Dec. 5, 1944. M. H. TUTTLE 2,364,492

METHOD OF COKING AND CRACKING PETROLEUM RESIDUES OR THE LIKE

Filed May 31, 1941 2 Sheets-Sheet 1

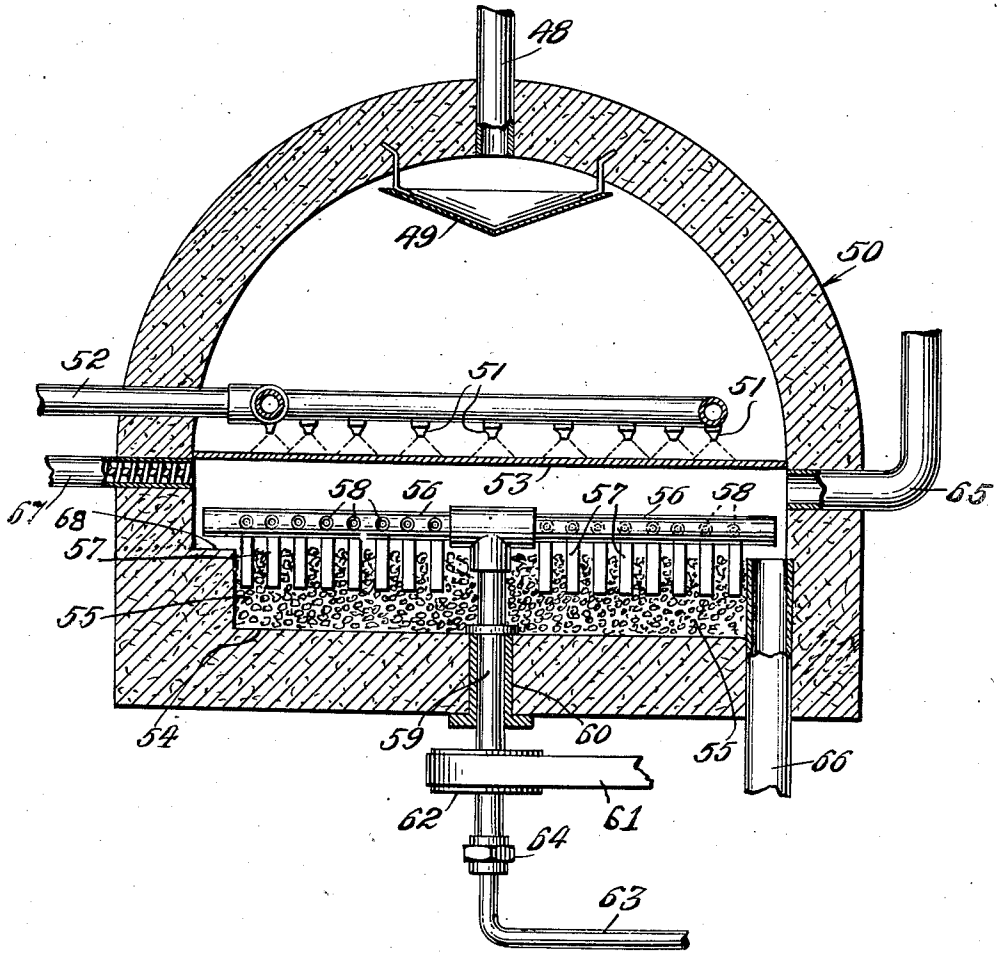


Fig. 1.

