This invention relates to the distillation of solid carbonaceous substances such as coal, peat or oil shale, or mixtures or blends of such substances, for the production of a smokeless fuel by distillation at low, medium or high final temperature.

The invention has among its objects to carry out the distillation in the efficient utilisation of heat and at a low cost for plant and maintenance.

The distillation is carried out within retorts or tubes of small cross-sectional dimensions suspended or supported at one end to depend vertically in close proximity in series, and caused to pass slowly and continuously or intermittently through a heating chamber of elongated vertical cross-section wherein the retorts are enclosed and subjected to heat under regulation, the retorts or tubes having lateral outlets through which the vapours and gases evolved are passed into a hydraulic main disposed in the direction of the path of travel of the retorts or tubes through the heating chamber, whereby during the evolution of gas and vapour the gas and vapour outlets of the retorts or tubes may remain immersed in the liquor in the hydraulic main beneath the edge of a wall extending downwardly into the liquor and defining a part of the width of the main that is enclosed, the liquor being exposed to one side of the wall.

The hydraulic main may advantageously be provided below and parallel with the heating chamber and the gas and vapour outlets of the retorts or tubes be positioned towards or at the lower ends of the retorts or tubes. The hydraulic main may, however, be mounted in position above the heating chamber and the retorts or tubes be provided with outlet pipes or fittings at or near the upper end of the retorts or tubes at a position above the heating chamber.

The hydraulic main is provided with the lower part extended laterally of the said wall for the exposure of the surface of the liquor in the hydraulic main for the entry of the laterally extending parts of the outlets of the retorts or tubes and where the hydraulic main is below the heating chamber such laterally extending part of the hydraulic main may serve also for the immersion of the lower ends of the retorts or tubes, whereby the said ends are sealed in the liquor and a positive air and gas-tight closure is afforded to the lower ends of the retorts or tubes, such closure functioning as a safety valve in the event of the existence of an obstruction in the gas and vapour outlet of a retort or tube.

The hydraulic main is provided at its respec-
perforated for the egress of gas and vapour from the retort or tube into an end fitting provided with the lateral gas and vapour outlet, the removable closure plate supporting the charge within the retort or tube.

The charge within a retort or tube may alternatively be supported upon a perforated supporting plate, grid or the like, disposed within the retort or tube at a short distance above the gas and vapour outlets. Such supporting plate or grid may be provided to be engaged in a removable manner with supporting lugs, catches or the like, in suitable disposition within the retort or tube. The supporting plate or grid may be pivotally mounted upon the retort or tube and may be retained in the operative position by a lug or catch which also may be pivotally mounted and adapted to be rotated automatically from the exterior of the retort or tube for the release of the supporting plate or grid.

The retorts or tubes may be grouped to form retort units and such units may be provided with end fittings which may have a gas and vapour outlet common to the retorts or tubes of the unit, which also may be closed by a common closure plate.

The invention also comprises a setting having a longitudinal heating chamber through which the retorts or tubes suitably suspended are caused to travel from end to end, the heating chamber being defined by walls that may be formed of box-bricks or other refractory bricks or of material adapted for the radiation of heat upon the retorts or tubes in their passage through the heating chamber, which walls may separate the heating chamber from a series of combustion chambers and heating flues disposed and arranged in series alternately along the length of the setting, the corresponding combustion chambers and the heating flues being in communication in such manner as to afford a tortuous path for the heating gases on their passage to a discharge flue.

The combustion chambers are advantageously provided with means for the supply of gas and air under individual control whereby the temperature in the heating flues at any position in the length of the setting may be determined.

The invention also comprises a setting comprising, in longitudinal disposition along it on each side of the heating chamber, longitudinal series of metal tubes or hollow structures extending along the length of the heating chamber of the setting and serving for the radiation of heat from the gases derived from burners provided at the one end of the tubes or structures, the waste gases being discharged at the far end of the tubes or structures to an exhaust flue. There may be provided a combustion chamber or chambers and a communicating heating flue or flues delivering the heating gases into the tubes or structures. Such series of tubes or hollow structures may be succeeded along the setting by other series or by heating flues that serve to deliver the waste heating gases to an exhaust flue.

The invention further comprises the features which are hereinafter described.

The invention is illustrated by way of example in the accompanying diagrammatic drawings.

Figures 1(a), 1(b) and 1(c) together form a longitudinal sectional elevation of a coal distillation plant according to the invention.

Figures 2(a), 2(b) and 2(c) together form a sectional plan of the plant represented in Figures 1(a), 1(b) and 1(c).

Figure 3 is a cross-section of the plant illustrated in the foregoing figures, taken on the line 3—3 of Figure 1(b).

Figure 4 is a cross-section of the plant illustrated in Figures 1(a), 1(b) and 1(c) and Figures 2(a), 2(b) and 2(c), taken on the line 4—4 of Figure 1(c).

