

Oct. 15, 1935.

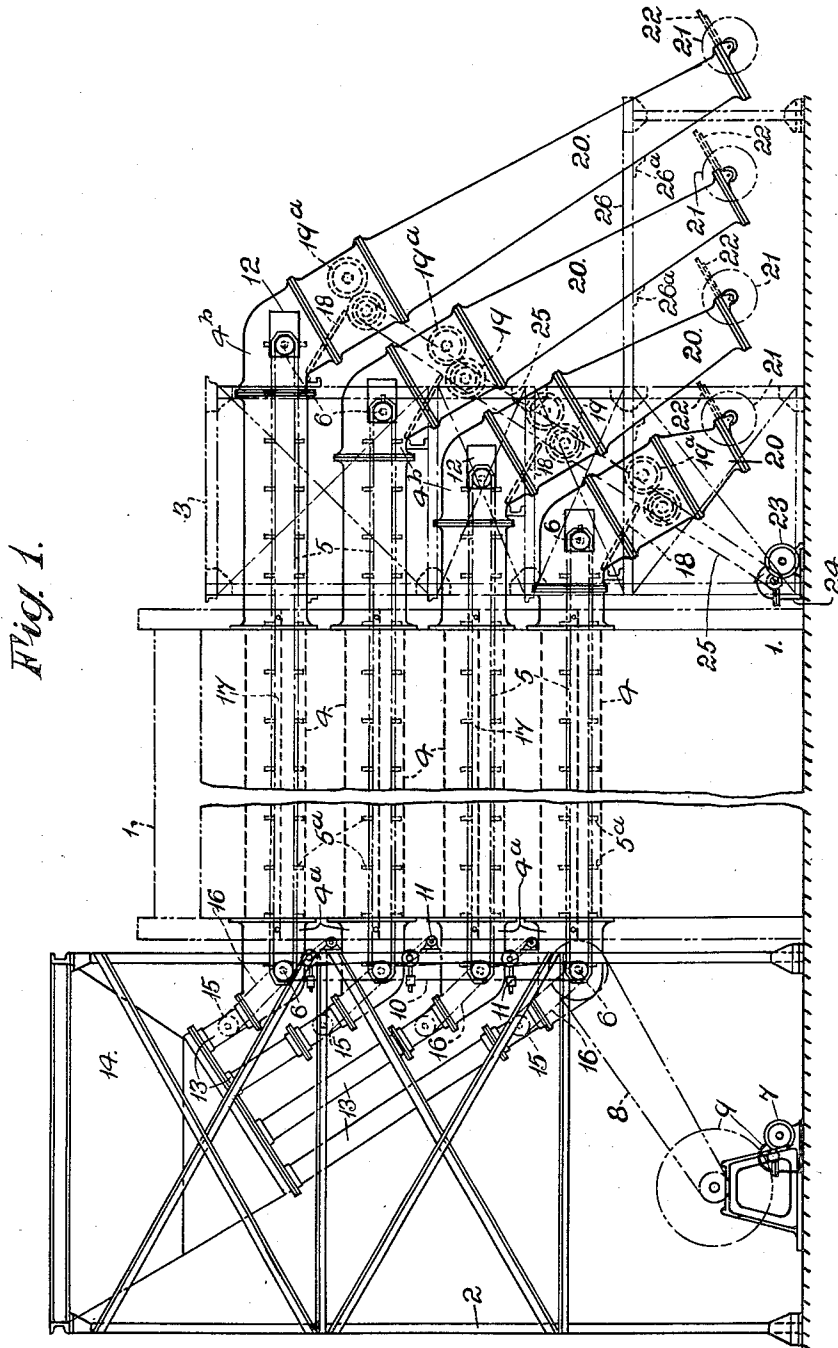
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2,017,442

DISTILLATION OF FRAGMENTARY MATERIALS

Filed April 30, 1932

4 Sheets-Sheet 1



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DISTILLATION OF FRAGMENTARY MATERIALS

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4 Sheets-Sheet 2

Fig. 2.

