J. NELSON.

PROCESS FOR THE CRACKING OF HYDROCARBON OILS AND THE LIKE.

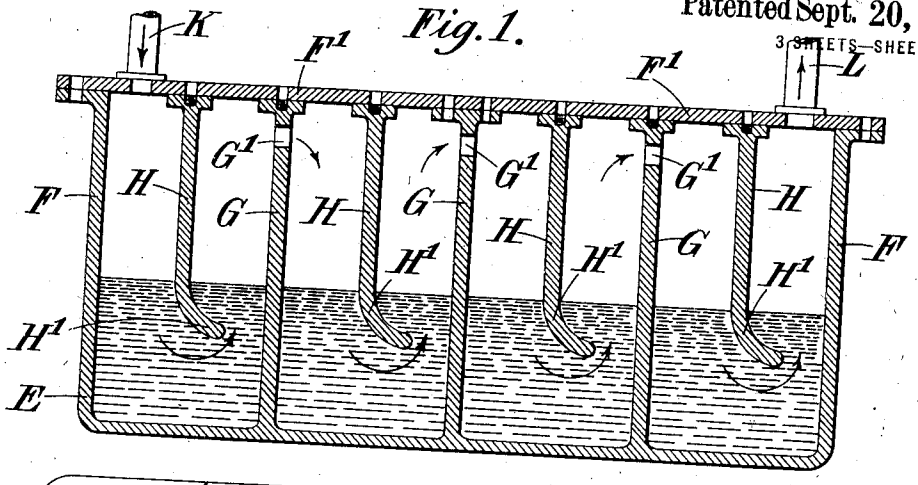
APPLICATION FILED OCT. 27, 1919.

1,391,568.

Patented Sept. 20, 1921.

3 SHEETS—SHEET 1.

Fig. 1.



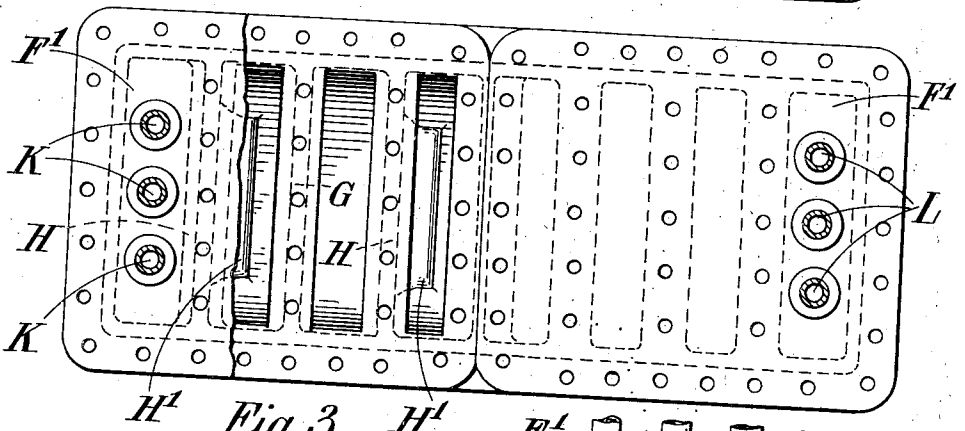


Fig. 3.

Fig. 7.

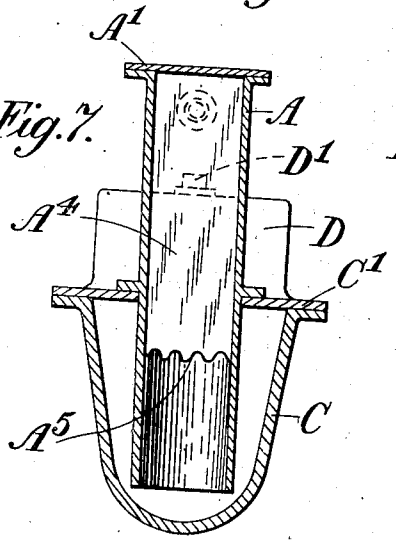
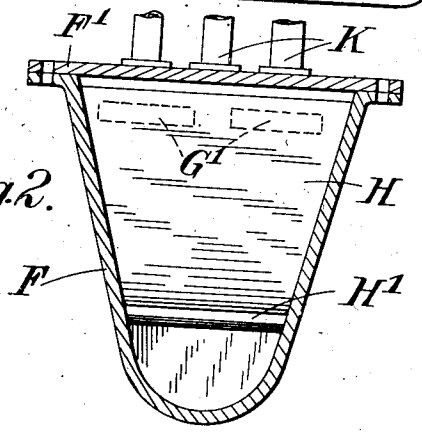


Fig. 2.



