June 5, 1928. 1,672,459

H. J. JANSEN

PROCESS AND APPARATUS FOR THE DISTILLATION AND CRACKING OF HYDROCARBON OILS

Filed July 13, 1925

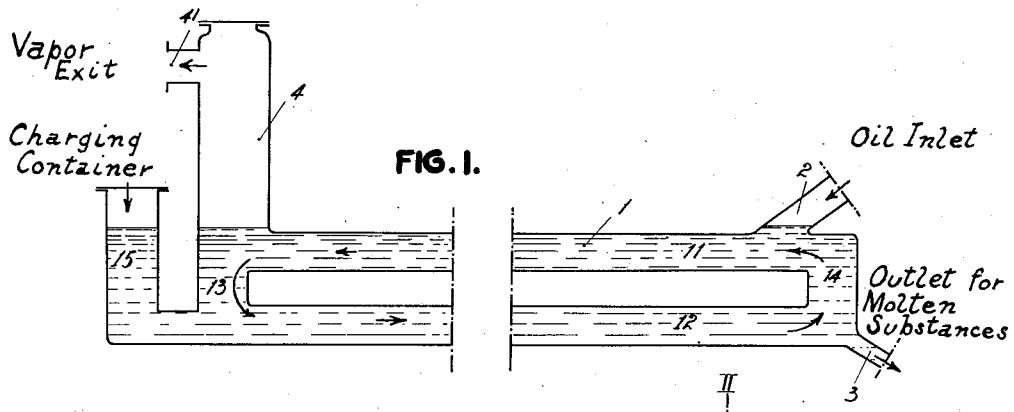


FIG. 1.

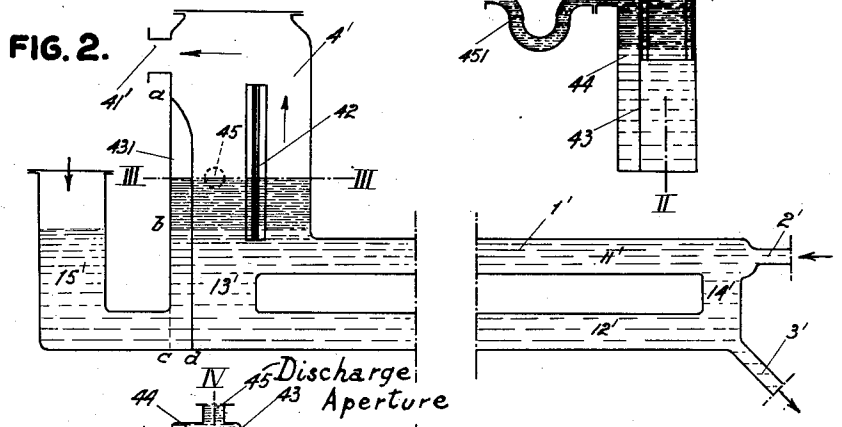


FIG. 2.

FIG. 4.

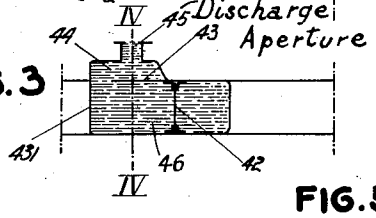


FIG. 3

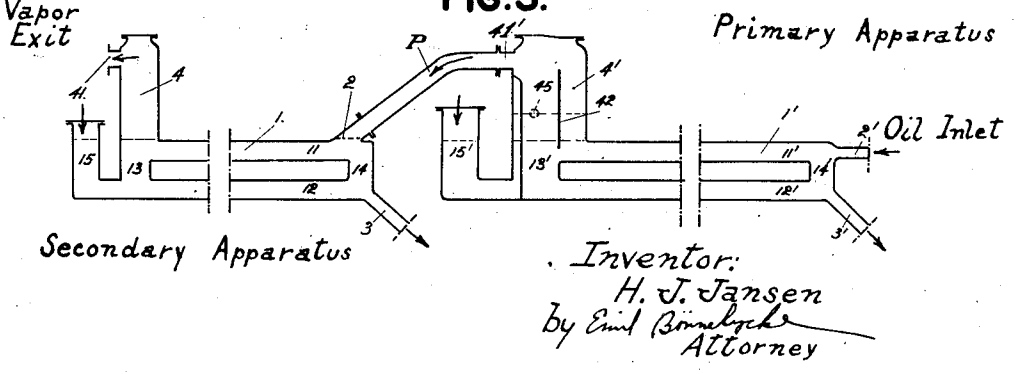


FIG. 5.

Inventor:
H. J. Jansen
by Emil Bimelocks
Attorney

Patented June 5, 1928. 1,672,459

UNITED STATES PATENT OFFICE.

HERMANUS JOHANNUS JANSEN, OF SCHIEDAM, NETHERLANDS.

PROCESS AND APPARATUS FOR THE DISTILLATION AND CRACKING OF HYDRO CARBON OILS.

Application filed July 13, 1925, Serial No. 43,339, and in Great Britain July 18, 1924.

