J. S. LANG.

APPARATUS FOR DISTILLING HYDROCARBON OILS.

APPLICATION FILED APR. 2, 1909.

954,575.

Patented Apr. 12, 1910.

2 SHEETS—SHEET 1.

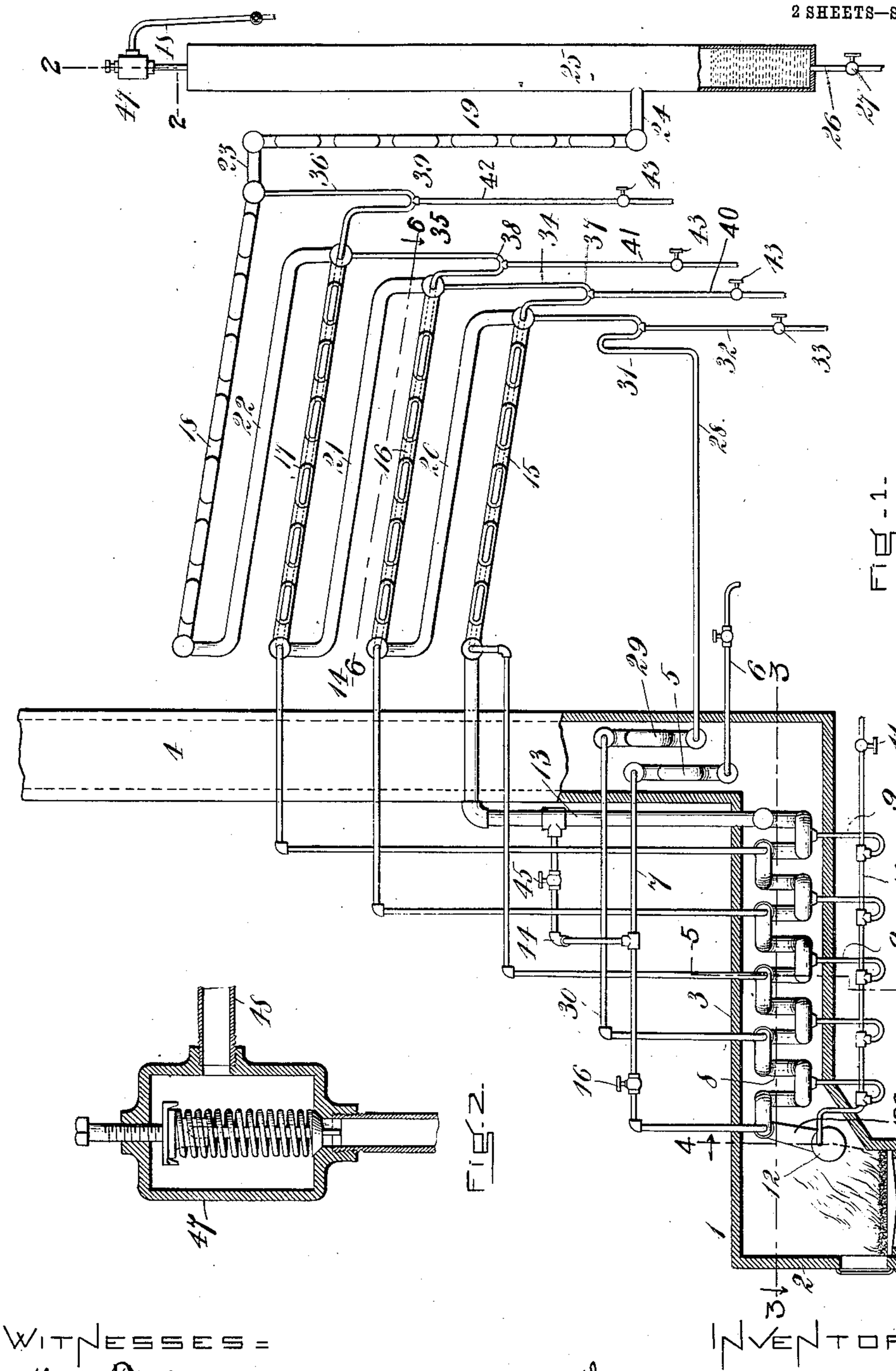

FIG. 1.

FIG. 2.