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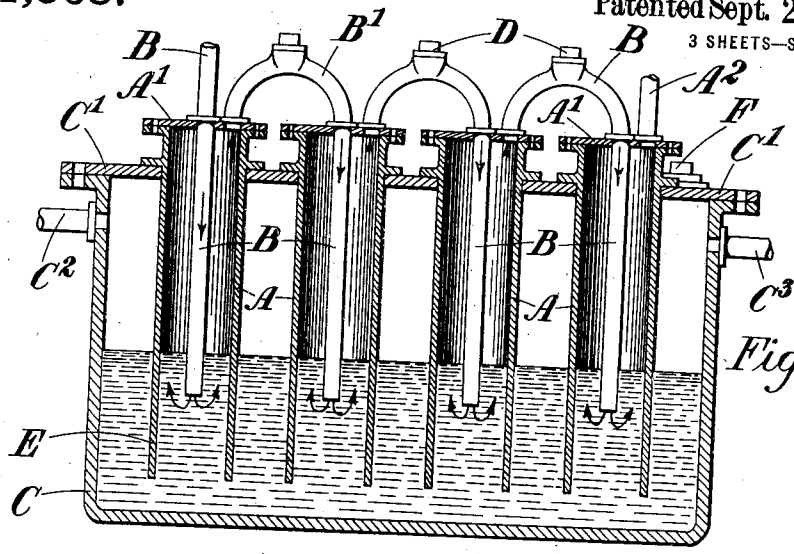

Fig. 4.

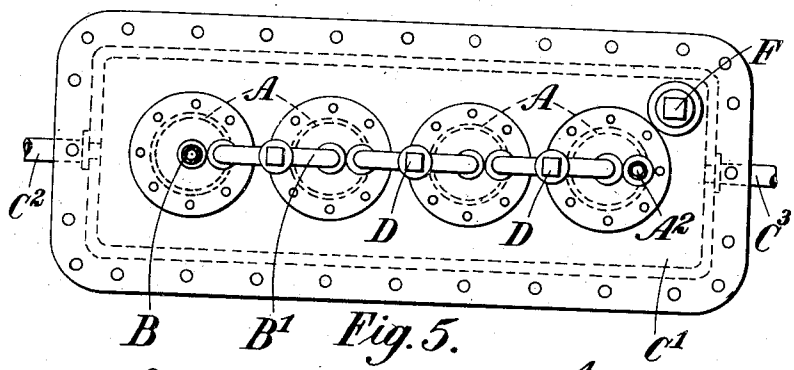

Fig. 5.

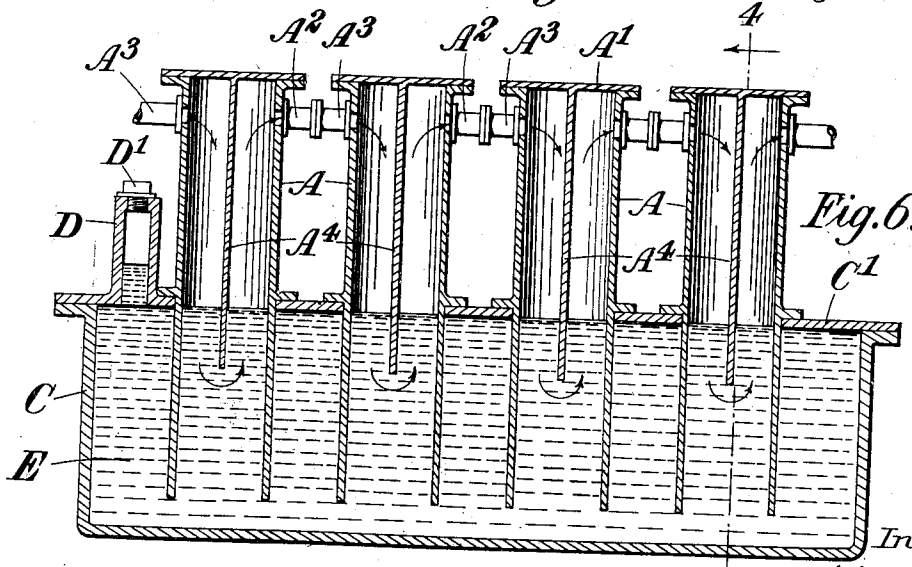

Fig. 6.