This invention relates to the distillation and cracking of hydrocarbon oils such as mineral oils, tar and the like, and to apparatus suitable for this purpose.

In the process of cracking hydrocarbon oil it is well known to conduct the oil in liquid or vaporized condition through molten metal such as lead in various different ways.

According to the present invention, the drawbacks inherent in the prior processes, and which need not here be specified, are overcome by passing the hydrocarbons through a molten mass heated to a cracking temperature in such manner that the hydrocarbon vapors are compelled to follow an extended and substantially horizontal path through the molten mass, which has only a small free surface at the end from which the cracked vapors escape, said vapors carrying the formed carbon in suspension and without leaving any residue on said surface.

This process can be applied directly to hydrocarbon oil with a comparatively low carbon content which can be vaporized entirely without leaving a substantial liquid or solid residue such as kerosene and the like.

The molten mass through which the hydrocarbon is passed may be a metal such as lead or a salt such as zinc chloride or a metal covered with a salt, such as lead covered with zinc chloride.

One of the advantages of the process is that it can be carried out without high pressure. A pressure not substantially higher than required for passing the hydrocarbons through the molten mass (for instance ¼ atmosphere) is sufficient in many cases.

When a metal bath is employed, it may be composed of metals or alloys, which have suitable melting points in accordance with the temperatures to be obtained (for instance 450° C.) and which are not attacked to any substantial extent by the hydrocarbon oils. In many cases lead may be used with advantage.

Other suitable substances may be metal salts and the like. If the oils are merely to be cracked, metals are preferable to salts, because metals are better conductors of heat. If, however, it is desired to obtain a deodorized cracking product it is advantageous to use a bath of a molten salt, such as zinc chloride. Even when using a metal bath, such as a lead bath, the cracked oil is of better quality and odor than oil cracked according to the known art, which is probably due to a catalytic action of the metal.

The best results in many respects are obtained with a lead bath covered with a layer of molten zinc chloride.

If oils with comparatively high carbon contents are used, such as heavy asphaltic oils, the process is modified in such a way that the heavy oils are treated in two steps. In a preliminary step the heavy hydrocarbon oil is passed through a molten mass, having only a small free surface, for a sufficient time and at a sufficient temperature to decompose the oil into a heavy liquid residue which collects over a small area on the molten mass and takes up the formed carbon and which is quickly discharged from the apparatus, and a vaporized fraction which is further cracked in the second step of the process by passing it through a molten mass heated to cracking temperature in such manner that it is compelled to follow an extended substantially horizontal path through a molten mass which has only a small free surface at the end from which the cracked vapors escape; said vapors carrying the formed carbon in suspension without leaving any residue on said surface. This second step or treatment of the vaporized fraction corresponds to the above described treatment of hydrocarbon oil which can be vaporized without leaving a residue. In both steps the feature that the molten mass has only a small free surface is of equal importance. If no liquid residue is left, the smallness of the free surface prevents carbon from being retained thereon, and causes it to be entirely carried away by the strong gas current. If liquid residue is left, this does not stagnate for a long time on the heated metal but can be continually and rapidly discharged. It has no opportunity of being overheated or to form crusts, carbon deposits, coke and the like; it absorbs all the carbon formed and yet remains sufficiently liquid to separate readily from the metal or the like and to prevent the formation of mixtures of metal or other molten substance with solid constituents of the residue.

The apparatus used for cracking hydrocarbon which is vaporized without leaving

a substantial residue according to this invention, either as the single step in the process or as the second step in the two-step process for cracking heavy hydrocarbon oil, comprises a substantially horizontally extending container entirely filled with molten substance, provided with an inlet for hydrocarbon at one end and a dome at the other end having a vapor exit.

The apparatus for carrying out the first step in the two-step process for cracking heavy hydrocarbon oil may be of a similar construction, although other constructions are also suitable.

Other features of the invention relating to apparatus will be explained with reference to the accompanying drawings. The invention however is not limited to the described apparatus but only by the claims.

Fig. 1 represents a longitudinal section of an apparatus for cracking in which no liquid residue is obtained.

Fig. 2 is a longitudinal section on line II—II, Fig. 4, of a similar apparatus for primarily cracking heavy hydrocarbon oils in which a liquid residue is obtained.

Fig. 3 is a horizontal section on line III—III of Fig. 2.

Fig. 4 is a vertical section on line IV—IV, Fig. 3.

Fig. 5 represents a combination of Figs. 1 and 2 for carrying out the invention in the preferred manner.