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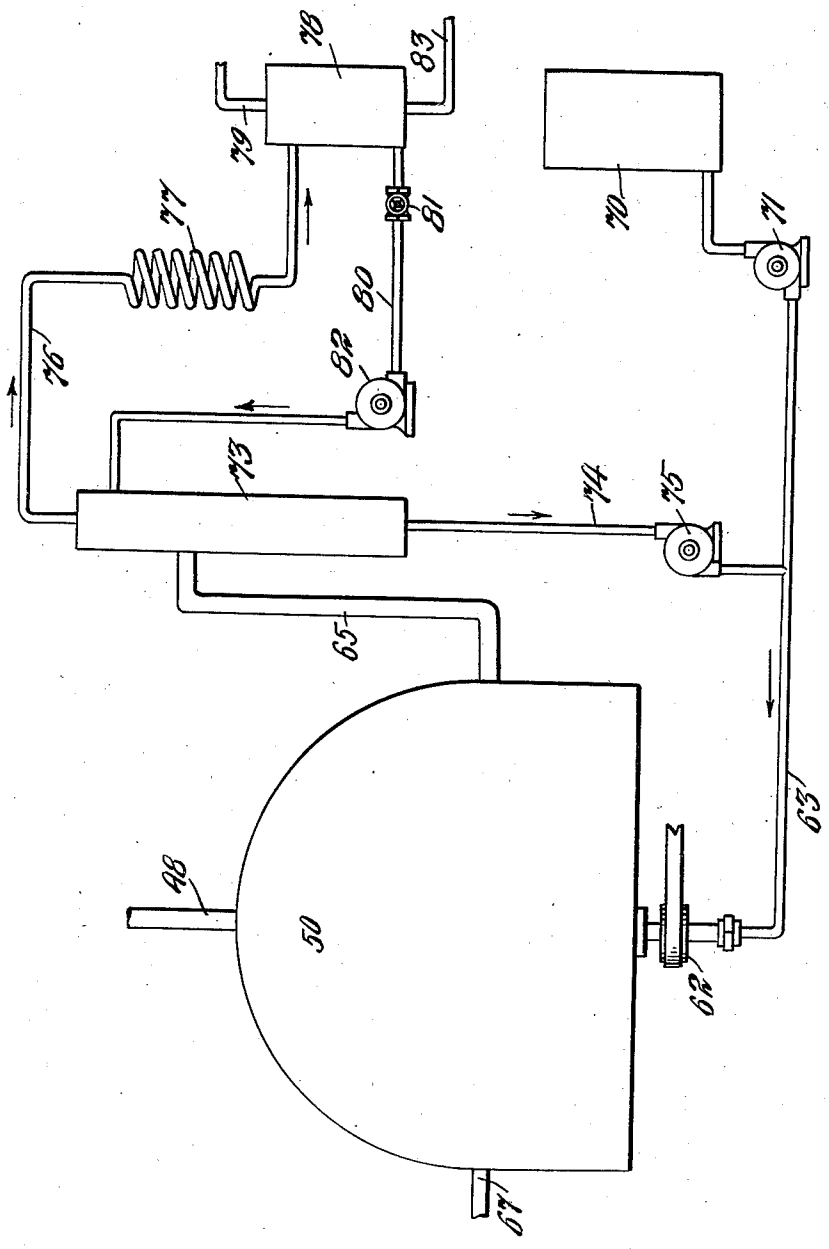


Fig. 2.

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METHOD OF COKING AND CRACKING PETROLEUM RESIDUES OR THE LIKE

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Application May 31, 1941, Serial No. 396,020

3 Claims. (Cl. 196—61)

This invention relates to a method of coking and cracking petroleum residues or the like.

It has heretofore been proposed to spray petroleum residues onto a bed of coke which rests on the floor of a still and which is heated from below. Among the disadvantages of this method is the need for interrupting operations from time to time in order to remove the resulting mass of material.

In U. S. Patent No. 2,314,112, issued March 16, 1943, on my copending application Serial No. 394,658, filed May 22, 1941, there is shown and described in connection with Fig. 1 a method in which granular material is preheated and is fed onto a bed onto which petroleum residue is sprayed. Although that method is entirely satisfactory in many respects it has certain disadvantages. For example, the rate of feed of petroleum depends on the temperature and the amount of the preheated granular material supplied. Moreover, it is difficult to maintain constant operating conditions.

