May 29, 1923. 1,457,083

C. V. McINTIRE

RETORT FURNACE

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Fig. 1

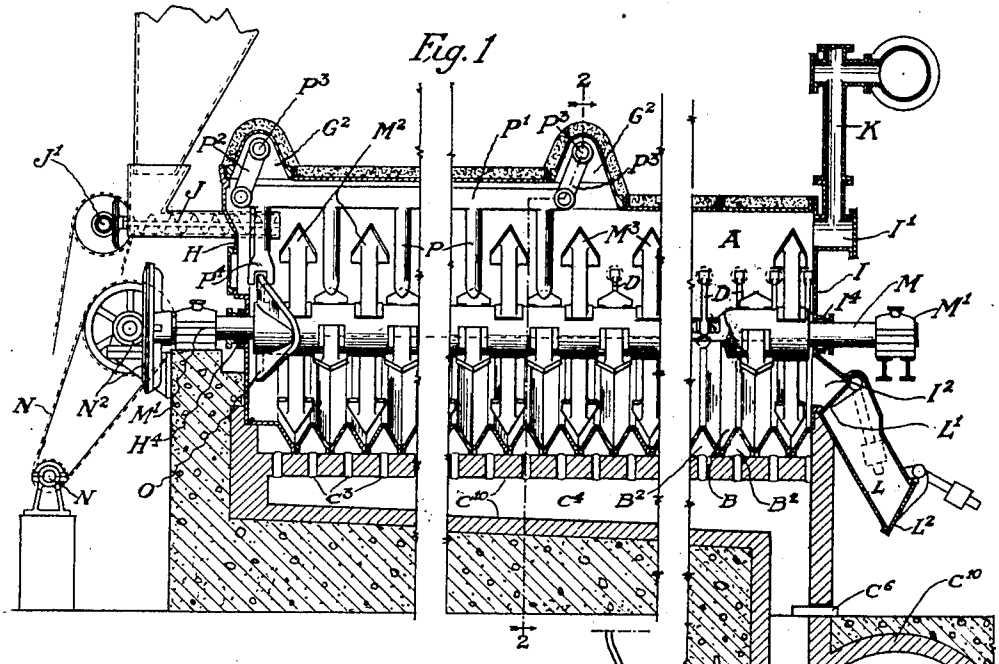


Fig. 3



Fig. 2

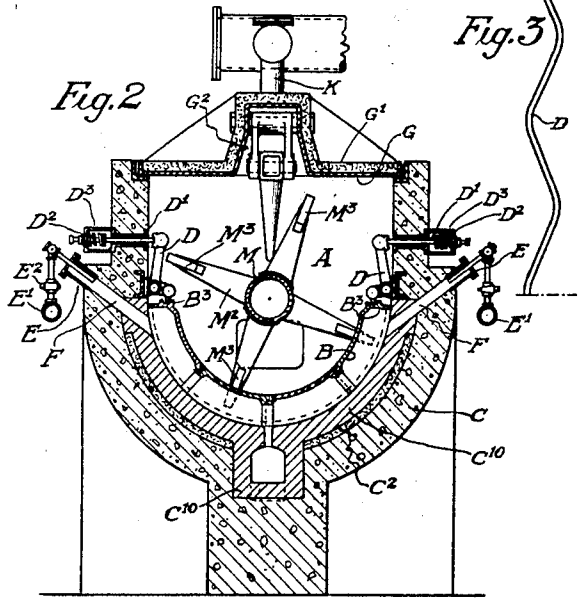
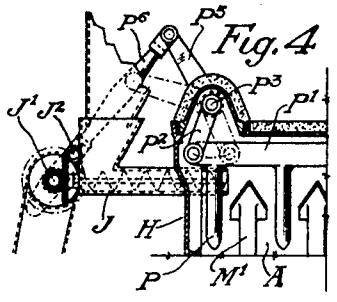


