Nov. 4, 1924.

C. S. PALMER

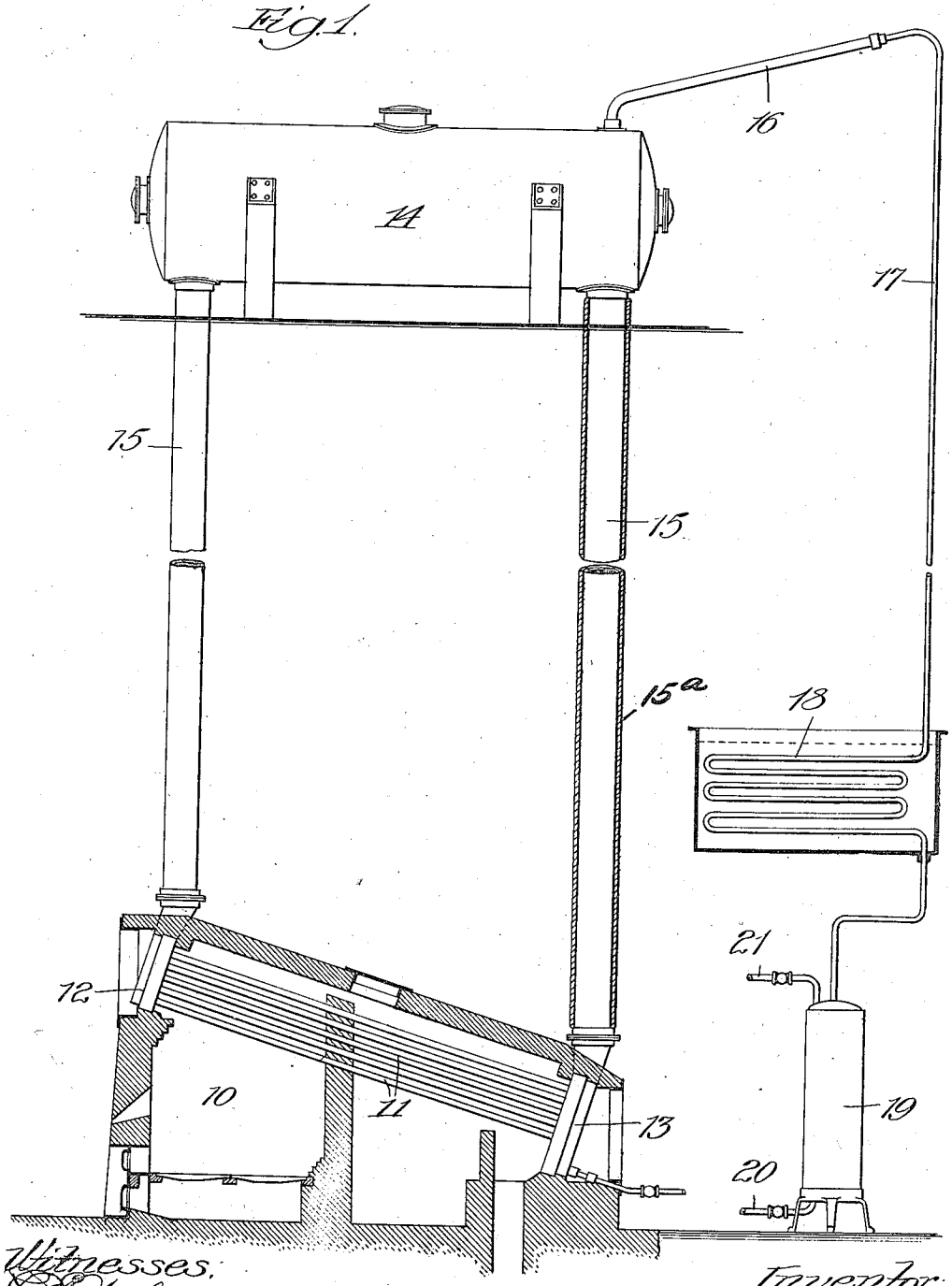
1,514,098

ART OF TREATING PETROLEUM OILS

Filed July 5, 1917

2 Sheets-Sheet 1

Fig. 1.



