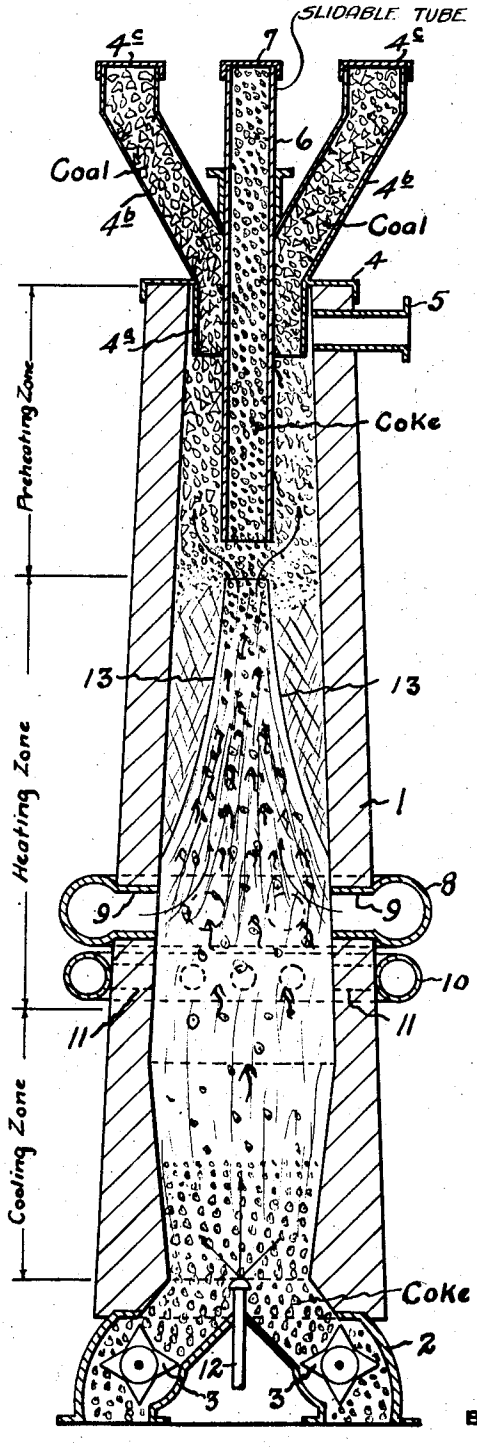
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COKING RETORT

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COKING RETORT

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This invention relates broadly to improvements in retorts and operating methods therefor as applied to the production of high grade coke, low temperature oils and fuel gas from coals and particularly fine sized coking coals.

One of the important objects of this invention involves apparatus and methods for producing and controlling the plastic, gas resistant barrier which forms in coking retorts at the point of transition of the coal into coke.

A further object of this invention is the provision of retorts and methods for use in the heat treatment of fuels in which an accurate control of the reactions therein is obtained and from which the gaseous products produced may readily be removed.

Another object of this invention involves a method of maintaining the plastic barrier vented so that the gases formed within the barrier may readily escape outside of it.

A still further object of this invention is to form and control the size and position of the plastic barrier and maintain it vented in order to secure uniform products from the retort and uniform operating conditions.

A still further object of this invention involves the control of the plastic barrier or film so as to keep the vapors formed on each side thereof separated until they are beyond the heating zone.

A still further object of this invention involves the control of the plastic barrier by control of the throughout for the purpose of producing a high grade coke of relatively high volatile content while maintaining the production of gaseous products at a minimum.

These and many other objects as will appear from the following disclosure are secured by means of this invention.

This invention resides substantially in the combination, construction, arrangement, relative location of parts, steps and series of steps all as will be described in detail below.

Referring to the drawing the single figure is a vertical cross sectional view through the apparatus of this invention illustrated diagrammatically.

