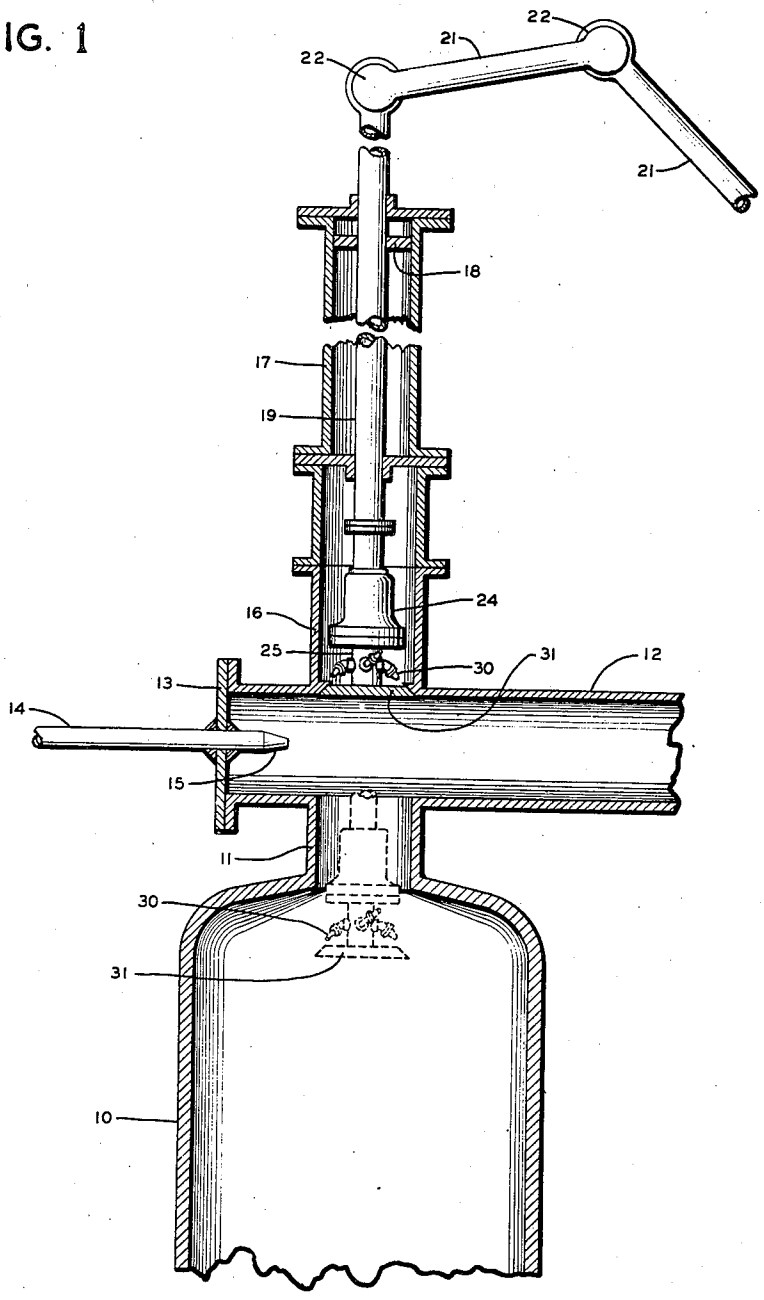
Aug. 10, 1943. R. J. DIWOKY 2,326,525

METHOD OF PREVENTING DELETERIOUS COKE DEPOSITS

Filed Aug. 28, 1940 3 Sheets-Sheet 1

FIG. 1



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Filed Aug. 28, 1940 3 Sheets-Sheet 2