My invention provides a method which avoids the foregoing disadvantages. According to the preferred mode of practising my invention, a bed of loose granular coke is maintained in a retort and is heated to high temperature by radiant heat directed onto the bed from above. The bed is rabbled and petroleum residue is distributed over the hot rabbled surface at such a rate that no substantial amount of liquid accumulates in the bed. I have found that as the petroleum is coked small particles of coke form and these particles gradually build up to larger and larger sizes. By continuously feeding the petroleum to the bed and rabbling the surface (preferably in the manner described in the above-identified patent), the larger particles work toward the top and can be continuously discharged from the top of the bed, so that it is unnecessary to feed in any granular material. In this way it is possible to maintain the bed practically constant while coke and hydrocarbon vapors are continuously withdrawn.

I have found that the vapors produced from the petroleum can be cracked adjacent the top of the bed at the high temperatures employed. The cracking is facilitated by providing an open space between the top of the bed and the radiant heating surface.

My present method lends itself to particularly close control of the temperature conditions in the retort. Moreover, by applying the heat directly to the top of the bed, the petroleum strikes the hottest part of the bed and is coked practically as soon as it strikes the bed. Thus the rate of feed of the petroleum becomes practically independent of the speed of rabbling. Tars which have heretofore been considered of little value can be decomposed by my method into dry coke and a distillate which is rich in aromatic hydrocarbons.

Other features, objects and advantages of the present invention will in part become apparent and in part be pointed out in connection with the following detailed description of one preferred mode of practising the invention, reference being had to the accompanying drawings wherein:

Fig. 1 is a central vertical section through a retort suitable for carrying out the present method; and

Fig. 2 is a diagrammatic flow sheet illustrating one mode of recovering the vapors produced in the retort in accordance with the invention.

In Fig. 1 there is shown a circular retort 50 constructed of refractory material and divided into upper and lower portions by a metal partition 53. Within the upper portion there are burners 51 to which gas is supplied by a pipe 52. These burners are arranged in a ring and direct their heat onto the metal partition so as to uniformly heat the upper surface of a stationary bed of granular material 55 supported on the floor 54 of the retort. The products of combustion are withdrawn around a baffle 49 and through an exhaust stack 48.

A pair of hollow rotating arms 56 are provided with fingers 57 for rabbling the surface of the bed and with ports 58 for feeding petroleum residues or the like onto the top of the granular material. These ports are arranged in the rear sides of the arms 56 so that the petroleum is fed in back of the fingers 57, that is to the portions of the surface of the bed which have just been rabbled. The rabbling is preferably conducted as described in the above-identified patent. That is to say, the fingers 57 preferably extend into the bed to a depth greater than the depth to which wet petroleum penetrates. The rate of rotation of the rabble arms and the rate of feed of the petroleum are preferably such that the petroleum on each portion of the bed is dry before that portion of the bed is again rabbled. The arms 56 are mounted on a hollow shaft 59 which is journaled in a suitable bearing 60. The shaft is connected to a supply pipe 63 through a coupling 64, and is rotated in any convenient manner, for instance by means of a belt 61 and pulley 62.

In the bottom of the retort a circular shelf 68 is provided adjacent the wall of the retort. The top of this shelf lies just beneath the ends of

the rabble arms 56 which extend over the shelf. At one side of the retort an outlet pipe 66 is set into the shelf so that the top of the pipe is flush with the top of the shelf. As the relatively large particles of coke rise to the top of the bed they are thus discharged from the outlet pipe 66. The apparatus thus serves as a classifier. A conduit 65 is provided for withdrawing the vapors produced.

In conducting my method, I prefer to maintain the top of the bed at a temperature in the order of 1400° F. to 1600° F. By operating at such high temperatures, and by feeding the petroleum so that no substantial amount of liquid can accumulate in the bed, rapid coking is achieved. In carrying out my method, it is possible to make coke particles of pea size which can be continuously discharged from the retort, and which are substantially free from constituents which are extractible by naphtha or volatile when the particles are heated up to 1000° F.

