

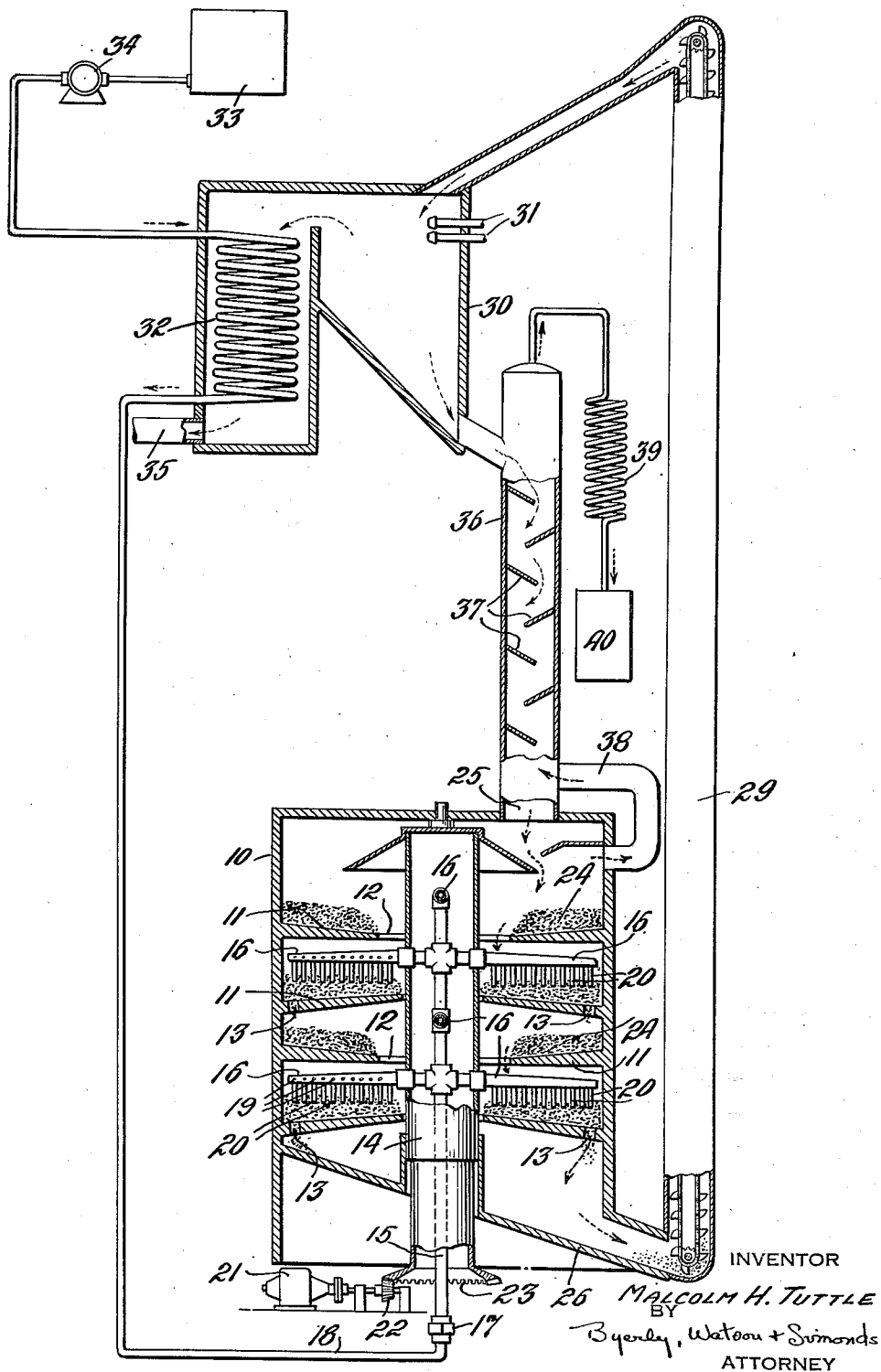
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METHOD OF CRACKING HYDROCARBON VAPORS

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METHOD OF CRACKING HYDROCARBON VAPORS

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4 Claims. (Cl. 196—52)

This invention relates to a method of cracking hydrocarbon vapors and producing such vapors from petroleum residues or the like.