Witnesses.

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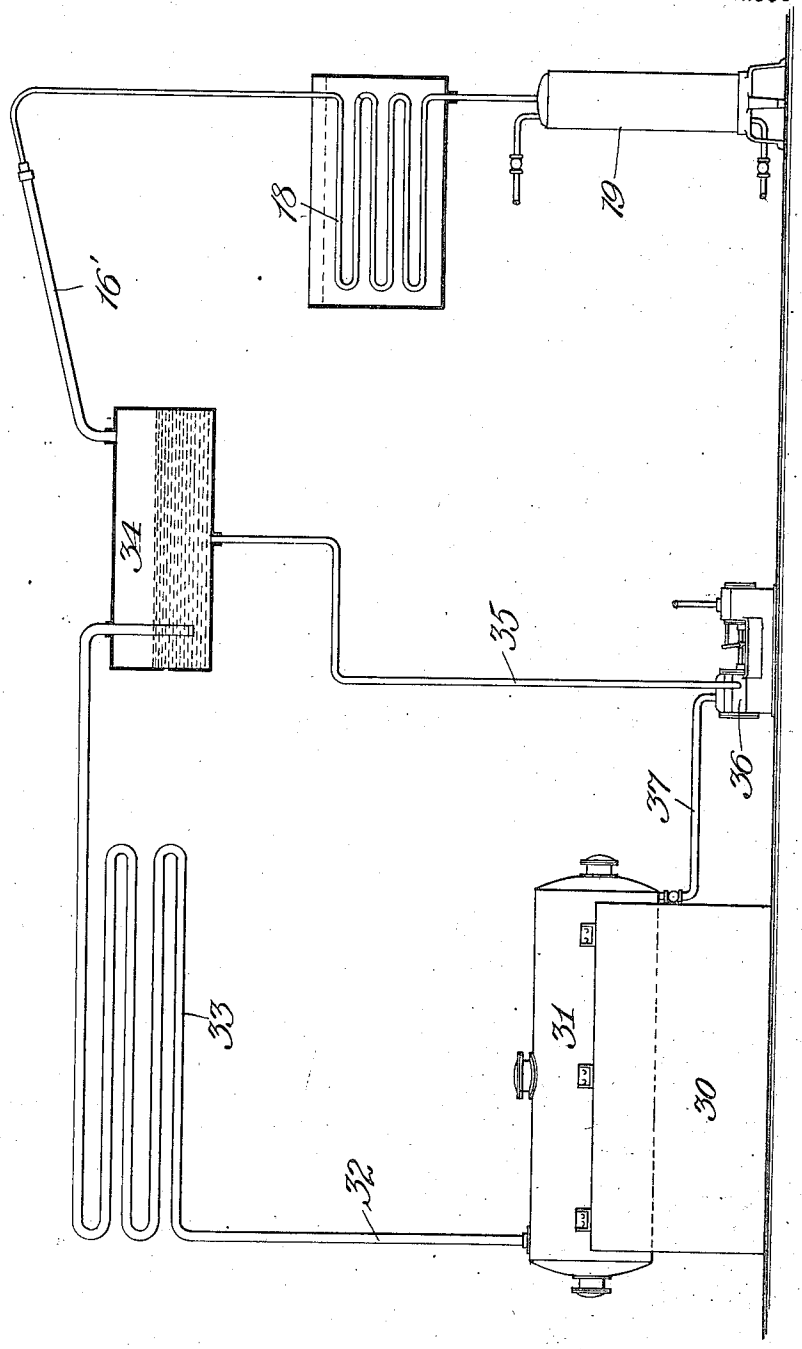


Fig. 2.

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UNITED STATES PATENT OFFICE.

