

B. LOOMIS.

APPARATUS FOR TREATING FURNACE GASES AND PREPARING FUEL.

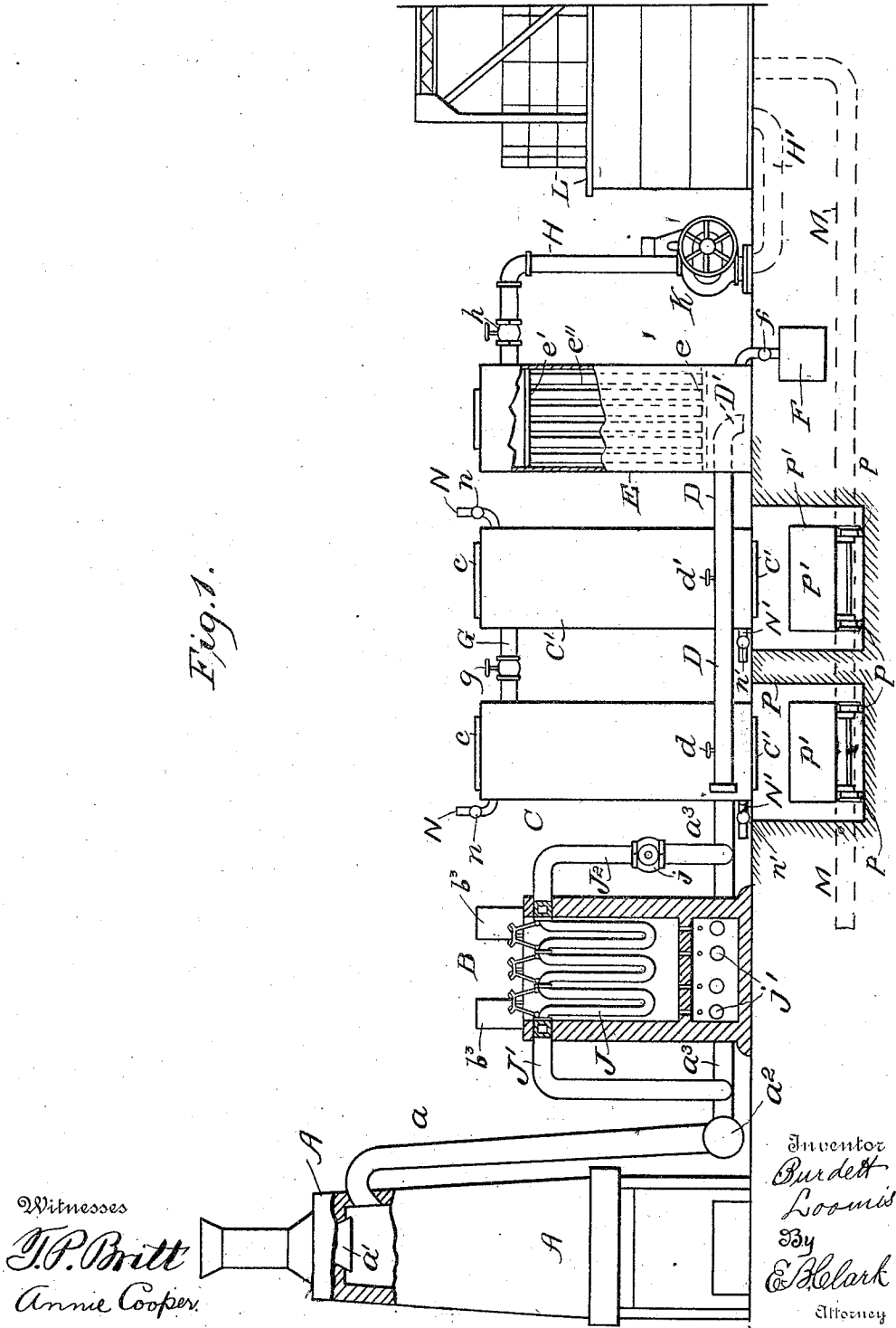
APPLICATION FILED MAR. 5, 1910.

1,066,296.

Patented July 1, 1913.

3 SHEETS-SHEET 1.

Fig. 1.



