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APPARATUS FOR CONVERTING HEAVY HYDROCARBONS INTO LIGHTER ONES

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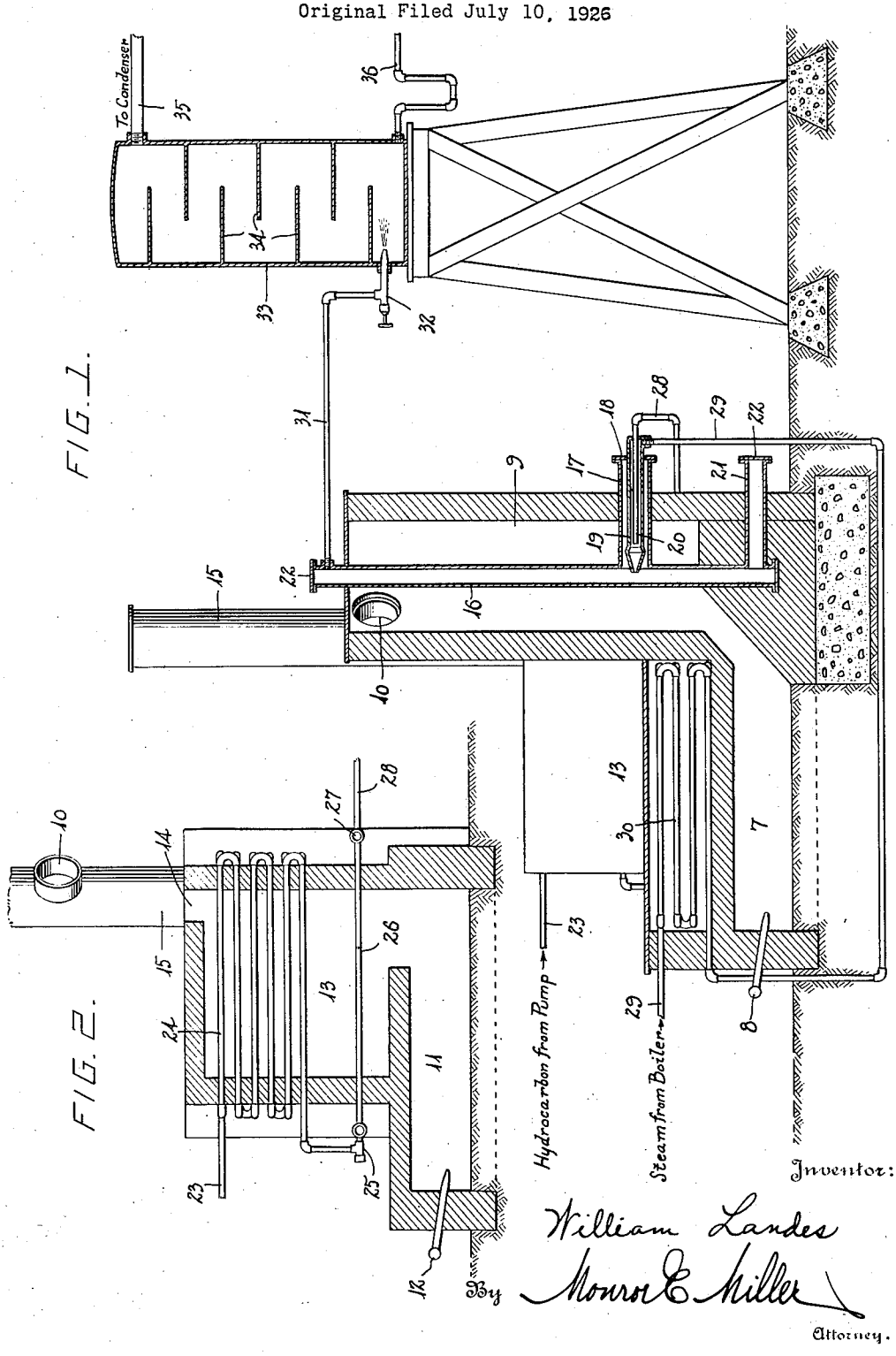


FIG. 1.

FIG. 2.

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APPARATUS FOR CONVERTING HEAVY HYDROCARBONS INTO LIGHTER ONES

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The present invention relates to conversion of petroleum, crude oil and other heavy hydrocarbons into lighter hydrocarbons, such as gasoline, kerosene, and the like, and it is an object of the invention to provide a novel and improved apparatus for converting heavy hydrocarbons into lighter ones, both the apparatus and process being simple, efficient and economical.

Another object of the invention is the conversion of the heavier hydrocarbon by the use of heat, pressure and expansion, with attendant physical energy, with conversion occurring in an expansion chamber under low pressure.

A further object is the provision of such a process and apparatus by means of which the operation may be carried on continuously, without interruption, excepting for periodic cleaning of the apparatus, or should repairs be necessary.

The apparatus is illustrated in the accompanying drawing, wherein—

Figure 1 is a vertical section of the apparatus, portions being shown in elevation.

Fig. 2 is a vertical section of the hydrocarbon heating furnace.

The apparatus includes a furnace 7 heated by a hydrocarbon burner 8, as shown, and having an upright cylindrical chamber 9 through which the products of combustion pass upwardly to the outlet 10 in the upper end portion of the chamber 9. A second furnace 11, also heated by a hydrocarbon burner 12 as shown, has a chamber 13 through which the products of combustion pass into a chimney or smoke-stack 15 into which the outlet or flue 10 discharges, thereby using the same chimney or smoke-stack 15 for both furnaces.

