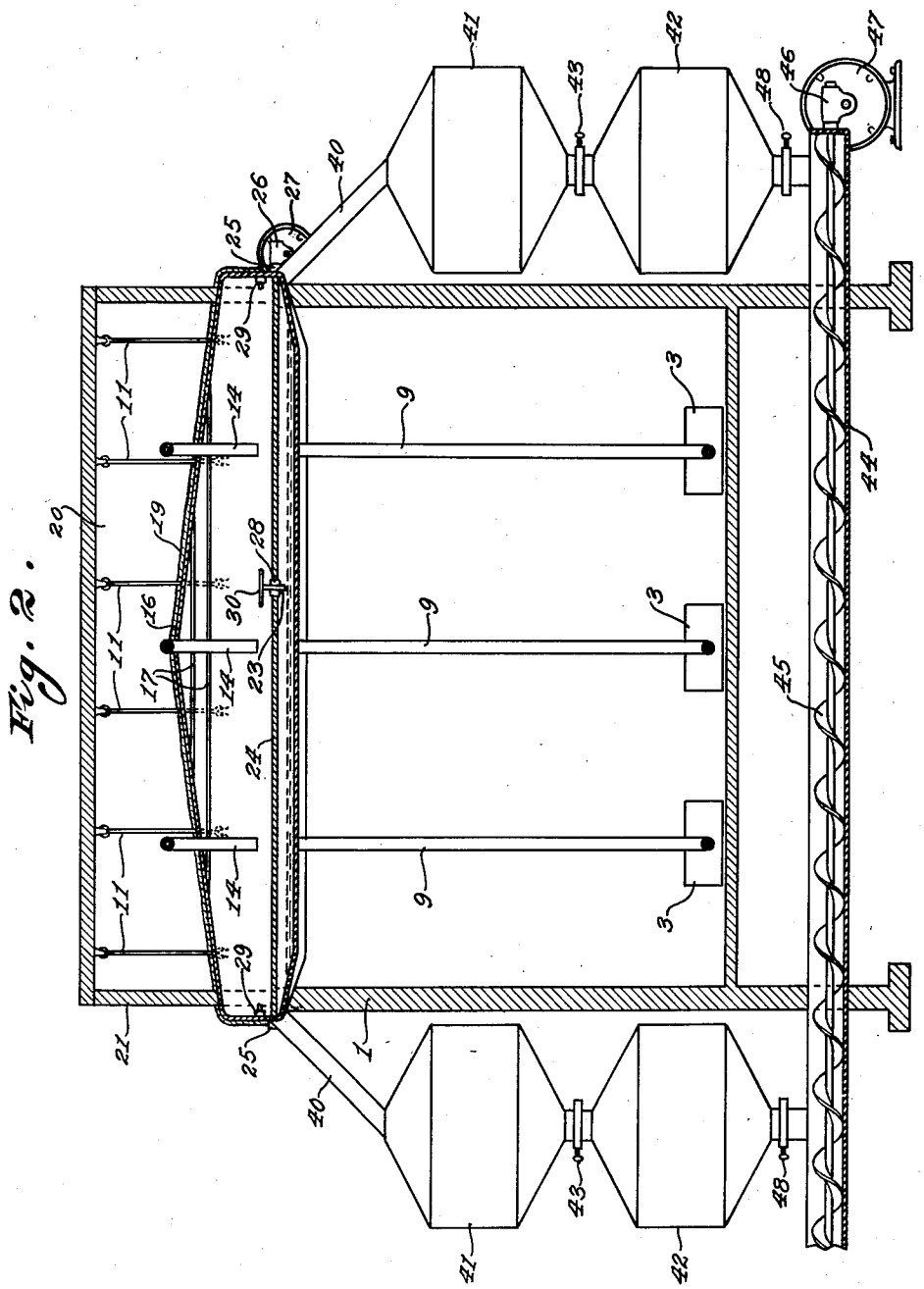


Fig. 2.