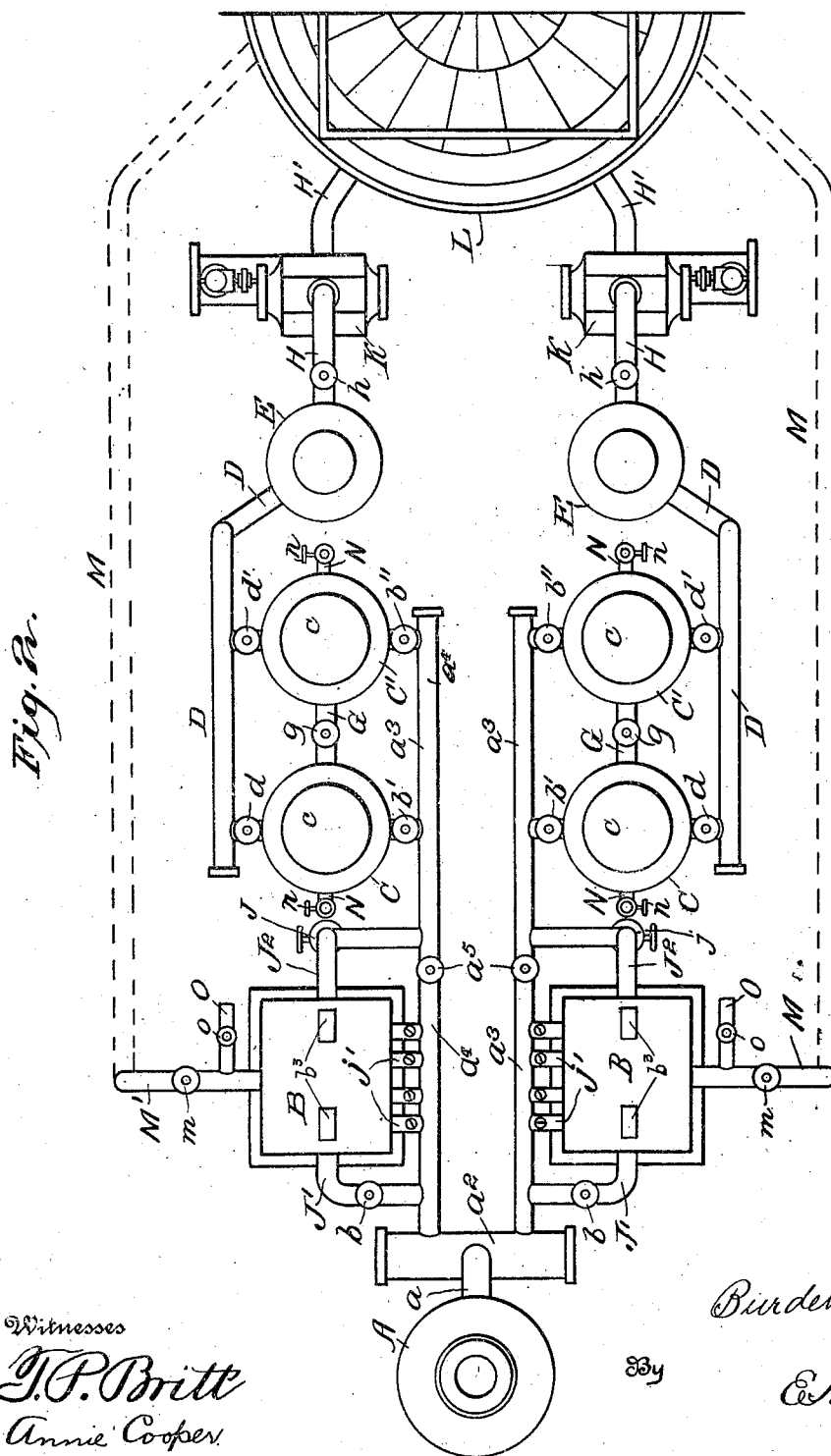
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