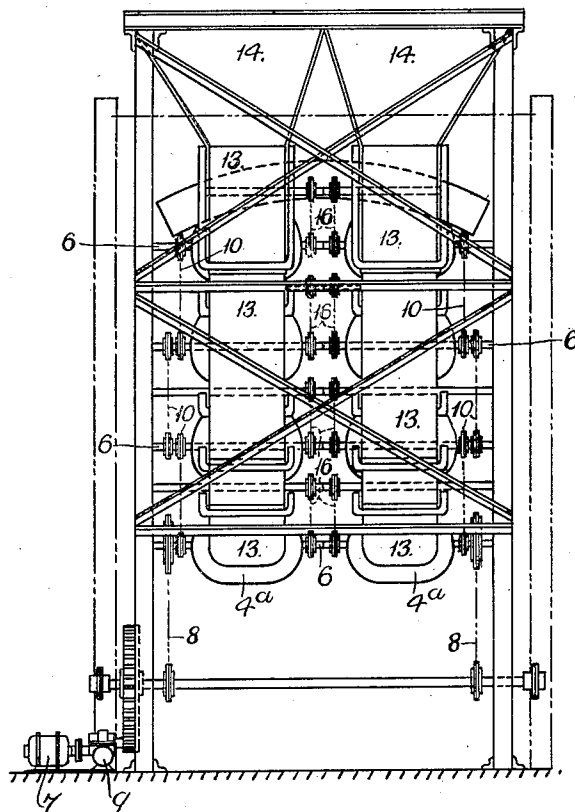


Fig. 3.

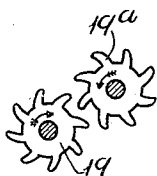


Fig. 4.

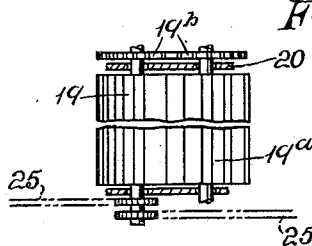
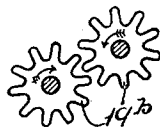


Fig. 5.



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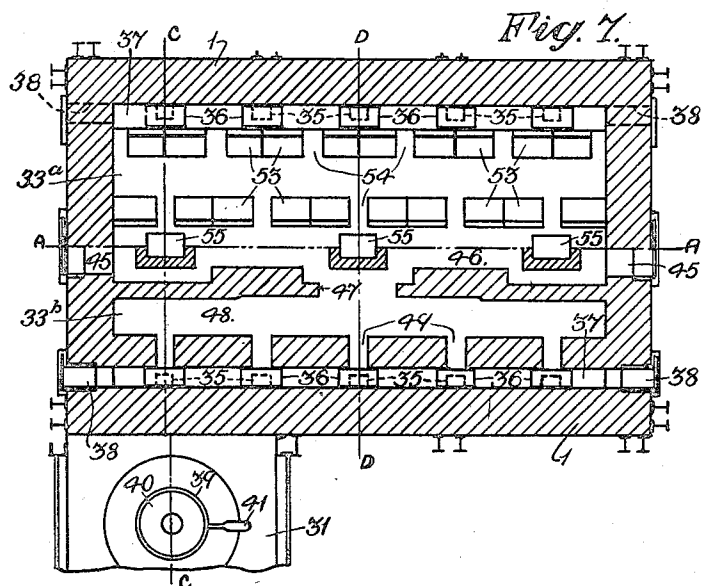
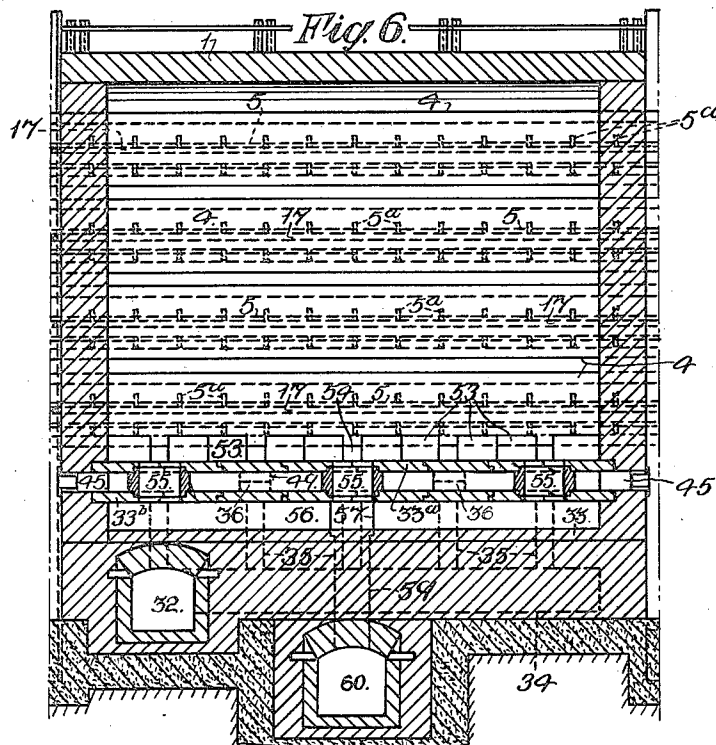
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DISTILLATION OF FRAGMENTARY MATERIALS