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APPARATUS FOR TREATING PETROLEUM

Filed Dec. 28, 1929 3 Sheets-Sheet 3

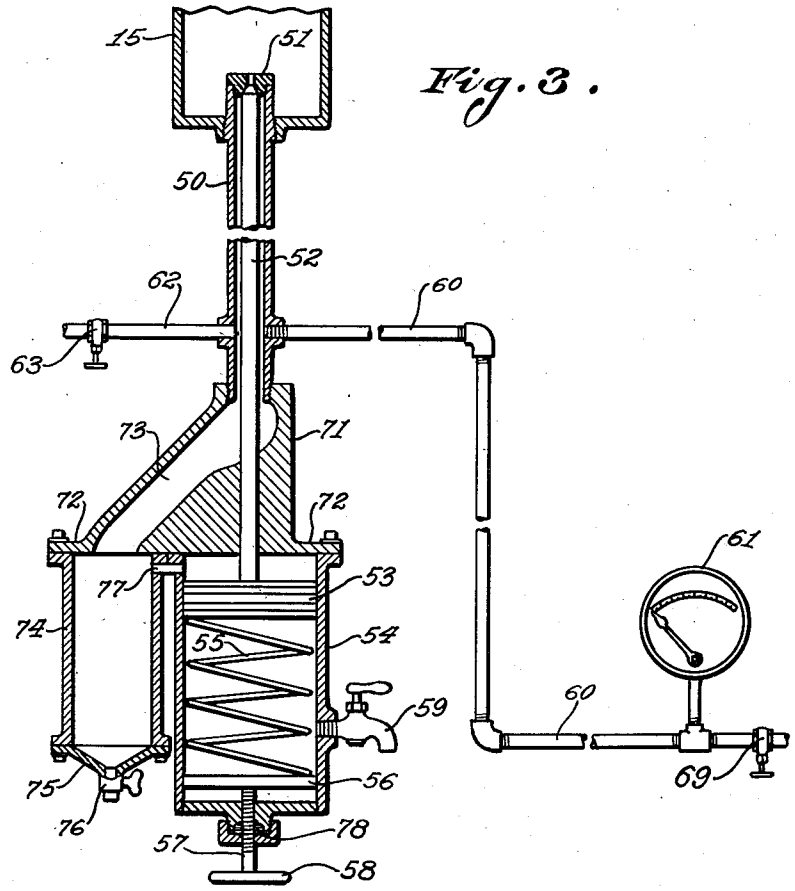


Fig. 3.

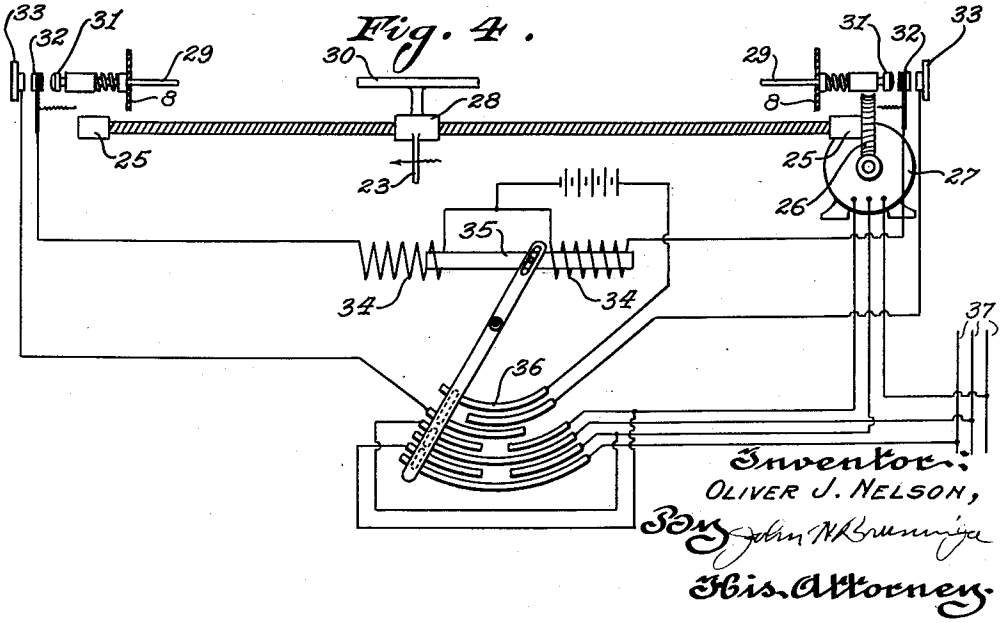


Fig. 4.