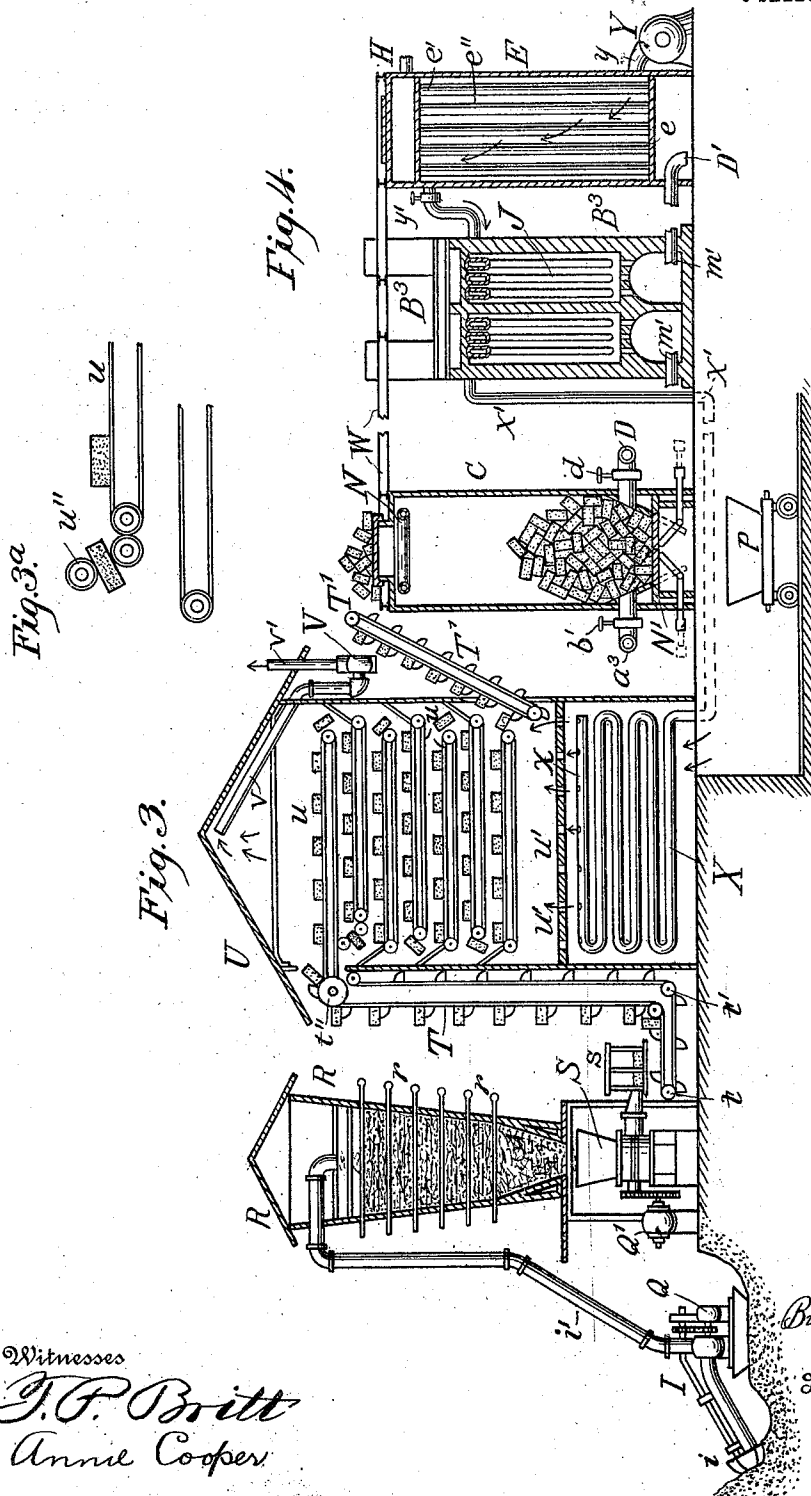
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UNITED STATES PATENT OFFICE.

