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CARBONIZING PROCESS

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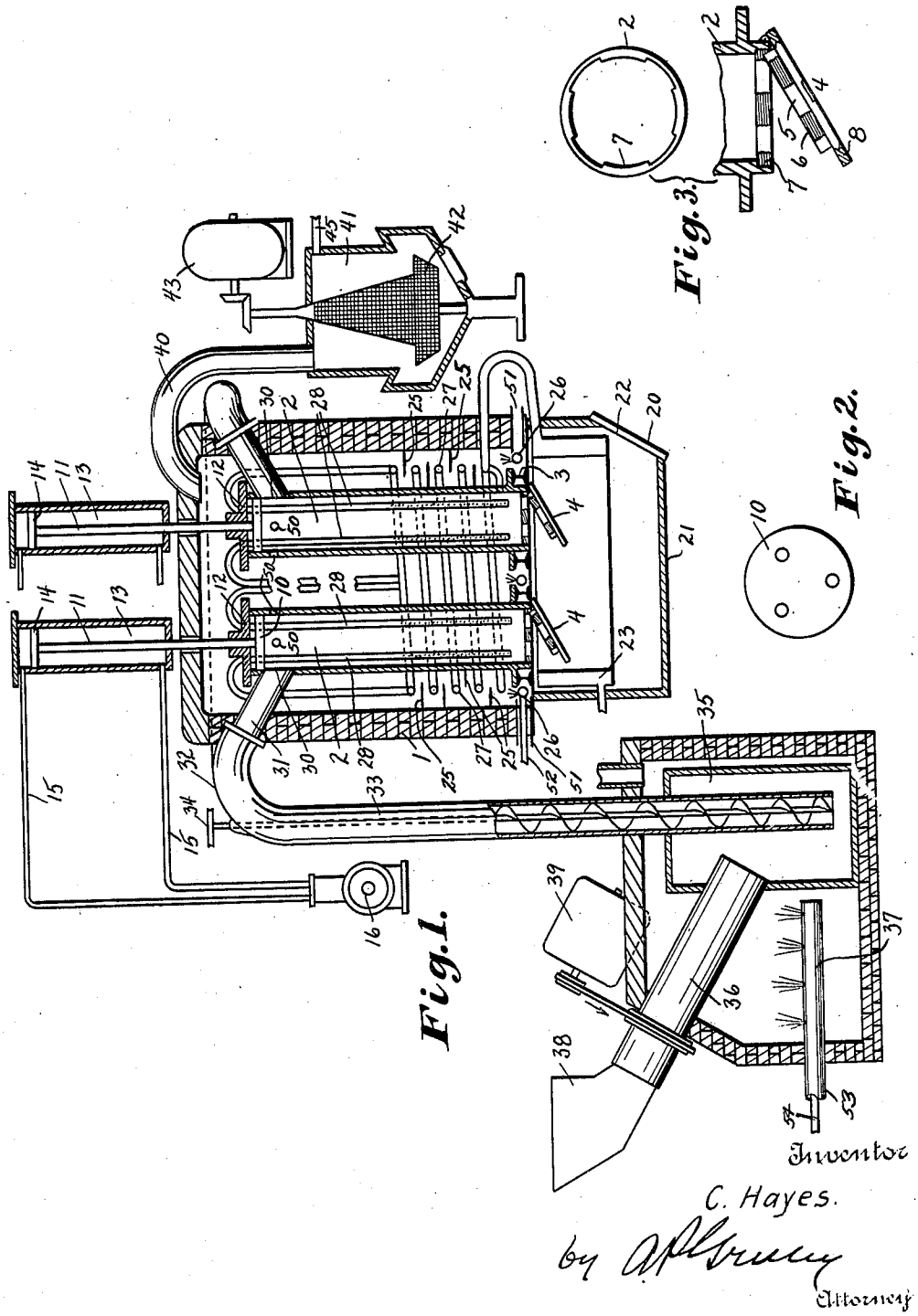


Fig. 1.

Fig. 3.

Fig. 2.

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UNITED STATES PATENT OFFICE.

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CARBONIZING PROCESS.

Application filed May 22, 1926, Serial No. 110,948, and in Canada May 16, 1925.

My invention relates to processes of carbonizing coal and has for its object to provide a simple, efficient and inexpensive method by which coal and coal-like material containing an excess of volatiles may be so far freed from volatiles as to leave a coke-like product high in fixed carbon with only such proportion of volatiles as may be desired for the purpose of enabling it to be readily ignited.

The value of coal for use as fuel depends upon the proportionate content of fixed carbon. If not too high in volatiles it may be used as a steam coal or may be coked. But there are large deposits of coal which is so high in volatiles as to be non-coking and of little value as fuel. This is particularly true of the coal classed as a lignite which is not only high in volatiles but also carries a large percentage of water.