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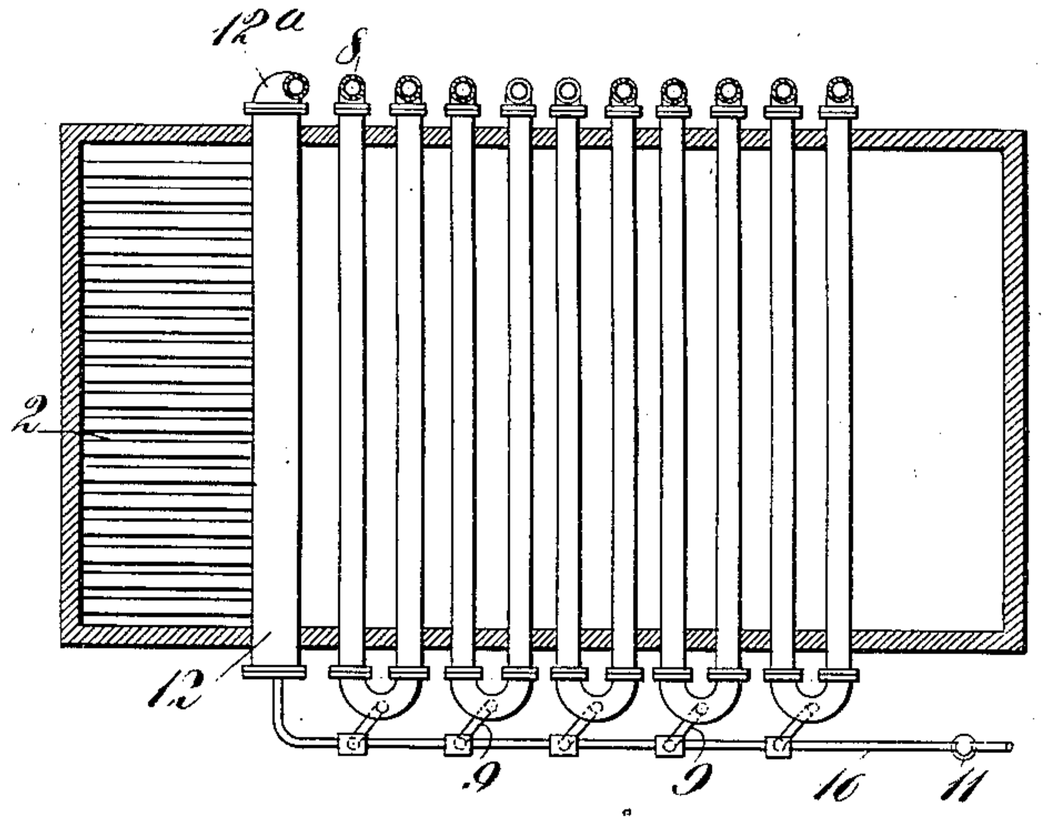

Fig. 3.

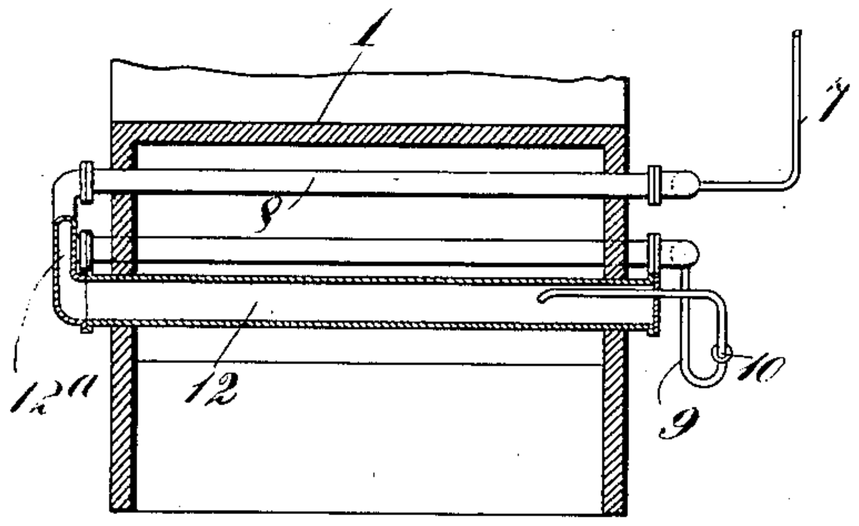

Fig. 4.

