

H. A. KUHN.

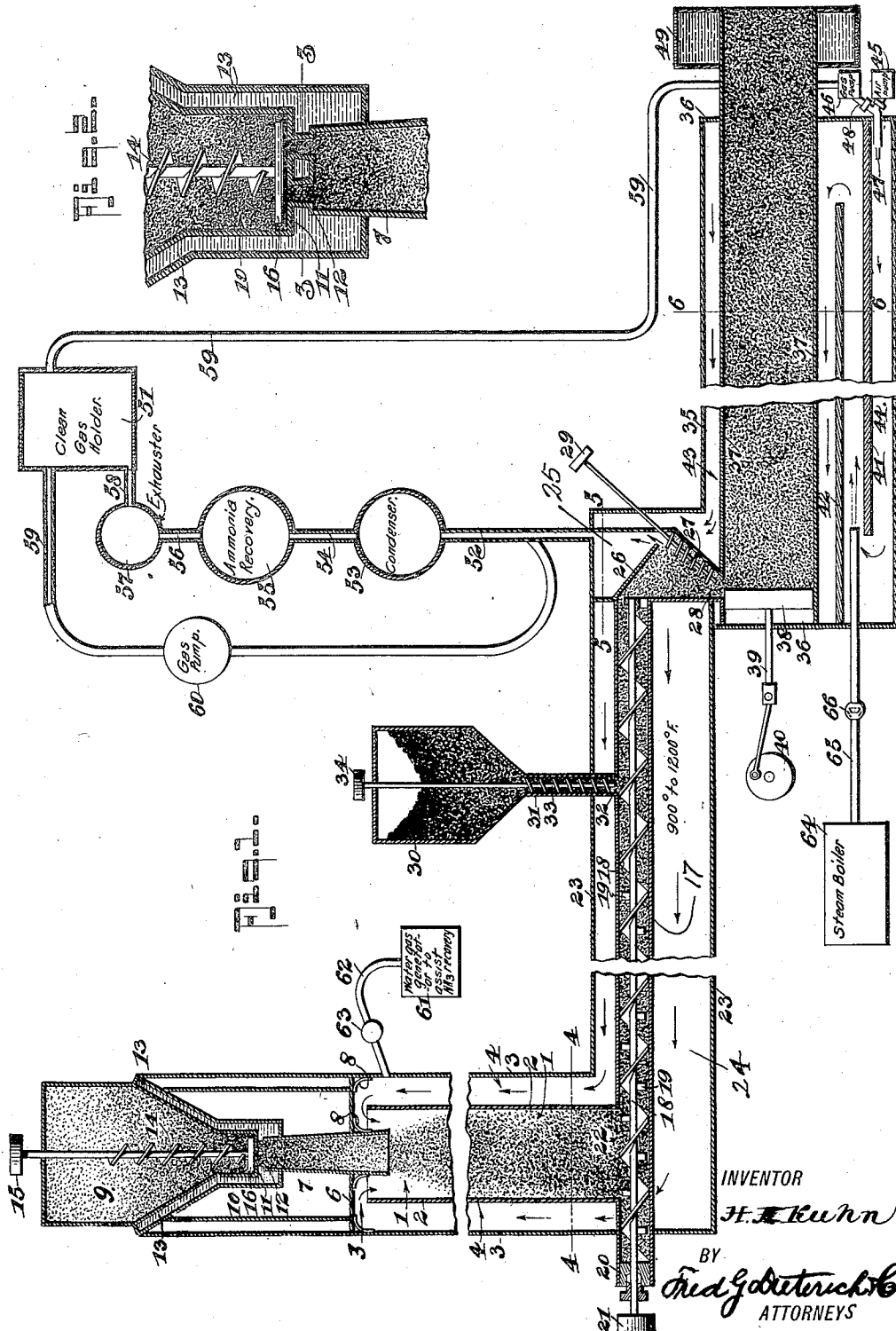
METHOD AND APPARATUS FOR LOW TEMPERATURE DISTILLATION OF COAL.

APPLICATION FILED FEB. 29, 1916.

Patented Nov. 14, 1916.

2 SHEETS—SHEET 1.

1,204,789.



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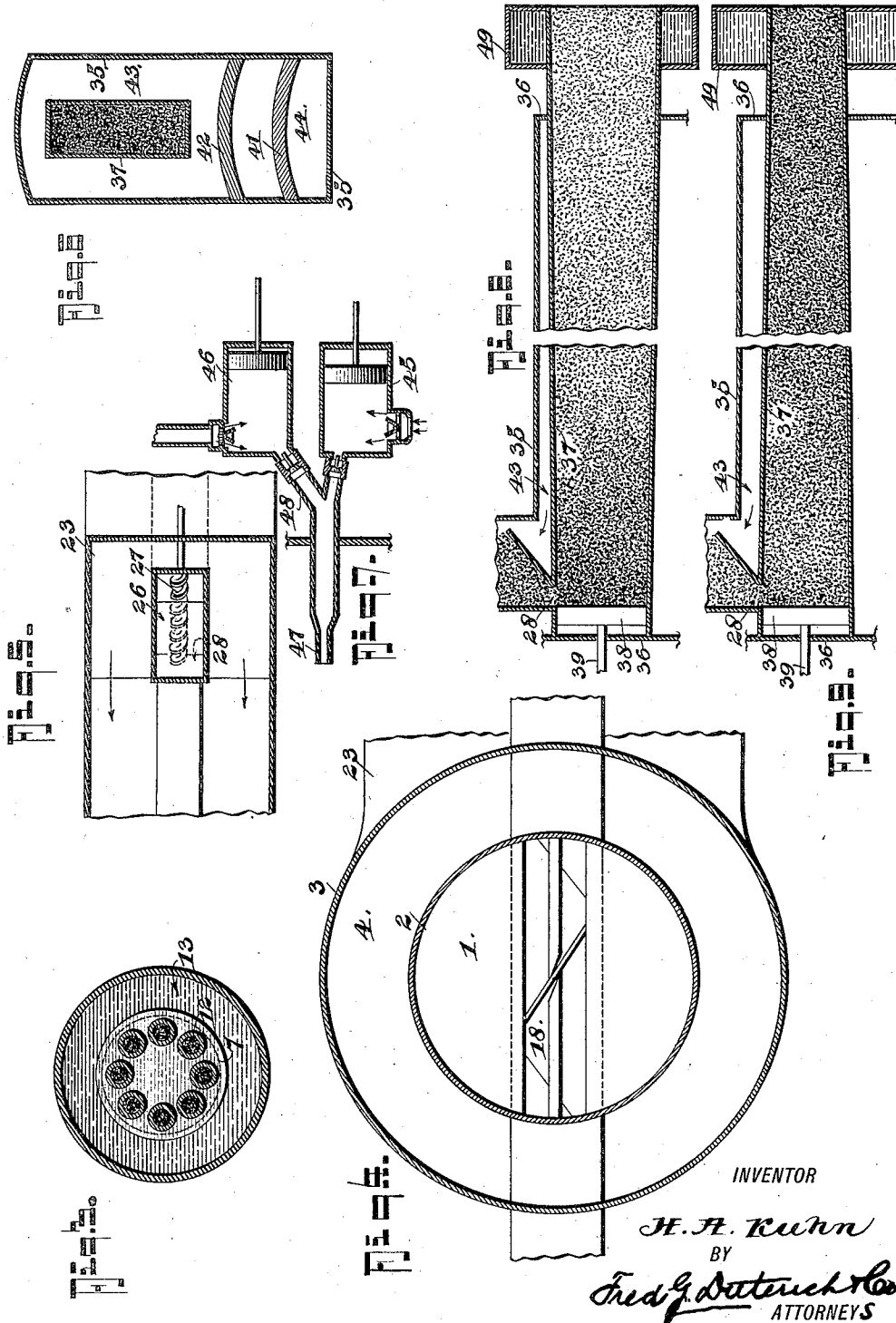
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UNITED STATES PATENT OFFICE.

