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VERTICAL RETORTS WITH A SIDE DISCHARGE DEVICE

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4 Sheets-Sheet 1

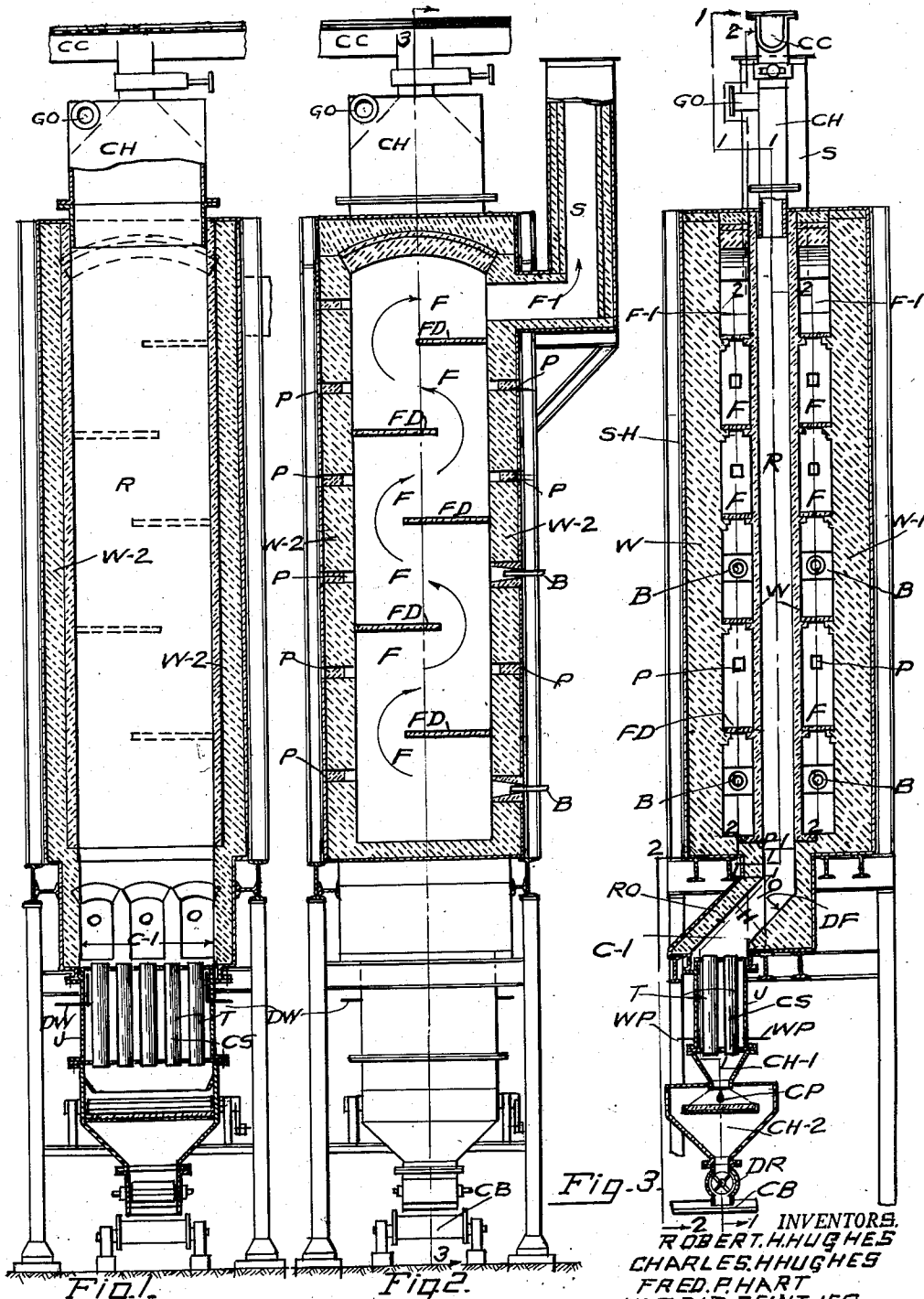


Fig. 3.

