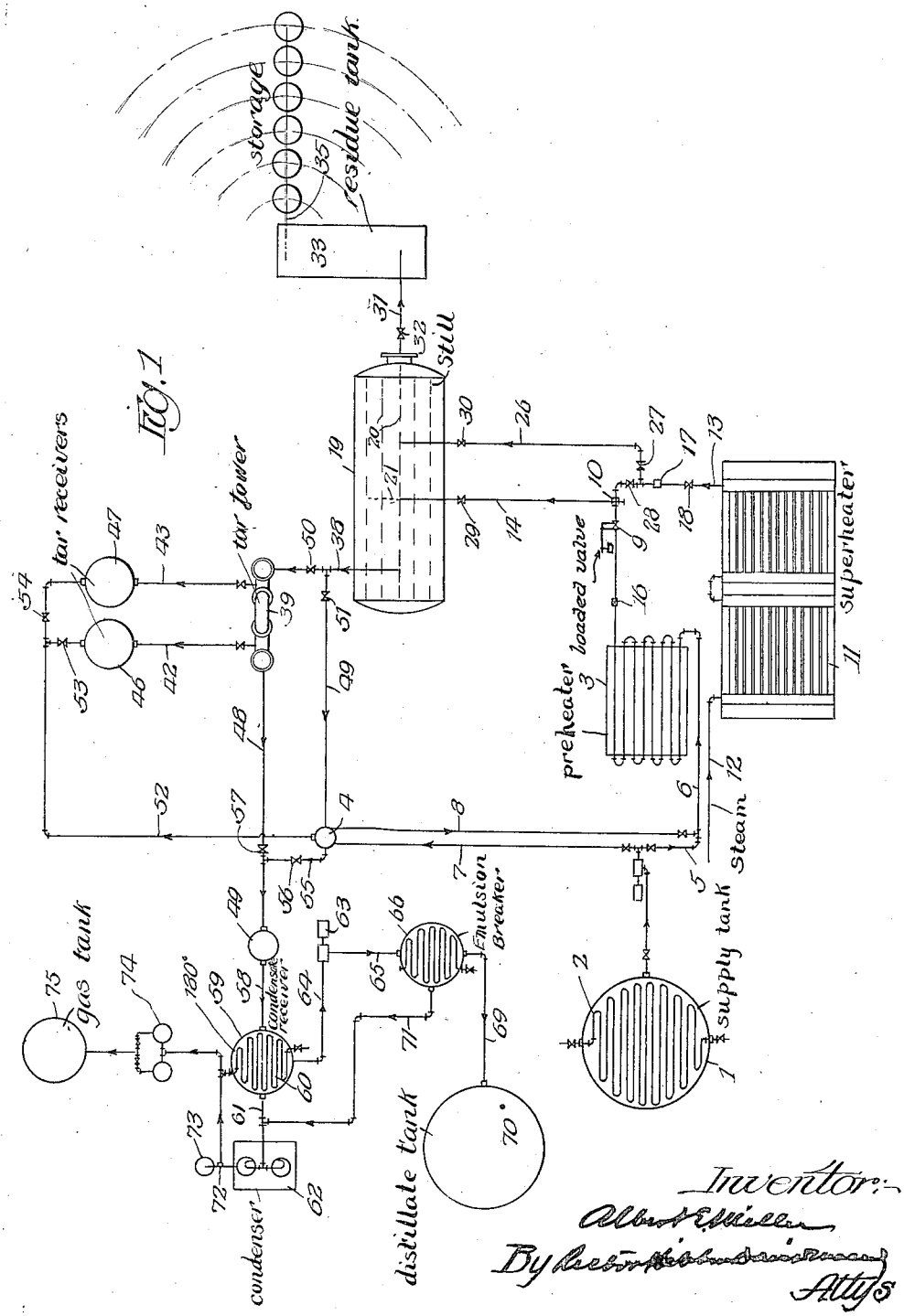
Oct. 25, 1927. 1,646,760

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PROCESS FOR HANDLING CRUDE OIL AND RESIDUALS

