Dec. 14, 1954 J. M. BRADLEY 2,697,069

MANUFACTURE OF COKE FROM LIQUID HYDROCARBONS

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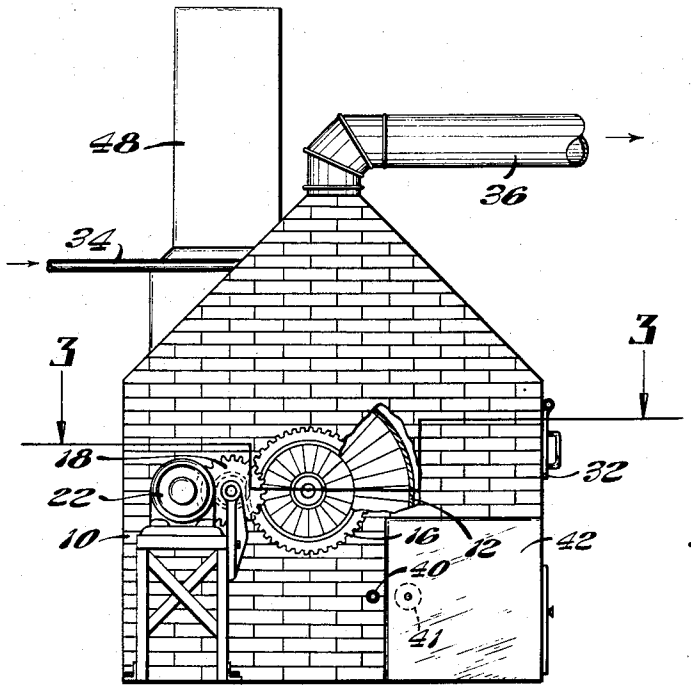