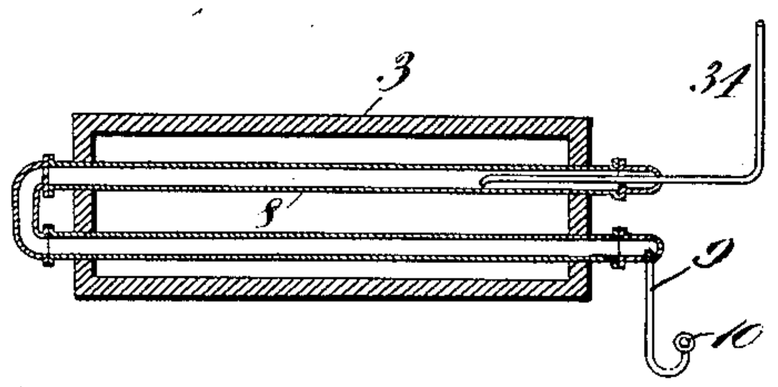

Fig. 5.

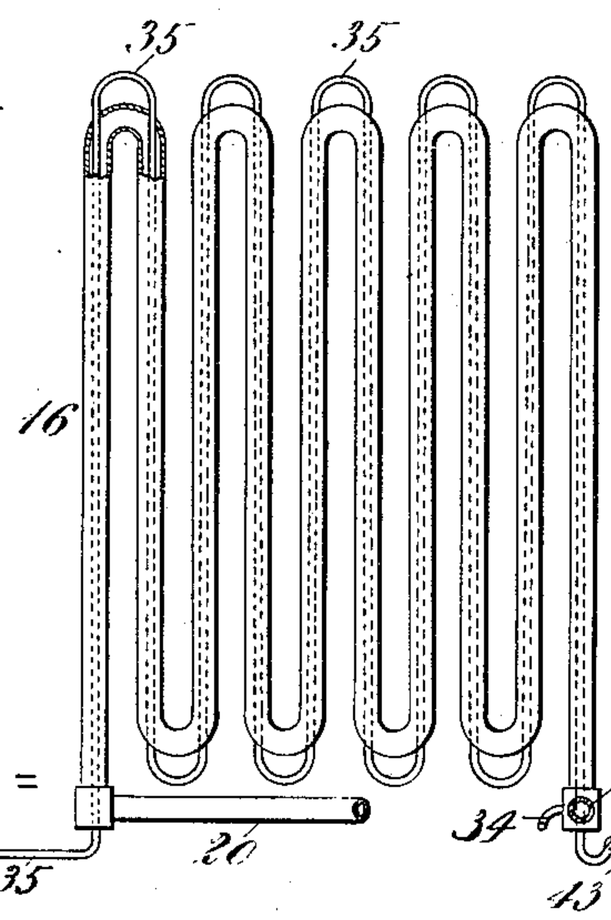

Fig. 6.

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR DISTILLING HYDROCARBON OILS.

954,575. Specification of Letters Patent. Patented Apr. 12, 1910.

Application filed April 2, 1909. Serial No. 487,541.

To all whom it may concern:

Be it known that I, JAMES S. LANG, of Boston, in the county of Suffolk and State of Massachusetts, a citizen of the United States, have invented a new and useful Improvement in Apparatus for Distilling Hydrocarbon Oils, of which the following is a full, clear, and exact description, reference being had to the accompanying drawing, forming a part of this specification, in explaining its nature.

Although it is my purpose to provide an apparatus of the above entitled character, the especial object of my invention is to provide an apparatus embodying means for effecting the destructive distillation of crude hydrocarbon oil for obtaining as an ultimate product a hydrocarbon oil of predetermined volatility and especially an oil of relatively high volatility or such high volatility that the oil will continue to vaporize at a relatively low temperature or that vaporization will continue when the oil is contained in snow and the vapor therefrom burned for melting the snow in accordance with the process described in my patent, No. 863,855, dated August 20, 1907.

The apparatus embodying my invention can best be seen and understood by reference to the drawing in which—

Figure 1 shows the apparatus diagrammatically and mainly in side elevation but partly in vertical section. Fig. 2 is a section taken on the line 2—2 of Fig. 1. Fig. 3 is a section taken on the line 3—3 of Fig. 1. Fig. 4 is a section taken on the line 4—4 of Fig. 1. Fig. 5 is a section taken on the line 5—5 of Fig. 1. Fig. 6 is a section taken on the line 6—6 of Fig. 1.