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PROCESS FOR HANDLING CRUDE OIL AND RESIDUALS

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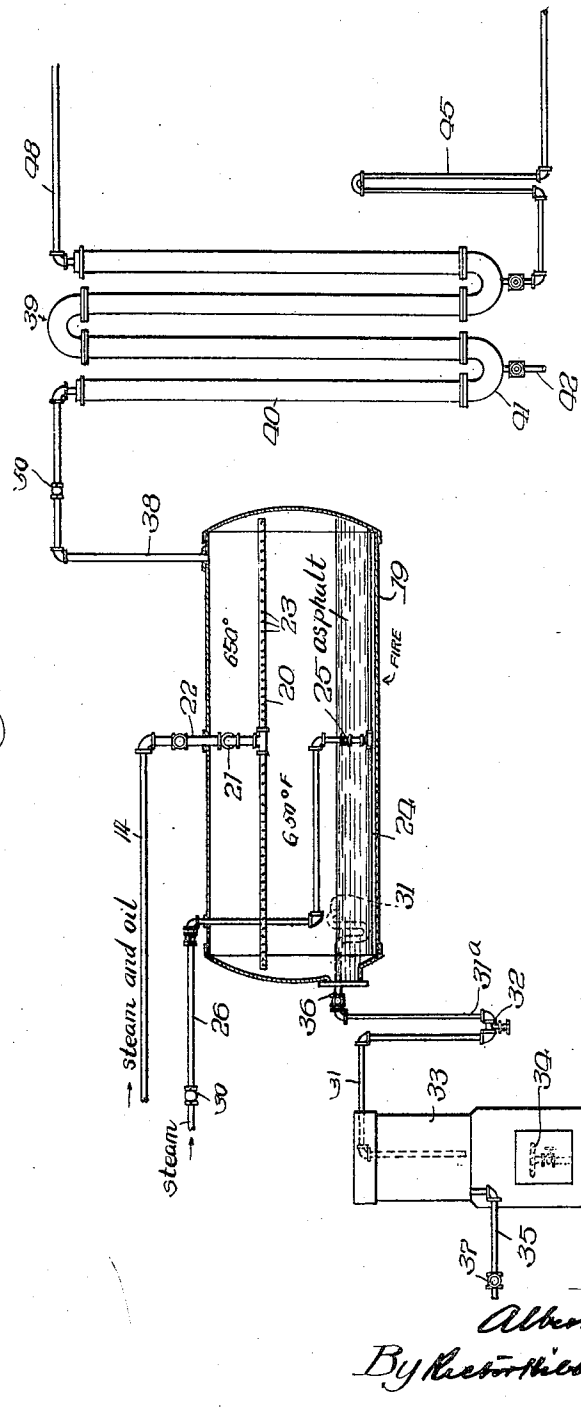


