April 27, 1943. E. UTTERBACK 2,317,566

APPARATUS FOR COKING OILS

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Fig. 1.

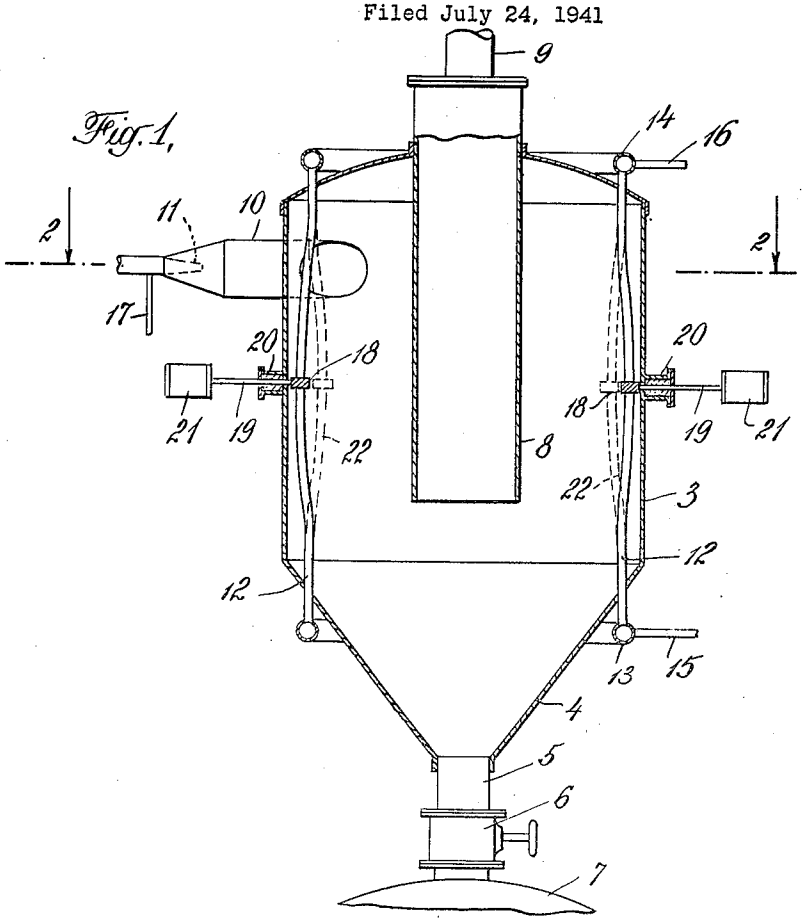
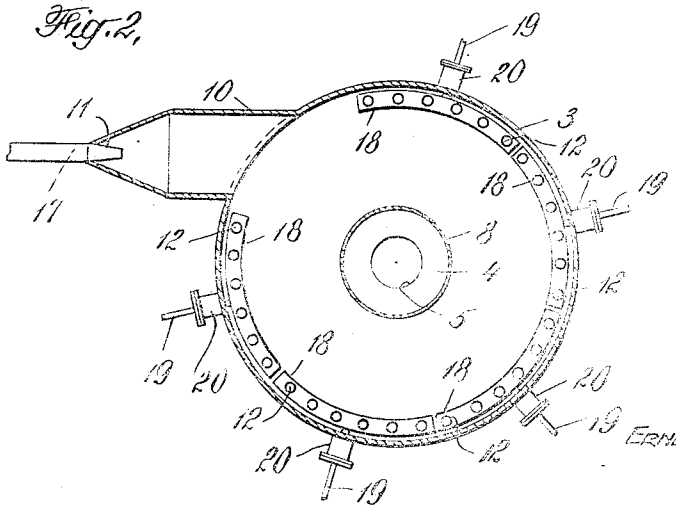


Fig. 2.



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APPARATUS FOR COKING OILS

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4 Claims. (Cl. 202—96)

This invention has to do with method and means for the coking of heavy petroleum oil fractions, and is particularly concerned with such processes wherein the oil is introduced in the form of a spray into the chamber wherein coke is deposited.

A major difficulty with most spray coking processes is the tendency of coke to adhere or "hang-up" on the interior surfaces of the chamber wherein it is formed, defying removal, and leading to unduly quick shutdowns of apparatus because of clogging. This is apparently due to the coke passing through a plastic, highly adhesive stage at some point in its reduction from liquid to solid. On this account, spray coking systems have usually attempted to complete the reduction from liquid to solid while holding the particles suspended in a stream of heated gaseous medium, such as steam, or heated petroleum materials which are vaporous at the temperature and pressure of coking. Due to the rather large volume required for such gases, they render difficult the complete separation of coke particles from the vapor stream. Additionally, these volume requirements call for a coke forming and collection chamber of considerable relative volume, and this factor alone has discouraged attempts to apply heat to the coke forming zone by other than gaseous media of various sorts intermingled with the hot oil stream being coked.

This invention has for its object the provision of method and apparatus whereby spray coking may be carried out in conjunction with the application of heat by radiation and convection to the vapors at the point where coking is taking place. A further object is the provision of apparatus adaptable to this sort of process wherein arrangements are made to enable the heat transfer surfaces exposed to the coking operation to be maintained reasonably free from adherent coke over commercial periods of operating time.

To this end I have devised the process and apparatus set forth in the drawing attached hereto, the several figures of which show sectional elevations and sections in plan and various details of an apparatus wherein my process may be accomplished.