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Patented Mar. 5, 1935 1,993,017

UNITED STATES PATENT OFFICE

1,993,017

APPARATUS FOR TREATING PETROLEUM

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Application December 28, 1929, Serial No. 417,094

15 Claims. (Cl. 196—118)

This invention relates to the treatment of petroleum and more particularly heavy asphaltic crudes. Such crudes frequently contain large percentages of asphalt, sulphur, water emulsified therewith, salts and so forth. Some crudes are so contaminated as to render them impractical or difficult for transport in pipe lines, and impractical in some cases for normal refinery use. When it is attempted to crack heavy asphaltic crudes in accordance with the ordinary methods, such practice is found to be uneconomical and frequently impossible, more particularly on account of the asphalt and sulphur contents. As to some of its features, however, this invention is applicable to the treatment of crudes generally, containing sulphur or water emulsified therewith, or even petroleum containing none of those objectionable impurities.

One of the objects of this invention, therefore, is to develop and provide a process of treating asphaltic crudes in a simple and effective manner, so as to crack this crude into hydrocarbon vapors and coke and to condense these vapors to form a synthetic crude capable of not only being readily handled in pipe lines, but also of employment in standard refinery practice.

Another object is to develop and provide a process of treating petroleum containing sulphur or sulphur compounds and more particularly asphaltic crudes, whereby the sulphur or sulphur compounds will be eliminated in a simple and effective manner.

Another object is to develop and provide a process of treating petroleum emulsified with water and more particularly asphaltic crudes, whereby the emulsion will be broken in a simple and effective manner.

Another object is to develop and provide a process of treating asphaltic crudes, whereby the same are not only transformed into lighter gravity products, but whereby the latter are distilled, fractionated and condensed in a simple and effective manner.

Another object is to develop and provide a process whereby the heavy hydrocarbons are not only transformed into lighter hydrocarbons, but whereby the latter are distilled, fractionated and condensed in a simple and effective manner.

Another object is to develop and provide a process whereby such crudes are not only completely cracked into hydrocarbon vapor and carbon, but whereby both of the constituents are recovered in a simple and effective manner.

Another object of this invention is to provide an apparatus for carrying out the process embodying this invention and in order to attain the objects as heretofore enumerated.

In order to attain the objects of this invention and particularly in order to secure a synthetic crude, in accordance with one embodiment of this invention, the crude is injected into the bottom of a column of fused material of a height and maintained at a temperature sufficient to vaporize as much of the crude as possible; the vapors are then condensed to form a synthetic crude while the coke floating on the column is gathered and reclaimed. The zone above the fused material is, however, preferably maintained at a temperature which is non-condensing with reference to the vapors. Such a synthetic crude will be suitable for pipe line transportation or distillation in the usual refinery practice and will be free from asphalt as well as other objectionable impurities interfering with or hindering its economical transportation and distillation. It is obvious that a synthetic crude for such use should be in as near as possible the same state as the original petroleum, and, accordingly, when the process of this invention is employed for producing a synthetic crude, it is apparent that the temperature and pressure conditions should be so regulated that, although all the impurities are removed, the minimum cracking should take place.

Another feature of this invention resides in the fact that a petroleum containing sulphur or sulphur compounds, either alone or with other impurities, and particularly as found in an asphaltic crude, is injected into the bottom of a fused sulphur absorbing or reactive material, so that the sulphur or sulphur compounds will be separated or absorbed while the petroleum vapors issuing from the column are conducted away and reclaimed. The absorbing or reactive material can then be revivified by injecting an oxidizing gas, such as air, into the column. In practice the material is revivified at intervals by passing air through the column, at which time the injection of the petroleum is stopped. In this operation, any sulphide formed will be converted into and pass off as sulphur dioxide; any oxide formed will be reduced as soon as the injection of the petroleum is again proceeded with. Such revivification or clearing of the material of accumulated sulphur or sulphur compounds may be performed at intervals, depending upon the percentage of sulphur or sulphur compounds in the petroleum.

Another feature of this invention resides in the fact that a petroleum emulsified with water, and which may also contain other impurities

which may be present in an asphaltic crude, is injected into the bottom of a column of fused material of a height and at a temperature sufficient to break the emulsion. The petroleum and water vapors issuing from the column may then be separated to reclaim the petroleum. When the petroleum is roily, the passage through the fused material will not only break up the emulsion and vaporize the water, as well as the petroleum, but any salt or other solid impurity will float on top of the column and can be removed.

Where the space above the fused material or the walls thereof are allowed to cool enough to cause condensation and falling back of condensed vapors, these vapors, mixing with the carbon floating on the column, may cause the formation of an undesirable and unmanageable pitchy conglomerate. One of the features of this inventions, therefore, resides in the fact that the zone above the fused material is maintained at a temperature which is noncondensing with reference to the vapors in that zone. This is accomplished in accordance with one embodiment of this invention by insulating the walls of the retort or dome so as to maintain the same at a temperature sufficient to prevent condensation of the vapors thereof.