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METHOD AND APPARATUS FOR LOW-TEMPERATURE DISTILLATION OF COAL.

1,204,789.

Specification of Letters Patent.

Patented Nov. 14, 1916.

Application filed February 29, 1916. Serial No. 81,154.

To all whom it may concern:

Be it known that I, HARRY A. KUHN, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and Improved Method and Apparatus for Low-Temperature Distillation of Coal, of which the following is a specification.

My invention relates to the art of distillation of coal having for its object the production of coal gas and the resultant by-products coke, tar and ammonia, the principal object of the invention being to provide for as complete an abstraction of the gas and recovery of the vaporizable by-products as possible, and the production particularly of a coke or semi-hard coal product that can be employed satisfactorily as metallurgical coke in blast furnace work; or the ordinary coke for domestic fuel purposes can be formed.

Those processes of carbonizing coal which have heretofore been commonly employed involve conducting heat through the wall of a retort and into and through a mass of coal. In using retorts, such as the well-known gas-house retorts, the temperature outside the retort has to be very much higher than that necessary to drive the volatile matter out of the coal and the heat is conducted very slowly through the walls of the retort and through the mass of coal, so that for charges three inches or four inches thick it takes from four to six hours to drive out the volatile matters in a semi-vacuum. The coke left is more or less spongy. The temperature of the walls of the retort is so high that the resinous matter in the coal, which volatilizes at about 700° to 750° F., cracks up when the vapors come under the influence of the higher temperatures, thereby depositing carbon in the retort and also giving the tars a heavier carbon content. This resinous matter in coal, which is the first to volatilize, as stated before, also acts as the binding material in the coke body; the vapors on coming under the influence of higher temperatures crack up and release finely divided carbon, part of which is afterward found deposited in the cell walls of the coke body, and serves to bind the other particles of carbon into a hard cellular mass.

The "by-products" or "retort" oven is merely a variation of the gas-house retort.

The temperatures are higher and because of the thicker mass of coal (about 9 inches) it takes from eighteen to twenty-four hours of extremely high temperatures (2000 to 2500° F.) in the flues to conduct sufficient heat to carbonize (or distil the volatiles out of) 9 inches of coal. The higher temperatures acting on the resinous vapors create a slightly harder deposit of finely divided carbon, the result being a hard coke.

The "low temperature processes" usually involve the employment of a retort (which may be of iron) and the conduction of heat through the walls of the retort, and also the slow conduction of heat through the mass of coal. In low temperature processes where the charge is undisturbed, the cells are large, the fuel body spongy so that it will not stand handling, the binding material having been vaporized and drawn off. Even the application of pressure to the mass is of little effect when the binding material is absent. Some of these latter processes involve the stirring up of the mass of coal so that as much of the coal as possible may come in contact with the hot walls of the retort. The difficulty, however, in these processes lies in this that there is no chance for a quiet deposit of sufficient finely divided carbon as happens in the gas-house retort or the by-product oven, and the fuel body left is uncemented, or if cemented it is usually so spongy and so soft that it is of no market value, as it is liable to reach the customer partly in the shape of breeze or dust. These various processes involve a very large investment of capital in each retort compared with the amount of coal carbonized.

It is therefore an object of my invention to provide a process and an apparatus through which the objectionable features in the old processes are in large measure eliminated.

In its generic nature, the process constituting my invention consists in the production of a current of hot gas through a vertical chimney structure into which coal dust is dropped out of contact with the surrounding atmosphere, whereby the necessary heat for the distillation is applied to the coal dust, and the gaseous and volatile products are liberated from the coal dust as it falls through the hot gases; the gaseous vapors being taken up by the hot gases and conveyed to the condensing and recovery appa-

ratus for the volatile products while the coal dust particles are deposited at the bottom of the vertical retort chamber from which they are conveyed through a passage which
 5 serves, as it were, as a secondary heating chamber in which the heated mass is mixed and agitated to drive off any gases or vapors that may not have been liberated in the first chamber; the mass in the second chamber
 10 is mixed with raw coal dust prior to its discharge from the second chamber for the purpose of supplying, the necessary binding material to the mass to take the place of the binding material vaporized or extracted
 15 during the time the coal dust is dropping down the vertical retort or stack, the mixed mass being discharged from the conveyer and passed through a retort under predetermined pressure and cooled as it reaches
 20 the discharge end of the final retort to form semi-hard coal or coke masses suitable for use in blast furnaces. The process also includes provision for the introduction of water gas, or superheated steam, or both,
 25 into the gaseous atmosphere through which the coal dust is dropped to assist in the recovery of the ammonia.

The apparatus which also constitutes a part of my invention consists essentially of
 30 a vertical retort chamber or stack having a jacket around which the hot gases of previous distillation are passed upwardly and then downwardly into the stack, the gases being drawn through the stack and dis-
 35 charged at the bottom of the same into a horizontal conveyer chamber in which the heated coal dust deposit is collected, the conveyer having provision for mixing the mass and passing it to the discharge end of the
 40 conveyer chamber where the gases and solid products pass out of the conveyer into a separation chamber from which the gaseous products are removed and further treated in the usual way to separate the gas, ammonia
 45 and tars, the solid product being deposited into a final retort through which it is forced by a plunger device, the discharge end of the final retort being water-jacketed to cool the product prior to its discharge from the
 50 same; provision is made whereby the boiler feed water of the plant can be passed through the water jacket to absorb the heat from the pressed coal or coke product before passing the water into the boiler, thus conserving the energy as much as possible. The
 55 apparatus also includes a water-jacketed hopper for receiving the coal dust and a throat for conveying the coal dust from the hopper into the upper end of the vertical
 60 retort chamber or stack in such manner that fusion of the coal dust will not occur until it is passed away from the discharge end of the hopper thus preventing clogging. The invention also provides means for introduc-
 65 ing hot water gas into the heating gases

prior to their admission into the vertical retort mixing chamber or stack and it also provides for the introduction of superheated steam into the gaseous atmosphere, if desired, to assist in the ammonia recovery. 70

The apparatus employed in carrying out my process furthermore includes a hopper and feed for delivering raw coal dust into the conveyer which carries the hot coal dust mass from the bottom of the stack to the dis- 75 charge place where it enters the separating chamber so that raw coal dust may be introduced and mixed with the mass at a predetermined time and place and to a predetermined extent, to supply the necessary 80 binding material for holding the particles of the mass in coherence in order to give a strong body to the solid material finally discharged from the apparatus.

The process, which constitutes a part of 85 the invention, includes several sub-processes or steps by which the art of coal distillation is advanced and the invention also includes novel details of construction, combination and arrangement of parts of apparatus as 90 will be clear to those skilled in the art.

In the drawings, I have shown, graphically, an apparatus for carrying out my process and by reference to the drawings it will be seen that Figure 1 is a vertical section 95 largely diagrammatic illustrating the complete apparatus. Fig. 2 is an enlarged detail vertical section of the discharge end of the hopper. Fig. 3 is a horizontal section on the line 3—3 of Fig. 2. Fig. 4 is a longi- 100 tudinal cross section on the line 4—4 of Fig. 1. Fig. 5 is a horizontal section on the line 5—5 of Fig. 1. Fig. 6 is a vertical section on the line 6—6 of Fig. 1. Fig. 7 is an enlarged detail view of the air and gas pumps. 105 Figs. 8 and 9 are detail vertical longitudinal sections showing modified forms of the final retort tunnel.