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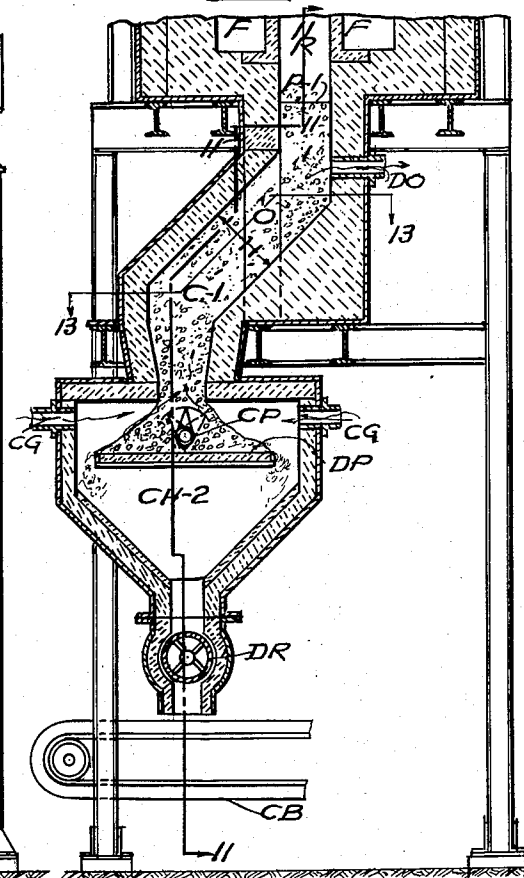
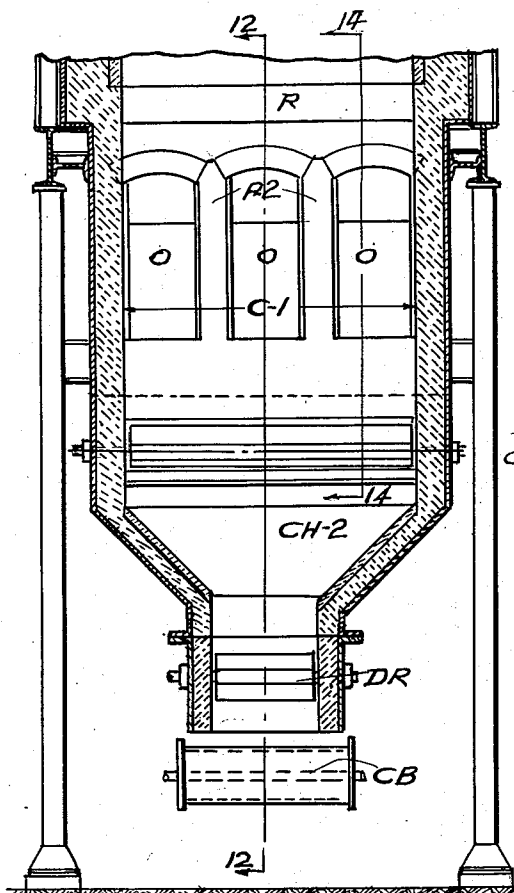
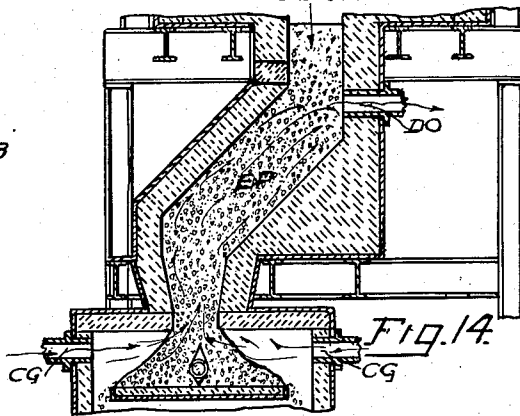
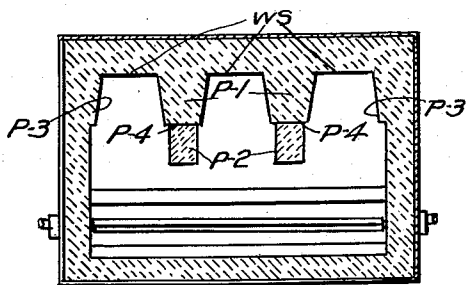
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4 Sheets-Sheet 3



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VERTICAL RETORTS WITH A SIDE DISCHARGE DEVICE

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4 Sheets-Sheet 4

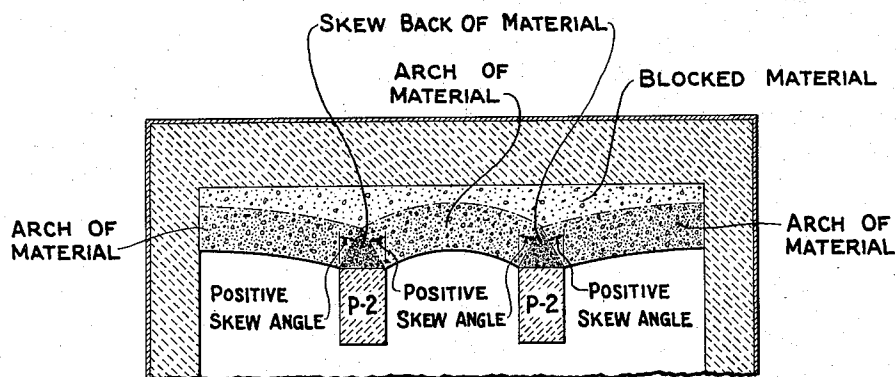


Fig. 15.

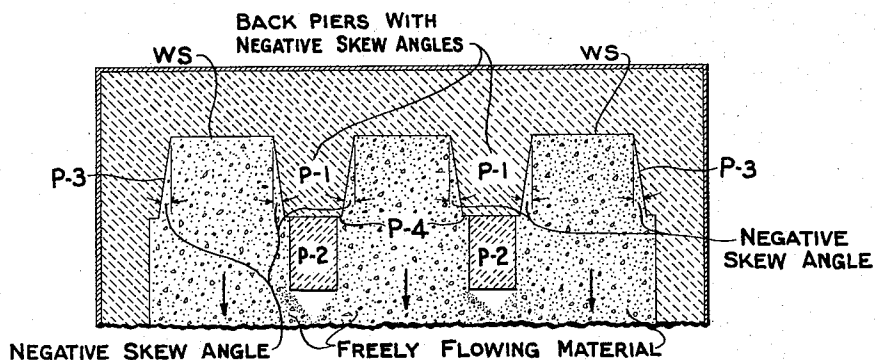


Fig. 16.

