Aug. 5, 1930. F. C. GREENE ET AL 1,771,999

CARBONIZATION PROCESS AND APPARATUS THEREFOR

Filed Sept. 18, 1924

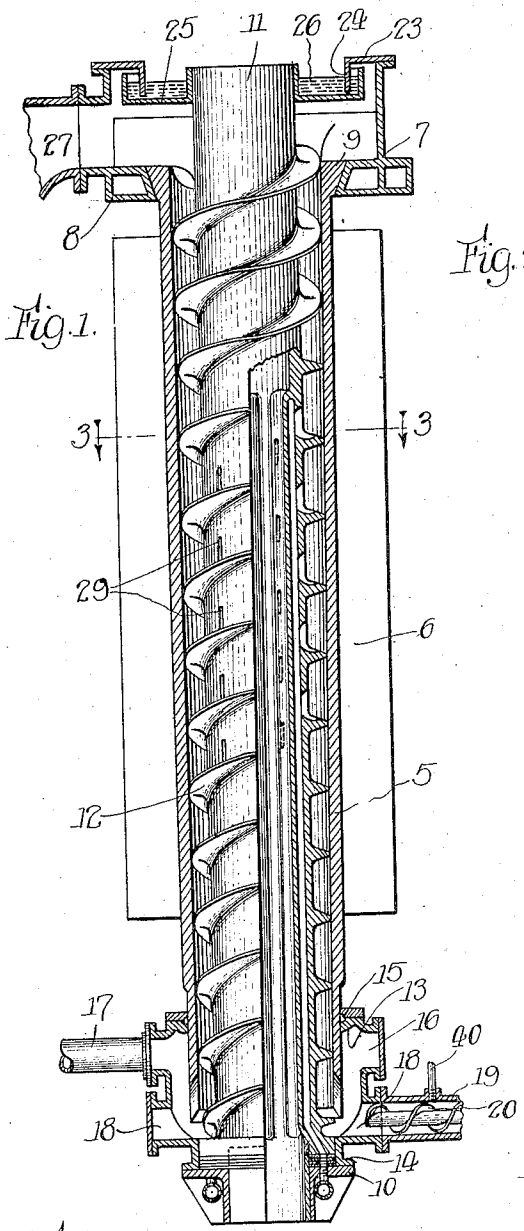


Fig. 1.

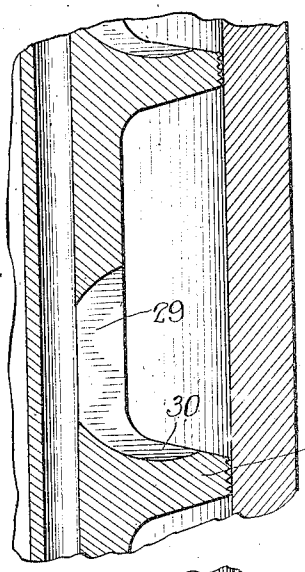


Fig. 2.

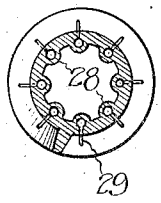


Fig. 3.

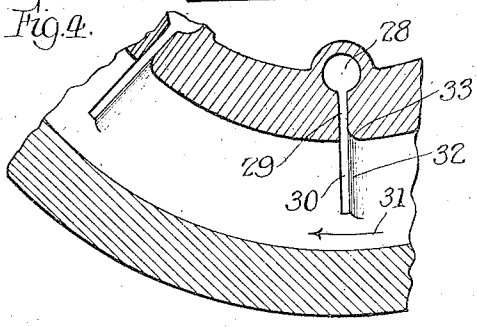
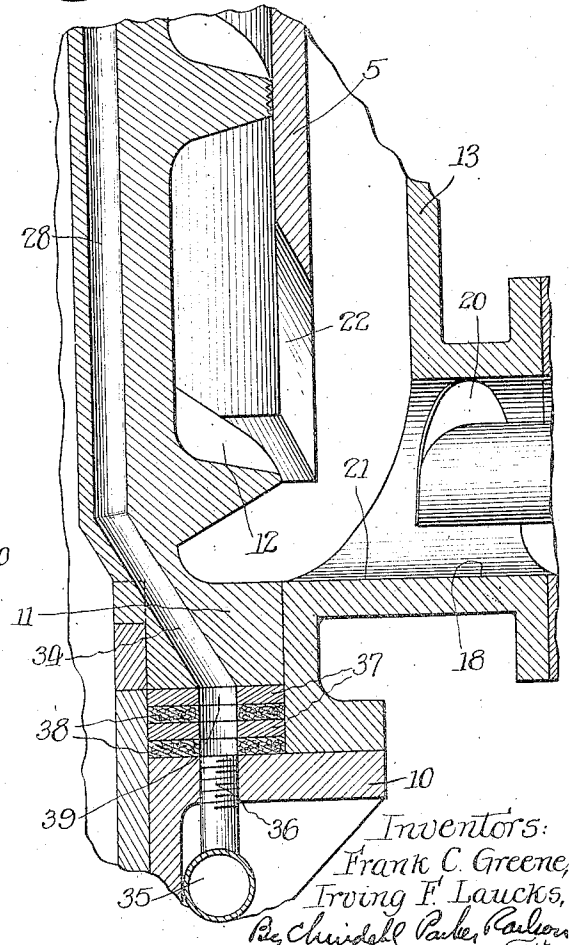


