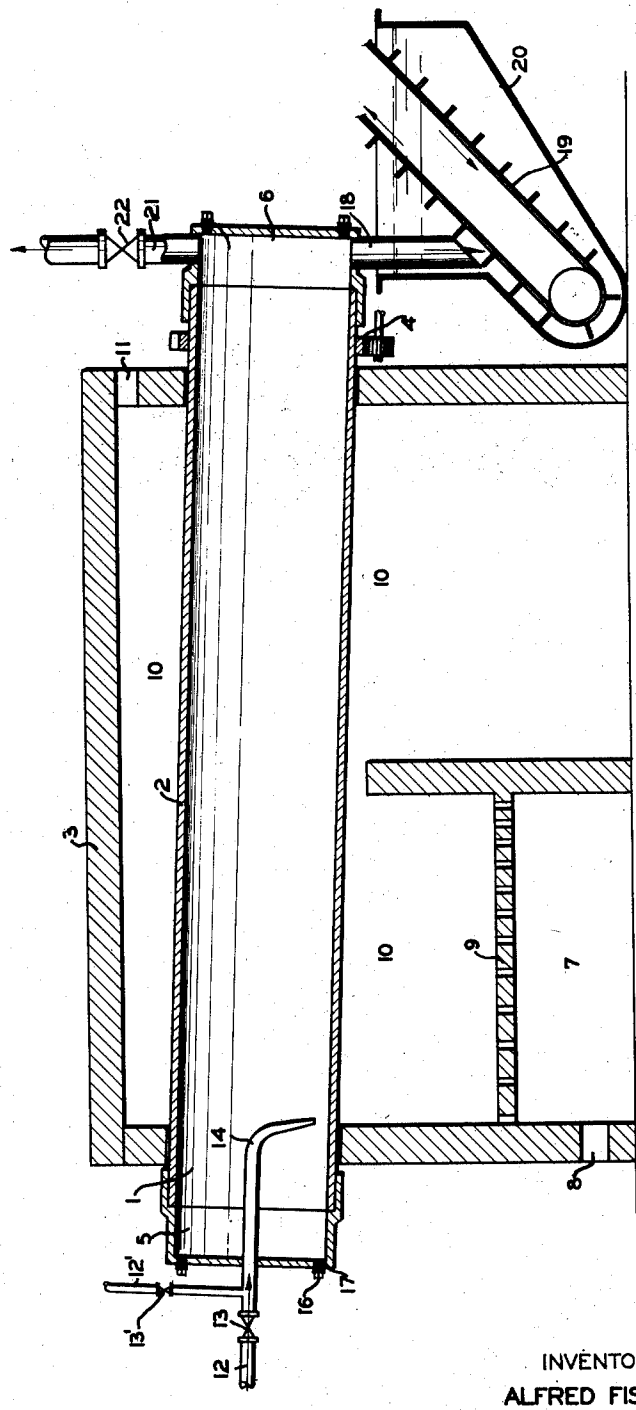
June 6, 1933. A. FISHER 1,912,629

TREATMENT OF HEAVY HYDROCARBONS

Filed Dec. 28, 1931



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Patented June 6, 1933 1,912,629

UNITED STATES PATENT OFFICE

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TREATMENT OF HEAVY HYDROCARBONS

Application filed December 28, 1931. Serial No. 583,601.

This invention relates to the treatment of solid carbonaceous and hydrocarbon oil mixtures and more particularly refers to substantial devolatilization or coking of materials such as hydrocarbon oils containing coal, petroleum coke or the like in finely dispersed form.

The use of externally heated rotary retorts for continuously coking mixtures of oil and carbonaceous material has been previously disclosed. The present invention is concerned with improvements to processes and apparatus of this type, the primary principles of which comprise intermittently arresting the coking operation, permitting the retort to cool somewhat and causing the layer of coke or carbonaceous material to break and scale away from the wall of the retort, due to their unequal contraction so that it may be removed from the zone of treatment. After the cooling and coke-removing period the coking operation may continue as before.

I have found that by this method of removing coke which adheres to the walls of the retort it normally falls away in relatively large pieces thus minimizing the production of small coke particles or fines which predominate in many other methods of coke removal. This feature obviates the necessity of briquetting the carbonaceous fuel. It is also characteristic of the process of the present invention that the temperature in the coking zone may be reduced only sufficiently to cause the adhering carbonaceous layer to crack and scale away from the walls of the retort, after which the coking operation may be resumed without first substantially increasing the temperature of the heated retore shell. This is due to the fact that the furnace temperature preferably is gradually increased as the layer of carbonaceous material builds up on the walls of the retort, to compensate for the reduced rate of heat transfer caused by the insulating properties of said carbonaceous material, resulting in a substantially higher temperature in the retort shell at the end than at the start of the coking period. Thus the temperature to which the retort shell is cooled during the cleaning period may not be substantially lower than the temperature required to start the succeeding coking operation.