CHARLES S. PALMER, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO STANDARD OIL COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF INDIANA.

ART OF TREATING PETROLEUM OILS.

Application filed July 5, 1917. Serial No. 178,609.

To all whom it may concern:

Be it known that I, CHARLES S. PALMER, a citizen of the United States, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented new and useful Improvements in Art of Treating Petroleum Oils, of which the following is a specification.

My invention relates to certain improvements in the art of treating petroleum oil and more particularly to the pyrogenetic decomposition of relatively heavy petroleum products, to produce relatively light products of the character of gasoline.

The invention will be fully understood from the following specification taken in connection with the accompanying drawings, in which—

Figure 1 is a side elevation partly in section and partly diagrammatic of one form of apparatus adapted for the practice of my invention, and Figure 2 is a diagrammatic side elevation of a modified form of apparatus.

Referring more particularly to the drawings, the numeral 10 in Figure 1 designates a coal-burning furnace of ordinary type, having mounted therein a plurality of tubes 11, which extend between front and rear headers 12 and 13 respectively, the tubes being preferably arranged at a slight inclination, as shown in the drawings. At a considerable distance above the furnace 10 there is supported a horizontal drum 14, which is connected with the headers 12 and 13 by vertical conduits 15 of relatively large size.

An upwardly-inclined vapor pipe 16 is tapped into the top of the drum 14 and to the outer end of this vapor pipe there is connected a condenser line 17 which leads downwardly to an ordinary water-cooled condenser 18. The latter is arranged to drain into a receiving drum 19 provided at the top and bottom with valved liquid and gas escape pipes 20 and 21, respectively.

In the operation of the apparatus above described a charge of relatively high boiling point petroleum products, such, for example, as the residue known as fuel oil or gas oil, is introduced into the drum 14, partially filling the latter and wholly filling the vertical conduits 15, headers 12 and 13 and tubes 11. It is to be noted that the drum 14 is mounted at some very considerable distance above the tubes 11, so that an appreciable hydrostatic pressure is developed within the latter by the liquid head alone. If, for example, the vertical conduits or risers 15 are seventy feet in height, a hydrostatic pressure of the order of two atmospheres will exist within the tubes 11.

The furnace 10 being fired, the oil within the tubes 11 becomes heated and, the liquid level being maintained at some intermediate point in the drum 14, a thermo-siphon circulation of the oil in the system will be set up, according to the well-understood manner of operation of tubular boilers. Owing to the relatively heavy hydrostatic pressure developed by reason of the great liquid head imposed upon the heating tubes, the oil in the latter may be caused to attain a temperature far in excess of its normal boiling point at atmospheric pressure, without the liberation of any vapors, and under such elevated temperature the oil within the tubes will suffer pyrogenesis, as the result of which a certain proportion of relatively low boiling point products will be formed in the liquid body. The liquid mass passing upward in the front riser 15 will, therefore, be of different composition from that passing downwardly in the rear riser 15. In its passage upward the partially decomposed or cracked oil will become cooler, through the radiation from the unlagged front riser 15, so that the temperature of the oil body in the drum 14 will be perceptibly lower than the temperature in the tubes 11. This temperature will nevertheless be sufficiently high to avoid condensing, or to cause the evaporation of the lower boiling point products of the re-action, i. e., the gasoline-like products, and the vapors of such products will be continuously evolved from the surface of the liquid in the drum 14, and will pass outwardly through the pipe 16. They will here be subjected to a selective condensing action, as the result of which their heavy or less volatile constituents will return to the liquid state and drain backwardly into the drum. The more volatile products which are to constitute the net result of the process, pass unchanged through the inclined vapor pipe 16 and through the line 17 to the condenser 18, where all of the readily condensable portions thereof are condensed. The condensate, ac-

companied by any incondensable gases which may be formed during the process, passes into the receiving drum 19, the liquid portion thereof being drained off continuously or intermittently through the pipe 20 and the gases discharged through the pipe 21.