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4 Sheets-Sheet 3



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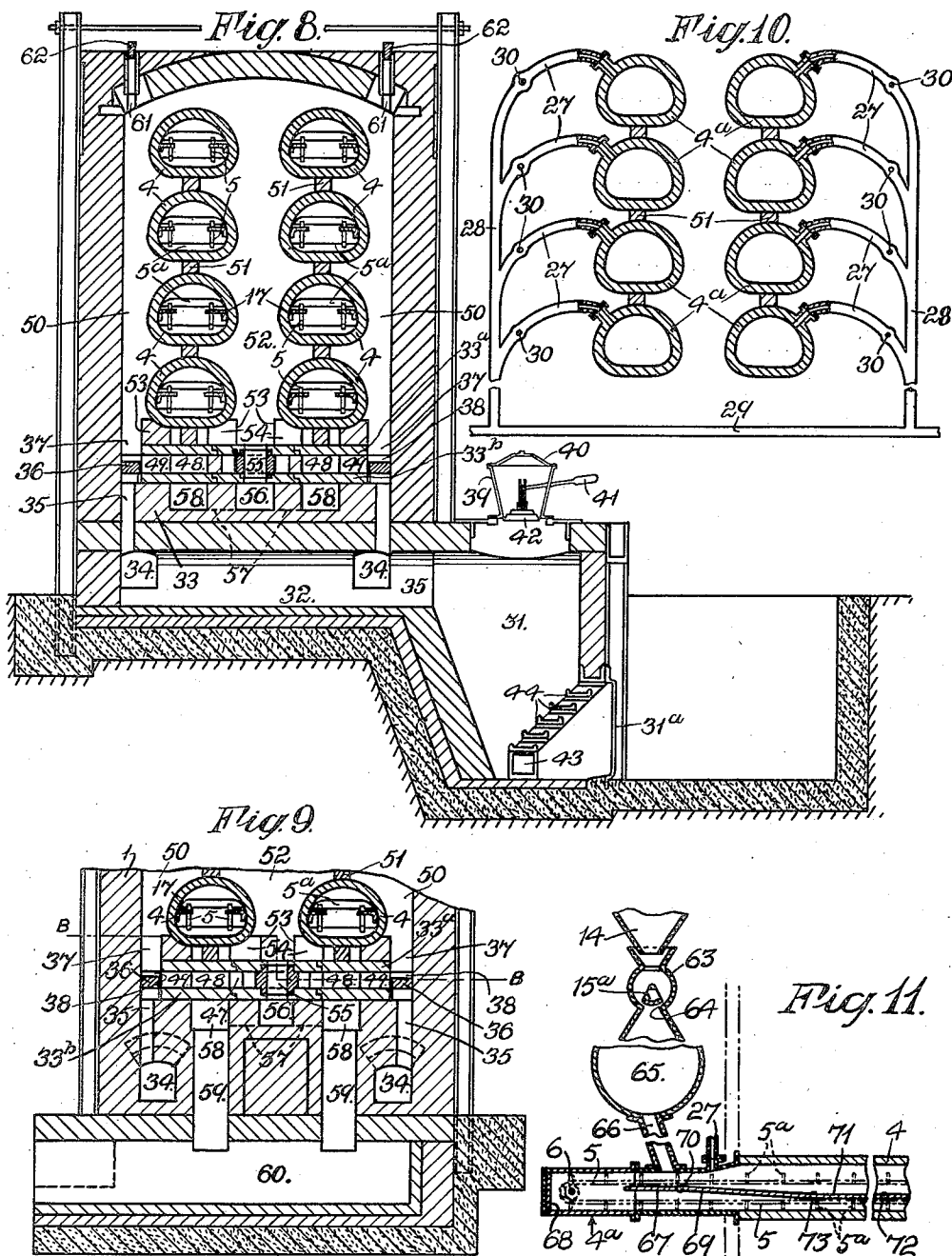
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DISTILLATION OF FRAGMENTARY MATERIALS