Before referring to the apparatus, however, it should be understood that at a given pressure the lower the volatility of a hydrocarbon oil the higher the temperature at which it will condense on which account the condensed oil will only give off vapor or an appreciable amount of vapor at a relatively high temperature. On the other hand, the higher the volatility of the oil the lower the temperature at which it will condense; in other words, the lower will be the temperature it takes to overcome its volatility. Consequently the condensed oil of high volatility will volatilize or give off an appreciable amount of vapor at a relatively low temperature. This principle I take advantage of in the apparatus constituting my invention and to which detailed reference will now be made.

Referring to the drawings, 1 represents a furnace. This furnace in so far as it is necessary to go into a description of the construction thereof, comprises a body portion 2 in which fuel is burned for generating heat, a relatively long-extending combustion chamber 3 through which the products of combustion are directed to pass, and a stack 4 into and through which the products of combustion pass from the combustion chamber. Located within the stack at a point preferably near the base portion thereof is what may be termed a primary heating coil 5. It is into this coil or primary heater that the crude hydrocarbon oil is first introduced to become vaporized therein by the heat products within and passing through the stack. The oil is led into the coil by way of an inlet pipe 6 and is preferably introduced under pressure.

Extending from the primary heater is an outlet pipe 7 which connects with the forward end of what may be termed a secondary or super-heater 8 located within the combustion chamber. This heater comprises a series of coils extending laterally back and forth to progress through the combustion chamber. The vaporized oil is introduced into the secondary heater from the primary heater by the way of the pipe 7 and as the vapor passes through the coils of the secondary heater it is subjected to a destructive distillation by the heat products within and passing through the combustion chamber. Owing to the fact that the secondary heater presents both a narrow and a somewhat extended passage the heat within the combustion chamber has full opportunity to effect such proper destructive distillation of the vaporized oil as may be desired to be obtained.

During the process of distillation undergone in the secondary heater the distillate as it passes off may leave a deposit or residue within the coils of the heater of a tarry nature. For the purpose of taking care of this tarry substance there connect with the heater at different sectional points throughout the same waste pipes 9 extending downwardly and connecting with a common pipe 10 through which the matter may be drawn off upon opening a cock 11 located within this pipe. I prefer, however, that the tarry matter or residue may be led back into a

retort 12 located within the combustion chamber at a point in front of the secondary heater or where it may be subjected to the direct influence of the heat from the burning fuel which will act to effect its further reduction. The deposit or residue will tend to work back into this retort from the pipe 10 since the chamber of the retort is located at a point below the coils of the secondary heater, the oil flowing into the retort tending simply to seek its level. In this connection also I would call attention to the fact that each of the waste pipes 9 is bent downwardly below the common pipe 10 before making its connection therewith, thereby forming a trap and preventing the entry or return of vapor through the pipe. Oil vaporizing in the retort 12 will pass directly to the secondary heater by way of the connecting pipe 12ª.

Extending from the rear end coil of the secondary heater is a pipe 13 connecting with a condenser 14. This condenser comprises a series of coils 15, 16, 17, 18 and 19 and it is with the bottom coil 15 that the pipe 13 connects. These coils of the condenser are progressively arranged one above the other and occupy an inclined position with the exception that the coil 19 has preferably a vertical disposition to facilitate the application of water for cooling this pipe, should such application be deemed desirable. The respective coils of pipes are severally connected, the bottom end of the coil 15 being connected with the top end of the coil 16 by a connecting pipe 20, the bottom end of the coil 16 being connected with the top end of the coil 17 by a connecting pipe 21, the bottom end of the coil 17 being connected with the top end of the coil 18 by a connecting pipe 22, and the bottom end of the coil 18 being connected with the top end of the coil 19 by a pipe 23. The pipe 19 connects at the bottom end thereof by a pipe connection 24 with a pipe receptacle 25 which receives the oil condensing in the coil 19. From the pipe receptacle 25 the oil may be drawn off, as occasion may require, through a draw-off pipe 26 controlled by a cock 27.

It will be understood that the vapor passing over from the secondary heater may condense in any one of the coils of the condenser depending upon the relative degree of volatility of the vapor passing through the respective coils. Some of the vapor having a relatively low degree of volatility will be condensed at a relatively high temperature and accordingly may condense in the first coil, or the coil 15, of the condenser. Vapor of slightly higher volatility will condense in the coil 16 of the condenser, or that coil in which the vapor will have cooled to a slightly lower degree of temperature than in the coil 15. In the same way vapor of a relatively increasing degree of volatility will condense in any one of the remaining coils of the condenser depending upon the degree of its volatility. Vapor of a relatively high degree of volatility will condense in the coil 19 and the condensed oil from this vapor is the oil I desire to obtain.