By my invention this non-coking coal and lignite may be, quickly and at little expense, freed from excess of volatiles and water so as to leave a product composed mainly of fixed carbon free from water and containing only such slight percentage of volatiles as may be desired to make the product easy to ignite. The product obtained by my method is coke-like and is well adapted for use as domestic fuel as well as for use for any other fuel purpose, and is particularly uniform in quality whatever the original material from which it is made. The volatiles driven off are largely composed of condensable vapors and the oils condensed from these vapors are of substantial value and the volatiles driven off as fixed gas are of value for heating the digesters or for sale as gas for heating and illuminating.

With the objects above indicated in view my invention consists on the process hereinafter described and claimed.

Referring to the drawings:—

Figure 1 is a vertical sectional view, partly diagrammatical, of a plant adapted to carry out my invention.

Figure 2 is a detail cross plan view of the piston of one of the digesters.

Figure 3 is a detail plan and vertical sectional view showing the construction of the digester bottom.

It should be understood that the drawings are illustrative only and are not to be taken as restricting the invention to the use of the particular apparatus shown.

In the drawings 1 indicates a chamber preferably of brick work having arranged therein two or more vertical digesters 2 preferably tubes or cylinders of iron or steel. These digesters are open at their upper ends and at their lower ends rest upon suitable cross beams 3. Near their upper ends the digesters are provided with openings 50 for the escape of gases from the digesters into chamber 1. At their lower ends these digesters are closed by hinged bottoms 4 preferably each consisting of a main portion 5 provided with interrupted screwthreads 6 adapted to be engaged with corresponding interrupted screw threads 7 in the lower end of the digester, the main portion 5 being adapted to rotate in a ring 8 which is hinged to the digester, this construction being adapted to be readily locked and released and when locked in closed position capable of supporting heavy pressure.

In each digester is arranged a piston 10 carried by a rod 11 extending through guide plate 12 into a cylinder 13 arranged above the top of chamber 1 and carrying a piston 14. Water or oil supplied to cylinder 13 by pump 16 serves to force the piston 10 downward or to withdraw it as desired.

Below the lower ends of the digesters 2 is a bin 20 the bottom 21 of which is arranged at a distance from the lower end of the digester about equal to half the vertical height of the digester so that when the bottom of the digester is opened and the piston 10 is operated to expel the lower portion of the charge this expelled portion being a solid mass of coke-like material with its lower end resting on the bottom 21 of the bin forms a supporting column by which the less solid upper portion of the charge will be supported and prevented from dropping out of the digester. When the bottom is again closed this less solid portion of the charge will be in the lower portion of the digester in position to be subjected to the relatively higher heat and to be formed into a solid coke-like mass. A door 22 at one side of the bin 20 permits the finished fuel product to be removed.

About the wall of the bin is arranged a chamber or tank 23 to be supplied with water

to be converted into steam by the heat of the material discharged from the digester. The mass of material may, if desired, be further cooled by water from a hose or by other means.

About the digesters 2 between them and the walls of chamber 1, are preferably arranged baffle plates 25 and beneath these baffle plates are burners 26 preferably for burning fuel oil though the digester may, of course, be heated by other means. The air necessary for combustion may be supplied to these burners in any usual manner as by an air pipe 51 surrounding oil supply pipe 52. Between the baffle plates is arranged a coil 27 which is supplied with steam from any convenient source the coil 27 serving to superheat the steam so supplied. The upper end of the coil 27 is connected with pipes 28 preferably three for each digester, leading through guide plate 12 downward nearly to the lower end of the digester, these pipes being perforated at intervals from their lower ends to a point about opposite the midlength of the digester. The pistons 10 are provided with suitable openings for these superheated steam pipes. The three superheated steam pipes for each digester are preferably equally spaced apart and at points about midway between the center of the digester and its inner periphery.

Near the upper end of each digester is an inlet opening 30 to which leads a pipe 31 from a supply pipe 32 which leads from a conveyer 33, here shown as a screw conveyer of ordinary construction, operated by a pulley 34. This conveyer is adapted to receive coal or other material from a bin 35 and discharge it into pipes 31 and so into the digesters.

The coal or other material is supplied to bin 35 from a preliminary heater 36 arranged to be heated by burner 37 and having at its outer end a hopper 38 to which the coal is supplied preferably broken so that its particles will not be too large to pass through a quarter inch screen. The air necessary for combustion may be supplied to these burners in any usual manner as by an air inlet pipe 53 inclosing oil supply pipe 54. This preliminary heater is arranged to be rotated, by a motor 39 so as to effect agitation sufficient to prevent the particles of coal from sticking together and to ensure even heating.

From the upper part of chamber 1 a pipe 40 leads to a chamber 41 in which by means of a rotary screw 42 driven by motor 43 any particles of dust or other solid matter carried over from the digester will be thrown outward against the walls of the chamber to collect at its bottom.

The gas and vapors pass from chamber 41 by pipe 45 for such separation of the vapors and recovery of condensates therefrom and such use of the fixed gas as may be desired.