Figure 5 is a detail sectional view to a larger scale.

Figure 6 is a side elevation, partly in section, of a retort or tube unit and suspension mechanism as used in the plant illustrated in the preceding figures.

Figure 7 is an end elevation, partly in section, of the retort or tube unit and suspension mechanism represented in Figure 6, the closure plate or door being in the open position.

Figure 8 is a part end elevation of the retort or tube unit represented in Figure 6, showing the closure plate or door in the closed position.

Figure 9 is a plan of the lower part of the retort or tube unit represented in Figure 6.

Figure 10 is a side elevation, partly in section, of a retort or tube-discharging apparatus, for use with the units represented in Figure 6.

Figure 11 is an end elevation, partly in section, of the retort or tube-discharging apparatus illustrated in Figure 10.

Figure 12 is an end elevation of a retort or tube-discharging apparatus, for use with the units represented in Figure 6.

Figure 13 is a sectional elevation, transverse to the heating chamber, of a modified coal distillation plant according to the invention.

Figure 14 is a part side elevation and part sectional elevation of the plant illustrated in Figure 13.

Figure 15 is a sectional elevation, transverse to the heating chamber, of part of another modified construction of the coal distillation plant.

Figure 16 is a longitudinal sectional elevation corresponding to Figure 15.

Figure 17 is an underside view of the two-retort unit represented in Figures 15 and 16, on an enlarged scale.

Figure 18 is a sectional elevation, transverse to the heating chamber, of a further modification in construction of the coal distillation plant.

Figure 19 is a fragmentary sectional view of the setting shown in Figure 18, the retorts being omitted.

Figure 20 is a vertical section on the line 28—29 of Figure 19.

Figure 21 is a longitudinal section in elevation of a form of heating chamber and setting, similar to that of Figures 1(a), 1(b), 1(c) and 2(a), 2(b) and 2(c).

Figure 22 is a sectional plan on the line 22—23 of Figure 21.

Figure 23 is a sectional plan of a modification of the heating furnace setting represented in Figures 21 and 22.

In carrying the invention into effect according to the construction represented, by way of example, in Figures 1 to 9 of the accompanying drawings, the retorts or tubes of steel or cast iron are provided of a small diameter, such as six inches or more or less, and of a moderate or short length, such as from five to fifteen feet, but no limitation is imposed by such dimensions. While the retorts or tubes are advantageously circular in cross-section, they may be of oblong or other form and are so disposed that the narrowest cross-sectional dimension extends across the heating chamber. The cross-section in any
form of the retorts or tubes may increase in area downwardly. The retorts or tubes may be of a heat-resisting alloy and may be in continuous lengths or formed in sections, the sections being welded or otherwise secured together.

The retorts or tubes 1, as represented in Figures 6 to 9, are grouped in a series of five in alignment to form a retort unit. They are closed off upwardly by a common closing plate 2 welded or otherwise secured to the tubes 1, the lower ends of which are welded or otherwise secured to or in a rectangular plate 3 in register with circular seatings or openings therein. The plate 3 forms the upper end of a hollow rectangular end fitting open at the lower end and having lateral walls 4, 5 and end walls 6. The wall 4 of the fitting extends downwardly short of the lower end of the fitting and is continued as an outwardly extending horizontal plate 7 flanged upwardly at its outer edge and joining at its ends lateral extensions 8 of the end walls 6. There is thereby formed a laterally extending gas and vapour outlet for the retorts or tubes 1, which discharges gas and vapour into the hydraulic main in the manner hereinafter described.

For the support of the charge within the retorts 1 there is provided a door or closure plate 9 that is common to the retorts of a unit and is adapted to close upon the lower end of an annular skirt plate 10 common to the retorts 1 and formed with perforations or louvered openings whereby the gas and vapour from the charges in the retorts may pass into the end fitting and thence escape by the outlet.

The door or closure plate 9 is pivoted by hinge pins 11 to lugs or brackets 12 provided on the inner face of the lateral wall 8 of the end fitting and is fitted at each end with a bracket 13 to which is pivoted a link 14 the outer end of which is pivotally connected to one arm of a bell-crank lever 15 having an operating arm 16. The door or closure plate 9 is maintained in the closed position under the action of a pair of leaf springs 17 anchored respectively to the inner faces of the extensions 8 of the end walls of the end fitting and carrying at their free ends rollers 18 which bear always upon cam arms 19 set in fixed relation to the levers 15 which are coupled together by the spindle 20 supported in brackets 21 on the lateral wall 5 of the end fitting.