Fig. 2

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PROCESS FOR HANDLING CRUDE OIL AND RESIDUALS

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Fig. 3

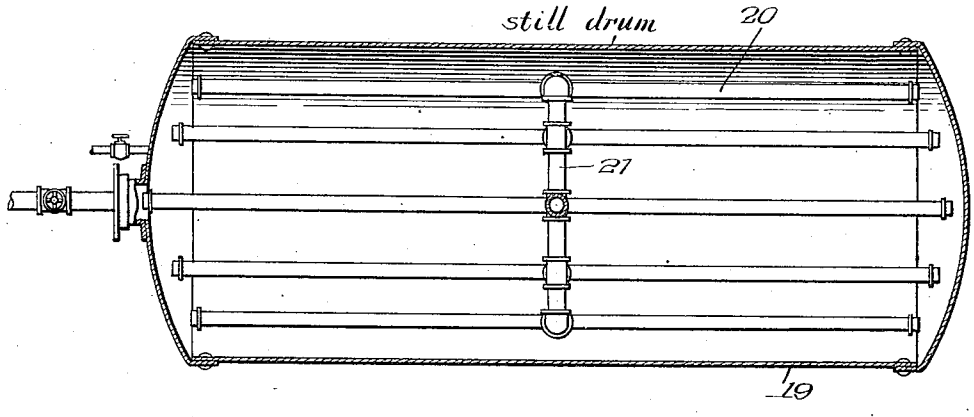


Fig. 4

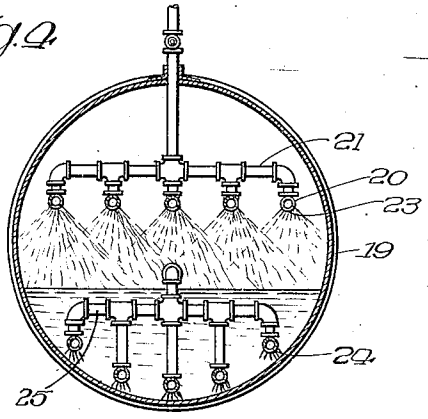


Fig. 5

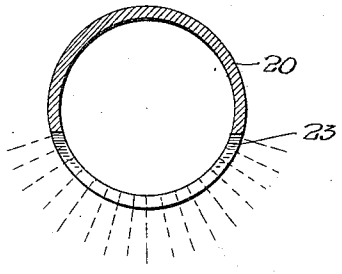
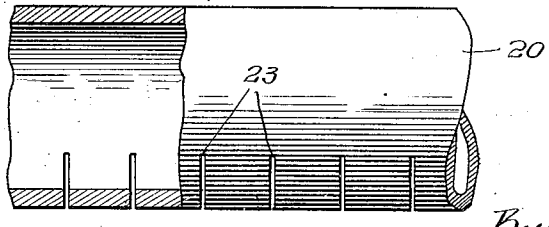


Fig. 6



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Fig. 8

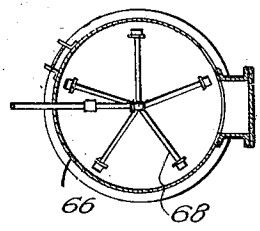


Fig. 9

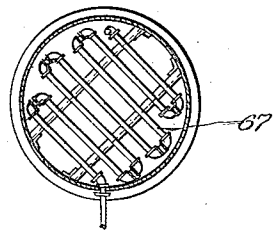


Fig. 7

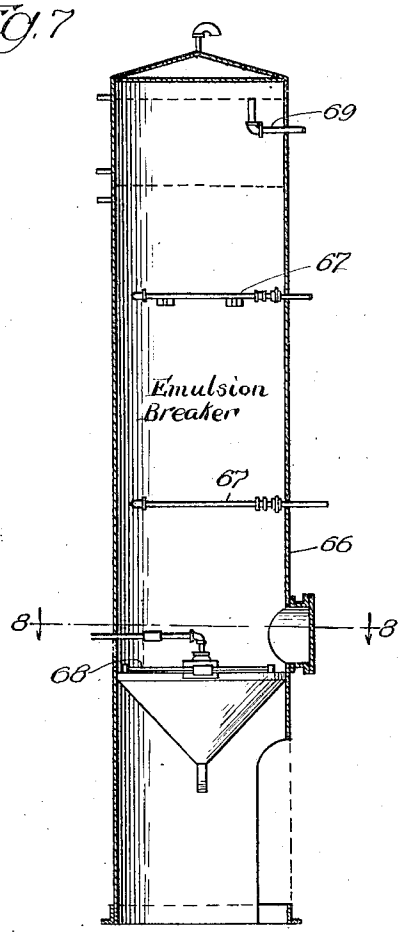
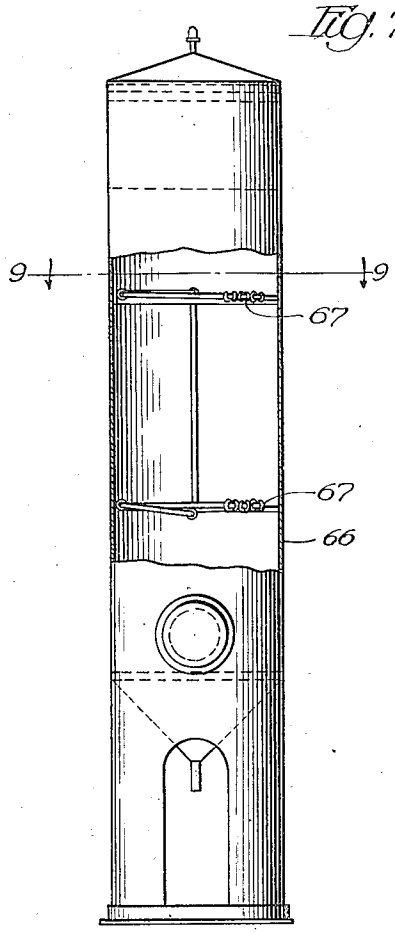