Filed April 30, 1932

4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,017,442

DISTILLATION OF FRAGMENTARY
MATERIALS

Samuel Moore, Hoylake, England

Application April 30, 1932, Serial No. 608,545
In Great Britain April 30, 1931

2 Claims. (Cl. 202—117)

This invention relates to the distillation, calcination, or heat treatment of coal, shale, peat, wood, and other suitable fragmentary solid or semi-solid materials according to the method in which the material is delivered into externally heated horizontal retorts and conveyed there-through in contact with the floors thereof and in a series of separate charges by conveyors of push plate type.

The present invention provides an improved method of and apparatus for carrying out such a process, and is distinguished in that the material under treatment is conveyed through a plurality of stationary horizontal or substantially horizontal retorts by means of individual conveyors of push plate type one of which extends through and operates in each retort, and the retorts are all externally and simultaneously heated by admitting a suitable gaseous heating medium—such as producer gas or steam—into the hollow interior of a common heating jacket or chamber surrounding the retorts through a plurality of inlets which are so spaced and controlled as to provide for desired temperature regulation of each retort throughout the heated portion thereof.

Gaseous heating medium—such as producer gas—may be circulated through interconnected passages in the floor or/and side walls of the common retort-heating chamber, and a controlled supply of supplemental secondary air for supporting combustion of the gas may be similarly circulated through other interconnected passages in the floor or/and side walls and preheated by the gaseous heating medium prior to its entry into the interior of the retort-heating chamber, such preheated air being preferably delivered through spaced floor ports or inlets into the gaseous heating medium immediately on entry into the retort-heating chamber.

Various operative elements of the apparatus, such as conveyor chains, delivery valves and crushers, are preferably actuated by suitable driving means located outside the retort-heating chamber.

If so desired, means may also be provided to compress or prevent undue expansion of the coking charges of material during their passage through the retorts.

Other and additional features of my invention are hereinafter described and pointed out in the claiming clause concluding this specification.

I will further describe my invention with the aid of the accompanying sheets of explanatory drawings which illustrate, by way of examples only, apparatus more particularly intended for the

low temperature carbonization of coal or the like.

In said drawings:—

Fig. 1 is a side elevation and Fig. 2 a feed-end view of one form of apparatus.

Figs. 3 to 5, inclusive, are detail views, drawn to an enlarged scale as compared with the preceding figures, of one of the crushing devices or appliances illustrated in Fig. 1.

Figs. 6 to 9, inclusive, illustrate the construction of the retorts and the common retort-heating chamber or setting; Fig. 6 being a longitudinal section taken as on line A—A Fig. 7; Fig. 7 a sectional plan taken as on line B—B Fig. 9; Fig. 8 a transverse section taken as on line C—C Fig. 7; and Fig. 9 a similar section taken as on line D—D Fig. 7.

Fig. 10 illustrates—more or less in diagram—a discharge pipe line arrangement at the feed end of the retorts.

Fig. 11 illustrates an alternative construction. In the several views like characters of reference denote like or equivalent parts wherever they occur.

Referring first to the apparatus illustrated in Figs. 1 to 10, inclusive, 1 generally designates a hood, casing, or setting constructed of suitable refractory material and 2, 3 denote metal frames erected at the respective ends of the setting and suitably connected together so as to support various operative parts of the apparatus.