It is the ultimate object of my invention to secure only an oil of relatively high volatility or such oil as will condense only in the coil 19. I have accordingly provided means whereby oil condensed in any one of the coils 15, 16, 17 or 18 may be conveyed back to the secondary heater and there subjected to a further destructive distillation tending to reduce this oil to such condition that the distillate will be of a sufficiently high volatility to condense only in the coil 19. For this purpose there extends from the bottom end of the coil 15 a return pipe 28. This pipe connects with the coil 29 located in the stack of the furnace and thence with the secondary heater by a pipe 30. The coil 29, which forms a section of this return pipe, is located within the stack for the purpose of vaporizing the oil that may condense in the coil 15 of the condenser so that it may ultimately return to the secondary heater as vapor. Attention is also directed to the fact that the pipe 28 is bent at the point 31 to form a trap, some oil constantly remaining in this trap to prevent the entry or reentry of vapor through the return pipe.

Should it be desired to obtain some of the oil condensing in the coil 15, arrangement is made whereby this may be done by means of a draw-off pipe 32 connecting with the return pipe at the point of the trap formed therein, this draw-off pipe being controlled by a cock 33.

Inasmuch as the oil condensing in the coil 15 or the first coil of the condenser is an oil of low volatility, as it condenses at a relatively high temperature, it is necessary that the vapor from this oil should be subjected to a considerable degree of destructive distillation before the distillate will be reduced to a condition of high volatility or where it will condense in the last coil of the condenser and there be secured an oil of high volatility which is the oil I desire to obtain. On this account the part 30 of the return pipe, which connects with the secondary heater, connects with it at a sectional point near the front end of the heater so that the vapor entering the heater at this point will pass through the major portion of the heater in order that the proper destructive reduction of the oil may be obtained by reason of the protracted period of destructive distillation to which the vapor will necessarily be subjected. Connecting also with the secondary heater are return pipes from each one of the other coils of the condenser for returning oil that may condense in these coils. with the exception of

the last coil 19, the oil condensing therein escaping, as before described, into the receptacle 25 from which it may be drawn off. These return pipes are numbered 34, 35 and 36, respectively, the pipe 34 returning to the secondary heater from the bottom end of the coil 16, the pipe 35 from the bottom end of the coil 17 and the pipe 36 from the bottom end of the coil 18. In order that the oil returning through these respective pipes may be vaporized before entering the secondary heater I have provided for such vaporization of the oil by directing each pipe to return through a coil of the condenser below and next to the coil from which the pipe extends. As before described, the coils of the condenser are successively or progressively arranged, one above the other, and not only are they inclined so that oil condensing in each coil will flow to the bottom end thereof, but the coils are so far separated one above the other that oil returning from the bottom end of one coil may flow back through the return pipe passing through the adjacent coil, the oil tending simply to seek its level. Now as the oil passes through that portion of the return pipe contained in the coil below and adjacent to the coil of the condenser from which the oil is returning it will be subjected to a higher degree of temperature from the vapor within this pipe than the temperature within the coil from which it returns. In other words, the temperature in the coil through which the return pipe extends will be so high as to vaporize the oil contained within the return pipe so that it may ultimately return to the secondary heater in the form of vapor prior to its further reduction.

In connection with the return pipes 34, 35 and 36 attention is directed to the fact that these pipes connect with the secondary heater at different sectional points dependent upon the relative degree of volatility of the oil or vapor returning through the pipes. In other words, the oil condensing in the pipe 16 returning through the return pipe 34 will be of a lower degree of volatility than the oil condensing in the coil 17 and the oil condensing in this coil in turn will be of lower volatility than that condensing in and returning from the coil 18. Accordingly the respective return pipes connect with the secondary heater at such points that the return vapor may be subjected to a greater or less degree of destructive distillation dependent upon the degree of its volatility when it enters the secondary heater. The pipe 34 returning from the coil 16 connects accordingly with the secondary heater at a sectional point some distance removed from the end of the heater and just forward of the point where the pipe 30, returning from the coil 15, connects with the heater. The pipe 35 returning from the coil 17 will connect with the heater at a sectional point just forward of where the pipe 34 connects therewith but nearer the end of the heater, while the pipe 36 connects with the heater at a sectional point still nearer the end thereof inasmuch as the oil returning through this pipe has almost the requisite degree of volatility and so need be subjected to but slight further destructive distillation in order to obtain its proper reduction. In further connection with the return pipes 34, 35 and 36 it is to be observed that each one of these pipes is bent to form a trap, the pipe 34 being bent to form the trap 37, the pipe 35 to form the trap 38 and the pipe 36 to form the trap 39. These traps by the oil remaining in them prevent the entry or reentry of vapor through the respective pipes.