The employment of a column of fused material into which the petroleum is injected has met with difficulties. This is for the reason that the conditions arising in the treatment of a product like petroleum, and more particularly an asphaltic crude and particularly one containing sulphur compounds emulsified with water, have not been understood and these conditions have not been properly met. Petroleum generally, and a heavy asphaltic crude in particular, is not only a complex but variable product. Accordingly, when such a product is injected into and allowed to travel through a column of highly heated and fused material, the result will be unsatisfactory unless the conditions are proper. Severe agitation and bumping of the material are liable to take place unless the injection is so slow as to affect the efficiency and economical operation of the process.

Where petroleum is injected by a pipe passing downwardly through a column of fused material to the bottom thereof, carbon will deposit in the pipe as well as on the outside surface thereof. This is partly due to the fact that the petroleum in the pipe is subject to the heat of the bath while the oil issuing from the bottom of this pipe will tend to crawl along the outside thereof, resulting in carbon deposit therein and thereon. One of the features of this invention, therefore, resides in the fact that the petroleum is injected into the bottom of a fused column; but by properly proportioning the quantity injected with reference to the volume and height of the column and the temperature thereof, this petroleum is completely cracked into hydrocarbon vapors and carbon. The hydrocarbon vapors issuing from the bath are conducted off and reclaimed, while the carbon floating on the column is continuously collected and conveyed away.

Another feature of this invention resides in the fact that the petroleum is conducted externally of the column of fused material and injected into the bottom thereof. This is accomplished in accordance with one embodiment of this invention by a petroleum conduit or pipe external of and leading to the bottom of the column and preferably rising from below into the bottom of the column. The petroleum is forced through this conduit or pipe and into the column, and means is provided adapted upon a predetermined pressure in the conduit to inject the petroleum into the column. A valve is placed in the conduit and preferably within the column; this valve is normally closed but upon the pressure reaching a predetermined value the petroleum is forced through the conduit past and to open the valve. By this means there will be no long length of pipe exposed to the heat of the fused bath, so that deposit of carbon within this pipe is obviated.

Another feature of this invention resides in the fact that the vapors resulting from the passage of the petroleum through the column of fused material are passed in contact with the petroleum thereafter injected into the column; in such case the remaining vapors are condensed. The resulting vapors may be passed in contact with water or steam and also with petroleum to form the stock which is thereafter injected into the column.

In accordance with one embodiment of this invention, the vapors issuing from the bath are conducted to a tower where they may be passed in contact with petroleum and/or with water or steam, which, as heretofore described, may thereafter be injected into the column of fused material. The vapors leaving the tower may be condensed to form the synthetic crude as heretofore described. However, these vapors may be fractioned into various cuts as desired. In such a case the low boiling point vapors leaving the tower are so controlled as to give the desired end point, and upon leaving the tower these vapors may be conveyed to heat exchangers and condensers, where they are condensed. Suitable arrangements may be made so that, if desired, the heavier hydrocarbons, which are condensed in the towers, may be withdrawn and refluxed with the raw charging stock.

Where the raw petroleum contains water, it is found that the cracking will be performed efficiently in the still; where, however, the crude does not contain any or sufficient water, the latter can be furnished by injecting water with the charging stock.

The resultant products may be varied to suit requirements. Where only a synthetic crude is desired for pipe line disposal or future redistillation, then no fractioning need take place; the resultant products may in such a case be collected in the form of a synthetic crude. This crude will be suitable for pipe line transportation or redistillation in the usual refinery practice and will be free from asphalt, sulphur, emulsions and other impurities.

In accordance with this invention, the system need not be under pressure, but can operate at practically atmospheric pressure. It may, however, if so desired, be operated at pressures either greater or lower than atmospheric. This is possible due to the fact that the necessary temperature for the necessary duration is attained by the column of fused material and by the passage of petroleum therethrough in the manner as previously described. It will be understood that by suitable arrangement of relief valves and vacuum pumps, any desired pressure, either above or below atmospheric, may be maintained on any part of or on the entire system.

Further objects and features will appear from the detail description taken in connection with the accompanying drawings, in which—

Figure 1 is an elevation showing the still or re-

tort in section and showing the reclaiming and condensing apparatus in diagrammatic form, capable of carrying out the process embodying this invention;

Figure 2 is a section on the line 2—2, Figure 1;

Figure 3 is a detail section of one of the fused material loops or legs and showing also the inlet valve and its controlling mechanism; and

Figure 4 is a detail, somewhat in diagrammatic form, showing the coke gathering mechanism.