By reference to the drawings, it will be seen that the vertical structure of the ap- 110 paratus is in the nature of a chimney or stack composed of the inner wall 2 and the outer wall 3, thus providing an inner chamber 1 and a surrounding chamber 4. The outer wall 3 extends above the top of the 115 inner wall 2 and supports a head 6. 5 designates the space through which the hot gases are drawn from the annular chamber 4 into the interior chamber 1, suitable baffles 8 being provided to render a quiescent 120 flow of the gas.

In order to deposit the coal dust into the gaseous atmosphere in the chamber 1 in such a manner that the coal dust will not fuse together at its place of entrance, I 125 employ a mechanism whereby the temperature of the coal dust is kept down below the fusion point until the dust shower comes into contact with the hot gas current in the chamber 1. As a preferred way of ac- 130

completing this result, I have provided a hopper 9 having a throat 10 that is provided with discharge orifices 12 the cross sectional areas of which increase from the hopper side toward the outlet side. These orifices, being located somewhat above the head 6 are arranged to deliver the coal dust into a duct 7 that projects through the head 6 into the chamber 1 and discharges the dust into such chamber at a place somewhat below the gas inlet 5. The duct 7, like the orifices 12 is preferably of greater cross sectional area at its discharge end than at its entrance end, the object of this being to permit separation of the dust particles in falling, so that when the particles meet the gaseous atmosphere in the chamber 1, they will be completely bathed in the hot gases and almost instantly brought to the temperature at which the volatiles are liberated.

In order to assist further in preventing fusion of the dust particles as they pass through the orifices 12 in the bottom 11 of the hopper, I water-jacket the bottom of the hopper, the walls of the throat, the walls of the orifices 12 and the upper or receiving end of the duct 7. A screw-shaft 14, having an agitator 16, is driven by a pulley 15 (or in any other suitable manner) and serves to prevent bridging of the coal dust in the hopper, thus insuring a continuous flow of coal dust from the hopper into the duct 7.

The horizontal structure which constitutes a part of the apparatus includes a duct 17 with a mixing chamber in which a screw conveyer 18 is located, the shaft of the conveyer passing through a packed bearing 20 (which also acts as a seal) and is provided with a driving pulley 21. The conveyer may be provided with mixing paddles 19, if desired. The duct 17 has an entrance 22 which is in communication with the lower end of the chamber 1 so that the coal dust as it is deposited at the bottom of the chamber 1 will be conveyed away from the chamber 1 as fast as it falls and at the same time the mass will be agitated and tumbled over to allow as complete liberation of the volatiles as possible.

The duct 17 is surrounded by an outer wall 23 which incloses a heat chamber 24 one end of which communicates with the lower end of the annular chamber 4 of the stack or vertical structure, while the other end communicates with the heat chamber of the final retort, hereinafter referred to.

25 designates what I term, for convenience, the separating box. The separating box receives both the solid and gaseous contents of the duct 17 and it is from this separating box that the gaseous products are withdrawn (as later described) for further treatment. The box is provided with

a baffle 26 over the entrance from the duct 17 so that the solids will not be sucked up with the gaseous products or volatiles as the latter are withdrawn from the separating box. The solids as they enter the separating box gravitate toward the outlet 28 and in this they may be assisted by a feed screw 27, driven in any suitable way, as for instance by a pulley 29.

30 is an auxiliary hopper whose throat 31 is arranged to discharge into the duct 17 at a place 32 located at a predetermined distance from the discharge end of the duct. The hopper throat 31 may be provided with a feed screw 33 which may be driven by a pulley 34.

The final retort into which the carbonized mass is deposited may also be utilized for the generation of the hot gases. The retort furnace includes an outer wall 35, closed at its ends by heads 36 and through which the open ended retort 37 passes. The entrance end of the retort 37 is arranged to receive the solids from the separating box 25, the mass being rammed through the retort 37 and discharged therefrom by a piston 38, whose rod 39 is reciprocated by a suitable crank motion 40.

41 is a baffle arch that extends from the front head 36 toward the rear head 36 and 42 designates another baffle arch which is located above the arch 41 and extends from the rear head 36 to form a zig-zag passage in which the hot gases are generated prior to their liberation into the heating space that surrounds the retort 37.

The retort 37 may be of uniform cross section, as indicated in Fig. 1, or it may increase in cross sectional area from the inlet end toward the outlet end, as indicated in Fig. 8, or it may decrease in cross section, as indicated in Fig. 9, the form of retort used depending upon the desired density of the product.

In order that a suitable hot gas may be generated and one that will be free from uncombined oxygen I introduce the combustible gas into the combustion chamber 44 through a nozzle 47 having branches 48 that communicate with separate air and gas pumps 45 and 46 respectively. Any suitable type of pump having provision whereby the amount of fluid pumped can be regulated at will may be used. The object in using separate air and gas pumps is to enable measured quantities of air and gas to be introduced into the combustion chamber as desired.

I prefer to water-jacket the outlet end of the retort 37 in order to cool the mass prior to its final discharge from the apparatus. Any suitable gas may be used as the combustible, although in practice it is convenient to use gas of previous distillation, the gas being taken from the clean gas

holder 51 and conveyed by a pipe 50 to the gas pump.

The gas and volatiles are drawn from the separating box 25 by the exhaustor 57, passing through the pipe 52 to the condenser 53 where the heavier distillates are released, the remaining volatiles passing through the pipe 54 into the ammonia-recovering apparatus 55, the remaining gases passing through the pipe 56 to the exhaustor 57 from which the clean gas is forced through a pipe 58 into the gas holder 51. When the condenser is operated by cool gas, gas from the tank 51 may be forced by a gas pump 60 through pipes 59 into pipe 52.

To assist in the ammonia-recovery I may provide a water-gas generator 61 from which hot water gas may be conveyed by a pipe 62 into the gas chamber 4, a control valve 63 being provided, if desired. Instead of using the water gas, or in addition thereto, if desired, I may introduce superheated steam into the hot gaseous atmosphere and in that event I provide a steam boiler 64 and introduce the steam through a pipe 65, preferably, into the combustion chamber where the hot gaseous atmosphere is generated. The steam pipe 65 may have a throttle valve 66 for controlling purposes.

It should be stated that the walls of the apparatus may be constructed of any suitable material, such as brick or iron, as may be found most advantageous in practice.

In practice, the vertical structure or stack may be of any height desired, in order to obtain the required distillation of the dust during its fall. A height of approximately thirty feet is believed sufficient. I do not desire to be understood, however, as limiting myself to any particular proportion of parts of the apparatus, as the respective proportions of parts will be determined in the practical application of the invention.

In operation, the coal is ground to dust and placed in the hopper 9, the feed screw 14 being driven by any suitable power applying medium. Gas and air are pumped into the combustion space 44 in such proportions that there will be an excess of unburned gas so that there may be no uncombined oxygen in the heated gas, sufficient air and gas, however, being admitted to raise the temperature of the heated gas to the desired degree, the inert or non-oxidizable gas being drawn from the retort chamber 43 through the chamber 24 in a direction opposite to the travel of the coke mass and then up the outer space or chamber 4 of the stack, the gas passing through the passage 5 down into the inner chamber 1 of the stack and being drawn down into the conveyer chamber 17 along the conveyer chamber 17 to the separating box 25 and up through the gas and volatiles recovery apparatus, as before indicated.

The temperature of the hot gases in the stack and in the chambers 24 and 43 are kept at the desired temperature say, about 900 to 1200 degrees F. and as the coal particles are showered into the top of the stack, they will gravitate to the bottom, being assisted in this act by the gas current and at the same time will be heated to the temperature necessary to drive off the volatiles.