FIG. 2

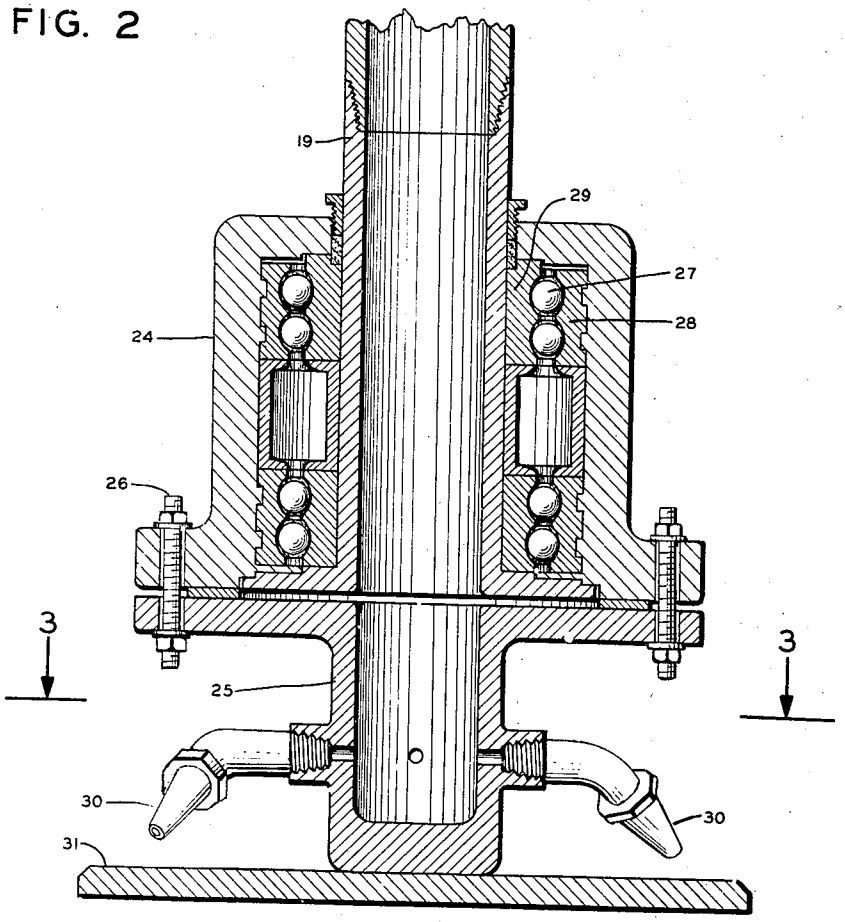
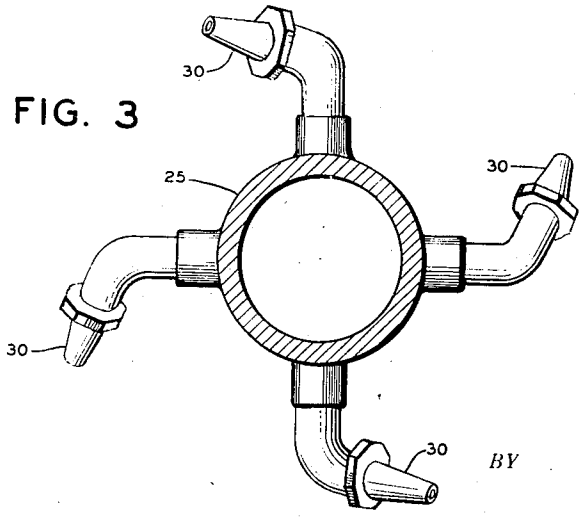