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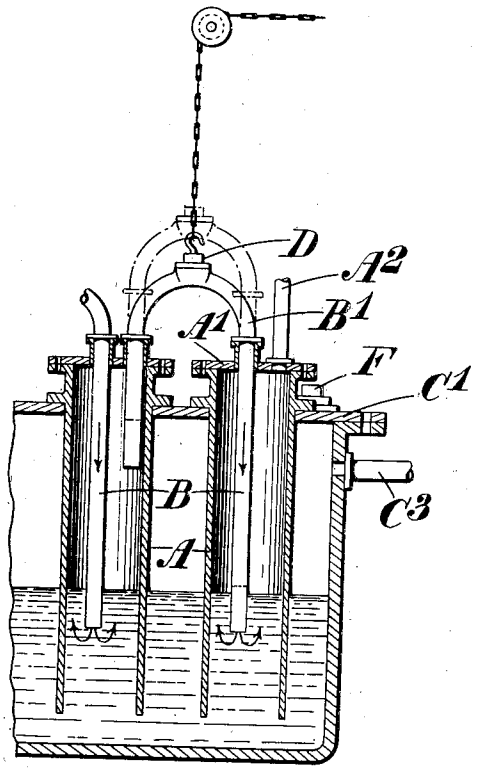
3 SHEETS—SHEET 3.

Fig. 8.



Inventor.
John Nelson
by Bakewell, Byrnes & Parmele
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UNITED STATES PATENT OFFICE.

JOHN NELSON, OF GLASGOW, SCOTLAND.

PROCESS FOR THE CRACKING OF HYDROCARBON OILS AND THE LIKE.

1,391,568. Specification of Letters Patent. Patented Sept. 20, 1921.

Original application filed March 2, 1918, Serial No. 219,950. Divided and this application filed October 27, 1919. Serial No. 333,733.

To all whom it may concern:

Be it known that I, JOHN NELSON, a subject of the King of England, residing in Glasgow, Scotland, have invented certain new and useful Improvements in a Process for the Cracking of Hydrocarbon Oils and the like, (for which I have filed applications in Great Britain, No. 116,304, filed March 13, 1917; Australia, No. 6,800, filed March 13, 1918; New Zealand, No. 39,823, filed February 15, 1918; India, No. 3,555/18, filed February 21, 1918; France, No. 489,142, filed March 6, 1918; Italy, No. 483/49, filed February 28. 1918; Spain, No. 66,395, filed February 16, 1918; Portugal & Cols., No. 10,331, filed February 22, 1918; Roumania, No. 4,643, filed March 15, 1919; Argentina, No. 14,921 filed April 22, 1918; Chile, No. 3,751, filed June 15, 1918; Uruguay, No. 942, filed April 12, 1918; Mexico, No. 17,244, filed April 8, 1918; Venezuela, No. 390, filed April 8, 1918; Cuba, No. 3,128, filed April 8, 1918; Trinidad, No. 3 of 1918, filed March 20, 1918; China, No. 18,025, filed April 12, 1918; Cairo, Egypt, No. 80/43 A. J., filed May 3, 1918; Alexandria, Egypt, No. 174,-314, vol. 24, filed May 18, 1918; Mansourah, Egypt, No. 13/43 A. J., filed May 23, 1918; Newfoundland, No. 264, dated June 1, 1918; Brit. N. Borneo, No. 111, filed June 6, 1918; South Africa, No. 179/18, filed March 22, 1918; Rhodesia, No. 1,368, filed March 27, 1918; Mysore, No. 6 of 1918–19, filed Dec. 3, 1918; Japan, No. 37,046, filed Mar. 8, 1918; Belgium, No. 20,893, filed Feb. 28, 1918; Hungary, No. 3,039, filed Mar. 12, 1918; Holland, No. 9,570, filed March 11, 1918; Germany, No. 17,215, filed March 12, 1918; Austria, No. 1,283, filed March 6, 1918; Brazil, filed Dec. 4, 1918; Canada, No. 218,-559, filed March 6, 1918,) of which the following is a specification.