The apparatus and method of this invention relate to and involve the heat treatment of solid carbonaceous fuels, such as coal and particularly coking coals for the purpose of producing therefrom high grade coke of uniform size, low temperature oils and gaseous fuels. The invention may be applied to continuous internally heated retorts, regardless of the source of heat, whether generated within the charge or externally. In coking retorts of this type it has been found that at the surface of transition of the coal into coke a plastic barrier or film forms which is more or less gas impervious. This film is composed of melted coal which is produced at a temperature of around 750 degrees F. The film or barrier is in a plastic state and normally has a thickness of approximately one-quarter of an inch. This barrier of melted coal exists between the uncoked coal and the formed coke. It has been found that the formation of this film is the cause of the difficulties normally encountered in the production of coke at low temperatures in continuous internally heated retorts. Because the film is gas impervious, the gaseous products formed within it are not easily removed and as a result a back pressure is built up within the retort. Furthermore, the formation of this film has been found to be the cause of the lack of uniformity in the operation of such retorts and the products produced thereby.

The prime object of this invention is to employ this very barrier or film for the purpose of producing uniform operation and uniform products.

In both externally and internally heated continuous retorts the plastic barrier occurs in the form of an inverted cone with the apex pointing downwardly. By means of this invention the position of the cone is reversed and its apex is vented to permit the escape of the gaseous products formed within it. Venting of the plastic cone is effected by feeding a central core of coke into the retort in such a manner as to maintain the top of the cone open so that the gaseous products formed within it may pass freely through the gas pervious coke cone.

In ordinary internally heated continuous vertical retorts, especially when using fine sized coking coal, this plastic hollow, unvented cone tends to shift about in the retort varying both its size and position under different operating conditions so that it is impossible to produce uniform products and uniform operating conditions.

By means of this invention the position of the plastic cone is relatively fixed and its size is controlled to aid in producing uniform products and operating conditions.

The retort which may be constructed in accordance with standard practice is shown in the figure and is preferably in the form of a truncated pyramid of increasing cross sectional area downwardly. Near the bottom of the retort the walls may be so formed that they converge downwardly to the point where the coke and other residue is discharged.

The lower end of the retort is provided with a suitable discharge apparatus such as is shown in the drawing comprising a casing 2 within which are mounted rotatable discharge gates 3. The top of the retort is provided with a cover 4 which is shown as provided with a depending skirt 4^a and upwardly extending feed hoppers 4^b provided with covers 4^c. It is likewise apparent that the form of feeding mechanism employed may be any of the well known types. The general characteristic of the feeding mechanism is merely that it shall be able to feed the coal continuously into the retort without substantially opening the retort to the atmosphere. There are many known types of continuous feed hoppers for such retorts. Extending centrally through the cover 4 is a tube 6 of any suitable cross section and provided with a cover 7. This tube is vertically adjustable through the cover. The top of the retort is provided with gas take-off connections 5 of which only one is shown.

Extending around the retort near the base of the heating zone is a tuyère provided with a series of discharge connections 9 opening directly into the retort. Just below the tuyère 8 is a second tuyère 10 likewise provided with space discharge connections 11 opening into the retort. At 12 is a connection into the retort provided with a spray nozzle by means of which steam may be discharged into the retort.

As indicated in the drawing the retort may be divided into three zones. The lower zone is termed the "cooling zone" in which the coke and other residue is gradually cooled. In the next zone, called the "heating zone", the fuel is heated either by the introduction of sensible heat through the tuyères or by direct combustion to a temperature to liberate the gaseous products thereof. The last zone is called the "pre-heating zone" and represents the volume where the fresh incoming fuel is heated by the gases ascending from the heating zone. In the pre-heating zone, for weakly coking coals the higher temperature volatiles are condensed on the relatively cold incoming fresh fuel. These condensation products flow back toward the heating zone where they are cracked down into simpler forms and revolatilized.

The method of this invention and the apparatus disclosed operates continuously. In other words, fuel is continuously fed into the top and travels continuously downwardly through the retort and out at the bottom. As already stated, there are many known forms of feeding and discharging mechanism for effecting such a continuous operation.

In the operation of this retort the heating zone may be maintained either by combustion or by the passage of highly heated gases therethrough. In the form of apparatus shown in the drawing hot producer gas or other suitable heated gases may be introduced into the retort by means of tuyère 8.