It may be desired to draw off oil condensed in any one of the coils 16, 17 or 18, and provision is made for doing this by the draw-off pipes 40, 41 and 42 connecting respectively with the return pipes from the respective coils at the points of the traps formed therein, each of the draw-off pipes being controlled by a cock 43.

It is sometimes found necessary or desirable to use a crude oil in the apparatus, which is of a very complex nature. In other words, the crude oil contains oils of a highly volatile nature which if subjected to a degree of temperature more than sufficient to vaporize them would be converted into gas. I have accordingly provided in the apparatus shown means whereby when treating crude oil of the above character the oil may only be vaporized and sent directly to the condenser without being subjected to any destructive distillation. The highly volatile oils in the crude oil thus vaporized will be condensed and that portion of the oil condensing in the last coil of the condenser may be drawn off and saved in the manner described above. The remaining oil condensing in the condenser will be returned to the secondary heater from that portion of the condenser in which it may be condensed, and in the secondary heater will be subjected to such destructive distillation as will secure its proper reduction.

The means I have provided for primarily preventing the destructive distillation of the crude oil in question is the pipe 44 interposed between the pipe 7, which connects the primary heater or vaporizer with the secondary heater, and the pipe 13 which joins the end of the secondary heater to the condenser. In this auxiliary connecting pipe 44 is located a valve 45. A valve 46 is also located in the pipe 7 beyond the point where the pipe 44 connects therewith, with the effect that by closing the valve 46 and opening the valve 45 the oil vaporized in the primary heater will pass directly to the condenser.

When oil is treated that does not contain

oils of a relatively high degree of volatility and which needs primarily a destructive distillation then the valve 45 is closed and the valve 46 opened by which means the oil vaporized in the primary heater will pass directly to the secondary heater.

Inasmuch as it is not my purpose to obtain gas as an ultimate product through the destructive distillation of oil treated in the apparatus, it is not necessary to subject the oil in the secondary heater to any extreme degree of heat, a normal fire only being maintained in the furnace. Though precautions may be taken to prevent an excessive heating of the oil and its conversion into gas, yet gas may form in the apparatus. I have arranged to take care of this gas by providing an escape valve 47. This valve may be any one of a number of well known varieties and is preferably arranged in the top of the receptacle. The valve 47 is so set as to allow the gas to escape through the valve and the pipe 48 connecting with it, when the pressure of gas within the system reaches a determinate degree of compression above the pressure normally maintained therein. The gas so escaping may be saved or it may be conveyed back into the body of the furnace and burned.

The operation of the apparatus is briefly as follows: Crude oil preferably under pressure is introduced by way of an inlet pipe 6 into the primary heating coil 5 where it becomes vaporized. Thence the vapor passes by way of an inlet pipe 7 to the secondary or super-heater 8 where the vapor is subjected to a destructive distillation. Any oil or tarry matter that may collect in the secondary heater may be drawn off by way of the waste pipes 9 and connecting pipe 10 upon opening the cock 11 located in the pipe 10 or by closing this cock the tarry matter may be conveyed back to a retort 12 where the oily product may become vaporized and again pass by the way of the pipe 12ª into the secondary heater. The vapor having undergone a destructive distillation in the secondary heater will pass out of this heater by way of the pipe 13 to the condenser 14 and will pass through the several coils 15, 16, 17 and 18 of the condenser to a coil 19, that is, if the vapor is of sufficiently high volatility. Vapor condensing in the coil 19 passes over by way of the connecting pipe 24 to a receptacle 25 where the condensed vapor or oil may be drawn of. Oil condensing the primary coil 15 of the condenser is conveyed back by way of a return pipe 28 to a vaporizing coil 29 arranged in the stack whence the vapor returns by way of the pipe 30 to the secondary heater. If desired, oil condensing in the coil 15 of the condenser may be drawn off by way of a pipe 32. Oil condensing in any one of the pipes 16, 17 or 18 of the condenser is returned to the secondary heater at different sectional points therein by the respective return pipes 34, 35 and 36, these pipes passing in turn through the coil of the condenser next adjacent to the coil from which they return on which account the returning oil will become vaporized before entering the secondary heater. In case it is desired to obtain oil condensing in any one of the coils 16, 17 or 18 of the condenser such may be obtained by drawing it off by way of the draw-off pipes 40, 41 and 42 connecting with the respective coils of the condenser, each pipe being controlled by a cock 43.