For the support of the retort unit from the track there is provided in a middle position upon the closing plate 2 a longitudinally disposed vertical suspension plate 22 which, near the upper end, is formed with spaced holes 23 of rectangu- lar cross-section. The plate 22 also serves to support a horizontally disposed plate 24 which, with the corresponding plates of the preceding and succeeding retort units, serves to seal the longitudinal slot in the top of the heating chamber through which the suspension plates travel. The plates 24 are provided with upstanding channel fittings 25, closed at the upper ends, which are so spaced apart that the edges of the corresponding plate 22 may be slidably received therein. The plates 24 are thus supported on the plates 22 by the upper closed ends of the channel fittings 25, with freedom to move upwardly upon the plates 22 to the limited extent determined by transverse stop pins 26.

Each retort unit is provided with a detachable track carriage comprising a substantially triangular fitting 27, which supports at one side upon stud spindles, grooved truck rollers or wheels 28. Towards one end the fitting 27 is provided with an upstanding driving arm 29 and at the two ends with laterally projecting buffer plates 30 by which one carriage may contact and move another. At the lower end of each fitting 27 there is supported upon a transverse pivot pin 31 a bearing member 32 in which there is supported upon a longitudinally disposed pivot pin 33, set in the vertical plane of the track rail or track rollers or wheels 28, spaced hook members 34 in fixed relation, for engagement in the holes 21 of the suspension plate 22, the hooks being provided with an operating spur or trigger 35.

In the plant illustrated in Figures 1(a), 1(b), and 1(c) and 2(a), 2 (b) and 2(c) of the accompanying drawings there is represented a heating chamber 36 adapted to receive two lines of retort units side by side. The chamber 36 is formed in a settling 37 of refractory brick work or heat insulating material supported upon a reinforced concrete entablature 38 carried by spaced standards or pedestals 39 from a ground surface. At the lateral edges of the entablature there are provided spaced pairs of 14 section up- rights 40 that support transverse bearer members 41, also of 14 section, from which the supporting tracks for the retort units are suspended. The brickwork or material of the heating chamber is supported between the uprights 40 and spaced from the entablature for the reception below it of the hydraulic main 42, formed in heavy plate metal, the upper plates of which may support the brick work or material of the heating chamber. The latter is of rectangular cross-section and has the upper wall 43 formed with narrow longitudinal slots 44 to permit the edge-wise passage of the suspension plates 22 of the retort units and the lower wall formed with similar slots 45 of relatively considerable width to admit the retorts 1 of the retort units with adequate clearance.

Within the heating chamber there are provided four vertical series of horizontally disposed radiant tubes 46 spaced in pairs for the passage between them of the retort units with suitable clearance. The outer series of tubes 46 is supported in vertical transversely disposed bracket plates 47 having their inner edges formed with a series of pockets or recesses in which the tubes 46 are seated. The inner series of tubes 46 of the two pairs of series are similarly supported upon common transverse bracket plates 48 which may serve also for the support of the middle section of the upper wall 43 of the heating chamber.

At one end of the tubes 46 and to the outer side of the first of the bracket plates 47 and 48 there is formed in the heating chamber a combustion space 49 in which, for each series of tubes, there is provided a fuel gas burner comprising a tube 50 fitted with a burner nozzle 51, with conical head, for each tube in the particular series, the head delivering fuel gas into a Venturi bush 52 (Figure 5) fitted in the end of the tube. The fuel gas is supplied from an overhead supply pipe 53 common to the several burner tubes, by way of corresponding branch pipes 54 fitted with control cocks 55.

In order to secure effective supply to the series of burner nozzles 51 the burner tubes 50 are advantageously provided with parallel equilateral tubes 55 that are connected to the burner tubes near to the control cocks 55 and at the lower ends. At the other end the tubes 46 are set in a transverse wall 57 that separates the heating chamber 36 from discharge flues 58, 59 and 60.
which communicate at the lower ends with a waste gas flue 54 that may lead to a chimney. The walls 57 and 62 are pierced only by the passages whereby the retort units enter the heating chamber, the discharge flues also being separated from the said passages. The disposition of the burners at one end of the tubes 46 ensures that the highest temperature in the heating chamber is in the proximity of the burners and that thence the temperature falls gradually to the lowest value at the position of the discharge of the waste gases into the flues 58, 59 and 60. The retort units are thus subjected to a gradually increasing temperature as they approach the burners. As the retort units leave the heating chamber it is advantageous to subject them to cooling by passing the air for combustion into contact with them so that it arrives at the burners in a preheated condition. For the purpose the retort units are caused to travel through a massive extension 63 of the brickwork or material of the heating chamber that is formed only with the passages 64 for the retort units, the air entering by the open ends of the passages 94.

The hydraulic main 62 is formed by a base plate 65, a top plate 66 in three sections spaced apart to admit between them the retorts or tubes 1 and extending transversely to the uprights 46, side plates 67 and downwardly depending intermediate plates 68 defining the longitudinal chamber into which the gases and vapours are passed from the outlets of the retort units. At the two ends there are formed short uncovered extensions 69 of a reduced width sufficient to take with clearance the width of the end fittings of the retort units and so disposed that as the retort units enter the heating chamber 56 and leave the cooling extension 63 of the setting in the one case they may be lowered to immerse the gas and vapour outlets into the liquor in the hydraulic main so as to be below the level thereof and in the other case they may be raised to withdraw the gas and vapour outlets from the liquor.