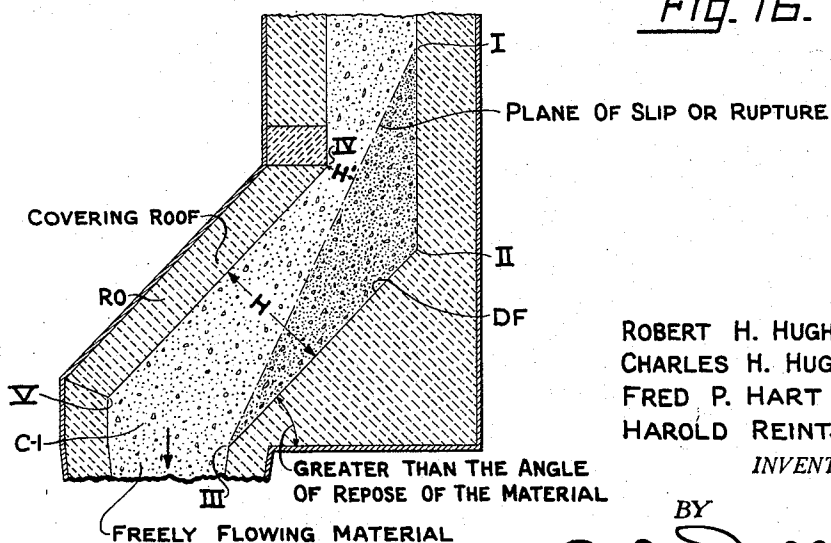


Fig. 17.

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VERTICAL RETORTS WITH A SIDE DISCHARGE DEVICE

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Application September 13, 1954, Serial No. 455,532

4 Claims. (Cl. 202—120)

The present invention relates to continuously-operated vertical retorts with side discharge devices, and, more particularly, to an improved process of operating the same for the heat treatment of carbonaceous or other materials for producing coke or carbonaceous residues or other heat treated or calcined products and for recovering by-products including volatile hydrocarbons and other compounds.

It is well known that vertical retorts have been used heretofore and that the column of finished carbon product or material including coke, char, etc., is heavy and extremely hot. Such a vertical column of hot coke, char, etc., was discharged out through a device located directly underneath and in alignment with the axis of the retort and the column of coke. The problem of supporting the heavily loaded retort shaft walls was very difficult and was complicated by thermal and other conditions of the red hot coke or other heat-treated material. The well formulated and established theories of Janssen and other authorities demonstrate that the weight of the material being processed is largely transmitted to the retort walls and thereby to the wall supports (see for example, Ketchum's "Structural Engineers' Handbook," published by McGraw-Hill Book Co., Inc. in 1924 and especially page 319).

It has now been discovered that an improved vertical retort combined with a side discharging device can operate continuously in such a manner that the carbonaceous or other materials under heat treatment travel in a continuous stream from the supply hopper downward through the externally heated vertical retort or retorts where the finished product, either hot or cooled, is first deflected sideways across a refractory slope and then mechanically discharged into quench cars or onto conveyors without detrimentally affecting the finished product or the novel discharging device or the unique supporting means for the retort.

It is an object of the present invention to provide a vertical retort side discharging device having special interior contours so shaped as to insure the free flow of the hot coke, char, or carbonaceous product from the bottom of the base of the retort onto a horizontally disposed discharge platform.

Another object of the invention is to provide a vertical retort discharging device having water-cooled means located in the discharge section of the retort to reduce the temperature of the coke, char, etc., before it is deposited upon a receiving platform which controls the throughput or capacity of the retort.

The invention also contemplates providing an improved vertical retort with an off-set discharging device which is particularly adapted for heat treating sub-bituminous coal or lignites for the removal of the "bed" moisture and volatiles and to recover the carbon residue in the form of coke, char, etc.

It is a further object of the invention to provide an im-

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proved vertical retort with an off-set discharging device having brick walls and insulating materials which are capable of protecting the retort from the heat of the hot coke, char, etc. or other hot products, as well as preventing such heat from reaching the structural steel supports.

The invention further contemplates providing an improved vertical retort with a special coke or char pusher in the off-set discharging device for discharging the char in controlled amounts into a receiving hopper and for regulating the capacity of the retort.

It is another object of the invention to provide an improved vertical retort with a novel off-set discharging device and with standard tongue and groove shapes or bricks made of silicon carbide refractory materials to insure rapid transfer of heat from the heating flues into the carbonaceous mass undergoing treatment and to keep the side walls of the retort in proper alignment and to prevent leakage of gases between the retort and the heating flues.

Still another object of the invention is to provide an improved vertical retort having a new side discharge device and having a shape suitable for handling any free-flowing carbonaceous or other material and also to provide such a retort with fuel burners so sized and located as to supply the process heat required at various elevations.