Referring to the accompanying drawings, 1 designates a furnace of any suitable construction and having a combustion chamber 2 connected therewith by one or more inlets 3 for the products of combustion and provided with one or more burners 4. The furnace may be provided with a bridge or division wall 5 over which the products of combustion pass downwardly to one or more outlet pipes 6 connected with a stack (not shown). The furnace may be of any suitable masonry construction and may be supported on pillars 7 so as to provide a space therebeneath.

Arranged in the furnace is a retort comprising a header 8 and one or more loops or legs 9. The header may be suspended from the top 10 of a chamber thereabove by any suitable suspension devices 11, and the top 12 of the furnace chamber proper may have a sealing connection with the header as well as with the loops or legs. The loops 9 open from the bottom of the header 8 and preferably extend across the bridge or partition wall 5 at the bottom, and each has a leg 13 which rises through the wall 12 and is provided with a return bend 14 passing through the top of the header and opening some distance above the bottom thereof. This leg 13 is provided with a downward extension 15 into which the injection of the petroleum takes place.

The header is provided with a dome 16 through which the bend 14 passes, and this header may be provided with baffles 17. A vapor line 18 extends from the top of the dome 16 and has a slight downward inclination at the right, Figure 1.

The header is preferably made from sheet steel with all parts welded together, while the loops or legs may be made from seamless nickel steel tubing or other suitable material, in order to be able to withstand the products of combustion. All joints between the loops and the header should be carefully made by welding or fusing, so as to be gas, as well as fluid, tight. The top of the header, as well as its dome, should be suitably lagged with a heat insulating covering 19, and such a covering should also be applied to the pipe 14, as well as to that part of the leg 13 extending above the wall 12. The bottom of the header may be curved, as shown in Figure 1. The top of the header, as well as the loops above the wall 12, may be enclosed in a chamber 20, the walls 10 and 21 of which may be of insulating material.

The retort, including the header and the loops or legs 9, 13, is arranged to receive a suitable material adapted to remain liquid at a sufficiently high temperature to attain the objects of this invention, but without vaporizing. A material particularly suitable for this purpose is lead, or lead alloy, which can be readily maintained, in a fluid state, at a temperature of 1000° F. No oxidation of this lead will take place, as the atmosphere within the header is normally a reducing, as distinguished from an oxidizing, atmosphere, except when oxidation of sulphurous compounds is to take place, in which event air is passed through the lead, which need only be for a period sufficient to secure oxidation of the sulphur compounds to sulphur dioxide. Moreover, even if oxidation of the lead should take place, the oxide is reduced to metallic lead upon resuming the injection of the petroleum. Lead, however, has the desirable property of absorbing or reacting with sulphur and sulphur compounds in the petroleum. In order to secure the desired result, the loops or legs may be two inches in diameter and of a height so as to contain columns of lead of eight feet.

Arranged along the header are suitable guides 22 along which is arranged to travel a gatherer or scraper 23, the bottom of which may be arranged just above the level of the fused material. This scraper can be mounted on a screw 24, which in turn is mounted in bearings 25 at the end of the header, and which screw is driven by suitable gearing 26 from any suitable motor, such as an electric motor 27. In order to secure travel of the scraper along the screw, this scraper is provided with a collar 28 threaded on the screw, the scraper being held against turning by the guides 22. At each end of the header is arranged a switch actuator 29, shown in detail in Figure 4, which switch actuators are arranged to be engaged by a tappet head 30 on the sleeve 28. The reversing mechanism may be of any standard or usual construction, such as shown in Figure 4. It comprises a spring-pressed plunger 31 moving a contact 32 to cooperate with a fixed contact 33 in circuit with a solenoid 34, whose plunger 35 controls a switch 36 in circuit with the motor 27 and the line 37. In the particular construction shown, the motor is of the three-phase type, but the mechanism is adapted for the reversing of direct current motors.

The header is provided at its ends with conduits 40 opening above the level of the fused material and discharging into drums 41. Each of these drums discharges into another drum 42, and there is a valve 43 between the drums 41 and 42 at each end of the retort structure. The drums 42 discharge into a conveyor 44 provided with a screw 45 driven through suitable gearing 46 by any suitable motor, such as an electric motor 47. A valve 48 is arranged between each drum 42 and the conveyor 44.