The hydraulic main is advantageously divided into compartments by the provision of transverse partition plates 70 that extend between the intermediate plates 68 but which are symmetrically reduced in width at a level that is below the level of the liquor, to permit the passage of the gas and vapour outlets of the retort units. Each compartment is provided with a takeoff pipe 71, that acts as a weir to determine the level of the liquor in the hydraulic main and for the withdrawal of the gas and vapour which is carried away by the pipe 72. Liquor passing into the pipe 71 is drained away by the pipe 73.

The retort units are supported by their track or rail 74 formed by one flange of an angle-iron beam the second flange of which is carried upon bracket members 75 suspended from the transverse bearer members 41. Throughout the length of the heating chamber and the cooling extension the disposition of the transverse bearer members is such that the retort units are supported in the position to dispose their respective plates 24 so as to rest upon the upper surface of the brickwork of the setting and to close the longitudinal slots 46. To ensure the retention of the track rollers, or wheels 25 on the track rail 74 there is advantageously provided a guard rail 76 supported from the bracket members 75 on distance members 77. In order that the retort units may have imparted to them the movement in the vertical direction necessary to cause the gas and vapour outlets to dip or rise from the liquor, in the extensions 69 of the hydraulic main the track rail 74 is inclined in the necessary directions above the two extensions 65. Thus, when the retort units approach the admission end of the heating chamber 36 they are travelling at an elevation above which they occupy in travelling through the heating chamber the wheels 25 of the retort units are under control into the range of an endless chain 78 the lower part of which is constrained by end sprocket wheels 79 and 80 and a guiding sprocket wheel 81 to follow closely the profile of the guard rail 76. The chain 78 is driven by an electric motor 82 through a reduction gear 83 and a chain drive 84 the driven member of which is in fixed relation to the sprocket wheel 79. An auxiliary framing 85 is provided for the support of the chain 78, its driving motor 82 and the accessory elements. The tension of the chain is maintained by an adjustable guide sprocket wheel 86. Each retort unit approaches the chain 78 down a slight incline in the track rail 74 and in such a manner that the driving arm 29 of the track carriage is received between spaced sleeves 87 and 88, mounted on determining members 89 of the chain 78, the foremost sleeve 87 serving to retard the movement of the track carriage down the incline of the rail 74 and the sleeve 88 to drive the carriage forward when it has passed to the level track rail above the heating chamber. The retort units are fed through the heating chamber and the cooling extension by the chain 78, those that have passed out of range of the chain being propelled through the contacting of the rear buffer plates 30 with the forward buffer plates of the following rail 74 so that in the same time the slot-sealing plates 24 are maintained in radial contact, or nearly so, for the closure of the upper part of the heating chamber; and the cooling extension. As the retort units are about to leave the cooling extension they are moved into the range of a second endless chain 80 which follows closely the upward inclination of the track rail 74. The chain 80 is mounted upon an auxiliary framing and driven by an electric motor, as in the case of the chain 78. It requires only driving sleeves 90 set at equally spaced intervals throughout its length.

The retort units are raised by the chain 89 and the track rail 74 to a higher elevation than that from which they descend into the heating chamber, in order that they may proceed by gravity to the discharging stations and thence to the charging station. After being charged they may proceed by gravity to the position of engagement with the chain 78. A simple and convenient discharging mechanism is represented in figures 10 and 11. Each line of retort units passes to a level section of the track rail 74 where it may be moved transversely over a discharge hopper 91 which has two inlet openings 92, so disposed that a retort unit may be readily aligned with one of such openings on being inclined slightly out of the vertical by pressure applied by the plungers 93 of one of two oppositely disposed pairs of hydraulic rods 94. The door-operating arm 15 of the retort unit may be automatically operated by a cam plate 95 or the like in the lateral movement of the end fitting of the unit as it moves into position over an inlet opening 92. Each hopper 91 may deliver the product from the retort units between screening plates co-operating with a transporter or end-
less band conveyor 95 serving to deliver the product as may be desired. At the charging station the retorts units again pass to a section of the track rail 74 which is horizontal. As the retort tubes are closed at the upper ends, it is necessary to make provision for their inversion before they are charged. For the purpose there may be conveniently provided mechanisms such as that illustrated in Figure 12. The retort unit is moved into a position in which it is laterally disposed in relation to a rotatable carrier 97 supported upon a horizontal spindle by a pedestal or pedestals 98. The carrier is provided at the upper and lower ends with jaws 99 that are carried upon pivot pins set in the longitudinal direction of the carrier. Thus the jaws 99 may be caused to engage and hold the retort unit at the two ends of its cross-section. The hooks 34 may then be disengaged from the suspension plate 22 and for the purpose there is provided a vertically disposed hydraulic ram 100 the plunger 101 of which is fitted with an arm 102 to engage and depress the operating spur or trigger 35 of the hooks 34 and to rotate the hooks about their pivot pin. The retort unit may then be rotated by rotation of the carrier 97 through 180°. This movement positions the lower end of the end fitting of the unit beneath a feed pipe or pipes 103 adapted for charging all the retorts or tubes of the unit at the same time and coupled to two feeding devices 104 and 105 respectively for coal and breeze, for example, which are supplied from corresponding hoppers 106 and 107 supported upon elongated transverse bearer members 41. The door-operating arm 16 of the unit may be moved to open the door by the plunger 108 of a hydraulic ram 109. The retorts or tubes are charged first with coal and finally with a small proportion of breeze, whereupon the ram 100 is caused to permit the door to close. The unit is then restored to its normal position by a reverse movement of the carrier 97, whereupon the plunger 101 of the ram 100 is retracted to permit the hooks 34 again to engage the suspension plate 22 of the unit. The jaws 99 are then released and the charged unit is free to be sent forward upon the track rail 74 by gravity to engage the charging chute 18.