Fig. 4.



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UNITED STATES PATENT OFFICE

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CARBONIZATION PROCESS AND APPARATUS THEREFOR

Application filed September 18, 1924. Serial No. 738,326.

This invention relates generally to the coking of coal and in particular to coking coal in a retort having a screw conveyor.

In the coking of coal, the rotary screw conveyor is a desirable structure which heretofore has met with little or no success in practice. Considering generally a coking process in such a retort, the coal is advanced through the retort producing three zones; first, the granular zone in which the coal is heated; second, the plastic zone in which the hot coal becomes agglomerated into a sticky mass, sometimes almost liquid, and thirdly, the setting zone in which the plastic material begins to solidify for the formation of coke. Throughout all these stages volatile matter is eliminated, permitting the change in character from the granular state to the coke. It has heretofore been found that in the plastic zone the material adheres to the rotor to such an extent that a retort of this character generally clogs, making it difficult to operate without the use of heavily constructed apparatus and a tremendous driving force. Because of these operating difficulties, it is advisable to shorten the length of the plastic zone in order to make more practical a retort of this character. However, it is more desirable to lengthen the plastic zone in order to control the character of the products eliminated in the carbonizing process. Consequently, it is desirable in lengthening the plastic zone to provide some means or method which will overcome the sticking tendency of the coal to the rotor, thereby eliminating the operative difficulties. One method by which sticking of the plastic coal to the rotor may be avoided is by the use of a heated rotor, heat being so applied to the rotor that in the plastic zone it is at least as hot and preferably hotter than the temperature of the retort walls at the opposite points. This method has been found operatively successful in reducing friction or adherence of the plastic material to the rotor. However, there is one disadvantage in applying this method for this purpose, since when it is desired to lengthen the plastic zone the means employed for the purpose introduce an additional quantity of heat to the retort, thereby tending to hasten the process and to shorten the plastic zone. It is therefore desirable that other means or method be employed aside from the heated rotor. One of the effects of the heated rotor in eliminating adherence of plastic coal is due to the generation of a gas at the interface of the rotor and the coal. The effect of the gas is to form a film or cushion between the coal and the rotor to reduce the area of the material in direct contact with the rotor, thereby favoring selective adhesion of the coal to the retort wall in preference to the rotor wall. The manner of doing this is the formation of bubbles in the highly plastic coal and by the formation of an elevating layer of gas in the more nearly solid coal, the escape of the gas from the interface elevating the material from the rotor.

It is the object of this invention to coke coal in a retort having a screw conveyor by producing a similarly functioning film or layer at the interface of the coal and the rotor in any other practical manner, in distinction from utilizing the decomposition of the coal as a source of the material forming the cushioning film.

It is a particular object of the invention to introduce at the interface of the coal and the rotor a suitable substance which will prevent or minimize adherence of the coal to the rotor.

It is another object of the invention to maintain a supply of such a suitable substance within the rotor for introduction at the interface. Still another object is the provision of a rotor of a type suitable for maintaining such a supply, and furthermore to provide a construction associated with the rotor for maintaining the supply from an external source if desired.

It is another object of the invention to add, directly with the charge of the retort, a substance of such a nature that it will function as a lubricant or cushioning film in the process either by its mere presence or by a production of a suitable cushion by its decomposition along with the coal.

Other and ancillary objects and advantages will appear hereinafter, from the description of a particular construction, shown

in the accompanying drawings, of one form of apparatus capable of producing the desired film effect.

In the drawings, there is illustrated one type of retort capable of producing the film effect, in which Figure 1 illustrates generally a longitudinal cross-section of the retort.