BURDETT LOOMIS, OF HARTFORD, CONNECTICUT, ASSIGNOR TO LOOMIS UTILIZATION COMPANY, A CORPORATION OF NEW JERSEY.

APPARATUS FOR TREATING FURNACE-GASES AND PREPARING FUEL.

1,066,296.

Specification of Letters Patent.

Patented July 1, 1913.

Original application filed May 28, 1906, Serial No. 319,148. Divided and this application filed March 5, 1910. Serial No. 547,494.

To all whom it may concern:

Be it known that I, BURDETT LOOMIS, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Apparatus for Treating Furnace-Gases and Preparing Fuel, of which the following is a specification.

10 This invention relates to apparatus for charring peat or finely divided wood, cleaning, enriching and utilizing blast-furnace and other gases, separating and collecting by-products of condensation from peat-vapors and gases.

The object of my invention is to provide improved apparatus for cleaning blast-furnace or produces gases, at the same time charring peat or divided wood, such as sawdust, by means thereof, and distilling volatile hydrocarbons and other products from the peat or wood, thereby enriching or carbureting the gases and fitting them for use in the smelting operation, or for heating hot blast or other heating stoves, or for illuminating purposes, or for operating gas engines or for other purposes in the industrial arts.

In certain localities wood-charcoal is used for smelting iron ore in blast-furnaces, but, owing to the rapidly diminishing supply of wood, the expense of charcoal has become almost, if not quite, prohibitive for smelting purposes. A great, and heretofore, profitable industry in certain localities is therefore threatened with extinction. In these same localities peat bogs are found from which may be excavated an abundant supply of high grade peat which may be effectively and economically utilized in smelting operations and for generating enriched gas. In my process and apparatus, the peat is first used for cleaning and enriching blast-furnace gases, while, at the same time, the hot gases serve to distil peat and reduce it to coke or char-peat and thereby enrich the gas. The volatile hydrocarbon matter distilled from the peat and carried by the blast-furnace gases is partly condensed to the condition of peat tar and peat tar-water and the ammonia is also condensed. A certain portion of the volatile matter in the peat is converted into

rich hydrocarbon gas which serves for enriching the blast-furnace gases. These gases, thus enriched, are free from sulfur and are of high calorific value, suitable for motive power in gas engines and for illuminating purposes. In my process, part of the enriched gas, after passing the condenser, is returned and burned in a gas heating furnace in which the blast-furnace gases may be additionally heated in pipes if required, to adapt them for more effectively distilling and charring the peat. The gases passed from the blast-furnace may sometimes be not sufficiently hot for charring peat and for this reason may be additionally heated before admission to the charring chambers. The gases not required for this heating operation may be stored in a holder and withdrawn for other uses as above indicated. Two varieties or qualities of charred peat will be made, which may be designated as peat-coke and peat steam-coke. The peat-coke serves as a substitute for wood charcoal for the manufacture of refined iron and for other purposes. For this purpose the peat-coke may be compressed or consolidated in the form of briquets to such a degree that it possesses almost the same strength of compression as coke produced from coal. The peat steam-coke burns with a flame and serves as a fuel for locomotives, and for use in factories and private houses, it may also be compressed into briquets.

From the peat tar may be manufactured motor oil, gas oil, creosote, paraffin and lubricating oil. Moist sawdust or other waste divided wood may be used and treated in substantially the same manner as above described with reference to peat, producing similar products of distillation, and a similar residual charred product, which may be used for the same purposes as peat-coke and which may be compressed into briquets.

The peat tar-water separated in the condenser yields under proper treatment, ammonium sulfate, calcium acetate and methylic alcohol, commonly known as wood alcohol.

The matter constituting my invention will be defined in the claims.

I will now describe the details of construction of my apparatus and the method

operating the same by reference to the accompanying drawings, in which:

Figure 1 represents an elevation of the apparatus with parts in section. Fig. 2 represents a top plan view of the same. Fig. 3 represents a sectional elevation of apparatus for excavating and drying peat, a pug mill, a peat charring chamber and suitable connecting conveyers for supplying blocks of peat to the charring chamber. Fig. 3^a represents a sectional detail view, on enlarged scale, of part of the peat drier. Fig. 4 represents a sectional elevation of a condenser and a connected fan blower.

The blast furnace A may be of the usual construction and provided with a charging bell *a'*. The gas take-off pipe or down-comer *a* may lead from the top of the furnace in the usual manner and at its lower end connect with a header or main pipe *a*². With this header connect two gas outlet pipes *a*³ and *a*⁴ leading into heating furnaces B and B¹ and by connections, preferably, to the bases of the gas cleaning and peat charring chambers C, and C¹.