Normally, the valves 43 are closed while the valves 48 may be open. As the gatherer travels along the header from end to end, any carbon or other solid matter is scraped into the conduits 40 and falls into the drums 41, escape of the vapors being prevented by the fact that the valves 43 are closed. When the drums 41 fill, the valves 43 are opened, in order to discharge the contents into the drums 42. The valves 43 are then again closed while the valves 48 are opened in order to discharge the contents of the drums 42 into the conveyor.

Each of the loops 9, 13, or rather the extension 15 thereof, has extending therein a petroleum conduit 50, which is provided with a cap 51 having a seat for a needle valve 52. It is well-known that with such an extension as 15, the lead or other material in the retort will have a tendency to become solid at the very bottom thereof, and, accordingly, the seat for the needle valve 52 is preferably disposed slightly above the bottom of the extension 15, as clearly illustrated in Figure 3, so that under ordinary operating conditions, the valve seat is substantially adjacent the bottom of the fused column, although there may exist below the seat of the

needle valve 52 a sluggish, if not solid, layer of lead. This needle valve is connected with a piston 53 working in a cylinder 54 and normally held raised to close the valve by a spring 55 engaged by an abutment 56 tensioned by a screw 57 provided with a handle or knob 58. A drain cock 59 may be provided for the cylinder 54. The pipe 50 is connected with a petroleum pipe 60, to which is connected a suitable gauge 61. An air inlet pipe 62 provided with a valve 63 may be connected with the pipe 50, and an air outlet pipe 64 provided with a valve 65 may be connected with the vapor pipe 18. Petroleum is supplied under pressure to the pipes 60 and 50 by a suitable pump 66 driven by a suitable motor, such as an electric motor 67 provided with a suitable controller 68. The pipes 60 and 18 are provided with valves 69 and 70.

The cylinder 54 is bolted on the flange 72 of a bracket 71 provided with an inclined passage 73 opening into a trap 74 also bolted to the flange 72. The trap is provided with a removable coned bottom 75 provided with a drain cock 76. The trap connects with the top of the cylinder 54 by a pipe 77. All joints are packed and the stem 57 also has a packing 78. The trap 74 catches any lead passing the valve 50 when opened, as well as sediment, and both may be removed by removal of the bottom 75, and the trap may be drained by opening the cock 76.

Heat being supplied to the retort, including the header and the loops, so as to maintain the material therein in a fused condition and at a suitable temperature, petroleum is forced into the pipe 50. When the pressure reaches a predetermined value, as may be governed by the controller 68, so as to overcome the tension of the spring 55, whose tension may be adjusted by the screw 57, the needle valve will be opened, so as to inject the petroleum into the bottom of the column of fused material. As the petroleum passes up this column, not only will it be vaporized, but also cracked, so as to break up the same into vapors and coke. The vapors and coke pass into the header, where the coke is deposited on top of and so as to float on the fused material. As this coke is in a finely divided condition and may be carried upwardly, it is caught by the baffles 17. The vapors, including any water, pass off to the vapor line 18, while the coke is gathered and delivered to the conveyor 44 as heretofore described. Not only will the emulsion be broken up, but any sulphur compounds are absorbed or react with the lead while any other impurities float on the top of the column in the header and are gathered with the coke. When it is desired to revivify the fused material, the valves 69 and 70 are closed and the valves 63 and 65 are opened, so as to cause air to pass through the lead in order to oxidize the sulphur compounds to sulphur dioxide, this air being, of course, supplied to the pipe 62 under pressure and the sulphur dioxide escaping through the pipe 64.

The vapor line 18 discharges into a tower 81 comprising a metal casing provided with baffle trays 82, the connection being near the lower end of the tower, in order that the vapors may pass upwardly therethrough. From the tower a vapor line 83 leads to a heat exchanger 84, and from there to a condenser 85, in which the vapors may be wholly or fractionally condensed, depending upon whether it is desired to obtain a synthetic crude or take a number of cuts. Such fractional condensers are well known in the art, and a detailed description thereof is, therefore, unnecessary. In Figure 1, a condensate line 86 leads to a separator 87 provided with an outlet 88 for fixed gases, the condensate outlet 880 leading to storage and a water outlet 89 provided with an adjustable terminal 90, whereby the level of the water may be controlled, the water overflowing through 90 while the condensate overflows through 880. Suitable relief valves 91 and 92 may be provided.