It is likewise within the contemplation of the invention to provide an improved vertical retort with a novel supporting structure and with horizontal flues in the heating system capable of insuring substantially uniform distribution of heat over substantially the entire heating flue surface of each extended side of the retort.

It is also the purpose of the invention to provide an improved vertical retort with unique supporting means and with horizontal heating flues having horizontal brick baffle shapes capable of permitting free movements of such shapes to allow for the difference in vertical expansion between the silicon carbide walls of the retort proper and the outer walls of the retort.

Among the further objects of the present invention is the provision of an improved vertical retort with a feed hopper capable of permitting the flow of hot volatile vapors coming from the retort and going through the carbonaceous material being fed to the retort to remove some of the surface moisture and finally being discharged via a gas offtake pipe near the top of said hopper under control whereby the vapors and gases thus discharged enter auxiliary apparatus where they are scrubbed and treated for the recovery of the by-products and thereafter returned to the burners for use as fuel for heating the heating flues of the vertical retorts.

Other objects and advantages will become apparent from the following description taken in conjunction with the accompanying drawing, in which:

Fig. 1 is a vertical sectional view taken on the line 1—1 of Fig. 3 through one vertical retort or chamber oven embodying the present invention and adapted to produce coke, char, etc., volatiles, gases, and by-products;

Fig. 2 is a view similar to Fig. 1 but taken on the line 2—2 of Fig. 3 through the heating system arranged in each side of the vertical retort;

Fig. 3 depicts a vertical cross section taken on the line 3—3 of Fig. 2 through the retort, heating flues and discharge mechanism including the water cooled tubes in which the temperature of the char is reduced below the ignition temperature;

Fig. 4 illustrates an enlarged vertical section of the lower part of the retort taken on the line 4—4 of Fig. 5 showing the means for cooling the char, the discharge hopper, the discharge platform, and the discharge mechanism.

Fig. 5 is a view similar to Fig. 4 but taken on the line 5—5 of Fig. 4 illustrating the side discharge outlets for

the char at the base of the retort, means for cooling the char, and the novel mechanism for discharging the cooled char into a seal valve or drop out device and onto a suitable conveyor;

Fig. 6 shows a plan section taken on the line 6—6 of Figs. 4 and 5 illustrating the contour of the wall surfaces required to insure the free flow of the char from the retort into the cooling system;

Fig. 7 is a view similar to Fig. 6 but taken on the line 7—7 of Fig. 4 to indicate the staggered position of the tubes in the char cooling system;

Fig. 8 is a fragmentary detail view showing the drive and speed reducer for oscillating the means provided for shoving or pushing the cooled char from opposite sides of the horizontal receiving platform;

Fig. 9 illustrates a plan view of the drive and speed reducer shown in Fig. 8 for controlling the speed and movement of the means used to push the char off the platform and thus to control the discharge rate of the retort;

Fig. 10 shows an enlarged fragmentary detail view of the means for shoving the cooled char alternately from opposite sides of the platform;

Fig. 11 is a fragmentary vertical sectional view taken on the line 11—11 of Fig. 12 through the bottom of a vertical retort embodying the present invention;

Fig. 12 is a view similar to Fig. 5 without the char cooling system but taken on the line 12—12 of Fig. 11 showing side openings for discharge of hot char onto the horizontal receiving platform, the char pusher, the brick-lined hopper and the discharge device;

Fig. 13 shows a plan sectional view taken on the line 13—13 of Fig. 12 illustrating the taper in the piers necessary for the free travel of the hot char;

Fig. 14 is a fragmentary vertical sectional view taken on line 14—14 through the bottom of a vertical retort illustrating means for cooling hot char with cool gases;

Fig. 15 is a schematic view of a discharge from a vertical retort showing the formation of arches of material across the supporting columns when the present invention is not embodied in the structure;

Fig. 16 is a sectional view, partly fragmentary and diagrammatic, of the side discharge outlets at the base of the retort illustrating the back piers having negative skew angles; and

Fig. 17 is a vertical section of the lower part of the retort showing the side discharge provided with a covering roof to form a closed conduit to insure the free flow of the material coming from the bottom of the retort.

Generally speaking, the present invention contemplates an improved vertical retort with a special side discharge device having a vertical shaft or heat processing section or zone R which is formed by the plurality of enclosing walls W, W-1 and W-2 and which is rectangular in shape as may be seen from Figs. 1 and 3. The walls of the heat processing section are preferably made of standard brick shapes having tongue and groove construction to prevent leakage and to keep the walls in alignment. Although the standard brick shapes can be made of any suitable refractory material, it is preferred to make them of silicon carbide to provide a rapid transfer of heat from the heating flues to the carbonaceous material undergoing heat treatment such as coal.

The heating system for the retort is located on each wide or broad side of the rectangular shaft RS and is arranged between the inner retort walls W and the outer retort walls W-1 (see Figs. 1 to 3). Each heating system is constituted of a plurality of short horizontal flues connected together to form a circuitous path. The flues are formed by horizontally disposed baffle walls made of brick shapes FD. Such an arrangement of flues directs and causes a flow of hot heating gases over substantially the entire surface of each broad side wall of the retort. It is preferred to provide burners B in selected flues, the size and location of the burners being governed by the require-

ments of the material being heat treated. The hot combustion gases flow through the circuitous heating flue system and are discharged to a waste gas stack S via flues F-1.