Disposed centrally within the chamber 9 is a vertical elongated expansion chamber 16, provided between its ends with a branch or arm 17 extending through the wall of the chamber 9 to the exterior of the furnace, with a removable cap 18 attached to the outer end of said arm. A steam discharge nozzle 19 extends through the cap 18 into the arm 17, and a hydrocarbon discharge nozzle 20 extends within the nozzle 19, whereby the steam discharging through the nozzle 19 under high pressure will create an atomizing action. The expansion chamber 16 is provided at its lower end with another branch or arm 21 extending to the exterior for cleaning out the sediment or deposit in the lower portion of said chamber, and the upper end of the chamber 16 and arm 21 are normally closed by removable caps 22.

The hydrocarbon is pumped through a pipe 23 into a heating coil 24 disposed within the chamber 13, for heating the hydrocarbon, and the coil 24 is connected through a control valve 25 with a pipe 26 leading through the chamber 13 below the coil 24. The pipe 26 is connected through a valve 27 with a pipe 28 leading to the nozzle 20, whereby the hydrocarbon in passing through the coil 24 and pipe 26 will be heated to the desired temperature.

Steam is supplied from a suitable boiler (not shown) through a pipe 29 which has a coil 30 in a chamber of the furnace 7, in order to superheat the steam, and the pipe 29 leads to the nozzle 19.

A vapor discharge pipe 31 is connected to the upper end portion of the expansion chamber 16 and has a needle valve 32 at its discharge end which discharges the vapor into the lower portion of a trap chamber 33 having baffles 34 therein above the valve 32, with a vapor outlet pipe 35 leading from the upper portion of the chamber 33 and a liquid outlet pipe 36 leading from the lower portion of said chamber. The pipe 35 may lead to a suitable water cooled condenser (not shown) while the pipe 36 leads to a storage tank (not shown).

In carrying out the process with the apparatus shown and described, the steam is supplied from the boiler through the pipe 29 under a pressure between 125 and 150 pounds, depending on the nature of the hydrocarbon, and is heated in the superheating coil 30 to a temperature between 750 and 1000 degrees F. The hydrocarbon is pumped through the pipe 23 under a pressure of approximately 300 pounds, and in passing through the coil 24 is heated to a temperature between 600 and 700 degrees F. The steam and hydrocarbon

discharge through the respective nozzles 19 and 20 into the expansion chamber 16, thereby having the effect of atomizing the hydrocarbon as it is discharged into said expansion chamber. The expansion chamber is heated within the chamber 9 to a temperature between 900 and 1000 degrees F., depending on the nature of the hydrocarbon. As the steam and hydrocarbon are discharged into the vertical expansion chamber 16, the hydrocarbon is atomized, and expansion takes place in the chamber 16 under high temperature, causing the vaporization of the hydrocarbon. This provides a vapor phase process, inasmuch as cracking takes place by the vaporization. The vapor passes up through the pipe 31 into the chamber 33, from which the vapor passes through the pipe 35, while the precipitated liquid flows through the pipe 36.

In heating the hydrocarbon, in the coil 24, to an initial temperature between 600 and 700 degrees F., the hydrocarbon is heated to a point below the danger zone at which coking takes place, and the hydrocarbon being discharged into the expansion chamber with the steam heated to a higher temperature, with the expansion chamber also heated to a higher temperature, will result in the vapor expansion phase taking place under a desirable cracking temperature. The superheated steam serves several purposes in that it affords a medium of expansion within the chamber 16, eliminates corrosion, serves as a heat conductor, assists in the flow of hydrocarbon and discharge thereof into the expansion chamber, and adds physical energy to the vapor phase. Furthermore, freed oxygen of the steam vapor will combine with atoms of carbon, to form carbon dioxide, thereby eliminating corrosion that might otherwise take place. Freed hydrogen of the steam vapor will also mingle with the hydrocarbon vapor to assist in building up the lighter hydrocarbons.

By heating the hydrocarbon in the coil 24 to almost a cracking temperature, but below a coking temperature, the hydrocarbon is discharged with the steam into the expansion chamber at a temperature so that its temperature is quickly raised to the cracking temperature of the steam and expansion chamber.

The process is a continuous one, so that the apparatus has a large capacity, and, furthermore, coking is reduced to a minimum within the expansion chamber 16.

If the chamber 16 were heated only from the exterior this would result in the coking of the hydrocarbon on the interior surface of said chamber, due to the fact that the molecules would receive excessive heat immediately adjacent to the inner surface of said chamber, and the heat would not be transmitted sufficiently rapid from molecule to molecule to heat the molecules uniformly within the chamber. Consequently, the burning or coking action would take place. However, by filling the chamber with superheated steam with several times the volume of steam to that of hydrocarbon, the entire interior of the chamber will be heated so that each molecule of hydrocarbon is quickly heated when discharged into the chamber, and without coking taking place along the interior surface of said chamber. Thus, the chamber is heated not only from the exterior but also from the interior by the superheated steam which fills the chamber.

Having thus described the invention, what is claimed as new is:—

An apparatus for converting hydrocarbons comprising a furnace, an upright chamber leading upwardly from the furnace and through which the products of combustion flow from said furnace, an upright elongated expansion chamber located centrally within the first named chamber and having an arm projecting to one side thereof between the ends of said expansion chamber, said expansion chamber having an upper vapor outlet and having lower discharge means, hydrocarbon and steam nozzles extending through the entire length of said arm to direct hydrocarbon and steam against the opposite wall of the expansion chamber, means for delivering superheated steam to one nozzle, and means for supplying preheated hydrocarbon to the other nozzle.

In testimony whereof I hereunto affix my signature.

WILLIAM LANDES.