Fig. 7a



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UNITED STATES PATENT OFFICE.

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PROCESS FOR HANDLING CRUDE OIL AND RESIDUALS.

Application filed May 9, 1921. Serial No. 467,391.

My invention relates more particularly to the handling of heavy crude oil containing considerable amounts of asphaltic hydrocarbon of which the petroleum obtained from the Mexican field and known as Mexican crude oil is typical, as well as heavy crude residuums, flux, asphaltum oils, etc. It has for its purpose to separate the asphaltic and non-volatile heavy end in the crude oil from the volatile components thereof, leaving the latter as little changed as possible and in the most favorable condition for further treatment by distillation, refining, etc. By my improved process the crude oil is heated to such a temperature and under such conditions that all or substantially all of the more volatile components are driven off from the asphaltic and substantially non-volatile residue without substantial cracking, the vapors given off being condensed into a distillate which is quite similar to the original crude oil though differing therefrom in that the asphalt and non-volatile end have been removed. In carrying out the process of the present invention the effective boiling point of the higher boiling constitutents of apparatus for practicing the process of the crude oil is lowered by the presence of a large percentage of steam or other suitable vapor or gas in the atmosphere of the still and the time during which the oil is subjected to the high temperature is limited so that no substantial cracking occurs.

In the accompanying drawings I have illustrated a perferred form of apparatus, and described the same and a preferred method of practicing the invention in the following specification, but it is to be understood, that the specific disclosure is for the purpose of exemplification only, and that the form and arrangement of apparatus may be varied and the process practiced in other apparatus without departing from my invention, the scope of which is defined in the following claims in which I have endeavored to distinguish it from the prior art so far as known to me without however relinquishing or abandoning any portion or feature thereof.

In the drawings Fig. 1 is a diagrammatic plan of the preferred form of apparatus for practicing my invention; Fig. 2 a partially diagrammatic side elevation of a portion of said apparatus including a still, shown in vertical section; Figs. 3 and 4 a horizontal and a transverse vertical sectional view, respectively, of said still; Figs. 5 and 6 views of a detail in vertical cross section and longitudinal section showing a type of slotted spider arms; Fig. 7 a vertical section through a portion of the apparatus for breaking emulsions, parts being shown in elevation; Fig. 7ª an elevation partly in vertical section of the same on a plane perpendicular to that of Fig. 7; and Figs. 8 and 9 horizontal sections of the same on the lines 8—8 and 9—9, respectively.

Each part is identified by the same reference character wherever it occurs in the several views.

Referring now to the diagrammatic view shown in Fig. 1, in the preferred form of the invention there illustrated the crude oil is heated, mixed with superheated steam and sprayed into the still from which the vapors are led to condensing and separating apparatus, the residue being drawn off from time to time from the still.