The passage of the volatiles, gases and solids through the conveyer chamber 17 has already been referred to and need not be here repeated. It should be stated, however, that the entrance 32 of the raw coal dust through 31 is located a predetermined distance from the discharge end of the conveyer. This distance will depend upon the temperature employed and the speed of the conveyer 18 so that the mixture of raw coal dust with the heated solids reduces the temperature of the mixed mass but not below the melting point of the raw coal, so that by the time the mixtures enter the final chamber the heat of the carbonized mass has penetrated the raw dust, with the result that the temperature of the mixture causes the binding material to flow or fuse with some small evolution of gaseous product forming cells in the mass, which may be eliminated if desired by exerting extra pressure on the mass.

It will be observed that by grinding up the coal into coal dust and letting it drop down the chimney, or vertical retort structure, in the atmosphere of semi-spent gas free from uncombined oxygen, each particle is bathed for a few seconds in the hot gases and has its temperature raised to a degree which will almost instantly vaporize the volatiles, especially the first volatiles (rich in light oils and acids) which supply the binding material for the coke body in the ordinary process; I therefore secure for a given amount of apparatus and investment in the same, a very large tonnage in twenty-four hours. If five pounds of dust are dropped every second down the chimney in an atmosphere of gas maintained at a temperature of between 800° F. and 1400° F. two hundred sixteen tons of coal may be carbonized and the volatiles distilled out of the same in twenty-four hours; thereby securing the first great advantage of my invention,—a large tonnage from a small investment in apparatus and an excess production of the rich oils and acids as compared to the production heretofore in by-product ovens.

A second great advantage which I secure by the use of my process may be outlined as follows: American coal generally contains about 1.5% of nitrogen. Reduced to a sulfate of ammonia basis this nitrogen is worth about \$3.00 net value per ton of coal. In gas-house and by-product practice about 15% of the nitrogen is caught as ammonia

gas (NH_3) and turned into the sulfate; 85% is lost or unavailable, of which about 50% stays fixed in the coke and about 35% goes off in the gas as free nitrogen. The
 5 35% is lost partly on account of the high temperatures of the common retorts, which are heated above the decomposing temperature of ammonia gas, namely about 1440° F. It is obvious, therefore, that it is important
 10 to keep the temperature of the gas in the chimney, or vertical retort structure above 750° F. to 800° F. and under 1440° F. The best results, I believe, are obtainable with the temperature of the gas ranging from
 15 900° F. to 1200° F.

It is also true that if the coal is distilled in the presence of a considerable quantity of free hydrogen and at a temperature under 1440° F. that the nitrogen driven out of the
 20 coal body combines very largely with the free hydrogen, forming ammonia gas (NH_3). The reason that about half the nitrogen stays fixed in the coke is partly on account of the deposit of finely divided carbon in the cell walls or in the surface surrounding the bubbles in the coal body when the distillation starts. This deposit of finely
 25 divided carbon acts as a seal so that half the nitrogen is practically sealed in through the deposition of the fine carbon (cracked out of the resinous vapors). It is obvious that when each particle of dust is bathed in an atmosphere of hot, semi-spent gas that the nitrogen has full opportunity to escape and when this occurs in a gas rich in
 30 free hydrogen under a temperature of 1440° F., a very large part of the nitrogen will combine with the hydrogen, forming ammonia gas, so that instead of securing 60¢ or 70¢ worth of sulfate of ammonia per ton of coal, treated under the other process we are able to secure several times this amount.

A third great advantage of this process
 45 is in the introduction of binding material in its cheapest form, *i. e.*, raw coal dust. The hot gases through which the coal dust is dropped down the chimney (in a semi-vacuum which helps the distillation and
 50 helps the escape of nitrogen) subtracts from the coal particles the resinous matter or binding material which is necessary to cement or fix the mass together in order to make a merchantable fuel body.

55 It will be seen that in order to provide a fuel which may be either in the shape of something similar to hard coal (with a small amount of volatile matter in it) well cemented together and free from large cells, or to supply a hard coke bound together by a sufficient amount of the resinous matter, I provide for the introduction into the screw conveyer and mixer, of raw coal dust which mixes with the chimney coal dust
 60 that has been denuded of its binding mate-

rials. The second injection of coal dust being introduced as a mass and mixed *en masse*, and not exposed to heat for a very long period until it reaches the finishing retort, does not lose much of the volatiles,—as
 70 its temperature has to be raised by mixing and by the time this is well accomplished, it has reached the finishing retort. The mixed product has a temperature sufficient to melt down the resinous matter and bind the
 75 whole matter together as it passes through the final retort under pressure. The raw coal will not heat sufficiently long to lose much of its binding material before it enters the final chamber, so that the mass en-
 80 tering the final chamber or retort is at a melting and carbonizing temperature, the material is mixed and the heat mixed or distributed, or, in other words, the introduction of the raw coal dust and its intimate
 85 mixture with the heated mass in the conveyer results in the reduction of the temperature of the aggregate by the time the mixture enters the final retort, but the temperature is still high enough to fuse the
 90 mass together and for the formation of cells if the latter is desired,—or by pressure these may be eliminated. The small amount of gas liberated in the final retort may be drawn
 95 off and used. The open end of the final retort may have a large receiving hopper which may be normally closed from the outside atmosphere in order to effect the almost complete recovery of gas evolved in the final retort. For example, assume 1000 pounds
 100 of chimney dust in the mixture at 1200° F. and 500 pounds introduced and mixed with the same at 600° F. The mixed aggregate of 1500 pounds will be at a temperature of approximately 1000° F.

105 The walls of the final retort are kept heated but the necessary heat is disseminated throughout the mass before it enters the final retort, and the heated walls of the final retort help but do not dominate the
 110 finishing process so that there is no delay or lost time as is found in other processes where heat must be conducted slowly through retort walls and then through a mass of coal.

115 It will be observed that when the raw coal dust is mixed with the hot mass in the mixing conveyer, there is a gradual transfusion of heat into the raw coal dust from the carbonized solids; this transfusion culminates about the time the mixture enters the final retort; the temperature throughout the entire mass, as it enters the final retort, is high enough to carbonize and bind together the mixture; it is during the short
 120 period of time when the heat is being conducted from one small particle of heated coal to a raw coal particle that the mixture is conveyed and moved into the final retort; this small period of time is not sufficiently
 130

long to permit the escape or volatilization of the binding material in the mass to any great extent.

When the final retort is constructed so as to flare outwardly and the coal is pushed through under slight pressure, the cells, due to the melting of the resinous matter and whatever of gas, are formed and the resultant product has a cellular body, the necessary hardness being given by the cementing material fixed under heat and pressure.

If a fuel body is desired in the shape of something like hard coal where the cells are to be very small or practically invisible, the retort may be reduced in area at the far or outlet end which tends to create a heavier pressure on the coal body and the heat and pressure cements the fuel together by means of the resinous matter in practically a solid mass. This latter product can afterward be broken up by crushers (in the manner that hard coal is treated) and marketed as a semi-hard coal. It is obvious also that my process would increase the output of a typical by-product oven plant. The heated mixture could be conveyed to the oven, the charge would be heated already throughout and the heat of the oven walls would quickly harden the mass into hard cellular coke, thereby increasing the output of an oven plant several times.

Instead of using a gas pump and an air pump at the primary combustion engine, I desire it understood that I may inject coal dust and air in such proportions as to partly burn the coal dust and yet leave the hot gaseous product free from uncombined oxygen, the suction of the exhauster working on the plant will create sufficient current to carry over such particles of coal dust as may be entirely unconsumed and these particles would be caught in the mass in the conveyer tube.

From the foregoing description, taken in connection with the accompanying drawings, it is thought the advantages and also the construction of the apparatus which is preferably employed in carrying out the process, will be fully understood by those skilled in the art, and I desire to say that while I have illustrated an apparatus for carrying out my process, it is obvious that slight changes in the details of the process and of the apparatus may be made to adapt the same to the manufacture of the particular grade of fuel body desired.