Fig. 4



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Fig. 5

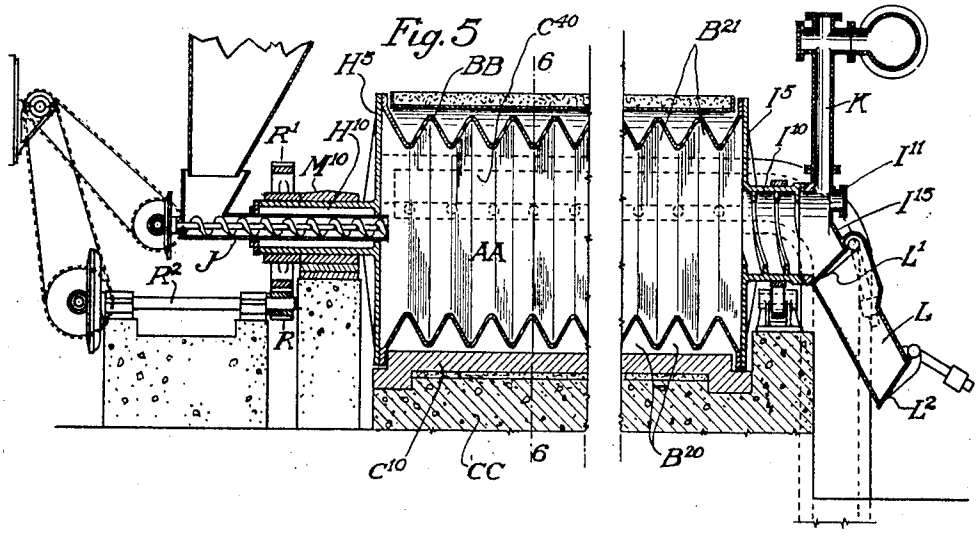
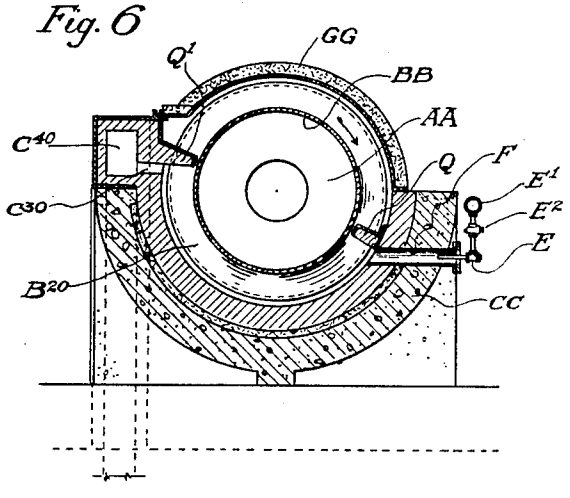


Fig. 6



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UNITED STATES PATENT OFFICE.

CHARLES V. McINTIRE, OF EAST ORANGE, NEW JERSEY.

RETORT FURNACE.

Application filed June 18, 1921. Serial No. 478,466.

To all whom it may concern:

Be it known that I, CHARLES V. McINTIRE, a citizen of the United States, and resident of East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Retort Furnaces, of which the following is a specification.

The general object of my present invention is to provide an improved retort furnace especially devised and adapted for use in continuously carrying on the so-called low temperature carbonization of coal though it may be used for other purposes.

My improved retort furnace comprises a horizontally disposed retort proper, into which the coal to be carbonized or other material to be treated is introduced at one end, the unvolatilized residue being discharged from the retort at the opposite end. The retort may be rotated to agitate the charge and to cause a slow gravity feed of the latter through the retort from one end to the other, but in a preferred embodiment of my invention the retort is stationary and novel means are provided within the retort for stirring the charge and causing a slow gravity feed of the latter through the retort.

In the stationary type of my improved retort the lower portion of the retort wall is shaped to provide hollow ribs on its inner side the channels in which form retort heating flues. Preferably this wall portion is in the form of a section of a cylinder corrugated to provide internal ribs with external grooves therein extending circularly about the axis of the cylinder. These external corrugation grooves form heating flues which are closed at their outer edges by the adjacent portion of the retort housing, while the internal grooves and ribs between them desirably retard the travel of the charge through the retort. In the rotary type of my improved retort the body of the retort is formed of a corrugated metallic cylinder so mounted in the retort housing that portions of the external corrugation grooves form heating flues closed at their outer edges by the retort housing.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, and its advantages and specific objects attained with it, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described preferred embodiments of my invention.

Of the drawings:

Fig. 1 is a sectional elevation of a preferred embodiment of my invention;

Fig. 2 is a section on the broken line 2—2 of Fig. 1.

Fig. 3 is a view showing development of the peripheral edge of a cam employed in the apparatus of Figs. 1 and 2;

Fig. 4 is a partial sectional elevation taken similarly to Fig. 1, and illustrating a modification of a portion of the stirrer cleaning mechanism employed in Fig. 1;

Fig. 5 is a view taken similarly to Fig. 1 illustrating a modified retort structure; and

Fig. 6 is a section on the line 6—6 of Fig. 5.