FIG. 3



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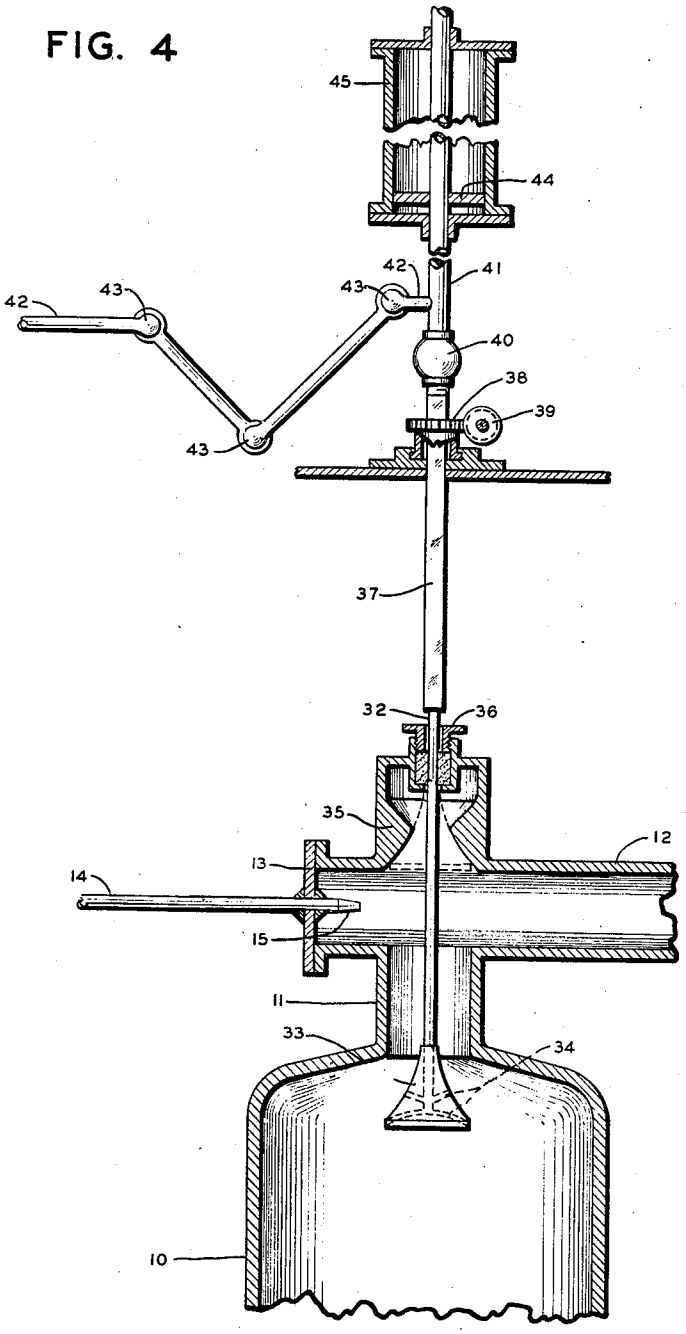
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METHOD OF PREVENTING DELETERIOUS COKE DEPOSITS

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FIG. 4



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METHOD OF PREVENTING DELETERIOUS COKE DEPOSITS

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Application August 28, 1940, Serial No. 354,542

4 Claims. (Cl. 196—69)

This invention relates to certain improvements in the art of cracking hydrocarbons for the purpose of removing coke formations and preventing the building up of deleterious coke formations in the cracking apparatus.

The invention pertains particularly to means for maintaining the vapor transfer lines from reaction chambers free from injurious coke deposits. A problem has been presented, particularly in the vapor phase or high temperature cracking of hydrocarbon oils, of maintaining the vapor transit passages from the reaction chambers free from harmful coke deposits. Various schemes involving the introduction of a cooling medium into the vapor line have been employed. It is, however, an extremely delicate proposition to provide sufficient cooling to prevent the formation of coke deposits in the vapor passages while at the same time avoiding reducing the temperature of the mass of vapors in the reaction chamber and unduly reducing the temperature of the outgoing vapors. One method of coke prevention which has been quite successfully employed is to provide a ring sprayer in the reaction chamber immediately adjacent to the vapor outlet, the sprayed oil being introduced in such quantity that substantially all of it, either as vapors or entrained liquid, will be carried out with the outflowing vapors. Due to the limitations imposed by the necessity of avoiding the cooling of the mass of vapors in the reaction chamber, it has been found impossible when making runs of considerable length to completely prevent the formation of coke deposits in the vapor line or adjacent the entrance thereto and resort has been had to the use of a coke knocker for periodic operation for removing the coke deposit. The function of the coke knocker is to break off the coke stalactites which form around the spray ring. These coke stalactites if not removed grow in size and eventually restrict the vapor line opening, thus causing an increase in pressure until the safe operating pressure on the reaction chamber is reached, forcing the unit to shut down. It has been found that in many cases the coke formation may be of a soft, tarry nature with the result that the coke mass instead of being broken off is merely pushed aside by the knocker and may remain adjacent the vapor outlet in a condition well adapted to form a nucleus for the building up of additional coke deposits and the eventual formation of harder deposits that will not be reached or renewed by the coke knocker, necessitating the shutting down of the unit.