The oil under treatment, relieved of the more volatile compounds produced by the action of heat and pressure within the heating tubes 11, will continuously return to the tubes through the rear riser 15, and the latter being lagged with insulation, as indicated at 15ª there will be no perceptible loss of heat during such return. The process may be continued until the oil-body remaining in the system becomes so refractory or so filled with suspended carbon as to make it uneconomical and dangerous to continue. The system may then be drained, cleaned and a fresh charge of oil introduced.

Instead of depending wholly upon the hydrostatic head for obtaining the required pressure by which the cracking temperature is attained in the tubes 11, the pressure may be produced in part by the gases of distillation. Thus, if the oil is of a character which produces a considerable volume of incondensable re-action products, such as methane, ethylene and the like, such products may be confined within the system by closing the valve in the gas-escape pipe 21 and any desired operating pressure may thereby be built up and maintained by the proper regulation of this valve. For example, if it is desired to operate with a pressure of five atmospheres in the cracking tubes 11, this pressure may be produced by the use of an apparatus giving a liquid head of approximately seventy feet, and thereafter regulating the valve in the gas-escape pipe 21 to produce a gas pressure of three atmospheres upon the free surface of the liquid in the drum 14.

In Figure 2 I have shown a modified form of apparatus, including a furnace 30, arranged to heat a horizontal cylindrical converter 31. From the top of the converter a pipe 32 leads to a coil 33, the said pipe and coil being of relatively small diameter to provide a considerable resistance to the flow of liquid. The discharge end of the coil 33 opens into a release drum 34, and from the bottom of the latter a return pipe 35 is led to the inlet side of a power-driven pump 36, the discharge line 37 of which communicates with the base of the converter 31, and preferably at the end opposite the pipe 32.

The release drum 34 has a vapor outlet pipe 16 of the same form as the pipe 16 of Figure 1, and communicates with a condenser 18 and receiving apparatus 19 of the form heretofore described.

In the apparatus shown in Figure 2, a pressure equivalent to the hydrostatic pressure is developed by the resistance to liquid flow of the coil 33. The apparatus of Figure 2 being filled with oil up to the line indicated in the drum 34 in Figure 2, and the pump 36 set in operation, the converter 31 and discharge pipe 32 and coil 33 become completely filled with liquid, which courses through the latter members at a relatively high velocity, and owing to the resistance to flow, which the oil meets in its passage through the discharge line and coil, a considerable liquid pressure is constantly maintained within the converter 31, this pressure being variable by varying the speed of the pump 36. The furnace 30 being fired, the oil-body within the converter 31 may therefore be raised to a temperature greatly exceeding its atmospheric boiling point and the desired re-action by which lower boiling point products are formed may therefore be carried out.

In the form of apparatus illustrated in Figure 2 as well as in that shown in Figure 1, it will be noted that the oil in the heated zone is maintained under a considerable liquid pressure or head, which head becomes slowly reduced as the oil passes toward the vapor release drum. The temperature of the oil-body will likewise, in general, decrease, owing to radiation from the front riser 15 or coil 33. By properly proportioning the radiating surface, the reduction in temperature of the oil may be made to correspond to the drop in pressure along the line of its flow, so that no considerable evolution of gas within the moving liquid-body will take place.

In the form of apparatus shown in Figure 2, as well as in that shown in Figure 1, the pressure within the heated zone may be created and maintained not only by the liquid head, but also by the imposition of a gas pressure upon the free surface of the oil within the release drum.

While I have shown and described in considerable detail two specific forms of apparatus for carrying out my invention, together with the preferred manner of operation, it will be understood that this is illustrative only, and for the purpose of making clear the nature and mode of application of the invention, but I do not regard the invention as limited to the details of construction or procedure described, except in so far as such limitations are included within the terms of the accompanying claims, in which it is my intention to claim all novelty inherent in my invention as broadly as is permissible in view of the prior art.