If by reason of the nature of the oil it is not thought desirable to subject the oil to destructive distillation in the secondary heater the vapor from this oil produced in the primary heater may be led directly to the condenser by way of the outlet pipe 7 and connecting pipe 44, the valve 45 being opened and the valve 46 being closed. Ordinarily in the operation of the apparatus the valve 45 will be closed and the valve 46 opened, that is, when an oil is being used which it is desired to subject not only to the influence of the primary heater, but also to the influence of destructive distillation in the secondary heater. In case gas is formed in the apparatus this gas may escape through an escape valve 47 arranged in the top of the standpipe or receptacle 25, that is, when the gas reaches a degree of compression sufficient to open the valve.

Having thus fully described my invention, I claim and desire to secure by Letters Patent of the United States:—

1. In an apparatus of the character specified, the combination of a furnace, a heater comprising a series of coils progressively arranged, a condenser comprising a series of coils also progressively arranged, and return pipes from said condenser to said heater, said pipes connecting with the coils of said condenser for returning the oil condensing therein to said heater and which coils connect with said condenser and return to connect with said heater at sectional points relatively commensurate with the order of progression of their respective coils.

2. In an apparatus of the character specified, the combination of a furnace, a heater comprising a series of coils progressively arranged, a condenser comprising a series of coils also progressively arranged, return pipes from said condenser to said heater, said pipes connecting with the coils of said condenser for returning the oil condensing therein to said heater and which coils connect with said condenser and return to connect with said heater at sectional points relatively commensurate with the order of progression of their respective coils, and means

whereby the oil returning through said pipes may be vaporized before entering said heater.

3. In an apparatus of the character specified, the combination of a furnace having a combustion chamber, a heater located in said combustion chamber, the heater comprising a series of coils progressively arranged, an auxiliary retort located within said chamber, and drain pipes connecting with said heater at sectional intervals therein and which connect with to empty into said retort for returning to said retort the tarry residue that may accumulate in said heater, each of said pipes being bent to form a trap.

4. In an apparatus of the character specified, the combination of a furnace having a combustion chamber and stack rising from said chamber, a primary heater, means whereby oil may be introduced into said primary heater, a secondary heater located in said combustion chamber, a connection between said primary and secondary heaters, a condenser of sectional character with which said secondary heater connects, a return pipe extending from the primary section of said condenser and returning to said secondary heater, said return pipe comprising in part a connection subjected to the heat from said furnace, and a series of return pipes extending from said condenser at different sectional points therein to connect with said secondary heater, each of which pipes is arranged to return through a section of the condenser in which the vapor therein during the operation of the apparatus is at a higher temperature than the vapor in that section of the condenser from which the pipe returns.

5. In an apparatus of the character specified, the combination of a furnace, a primary heater, means through which oil is introduced into said heater, a secondary heater, a connection between said heaters, a condenser, a connection between said secondary heater and condenser, means whereby a direct connection may be had between said primary heater and condenser, and a series of return pipes between said condenser and said secondary heater whereby vapor condensing at different sectional points therein may be returned to said secondary heater.

6. In an apparatus of the character specified, the combination of a heater and a condenser with which said heater connects, return pipes from said condenser to said heater, said pipes conecting with said condenser at different sectional points thereof for returning oil condensing therein to said heater, each of said pipes returning through a portion of the condenser in which the vapor therein during the operation of the apparatus is at a higher temperature than the vapor in that section of the condenser from which the pipe returns and which pipes connect respectively with the heater at different sectional points from the end of said heater.

7. In an apparatus of the character specified, the combination with a heater, of a condenser with which the heater connects and a return pipe from said condenser connecting with said heater for returning to said heater oil condensing in said condenser, said pipe returning to the heater through a portion of the condenser in which the vapor therein during the operation of the apparatus is at a higher temperature than the vapor in that part of the condenser in which the returning oil is condensed, whereby said oil may be vaporized before its return to the heater.

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Witnesses:
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