It has heretofore been proposed to distill petroleum residues and then heat the resulting vapors to high temperature to cause cracking. One of the disadvantages of this method is that carbon forms on the heating surfaces of the cracking apparatus. Moreover, if the distillation is carried too far a crust of carbon builds up in the tubes or on the heating surfaces of the still. This crust is very hard to remove. If the distillation is not carried to completion there remains a heavy tar which is a by-product of low value.

In order to avoid the deposition of carbon in the cracking apparatus it has been proposed to pass the distilled vapors through a mass of catalytic material retained in a suitable cracking chamber. In this procedure, the effectiveness of the catalyst is continuously changing as the cracking operation continues. Hence, the rate of feed of the vapors must be varied to make the best use of the catalyst and after a time the catalyst must be reactivated. Although this procedure is an improvement over the previous method of cracking by heat alone, it does not obviate the aforementioned disadvantage in the distillation step.

In accordance with the invention, petroleum residues or tars are sprayed onto loose, granular material heated to the proper temperature, and the resulting vapors are then passed counter-current to a stream of the hot granular material. The hot granular material which serves to heat and crack the vapors in this second stage is then used as a medium on which the petroleum residue or the like is deposited in the first stage in order to distill off vapors and convert the rest of the petroleum residue to coke. In order to reheat and revivify the catalyst the coke-coated catalyst is withdrawn from the coking stage and is burned in a suitable furnace, the hot gases from the furnace being used to preheat the petroleum residue which is fed to the coking stage. In this way, the effectiveness of the catalyst remains constant during the cracking operation, the cracking and coking are carried on continuously, and efficient use is made of the heat contained in the granular material.

Other features, objects and advantages of the invention will be pointed out or become apparent in connection with the following detailed description of one mode of practicing the invention. A form of apparatus suitable for carrying out the

method is illustrated diagrammatically in the accompanying drawing.

In the drawing there is shown at 10 a still which includes a number of shelves 11 having openings 12, 13 disposed alternately near the center and near the outside wall of the still. In the center of the still there is a rotating housing 14 in which is mounted a pipe 15 carrying horizontal arms 16. The pipe 15 is connected through a suitable coupling 17 to a pipe 18 through which petroleum residues or tars are supplied. The arms 16 are adapted to spray petroleum residues through ports 19 in the rear faces of the arms as they rotate (in a clockwise direction, looking down). The arms 16 also serve as rabble arms, and for this purpose are provided with projections or teeth 20 which agitate the granular material and thus prevent the particles from sticking together. This raking action rearranges the particles so as to obtain maximum surface contact with the tar. The member 14 and arms 16 may be rotated in any convenient manner, for instance by means of a motor 21 and bevel gearing 22, 23.

Granular material 24 is introduced into the still 10 through an opening 25 in the top. This granular material falls onto the upper hearth of the still and is agitated by the rabble arms 16, which feed it continuously toward the central opening 12 in this hearth, and thence along the other hearths of the furnace. The petroleum residue or the like is sprayed onto the granular material which is hot, preferably between 900° and 1400° F. The heat thus transferred to the petroleum residue or the like converts it into vapors and coke. Reference is made to my co-pending application Serial No. 394,658, filed May 22, 1941, now U. S. Patent No. 2,314,112, issued March 16, 1943, for further details in regard to the coking stage.

The granular material coated with coke drops from the last hearth onto the inclined bottom 26 of the furnace 10. It is then conveyed by any suitable device, such as a bucket elevator 29, into a furnace 30 to which air is admitted through tuyeres 31. The coke is thus burned off the granular material as in a powdered coal furnace. The hot gases from this furnace may be passed through a tube still 32 in which the petroleum residue, passed from reservoir 33 by pump 34, is preheated. The hot gases then pass to the stack through a suitable outlet 35. The vapors from the top of the cracking tower 36 are passed through condenser 39 into receiver 40.