What I claim is:

1. A method of distilling coal which includes the following steps namely,—providing a retort having a vertical chamber and a horizontal chamber into which the vertical chamber discharges, creating a current of hot gases down through the vertical chamber and along through the horizontal chamber, dropping coal dust down through the

atmosphere of hot gases in the vertical chamber, conveying the accumulated heated mass along the horizontal chamber from its receiving end to its discharging end, drawing off the volatile products of distillation for further treatment, introducing a quantity of raw coal dust into said horizontal chamber, and mixing the same with the mass therein prior to the discharge of said mass substantially as specified.

2. The method of distilling coal which includes the following steps namely,—the provision of a retort having a vertical chamber and a horizontal chamber, the bottom of said vertical chamber communicating with said horizontal chamber adjacent to one end, said horizontal chamber having a discharge end, establishing a circulation of hot gases through said chambers while excluding the external atmosphere from said chambers, introducing coal dust into the said vertical chamber near its top, whereby the coal dust falling through the heated atmosphere within the vertical chamber will become fused, conveying the deposited mass through said horizontal chamber and introducing raw coal dust into the mass while in said horizontal chamber, mixing the mass together and discharging it from the horizontal chamber, and then separately collecting the mass and volatile products for further treatment.

3. A method of distilling coal which consists in providing a retort having a vertical chamber and a horizontal chamber into which the vertical chamber discharges, said method consisting further in creating a current of hot gases at approximately a temperature from nine hundred to twelve hundred degrees Fahrenheit down through said vertical chamber and along through said horizontal chamber, dropping coal dust down through the atmosphere of gases in the vertical chamber, agitating the mass received in the horizontal chamber and conveying the same from the receiving to the discharging end of the horizontal chamber, applying external heat to the horizontal chamber, introducing a quantity of raw coal dust into the mass prior to its discharge from the horizontal chamber, mixing the raw coal dust so introduced with the remainder of the mass in the horizontal chamber prior to the discharge of the same, and separately collecting the resultant mass and gaseous distilled products for further treatment.

4. A method of distilling coal which consists in providing a retort having a vertical chamber and a horizontal chamber into which the vertical chamber discharges, said method consisting further in creating a current of hot gases of previous distillation at approximately a temperature from nine hundred to twelve hundred degrees Fahrenheit down through said vertical chamber and

along through said horizontal chamber, dropping coal dust through the atmosphere of gases in the vertical chamber, agitating the mass received in the horizontal chamber and conveying the same from the receiving to the discharging end of the horizontal chamber, applying external heat to the horizontal chamber, introducing a quantity of raw coal dust into the mass prior to its discharge from the horizontal chamber, mixing the raw coal dust so introduced with the remainder of the mass in the horizontal chamber prior to the discharge of the same, and separately collecting the resultant mass and gaseous distilled products.

5. The method of distilling coal which includes the following steps: establishing a circulation of hot gases out of contact with the atmosphere through a retort having two distinct zones, dropping coal dust into and through the first zone to effect a primary distillation of the coal dust, collecting the deposited mass as it forms and conveying the same through the second zone while maintaining the temperature of the mass at the required degree to complete the driving off of the gases and volatile products from the mass, and separately collecting the resultant mass and the discharged gases as they pass from the second zone.

6. The method of distilling coal which includes the following steps: establishing a circulation of hot gases out of contact with the atmosphere through a retort having two distinct zones, dropping coal dust into and through the first zone to effect a primary distillation of the coal dust, collecting the deposited mass as it forms and conveying the same through the second zone while maintaining the temperature of the mass at the required degree to complete driving off the gases and volatile products from the mass, separately collecting the resultant mass and the discharge gases as they pass from the second zone, and mixing raw coal dust with the mass at a predetermined place while in the second zone to supply the necessary binding material to the mass.

7. The method of distilling coal which includes the following steps: establishing a circulation of hot gases out of contact with the atmosphere through a retort having two distinct zones, dropping coal dust into and through the first zone to effect a primary distillation of the coal dust, collecting the deposited mass as it forms and conveying the same through the second zone while maintaining the temperature of the mass at the required degree to complete driving off the gases and volatile products from the mass, mixing raw coal dust with the mass at a predetermined place while in the second zone to supply the necessary binding material to the mass, receiving the mass of material discharged from the second zone and

applying pressure to the same to form a semi-hard product.

8. The method of distilling coal which consists in first passing coal dust through an atmosphere of hot gases of previous distillation out of contact with the external atmosphere to heat the dust to the point of fusion, collecting and confining the mass and the gasses out of the influence of the external atmosphere for a time in a second heat zone before discharging the same, and admitting fresh coal dust to the mass while in the second heat zone prior to the discharge of the mass therefrom.

9. The process of distilling coal which includes the following steps namely: establishing an atmosphere of hot gases containing no free oxygen, showering coal dust through said atmosphere to cause a separation of the volatile and non-volatile products of the coal dust, collecting the non-volatile mass as it forms and passing the same together with the atmosphere of gases and volatile distillates through a duct out of the influence of the external atmosphere, introducing raw coal dust into said duct and mixing the same with the passing mass, and separately collecting the discharge volatile and non-volatile products from the duct.

10. A process of distilling coal which includes the following steps:—showering coal dust into an atmosphere of semi-spent gas free from uncombined oxygen, which gas is at such temperature that each particle bathed in the gas for a short space of time will quickly have its volatiles vaporized.

11. A process of distilling coal which includes the following steps:—showering coal dust into an atmosphere of semi-spent gas free from uncombined oxygen, which gas is at such temperature that each particle bathed in the gas for a short space of time will quickly have its volatiles vaporized, collecting the resultant non-volatile mass and liberated volatiles and passing the same from the place of collection to a place of separation, introducing binding material into the mass while being conveyed to the place of separation, and separately collecting the resultant mass and volatiles for further treatment.

12. A process of distilling coal which includes the following steps:—showering coal dust into an atmosphere of semi-spent gas free from uncombined oxygen, which gas is at such temperature that each particle bathed in the gas for a short space of time will quickly have its volatiles liberated, collecting the resultant mass and liberated volatiles and passing the same from the place of collection to a place of separation, introducing binding material into the mass while being conveyed to the place of separation, and separating the volatiles from the non-volatile

tile mass, and collecting the same, collecting the non-volatile mass and applying pressure to the same to condense its structure.

13. A process of distilling coal which includes the following steps:—showering coal dust into an atmosphere of semi-spent gas free from uncombined oxygen, which gas is at such temperature that each particle bathed in the gas for a short space of time will quickly have its volatiles liberated, collecting the resultant mass and liberated volatiles and passing the same from the place of collection to a place of separation, introducing binding material into the mass while being conveyed to the place of separation and separating the volatiles from the non-volatile mass, and collecting the same, collecting the non-volatile mass and applying pressure to the same to condense its structure while under the influence of heat.

14. A process of distilling coal which includes the following steps:—showering coal dust into an atmosphere of semi-spent gas free from uncombined oxygen, which gas is at such temperature that each particle bathed in the gas for a short space of time will quickly have its volatiles vaporized, collecting the resultant mass and liberated volatiles and passing the same from the place of collection to a place of separation, introducing binding material into the mass while being conveyed to the place of separation, drawing off the volatiles and condensing the mass into a hard formation by the application of pressure.

15. A process of distilling coal which includes the following steps:—showering coal dust into an atmosphere of semi-spent gas free from uncombined oxygen, which gas is at such temperature that each particle bathed in the gas for a short space of time will quickly have its volatiles vaporized, collecting the resultant mass and liberated volatiles and passing the same from the place of collection to a place of separation, introducing binding material into the mass while being conveyed to the place of separation, drawing off the volatiles and condensing the mass into a hard formation by the application of pressure to the mass and cooling the same.