This invention relates to an improved process for cracking hydrocarbon oils and the like by means of a liquid contact substance, and has been divided out from my application Serial Number 219,950, filed March 2nd, 1918, of which the subject is an apparatus suitable for carrying the process herein described into effect.

According to this invention the improved process for the cracking of hydrocarbon oils and the like by the aid of a liquid contact-substance, such, for example, as molten lead, is characterized by submitting the oil to the action of the contact-substance in a series of steps, each period of contact being of short duration. The temperature may be the same for each period of contact, or a decreasing temperature may be employed. The contact material is agitated during the treatment, as, for example, by the passage of the hydrocarbon vapors or gases. If the oil to be cracked contains tarry matters, or other objectionable products which cannot be eliminated during the cracking process, the oil may be distilled from an auxiliary vessel and the distillate or vapors subjected to the cracking operation.

The extent of the cracking may be varied within certain limits by varying the depth at which the hydrocarbon or its vapors are delivered beneath the surface of the contact-substance, and by the number of contact periods. As one object of the invention is to reduce the deposition of carbonaceous matter, it is material to avoid subjecting the oil or its vapors to the cracking temperature in constricted channels. The apparatus herein described and forming the subject of the application above referred to affords special provision against this, as well as providing for the operation of the process herein set forth.

The selection of the liquid substance to be used depends, among other considerations, upon the working temperature required. In operating at moderate temperatures (such as are employed in the production of volatile spirits for use in petrol engines) it is preferred to use a bath of molten lead as the contact-substance, and to pass the hydrocarbon or its vapors into the bath at a suitable distance below its surface. The gases and vapors passing through the liquid metal keep it agitated; local accumulation of carbonaceous matter is prevented, and the maintenance of a uniform temperature in the contact-substance is facilitated.

If temperatures exceeding those at which lead can be satisfactorily employed are required metals or alloys of higher melting point than lead may be used.

It will be understood that the liquid contact-substance comes directly into contact with the hydrocarbon itself and is not used merely as a means for the external heating of the contact-chamber. The cracking takes place solely in contact with the molten metal, or substantially so.

It has been found that if the treatment of the oil be carried out in a series of steps as

described, each step being of comparatively short duration, a much more satisfactory conversion of the oil can be effected than by a long contact at one operation. It is to be understood, however, that the total period of contact between the oil and the contact-substance is not necessarily short; it may be prolonged as desired to secure the maximum degree of conversion under the particular conditions of working; it is each step of contact which is short.

As the time during which the hydrocarbon and its product remain in contact with the hot liquid substance is brief, the whole product or any desired fraction thereof may be subjected to one or more re-treatments; for example the heavier fraction, condensed out of the hot vapors by means of a dephlegmator in the known manner, may be thus re-treated.

My invention will be better understood by reference to the attached drawings, forming a part thereof, and in which:

Figure 1 shows diagrammatically a sectional elevation of apparatus for carrying out the invention;

Fig. 2 shows a cross section of the device of Fig. 1;

Fig. 3 shows a plan view of the device of Fig. 1;

Figs. 4 and 5 show a sectional elevation and plan view, respectively, of a modified apparatus;

Figs. 6 and 7 show sectional elevation and cross sectional views, respectively, of a further modified apparatus; and

Fig. 8 shows a cross sectional view of an arrangement similar to that shown in Figs. 4 and 5.

Various forms of apparatus may be used for carrying out the process. One form consists of a covered horizontal tank set in a furnace and containing a quantity of the liquid contact substance. The tank is provided with oil-inlet and vapor-outlet pipes and with a series of internal vertical partitions so arranged that the hydrocarbon vapors are caused to flow alternately up over or down under the partitions and thus to bubble up through the liquid contact substance in the alternate compartments. To insure a steady flow of the vapors, the lower edges of the alternate partitions may be serrated or provided with perforations for breaking up the vapors into small streams.

A preferred apparatus of this type is shown diagrammatically in sectional elevation, cross-section, and plan respectively in Figs. 1, 2 and 3 of the accompanying drawings. The covered horizontal tank F, which is of V-shaped cross-section and into which the oil is fed under pressure through the inlet pipes K, contains the liquid contact substance E, for example, molten lead, and is provided with vapor-outlet pipes L. The tank is divided into a series of compartments (of which four are shown in the drawing) by transverse partitions G having ports G^1 at the upper part for the passage of the hydrocarbon vapors, and these compartments are further divided by a series of depending partitions H, the lower parts of which are curved and immersed to a suitable depth in the molten lead as shown. The hydrocarbon vapors are by this arrangement caused to pass through the apparatus in the direction shown by the arrows and are subjected repeatedly to the action of the molten lead. The V-shaped cross-section of the tank is specially advantageous when two or more such units are mounted side by side in one furnace.