For the purpose of observing the progress of the combustion in the heating flue system and the taking of temperatures, an observation port P is provided in each heating flue F and on each side thereof. The brickwork can likewise be inspected through the observation ports as those skilled in the art will readily understand. For protecting the exterior of the brick structure and for preventing the infiltration of air, a steel shell S-H encases and encloses the retort except for appropriate apertures surrounding the burners, the observation ports, etc.

In carrying the invention into practice, it is preferred to employ a vertical retort which is of the order of twenty-five feet high or so, about six feet wide or so, and about one foot deep or so. The retort can carry a column of carbonaceous material, such as coal, lignite, etc. Such a column subjects the retort to a load which must be supported while the coal or the like is flowing through the retort and undergoing heat treatment.

It has been discovered that an effective manner of supporting such a load is by the use of a special side discharge device. In this device, the discharge openings or ports are constructed at a critical angle. As a result of tests, it has been found that the angle which gives satisfactory discharge of certain hot char or coke or heat-treated carbonaceous product must be greater than the angle of repose of the heat-treated material. In constructing the vertical retort and side discharge device, it is essential that the steel structural members must be protected from the heat coming from the interior of the retort by means of suitable refractory brick linings, insulating, etc. Similarly, it was found that specially designed piers had to be provided in order to direct the free flow of hot char, coke, etc., from the vertical retort into the side discharge device.

For the purpose of giving those skilled in the art a better appreciation of the advantages of the construction used in the novel structure, reference should be made to the drawings, particularly Fig. 6. The exposed vertical faces of piers 1, 2, and 3 form an obtuse angle with the wall surfaces WS. In practice, piers P-1 must be wider than piers P-2, preferably at least about one-half inch or so at the point of contact P-4. In the event this precaution is not taken, hot end products will be permanently deposited in each wall corner and will impede the flow of char. As may be seen from Figs. 3 and 5, the top of piers P-1 must be level with the bottom of the main body of the retort. Wall surfaces P-3 must have substantially the same slope as piers P-1. Side discharge ports or openings O are provided with floors DF having an angle greater than the angle of repose of the end product. It is necessary to construct roofs RO with approximately the same angle. The floors and roofs together with the side walls define and encompass closed discharge chamber C-1 which preferably has a height of about eighteen inches or so and extends across the entire width of the retort R. By this arrangement, an even distribution of the descending hot char into each tube of a cooling system CS is effected. As may be seen from the drawings, particularly Figs. 4 to 7, the cooling system CS is constructed of a plurality of vertically-disposed metal tubes T. While it is preferred to use heat-resisting and corrosion-resisting metals and alloys, nevertheless, for practical purposes heavy steel tubes may be employed. In a vertical retort having a production of about 1.5 tons of char, coke, etc., per hour, ten tubes may be employed and each tube may have a diameter of about ten inches or so and a length of about six feet or so. The outside of the tubes is surrounded by a jacket J which has an inlet pipe WP for a coolant fluid, such as cooling water, and an outlet pipe DW for such coolant. During the down-

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ward travel of the hot char, coke, etc., through the cooling system, the temperature of the hot char, etc., can be reduced from about 1700° F. to a temperature below the ignition temperature of the char, such as 600° F. As understood by those skilled in the art, the reduction in temperature can be controlled by controlling the volume of water or other coolant flowing through the cooling system as well as the velocity thereof. Cold fuel gas or cool inert gas may be passed through the hot end product, as shown in Fig. 14, to provide cooling of the product. The cooling gases under pressure enter openings or ports CG, pass upward by and continuously through the heat-treated end product EP and are discharged through outlet port and off-take pipe DO. However, it is obvious to those skilled in the art that by closing valves (not shown) in gas off-take pipe DO, the cooling gases under certain circumstances can be passed upwardly through the bed of material in the retort thereby releasing heat to increase the overall thermal efficiency of the operation. The cooling gases would then pass upwardly through hopper CH and out through gas off-take pipe GO.

From the foregoing description, the operation is obvious to those skilled in the art. Coal, lignite or other carbonaceous material to be heat treated when delivered by conveyor CC (see Figs. 1 to 3) is fed into coal hopper CH and then into retort R where it forms a vertical column. Heat from the heating flues passes through the silicon carbide walls and subjects the vertical column of coal to heat treatment. Moisture is first removed from the coal and then volatiles, such as hydrocarbons, etc., via gas off-take pipe GO (see Figs. 1 to 3). After removing moisture, gases, and desired volatiles, the residual carbonaceous material is subjected to such further heat treatment as required to produce the desired char, etc. The hot char, coke, etc., passes through the side discharge device via side-angle ports or openings O into the discharge chamber C-1. From this chamber, the hot char is cooled by passing through cooling tubes T of the cooling system or by gas cooling (Fig. 14), and then flows to hopper CH-1 and onto a horizontal discharge platform DP. From such a platform, the cooled char is continuously displaced on each side by the lateral movement of a reciprocating pusher CP. Such movement causes the char to fall into discharge hopper CH-2. The char, coke, etc., falling into the discharge hopper can be discharged by the rotation of discharge valve DR which drops the discharge char, coke, etc., onto a belt conveyor CB. By the use of the discharge valve, infiltration of air into the retort is prevented.