The charging stock or crude is taken from storage by a line 93 to the pump 66, from which a pipe 94 leads directly to the pipes 60 and 50. A pipe 95 leads from the pump to the heat exchanger 84, from which a pipe 96 leads to the top of the tower 81 and terminates in a rose 97, discharging on the baffles in the tower, so that the vapors will pass in contact therewith. The stock passes from the bottom of the tower either by a pipe 98 to the pipes 60 and 50 leading to the columns, or by a pipe 99 leading to the intake of the pump. Suitable valves 100 are provided whereby the flow of the charging stock may be controlled, so as to pass in the following manner: Direct to the columns through the pipes 94, 60 and 50; through the heat exchanger 84, tower 81 and back to the pump by the pipes 95, 96 and 99; through the heat exchanger, tower and direct to the columns by the pipes 95, 96 and 98.

Water or steam may be supplied to the tower 81 by a pipe 101 provided with a rose 102, and water may be supplied to the condenser 85 by a pipe 103, the outlet pipe being indicated at 104.

The operation of the process may be briefly summarized as follows: The charging stock may be passed directly into the columns by being forced by the pump 66 through the pipes 94, 60 and 50, so as to be injected into the bottoms of the columns of fused material. In passing upwardly through the columns, the petroleum is vaporized and cracked into hydrocarbon vapors, carbon and fixed gas, and where water is present, into steam. The carbon floats on top of the fused material and is continuously carried off and stored while the vapors issuing through the vapor line 18 are passed to the tower 81, the heat exchanger 84, and the condenser 85 and condensed, finally leaving the apparatus by the pipe 880 and going to storage. Where only a synthetic crude is desired, then no fractioning will take place, and the condensate may be discharged directly into the pipe line. Where it is desired to fraction the vapors, then the fractioning condensers are arranged to secure that result in order to obtain a number of cuts.

Where the tower 81 is employed partially as a heat exchanger and partially for refluxing, and where the heat exchanger 84 is used, the charging stock will pass successively through the heat exchanger and tower and then can pass directly to the pump and from there to the columns. In this case, the high boiling point vapors, as well as water, can be condensed in the tower, while only the low boiling point vapors go to the heat exchanger and the condenser. Various cuts from the tower 81 may be selected and refluxed with the raw charging stock for recycling through the system, thereby producing large quantities of low boiling point fractions.

In practice it is found that the carbon is very light and fluffy, resembling in nature and structure carbon black made from the burning of natural gas. In the case of heavy asphaltic crudes found in the Arkansas, Kansas, California and Wyoming fields, with a bath temperature between 950° and 975° F., the carbon may constitute approximately ten percent by weight of the total crude charged, although this will vary in ac-

cordance with the character of the crude. This carbon can be used industrially for various purposes.

It will be particularly noted that the petroleum is conducted to the columns externally of these columns and particularly by pipes rising from underneath the furnace. Accordingly, the petroleum is not subject to any action while in the pipe which will cause a deposit of carbon either inside or outside of the petroleum conducting pipe. The petroleum is continuously injected into the bottom of the column and is under such control that the injection may be at the required rate, in order to secure the desired vaporization and cracking. The pressure required can be readily determined from the indication on the gauge 61 and can be controlled not only by the automatic valve, but also by the controlling means 68 for the pump 66. If for any reason this pressure should drop below that required to counteract the pressure of the fused material in the tubes, the valve will be automatically closed by its spring 55, whose tension can also be controlled. Accordingly, by control of the tension of this spring by the controlling device 57, the pressure at which the valve opens can be regulated in accordance with the pressure required to counteract the pressure of the column of fused material. It is then only necessary to build up the pressure of the petroleum to the point where the valve will be opened.

The temperature and pressures may be varied to suit the requirements. Ordinarily temperatures of between 950 and 1000° F. are satisfactory, particularly in the case of asphaltic crudes, where the height of the fused material in the column is eight feet, with two inch tubes, this giving a pressure of about forty pounds per square inch, against which pressure the stock is injected into the bottom of the fused material. On account of the inherent adjustments of the system, the feed, temperature, etc., can be adjusted to suit the requirements under these conditions.