In the drawings and referring first to the apparatus shown in Figs. 1, 2 and 3, A represents a stationary retort which is horizontally disposed though the axis of the retort need not be exactly horizontal. The bottom wall of the retort A is a structure B in the form of a half cylinder corrugated to provide alternating internal and external grooves B and B^2, respectively. The structure B rests in a cylindrical seat formed in the refractory retort housing C. The body of the retort housing may be formed of reinforced concrete or analogous material but the seat for the structure B and the walls of the off-take flues hereinafter referred to may advantageously be lined with fire brick. As shown a layer C^2 of infusorial earth or other refractory heat insulating material is interposed between the fire brick lining forming the seat C^{10} for the structure B and the concrete portion of the housing C. The structure B may advantageously be formed as shown in the drawings, in sections of suitable proportions which overlap at the joints except at the outer peripheral edges of the internal grooves B′ where the joints between the adjacent section edges are sealed by contact with the refractory housing or by interposed luting material. The parts composing the structure B are preferably cast steel but they may be made of other refractory materials. The ends of the external grooves B^2 are closed by flange portions B^3 of the structure B. Suitable provisions should be made for

holding the structure B in position in the retort housing with the necessary freedom for relative expansion and contraction of the parts as the temperatures to which they are subjected vary. The provisions shown for this purpose comprise bell crank levers D pivotally connected to the retort housing and pressed against the flanges B^3 by springs D^2 which are mounted in exterior spring housings D^3 and act on the levers D through connecting rods D'.

The means for heating the retort comprise burners E mounted in the outer ends of burner channels F formed in the opposite sides of the retort housing and communicating at their inner ends with the upper ends of the arc shaped flues formed by the external grooves B^2 of the metallic structures B and the adjacent concave surface of the retort housing. The products of combustion escape from the flue grooves B^2 at their bottoms through outlet ports C^3 opening into an off-take flue C^4 communicating with a conduit C^5 running to a stack or other draft creating device. C^6 represents a damper by means of which the draft may be regulated. As shown the burners E are of the Bunsen type and receive fuel gas from supply mains E' through branch pipes containing fuel regulating valves E^2.

The side walls of the upper portion of the retort are formed, in the construction shown in Figs. 1, 2 and 3, by vertical portions of the refractory housing C, and the top wall of the retort is formed by a removable metallic cover member G covered with suitable heat insulating material G'. The ends of the retort are closed by metallic end members H and I. The coal to be carbonized, or other material to be treated in the retort, is introduced into the latter by a screw conveyor J which extends through the end wall H, and comprises a belt driven shaft J' conected by bevel gears to the conveyor shaft proper. The end wall I is formed with an outlet I' for gases of distillation this outlet being connected to gas piping K. A second outlet I^2 is formed in the end wall I beneath the shaft M for the discharge of the semi-coke or other non volatile residue of the material treated in the retort. As shown this outlet opens into a discharge spout L provided with doors L' and L^2 at top and bottom which are gravity urged into their closed position to permit the discharge of semi-coke or other solid residue while effectively preventing the outflow of gas through the opening I^2.

In the low temperature carbonization of coal and analogous operations provisions are required for agitating the material treated in the retort. The means shown in Figs. 1 and 2 for this purpose comprise a stirrer shaft M longitudinally disposed in the retort and with its ends passing through the end walls H and I, and journalled externally of the retort in bearings M, suitable stuffing boxes H^4 and I^4 being provided to prevent leakage along the shafts through the end walls of the retort. Within the retort the shaft M carries radial stirrer arms M^2 which are provided at their outer ends with paddle portions M^3 having their opposite edges inclined to correspond to the inclination of the walls of the internal groove B' which are swept by these paddle portions. As shown the arms M^2 are arranged in oppositely extending pairs, and the two arms in any one plane transverse to the shaft M are angularly disposed 90° from the adjacent arms. The shaft M is rotated through connections comprising a belt N' and bevel gears N^2, by a power driven shaft N. The shaft M may be rotated continuously in one direction, but in practice I prefer to operate the shaft M first in one direction and then in the opposite direction to avoid the concentration of the charge at one side of the retort which is experienced when the shaft M is rotated continuously in one direction.