The high temperatures required for heat processing the coal to drive off the "bed" moisture, gases and volatile matter produces a char, coke, etc., which leaves the retort at temperatures between about 1500° F. and about 2400° F. It will be recognized that the steel-work supporting the retort must be protected from the heat radiating from the hot char, coke, etc. Such protection can best be provided by special discharge means constructed of refractory materials with heat resisting and insulating properties. The slope and contour of the side discharge flues must be designed to provide a free flow of the char and prevent the char from packing into a solid mass as it would if supported on a flat base and herein resides an important aspect of the invention.

The movement and timing of the char pusher CP, which is constructed of suitable material, can be regulated by the use of a speed reducer SR. The length of stroke of the char pusher CP can be regulated by changing the place where lever L is attached to holes in the graduated diameters of concentric rings on Cam CM (see Figs. 8 and 9). The speed of discharge valve DR can be regulated by speed reducer SR' which is operated by motor M'.

A modified embodiment of the invention is illustrated in Figs. 11, 12, and 13 of the drawings. Generally speak-

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ing, the modified structure is similar to the one shown in Figs. 1 to 10 except that the water-cooling system CS has been omitted. In the modified embodiment, the treated carbonaceous product goes directly to the discharging device as may be clearly seen from Fig. 12. Fig. 14 illustrates the utilization of gas cooling in this embodiment.

While the complete theory underlying the flow of material, particularly highly heated material such as red hot coke or calcined or roasted products, in, through, and from a vertical retort or the like with a discharge device has never been fully explained as far as is known, it is believed that the following description, taken in conjunction with Figs. 15, 16 and 17, will assist in giving a better understanding of the invention. Referring more particularly to Fig. 15, it will be observed that the flow of hot material is inhibited by columns P-2. Hot material becomes compacted behind the columns in the shape of positive skew backs which are readily recognized as and known to be arch-supporting elements. The discrete or particulate material then bridges and forms arches of its own and thereby prevents the flow of subsequent or pursuing material through the outlet ports in the sloping side of the discharge device.

Now referring more particularly to Fig. 16, it is to be observed that special refractory back piers P-1 have been incorporated in the novel structure in the retort shaft and behind the retort wall supporting columns P-2. These special back piers have a negative skew angle and have a width wider than that of columns P-2. Their presence prevents compaction of material behind columns P-2 and their negative skew shape does not permit arches of material to form within the flowing particulate or discrete material. By providing this novel structure, material which has been processed in the retort then flows freely and uninterruptedly through the side outlet ports of the side discharge device.

By referring to Fig. 17, it will be clearly seen that there is a continuation of the material flow. When the material is permitted to flow out under point IV at its natural angle of repose, then the triangle of material I-II-III is set up and become stationary. It will be observed how it effectively and substantially restricts the cross section of flow. Under such conditions, material is free to flow only through a restricted throat H'. The material within the triangle I-II-III is, as is well known to those skilled in the art, stationary and forms a false bottom I-III down which the flowing material slides.

By utilizing the novel combination embodied in the present invention, the foregoing undesirable formation and flow and their deleterious effects have been overcome by providing a roof cover RO, thus forming a closed conduit. When material flow is thus confined in a closed conduit, a full cross section H of that conduit is effective. The material flowing does not become accumulated and clogged as in triangle I-II-III and the flow restricted to throat H'. The full cross-section of the conduit H is then completely utilized by the flowing material.

The novel combination of structural elements makes possible, for the first time, a free and uninterrupted flow of material permitting truly continuous retorting operation. The side discharge outlet permits the use of structural supports remote from the high temperature zone which avoids detrimental effects on the strength of the steel or other material of construction used in the supports.

It is to be observed that the direction of flow of granular solids from the bottom of a body or column thereof in a container having a restricted outlet is not along the angle of repose of about 37° from the horizontal but is along the angle of the plane of rupture of about 70° from the horizontal. It was found as a result of experimenting and testing that the same flow conditions were found to prevail in vertical retorts provided with a sloping floor. In these experiments, it was likewise found

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that unless the side discharge opening or port was so high as to make the retort virtually inoperable, discharge of hot solids was much too uncertain for successful operation. Then, again, when the floor was constructed at an angle equivalent to that of the plane of rupture, or at a lesser angle where the material itself built up to the aforesaid angle and, in effect, acted as a false bottom, the results were equally unsatisfactory.

A further difficulty encountered in conducting a stream of granular solids through restricted openings or ports is that of arching or bridging of material behind the columns supporting the structure surrounding the ports. So long as the angle of the walls of the restricted section through which the material must pass is such that the material can bear against it without slipping, a natural arch of material will form and will act as a dam against and will prevent further movement.

Those skilled in the art appreciate the difficulty of maintaining steel supports in close proximity to a hot charge in a vertical retort. Under such conditions, it is desirable to provide a bulwark of refractory or insulating material between the steel supports and the hot materials in the vertical column constituting the charge. By combining such bulwark of refractory or insulating material with a sloping floor and by encompassing said floor with sides and a roof to form a closed conduit, it has been found possible to effect a suitable flow of the hot material of the charge even though peculiar flow conditions prevail when the material is withdrawn from the bottom of the column.