By compressing the coal while it is in relatively soft condition the formation of gas pockets is prevented and the material is made dense and solid, the resulting fuel being more dense and solid than ordinary coke and having a specific gravity about the same as that of the raw material used. By reason of its density and relatively high specific gravity the finished product is adapted to be transported at lower freight rates than ordinary coke.

In carrying out the process the coal or lignite previously crushed is introduced into the preheater 36 where it is subjected to a heat of about 400 degrees F., the preheater being agitated to ensure evenness of heating. From the preheater 36 the heated coal is discharged into bin 35 from which it is conveyed by conveyer 33 to the upper end of the digester which is heated by burners 26 arranged at its base so that its lower portion is more highly heated than its upper portion, thus forming a lower high heat zone and an upper less heated zone. When the digester is filled with the preheated coal the plunger 10 is operated to compress the charge of coal, the effect of this first compression being to force the particles of coal into a compact mass free from any large air or gas pockets. The heat being greater towards the lower ends of the digester the coal in that portion of the digester becomes quickly softened and the coal in the upper portion becomes more or less softened. The plunger is then again operated compressing the softened coal into a compact mass and leaving a considerable space above it. Additional coal is then fed into the upper end of the digester until it is full, and the plunger is operated to compress this additional charge. The heat being continued, the coal in the lower portion of the digester becomes a relatively solid mass of coke-like material from which the volatiles have been mainly eliminated leaving only sufficient volatiles to make the fuel product readily ignitable.

As soon as the material in the lower portion of the digester is sufficiently heated the lower end of the digester is opened by unlocking the bottom 4 and permitting it to swing down and the plunger is again forced down to force the contents of the digester downward until the lower end of the expelled mass strikes the bottom 21 of the bin 20 and its further movement is prevented, the digester being thus left filled for about half its length, the partly treated material previously in the upper portion of the digester being forced down into the lower portion, or highly heated zone, of the digester ready to have its treatment

there completed by the action of the heat by which the volatiles are more completely driven off, and the tarry material rendered soft and in condition to hold the particles of solid matter together, so that when compressed the material in this lower zone will be rendered solid, compact and dense.

This mass forced out from the lower end of the digester is sufficiently solid to form a column of the diameter of the digester which effectually plugs the end opening and prevents the overflow of the less solid partly treated material from the upper or cooler zone.

The preferred temperature for the lower zone should be about 800 degrees F. at its most highly heated point and the temperature of the upper zone about 600 degrees F. in its coolest portion.

After the mass has been thus expelled from the digester it should be cut off and the bottom 4 closed.

The plunger being withdrawn more coal is run into the digester until it is filled and the plunger is operated to compress the charge. The operation of heating until the coal is softened, compressing, further heating and expelling the lower portion of the charge is repeated, the operation being thus substantially continuous.

The operation has been described as conducted with a single digester but it is to be understood that two or more digesters are to be used.

The superheated steam is discharged through the perforations in pipes 28 throughout the lower portion of the charge, aiding in equalizing the heat throughout the charge, and this steam finds its exit through openings 50 in the upper end of the digester and through pipe 40 to the dust collector 41 carrying with it the volatiles in the form of vapors and gas and more or less solid matter which is eliminated by the dust collector.

The intervals of time between the compressing operations will depend somewhat upon the temperature and the character of the raw material, but will not be more than a few minutes. After each compression or operation of the piston it should be withdrawn to above the inlet for the coal so as to permit free escape of volatiles and also to permit of such expansion or swelling of the raw material as is likely to take place, as it is heated to the point of driving off the volatiles particularly with coal such as cannel coal.

I do no herein claim the apparatus shown and described, as that forms the subject-matter of a separate application for patent for apparatus for carbonizing coal, filed May 22, 1926, Serial Number 110,947.

Having thus described my invention what I claim is:—

In a process of carbonizing coal, heating comminuted coal to drive off moisture, introducing the coal in heated condition into a digester closed at its discharge end and so heated by externally applied heat that the heat at its discharge end is greater than at its inlet end, applying force to the charge to compress it and to force it towards the discharge end of the digester and immediately withdrawing the force applied, discharging superheated steam into the charge, subjecting the charge to the heat of the digester and of the superheated steam to drive off volatiles and to soften the coal in the more highly heated portion of the digester, again applying force to the charge to solidify the softened coal and immediately withdrawing the force so applied, filling the space resulting from compressing the charge with heated coal, applying force to the coal so introduced to compact it and to further solidify the coal in the more highly heated portion of the digester, subjecting the charge to further action of the heat of the digester and of the superheated steam, opening the discharge end of the digester and applying force to the charge to move the portion thereof last introduced from the less highly heated portion of the digester to the more highly heated portion and to expel the solidified mass contained in the more highly heated portion.

In testimony whereof, I hereunto affix my signature.

CHAS. HAYES.