In the low temperature distillation of coal and analogous operations there is a tendency for the material to cake between and about the stirrer arms. Trouble from this cause is avoided with the construction shown in Figs. 1 and 2 by stirrer cleaning fingers P which are moved back and forth in a vertical plane extending longitudinally of the retort. As shown the cleaner fingers P are carried by a bar-like member P' with which they unite to form a comb-like structure which extends longitudinally along the top of the retort from the charging end toward the delivery end for a suitable distance. The cleaning comb is suspended by links P^2 from transverse shafts P^3 secured at their ends in the walls of pocket-like portions G^2 of the retort roof. The comb is oscillated in proper timed relation to the rotation of the shaft M by means of a cam rib O carried by the shaft M, and having its edge working in a groove formed in the end finger P^4 of the cleaning comb. The cam O of which a development is shown in Fig. 3 is shaped to move each comb finger toward and away from the path of movement of the arms M as many times in each revolution of the shaft M as there are arms M^2 working in the same plane.

In the contemplated mode of operation of the apparatus shown in Figs. 1, 2 and 3, in low temperature carbonization the coal to be carbonized is fed into the retort continuously by the conveyor J at the proper rate, and travels slowly through the retort to the outlet end of the latter where the semi-coke formed in the retort is discharged through the outlet I^2. The distillation gases issuing from the coal escape from the retort

through the outlet I′ into the pipe K ordinarily connected to the usual apparatus for purifying and utilizing the gas and recovering by-products therefrom. The retort is heated at the bottom by the burning gases supplied through the upper ends of the arc shaped flue grooves B^2 through the burner channels F. The distillation process is facilitated, and the desired gravity flow of the charge longitudinally of the retort is effected by the action of the rotary stirrer and of the comb stirrer cleaner mechanism which prevents the material from collecting in more or less plastic masses between and around the stirrer arms. This caking tendency ceases in an intermediate portion of the operation and hence the cleaner may terminate as shown some distance from the discharge end of the retort.

Among the special advantages of the construction disclosed are the following:

The corrugated form of the retort wall portion B gives a relatively large retort heating surface which because of its thinness and shape is of uniformly high effectiveness in transferring heat. Because of the rapidity with which heat is transmitted through the wall portion B, especially when made of metal, an adequate portion of the available heat in the heating gases may be absorbed from the latter with a relatively rapid velocity of flow through the comparatively short flue grooves B^2 thus augmenting the capacity of the apparatus. The provision of the relatively large number of closely spaced heating flues each of which may be provided at its opposite ends with individual burners, facilitates the desired heat distribution longitudinally of the retort. The alternate ribs and grooves at the inner wall of the retort tend to retard the travel of the material treated axially of the retort which is ordinarily desirable. The formation of the wall structure B in comparatively small sections minimizes the tendency of the structure to crack under expansion and contraction stresses, and, coupled with the provisions for access to the interior of the retort and the manner in which the sections are held in place, facilitates speedy repairs and the ready renewal of burnt out or cracked sections.

The modification illustrated in Fig. 4 differs from the construction shown in Figs. 1, 2 and 3, in that the cam O is omitted, and the cleaner comb is oscillated by connections from the conveyor driving shaft J′. The connections shown for this purpose comprise crank pin J^2 carried by the shaft J′ and connected by a link P^6 to an arm P^5 secured to the adjacent comb suspension shaft P^3 which, in this form of my invention, is a rocker shaft to which the corresponding comb supporting arm P^2 is fixed.

In the rotary type of retort shown in Figs. 5 and 6, the wall of the retort AA proper, is formed by a corrugated metallic cylinder BB which is closed at its ends by heads H^5 and I^5. The head H^5 is provided with a hollow trunnion like extension H^{10} journalled in a suitable bearing M^{10} and carrying a gear R′ through which the retort is rotated by a gear R carried by the power driven shaft R^2. The conveyor J for feeding the coal or other material to be treated in the retort extends through the hollow trunnion extension H^{10}. The header I^5 is provided with a hollow trunnion extension I^{10} through which the unvolatilized residue of the charge passes out of the retort through a stationary member I^{15} which closes the outer end of the trunnion extension I^{10} and is connected to the gas piping K and to the discharge spout L. The extension I^{10} is provided with internal spiral ribs I^{11} to facilitate the discharge of the semi-coke. In the apparatus shown in Figs. 5 and 6 the retort is heated by burners E mounted in the outer ends of burner channels F′ which communicate at their upper ends with the flue grooves B^{20} formed by the corrugations in the wall of the cylinders BB and the adjacent portion of the retort housing CC. As shown the housing CC carries fingers Q and Q′ which enter the exterior corrugation flues B^{20} at opposite sides of the retort, the fingers Q being located just above the burner channels F′ and the fingers Q′ just above the outlet C^{30} from the flue grooves into the off-take flue C^{40}.