In the construction represented in Figures 13 and 14 the retorts or tubes 110 are of a diameter of six inches or more or less, or of oblong or other shape, having a narrow cross-sectional dimension. The upper ends of the retorts or tubes are inwardly flanged at 111, or alternatively outwardly flanged, to permit of the fastening thereto by means of bolts or the like of disc-like cover plates 112. The lower ends of the retorts or tubes which are adapted for dipping into the liquor in the hydraulic main 113 remain open and at a short distance from the lower edge each retort or tube is provided with a gas and vapour outlet pipe 114 extending laterally. At a determined distance above the gas and vapour outlet pipe the retort or tube is fitted with a perforated plate or grid 115 for support of the charge of the substance to be distilled. The said perforated plate or grid is removable and is mounted upon supporting lugs 116 or the like provided on the inner surface of the retort or tube. Thus, the plate or grid may be recessed at the periphery and may then be removed, the lugs at positions corresponding with those of the lugs at 116 may then be entered past the lugs and may then be turned through an angle to seat on the lugs. The said retorts or tubes 110 are charged with the closed end downwardly disposed and after the charge has been introduced there is advantageously applied upon the surface of the charge a small quantity of breeze or small pieces or "peas" of the residue of distillation of the substance being distilled, whereupon the perforated plate or grid 115 is fitted in position.

Alternatively the charge supporting plate or grid may be of fixed position within the retort and the upper closure plate may be removable for the charging of the retort.

The heating chamber 117 through which the retorts or tubes 110 travel is advantageously of a vertical section similar to but of larger dimensions than the longitudinal cross-section of the retorts or tubes that is transverse to the path of movement. The heating chamber is formed in a setting 118 which extends longitudinally for such a distance as is required to permit the retorts or tubes to be subjected to the varying stages of heat treatment. The setting is provided to be supported upon a base 119 of metal, concrete, or reinforced concrete such that the setting is elevated at a distance from the ground level that will permit of the disposition of the hydraulic main 113 below the setting in a direction parallel with the length of the heating chamber 117. Alternatively the setting may be disposed upon the ground level above a tunnel or open channel in which the hydraulic main is situated.

The retorts or tubes 110 extend downwardly through a slot or longitudinal opening 120 in the base in order that the lower ends of the retorts or tubes 110 and the gas and vapour outlet pipes 114 may be immersed in the liquor in the hydraulic main 113.

The retorts or tubes 110 are suspended from a track or rail 121 comprising an I section beam by a suspension member comprising a rod 122 or the like, the upper end of which is forked to carry sub-spindles for track wheels 123 which run upon the upper surfaces of the lower flange of the rail 121. The lower ends of the suspension members 122 are pivotally connected by pivot pins 124 mounted in lugs 125 upon the closure plates 112. The retorts or tubes may be fitted alternatively with pivot bale members to which the suspension members may be connected.

In order that the suspension members 122 may travel along the setting 118 when the retorts or tubes 110 are within the heating chamber 117 the upper part of the setting is slotted at 126 in the centre line of the track or rail 121. The slot may be closed in any suitable manner. Thus, each suspension member may be provided with a slidable mounted transverse plate 127 which at the opposite sides is provided with downwardly extending flanges that may dip into sand or other similar loose material contained in longitudinal channels 128 bounding the slot 126.