In the drawings a feed tank 1 for the crude oil is shown as provided with a steam coil 2 by which the crude oil is maintained at a proper temperature, say, 170 degrees F. From this tank the material is pumped either directly to heater 3 or through an intermediate heater 4. In the diagram Fig. 1, I have shown the direct connection through the pipes 5 and 6. The indirect connection between the feed tank and the crude preheater through the heater 4 is by means of the pipes 7 and 8. The heater 4 will be described at a later point in the specification where the course of the vapors from the still, which constitute the heating medium for said heater, is described.

The preheater 3 may be of any known or desirable character or form which will provide the heat necessary to raise the temperature of the oil to about 600 degrees F. I have shown it diagrammatically as a pipe coil for the oil passing through a heating chamber. The oil in the preheater is maintained under a pressure of about fifty pounds per square inch by means of a loaded valve 9 or the like. Beyond the valve 9 the crude oil passes to a mixing valve 10, which may be of the well-known Schutte

and Koertting type, in which the oil is mixed with superheated steam. In the diagram I have shown a superheater for the steam at 11, a supply pipe therefor at 12 and exhaust pipe at 13. The superheated steam, however, may be supplied from any other form of superheater or if desided other neutral gases or vapors may be employed for this purpose, but they are preferably heated whatever the composition. A portion of the superheated steam, or other neutral vapor or gas, passes from the line 13 to the mixing valve 10 to which reference has been made where it is mixed with the crude oil and whence the mixture passes by pipe 14 to the still. Preferably I use from two to three parts by volume of water as steam with one part of oil. In order to prevent an accidental flow of the steam to the crude preheater the line 15 between said preheater and the loaded valve 9 is provided with a check valve 16 and that no crude oil may by accident reach the steam superheater the line 13 is provided with a check valve 17. A hand valve 18 is also included in line 13 to permit manual control of the steam.

Preferably the steam is superheated to about 650 degrees F. and consequently the mixture of crude oil and steam is at a temperature intermediate that named and 600 degrees, the temperature to which the crude oil is raised in the preheater. The mixture is sprayed into the still 19 by means of a number of spray pipes 20 connected to a common header 21 which in turn is connected to pipe 14 by vertical pipe 22. (See Figs. 2 and 3.) Still 19 is provided with any suitable heating means by which it may be maintained at a temperature of about 650 degrees F. For this purpose the still may be fired externally in the usual manner. Preferably the spray pipes 20 are slotted at 23 transversely as shown in Figs. 5 and 6 so that the mixture of oil and superheated steam is discharged therefrom in the form of series of thin sheets which are immediately broken up into fan shaped sprays and the more volatile constituents are instantaneously vaporized. Preferably the slits are more closely spaced near the ends of the tubes 20 so as to more nearly equalize the distribution of spray throughout the drum. The volatile components of the crude oil quickly escape from the still by connections hereinafter described leaving the asphaltic and non-volatile constituents as a residue in the bottom of the still which soon forms a pool therein of sufficient depth to form a considerable surface as seen in Figs. 2 and 4. The slits of the spray pipes are on the underside thereof so that the spray is mainly discharged against the surface of this pool of non-volatile tarry matter whereby any volatilizable matter not vaporized in the space above the liquid is volatilized due to the temperature of the residue. By discharging the spray against this asphaltic material rather than against the metal of the still cracking of the volatile hydrocarbons is minimized.

As heretofore stated the still may be heated by external means but I prefer to aid in maintaining the temperature of the body of asphaltic material in the still by providing near the bottom of the latter a series of perforated or slotted steam pipes 24 by which steam is injected into the residuum which pipes are connected to a common header 25 (see Fig. 4) and the latter by means of pipe 26 to the superheated steam pipe 13. As the steam from this pipe is superheated to approximately the temperature at which the still is maintained it materially aids in maintaining the temperature of the residuum in the still and thus renders it easy to avoid burning or hot spots due to the externally applied heat. It also assists in concentrating the asphalt by carrying off volatile matters contained therein and in maintaining a partial pressure of steam in the still. As shown in Fig. 1 the pipe 26 is provided with a hand valve 27, and the pipe 13, between its junction with said pipe 26 and the mixing valve 10, also includes a hand valve 28 so that the steam fed to the steam pipes in the bottom of the still and the mixing valve may be properly regulated and proportioned. Preferably the pipes 14 and 26 are also provided with hand valves 29 and 30 respectively adjacent the still for convenience of control.