Air and/or steam may be introduced into the retort through the tuyère 10 where the combustion type of internally heated retort is employed to aid in complete combustion and to effect the control of temperature at the combustion zone. When a temperature of approximately 750 degrees F. is attained in the retort by any method of heating, the plastic film forms which has been indicated diagrammatically at 13 in the form of a truncated cone. This film separates the uncoked coal from the formed coke at the center. The coke which is fed through pipe 6 forms a center core which maintains the top of the plastic cone 13 vented so that the gases formed within the cone may readily escape as indicated by the arrows. In this invention this cone is employed to keep the gases formed each side of the cone separated until they reach a point where their temperature has fallen to a value where no harm results from their intermixture. In other words, the low temperature volatiles formed outside of the plastic cone do not mix with the high temperature volatiles formed within the plastic cone until they get above the upper end of the cone at which time they may be mixed without degradation of the low temperature oils. The center core of coke maintains the top of the plastic cone vented, permitting easy escape of the gases formed within the cone. The heated gases rising through the upper portion of the retort through the preheating zone act to pre-heat the fresh incoming coal in the preparation for coking before they are withdrawn through the connection 5.

At this point it is interesting to note that a portion of the gaseous products after having the oils condensed therefrom and washed may be delivered back into the retort through the tuyères in the case where internal combustion is employed to effect further operation of the retort. They can likewise be burned in an outside combustion chamber and the hot products of combustion tempered with steam if desired, introduced into the retort to further its operation.

The height of the cone 13 is determined by the rate of throughput which is governed by heat potential. The throughput can be controlled either by increased heat potential or larger volumes at the same heat potential. The plastic cone terminates at the point where the temperature of the coking coal falls below 750 degrees F. The tube 6 is made vertically and telescopically adjustable so that the upper end of the cone 13 may be maintained vented regardless of its vertical extent.

While coke is preferably fed through tube 6 because it does not contaminate the finished product, it is apparent that lumps of any non-melting substance could be used for this purpose. The center core of coke is fed downwardly continuously with the fresh incoming fuel to maintain a gas pervious center core at and beyond the point where the coal begins to melt.

As the coke and other residue descends below the heating zone, it is cooled by discharging steam into it through pipe 12 and its attached nozzle. By cooling the coke in a zone below the heating zone by the introduction of steam, the steam is super-heated as it rises through the heating zones and mixes with the hot products produced in the heating zone to thereby form a vehicle for suitably distributing heat in both the heating and preheating zones. The coked product is finally discharged after cooling from the retort through the discharge mechanism.

Another advantage of this method and apparatus which causes the formation of the plastic cone as shown is that the cone of coke within the plastic film is surrounded by a compacted cup of coal so that the coke is continuously subjected to pressure. As a result the coke cannot expand and deteriorate as is the case in previous apparatus where the cone is inverted so that the coke is in the form of an outside cup with a center core of coal.

In all continuous retorts the retorts are tapered to facilitate easy discharge. This invention allows any taper desired without disturbing the coke

during formation. The loose coal is continuously taking up the extra space made by the taper and does not allow the coke to swell; that is, does not make the coke too porous.

From the foregoing description it will be apparent that this invention resides in certain forms of apparatus and principles of operation which may be embodied by those skilled in the art in other ways without departure from the invention. I do not, therefore, desire to be strictly limited to the disclosure as given for purpose of illustration but rather to the scope of the appended claims.

What I seek to secure by United States Letters Patent is:

1. The combination with a vertical retort, of a feeding enclosure device mounted on the top thereof, including a pair of telescoped conduits having their discharge ends longitudinally displaced, the inner conduit being longer than and slidable telescopically within the outer conduit, residue discharge mechanism at the bottom of the retort, tuyères discharging into the retort intermediate the ends thereof, and a gas outlet connection for the retort positioned to withdraw gas therefrom at a point above the discharge end of the inner conduit of the telescoped conduits.

2. The combination with a vertical retort, of a feeding enclosure device mounted on top thereof, including means for feeding coking coal peripherally into the retort to form a coal body, an elongated conduit open at its lower end, closed at its upper end and filled with coke, said conduit being slidably adjustably positioned within the retort whereby coke is fed to form a gas pervious core for the coal body, said tube being adapted to change the length of the core, residue discharge mechanism at the bottom of the retort, tuyères discharging into the retort intermediate the ends thereof, and a gas outlet connection for the retort positioned to withdraw gas therefrom at a point above the open end of said conduit.

ARTHUR WOODWARD WARNER.