Referring now to Figs. 1 and 2, I preferably construct the gas heaters and the peat charring chambers in two series, so that coke in one series may be cooled off, and discharged while the other set is in active operation for cleaning blast-furnace gas and charring peat or divided wood. For the purpose of illustration, I show two charring chambers connected in each series, so that hot gas may be passed up and down in one direction and then reversed and passed in the opposite direction through the series. I will describe one series only and the operation therein, as both series will be constructed and operated alike. The charring chambers C and C¹ are constructed of plate steel, or boiler iron, riveted together in a well known manner, and are provided with top charging openings and tight fitting lids *c* and, at the bottom, with discharging doors *c'*. The gas pipe *a*³ leading from heater *a*² connects by a branch pipe J¹, having a valve *b*, with the return bend pipes J in heating furnace B, by pipes *j'* with the interior of furnace B and with the bases of the charring chambers C and C¹ by means of branch pipes having valves *b'* and *b''*, as shown in Fig. 2. A gas outlet pipe D connects by branch pipes having valves *d*, *d'* with the bottoms of the chambers C and C¹ and leads from the last chamber into the base of the condenser E where it terminates in a curved dip-pipe D¹ having its lower end sealed in the liquid. The chambers C and C¹ are also connected at the top by a pipe G having a valve *g*, so that hot gases may be passed up and down in either direction through them. The charring chambers C, C¹ are supported on suitable posts or foundations P, for providing chambers or passage-ways below

them in which are laid tracks *p*. On this track are run cars *p'* adapted to be centered below the discharging doors *c'* for receiving coke, charcoal or char-peat from the chamber. The blast-furnace gases may at times be too low in temperature for effectively charring peat; and I therefore provide for heating such gases before admission to the charring chamber. A gas heating furnace B is provided with a series of return-bend pipes J, with which connects a pipe J¹, having a valve *b*, leading from the main pipe, *a*³. An outlet pipe J², having a valve *j*, leads from heating pipe J back into the main pipe *a*³. A valve *a*⁵ is connected in the main pipe *a*³ between the branch pipes J¹ and J², as shown in Fig. 2. By means of these pipe and valve-connections, gas may be passed either through the heater B and thence into the charring chambers or directly from the blast-furnace into the charring chambers. After the charring chambers C, C¹, have been filled with peat or moist sawdust in bulk or compressed blocks, as shown in Fig. 3, blast furnace gas is preferably passed directly from the furnace through pipe *a*³ into and through the chambers till most of the moisture and part of the volatile hydrocarbons are driven out and then valve *a*⁵ may be closed and valve *b* opened. The blast furnace gas is now highly heated by passage through heating pipes J in furnace B and is then passed by pipe J² into pipe *a*³ beyond valve *a*⁵ and thence into and through the charring chambers for continuing the distillation till the peat therein is suitably charred. While drying out the bodies of peat in chambers C, C¹, by means of gas direct from the furnace, the top lids *c* may at first be open, especially during the early stages when much moisture is to be driven off, but all valuable vapors will be condensed. The heating furnace B may be heated by gas drawn off from the holder through pipe M and admitted by pipe M¹, having a valve *m*, into the base of the heater. An air inlet pipe O, having a valve *o*, connects with pipe M¹ for supplying air to the burner. The burner may be of a well known kind and two or more of them may be arranged at different points in the circumferential wall of chamber B and at the base thereof, as shown. The waste products of combustion may pass off from the furnace through the chimneys *b*³, Fig. 1. The furnace B may also be heated directly by hot blast-furnace gas, admitted through valved pipes *j'*, Fig. 1, or by hot gas directly from any other gas producing furnace. The condenser E may be of the well known water tube variety, being constructed with upper and lower tube sheets *e* and *e'*, connected by tubes *e''* and provided with upper and lower gas chambers, as indicated in Fig. 1. An overflow tar-water pipe