Said refractory casing or setting 1 constitutes a common heating jacket or chamber for a plurality of stationary retorts 4 which extend horizontally through the interior of the chamber and are arranged in two sets, each set consisting of four retorts positioned one above another in suitably spaced relationship, the respective pairs of laterally-aligned retorts being correspondingly spaced, as shown to provide a structure which, whilst compact, possesses large output capacity.

Each retort proper 4 is in the form of a tube or conduit semi-cylindrical in cross section of fireclay, or other suitable refractory material, extending through the common chamber 1 which is heated as hereinafter described so that said retorts will be externally heated throughout their lengths. The retort extensions 4a, 4b—which are of metal—project externally of the surrounding heating chamber 1 and are supported by said metal end frames 2, 3 of the structure; and the conveyor driving mechanism is also located externally of chamber 1. Thus likelihood to fracture of these parts due to temperature variations is minimized, and access for repair and renewal facilitated.

The individual push plate conveyors 5—one of which extends longitudinally through and operates in the interior of each retort 4—are all driven through the medium of toothed or other suitable gear wheels mounted on cross shafts or spindles 6 passing transversely through the inlet and outlet extensions 4a, 4b, respectively of the retorts, the conveyor shafts at the inlet extensions 4a of the lowermost retorts being operatively connected with a variable speed electric motor 7 by means of chain-and-sprocket gearing 8 and speed reduction gear 9; whilst the conveyor shafts 6 at the inlet extensions of the other retorts are operatively connected by sets of chain-and-sprocket gears 10 with the lowermost conveyor shafts, so as to operate in unison with these shafts when said driving motor 7 is set in motion to cause the push plates 5a of the endless conveyors 5 to traverse the retorts at a constant rate of travel, say—when coal is being treated—three quarters of an inch per minute. The several chains of the gears 10 are tensionized by means of weight or jockey pulley devices 11 mounted on the end frame 2, and the chains of the retort conveyors 5 are maintained taut by the aid of screw-type or other suitable tensioning devices, which act upon the conveyor shafts 6 disposed at the outlet or discharge ends of the retorts, and are enclosed within removable cover plates or boxes 12 attached to the extensions 4b of the retorts. Where the conveyor shafts 6 pass through the retort extensions 4a suitable bearing joints are provided to seal the wall openings.

The extensions 4a of each set of retorts individually communicates by way of inclinedly-arranged delivery trunks or conduits 13 with a common supply hopper or bin 14 mounted upon the end support frame 2 above the inlet ends of the several retorts, so that the material to be treated, when delivered into said hoppers, will gravitate to the retorts through the separate branch trunks or conduits. In order to control or regulate the delivery of material to be treated into the retorts from said common supply hoppers, there is fitted in each branch conduit 13, a substantially gas-tight rotary delivery valve 15 of any suitable—say cruciform—type which is rotated at a rate coinciding with the linear movement of the particular retort conveyor 5 it is arranged to feed by means of a chain-and-sprocket gear 16 driven from the conveyor shaft 6 disposed at the inlet end of the retort. The transfer capacity and rate of rotation of each of said feed valves 15 are so predetermined in relation to the linear speed, and spacing and size of the push plates 5a of each conveyor 5, that at each delivery operation it (the valve) will admit into its retort a charge of material just sufficient to fill a compartment between two adjacent push plates to a height approximately equal to that of a push plate. For example, a retort with a floor or base twenty-four inches in width may be fitted with a conveyor having a series of push plates two to two and a half inches in height spaced nine inches apart. The comparatively small quantity of material forming the separate charges delivered into the retorts is of importance to the efficient working of the apparatus: and, moreover, the rate of feed of material into a compartment of a retort conveyor, compared with the operative movement of the conveyor, is such that a charge will be of uniform depth or thickness.

By introducing a charge of material in the manner described and subjecting it to the heat

treatment almost immediately on entering the retort (the retort extensions 4a, as shown in Fig. 1, being short in length to ensure rapid admission of the charges into the retorts 4) the particles of material in contact with the floor of the retort abut against each other and at once commence to consolidate and adhere together and there is created a thin binding skin or film of carbonized material in contact with the part of the retort floor between adjacent push plates 5a which are conveying the charge through the retort; such skin or film slides freely along the floor of the retort and acts as a support base for the bulk of the charge as it travels along the retort in order that the heat will gradually and uniformly penetrate the charge to distill or extract therefrom all the useful products resultant on the treatment and so that the desired degree of consolidation will be effected at or near the discharge end of the refractory portion or heat zone 4 of the retort: the process is thus continuously and progressively carried out as the charges are slowly conveyed through the retorts.