The hydraulic main 113 is disposed below the setting, as in the case of the construction previously described, and is a tank-like structure extending longitudinally. To receive the gas there is provided, for a little less than half the width of the main, a dome-like closure 131 forming an inner downwardly depending wall with its lower edge immersed in the liquor. The open hydraulic main extends at the two ends beyond the setting to permit the gas and vapour outlet pipes 114 of the retorts or tubes 110 to enter and leave the main, the track rail 121 being inclined at these positions. In order that the flanges of the slidably mounted plates 127 upon the sus-
pension members 122 may enter or leave the channels 126 each suspension member 122 may be provided with an adjustable collar 130 so disposed that when the suspension member rises or falls on following the inclined parts of the track rail 121 the said collars may rise into contact with or move out of contact with the slidably mounted plates.

The modified construction represented in Figures 15 to 17 the retorts or tubes 131 are provided in pairs that are connected together at the ends to form a unit.

The lower ends of the retort units are closed by perforated closure plates 132 mounted pivotally in bearings provided in the end fitting 133, the perforated plates being maintained in the closed position by means of a supporting lug 134 provided upon a vertically disposed spindle 135 mounted in bearings on the wall of the end fitting and having at the lower end an outwardly extending arm 136 whereby the closure plate may be released automatically by engagement with a suitably disposed fixed stop, as the retorts arrive at the position at which the solid residue of distillation is to be discharged therefrom.

The end fitting 133 is fitted with gas and vapour outlets 137 in the form of a lateral extension of an inverted U-shape in cross section.

The track rail 138 is supported by bracket members 139 from an overhead framework and adapted to receive carriages 140 provided with grooved wheels 141 for running upon the rail. Each carriage supports a retort unit by means of a suspension rod 142 which is suitably mounted upon the closed ends of the retorts and engaged downwardly extended part of the carrier by means of a hook or like formation 143 at the upper end.

The retorts are moved through the heating chamber by a conveyor drive comprising an endless chain 144 adapted to move about vertical axes and having laterally extending driving pins 145 for contacting with the suspension rods of the retorts.

The walls of the heating chamber 117 (Figures 13, 15 and 17) are formed of open box bricks 146 which separate the heating chamber from combustion chambers 147 and flues 148 (Figures 13 and 14) which in the direction transverse to the heating chamber are of narrow cross-section. In each case the combustion chamber is provided at the upper end with a gas burner or burners 149 (Figure 13) and with means for the admission of air for combustion so that the heating gases travel downwardly along the combustion chamber and through an opening 150 at the lower end of the wall 151 separating the combustion chamber from the adjacent vertical flue. The gases then pass upwardly along the flue 148 into a discharge conduit 152 extending the length of the setting and communicating either directly with a chimney or through regenerators or recuperators by which the air for combustion may be heated.

The wall intervening between each combustion chamber and its associated flue may be apertured upwardly or at the upper end, as at 153, to permit of recirculation of the heating gases from the flue 148 to the combustion chamber 147 to a determined degree.

In the construction represented in Figure 18 the retorts or tubes 154 are reduced in diameter at the upper part 155 to form gas and vapour spaces and each is provided with an outer jacket 156 forming an annular space extended beyond the upper end of the retort or tube 154 which, when charged, is advantageously closed with a cap 157, after which a luting of sand may be charged into the jacket. After the retorts or tubes emerge from the heating chamber and are cooled, the luting of sand may be removed or partially removed through an outlet 158. Similarly, at the lower end an inverted cap 159, of a diameter slightly larger than the retort tube, may be applied, for the reception of a luting of sand or other luting material, and the inverted cap may be secured in position by any convenient means, such as by fastening members that may be disposed at the side in diametrical opposite positions and connected to fittings suitably mounted in corresponding positions above the inverted cap.

The retorts or tubes 154 with the jackets 156 extend above the upper part of the setting to the extent of the length of the jacket, and the outwardly extending ends of the retorts or tubes may be enclosed within a casing 160 serving also as a cover for the open upper end of the heating chamber 161, and supported upon the setting. Alternatively, instead of the casing, angle members may be provided on each side of the retort jackets to extend into channel members, as in Figures 19 and 15, provided to extend adjacent the retorts on the setting, the channels being filled with a luting of sand in the manner hereinafore described. The retorts are suspended from an overhead rail or track in the manner hereinafore described, by suspension members 162 that pass through a slot 163 left in a central or other position at the top of the casing or cover 160. The hydraulic main 164 is mounted upon the setting in position adjacent the casing or cover 160. The gas outlet pipe, which extends outwardly from the jacket 156, projects through a longitudinal slot in the casing or cover 160.

The setting illustrated in Figures 18 to 20 is provided with a series of combustion chambers 165 and connected flues 166 disposed at each side of the heating chamber 161, after the manner of the construction represented in Figure 14. The flues may be vertical or horizontal. The flues 166 deliver the waste gases into the common discharge flue 167.

It will be understood that the invention is not limited to the use of any particular form of setting or to any individual means for applying the necessary heat under-regulation to the retorts or tubes.

The settings hereinafore described are examples, but any other suitable setting may be used.