Fig. 2 shows an enlarged detailed and fragmentary view of the parts of Fig. 1.

Fig. 3 is a cross-section of the rotor on the line 3—3 of Fig. 1.

Fig. 4 is an enlarged detailed view of a portion of the cross-section of the retort on line 3—3 of Fig. 1.

In the drawings we have chosen to illustrate the invention as embodied in a coking retort having a continuous feed of coal therethrough from the bottom to the top. In such a retort the movement of the coal upwardly is naturally retarded by friction or sticking to the rotor. In ordinary coking practice such a retort will clog and be inoperative primarily because of the stickiness. It is commercially desirable to decrease the friction or sticking, in order to be able to feed a considerable quantity of coal through the coking zones in a relatively short time.

The retort in general comprises a cylindrical chamber 5 of any desired construction and preferably slightly flaring in the direction of passage of the coal. Suitable means for heating the retort are diagrammatically represented by the combustion space 6 surrounding the retort. The retort is shown as suspended from suitable supports 7 and 8 by an enlarged cooperating tapered head 9 on the retort.

Upon an annular base 10 beneath the lower end of the retort is supported a cylindrical rotor 11 having helical ribs or flights 12 thereon arranged to fill the inside of the tapered retort 5, a snug fit being provided. The rotor 11 extends through the retort at the top for operation by any desirable power means (not shown). Both ends of the retort are suitably closed off. The lower or feeding end has a casing 13 thereabout external to the retort. Means for feeding coal to the retort and means for withdrawal of vapors, are associated with the casing.

The casing 13 is substantially annular in form supported at 14 on the base 10, and sealed by packing 15 at the top about the retort, which is thereby free to expand and contract. Suitable vapor exits 16 are constructed near the top of the casing, one of which is utilized by the vapor pipe 17. Other openings 18 are provided for feeding means. The opening 18 at the right of the Figs. 1 and 2 has a pipe 19 connected thereto containing a feed screw 20 for introducing coal onto the floor 21 of the casing, whence it is carried upwardly into the retort by the rotor flights 12. The bottom of the retort wall 5 extends close to the floor 21 and at the end is provided with suitably long openings 22 which permit the escape of vapors to the upper part of the casing.

The sealing means at the upper end comprise a chamber formed by the supports 7 and 8 and by a suitable liquid seal. An annular ring 23 is rigidly mounted with reference to the supports, said ring having a vertical cylindrical portion 24 projecting downwardly. The rotor 11 carries an annular channel member 25 into the channel space of which a liquid 26 is placed. The part 24 dips into the liquid to effect the seal. A suitable inclined passage 27 is provided to carry off the char delivered by the rotor.

Vertically through the rotor in the casing thereof are ducts 28 communicating with the retort chamber in the so-called plastic or sticking zone of the retort. Circular slots or ports 29 radially cut into the rotor constitute the means of communication in the present instance. The slot covers about one-half the space between the flights and also a considerable portion of the flight itself, forming a cup-shaped portion 30 in the rotor. In Fig. 4 the direction of rotation is indicated as clockwise by the arrow 31. The rear side of the slot 29 is chamfered at 32 in the flight and at 33 in the rotor. The ducts 28 extend through the rotor at the bottom, having the angular portion 34. A supply pipe 35 is arranged beneath the support 10 and communicates therethrough in a series of pipes 36. Bearing rings of metal 37 and of fibroid 38 are interposed between the base 10 and the rotor 11. Holes 39 through said rings serve to connect the pipes 36 to the rotor channels 34. Suitable lubricants or cushion forming substances are thus introduced from the supply pipe 35 to the rotor flights directly. Optional means are shown at 40 in the pipe 19 for introducing some suitable material into the retort with the coal itself.

As to the manner of producing a lubricating cushion, various substances are available for choice. For example, oil as a lubricant may be introduced, its character being such that it is not completely destroyed by the temperature of the sticking zone, or otherwise, its supply being sufficient to effect lubrication. Graphite may be introduced in the powder form by a stream of conveying gas, the graphite being a mechanical lubricant, and the gas forming a suitable cushion between the charge and the rotor. A gas under pressure may be admitted to form a gaseous film under the material to minimize the sticking. Petroleum residues may be added and the char resulting therefrom removed with the coke derived from the coal. In the latter case where a considerable quantity of petroleum may be added, it may be desirable to mix the same with the charged coal by addition through pipe 40.