While several embodiments of this invention have been described, it will be understood that this invention is susceptible of various embodiments. Furthermore, while the process and apparatus disclosed are particularly applicable for the treatment of heavy asphaltic crudes and crudes containing sulphur and its compounds, as well as crudes containing water and emulsion, it will be understood that certain features of this invention are adapted for the treatment of petroleum generally. It will furthermore be understood that certain features, operations and sub-combinations are of utility and may be employed without reference to other features, operations and sub-combinations; that is contemplated by and is within the scope of the appended claims. It is furthermore obvious that various changes may be made in details of construction, within the scope of the appended claims, without departing from the spirit of this invention. It is, therefore, to be understood that this invention is not to be limited to the specific details shown and/or described.

Having thus described the invention, what is claimed is:

1. An apparatus for treating petroleum, comprising, a heated retort containing a column of fused material, a petroleum conduit external of and leading to the bottom of said column adapted to inject the petroleum into material in the column and regulable means for controlling the injection, said means being responsive to pressure on the petroleum in said conduit to prevent injection until the desired pressure is reached.

2. An apparatus for treating petroleum, comprising, a heated retort containing a column of fused material, a petroleum conduit leading to the bottom of said column, a valve in said conduit and within said column, and means for forcing petroleum from said conduit past said valve and into said column.

3. An apparatus for treating petroleum, comprising, a heated retort containing a column of fused material, a petroleum conduit leading to the bottom of said column, a valve in said conduit and normally closed, and means operating by the pressure on the petroleum in said conduit to open said valve.

4. An apparatus for treating petroleum, comprising, a heated retort containing a column of fused material, a petroleum conduit leading to the bottom of said column, a valve in said conduit, and means operated by pressure of petroleum in said conduit adapted to control said valve.

5. An apparatus for treating petroleum, comprising, a heated retort containing a column of fused material, a loop leading from the bottom of said retort and passing through the top thereof, and means for injecting petroleum into the bottom of said loop.

6. An apparatus for treating petroleum, comprising, a heated retort containing a column of fused material, a valve having a seat at the bottom of the fused column, and means for conducting petroleum to said valve for injection into the column.

7. An apparatus for treating petroleum, comprising, a heated retort containing a column of fused material, a valve at the bottom of the fused column, means for conducting petroleum to said valve having a seat for injection into the column, and means for automatically regulating the injection of the petroleum.

8. An apparatus for treating petroleum comprising, a retort having a header and a loop extending above and below the header and adapted to contain a column of fused material, a heating chamber having part of said retort exposed therein, and means for injecting petroleum into the loop below the header.

9. An apparatus for treating petroleum comprising, a retort having a header and a loop extending above and below the header and adapted to contain a column of fused material, a heating chamber having a wall of the header and lower portion of said loop exposed therein, the upper portion of said loop being insulated from the heating chamber, and means for injecting petroleum into the retort.

10. An apparatus for treating petroleum comprising, a retort adapted to contain a column of fused material, a valve seat located within the retort and adjacent the bottom of the fused column, a valve member cooperating with said seat, and means on the exterior of said retort for operating said valve member.

11. An apparatus for treating petroleum comprising, a retort adapted to contain a column of fused material, a valve seat located within the retort and adjacent the bottom of the fused column, a valve member cooperating with said seat, and pressure responsive means controlling said valve member.

12. An apparatus for treating petroleum comprising, a retort adapted to contain a column of fused material, a petroleum inlet for said retort, a needle valve seated adjacent the bottom

of the fused column for controlling the inlet, and means on the exterior of the retort for operating the needle valve.

13. An apparatus for treating petroleum comprising, a retort adapted to contain a column of fused material, a petroleum inlet at the bottom of the retort, a valve seat in said inlet positioned slightly above the lower extremity of the material confining space in the retort but in the region of the bottom of the fused column, and a valve member cooperating with said seat.

14. An apparatus for treating petroleum comprising, a retort adapted to contain a column of fused material, a petroleum inlet at the bottom of the retort, a valve for said inlet having an operating member extending upwardly into the bottom of the retort, and a seat for said valve substantially surrounded by the material within the retort.

15. An apparatus for treating petroleum comprising, a retort adapted to contain a column of fused material, a petroleum inlet, a petroleum conduit connected to said inlet, an oxidizing gas conduit connected to said petroleum inlet, and pressure responsive means controlling the inlet.

OLIVER J. NELSON.

CERTIFICATE OF CORRECTION.

Patent No. 1,993,017. March 5, 1935.

OLIVER J. NELSON.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, second column, line 39, claim 7, strike out the words "having a seat" and insert the same after "valve" in line 37, of said claim; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 9th day of April, A. D. 1935.

Leslie Frazer

(Seal) Acting Commissioner of Patents.