The granular material from which the coke has

been burned in the furnace 30 passes into the top of a tower 36 which is provided with suitable baffles 37, for causing the granular material to take a zigzag path through the tower. The vapors from the coking operation in the furnace 10 pass through an elbow 38 into the bottom of the tower 36, and thus rise countercurrent to the descending granular material in the tower. This granular material, as it enters the top of the tower, is so hot that it produces vapor phase cracking of the vapors ascending through the tower. Advantageously, the granular material is introduced at the top of the tower 36 at a temperature of about 1200°-1600° F., and enters the furnace 10 at a temperature of about 1000°-1400° F. If desired, heat from a suitable external source (not shown) may be added to the granular material while it rests on the shelves 11. The petroleum residue may be preheated in the tube still 32 to any desired temperature below coking temperature, for instance to 750° F. By thus correlating the temperature of the granular material which is introduced into the top of the tower 36 and the rate of vaporization in the still 10, both the coking and cracking operations can be carried out efficiently.

As the granular material for use in accordance with the present invention I prefer to employ an infusible catalytic material such as ground bauxite. It will be understood that other catalytic materials may be employed instead of bauxite; many such substances which have a catalytic effect in the cracking of petroleum hydrocarbons are known. In some cases, satisfactory results may be obtained by the use of inert granular material, such as sand or coke. In this case the temperature of the material in cracking stage should be about 250° F. higher than in the case where a catalytic substance is used. It is also possible to activate such inert materials by absorbing catalytic substances on their surfaces. When an incombustible granular material is employed the deposit of coke on this material results in a material which can be readily burned in ordinary powdered coal furnaces, additional heat being supplied if the coke deposit is insufficient, when burned, to raise the temperature of the granular material sufficiently for use in the cracking stage. When coke is used as the granular material it is only partially burned in furnace 30 and any excess not recycled may be withdrawn and sold as a by-product.

The term "granular," as used herein, does not mean that the particles are very fine, but includes material the particles of which range from pea size to 30-60 mesh. For the cracking step the smaller sizes are advantageous but I prefer to use larger sizes inasmuch as these are better adapted for use in the coking stage of my process. The term "tar," as used herein, includes petroleum residues, pressure tars, coal tars, and other similar liquid or liquefiable tarry materials which yield hydrocarbon vapors and coke on heating, whatever their source.

My process has a number of advantages: By passing the granular, heat-carrying material countercurrent to the vapors, the vapor phase cracking can be uniformly controlled. When a

catalyst is employed its effectiveness does not vary during its contact with the vapors. The process does not have to be interrupted to recondition the catalyst. By operating as described, the granular material may be employed at the desired high temperature during the vapor phase cracking, and the rate of flow may be adjusted so that the desired amount of heat is supplied to the liquid phase coking stage. In this manner, the temperatures in the liquid phase treatment can be controlled so that they are sufficiently high to coke the petroleum residue or the like.

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. The method of coking tar and cracking the hydrocarbon vapors produced which comprises continuously passing a granular heating medium countercurrent to such vapors, continuously passing the hot granular heating medium from the previous step onto a bed of such medium, spraying tar onto said bed, agitating the bed to keep it in loose condition, and passing the vapors produced from the tar to the first step recited.

2. Method of treating tar which comprises continuously advancing and agitating a bed of hot granular material, continuously depositing tar on said granular material to coke the tar and produce vapors, withdrawing coke-coated granular material thus produced and burning same, and continuously passing said vapors countercurrent to the thus heated granular material prior to depositing the tar thereon.

3. Method of treating tar which comprises depositing the tar on hot granular catalytic material whereby part of the tar is converted to vapors and part to coke, rabbling the bed to keep it in loose condition, withdrawing catalytic material coated with coke, burning the coke off said material, using the hot gases produced in the burning operation to preheat the tar, and passing the hot catalytic material countercurrent to the vapors from the coking operation prior to depositing tar on said catalytic material.

4. The method of coking tar and cracking the vapors thus produced in two stages which comprises heating granular catalytic material to a temperature sufficient to crack hydrocarbon vapors and well above the temperature necessary to coke tar, feeding said hot catalytic material in a continuous stream onto a bed containing similar material, depositing tar on the hot surface of said bed to convert the tar into vapors and coke, keeping the surface of the bed in a loose condition, cracking the vapors by passing them countercurrent to the stream of hot granular material, condensing the cracked vapors thus produced and withdrawing from the bed catalytic material coated with coke.

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