It is to be understood that the aforesaid difficulties can be overcome by providing an off-set or a side discharge device for a vertical retort in the form of a closed sloping conduit having a sloping floor and having substantially the same cross sectional dimensions as those of the vertical retort. It has been discovered that the desirable angle of the sloping floor is an angle which is just sufficiently greater than the angle of repose to effect a free flow of material. As a result of experimentation, it has been found that the closed conduit, which can most advantageously be employed, is one having a sloping floor with an angle of about 45°, to the horizontal or slightly greater. It is preferred that too great an angle should not be used, otherwise there is a tendency to restrict the area of the passage between the vertical shaft or column and the closed conduit. The wall of the retort through which the sloping conduit is led must be supported on refractory columns which carry the load to the protected steel supports.

It is also to be noted that the present invention has many features. For instance, one feature of this invention is to provide piers in the retort shaft behind the wall supporting columns of cross sectional shape such that a negative skew angle will be provided to prevent bridging or arching. Still another feature of this invention is to provide a special pushing or distributing device incorporated in the retort below the discharge end of the sloping discharge conduit. In vertical retorts of the types heretofore used by the prior art, treated materials have been delivered from the treating zone directly to mechanical valves of the type designed to prevent influx of air, such as the well-known rotary star valve. Such prior valves are, however, rough in their action, so that considerable attrition of the treated material results from the grinding action inevitably occurring when the vanes of the valve are full of material. When the treated material is soft or brittle, as is the case with coal char, and other similar carbonized products, the percentage of fines produced in the valve is inordinately high, representing a serious economic loss. While a mechanical discharge valve is employed at the bottom of the present vertical retort, it is interposed between the discharge conduit and a distributing device consisting of a platform and a specially shaped pusher. When this

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pusher is actuated, the solid material is gently pushed outwardly and falls over the edge of the platform and flows gently down the walls of the hopper feeding the valve. Thus, the valve is never filled to capacity and as a result there is little grinding action exerted on the material.

It is likewise to be observed that the present invention provides a novel vertical retort for heat treating solid materials, particularly carbonaceous materials, in the form of particles, aggregates, lumps, and the like, in which such materials may be caused to flow through the vertical retort as a continuous stream. By reason of the features of the invention including the sloping discharge conduit, negative skew piers, and pushing device, the treated material is so gently heat treated and handled that break-up of material is reduced to a degree never before equalled or even approximated in the prior art.

Furthermore, the present invention provides for the heat treatment of carbonaceous material, removal of "inbound" water, volatiles, tars, and aromatics, such as light oil, and recovery of the solid residue which can be used in the operation of electric furnaces for burning phosphate rock, etc.

Moreover, the invention provides means for heat processing lignite for the recovery of a dehydrated carbon fuel and valuable by-products in the form of tars and gases are evolved. It has been discovered that large quantities of montan wax can be recovered by distilling the tars and scrubbing the evolved gases from lignite.

While it is to be understood that any suitable pushing or distributing mechanism can be employed in the discharge device at the bottom of the retort, it is preferred to use the one which has been invented by Robert H. Hughes and Fred P. Hart and which is illustrated in Figs. 1, 3, 4, 5, 8, 9, 10, 12 and 14 hereof.

Although the present invention has been described in conjunction with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention, as those skilled in the art will readily understand. Such modifications and variations are considered to be within the purview and scope of the invention and appended claims.

We claim:

1. In a continuously-operated, vertical retort having a rectangular cross section and heated indirectly by external flues capable of heat treating solid material including the carbonization of carbonaceous material and the production of red hot coke and other hot products, the improvement which comprises a refractory deflector floor located directly under the retort to support the vertical, rectangular column of hot material undergoing heat treatment and extending from a broad side of the rectangular retort to beyond the axis of the retort and the other broad side thereof, said deflector floor having a slope greater than the angle of repose of the heat-treated material after heat treatment and being constituted of a substantially flat sliding surface, a plurality of front piers and associated arches supporting said other broad side of said retort to provide side discharge ports for the heat-treated material, back piers having negative skew angles and extending from said front piers to the wall surface of said first named broad side of said retort, said back piers being wider than said front piers at the plane of junction to prevent the depositing of heat-treated material and the impeding of flow of said material, a covering roof located over said deflector floor at approximately the same angle thereof and defining and encompassing a closed discharge chamber with said floor and side walls, said discharge chamber communicating with said side discharge ports, supporting means positioned underneath said deflector floor, covering roof and side walls to support the same together with the vertical, rectangular column of material undergoing heat treatment in the retort and the hot heat-treated ma-

terial being discharged therefrom, said supporting means being protected from the heat coming from the interior of said retort, and discharging means mounted under said discharge chamber to remove free-flowing hot heat-treated material.