Fig. 1

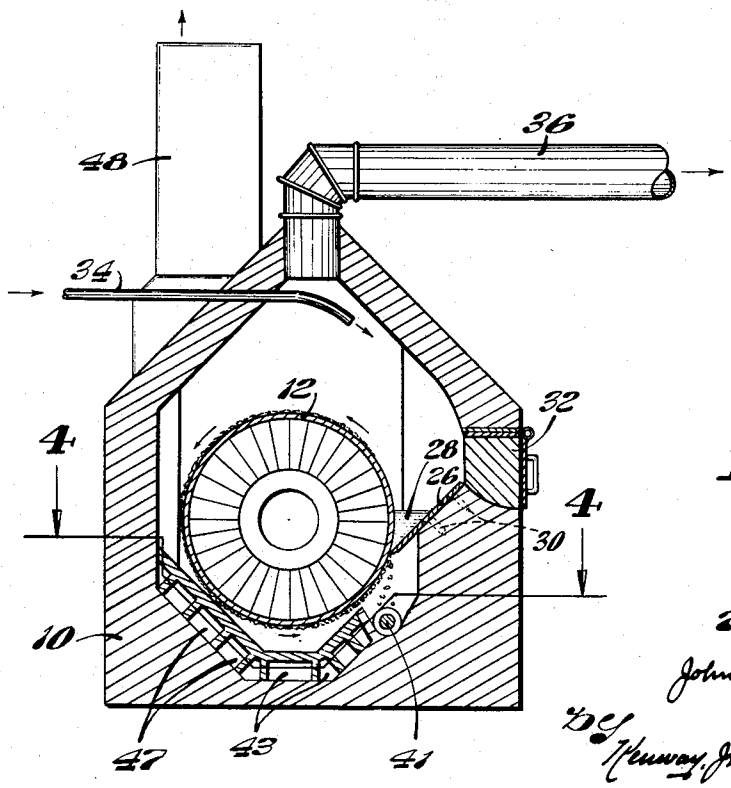


Fig. 2

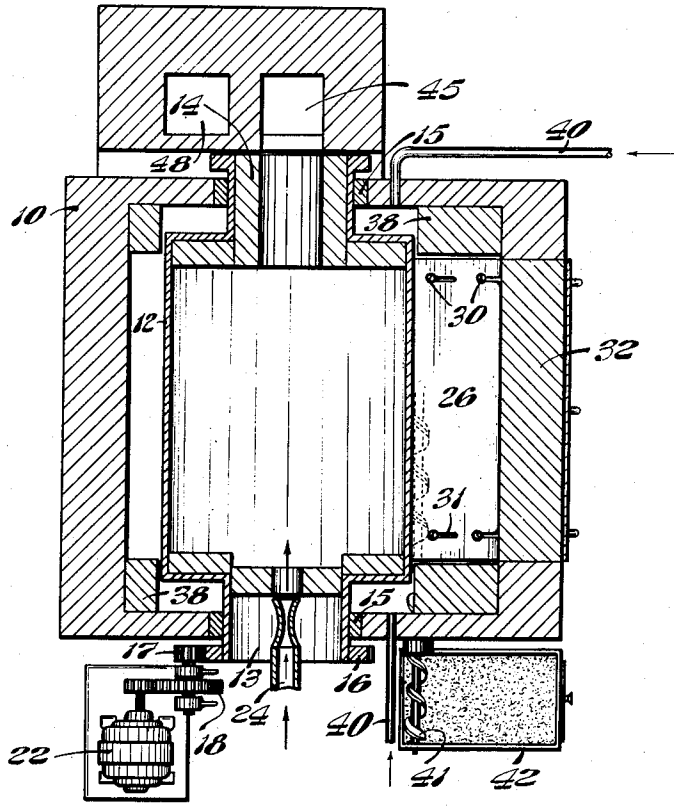
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Fig. 3



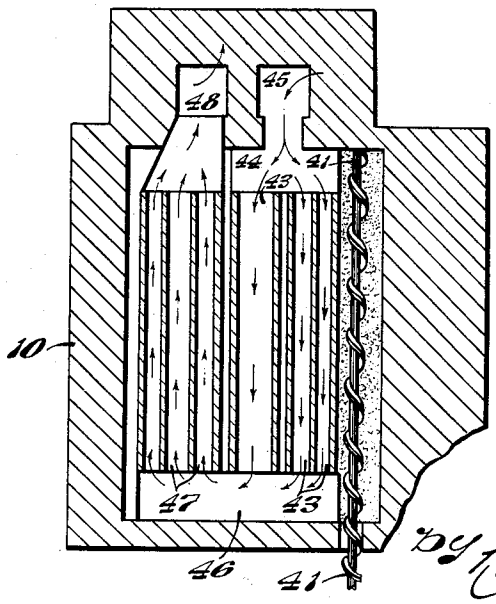


Fig. 4

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MANUFACTURE OF COKE FROM LIQUID HYDROCARBONS

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3 Claims. (Cl. 202—136)

This invention relates to the manufacture of coke from liquid hydrocarbons and comprises more particularly a new and improved process for producing such coke in a continuous operation. The invention includes within its scope novel apparatus for carrying out the said process.

At the present time, most petroleum, tar and pitch cokes are produced in the well-known broad oven process or by the delayed coker process. Both of these processes are batch processes which entail high operating costs and are objectionably wasteful of time.

There is a third process known as contact coking which is continuous but is not entirely satisfactory for several reasons. In contact coking, the raw hydrocarbon material is deposited upon particles of previously formed coke and is coked in a heated reaction chamber. Because the coke particles can hold only a thin layer of raw material, the coke builds up on the particles in very small increments so that the particles must be recirculated many times before any appreciable increase in volume is achieved.

It is an object of this invention to provide a continuous process for the production of coke from liquid hydrocarbons which is superior in efficiency and convenience to known processes and capable of producing coke more rapidly than has been heretofore possible.

It is a further object of this invention to provide improved apparatus suitable for carrying out the process of my invention.

The process of my invention is characterized by the steps of continuously depositing a thin coating of liquid hydrocarbon upon a moving surface, heating the coated surface while moving it through an atmosphere of inert gas thereby converting the liquid coating to a layer of solid coke, scraping the coke thus formed from the surface, and immediately recoating the surface. Preferably and as herein shown the surface employed may take the form of an endless band or cylinder and when this is the case this surface may be utilized to define in part a reservoir of liquid hydrocarbon from which the coating is drawn.

The best form of apparatus known to me for carrying out my novel process consists of an internally-heated drum mounted for rotation about its axis within a heat-insulated retort. Means are provided for depositing liquid carbonaceous raw material as a coating on the surface of the drum and for scraping off the coke product within the space of slightly less than a single revolution of the drum. Provision is also made for removing the coke and for recovering the fractions distilled from the liquid coating. Additionally, flues may be provided in the walls of the retort through which hot gases from the interior of the coking drum can be circulated to supply further heat externally to the coke layer on the drum. In the preferred embodiment of my invention the scraper blade may also serve as the bottom of the reservoir of liquid hydrocarbon.