It will be understood that the petroleum which is fed through the line 63 may be preheated to any desired temperature, such as 750° F., below that at which coking is initiated. I have found that the method can be carried out to good advantage by controlling the rate of feed of the petroleum and by controlling the temperatures used so that no solid coke need be introduced into the apparatus, the coke-coated product being withdrawn at a rate such that the bed of granular material in the retort remains substantially constant. It might be supposed that after operating in this manner for a considerable length of time the individual granules would tend to grow excessively large by the deposition of coke on them. I have found that when the surface of the bed is rabbled as described this is not the case, but that operations can be continued indefinitely without introducing additional granular material.

In case it is desired to introduce granular coke this may be fed into the retort by means of a worm 67. Part of the coke withdrawn at 66 may be recycled in this way. I have found that some types of coal which cannot be coked in the ordinary coking stills can be coked when mixed with petroleum and heated according to my present method. Such coals can be introduced in the form of small lumps by the worm 67. Also, they may be premixed with petroleum before being fed into the retort.

In the flow sheet, Fig. 2, there is indicated a system for coking petroleum residues and handling the vapors produced. Petroleum residue is preheated in a suitable vessel 70. Heat for this purpose may be obtained from the exhaust gases from the stack 48. The warm petroleum residue is then fed by a pump 71 through pipe 63 and thence into the retort as previously described. The vapors from pipe 65 are led through line 73 into a dephlegmator where any volatilized tar is condensed and recycled through line 74 and pump 75 into the line 63, where it mixes with the charging stock.

The vapors and fixed gases are passed from the dephlegmator 73 through line 76 and thence into a condenser 77. The condensed liquid and fixed gases are then passed into a separator 78 from which the fixed gases are exhausted through line 79. The condensate may be passed to storage through line 83, or a portion of it may be recycled into the dephlegmator through line 80 under control of valve 81 and pump 82.

Although granular coke is preferably used in starting up, it will be understood that other granular materials may be employed. After the method has been in operation for some time, the bed will consist of practically pure coke, unless other granular material is fed into the retort.

When the term "granular" is used herein, it means hard grains but does not mean that these grains must be very small. In the preferred practice of the present method the particles of coke are initially very small, when they are formed from petroleum residue, and grow to pea size or larger before they are discharged from the retort. Excessively large lumps are not desirable at the top of the bed inasmuch as they do not present as much surface to the liquid as do relatively small grains.

The present invention has been described in connection with the treatment of petroleum residues, but it may be applied to the coking of other tarry materials such as, for example, tars from solvent extraction processes, such as "Duo Sol," pressure tars, coal tars, and the like, which are adapted to be separated by heat into coke and vapors. Indeed, it is particularly adapted for treating low grade tars whatever their source. For simplicity, the term "tar" as used in the claims includes such materials whether obtained from petroleum or from other sources. The term "granular material" as used in the claims means any sort of sub-divided nuclei which are equivalent to coke or ground bauxite for the purposes mentioned.

The terms and expressions which have been employed are used as terms of description and not of limitation, and there is no intention, in the use of such terms and expressions, of excluding any equivalents of the features shown and described, or portions thereof, but it is recognized that various modifications are possible within the scope of the invention claimed.

What I claim is:

1. Method of coking tar which comprises maintaining a bed of loose granular material, continuously feeding tar to the top of the bed, maintaining a substantially constant temperature in the top of bed by radiant heat directed onto the bed through a partition above and parallel to the bed, cracking the vapors produced in a space between the bed and the partition, and withdrawing coke and vapors from the bed substantially at the same rate as produced.

2. Method of coking tar which comprises maintaining a stationary bed of granular coke, rabbling successive portions of the bed, directing radiant heat onto the top of the bed from above, and feeding tar to successive portions of the bed after they have been rabbled.

3. Method of coking tar which comprises maintaining a stationary, substantially constant bed of granular material, rabbling the bed, distributing tar over the freshly rabbled surface, and heating the bed in site by radiant heat applied from above.

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