In this drawing, Figure 1 is a diagrammatic vertical section of the apparatus I have devised and Figure 2 is a plan or horizontal section thereof, taken at the point indicated by the numerals 2—2. Reading both figures together, 3 is a vertical chamber, in which the spray coking is to be accomplished, and, as is usual, will be heavily insulated. Chamber 3 is cylindrical in shape, and conical at its lower end 4 wherefrom outlet duct 5 leads through some usual form of isolating valve 6 into coke receptacle 7. Depending interiorly into chamber 3 from its top is an interior vapor duct 8 connecting at its top end to vapor pipe 9 through which the vapors from coking are withdrawn from the chamber 3. A tangentially entering duct 10 admits the sprayed material to be coked, vapors, carrying gases if any, etc., to the chamber 3 and this entering stream is provided by some usual dispersion producing device, as indicated in diagram form by nozzle 11.

These essential portions of the apparatus are arranged to constitute a cyclone settler or separator of the usual type, wherein solids may be separated from a mixed stream of solids and gases by application of the usual principles of such settlers or separators.

Additional to this structure which is conventional, are heating means which are specially needful for the accomplishment of my process and are novel in my apparatus. They take the form of numerous pipes 12 disposed longitudinally over the inner surface of the chamber 3 in such a manner as to cover the whole of the vertical portion of the walls thereof. (For simplicity in drawing, the diagrammed apparatus in Figure 1 shows only two such pipes, and in Figure 2, those below the entry port of duct 10 are omitted.) These pipes 12 are connected, preferably externally of chamber 3, and preferably in groups as indicated in Figure 2 to headers 13 and 14. A high temperature heat transfer medium, such as, for example, a molten inorganic salt mixture at a temperature of about 900–1000° F. is supplied to and passed through these headers and tubes 12, as by pipes 15 and 16. This high temperature fluid heat transfer medium presents the supply of heat to the interior of chamber 3 in copious quantities and at high levels.

In operation an oil to be coked, heated to a temperature of say 950° F. is led to dispersion device 11, and there, with the addition of superheated steam, or other carrier, which may have been passed through the heating furnace with the oil, or may be added just prior to or at the point of spraying, as by pipe 17 is sprayed into the chamber 3. In chamber 3, under the combined influence of its contained heat, the heat and partial pressure effect of the steam, and heat from tubes 12, the oil is separated into vapors and a granular or droplike dry coke. The vapors are taken off through pipe 9 and the coke through duct 5.

In such operation, accumulation of adherent

coke upon the exposed heating surfaces of the tubes 12 is certain to occur, and will first mask the heat transfer from such tubes, and then render the apparatus inoperative.

To dislodge and remove this coke, I have provided the following arrangement. The tubes 12, in groups, as indicated in Figure 2, are passed, near their middle, through bar 18 and each bar 18 is connected to a rod 19 which passes through a gland 20 in the wall of chamber 3 and is connected at its outer end with a reciprocating means 21 (indicated diagrammatically in Figure 1). By this means, the tubes 12 may be flexed back and forth about their normal position, as indicated by dotted lines at 22 in Figure 1, and this flexing will serve to crack the accumulated coke scale from the tubes and cause it to be dislodged and fall to the bottom of chamber 3, in the same manner that bent tubes in water coolers are flexed to crack and remove scale therefrom.

By this means, I am enabled to keep the heating tubes 12 substantially free from accumulated scale coke for a considerable period of time.

This process has the characteristic of being capable of accomplishing spray coking in the presence of a minimum amount of carrying gases, if they are used at all, and attain that capability by being able to supply heat at high levels and in copious quantities, directly to the oil at the time it is converted into the spray form. No other process of which I am aware has this capability. It also avoids the fractionation and separation difficulties which arise from the presence of large amounts of a carrier gas such as steam or hydrocarbon vapors, since the amount of vapors present need be little, if any, greater in amount than those normally arising from the coking operation itself.

I claim:

1. Apparatus for the spray coking of heavy oils comprising a vertical cylindrical vessel, a tangentially entering duct near the upper end of said vessel, oil dispersing means connected to said duct to spray heated oil into said vessel, a centrally located vapor exit tube depending into said vessel for a substantial portion of the height thereof, a conical bottom on said vessel, means to remove coke therefrom, tubes longitudinally disposed upon the inner side of the cylindrical wall of said vessel, means to flex said tubes to dislodge coke therefrom, and means for circulating a high temperature fluid heat exchange medium through said tubes.

2. Apparatus for the spray coking of heavy oils comprising means defining a substantially vertical cylindrical coking zone, means to admit heavy oils tangentially to the upper part of said zone, heat exchange tubes for circulation of a heating medium within said zone in indirect heat exchange relationship with material in said zone, means for flexing said tubes to dislodge coke therefrom, means for withdrawing coke from the bottom of said zone and means disposed axially of said zone for withdrawing vapors from a region of said zone near the bottom thereof.

3. Apparatus for the spray coking of heavy oils comprising, a vertical cylindrical chamber, means for ejecting dispersed heavy oils substantially tangentially into the upper part of said chamber, means for withdrawing coke from the bottom of said chamber, means disposed axially of said chamber for withdrawing vapors from a region near the bottom thereof, spaced conduit means arranged about the inner cylindrical wall of said chamber, means for circulating a heat exchange medium through said conduit means, and means independent of said circulating means for vibrating said conduit means to loosen adherent coke therefrom.

4. Apparatus for the spray coking of heavy oils comprising a vertical cylindrical vessel, means for ejecting dispersed heavy oils substantially tangentially into the upper part of said vessel, means for withdrawing coke from the bottom of said vessel, means for withdrawing vapors through the top of said vessel, a plurality of groups of heat exchange tubes disposed about the cylindrical wall of said vessel, means for circulating a heat exchange medium through said tubes, and separate means for vibrating each group of tubes to effect removal of coke therefrom.

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