With reference to the last named substance

used in connection with the coal, it is obvious that the process in carbonizing the coal will likewise crack the petroleum. This will result in a mixture of volatile products derived both from the coal and from the petroleum, and when such a mixture is desirable, the apparatus will provide a valuable and practical continuous process for the cracking of oil, the coke formed from the coal serving as a vehicle to remove the char and residue left by the cracking process. Carrying the combination of oil cracking and coal carbonization one step further, the process herein disclosed may be effectively employed as a cracking process without regard for the coal carbonizing. In place of using a carbonizing coal which will enrich the volatile products from the petroleum with volatile products from the coal, a non-volatile coal or coal dust, or coke breeze may be employed as the vehicle to carry the oil and the char therefrom through the retort, thereby giving a continuous process for the cracking of oil, and the utilization of waste products.

Although the above described means and the above named substances all contribute to the formation of a cushion effect between the charge and the rotor, the disclosure of such means and the substances, and the disclosure of the various processes derived from the use thereof, are merely for the purpose of illustrating and explaining the invention. The matter above set forth is not to be construed as limiting the scope of the invention which is set forth and defined by the appended claims.

We claim as our invention:

1. A retort for coking of carbonaceous material comprising, in combination, an elongated circular chamber, means to heat said chamber, a rotor in said chamber, helical flights on said rotor closely fitting said chamber, means to feed raw material to said flights for conveying same through the retort, said rotor having a plurality of ducts therein longitudinally thereof, and having communicating holes therethrough from the outside to said ducts, and means to feed a lubricating substance into said ducts for distribution on the rotor.

2. A retort for carbonaceous material comprising, in combination, an elongated circular retort, means to heat said retort, a screw conveyor in said retort, means to feed carbonaceous material to said conveyor, and means to feed other material through the conveyor to produce a cushion between the flights of the conveyor and the carbonaceous material, said means including ports which open upon the flights.

3. A coking retort comprising, in combination, an elongated circular chamber, heating means therefor, a rotor in said chamber, conveying flights on said rotor, a duct within said rotor, the external wall of the rotor having holes therethrough communicating with said duct, said holes being substantially at the junction of the rotor wall and the flights at the material-supporting side of the flights, and means to communicate with the duct from a point external of the retort for discharging fluid under pressure upon the material-supporting side of the flights.

4. A coking retort comprising, in combination, an elongated circular chamber, heating means therefor, a rotary conveyor in the chamber having helical flights for passing material through said chamber, said flights extending substantially to the walls of said chamber, means to feed raw material to be coked to said flights, means in said rotor to feed a cushion-forming substance to the flights, and means to feed the substance to said means in the rotor.

5. A coking retort comprising, in combination, an elongated circular chamber, heating means therefor, a rotary conveyor in said chamber having helical flights thereon, means to feed material to be coked into the chamber, a plurality of ducts within the conveyor longitudinally thereof, means to feed a suitable substance into said ducts, and a plurality of holes in the conveyor above said flights communicating with said ducts.

6. A vertical coking retort comprising, in combination, an elongated circular chamber, heating means therefor, a rotary conveyor in said chamber having helical flights thereon, means permitting the provision of a supply of cushioning lubricant material in said rotor, and longitudinal slots in said rotor, said slots cutting the wall of the rotor to communicate with the lubricant supply, and said slots cutting the upper side of the flights to feed the lubricant thereonto.

7. A vertical coking retort comprising, in combination, an elongated circular chamber, heating means therefor, a rotary conveyor in said chamber having helical flights thereon for conveying the material being treated up and out of said chamber, means to provide a supply of cushioning material in said rotor, and means for introducing said material onto the rotor surface at the interface thereof with the coal to facilitate the sliding action therebetween.

8. A vertical coking retort comprising, in combination, an elongated circular chamber, heating means therefor, a rotary conveyor in said chamber having helical flights thereon, means permitting the provision of a lubricant supply in the rotor, longitudinal slots in said rotor, said slots cutting the wall of the rotor to communicate with the lubricant supply, and said slots cutting the upper side of the flights to feed the lubricant thereonto, the rear side of each slot, in the direction of rotation of the rotor, being chamfered.

9. In a coking retort, a screw conveyor

having helical flights, means permitting the provision of a lubricant supply within said conveyor, a plurality of slots through said conveyor wall to the lubricant supply, said slots being in the shape of a circle intersecting the supply and cutting into the conveyor flights, one side of each slot being chamfered in the conveyor wall and the flight.

10. In a coking retort, a screw conveyor having helical flights, means permitting the provision of a lubricant supply within said conveyor, a plurality of slots through said conveyor wall to the lubricant supply, said slots being in the shape of a circle intersecting the supply and cutting into the conveyor flights.