In carrying out the process of my invention, the coking drum is heated to pyrolyzing temperature, preferably by an oil or gas burner firing axially through one end, and is slowly rotated through a suitable gear train. The preheated liquid raw material, ordinarily petroleum or coal residues, tars, pitches and the like, is continuously fed to the reservoir or feed trough, one side of which is formed by the wall of the drum, and adheres to that wall as the drum rotates. In the course of rotation, the thin coating of liquid material rapidly cokes so that by the time any given point on the drum reaches the scraper, the coking

is complete. As the coke is scraped off it falls into or upon a conveyor whence it can be removed from the retort as produced. The products of combustion from the heating burner may be circulated through flues in the floor of the retort and thence exhausted to the atmosphere through a stack.

In the course of coking the lighter liquid fractions will distill off. These may be recovered through a flue in the roof of the retort and further refined as desired. To prevent escape of these distilled fractions, a gas seal may be provided by maintaining an inert gas atmosphere under slight pressure at the ends of the drum.

My invention will best be understood and appreciated from the following description of the preferred apparatus suitable for carrying out the process illustrated in the accompanying drawings, in which:

Fig. 1 is an end view of the retort,

Fig. 2 is a view of the retort in vertical section,

Fig. 3 is a view in horizontal section taken along the line 3—3 of Fig. 1, and

Fig. 4 is a sectional plan view of the duct system in the retort floors on the line 4—4 of Fig. 2.

The illustrated apparatus comprises a heat-insulated retort **10** of convenient size and shape. A drum **12** having elongated end sections or tubular journals **13** and **14** of reduced diameter is mounted in the lower portion of retort **10** for rotation in suitable bearings **15**. The drum may be rotated slowly and uniformly by any convenient means. As herein illustrated, the elongated end **13** of the drum is provided with gear teeth **16** around its periphery engaged with idler gear **17**. Idler **17** is fast on a shaft to which a second and larger idler gear **18** is also fixed and which is engaged with a gear secured on the shaft of motor **22**.

The drum **12**, which is preferably constructed of stainless steel but which may alternatively be of refractory material, is heated internally by gas or oil burner **24** of conventional design herein shown as located in the journal **13**. To prevent overheating of the metal end walls of the drum, these walls may be lined with fire brick or other refractory material. It is also desirable to line the interior of tubular journal **14** with refractory material as the hot combustion products from burner **24** pass therethrough to the flue system hereinafter described.

The liquid raw material to be coked is deposited on the surface of drum **12** from a reservoir **28**, one side of which is formed by the surface of the drum. The other side of this reservoir, which is in the form of a trough, is formed by a metal blade **26** having a sharp lower edge which bears tangentially against the surface of the drum. This blade **26** serves also as a scraper to remove the solid coke from the drum as hereinafter described. This scraper blade **26** may be attached to the side wall of retort **10** by any convenient means. As herein shown the retort wall is provided with a sloping shoulder in which threaded bolts **30** are embedded. Slots **31** are provided in scraper blade **26** through which the bolts **30** extend and the blade **26** may be held in place by nuts screwed onto the bolts. By loosening or removing the nuts, as the case may be, the scraper blade **26** can be adjusted to bear against the surface of the drum or removed for sharpening, replacement, etc. A longitudinal door **32** in the wall of retort **10** provides access to the scraper blade.

Raw material, preferably preheated, is introduced into the retort **10** through an overhead feed pipe **34** entering through the roof of the retort and adjusted to deposit the liquid material in the reservoir **28**. If conditions warrant, additional raw material can be dripped or sprayed onto the surface of the drum either by proper adjustment of the pipe **34** or through supplemental feed pipes located at any convenient point within the retort. A flue **36** in the roof of the retort is provided to conduct off the light fractions distilled from the carbonaceous raw material for further refining or other use.

To prevent escape of the distillate vapors around the ends of the drum where clearance must of necessity be left for rotation I utilize an inert gas seal. Although check walls **38** placed close to the elongated ends of the drum will retard escape of vapors, they do not alone entirely prevent their escape. Pipes **40** are therefore di-

rected into the zones at the ends of the drum for the introduction of an inert gas under sufficient positive pressure to fill the retort and prevent the outward passage of the distillate vapors.

In the area below the scraper **26** I provide means such as a screw conveyor **41** to remove the finished coke from the retort. This conveyor **41** leads into a hopper **42** from which the product may flow by gravity or be picked up by a bucket elevator, or be removed by any other convenient means.