2. In a continuously-operated, vertical retort having a rectangular cross section and heated indirectly by external flues and capable of heat treating solid material including the carbonization of carbonaceous material and the production of red hot coke and other hot products, the improvement which comprises a refractory deflector floor located directly under the retort to support the vertical, rectangular column of hot material undergoing heat treatment and extending from a broad side of the rectangular retort to beyond the axis of the retort and the other broad side thereof, said deflector floor having a slope greater than the angle of repose of the heat-treated material after heat treatment and being constituted of a substantially flat sliding surface, a plurality of front piers and associated arches supporting said other broad side of said retort to provide side discharge ports for the heat-treated material, back piers having negative skew angles and extending from said front piers to the wall surface of said first named broad side of said retort, said back piers being wider than said front piers at the plane of junction to prevent the depositing of heat-treated material and the impeding of flow of said material, a covering roof located over said deflector floor at approximately the same angle thereof and defining and encompassing a closed discharge chamber with said floor and side walls, said discharge chamber communicating with said side discharge ports, supporting means positioned underneath said deflector floor, covering roof and side walls to support the same together with the vertical, rectangular column of material undergoing heat treatment in the retort and the hot heat-treated material being discharged therefrom, said supporting means being protected from the heat coming from the interior of said retort, cooling means connected with said discharge chamber to cool the hot, heat-treated material, and discharging means mounted under said closed discharge chamber to remove free-flowing hot heat-treated material.

3. In a continuously-operated, vertical retort having a rectangular cross section and heated indirectly by external flues capable of heat treating solid material including the carbonization of carbonaceous material and the production of red hot coke and other hot products, the improvement which comprises a refractory deflector floor located directly under the retort to support the vertical, rectangular column of hot material undergoing heat treatment and extending from a broad side of the rectangular retort to beyond the axis of the retort and the other broad side thereof, said deflector floor having a slope greater than the angle of repose of the heat-treated material after heat treatment and being constituted of a substantially flat sliding surface, a plurality of front piers and associated arches supporting said other broad side of said retort to provide side discharge ports for the heat-treated material, back piers having negative skew angles and extending from said front piers to the wall surface of said first named broad side of said retort, said back piers being wider than said front piers at the plane of junction to prevent the depositing of heat-treated material and the impeding of flow of said material, a covering roof located over said deflector floor at approximately the same angle thereof and defining and encompassing a closed discharge chamber with said floor and side walls, said discharge chamber communicating with said side discharge ports, supporting means positioned underneath said deflector floor, covering roof and side walls to support the same together with the vertical, rectangular column of material undergoing heat treatment in the retort and the hot heat-treated material

being discharged therefrom, said supporting means being protected from the heat coming from the interior of said retort, cooling means connected with said discharge chamber to cool the hot, heat-treated material and constructed of a plurality of vertically-disposed metallic tubes, and discharging means mounted under said discharge chamber to remove free-flowing hot heat-treated material including a discharge hopper and valve permitting the discharge of material while preventing the infiltration of air into the retort.

4. In a continuously-operated, vertical retort having a rectangular cross section and heated indirectly by external flues and capable of heat treating solid material including the carbonization of carbonaceous material and the production of red hot coke and other hot products, the improvement which comprises a refractory deflector floor located directly under the retort to support the vertical, rectangular column of hot material undergoing heat treatment and extending from a broad side of the rectangular retort to beyond the axis of the retort and the other broad side thereof, said deflector floor having a slope greater than the angle of repose of the heat-treated material after heat treatment and being constituted of a substantially flat sliding surface, a plurality of front piers and associated arches supporting said other broad side of said retort to provide side discharge ports for the heat-treated material, back piers having negative skew angles and extending from said front piers to the wall surface of said first named broad side of said retort, said back piers being wider than said front piers at the plane of junction to prevent the depositing of heat-treated material and the impeding of flow of said material, a covering roof located over said deflector floor at approximately the same angle thereof and defining and encompassing a closed discharge chamber with said floor and side walls, said discharge chamber communicating with said side discharge ports, steel supporting means positioned underneath said deflector floor, covering roof and side walls to support the same together with the vertical, rectangular column of material undergoing heat treatment in the retort and the hot heat-treated material being discharged therefrom, said steel supporting means being protected from the heat coming from the interior of said retort by refractory and insulating means, and discharging means mounted under said closed discharge chamber to remove free-flowing hot heat-treated material.

References Cited in the file of this patent

UNITED STATES PATENTS

464,834	Dubbs	Dec. 8, 1891
1,228,879	Bueb	June 5, 1917
1,415,061	Smith et al.	May 9, 1922
1,698,345	Puening	Jan. 8, 1929
1,713,032	Debauche	May 14, 1929
1,772,189	McIntire	Aug. 5, 1930
1,838,622	Herrick	Dec. 29, 1931
2,167,503	Gilles	July 25, 1939
2,342,862	Hemminger	Feb. 29, 1944
2,519,340	Bailey	Aug. 22, 1950
2,560,767	Huff	July 17, 1951
2,702,269	Geller	Feb. 15, 1955

FOREIGN PATENTS

225,487	Switzerland	May 1, 1943
	(Addition.)	
669,420	France	Aug. 3, 1929
881,354	France	Jan. 22, 1943
1,069,343	France	Feb. 10, 1954
371,962	Great Britain	May 5, 1932
672,168	Great Britain	May 14, 1952
142/36	Australia	Aug. 7, 1936
115,290	Australia	June 4, 1942