The level of the residues in the still is preferably maintained constant or substantially so at about the point shown in Figs. 2 and 4, and for this purpose I employ draw off pipe 31, the intake of which opens downwardly at the desired level and so much thereof as is within the still is arranged below the level of the residuum so that it may be kept hot thereby. Outside the still the draw off 31 is provided with a trap having a cock 32 by which samples of the contents of the pipe may be taken and beyond the trap the residue, which is a low penetration asphalt, passes to the asphalt pan 33. The trap prevents the entrance of air to the still. Preferably these pipes are heat insulated and may if desired be warmed to avoid the congealing of the liquid therein. The pan is maintained at a suitable temperature to keep the asphalt liquid by means of a burner 34 and when full may be discharged through a draw off 35 into storage tanks, drums, or the like. The pipe 31 and the discharge 35 are provided with suitable valves 36 and 37 respectively. In the preferred operation of the still the residuum is tapped off continuously and is run down or evaporated to a point just short of coke so that the material may be handled in liquid condition.

Returning now to the still, it has been noted that by reason of the presence of the superheated steam or other neutral vapor or gas and the temperature of the still all of the hydrocarbons which are to form the overhead are instantaneously vaporized on being sprayed into the still. As these materials are converted into vapor they are quickly withdrawn from the still along with the steam or other vapor or gas by means of the vapor pipe 38, see Figs. 1 and 2. From the vapor pipe the vapors may be led in either of two courses as desired and according to the composition thereof. If they contain substantial proportions of tarry matter they may be led through a tar tower 39 which consists of a coil of pipe of larger diameter, the limbs 40 of which extend in a substantially vertical plane and the lower bends 41 of which collect the tar which may be drawn off by valved pipes 42 and 43 to the receptacles 46 and 47. These pipes may be provided with siphons 45. The distillate or vapors passing from the last limb of the tar tower are conducted by pipes 48 to a condenser 49.

If the tar tower 39 is not utilized the vapors may pass by way of line 49 to the heat interchanger 4 to which reference has been made. Hand valves 50 and 51 are provided to determine which of the described courses the vapors from the still shall take. The heat interchanger 4 may be of any approved or desired character and may serve as heretofore stated to give an intermediate heating to the crude oil on its way to the preheater 3. The temperature of the vapors from the pipe 49 are more or less lowered in the heat interchanger and a certain amount of tarry matters deposited therein are led by pipe 52 to either of the tar receivers 46, and 47 to which reference has been made, according to the position of valves 53 and 54. The vapors from the heat interchanger are led by pipe 55 into pipe 48, heretofore mentioned and thence to the condenser 49. Valves 56 and 57 may be utilized to control the passage of vapors.

The condenser 49 is preferably of the type known as Griscom and Russell's multi-whirl condenser. The condensate therefrom passes through pipe 58 to the bottom of a receiver 59 which is heated by steam coil 60 in the bottom thereof. This receiver is maintained more than two-thirds full of water which is maintained at a temperature of about 180 degrees F. The oil rises through this water to the top thereof. A small portion of the more volatile constituents of the oil in the receiver volatilizes and passes off by way of pipe 61 to a small water cooled condenser 62 the condensate from which passes by pipe 72 to receiver 73. The fixed gases pass to the naphtha absorption towers 74 and the unabsorbed gases to the tank 75. The bulk of the distillate in receiver 60 is forced by pumps 63 through lines 64 and 65 to an emulsion breaker 66.