Guide tracks 17—see Figs. 8 and 9—extending through the heat zones 4 of the retorts and anchored at their ends to the extensions 4a, 4b thereof are provided to support the top runs of the several conveyor chains, the lower runs of the conveyors being unsupported except at their ends, as shown.

After the heat treatment of the material in the apparatus, the residue is delivered through the extensions 4b of the retorts to removable inclined guide or feed plates 18 and is then fed between and acted upon by pairs of toothed, serrated, or other suitably formed rotary crushing or grinding rollers 19, 19a mounted within inclined discharge conduits 20, the residue after the extracting and grinding operation, being discharged from said conduits on the actuation of the hand-controlling wheels 21 of valve plates or dampers 22 slidably fitted at the outlet ends of the discharge conduits: said slide plates or dampers are connected with and individually operated from the hand wheels 21 by rack and pinion gearing or other convenient mechanism so that they may be moved laterally in one or other direction to open or close in substantially gas-tight manner the outlet ends of conduits 20.

In the particular arrangement shown, the crushers 19 of the several rotary crushing devices are conveniently operated from a variable speed electric motor 23 through the medium of a speed reduction gear 24 and a train of chain-and-sprocket gears 25, whilst the other crushers 19a of the several pairs are rotated in reverse direction to the crushers 19 by means of spur wheels or pinions 19b mounted at the opposite ends of the crushers. Where the spindle ends of said crushing rollers 19, 19a pass through the discharge conduits of the retorts suitable bearing joints are provided to seal the openings.

Also, in order to permit of expansion and contraction, if any, of the discharge conduits 20, and so obviate likelihood of fracture of these parts, a secondary frame 26 is associated with the main end frame 3 to provide several appropriately-spaced cross rails 26a which act as supports for the conduits, the latter being arranged to rest upon these cross rails, being thus to be self-adjustable in response to variations of temperature.

The products of vaporizable matter resultant on the heat treatment of material in the apparatus are discharged from the feed end of the retort 4 by way of a pipe branch 27—see Fig. 10—leading

from the inlet extension 4a of the retort to a common downpipe 28 which, at its lower end, communicates with a main horizontal discharge conduit 29 wherefrom said products are recovered in known suitable manner. Individually-operable valves 30 are provided in said pipe branches 27 to control or regulate, at will, the passage of the useful products from any particular retort, such valves being also located outside the heat zone of the retorts. If so desired, the vapours produced by the treatment may be discharged from one or other or both ends of each retort in somewhat similar manner to that just indicated.

The retort surrounding chamber or jacket 1 of the apparatus, and consequently the retorts 4, are simultaneously heated by producer gas generated in a combustion chamber 31 which communicates with the interior of said heating chamber 1 by way of a horizontal conduit 32 extending transversely of the chamber beneath the floor 33 thereof and opening to spaced parallel flues 34 which extend longitudinally of chamber 1 immediately beneath the side walls thereof and communicate with a plurality of horizontally-spaced vertical inlet ducts 35 formed in the floor 33 and opening to the interior of the heating chamber adjacent to its side walls. The upper ends of said gas ducts 35 are provided with plate valves or dampers in the form of refractory tiles or bricks 36 which are slidably disposed in internal longitudinal channels 37 in the floor above the ducts and may be moved individually or collectively, and in one or other direction, as desired—by, say, a hooked pole inserted through aligned ports 38 in the end walls of the heating chamber—in order to vary the size or area of the gas inlets and so regulate, at will, the admission of the gases into the interior of the retort-heating chamber 1. By so regulating the heating of said chamber it is ensured that the respective sets of retorts 4 may be externally heated and maintained at any desired temperature so that the charges of material may be subjected, as desired, to uniform or variable heating during their conveyance along the retorts. Preferably, said wall ports 38 are normally sealed by doors or like covers.