In Fig. 1 the bath of molten substance 1, for instance lead, is composed of an upper tube 11 and a lower tube 12, connected by two short connections 13 and 14. The lower tube 12 is connected to a container 15 through which the apparatus can be charged with lead or other substance. The tubular system 11, 13, 12, 14 is heated in any known or suitable way not indicated in the drawing. The tubular system is provided with an inlet 2 for liquid or vaporized oil and a discharge tube 3 for discharging molten substance, if required. At the end opposite to the inlet for hydrocarbon extends the dome 4, having a cross section which is small compared with the surface which the molten mass presents to the hydrocarbon on its way from the inlet 2 to the dome 4. The dome 4 has a vapor exit 41. This vapor exit is connected to condensing or dephlegmating apparatus of known or suitable construction, not shown in the drawing. When no hydrocarbon passes, the level of the lead or other substance is such that the tubular system is entirely filled with lead and the latter extends for a short distance into the dome. When hydrocarbon is fed into the apparatus in liquid or vaporized condition, the lead is set into a violent motion and circulates through the system in the direction 11, 13, 12, 14. The hydrocarbon is brought to a cracking temperature by contact with the heated mass and cracked. When no liquid residue remains, the apparatus according to Fig. 1 is used, and the vaporized hydrocarbons carrying with them any carbon which may be present in the form of a fine dust, pass away through the exit 41.

When a liquid residue is formed the apparatus according to Fig. 5 is preferably used, said figure representing the apparatus shown in Fig. 1 combined with that illustrated in Figs. 2–4. In Figs. 2–4, the numerals with the prime marks applied thereto indicate the same parts as the corresponding numerals in Fig. 1 without the prime marks, and the dome 4′ has two baffle plates 42 and 43 at right angles to each other, baffle 42 standing in the path of the vapor and extending from about one inch beneath the surface of the molten mass to far into the dome, and baffle 43 extending parallel to the flow of liquid to nearly the end of the tubular system. This baffle 43 extends to the bottom of the apparatus and constitutes the side wall of the dome proper, except for the space *a—b—c—d* between said baffle and the end wall 431 of the dome. The dome has further a lateral extension 44 with a discharge aperture 45 for the liquid residue, said extension being placed against the baffle 43 and extending to the wall 431. The baffles 42 and 43 form two of the walls of a chamber 46 behind the baffle 43. The rising vapors give a violent motion to the lead covered with residue in the part of the dome before the baffle 42. The residue passes to the chamber 46 under the baffle 42. By the violent motion of the molten mass the residue is intermittently introduced into the chamber 46 passing beneath the lower edge of baffle 42. In chamber 46 the residue begins to settle and flows around baffle 43 into the chamber 44, from which it is discharged in a continuous stream by the aperture 45 into a goose-neck 451.

In Fig. 5, the exit 41′ of the primary cracking apparatus is connected by a conduit P to the inlet 2 of the main or secondary cracking apparatus. Heated crude hydrocarbon oil is charged at 2′ into the primary cracking apparatus, and separated therein into a liquid residue which is discharged at 45 and a gaseous portion which passes through the exit 41′ and the conduit P to the inlet 2 of the main or secondary apparatus. The vapors are cracked in the latter apparatus and are discharged in cracked condition by the outlet 41, carrying with them any carbon formed and leaving no residue.

In order to avoid too large vapor bubbles being formed, the upper wall of such containers may be provided with plates, baffles or the like, in order to break up such bubbles and if desired, to increase the length of their path.

If desired, steam, hydrogen or other gases may be introduced at the same time with the hydrocarbon oil or vapors, in order to promote the cracking or to obtain more saturated cracking products.

What I claim is:

1. A process for cracking hydrocarbons, comprising the steps of passing the hydrocarbons in an extended and substantially horizontal path through a molten mass composed of lead with a top layer of zinc chloride which is heated to cracking temperature and which has only a small free surface; and withdrawing the hydrocarbon vapors escaping at such surface, and the carbon carried in suspension therein, so as to avoid the formation of a residue on said surface.

2. A process for cracking hydrocarbons, comprising the steps of passing a heavy hydrocarbon oil through a molten mass having only a small free surface, so as to decompose said oil into a heavy liquid residue which collects at such surface and takes up the carbon formed, and a vaporized fraction; withdrawing said residue from the apparatus; passing such a vaporized fraction in an extended and substantially horizontal path through a second molten mass which is heated to cracking temperature and which has only a small free surface, so as to subject said fraction to a further cracking action; and withdrawing the cracked vapors escaping at the free surface of the second molten mass and the carbon carried in suspension therein, so as to avoid the formation of a residue on said surface.

3. Apparatus for cracking hydrocarbons comprising a substantially horizontal container adapted to be entirely filled with a molten substance, said container being provided at one end with an inlet for hydrocarbons and at the other end with a dome of small section at the level of the molten substance and having a vapor exit.

4. Apparatus for cracking hydrocarbons comprising a substantially horizontal tubular container provided at one end with an inlet for hydrocarbons and at the other end with a dome having a vapor exit, and a second tubular container extending beneath the first container and connected to the same at opposite ends, both containers adapted to be entirely filled with a molten substance which can circulate through the containers.

5. Apparatus according to claim 4 in which means are provided for charging and discharging molten substance into and from the tubular system.

6. Apparatus for cracking hydrocarbon oils comprising a substantially horizontal container provided at one end with an inlet for hydrocarbons and at the other end with a dome, having a vapor exit, and vertical partitions in the dome disposed in the path of the vapors at right angles to each other, said dome having a residue exit in that part thereof which is protected by the partitions against the turbulent movement caused by the passing vapors.

In testimony whereof I affix my signature.

HERMANUS JOHANNUS JANSEN.