The emulsion breaker consists of a cylindrical tower which may be about twenty feet high and four feet in diameter, see Figs. 7, 7a, 8, and 9, containing steam heating coils 67 and is filled to a depth of about fifteen feet with water maintained at a temperature of about 170 degrees F. The overhead or condensate from the receiver 59 is more or less emulsified with water from the condensed steam and entering the emulsion breaker at the bottom through a perforated spider 68 passes up through the hot water and floats on top. By this operation ninety to ninety-five per cent of the emulsion is broken up. The clear oil overflows through a pipe 69 into a distillate tank 70. The very light end of the oil volatilized by the heat in the emulsion breaker passes through line 71 and pipe 61 to the condenser 62 to which reference has been made.

From the foregoing description it will be observed that the process is a continuous one. The crude oil being instantaneously vaporized within the still and depositing the non-volatile ends therein, the vapors quickly leaving the still before being subjected to the heat thereof for a sufficient length of time to crack them under the particular conditions obtaining in the still due to the presence of the steam or neutral vapor or gas. Sixty-five to seventy per cent of the material is realized as overhead or distillate and the remaining fraction is drawn off as tar just before it becomes too viscous to flow. The vapors are cleaned of any tarry matters and of tar or heavy ends in the vapor state and effectively condensed, the emulsification thereof broken up and the contained water separated out.

By the improved process and apparatus described, heavy asphaltic petroleum such as Mexican crude oil is deprived of its heavy, non-volatile components and the volatile hydrocarbons contained therein are effectively and cheaply prepared for further treatment without undergoing cracking to any substantial extent.

I claim:

1. A process of treating asphaltic petroleum oils and residues for separating constituents volatile below their cracking temperature from asphaltic residues non-volatile without substantial cracking of the separated volatile constituents which comprises. maintaining within a still a liquid body of asphaltic residues, preheating the oil to be treated under pressure, and preheating a neutral gas to a temperature in excess of 650 degrees F., reducing the pressure on the oil and then mixing it with the preheated neutral gas, spraying the mixture into the vapor space of the still and introducing a heated

neutral gas into the still through the body of asphaltic residues, maintaining the temperature in the still at about 650 degrees F., withdrawing the constituents volatilized under the conditions prevailing in the still as a vapor and withdrawing the asphaltic residues as a liquid substantially free from said volatile constituents from the body thereof in the still.

2. A process of treating asphaltic petroleum oils and residues for separating constituents volatile below their cracking temperature from asphaltic residues non-volatile without substantial cracking of the separated volatile constituents which comprises, maintaining within a still a liquid body of asphaltic residues, preheating the oil to be treated under pressure, and preheating a neutral gas to a temperature in excess of 350 degrees F., mixing the preheated oil with a larger volume of the preheated neutral gas, reducing the pressure on the oil and then mixing it with the preheated neutral gas, spraying the mixture into the vapor space of the still and introducing a heated neutral gas into the still through the body of asphaltic residues, maintaining the temperature in the still at about 650 degrees F., withdrawing the constituents volatilized under the conditions prevailing in the still as a vapor and withdrawing the asphaltic residues as a liquid substantially free from said volatile constituents from the body thereof in the still.

3. A process of treating asphaltic petroleum oils and residues for separating constituents volatile below their cracking temperature from asphaltic residues non-volatile without substantial cracking of the separated volatile constituents which comprises, maintaining within a still a liquid body of asphaltic residues, separately preheating the oil to be treated and a neutral gas, mixing the preheated oil and gas and spraying the mixture into the vapor space in the still and against the body of asphaltic residues therein, introducing a preheated neutral gas into the still through the body of asphaltic residues, maintaining the temperature in the still at about 650 degrees F., withdrawing the constituents volatilized under the conditions prevailing in the still as a vapor, withdrawing the asphaltic residues as a liquid substantially free from said volatile constituents from the body thereof in the still.

ALBERT E. MILLER.