In the arrangement illustrated, fuel for the production of the gaseous medium whereby the retort chamber 1 is heated is delivered into a supply or storage hopper or bin 39, the removable cover 40 of said bin is replaced in position, and the externally-projecting weighted lever 41 is actuated by hand to cause the conical valve 42 mounted in the base of the bin to move downwardly and permit some or all of the fuel contents to pass into chamber 31: thus the feeding of fuel into the combustion chamber 31 may be easily and safely effected. When starting up, a generous supply of atmospheric air to support combustion may be admitted to chamber 31 by opening a door 31a of the air flue 43, but during the subsequent operation of the apparatus said door is preferably closed and a restricted supply of air is admitted into the combustion chamber by way of slots or other suitable openings in the door.

Supplementary air for supporting combustion is also admitted through damper-controlled ports 45 in the respective end walls of the retort chamber 1 into a central conduit 46 created between vertically-spaced refractory floor plates 33a, 33b and extending longitudinally of the retort chamber as shown in Figs. 6 to 9, inclusive. From said conduit 46 the air travels by way of other outlets 47 into side floor conduits 48 arranged parallel

to conduit 46 and thence passes through the several horizontally-spaced inlet ports 49 into the floor channels 37 immediately above the gas inlet ducts 35. The incoming air is thus initially heated to the required extent in its sinuous course through the various passages of the refractory floor 33 of chamber 1 and is finally brought into intimate contact with the gases produced in the combustion chamber 31 immediately on entering the retort chamber to provide a highly inflammable or combustible mixture.

The gases themselves, after entry into the interior of the heating chamber 1, are directed upwardly through the side spaces 50 thereof owing to the presence of the longitudinal division walls 51 which span or bridge intermediate spaces between adjacent retorts and are thus diverted around the tops of the uppermost pair of retorts and pass downwardly through the central space 52 of the heating chamber 1: consequently, the gases act upon the whole of the exterior of the refractory retorts 4 to ensure complete heating of the same. The lowermost retorts are, as shown, mounted on refractory floor blocks 53, the spaces 54 between which constitute ports where-through the gases may enter into contact with the floor of said retorts. From the interior of the heating chamber the products resulting from the combustion of the gaseous heating medium pass by way of spaced floor ports 55 into a central conduit 56 extending longitudinally beneath the lowermost refractory floor plate 33b, then through ports 57 into side floor conduits 58 arranged parallel to conduit 56 and are discharged into a suitable outlet or chimney by way of a downflue 59 leading from each of said conduits 58 to a main horizontal discharge flue 60. It will, therefore, be seen that the hot products of combustion are caused to circulate through the various floor passages just referred to of the heating chamber 1 and the incoming secondary air for supporting combustion is heated by the waste gases as they circulate through the floor in passing from the interior of the heating chamber 1.

Cleaning and inspection apertures 61 are also preferably provided in the roof of the heating chamber, such apertures being normally sealed by means of plugs or stoppers 62.

In order to readily ascertain the temperature of the retorts, pyrometers—not shown in the drawings—are mounted in the walls or/and roof of the heating chamber 1 at suitably spaced intervals in order that heating of each retort may be controlled or regulated, at will, by appropriate setting of the gas inlet-controlling valves 36. Obviously, by these means, a retort may be uniformly or variably heated throughout its length, as may be desired. In some cases, however, heating of the retorts may be controlled or regulated automatically by pyrometer or similar temperature indicating instruments associated with suitable gas inlet-controlling valves adapted to be operated simultaneously with the actuation of the pyrometers, or the like, in response to temperature variations.

A plurality of the heat-treating structures may be operated in unison, in which case a furnace or other gas producer may be provided for individually heating each battery of retorts or for simultaneously heating all the batteries of retorts from a common source, suitable valve means being employed to control the admission of the gases into individual retort batteries when a common producer is employed. Alternatively, however, gas for heating the retorts may be supplied

to the installation from any source of supply other than a producer specially provided for the purpose; or a producer may be utilized merely for starting up the installation, the gases being subsequently generated by the plant itself.