The attached drawing is a vertical section of one specific form of apparatus in which the process of the present invention may be accomplished. The drawing and the following description are given for the purpose of more clearly illustrating the novelty and features of the invention. The rotary retort is indicated in general at 1. The cylindrical shell 2 of the retort is located in a suitable furnace setting 3 and is rotated by any suitable motivating means, not shown, through gear arrangement 4. Ends 5 and 6 of the retort, located outside the heating zone of the furnace, preferably are stationary and any suitable form of packing arrangement, not shown, is provided between the rotary shell 2 and stationary ends 5 and 6 to prevent escape of materials from the retort.

Any suitable fuel such as oil, gas, pulverized solid fuel or the like is supplied to combustion zone 7 of the furnace by means of any suitable burner, not shown, through burner port 8. The hot combustion gases pass upward through the perforated arch 9 of the furnace, along shell 2 of the retort through heating zone 10 and out of the furnace to a suitable stack, not shown, through flue opening 11.

The material to be coked may be supplied to the retort through line 12 and valve 13 falling upon a heated portion of shell 2 in a relatively thin stream from nozzle 14, it being understood that where coal or other solid matter is treated alone that the inlet feed pipe should be suitable for such purpose. Rotation of the retort shell 2 and slight inclination of the retort from the horizontal toward its discharge end effects substantially uniform distribution of the material supplied thereto over the entire inner surface of shell 2. Rotation of the retort also assists in maintaining a substantially uniform temperature around the entire circumference of the shell and the material distributed over the walls of the shell is sub-

stantially devolatilized and reduced to coke or carbonaceous residue.

As a layer of coke or carbonaceous material builds up upon the inner surface of shell 2, the poor heat conductivity of the carbonaceous material will reduce the flow of heat from the furnace to the material undergoing coking. To offset this reduction in the rate of heat transfer the furnace temperature preferably is gradually increased during the coking operation. The heated shell 2 of the retort is preferably constructed of a suitable metallic alloy, such as nickel chromium steel, capable of withstanding the relatively high temperatures to which the shell of the retort is subjected.

After a substantial layer of coke has been built up upon the inner surface of revolving shell 2 of the retort the supply of charging stock to the zone of treatment is stopped. Preferably heating of the retort is continued for a time after the feed is discontinued to substantially vaporize any volatile matter remaining on the surface of the coke layer. Firing is then discontinued to allow the retort to cool, thus establishing unequal contraction between the metal shell and the carbonaceous layer, the shearing force of which causes the layer of carbonaceous material to break and scale away in relatively large pieces. The slight inclination and the rotation of the retort causes the dislodged carbonaceous material to pass to the discharge end 6 of the retort from which it is removed through coke discharge tube 18.

Either or both of the stationary ends 5 and 6 of the retort may be provided with removable plugs 16. By means of openings 17, provided with the plugs 16 are removed, a rod, not shown, preferably sharpened at its end may be inserted and forced by means of a hydraulic ram, compressed air-gun or other suitable means, not illustrated, into the carbonaceous mass at a point close to the inner surface of shell 2, thus starting or assisting the breaking and scaling away of the coke during the cooling and cleaning period. Rotation of the retort is, of course, stopped during the rodding operation and a jet of steam may be directed through the openings 17 to prevent the escape of hot gases from the retort.

The lower end of coke discharge tube 18 is preferably immersed in liquid which acts as a seal to prevent the escape of vapors and gases through this port. Any suitable liquid such as oil or water may be employed and may serve also as a quenching medium for the coke. Coke may be discharged during the intermittent cleaning operation of the retort onto a continuous conveyor 19 of any suitable form, one end of which is immersed in the liquid seal and quenching chamber 20 and by means of which the coke may be removed to storage or elsewhere, as desired.

A line 12′ controlled by valve 13′ is provided for introducing steam or water into the retort, when desirable, to assist cooling of the retort during the coke-removing period and/or to keep the oil inlet nozzle 14 free of obstructions.

Vapors removed from the retort through line 21 and valve 22 may pass to fractionation, condensation, cooling and collection apparatus or to any other apparatus for desired treatment, means for which are well known and are not shown on the drawing. If desired, the heavy portions of the vapors may be separated from the lighter portions by fractionation and returned to the retort for further treatment together with the charging stock, by well known means not illustrated in the drawing.

Preferably the process is operated at substantially atmospheric pressure although relatively low super-atmospheric pressures or partial vacuum may be employed, if desired. Coking temperatures employed may range from 900 to 1300° F., more or less, depending primarily upon the type of material being treated and the desired volatility of the coke produced as well as the desired characteristics of the other products of the process. Preferably the temperature of the retort is reduced by from 300 to 600° F., more or less, during the cooling and coke-removing period of the operation.