16. The process of distilling coal which consists in establishing an atmosphere of partially spent gases free from uncombined oxygen, maintaining the temperature of the said gases between the limits of substantially 750° F. to 1440° F., showering coal dust into said atmosphere to subject the particles to a substantially instantaneous bath in the hot gases to thereby liberate the volatiles from the non-volatiles as they are deposited from the bath and separating the same for further treatment.

17. The process of distilling coal which consists in establishing an atmosphere of par-

tially spent gases free from uncombined oxygen, maintaining the temperature of the said gases between the limits of substantially 750° to 1440° F., showering coal dust into said atmosphere to subject the particles to a substantially instantaneous bath in the hot gases to thereby liberate the volatiles from the non-volatiles as they are deposited from the bath and reducing the temperature of the mass by the admixture therewith of raw coal dust to supply binding material to the mass and subsequently collecting the mass under sufficient pressure to cause coherence.

18. The process of distilling coal which consists in establishing an atmosphere of partially spent gases free from uncombined oxygen, maintaining the temperature of the said gases between the limits of substantially 750° F. and 1440° F., showering coal dust into said atmosphere to subject the particles to a substantially instantaneous bath in the hot gases to thereby liberate the volatiles from the non-volatiles as they are deposited from the bath and reducing the temperature of the mass by the admixture therewith of raw coal dust to supply binding material to the mass, subsequently collecting the mass under sufficient pressure to cause coherence, said process consisting further of the introduction into the gaseous atmosphere of an agent to assist in the liberation of the ammonia.

19. The process of distilling coal which includes the following steps namely:—applying heat to the coal to distil the volatile products from the same, mixing raw coal dust with the hot mass residue, charging the mixture into a heated retort or oven to quickly harden the mass into hard cellular coke.

20. The process of distilling coal consists in heating hot coal dust out of contact with atmospheric oxygen to liberate the volatiles from the same, introducing raw coal dust to the heated mass and mixing the aggregate together, placing the aggregate mass into a final retort while at a melting and carbonizing temperature to complete the coking operation before the binding material supplied by the raw coal dust shall have been liberated.

21. An apparatus for the distillation of coal which comprises an upright stack or retort, means for circulating an atmosphere of heated gases downwardly through said stack while excluding the atmospheric air, means for introducing coal dust into said stack to drop down through the same, means for collecting the deposited mass in said stack and conveying the same away from the stack, said means having provisions for excluding the atmosphere, means for introducing raw coal dust into said conveyer to mix with the heated mass, means for separately collecting the solid and gaseous products discharged from the conveyer for fur-

ther treatment, said last named means including a separating chamber from which the gaseous products are withdrawn, said separating chamber having a discharge opening for the solid product, and means for compressing said solid product while hot to form a semi-hard coal product, and means for cooling said product while under compression prior to its final discharge from the apparatus.

22. An apparatus for the distillation of coal which includes a vertical double wall structure having an inner chamber and an outer chamber, said chambers communicating adjacent to their tops, a horizontal double wall structure having an inner chamber, and an outer chamber, said inner chamber having its entrant end in communication with the lower end of said chamber of said vertical structure, a mixer within said inner chamber of said horizontal structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure, down through said inner chamber of said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber of said vertical structure to drop down with the current of hot gases and become heated thereby to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant end of said inner chamber of said horizontal structure and mixed and conveyed through said horizontal structure and out of the discharge end of the same.

23. An apparatus for the distillation of coal which includes a vertical double wall structure having an inner chamber and an outer chamber, said chambers communicating adjacent to their tops, a horizontal double wall structure having an inner chamber and an outer chamber, said inner chamber having its entrant end in communication with the lower end of said inner chamber of said vertical structure, a mixer within said inner chamber of said horizontal structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure, down through said inner chamber of said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber of said vertical structure to drop down with the current of hot gases and become heated thereby

to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant end of said inner chamber of said structure and mixed and conveyed through said horizontal structure and out of the discharge end of the same, and a supplemental device for introducing raw coal dust into said inner chamber of said horizontal structure to mix with the heated material prior to the discharge of the same from said inner chamber of said horizontal structure.

24. An apparatus for the distillation of coal which includes a vertical double wall structure having an inner chamber and an outer chamber, said chambers communicating adjacent to their tops, a horizontal double wall structure having an inner chamber, and an outer chamber, said inner chamber having its entrant end in communication with the lower end of said inner chamber of said vertical structure, a mixer within said inner chamber of said horizontal structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure down through said inner chamber of said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber of said vertical structure to drop down with the current of hot gases and become heated thereby to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant end of said inner chamber of said horizontal structure and mixed and conveyed through said horizontal structure and out of the discharge end of the same, and means for introducing water gas into said hot gaseous current before it enters said inner chamber of said vertical structure to assist in the recovery of ammonia.

25. An apparatus for the distillation of coal which includes a vertical double wall structure having an inner chamber and an outer chamber, said chambers communicating adjacent to their tops, a horizontal double wall structure having an inner chamber and an outer chamber, said inner chamber having its entrant end in communication with the lower end of said inner chamber of said vertical structure, a mixer within said inner chamber of said horizontal structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure, down through said inner chamber of

said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber of said vertical structure to drop down with the current of hot gases and become heated thereby to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant end of said inner chamber of said structure and mixed and conveyed through said horizontal structure and out of the discharge end of the same, a supplemental device for introducing raw coal dust into said inner chamber of said horizontal structure to mix with the heated material prior to the discharge of the same from said inner chamber of said horizontal structure, and means for introducing water gas into said hot gas current before it enters said inner chamber of said vertical structure to assist in the recovery of ammonia.

26. An apparatus for the distillation of coal which includes a vertical double wall structure having an inner chamber and an outer chamber, said chambers communicating adjacent to their tops, a horizontal double wall structure having an inner chamber and an outer chamber, said inner chamber having its entrant end in communication with the lower end of said inner chamber of said vertical structure, a mixer within said inner chamber of said horizontal structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure, down through said inner chamber of said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber of said vertical structure to drop down with the current of hot gases and become heated thereby to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant end of said inner chamber of said horizontal structure and mixed and conveyed through said horizontal structure and out of the discharge end of the same, and means for introducing steam into said hot gas current prior to the entrance of the same into said inner chamber of said vertical structure.

27. An apparatus for the distillation of coal which includes a vertical double wall structure having an inner chamber and an outer chamber, said chambers communicating adjacent to their tops, a horizontal double wall structure having an inner chamber and an outer chamber, said inner chamber having its entrant end in communication

with the lower end of said inner chamber of said vertical structure, a mixer within said inner chamber of said horizontal structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure, down through said inner chamber of said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber of said vertical structure to drop down with the current of hot gases and become heated thereby to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant end of said inner chamber of said structure and mixed and conveyed through said horizontal structure and out of the discharge end of the same, a supplemental device for introducing raw coal dust into said inner chamber of said horizontal structure to mix with the heated material prior to the discharge of the same from said inner chamber of said horizontal structure, and means for introducing steam into said hot gas current prior to the entrance of the same into said inner chamber of said vertical structure.

28. An apparatus for the distillation of coal which includes a vertical double wall structure having an inner chamber and an outer chamber, said chambers communicating adjacent to their tops, a horizontal double wall structure having an inner chamber and an outer chamber, said inner chamber having its entrant end in communication with the lower end of said inner chamber of said vertical structure, a mixer within said inner chamber of said horizontal structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure, down through said inner chamber of said vertical structure, and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber of said vertical structure to drop down with the current of hot gases and become heated thereby to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant end of said inner chamber of said horizontal structure and mixed and conveyed through said horizontal structure and out of the discharge end of the same, a separating chamber into which the gases are drawn from said conveyer and into which

the solid mass from said conveyer is deposited, means for conveying the gaseous matter from said last named chamber, and a retort into which the solid product from the receiving chamber is deposited, means for forcing the solid mass through said retort and discharging the same to the atmosphere.