It is an object of my invention to positively prevent the building up of deleterious coke deposits in the vapor line. In accordance with the invention a coke knocking apparatus is provided carrying fluid spraying means adapted for directing fluid under considerable force against the wall of the vapor line and adjacent parts. By the periodic application of the combined knocking and spraying device the coke is effectually removed from the vapor line and the building up of deleterious deposits such as would necessitate a shutdown is prevented. When the coke knocker comes in contact with any coke being formed in the vapor line, if it be of a soft or tarry nature such as would ordinarily be merely pushed aside by the knocker, the fluid sprays effectually flush out such soft material. If the formation is of a more brittle nature the coke knocker will function to break it off while at the same time the spraying fluid will thoroughly clean the vapor line wall and adjacent portions of the wall of the reaction chamber. In this way the use of the spray ring for continuously spraying oil immediately adjacent the entrance to the vapor line may be eliminated, since periodic use of the knocker element and its associated spraying mechanism may be relied on for keeping the vapor line free from coke deposits.

For the purpose of more fully disclosing the invention, reference is now had to the accompanying drawings wherein:

Fig. 1 is a sectional elevation of an apparatus illustrating the invention and constituting an embodiment thereof;

Fig. 2 is an enlarged partial section showing a rotary assembly for the fluid spraying means;

Fig. 3 is a plan view taken along line 3—3 of Fig. 2;

Fig. 4 is a sectional elevation showing a modified form of the invention.

In the drawings, 10 represents a reaction chamber for the cracking or conversion of hydrocarbon oils. Usually the hydrocarbon oil to be converted is passed through a heating coil and delivered to the reaction chamber wherein cracking conditions of temperature and pressure are maintained. The vapor line for the reaction chamber 10 includes a vertical riser section 11 and a horizontal section 12. One end of the horizontal section is closed by a blind flange 13 and the other end extends to subsequent apparatus such as a fractionating tower (not shown). A pipe 14 in axial alignment with the vapor line 12 extends through the blind flange 13 and is pro-

vided with a nozzle 15 for spraying oil into the vapor stream.

A pipe section 16 is provided in axial alignment with the vapor riser 11 and in open communication with the vapor line 12. The pipe section 16 supports a cylinder 17 having actuating means (not shown) for imparting a reciprocating movement to a piston 18 carrying a pipe 19. The pipe 19 is connected by means of a series of pipe sections 21 interconnected by swing joints 22 to a suitable source of oil supply under pressure.

At the lower end of the pipe 19 is mounted an element for rotary movement thereon carrying the spraying nozzles. The rotary assembly includes an upper casing 24, secured to a lower casing 25 as by means of bolts 26. Ball bearings 27 are suitably mounted within a ball race element 28 fixed to the casing 24 and a ball race element 29 fixed to the pipe 19. The casing 25 is provided with a plurality of discharge nozzles 30, adapted to discharge fluid tangentially to the pipe 19 so as to impart a rotary movement to the casings 25 and 24. It is advantageous to dispose the nozzles at various angles. Thus, as illustrated, a pair of nozzles on opposite sides of the casing 25 are directed upwardly at an angle of about 45° from the horizontal while another pair of nozzles on opposite sides of the casing are directed downwardly at an angle of about 45°. In practice, the nozzle openings are about ⅛ of an inch to $\frac{3}{16}$ of an inch in diameter and are constructed so as to be capable of discharging an even stream of liquid for a distance of at least 8 feet.