5 *f*, having a valve, leads from the lower gas chamber of the condenser into a tar well or trap F. A gas outlet pipe H, having a valve *h*, connects the upper gas chamber of the condenser with an exhaustor K and a pipe H² leads therefrom to the holder L. A gas outlet pipe M leads from the holder and conducts gas to heating furnace B and to other furnaces, for use as fuel therein.
 10 With the tops of the charring chambers C and C¹ I preferably connect water supply pipes N, having valves *n*, for supplying water to wash out dust and ashes from the charred peat, and cool the same so that it
 15 will not be ignited when being discharged from the charring chambers. Discharged pipes N¹, having valves *n'*, are connected with the bottoms of chambers C and C¹ for taking off washwater, carrying dust and
 20 ashes from the coke or char-peat. Cold gas may be admitted through pipes N, circulated in contact with the charred material and passed off through the bottom pipes N¹. This cold gas will effectively cool the material and improve its quality without in-
 25 juriouly wetting it.

Suitable apparatus for excavating peat from a bog, drying it, forming briquets and feeding the bricks to a charring chamber is illustrated in Fig. 3. A centrifugal excavating pump I and a connecting electric motor Q are mounted on a barge or other suitable support, and the pump is provided with a rotary cutter head *i* and with a discharge pipe *i'* leading to the top of a drying
 30 crib R. The crib R is provided with slots and a series of supporting rods *r* at different heights. Below the crib is placed a pug mill S and an operating electric motor Q¹. As the ground peat is discharged from this mill it is cut into blocks by a cutter *s*. An elevating conveyer T is passed over rollers *t*, *t'*, *t''* and so arranged that the blocks of peat will be taken from the pug mill and
 35 discharged at the top of the drying chamber U. In this drying chamber is arranged, one above another, a series of horizontal drying belts or aprons *u* on which the blocks of peat are traversed back and forth through the chamber while currents of hot
 40 air are circulated in contact therewith for carrying off the contained moisture. The blocks of peat, as delivered from the pug mill, are soft and would not make coke sufficiently dense and hard for the most suc-
 45 cessful use in a blast furnace. I therefore place in the upper part of drying chamber U, preferably at the end of the second drying apron *u*, a pair of squeezing rollers *u''*,
 50 Fig. 3², through which the blocks are passed and squeezed or compressed so as to make them more dense and hard. A second conveyer T¹ carries blocks of dried peat from the lower apron *u* to the working floor W,
 55 above the charring chambers. A perforated

horizontal partition *u'* is placed below the drying belts for distributing currents of hot air through the whole area of the chamber. In a chamber below this partition is ar-
 60 ranged a coil or serpentine of hot air pipe X, having an upper perforated discharge pipe *x* adjacent to the partition. Hot air is conveyed to the coil X by a pipe *x'* leading from a heating furnace or oven B², as shown in Fig. 4.

65 With the lower end of the tube chamber of the condenser is connected a fan blower Y by means of a pipe *y*. The cold air circulated between the tubes *e''* serves to cool and condense the vapors passing through
 70 the tubes while, at the same time, the air becomes heated. This heated air is passed off from the upper end of the tube chamber by a valved pipe *y'* into the series of pipes J of a heating oven or stove B³. In these
 75 pipes, the air is further heated by burning gas admitted by burners *m'* in the base of the furnace. This gas will be supplied from holder L. This heated air is then passed
 80 through pipe *x'* into the heating pipe in the base of the drying chamber U. On a suitable support near the top of the drying chamber is placed an exhaust fan V, hav-
 85 ing an inlet pipe *v* leading from the upper part of chamber U and an outlet pipe *v'* discharging into the outer air. By means
 90 of the devices for heating air and discharging it into the base of the drying chamber and the exhaust fan for drawing off moist
 95 air from the top of the drying chamber, the blocks of peat traversed back and forth on the aprons are rapidly dried and prepared for feeding into the charring cham-
 100 ber C.