29. An apparatus for the distillation of coal which includes a vertical double wall structure having an inner chamber and an outer chamber, said chambers communicating adjacent to their tops, a horizontal double wall structure having an inner chamber and an outer chamber, said inner chamber having its entrant end in communication with the lower end of said inner chamber of said vertical structure, a mixer within said inner chamber of said horizontal structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure, down through said inner chamber of said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber of said vertical structure to drop down with the current of hot gases and become heated thereby to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant end of said inner chamber of said structure and mixed and conveyed through said horizontal structure and out of the discharge end of the same, and a supplemental device for introducing raw coal dust into said inner chamber of said horizontal structure to mix with the heated material prior to the discharge of the same from said inner chamber of said horizontal structure, a separating chamber into which the gases are drawn from said conveyer and into which the solid mass from said conveyer is deposited, means for conveying the gaseous matter from said last named chamber, and a retort into which the solid product from the receiving chamber is deposited, means for forcing the solid product through said retort and discharging the same to the atmosphere.

30. An apparatus for the distillation of coal which includes a vertical double wall structure having an inner chamber and an outer chamber, said chambers communicating adjacent to their tops, a horizontal double wall structure having an inner chamber, and an outer chamber, said inner chamber having its entrant end in communication with the lower end of said inner chamber of said vertical structure, a mixer within said inner chamber of said horizontal structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure, down through said inner chamber of said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber of said vertical structure to drop down with the current of hot gases and become heated thereby to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant end of said inner chamber of said structure and mixed and conveyed through said horizontal structure and out of the discharge end of the same, a supplemental device for intro-

structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure down through said inner chamber of said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber of said vertical structure to drop down with the current of hot gases and become heated thereby to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant end of said inner chamber of said horizontal structure and mixed and conveyed through said horizontal structure and out of the discharge end of the same, means for introducing water gas into said hot gaseous current before it enters said inner chamber of said vertical structure to assist in the recovery of ammonia, a separating chamber into which the gases are drawn from said conveyer and into which the solid matters from said conveyer are deposited, means for conveying the gaseous matter from said last named chamber, and a retort into which the solid product from the receiving chamber is deposited, means for forcing the solid product through said retort and discharging the same to the atmosphere.

31. An apparatus for the distillation of coal which includes a vertical double wall structure having an inner and an outer chamber, said chambers communicating adjacent to their tops, a horizontal double wall structure having an inner chamber and an outer chamber, said inner chamber having its entrant end in communication with the lower end of said inner chamber of said vertical structure, a mixer within said inner chamber of said horizontal structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure, down through said inner chamber of said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber of said vertical structure to drop down with the current of hot gases and become heated thereby to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant end of said inner chamber of said structure and mixed and conveyed through said horizontal structure and out of the discharge end of the same, a supplemental device for intro-

5 ducing raw coal dust into said inner chamber of said horizontal structure to mix with the heated material prior to the discharge of the same from said inner chamber of said
 10 horizontal structure, means for introducing water gas into said hot gas current before it enters said inner chamber of said vertical structure to assist in the recovery of ammonia, a separating chamber into which the
 15 gases are drawn from said conveyer and into which the solid mass from said conveyer is deposited, means for conveying the gaseous matter from said last named chamber and a retort into which the solid product from
 the receiving chamber is deposited, means for forcing the solid product through said retort and discharging the same to the atmosphere.

20 32. An apparatus for the distillation of coal which includes a vertical double wall structure having an inner chamber and an outer chamber, said chambers communicating adjacent to their tops, a horizontal double wall structure having an inner chamber and an outer chamber, said inner chamber having its entrant end in communication with the lower end of said inner chamber of said vertical structure, a mixer within said inner chamber of said horizontal
 25 structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical
 30 structure, down through said inner chamber of said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means
 35 for introducing coal dust into said inner chamber of said vertical structure to drop down with the current of hot gases and become heated thereby to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant
 40 end of said inner chamber of said horizontal structure and out of the discharge end of the same, means for introducing steam into said hot gas current prior to the entrance of the same into said inner chamber of said vertical structure, a separating chamber into which the gases are drawn from said conveyer and into which the solid mass from said conveyer is deposited, means for conveying the gaseous matter from said last named chamber, and a retort into which the solid product from the receiving chamber is deposited, means for feeding the solid product through said retort and discharging
 45 the same to the atmosphere.

50 33. An apparatus for the distillation of coal which includes a vertical double wall structure having an inner chamber and an outer chamber, said chambers communicating adjacent to their tops, a horizontal dou-
 55 ble wall structure having an inner chamber and an outer chamber, said inner chamber having its entrant end in communication with the lower end of said inner chamber of said vertical structure, a mixer within said inner chamber of said horizontal structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure, down through said inner chamber of said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber

60 ble wall structure having an inner chamber and an outer chamber, said inner chamber having its entrant end in communication with the lower end of said inner chamber of said vertical structure, a mixer within said
 65 inner chamber of said horizontal structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure, down through said inner chamber of said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber of said vertical structure to drop down with the current of hot gases and become heated thereby to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant end of said inner chamber of said structure and mixed and conveyed through said horizontal structure and out of the discharge end of the same, a supplemental device for introducing raw coal dust into said inner chamber of said horizontal structure to mix with the heated material prior to the discharge of the same from said inner chamber of said horizontal structure, means for introducing steam into said hot gas current prior to the entrance of the same into said inner chamber of said vertical structure, a separating chamber into which the gases are drawn from said conveyer and into which the solid mass from said conveyer is deposited, means for conveying the gaseous matter from said last named chamber and a retort into which the solid product from the receiving chamber is deposited, means for forcing the solid product through said retort and discharging the same to the atmosphere.

70 34. An apparatus for the distillation of coal which includes a vertical double wall structure having an inner chamber and an outer chamber, said chambers communicating adjacent to their tops, a horizontal double wall structure having an inner chamber and an outer chamber, said inner chamber having its entrant end in communication with the lower end of said inner chamber of said vertical structure, a mixer within said inner chamber of said horizontal structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure, down through said inner chamber of said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber

of said vertical structure to drop down with the current of hot gases and become heated thereby to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant end of said inner chamber of said horizontal structure and mixed and conveyed through said horizontal structure and out of the discharge end of the same, a separating chamber into which the gases are drawn from said conveyer and into which the solid mass from said conveyer is deposited, means for conveying the gaseous matter from said last named chamber, a retort into which the solid product from the receiving chamber is deposited, means for forcing the solid product through said retort and discharging the same to the atmosphere, gas and air pumps for injecting fuel into said last named retort, said fuel adapted to be ignited to produce incomplete combustion around the compressing means, the spent gases from said incomplete combustion being conveyed into the outer chamber of said horizontal structure to form the hot gases aforesaid.