A plate or plunger element 31 is secured to the bottom of the casing 25 for the purpose of dislodging coke formations and protecting the nozzles. The plate or plunger 31 may assume various forms; for example, it may be in the form of an inverted cone and adapted to have a mechanical cutting action. When the piston 18 is in the upper position, as shown in Fig. 1, the plate 31 is seated at the bottom of pipe 16, closing the opening between the vapor line 12 and pipe 16 and when the piston is in the lower position the rotary nozzle assembly is in approximately the position indicated in dotted lines in Fig. 1. As the rotary assembly is moved downwardly through the vapor riser 11 coke formations are dislodged, while the streams from the rotating nozzles wash away any tarry or coky materials and serve to clean and scour the surface of the vapor riser. It will be noted that the rotary assembly is adapted to proceed downwardly somewhat below the upper wall of the reaction chamber so that fluid streams from the nozzles may be applied to the upper surfaces of the reaction chamber adjacent the outlet opening.

In the modified form of the invention illustrated in Fig. 4 a fluid supply pipe 32 is adapted for both rotary and reciprocating movement. Rigidly fixed to the lower end of the pipe 32 is a cone shaped combination plunger and nozzle member 33 which is formed with a plurality of discharge openings or orifices 34 for discharging fluid from the pipe 32 against the wall of the vapor riser 11 and upper portions of the reaction chamber 10. As illustrated, certain of the nozzle openings are inclined in an upward direction and certain of them are inclined in a downward direction. The member 33, when in the lower position, is positioned approximately as shown in the drawing and when in the upper position, as shown in dotted lines in the drawing, may be seated in a casing 35 which may also support a stuffing box 36 through which the pipe 32 moves. It is advantageous to provide oil cooling for the stuffing box. The pipe 32 is provided with a splined section or square section 37 adapted for slidable engagement with a rotary table 38 suitably geared to a motor driven worm or gear 39, so that the pipe 32 may be rotated while permitting the upward and downward movement of the pipe. The section 37 is connected by means of a rotary joint 40 to a pipe 41 which is connected to a piston 44 disposed in a cylinder 45 suitably provided with actuating means (not shown) for imparting the desired upward and downward movement to the pipe. The spraying fluid is supplied to pipe 41 by means of a series of pipe sections 42 interconnected by swing joints 43.

It is recommended that the spray fluid be supplied under pressures of the order of 1500 to 2000 lbs. and that the fluid be delivered from the nozzles at a rate of about 400 to 500 ft. per second. By supplying the fluid under such high pressure and by delivering the fluid from the nozzles at such high rates it is possible not only to readily remove any soft or tarry formations, but also to effectually scour the walls from any coke formations of a hard nature which may have become baked thereon.

In the practice of the invention the rotary nozzle assembly is normally held in the upper position while preferably a substantially continuous stream of fluid may be discharged into the vapor line through line 14. The operation is continued in this way for a time, without the application of any cooling medium to the vapors entering the vapor riser, and coke may be permitted to accumulate on the wall of the vapor riser or in the zone immediately adjacent the outlet opening of the reaction chamber. By periodically operating the rotary plunger and spraying nozzles any coke formations that may have lodged are effectually removed. Ordinarily it is necessary to operate the rotary plunger and spraying nozzles at intervals of about once or twice a day. And it is only necessary to carry on the spraying for brief periods such as a minute or at most two or three minutes.

The practice of the invention is well adapted for application in pressure cracking processes wherein the oil is discharged from the heating coil at temperatures of the order to 900° F. to 1000° F. into the reaction chamber wherein temperatures, usually in excess of 850° F. and often approximating 900° F., are maintained and in which the vapors are passed from the reaction chamber at temperatures in excess of 800° F. In an example of the invention, condensate stocks having end boiling points such as 650° F. to 700° F. are subjected to vapor phase cracking by being discharged from the cracking coil at temperatures in excess of 900° F. into the reaction chamber wherein the mass of vapors is maintained at temperatures of about 880° F. to 980° F. In the normal operation a continuous stream of cooling oil may be introduced through a line 14 into the vapor line 12 operating to cool the vapors somewhat and prevent coke deposition in the vapor line 12. The cooling medium is carried along with the flowing vapors and the mixture flows through the vapor line normally at temperatures of about 825° F. to 850° F. At intervals of about once or twice a day the coke knocker and spraying apparatus is applied to re-

move any coke deposits that may have formed in the vapor riser 11 or in the top of the reaction chamber 19 adjacent the outlet. The effect of the spraying is to reduce the temperature in the vapor passages, but since the spray need only be conducted for the comparatively brief interval of a minute or two the reduction in temperature is only temporary and normal working conditions are readily reestablished. Steam may be discharged through the nozzles to prevent the deposition to tarry material therein during period when the nozzles are not discharging oil.