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

1. The improvement in the art of treating petroleum oils to effect the pyrogenetic decomposition thereof, which consists in

passing the oils under treatment through a heated zone while maintaining them under such pressure of superimposed liquid as to prevent substantial evolution of vapors, and subsequently passing the oil through a cooling zone and simultaneously reducing the pressure.

2. The process of treating petroleum oils which consists in circulating such oils successively through a heating zone at a temperature to effect pyrogenetic decomposition thereof, and through a cooling zone, maintaining a substantial pressure of superimposed liquid upon the oil substantially throughout the heating zone, and gradually reducing such pressure within the cooling zone.

3. The process of treating petroleum oils which consists in circulating such oils successively through a heating zone at a temperature to effect pyrogenetic decomposition thereof, and through a cooling zone, maintaining a substantial pressure of superimposed liquid upon the oil within the heating zone and gradually reducing such pressure in proportion to the lowered temperature as the oil passes through the cooling zone.

4. The process of treating petroleum oils which consists in circulating such oils successively through a heating zone at a temperature to effect pyrogenetic decomposition thereof, a cooling zone and a vapor release drum, maintaining a substantial liquid pressure within the heating zone, whereby evolution of vapors therein is prevented, gradually reducing such pressure within the cooling zone, and relieving such pressure within the vapor release drum to permit evolution of vapors therein.

5. The process of treating relatively high boiling point petroleum oils for the production therefrom of relatively low boiling point oils, which consists in passing the high boiling point oils through a heating zone while under a substantial liquid pressure sufficient to prevent the evolution of vapors at the temperature required for decomposition of the oil, passing the decomposed oil through a cooling zone in which the pressure is gradually reduced in proportion to the reduction in temperature, and finally bringing the oil stream to such a temperature and pressure as to permit the evolution of the vapors of the lower boiling point products.

6. The process of treating petroleum oils which consists in maintaining a circulating system containing such oils under the pressure of the products of distillation thereof and passing the oils within the system through a heating zone at a cracking temperature while under an additional and substantial liquid pressure substantially maintained throughout said heating zone.

7. The improvement in the art of treating hydrocarbon oils to effect their pyrogenetic decomposition, which comprises establishing a supply of oil at a relatively elevated position, feeding oil from said supply to and through a confined passage in a heating zone below the same, heating the oil in passing through said heating zone to a cracking temperature, a portion of the product issuing from the heating zone being retained in the oil supply, continuously returning to the heating zone from the said supply said portion of the product issuing from the heating zone, maintaining the heating zone and supply chamber under the pressure of products of distillation, the heating zone being under an additional and substantial liquid pressure of products from the supply.

8. The process of treating petroleum oils for the conversion of relatively high boiling point oils into relatively low boiling point oils which consists in applying heat to a liquid body of such high boiling point oils while maintaining the said liquid body under a substantial pressure exerted by the liquid itself and not by a gaseous atmosphere in contact with the surface of the liquid.

9. The process of treating petroleum oils which consists in maintaining a circulating system filled with such oils under the pressure of the products of distillation thereof and passing the oils within the system through a heating zone while maintaining them under an additional and substantial liquid pressure sufficient to prevent substantial evolution of vapors therefrom.

10. The process of treating petroleum oils for the conversion of relatively high boiling point oils into relatively low boiling point oils which consists in applying heat to a liquid body of such high boiling point oils while maintaining the said liquid body under a substantial pressure exerted by the liquid itself and not by a gaseous atmosphere coming in contact with the surface of the liquid, said pressure being sufficient to prevent substantial evolution of vapors therefrom.

11. An apparatus for the treatment of petroleum oils and comprising a circulatory system including a pump, a heating zone, a cooling zone, a vapor release drum, and a communication between the vapor release drum and the pump, the parts being arranged in the order specified with relation to the passage of the liquid therethrough.

CHARLES S. PALMER.

Witness:
F. H. ALLISON.