35. An apparatus for the distillation of coal which includes a vertical double wall structure having an inner chamber and an outer chamber, said chambers communicating adjacent to their tops, a horizontal double wall structure having an inner chamber and an outer chamber, said inner chamber having its entrant end in communication with the lower end of said inner chamber of said vertical structure, a mixer within said inner chamber of said horizontal structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure, down through said inner chamber of said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber of said vertical structure to drop down with the current of hot gases and become heated thereby to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant end of said inner chamber of said structure and mixed and conveyed through said horizontal structure and out of the discharge end of the same, and a supplemental device for introducing raw coal dust into said inner chamber of said horizontal structure to mix with the heated material prior to the discharge of the same from said inner chamber of said horizontal structure, a separating chamber into which the gases are drawn from said conveyer, and into which the solid mass from said conveyer is deposited,

means for conveying the gaseous matter from said last named chamber, a retort into which the solid product from the receiving chamber is deposited, means for forcing the solid product through said retort and discharging the same to the atmosphere, gas and air pumps for injecting fuel into said last named retort, said fuel adapted to be ignited to produce incomplete combustion around the compressing means, the spent gases from said incomplete combustion being conveyed into the outer chamber of said horizontal structure to form the hot gases aforesaid.

36. An apparatus for the distillation of coal which includes a vertical double wall structure having an inner chamber and an outer chamber, said chambers communicating adjacent to their tops, a horizontal double wall structure having an inner chamber, and an outer chamber having its entrant end in communication with the lower end of said inner chamber of said vertical structure, a mixer within said inner chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure down through said inner chamber of said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber of said vertical structure to drop down with the current of hot gases and become heated thereby to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant end of said inner chamber of said horizontal structure and mixed and conveyed through said horizontal structure and out of the discharge end of the same, means for introducing water gas into said hot gaseous current before it enters said inner chamber of said vertical structure to assist in the recovery of ammonia, a separating chamber into which the gases are drawn from said conveyer and into which the solid matter from said conveyer is deposited, means for conveying the gaseous matter from said last named chamber, a retort into which the solid product from the receiving chamber is deposited, means for forcing the solid product through said retort and discharging the same to the atmosphere, gas and air pumps for injecting fuel into said last named retort, said fuel adapted to be ignited to produce incomplete combustion around the compressing means, the spent gases from such incomplete combustion being conveyed into the outer chamber of said horizontal structure to form the hot gases aforesaid.

37. An apparatus for the distillation of coal

which includes a vertical double wall structure having an inner chamber and an outer chamber, said chambers communicating adjacent to their tops, a horizontal double wall structure having an inner chamber and an outer chamber, said inner chamber having its entrant end in communication with the lower end of said inner chamber of said vertical structure, a mixer within said inner chamber of said horizontal structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure, down through said inner chamber of said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber of said vertical structure to drop down with the current of hot gases and become heated thereby to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant end of said inner chamber of said structure and mixed and conveyed through said horizontal structure and out of the discharge end of the same, means for introducing raw coal dust into said inner chamber of said horizontal structure to mix with the heated material prior to the discharge of the same from said inner chamber of said horizontal structure, means for introducing water gas into said hot gas current before it enters said inner chamber of said vertical structure to assist in the recovery of ammonia, a separating chamber into which the gases are drawn from said conveyer and into which the solid mass from said conveyer is deposited, means for conveying the gaseous matter from said last named chamber and a retort into which the solid product from the receiving chamber is deposited, means for forcing the solid product through said retort and discharging the same to the atmosphere, gas and air pumps for injecting fuel into said last named retort, said fuel adapted to be ignited to produce incomplete combustion around the compressing means, the spent gases from said incomplete combustion being conveyed into the outer chamber of said horizontal structure to form the hot gases aforesaid.

38. An apparatus for the distillation of coal which includes a vertical double wall structure having an inner chamber and an outer chamber, said chambers communicating adjacent to their tops, a horizontal double wall structure having an inner chamber and an outer chamber, said inner chamber having its entrant end in communication with the lower end of said inner chamber of

said vertical structure, a mixer within said inner chamber of said horizontal structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure, down through said inner chamber of said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber of said vertical structure to drop down with the current of hot gases and become heated thereby to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant end of said inner chamber of said horizontal structure and mixed and conveyed through said horizontal structure and out of the discharge end of the same, means for introducing steam into said hot gas current prior to the entrance of the same into said inner chamber of said vertical structure, a separating chamber into which the gases are drawn from said conveyer and into which the solid mass from said conveyer is deposited, means for conveying the gaseous matter from said last named chamber, a retort into which the solid product from the receiving chamber is deposited, means for forcing the solid product through said retort and discharging the same to the atmosphere, gas and air pumps for injecting fuel into said last named retort, said fuel adapted to be ignited to produce incomplete combustion around the compressing means, the spent gases from such incomplete combustion being conveyed into the outer chamber of said horizontal structure to form the hot gases aforesaid.

39. An apparatus for the distillation of coal which includes a vertical double wall structure having an inner chamber and an outer chamber, said chambers communicating adjacent to their tops, a horizontal double wall structure having an inner chamber and an outer chamber, said inner chamber having its entrant end in communication with the lower end of said inner chamber of said vertical structure, a mixer within said inner chamber of said horizontal structure, said outer chamber of said horizontal structure and said outer chamber of said vertical structure being in communication, means for drawing hot gases through said outer chamber of said horizontal structure up said outer chamber of said vertical structure, down through said inner chamber of said vertical structure and then through said inner chamber of said horizontal structure to the discharge end of the same, means for introducing coal dust into said inner chamber of said vertical structure to drop down

with the current of hot gases and become heated thereby to drive off the gaseous and vaporous products from the coal dust, the resultant mass being collected at the entrant end of said inner chamber of said structure and mixed and conveyed through said horizontal structure and out of the discharge end of the same, a supplemental device for introducing raw coal dust into said inner chamber of said horizontal structure to mix with the heated material prior to the discharge of the same from said inner chamber of said horizontal structure, means for introducing steam into said hot gas current prior to the entrance of the same into said inner chamber of said vertical structure, a separating chamber into which the gases are drawn from said conveyer and into which the solid mass from said conveyer is deposited, means for conveying the gaseous matter from said last named chamber and a retort into which the solid product from the receiving chamber is deposited, means for forcing the solid product through said retort and discharging the same to the atmosphere, gas and air pumps for injecting fuel into said last named retort, said fuel adapted to be ignited to produce combustion around the compressing means, the spent gases from said incomplete combustion being conveyed into the outer chamber of said horizontal structure to form the hot gases aforesaid.

40. An apparatus for the distillation of coal which comprises an upright stack or retort, means for circulating an atmosphere of heated gases downwardly through said stack while excluding the atmospheric air, means for dropping coal dust through said stack, means for collecting the deposited mass in said stack and conveying the same away from the stack, said means having provision for excluding the atmosphere, means for introducing raw coal dust into the conveyer to mix with the heated mass,

means for separately collecting the solid and gaseous products discharged from the conveyer for further treatment.

41. An apparatus for the distillation of coal which comprises an upright or retort, means for circulating an atmosphere of heated gases downwardly through said stack while excluding the atmospheric air, means for dropping coal dust through said stack, means for collecting the deposited mass in said stack and conveying the same away from the stack, said means having provision for excluding the atmosphere, means for introducing raw coal dust into said conveyer to mix with the heated mass, means for separately collecting the solid and gaseous products discharged from the conveyer for further treatment, said last named means including a separating chamber from which the gaseous products are withdrawn, said separating chamber having a discharge opening for the solid product and means for compressing said solid product while hot to form a semi-hard coal product.

42. The method of distilling coal which consists in first passing relatively finely divided coal particles through an atmosphere of hot gases to heat the coal particles to cause a separation of the volatile and non-volatile products, collecting the non-volatile mass as it forms, introducing raw coal dust into said collected non-volatile mass and separately collecting the volatile and non-volatile products.

43. The process of distilling coal which includes the following steps:—showering relatively finely divided coal particles into an atmosphere of semi-spent gas out of contact with the atmosphere, which gas is at such temperature that each particle bathed in the gas for a short space of time will have its volatiles vaporized, and separately collecting the resultant non-volatile mass and volatiles, and permanent gases.

HARRY A. KUHN.