To furnish additional heat, either to accelerate the rate of coking or to devolatilise the coke while still on the surface of the drum, I have found a system of longitudinal ducts in the floor of the retort to be particularly advantageous. These ducts **43** lead off from a manifold **44** supplied from the exit end **14** of the drum **12** and from a downward leading flue **45** into which the drum **12** opens. Circulation is provided through a manifold **46** at the other end of the retort so that passage for the gases is provided through additional ducts **47** leading to a stack **48**.

In operation the burner **24** is ignited and the drum **12** placed in rotation. When the surface of the drum has reached coking temperature, usually above 900° F., liquid raw material is introduced into the retort **10** through the pipe **34** at a rate of flow sufficiently high to maintain in the reservoir **28** an adequate supply of liquid. A proper working range of temperature for the drum is 900° to 1800° F.

As shown in the drawing, the drum **12** rotates in a counter-clockwise direction. A substantial quantity of the liquid raw material will adhere to the surface of the drum and be carried around upon it. By suitable adjustments of drum temperature and rotation speed, any degree of coking may be achieved for any given raw material. The coke may also be partially devolatilised on the drum, if desired, by reducing rotation speed to expose the finished coke for a longer time to heat.

Just as the raw material is continuously picked up and carried around on the surface of the drum **12**, so is the finished product continuously scraped off by the scraper **26**. The lower edge of the scraper blade may be aligned horizontally or it may be slanted for easier scraping provided the slant is not great enough to cause removal of a portion of the product before coking is complete.

The finished product removed by the scraper **26** falls into the screw conveyor **41** by which it is carried out from the retort for further processing or use. As here illustrated, the screw conveyor **41** leads into the hopper **42** from which the coke may be lifted by a bucket elevator, screw conveyed or otherwise removed.

While the liquid raw material introduced through pipe **34** will ordinarily flow into the reservoir **28**, the pipe **34** can be adjusted to deposit the liquid on the surface of the drum in such a way that excess liquid will flow into the reservoir. Such technique may be preferred to increase production when the raw material has a high initial coking rate.

While the use of heating flues **43** and **47** in the retort floor is not essential for satisfactory coking, it will be obvious that such use will increase the rate of coking and devolatilization by supplying additional heat and at the same time utilizing otherwise waste combustion heat from the drum **12**.

Ordinarily more than half the value of the products

obtained from the coking of residual oils, pitches, tars, etc. is represented by the so-called gas-oil fractions distilled therefrom. Such gas-oils contain gasoline and other light hydrocarbon fractions having many uses. These gas-oil fractions pass out of the retort through the flue **36** to a suitable vapor recovery and refining system.

During the coking operation escape of gas-oil vapors around the ends of the drum is prevented by maintaining an inert gas under pressure in the area between the ends of the drum **12** and the end walls of the retort **10**. This inert gas, which may be nitrogen, natural gas, steam, flue gas, etc., is supplied through pipes **40** connected into a source under sufficient pressure to offset the pressure generated by the expansion of gases within the retort.

Having thus disclosed my invention and described in detail illustrative apparatus and procedure, I claim as new and desire to secure by Letters Patent:

1. Apparatus for coking liquid hydrocarbons including, in combination, a retort having heat-insulated walls, a hollow cylinder mounted for rotation therein, means for supplying heat internally to the cylinder, an elongated metal blade secured to a wall of the retort and extending downwardly therefrom into tangential contact with the cylinder thereby forming with the cylinder a reservoir for liquid hydrocarbon and serving also as a scraper for removing solid coke from the cylinder and cleaning its surface as it enters the reservoir, and means for supplying liquid hydrocarbon to the reservoir.

2. Apparatus for coking liquid hydrocarbons including, in combination, a heat-insulated retort, a hollow cylinder mounted for rotation therein having an inlet opening and an outlet opening, an angularly disposed elongated metal blade having its lower edge sharp and bearing tangentially against the wall of the cylinder for substantially the full length thereof and approximately on a line with the axis of the cylinder and being secured at its upper portion to the side of the retort, thereby forming with the cylinder a reservoir adapted to hold liquids, means to supply liquid hydrocarbons to said reservoir, an axially-aligned fuel burner located at a non-peripheral point in the inlet end of the cylinder, means to rotate the cylinder, means positioned below the reservoir adapted to remove coke from the retort, a flue in the upper portion of the retort adapted to carry off vaporized materials therefrom, and means to supply an inert gas to the retort and exteriorly to the cylinder.

3. The apparatus of claim 2 further characterized by means for circulating the products of combustion of the fuel burner exteriorly of the cylinder but out of contact therewith.

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