Figs. 4 and 5 show, in sectional elevation and plan respectively, a modified arrangement in which the horizontal tank C, which is preferably of V-shaped cross-section, is provided with a series of vertical cylindrical chambers A, open at their lower ends and extending downward through the cover C^1 nearly to the bottom of the molten lead E contained in the tank. Each cylinder is closed at the top by a cover A^1 fitted with a vertically adjustable oil or vapor-inlet pipe B, which extends downward into the molten lead, and a vapor outlet pipe B^1 which connects with the inlet pipe of the adjacent chamber. Inspection plugs D are provided in the pipes B^1. The quantity of lead in the tank, and the depths to which the cylinders A and inlet pipes B are respectively immersed in the lead, must be so adjusted as to insure that the hydrocarbon vapors flow in succession from cylinder to cylinder through the connecting pipes B^1, and pass out by the outlet pipe A^2, as indicated diagrammatically by the arrows, and do not escape beneath the lower edges of any of the cylinders. A filling plug F for the molten lead is provided in the cover of the tank. To prevent oxidation of the lead, atmospheric air may be expelled from the tank by means of a reducing or indifferent gas or vapor; for example by introducing hydrocarbon oil or vapor through the inlet C^2 and driving out the air through the outlet C^3. Dephlegmators may be interposed between the cylindrical chambers.

Figs. 6 and 7 show, in sectional elevation and cross-section respectively, a modified arrangement in which the molten lead completely fills the covered tank C, and the vertical cylinders A, which are closed at their upper ends by the covers A^1, are connected by means of vapor pipes A^2, A^3, and provided internally with vertical partitions A^4 which extend downward for a short distance into the molten lead. The cylinders A extend downward nearly to the bottom of the lead. The depths to which the cylinders A and partitions A^4 are respectively immersed

in the lead must be so chosen as to insure that the hydrocarbon vapors flow through the apparatus as indicated diagrammatically by the arrows. The lower edges A^5 of the partitions may be serrated as shown in Fig. 7. A chamber D, formed in the cover C^1 and communicating with the interior of the tank C, provides space for the expansion and contraction of the molten metal while minimizing the risk of oxidation thereof. A plug D^1 gives access to the chamber for inspection or filling purposes.

It will be obvious that the apparatus shown in Figs. 4 and 5 may be modified by substituting, for the form of tank therein shown, a tank completely filled with the liquid contact substance as indicated in Figs. 6 and 7.

Fig. 8 shows a cross sectional view of an arrangement similar to that shown in Figs. 4 and 5, and in which means are provided for adjusting the position of the inlet pipe B so as to vary the extent of cracking by varying the depth at which the hydrocarbon is introduced beneath the surface of the contact substance.

The apparatus must in all cases be free from constrictions, interstices, or long channels of small cross-section, capable of being obstructed by carbonaceous deposits, at parts where high temperatures are reached.

What I claim as my invention and desire to secure by Letters Patent is:—

1. The herein described process for cracking hydrocarbon oils and the like, which comprises introducing the hydrocarbon into a liquid contact substance in successive steps of brief contact period.

2. The herein described process for cracking hydrocarbon oils and the like, which comprises introducing the hydrocarbon into a liquid metal contact substance in successive steps of brief contact period.

3. The herein described process for cracking hydrocarbon oils and the like, which comprises introducing the hydrocarbon into molten lead in successive steps of brief contact period.

4. The herein described process for cracking hydrocarbon oils and the like, which comprises introducing the vaporized hydrocarbon into a liquid contact substance in successive steps of brief contact period.

5. The herein described process for cracking hydrocarbon oils and the like, which comprises distilling the oil, and introducing the distillation products into a liquid contact substance in successive steps of brief contact period.

6. The herein described process for cracking hydrocarbon oils and the like, which comprises introducing the hydrocarbon into a liquid contact substance in successive steps of brief contact period, and varying the extent of cracking by varying the depth at which the hydrocarbon is introduced beneath the surface of the contact substance.

In testimony whereof I affix my signature.

JNO. NELSON.