11. A coking retort comprising in combination, a vertical elongated chamber, means to heat said chamber, a screw conveyor therein having helical flights, means at the bottom of the chamber to feed material to be coked onto said flights, means at the top of said chamber for receiving the coked material, means for withdrawing gas, and means for introducing a cushioning substance onto the flights of the conveyor at the interface thereof with the material passing through the retort.

12. A vertical retort comprising, in combination, an elongated circular chamber tapering toward the bottom, heating means therefor, a casing at the bottom closing said chamber, means to feed coal to the retort through said casing, a screw conveyor in the chamber to carry the coal to the top, exit means for the coked coal at the top, means for the withdrawal of vapors associated with the casing at the bottom, and means to introduce a cushioning substance onto the flights of the conveyor to facilitate passage of the coal through the heated zone of the retort.

13. A vertical coking retort comprising, in combination, an elongated circular chamber, means to suspend said chamber, a rotor in said retort, means to support said rotor at the bottom thereof, a casing about the lower ends of said chamber and said rotor, means associated with a casing to seal the end of the chamber, coal feeding means in said casing, means permitting the provision of a supply of cushion-forming material for said rotor, ducts in said rotor to receive the supply, and communicating means from the rotor to the rotor-supporting-means whereby to supply the material to said ducts.

14. A coking retort comprising, in combination, an elongated circular chamber, a rotor therein, a base to support said rotor at the bottom, bearing rings between said rotor and said base, a duct in said rotor opening at the end thereof, means permitting the provision of a supply of cushion-forming material, communicating means from the supply through said base, and rings intermediate said base and rotor having holes therein to supply said rotor duct with a cushioning substance during the rotation thereof.

15. The method of coking coal in a vertical retort provided with a screw conveyor which consists in moving the coal upwardly through the retort on the flights of the conveyor, heating the retort to coke the coal, and introducing a lubricant substance onto the flights of the conveyor to produce a cushion effect on the flights at the interface thereof with the plastic coal.

16. The method of coking coal in a vertical retort provided with a screw conveyor which consists in passing coal through the retort, heating the retort, and introducing into the retort a cushion forming lubricant substance acting at the interface of the plastic coal and the conveyor.

17. The method of coking coal in a vertical retort provided with a screw conveyor which consists in passing coal upwardly through the retort, heating the retort, and introducing a second substance onto the surface of the screw conveyor to form a film between the plastic coal and said conveyor.

18. The method of coking coal in a vertical retort provided with a screw conveyor which consists in feeding coal upwardly through the retort, heating the retort, introducing into the retort a liquid petroleum substance suitable to form a lubricating and cushioning film between the plastic coal and the conveyor at the interface, withdrawing the vapors, and removing the char produced from the coal and the petroleum substance.

19. The method of coking coal in a vertical retort provided with a screw conveyor which consists in passing coal upwardly through the retort, heating the retort, introducing onto the conveyor a liquid petroleum substance suitable to form a cushion at the surface thereof, to prevent sticking of the plastic coal to the conveyor in the passage therethrough, and removing the products formed by the heating.

20. The method of coking coal in a vertical retort provided with a screw conveyor which consists in passing coal upwardly through the retort, heating the retort, adding a liquid petroleum product to the coal passing through the retort, the heat serving to volatilize portions of the petroleum and of the coal and forming a char, the liquid of the petroleum and the boiling thereof in the retort forming a lubricating film at the interface of the conveyor and the plastic material whereby the passage through the retort is facilitated, and removing the char as a single product.

21. A retort for coking carbonaceous material that will become plastic upon sufficient heating comprising, in combination, an elongated chamber, a rotary conveyor in said chamber having helical flights thereon for passing said material through said chamber,

means for heating said chamber to heat said material in the course of its passage through said chamber to a temperature at which it becomes plastic, and means for supplying a foreign substance to the interface of said conveyor in the region in which said material becomes plastic, said foreign substance being introduced to facilitate the sliding action of the plastic material on said conveyor.

22. The method of coking coal that will become plastic upon sufficient heating in a vertical retort provided with a screw conveyor which consists in passing coal through the retort, heating the coal in the course of its passage through said retort to a temperature at which it becomes plastic, and introducing onto said conveyor in the region in which the coal is plastic a substance for facilitating the sliding action of the plastic coal on the conveyor.

In testimony whereof we have hereunto affixed our signatures.

FRANK C. GREENE.
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