Settings such as that described with reference to Figures 1 to 9 and having one or more series or panels of tubes or other hollow structures of metal adapted to form the heating walls of the heating chamber or part of the said walls may also vary in design. Thus, the metal tubes or structures may be supplied with heating gases from heating flues of refractory material which receive the heating gases from a connected combustion chamber or from an outside source. Such a construction is illustrated in Figures 21 and 22. On each side of the centre line of the heating chamber there is a combustion chamber 168 extending in the vertical direction and of small thickness, with gas burners and means for the introduction of air for combustion at the lower end. Each combustion chamber is connected to a heating flue 169 lying adjacent
thereto, communication being effected by an opening 170 at the upper end of the intervening wall. There may further be provided an inter-connecting passage 171 adjacent the burners which may be employed for re-circulation of the heating gases and may be provided with dampers or other means of control of the area of the opening. The heating gases passing downwardly in the flues 165 are caused to pass by way of an outwardly directed passage 172 to a vertical flue or conduit 173 closed at the upper end and provided in the front wall forming the separating wall of the heating chamber with a vertical series of horizontal openings 174. In each of such openings there is slidable mounted a bush-like connector 175 fixedly secured to one end of a tubular or like metal structure 176 serving as a radiator of the heat from the heating gases passing therethrough. The metal tubes or structures 176 are closed at the two ends and extend longitudinally along the interior of the heating chamber advantageously within a recess 177 in the wall of the chamber, such that the outer surfaces of the metal tubes or structures lie flush with the wall of the heating chamber in which are formed the combustion chambers and flues. At the far end the metal tubes or structures 176 are similarly provided with bush-like connecters 178 which are mounted in fixed positions in the wall of a second vertical flue 179 that is closed at the upper end and that may communicate with an exhaust 180 or a waste gas discharge flue. It will be understood that where necessary a plurality of sets of metal tubes or structures may be provided through which the heating gases may pass in parallel or in series according to the conditions of heating required and the sets of metal tubes or structures may be succeeded by heating flues formed in the setting. Means may further be provided in the setting for the pre-heating of the air for combustion by a recuperative or regenerative effect.

Where the metal tubes or structures are required to provide for a variation in the degree of heat applied at different positions in the vertical direction they may be connected in superposed groups to corresponding horizontal heating flues or combustion chambers, advantageously superposed and adapted for independent regulation of the heat applied to the respective groups of metal tubes or structures. It will be understood that any setting may be adapted for the passage of the retorts or tubes through a plurality of parallel heat chambers. Thus, as illustrated by Figure 22, in a setting similar to those hereinbefore described and provided with series of metal tubes or structures to serve as radiators of heat, there may be provided a number of parallel heating chambers 180, the intervening walls of which are formed, in proximity to the position of discharge of the retorts or tubes, with combustion chambers 181 and flues 182 set in alignment parallel with the path of the retorts or tubes, the flues delivering the heating gases to metal tubes or structures 183 which in turn deliver the heating gases to flues 184 for discharge to the position of the waste gas conduit 185. It is advantageous in such a construction of setting to provide each series of metal tubes or structures of a number of pairs of tubes or structures lying side by side in the horizontal direction. Such an arrangement of the metal tubes or structures has the effect of setting up a circulation of heated air such that the air passes upwardly between the units of the pairs of the metal tubes or structures and flows downwardly in contact with the retorts or tubes.

Whatever the form of the setting, the retorts or tubes discharged from the heating chamber or heating chambers are caused to travel (Figure 23) to a discharging station 186 where they are caused to dispose of the treated charges. The empty retorts or tubes then proceed to a charging station 187 at which they are charged before proceeding into the heating chamber or heating chambers 188.

In any type of setting the hot retorts or tubes may be used for the purpose of pre-heating the air required for the combustion chambers, to permit of the reduction of the temperature of the waste gases to about 150° C. before discharge. The carbonising of the substance distilled is advantageously effected under such conditions that gas of high calorific value rich in methane is produced in the early stages while in the later stages gas of low calorific value rich in hydrogen is produced. The conditions of carbonising may also be controlled in such manner that cracking of the gas to a determined extent is effected.

Again, the retorts or tubes and the hydraulic main may be provided to permit partial oxidation of the substances being distilled before carbonisation begins, in order to reduce swelling. For this purpose the retorts or tubes are heated in the normal manner but the dipping of the lower ends of the retorts or tubes into the liquor in the hydraulic main is delayed so that there is generated a current of air through each charge. It is advantageous for this purpose to provide a removable plug at the upper end of the retort or tube to enable this operation to be carried out.