As a specific example of the operation of the process of the present invention, a heavy fuel oil and about 200 mesh coal admixed in substantially equal parts by weight is supplied to the externally heated rotary retort at the rate of about 1000 pounds per hour. The furnace temperature, i. e., the temperature measured in the heating zone of the furnace adjacent to but outside of the rotary shell of the retort, is about 1350° F. when the feed is started. This temperature is increased, for example, by injecting a greater amount of fuel into the furnace, at the rate of about 100° F. per hour to approximately 1650° F. This temperature is maintained for about 7 hours during which time the rate of feed is gradually decreased to approximately 350 pounds per hour. The supply of carbonizable material being fed is then stopped and the furnace temperature is increased from approximately 1650 to about 1750° F. after which the fires are extinguished, permitting the retort to cool over a period of approximately one hour to about 1400° F. at which time substantially all of the carbonaceous material will have been dislodged from the walls of the retort and discharged from the zone of treatment. During the coking operation the vapors and gases from the retort are subjected to fractionation, their relatively heavy components comprising about 30 percent of the total liquid produced, being recycled to the re-

tort for further treatment, together with the charging stock, while the remainder of the distillate is subjected to condensation and cooling and separated from the gas.

An operation such as above outlined may yield approximately 50 percent, based on the weight of the charging stock, of coke, the maximum of which is recovered in relatively large pieces. This material may have a volatile content of about 8 percent and is suitable for domestic fuel as well as many other purposes. About 22 percent by weight of gas, having a calorific value of approximately 950 B. t. u's per cubic foot may also be recovered and in addition a total liquid recovery of approximately 30 percent by weight, some 6 to 8 percent of which may comprise motor fuel having an antiknock value equivalent to an octane number of 85 or more, may be recovered. The liquid products among other uses are highly suitable as charging stock for cracking.

I claim as my invention:

1. A process for the treatment of carbonizable materials to produce coke and cracked liquid products which comprises introducing the carbonizable material in a continuous stream into a rotating retort, simultaneously heating the rotating shell of the retort whereby the material introduced thereto adheres to the inner surface thereof and is reduced to coke, causing the coke to build up upon the heated walls of the retort and simultaneously increasing the furnace temperature around the retort to compensate for the decreased rate of heating and coking caused by the insulating coke layer, periodically stopping the supply of carbonizable material to the retort and simultaneously discontinuing heating of the retort, so as to allow it to cool to a predetermined temperature whereby the deposited coke is loosened from the retort walls, removing the coke from the retort, then resuming heating of the retort and again admitting carbonizable material thereto to repeat the operation above described.

2. A process for the treatment of hydrocarbon oil and coal mixtures to produce coke and cracked liquid products which comprises introducing the mixture in a continuous stream into a rotating retort, simultaneously heating the rotating shell of the retort whereby the material introduced thereto adheres to the inner surface thereof and is reduced to coke, causing the coke to build up upon the heated walls of the retort and simultaneously increasing the furnace temperature around the retort to compensate for the decreased rate of heating and coking caused by the insulating coke layer, periodically stopping the supply of coal and oil mixture to the retort and simultaneously discontinuing heating of the retort, so as to allow it to cool to a predetermined temperature whereby the deposited coke is loosened from the retort walls, removing the coke from the retort, then resuming heating of the retort and again admitting the coal and oil mixture thereto to repeat the operation above described.

3. A process for the treatment of heavy hydrocarbon oils to produce petroleum coke and cracked liquid products which comprises introducing the oil in a continuous stream into a rotating retort, simultaneously heating the rotating shell of the retort whereby the material introduced thereto adheres to the inner surface thereof and is reduced to coke, causing the coke to build up upon the heated walls of the retort and simultaneously increasing the furnace temperature around the retort to compensate for the decreased rate of heating and coking caused by the insulating coke layer, periodically stopping the supply of oil to the retort and simultaneously discontinuing heating of the retort, so as to allow it to cool to a predetermined temperature whereby the deposited coke is loosened from the retort walls, removing the coke from the retort, then resuming heating of the retort and again admitting the heavy hydrocarbon oil thereto to repeat the operation above described.

4. A process, as defined in claim 1, wherein steam is admitted during the cooling and coke-removing period.

5. A process for the treatment of carbonizable materials to produce coke and cracked liquid products which comprises externally heating a rotatable retort to a predetermined temperature and introducing the carbonizable material in a continuous stream into the rotating retort, causing said materials to spread over the inner surface of the retort in relatively thin layers, externally heating the rotating retort to reduce the material introduced into the retort to coke, whereby the coke builds upon the heated inner surface of the retort, regulating the temperature around the retort to increase the temperature thereof to compensate for the decreased rate of heat transference through the built up heat insulating coke, decreasing the rate of supply of carbonizable material to said retort as the layer of coke increases, periodically stopping the supply of carbonizable material to the retort, and concurrently stopping the heating of the retort so as to allow it to cool to below the first mentioned predetermined temperature, whereby the deposited coke is loosened from the retort walls, removing the coke from the retort, then resuming heating of the retort and again admitting carbonizable material thereto to repeat the operation above described.

In testimony whereof I affix my signature.

ALFRED FISHER.