The charring chambers having been filled with blocks of peat and the blast furnace or other gas producer being in operation, the hot gases discharged through the take-off
 105 pipe *a* into the header *a'* are passed therefrom through pipe *a'* and valves *a'* and *b'*, which are open, into the base of charring chamber C. The valve *g* being open, hot gases will pass up through chamber C, and
 110 down through chamber C¹, taking up volatile matter and thence by outlet pipe D into the base of the condenser E. The dust and ashes carried by the blast furnace gases will be arrested in contact with the lower layers
 115 of peat. Gases are passed directly from the blast furnace through the charring chambers, until the peat therein is freed from most of the contained moisture and volatile constituents and is in the best condition for
 120 readily charring and making coke and char-peat. The blast-furnace gas is now, preferably, passed through the heater B by closing valve *a'* and opening valve *b*, thereby causing the gas to pass through the heating
 125 pipes J which are heated by burners supplied by gas pipe M¹, and air pipe O. The

heated blast furnace gas is now passed by pipe J² and pipe a³ through valve b'' into the charring chamber C¹ and is thence passed from the top thereof through pipe G down through chamber C and is taken off at the base thereof through valve d and pipe D to the condenser E. The volatile matter is condensed and the fixed gases are drawn off through the condenser by the ex-
 5 hauster and may be passed directly to the holder L. The gas pipe M may conduct part of the gases back to the base of the heating furnace where they are burned to heat furnace B and the gases which are
 10 passed through pipe J. By means of the hot gases which pass into the chamber C¹, the peat is gradually distilled and charred, giving off its volatile hydrocarbons which are mixed with and carried off by the gases.
 15 The gases, still hot, pass from the chamber C¹ through upper pipe G and thence through the peat in chamber C where distillation and charring are partially effected and then the gases are passed off through
 20 pipe D. After the peat in chamber C¹ has become partially or sufficiently distilled and charred, the inlet valve b'' is closed and the inlet valve b' is opened, admitting heated gases directly into the base of chamber C.
 25 Valve d' being open and valve d closed, gas will now be passed from chamber C¹ through pipe D to the condenser, as before described.

In the condenser there is separated from
 35 the gas, tar and tar-water which flow off through pipe f into a tank F, which in practice will be provided with a trap or liquid seal. The tar and tar water will be afterward separately treated for obtaining valuable products. The peat-tar yields motor
 40 oil, gas oil, creosote and paraffin. The peat tar water, under proper chemical treatment, yields ammonium sulfate, calcium acetate, and methylic alcohol, or wood spirit. The
 45 gas, after passing the condenser, contains a valuable percentage of noncondensable carbureted hydrogen, making it sufficiently rich for incandescent gas lighting, for motive power in gas engines, for heating forge
 50 furnaces and various other uses.

When it happens that the blast furnace or other gases are not hot enough for effectively distilling and charring peat, they are passed first into the heating furnace B by
 55 closing valve a⁵ and opening valve b, and are therein heated by passing through the return bend pipes J. The valve j in pipe J² being open, hot gas is passed on through pipe a³ and is admitted therefrom either
 60 through valve b' or b'' into one or the other of the chambers C, C¹ where the charring operating is conducted, as above described. For the purpose of heating furnace B and the pipe J therein, gas is drawn from the
 65 holder through pipes M and M¹, and valve

m being open, is passed to the burner. At the same time, valve o is open, admitting air to the burner. The peat having been properly distilled and charred in the chambers of the first series, the blast furnace gases
 70 are shut off therefrom and may be directed into the second series of charring chambers where the charring operation may be repeated substantially as above described. Water may now be admitted through the
 75 pipes N into the tops of the chambers containing charred peat for cooling the same and washing out the deposited dust and ashes and at this time the top lids or covers
 80 c may be opened for permitting the escape of steam. The waste washwater, carrying dust and ashes, will be passed off through pipes N¹ by opening valves n'. The coke or char-peat, having been washed and cooled,
 85 may be discharged from the chambers through the bottom doors c' into cars p', and fed in any well known manner to the blast furnace or otherwise used. Charges of ore, char-peat, and limestone will be prepared in substantially the same manner as
 90 with wood charcoal and fed to the top of the blast furnace.

Instead of using water for cooling the charred material, cold gas may be admitted through the pipes N, circulated in contact
 95 with the charred material and passed off through the bottom pipes N¹. The charred material after having been sufficiently cooled may be drawn off by any suitable means from the charring chambers and passed through
 100 briquetting machines for compressing it into hard, dense briquets which may be effectively used in a blast furnace, a steam boiler furnace or for domestic heating and cooking.