In any form of the setting the combustion chambers may be provided in the length of the setting in a number of adjacent sections or panels whereby separate combustion chambers are provided, into which gas and air are admitted from adjacent supply conduits extending beneath the combustion chamber sections or panels. By such means the application of heat may be controlled in the sections or panels. Thus, for example, the sections or panels near the inlet end of the furnace may be maintained at a low temperature and each succeeding panel or section in the direction of the course of the retort tubes through the heating chamber may be maintained at a successively higher temperature, and the highest temperature may be maintained in the panels or sections near the adjacent outlet end of the heating chamber, the temperature gradient or increment being determined from section to section as required by the composition of the solid carbonaceous substance being treated, and the heat maintained at a substantially constant value in the respective panels or sections. It will however be understood that the temperatures maintained in the respective panels or sections may be adjusted in relation to the rate of travel of the retorts through the heating chamber, the length of the heating furnace setting as well as the length of the hydraulic main being advantageously so determined that the distillation is substantially completed at the final temperatures employed in the panels or sections near the outlet end of the heating chamber.

The process may be carried out with the charge under pressure and for the purpose a perforated cast iron weight, as represented in Figure 18, may be disposed on the top of the charge in each retort. The weight may be selected so as to
exert a pressure of 1 1/2 lb. per square inch.

It will be understood that the retorts may be discharged after the charges have been cooled, advantageously at atmospheric temperature, and both discharging and recharging of the retorts may be done at stations to which the retorts may travel under the action of gravity in the manner described.

The material subject to distillation may be coking coal or blends of coking and non-coking coals or other non-swelling additions in various proportions as may be required in particular cases for the purpose of securing a smokeless fuel having the desired characteristics, or the materials may be subjected to distillation in a briquetted or compressed form.

Where the retorts are provided as casings that while having a narrow dimension transversely are relatively wide, they may be provided with a number of gas and vapour outlet pipes or fittings and may be suspended from a number of positions or such retorts may in known manner be constructed of side walls that may be separated for the convenient discharge of the residue.

I claim:

1. Apparatus for the distillation of coal comprising retorts to contain charges of the coal, a furnace setting through which the retorts travel, an endless track, wheeled carriages on said track from which the retorts are suspended, both endless track and the wheeled carriages being outside the furnace setting, a heating chamber or chambers within the furnace setting, a discharge conduit in communication with each of the heating flues, said heating flues and intermediate combustion chambers being situated along the length of each heating chamber and on each flank of the retorts.

2. Apparatus for the distillation of coal as claimed in claim 1, in which the endless track from which the retorts are suspended is formed so that the laterally extending outlets from the retorts dip into the hydraulic main as the retorts enter the furnace setting and rise from the hydraulic main as the retorts leave the furnace setting.

3. Apparatus for the distillation of coal as claimed in claim 1, including means for maintaining successively higher temperatures along the lengths of the heating chambers.

4. Apparatus for the distillation of coal comprising retorts associated in groups to form units, the upper ends of the retorts being closed by a common closure plate attached to a vertical plate by which the retorts are suspended, an endless track, wheeled carriages on said endless track, the lower ends of the retorts being fitted with a perforated pivotal closure plate, the lower ends of the retorts being housed in a lateral extension formed on said common fitting for leading gas and vapour from the retorts, a hydraulic main situated at the base of a furnace setting, a vertical slot in the upper surface of said furnace setting through which vertical slot travels the said vertical plate, a slideable member for closing said vertical slot disposed on said vertical plate, the endless track on which the wheeled carriages travel being formed so that the lateral extension of the common fitting housing the lower ends of the retorts dips into the hydraulic main as the retorts enter the furnace setting and rises from the hydraulic main as the retorts leave the furnace setting.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,043,409</td>
<td>Doherty</td>
<td>Nov. 5, 1912</td>
</tr>
<tr>
<td>1,074,104</td>
<td>Darrin</td>
<td>Sept. 30, 1913</td>
</tr>
<tr>
<td>1,358,268</td>
<td>Phipps</td>
<td>Oct. 12, 1920</td>
</tr>
<tr>
<td>1,679,887</td>
<td>Winzer</td>
<td>July 31, 1928</td>
</tr>
<tr>
<td>1,832,887</td>
<td>Knott</td>
<td>Nov. 24, 1931</td>
</tr>
<tr>
<td>2,091,702</td>
<td>Daniel</td>
<td>Aug. 31, 1937</td>
</tr>
</tbody>
</table>

FOREIGN PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Country</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>241,747</td>
<td>Great Britain</td>
<td>Oct. 19, 1925</td>
</tr>
<tr>
<td>244,655</td>
<td>Great Britain</td>
<td>Mar. 6, 1925</td>
</tr>
<tr>
<td>428,840</td>
<td>Great Britain</td>
<td>May 20, 1935</td>
</tr>
<tr>
<td>488,313</td>
<td>Great Britain</td>
<td>July 5, 1938</td>
</tr>
<tr>
<td>534,049</td>
<td>France</td>
<td>Dec. 26, 1921</td>
</tr>
</tbody>
</table>