Referring now to the alternative arrangement illustrated in Fig. 11, the lower outlet end of the supply hopper or bin 14 communicates with a small chamber 63 wherein a mechanically or manually operable pivotal plate valve 15a is disposed to control the admission of material through the inlet 64 into a supplemental container or receptacle 65 which communicates directly with the interior of the extension 4a of the retort by way of a delivery pipe or conduit 66 opening to said extension 4a above the upper chain runs of endless conveyor 5. Thus, by appropriate actuation of plate valve 15a, a supply of material sufficient for, say, two hours operation, may be admitted into the supplemental receptacle 65, so that whilst the valve is closed material may gravitate to the retort as required and escape of useful gas or vaporizable matter produced by the heat treatment by way of inlet 64 and hopper 14 is definitely prevented.

The inlet extension 4a of the retort is also made longer than those illustrated in Fig. 1 to accommodate the feed end of the conveyor 5 which extends some distance beyond the mouth of the delivery pipe or conduit 66, and a baffle or deflecting plate 67 constitutes immediately below the mouth of said pipe 66 a stationary horizontal platform in line with the upper chain runs of conveyor 5, said platform 67 being of somewhat greater length than the distance between two adjacent push plates 5a so that each push plate on the upper run of the conveyor arrives at the outer edge of the platform at the same moment as a push plate on the lower run of the conveyor reaches a corresponding position immediately below the platform. By so arranging the parts, a charge of material of required proportions will be delivered onto platform 67 between an adjacent pair of push plates and carried clear of the outlet ends of pipes 66 along the platform, from whence it is projected, in the continued movement of the conveyor, over the edge of the platform into the space between the pair of push plates moving in reverse direction along the floor of the retort extensions 4a. Thus the material is delivered into and conveyed through the retort without coming in contact with the conveyor chain-carrying wheels mounted on the cross shaft or spindle 6 at the feed end of the retort, the wheels being conveniently disposed adjacent to an inspection door or cover 68 fitted on the outer end of the retort extension 4a. The charge of material, after dropping to the floor of the extension 4a of the retort, is carried between the adjacent push plates of the conveyor towards an inclinedly-arranged partition plate

69 hingedly attached at 70 to the feed platform 67, with the result that said plate 69 acts to uniformly spread the material between the adjacent conveyor plates to a height equal to that of the push plates and the charge consequently enters the heat zone of the retort in the most desirable condition for efficient treatment.

In addition, a convenient number of retaining plates 71 hinged or pivotally attached to each other as indicated at 72 and also similarly attached to the lower extremity of the inclined spreading plate at 73 are provided to compress or to prevent expansion of the series of separate charges of material whilst undergoing treatment in the whole or in a part of the retort: such retaining plates cannot, of course, cause particles of the charges to adhere to the floor of the retort since they are normally supported above and spaced from the floor of the retort by means of the push plates 5a of the conveyor.

It is to be noted that as the discharge mouth of hopper 14 merely extends into the correspondingly-formed portion of valve chamber 63 free expansion and contraction of the metallic extension 4a of the retort and parts associated therewith are permitted and fracture or straining of the parts thereby obviated.

What I claim as my invention and desire to secure by Letters Patent is:—

1. In an apparatus for destructively distilling coal, shale and the like material, a horizontal retort having a feed opening, means for feeding material through said opening to the retort, an endless chain conveyor provided with spaced push plates and having upper and lower runs, movable through said retort, a platform intermediate the runs of the conveyor beneath said opening, an inclined partition plate having one end pivotally attached to said platform, a pressure plate pivoted to said partition plate at its opposite end, said partition and pressure plates being located intermediate the runs of the chain conveyor.

2. In an apparatus for destructively distilling coal, shale and the like material, a horizontal retort having an extension provided with a feed opening, a chain conveyor provided with spaced push plates and having upper and lower runs, movable through said retort, a platform intermediate the runs of the conveyor beneath the opening, a partition plate attached to the platform, and a series of pivotally interconnected pressure plates between the runs of the conveyor secured to the partition plate, said pressure plates cooperating with the bottom of the retort and the push plates of the lower run of the conveyor to form a series of small chambers for holding the material while the latter is destructively distilled when heat is applied to the retort.

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