Although a preferred embodiment of the invention has been set forth in connection with apparatus having a particular constructiton and arrangement of parts and mode of operation, it will be seen that various changes and modifications may be made therein, while securing to a greater or less extent some or all of the benefits of the invention, without departing from the spirit and scope thereof.

I claim:

1. In a cracking process wherein vapors at a cracking temperature continuously flow from a reaction chamber through a vapor outlet line in immediate communication with the reaction chamber and wherein such flow of vapors is continued for an extended period of time, the method of removing coke deposits and maintaining the free flow of vapors from the reaction chamber through the vapor outlet line which comprises normally permitting the flow of vapors through the entrance to the vapor outlet line without the application of any cooling fluid at said entrance, at intervals forcing a plunger element through the vapor outlet line thence into the reaction chamber to thereby dislodge coke formations in the path thereof, as the plunger passes through the vapor outlet line directing a fluid medium against the inner wall thereof with sufficient force to wash away coke formations, and when the plunger is within the reaction chamber directing a fluid medium against that portion of the wall of the reaction chamber adjacent the entrance to said vapor outlet line with sufficient force to wash away coke formations.

2. In a cracking process wherein vapors at a cracking temperature flow continuously from a reaction chamber in an upward direction through a vapor riser and flow thence in a horizontal direction through a vapor conduit and wherein such flow of vapors is continued for an extended period of time, the method of removing coke deposits and maintaining the free flow of vapors from the reaction chamber through the vapor lines which comprises continuously introducing a cooling medium into the stream of vapors flowing in the horizontal direction while normally permitting the flow of vapors through the entrance to the vapor riser without the application of any cooling fluid at said entrance, at intervals forcing a plunger element downwardly through the vapor riser thence into the reaction chamber to thereby dislodge coke formations in the path thereof, as the plunger passes through the vapor riser directing a fluid medium against the inner wall thereof with sufficient force to wash away coke formations, and when the plunger is within the reaction chamber directing a fluid medium against that portion of the wall of the reaction chamber adjacent the entrance to the vapor riser with sufficient force to wash away coke formations.

3. In a cracking process wherein vapors at a cracking temperature continuously flow from a reaction chamber through a vapor outlet line in immediate communication with the reaction chamber and wherein such flow of vapors is continued for an extended period of time, the method of removing coke deposits and maintaining the free flow of vapors from the reaction chamber through the vapor outlet line which comprises normally permitting the flow of vapors through the entrance to the vapor outlet line without the application of any cooling fluid at said entrance, at intervals of the order of once or twice a day forcing a plunger element through the vapor line thence into the reaction chamber to thereby dislodge coke formations in the path thereof, and at such intervals directing a fluid medium against the inner wall of the vapor outlet line and against that portion of the wall of the reaction chamber adjacent the entrance to the vapor outlet line with sufficient force to wash away coke formations.

4. In a cracking process wherein vapors at a cracking temperature flow continuously from a reaction chamber in an upward direction through a vapor riser and flow thence in a horizontal direction through a vapor conduit and wherein such flow of vapors is continued for an extended period of time, the method of removing coke deposits and maintaining the free flow of vapors from the reaction chamber through the vapor lines which comprises continuously introducing a cooling medium into the stream of vapors flowing in the horizontal direction while normally permitting the flow of vapors through the entrance to the vapor riser without the application of any cooling fluid at said entrance, at intervals of the order of once or twice a day forcing a plunger element downwardly through the vapor riser thence into the reaction chamber to thereby dislodge coke formations in the path thereof, at such intervals directing a fluid medium against the inner wall of the vapor outlet line and against that portion of the wall of the reaction chamber adjacent the entrance to the vapor outlet line with sufficient force to wash away coke formations, and limiting the application of such fluid medium at said intervals to a period of time of the order of 1–3 minutes.

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