I do not herein claim the process of treating and utilizing blast-furnace gases and preparing peat for fuel, as that is made the subject matter of claims in my application, Serial Number 319148, originally filed May
 110 28, 1906, co-pending with the present application and of which application, Serial Number 319148, the present is a division.

Having described my invention, what I claim, and desire to secure by Letters
 115 Patent, is—

1. Apparatus for treating furnace gases and preparing peat for fuel, comprising a furnace for producing hot gas, a gas heater, a charring chamber for peat, means for admitting hot gas from said furnace and
 120 heater to the charring chamber, an exhauster for drawing hot gas through the peat, connections for drawing off gas from the charring chamber, whereby the furnace gas may be cleaned of dust and ashes and peat
 125 distilled and charred for enriching the cleaned furnace gas.

2. Apparatus for treating furnace gases and preparing peat for fuel, comprising a blast-furnace, two peat charring chambers
 130

connected at the top, means for admitting hot gas from the blast furnace at the lower ends of the charring chamber and passing it in reverse directions through the peat, an
 5 exhaustor and pipe connections for drawing off gas from the base of either charring chamber and means connected with the charring chamber for admitting a cooling fluid to the charred peat.

10 3. Apparatus for treating furnace gases and preparing moist material for fuel, comprising a blast-furnace, two or more peat charring chambers, pipes connecting them, one with another whereby gas may be passed
 15 in opposite directions through them, a gas take-off pipe leading from the blast-furnace and having a pipe and valve connection to each chamber, and a gas outlet pipe and valve connection from each chamber, where-
 20 by hot blast-furnace gas may be passed first in one direction and then in the reverse direction through bodies of peat in the chambers for cleaning the gas, distilling volatile vapors and charring peat.

25 4. The combination with a blast-furnace, of two or more peat charring chambers, a valved pipe directly connecting two chambers, one with another, a gas take-off pipe leading from the blast-furnace and a valved
 30 pipe connecting it with each chamber at one end, a valved gas outlet pipe connecting with each chamber at the opposite end, and a connected exhaustor.

35 5. The combination with a blast-furnace, of a series of peat charring chambers connected by valved pipes in series, whereby gas may be passed in opposite directions through the series, a gas take-off pipe leading from the blast-furnace, a valved pipe connection
 40 therefrom to each charring chamber and a valved gas outlet pipe leading from each of the chambers, of the series, and an exhaustor connecting with the outlet pipe.

45 6. The combination with a blast furnace, of a gas-heating furnace containing pipes for the flow of gas, means for heating said furnace and pipes, a pair of upright peat charring chambers, a pipe and valve connecting them at the top, pipes leading from

the blast furnace and from the heater and
 50 connecting by valved branches with the bases of said charring chambers, a valved gas outlet pipe connecting at the bottom of each chamber, and a connected exhaustor, whereby hot blast furnace gas may be passed
 55 up through one body of peat and thereby freed from dust and ashes, and then down through the other body of peat to distil off the volatile hydro-carbon and enrich the purified gas. 60

7. The combination with a blast furnace and a gas heating furnace having a series of connected pipes therein and means for heating them, of a pair of peat distilling and charring chambers, a valved pipe connecting
 65 them at the top, suitable pipe and valve connections for passing blast-furnace gas through the heater to the charring chambers or directly from the blast furnace past or around the heater to the charring chambers, 70 pipe and valve connections at the base of the charring chambers, and a connected exhaustor, whereby gas at a comparatively low temperature may be first passed directly from the blast furnace through the bodies of
 75 peat for cleaning the gas and carrying off moisture from the peat, and then more highly heated gas passed up and down through the bodies of peat for charring the same and enriching the gas with volatile
 80 hydro-carbon.

8. The combination with a charring chamber, and means for supplying it with hot gas, of a condenser, a pipe and valve connection from the charring chamber to the
 85 condenser, means for drying peat or other moist material and delivering it to the charring chamber, an air forcing device connecting with the tube chamber of the condenser and a pipe connection for conveying
 90 hot air from said tube chamber to the peat drier.

In testimony whereof I affix my signature in presence of two witnesses.

BURDETT LOOMIS.

Witnesses:

HERBERT W. WILSON,
 CHAS. E. HARPER.