The retort shown in Figs. 5 and 6 is intended to be rotated continuously in the direction indicated by the arrow applied to Fig. 6. With this direction of rotation there is a tendency for the unvolatilized material in the retort to concentrate at the left hand side of the retort as seen in Fig. 6 and on this account I preferably arrange the fingers Q below and the fingers Q′ above the hollow plane passing through the axis of the retort. The rotation of the retort stirs the charge and insures a gravity feed of the latter through the retort, this feed being desirably retarded by the internal corrugation grooves B^{21} and the intervening ribs. The undue loss of heat from the upper portion of the retort by radiation is prevented by covering it with a shield shown as formed by a removable iron body GG covered with heat insulating material G, though in this form of the invention as in that shown of the other figures an advantageous characteristic is that the upper portion of the retort is not directly heated and in consequence the distillation gases which pass through this portion of the retort are not subjected to undesirable overheating.

While in accordance with the provisions of the statutes I have illustrated and described the best forms of my invention now known to me, it will be apparent to those

skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of my invention as set forth in the appended claims, and that certain features of my invention may sometimes be used to advantage without a corresponding use of other features.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A horizontally disposed retort having a bottom wall portion formed with internal hollow ribs and means for passing heating gases through the ribs longitudinally of the latter.

2. A horizontally disposed retort having a bottom wall portion in the form of a section of a cylinder corrugated to provide alternate internal and external grooves extending circularly about the cylinder axis and a retort housing formed with a cavity receiving said retort and the wall of which unites with the external corrugation grooves to provide retort heating flues, and means for passing heating gases through said flues longitudinally of the latter.

3. A horizontally disposed retort having a bottom wall portion in the form of a section of a cylinder corrugated to provide alternating internal and external grooves extending circularly about the cylinder axis and a retort housing formed with a cavity receiving said retorts and the wall of which unites with the external corrugation grooves to provide retort heating flues, burner inlet openings to said flues, and outlets therefrom for products of combustion.

4. A horizontally disposed retort having a bottom wall portion composed of separable parts uniting to form a section of a cylinder which is corrugated to provide alternate internal and external grooves extending circularly about the cylinder axis, a retort housing in which said retort is seated and which closes the outer edges of said external corrugated grooves adapting the latter to serve as retort heating flues, and means for anchoring said parts in place in said housing with freedom for relative movement of the parts and housing as they contract and expand with temperature changes.

5. A horizontally disposed retort having a bottom wall portion composed of separable parts uniting to form a section of a cylinder which is corrugated to provide alternate internal and external grooves extending circularly about the cylinder axis, a retort housing in which wall portion is seated and which closes the outer edges of said external corrugation grooves, adapting the latter to serve as retort heating flues, and means exerting a yielding pressure against the opposite side edges of said section for anchoring said parts in place in said housing with freedom for relative movement of said parts and housing as they contract and expand with temperature changes.

6. The combination with a horizontally disposed retort of a rotatable stirrer shaft longitudinally disposed in the retort and provided with stirrer arms, and a device mounted in said retort to move back and forth longitudinally of the retort, to dislodge material collecting between and around the stirrer arms.

7. In combination, a horizontally disposed retort a rotatable stirrer shaft longitudinally disposed in the retort and provided with stirrer arms, a comb-like device longitudinally disposed in said retort, and means for rotating said shaft and for reciprocating said device longitudinally of the retort in timed relation to the rotative movement of the shaft so as to dislodge material collecting between and around the stirrer arms.

8. Apparatus for low temperature carbonization of coal comprising a horizontally disposed retort having a bottom wall portion corrugated to provide alternating internal and external grooves, a retort housing formed with a cavity receiving said retort and the wall of which unites with the external corrugation grooves to provide retort heating flues, means for introducing coal into one end of the retort, an outlet at the opposite end of the retort for semi-coke, and means for agitating the charge in the retort and thereby causing it to work slowly through the retort from said one end to said outlet.

Signed at New York, in the county of New York and State of New York, this 17th day of June, A. D. 1921.

CHARLES V. McINTIRE.