METHOD OF PREPARING A FUEL PRODUCT

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This invention relates to the manufacture of a solid fuel product containing a quantity of liquid fuel and moisture and the principal object thereof is to provide for baking such fuel with a maximum of safety and efficiency. The invention involves also the extraction of the vapors of the hydro-carbons and water from the fuel, thoroughly mixing the same, and reinjecting the mixture into the fuel directly underneath it and the introduction of air for oxidation, and steam, if desired, into the current, preventing the loss of efficiency by insuring the passage of all the vapors of moisture and oil in a continuous flow with oxygen through the fuel itself.

The invention also involves other features of the method such as the provision of additional air or steam and the preheating of the currents of the vapors before they enter the fuel products as will appear and various features of apparatus for carrying out the method in a practical way.

Other objects and advantages of the invention will appear hereinafter.

Reference is to be had to the accompanying drawings in which:

Fig. 1 is a side view of a part of an oven provided with means for applying this method of baking thereto;

Fig. 2 is a transverse sectional view on the line 2-2 of Fig. 1;

Fig. 3 is a similar view on the line 3-3 of Fig. 1; and

Fig. 4 is a sectional view on enlarged scale showing an air seal which constitutes a desirable feature of the apparatus.

Although I have referred to the application of this method to the manufacture of a specific fuel, I am aware of the fact that it is not limited strictly to such fuel as I have mentioned but that it can be applied with greater or less degree of efficiency to other materials in which there is a content of hydro-carbon, oils and water or even in which the moisture is introduced from the outside. The particular fuel which I have especially in mind to be used in the first practical embodiment of the case, is a low grade hard coal, which is de-ashed in accordance with certain inventions which are not involved in this case, and in which they are provided with approximately 15% by weight of hydro-carbon oil and also contain perhaps 10% moisture. Such fuel in a plastic state can be extruded through dies in the form of cylinders which can be dried more or less if desired and used directly as fuel.

This fuel containing both oil and water must be baked and supplied with oxygen, preferably in the form of air at the same time to become hard. An unnecessarily large amount of oxygen would be employed under the usual practice, involving lower efficiency and greater hazard. What may be regarded as the first feature of this invention is the provision of means for using the air and also the steam already present over and over. I also provide for letting in additional quantities of air whenever desired and even steam if that proves necessary. The process in general involves the provision of a receptacle or receptacles to carry the solid fuel through a baking chamber located over a heating chamber which heats this fuel by radiation. The mixture of oil vapors, steam and air or oxygen is forced in around the sides directly over the heating chamber and is preheated before it enters upwardly the body of solid fuel above. As it has a free passage through this fuel, the circulation thus created will insure more rapid as well as more uniform baking of the fuel product. The heating of the fuel in the first place drives out a considerable quantity of the moisture which collects above the fuel product and is drawn out in a current along a passage-way. Further additions to the degree of heat drive out the volatilizable hydro-carbon products which follow the moisture. They are then mixed thoroughly together and driven back under the fuel with or without additional air or oxygen as may be desired. This process continues over and over, thus utilizing the full oxidizing value of the air or oxygen admitted.

The introduction of additional steam would be desirable as a safeguard when the amount of air or oxygen applied might be sufficient to start combustion of the fuel product and if the steam already present is insufficient to prevent it.

After this brief description of the process, I will now refer to the drawings and describe the form of apparatus which I have chosen for illustrating the process. I have shown a long oven having heat chambers in
he bottom extending longitudinally. These heat chambers are heated by jets 12 along the sides in the manner of an ordinary Dutch oven and need not be described further except to say that they are all covered over at 13 and they perform their heating entirely by radiation, the products of combustion from this furnace below not mixing with the fuel or air above. The oil for the furnace may be obtained by the use of oil salvaged from the fuel in the process.

The oven has a top on which are a pair of rails 15 extending throughout its length. On these rails rest the wheels of an endless conveyor 16 made up of a plurality of sections adapted to contain the fuel. These sections have side walls and a perforated bottom through which air can pass and the fuel rests in them. They are connected together by any desired kind of pivotal connections so that they constitute endless chains which can pass around the device in an endless path.

Along the top their path is straight but around the ends they pass over sprocket wheels to dump the baked product at one end and receive the new fuel at the other end. Of course they return under the lower furnace.

The side skirts of the conveyor are each provided with a line of T-shaped irons 18 resting on their top and not moving with them and bottom side up so that the base of the T projects upwardly. Above that there is a stationary casing 19 provided with angle irons 20 arranged in two pairs spaced apart to receive the bases of these T irons to constitute an air seal, the purpose of which will appear hereinafter. This casing 19 is provided with three chambers extending along the oven. Two chambers 21 at their sides are pressure chambers and the central one 22 a suction chamber. This suction chamber is perforated in its bottom to receive vapors from the fuel and it extends along to a fan inlet 24 which conducts all these vapors of oil or steam and any volatile products to a fan 25 which mixes them thoroughly and forces them out with a considerable current.

This fan delivers to two pipes 26 extending in opposite directions from it and forces these vapors, together with any air or oxygen with additional steam if necessary which may be introduced by suction through a pipe 30, down around into the pressure chambers 21. These discharge through perforations in their bottoms outside the irons 20 into side passages 28. Now the air seals 18 and 20 on each side prevent these vapors from passing over the fuel and force them to go down between and under the wheels of the conveyor so that they pass inwardly from both sides over the oven top 13. In case forced draft of the air or oxygen and steam if necessary, is desired, it can be introduced at two points 27 in each of the chambers 21 and 1 have illustrated this only diagrammatically. The fan 25 is shown here as being assisted by a fan 31 and forcing its current through the passages 27 at the two sides.

The conveyor 16 is operated by any desired mechanical means and the several units thereof of move along the track very slowly so that by the time they move from one end of the oven to the other the fuel product has been sufficiently hardened and baked as required.

The mechanism which I have illustrated of course can be changed within wide limits by any person skilled in the art and various features of the process or method that I have mentioned can also be changed without departing from the scope of the invention as expressed in the claims. Therefore I do not wish to be limited to all the details of construction herein shown and described, but what I do claim is:

1. The method of preparing fuel containing moisture and hydro-carbons, which consists in driving the oil vapors and steam coming from the fuel, together with the air or oxygen required in the treatment around back under the fuel and through the body thereof and over the heating means to heat the said vapors and introduce them into the fuel to raise the fuel to the required temperature.

2. The method of baking and oxidizing fuel which consists in mixing steam, and the vapors of hydro-carbon oils and circulating a current of this mixture so as to deliver it directly underneath the fuel repeatedly in a continuous flow and applying heat to the current and to the fuel.

3. The method of baking a fuel comprising solid carbon, volatile hydro-carbon and moisture, which consists in the drawing out of the hydro-carbons and moisture by heat and suction from the fuel, mixing them, introducing and forcing them back under sufficient pressure and in such manner as to deliver the mixture of vapors directly underneath the fuel and permit their passage upward and through the fuel repeatedly in a continuous flow.

4. The method of baking a fuel comprising volatile fuel compounds and moisture, which consists in pre-heating the fuel to set free volatile matters therein, drawing the volatile substances out, mixing them with each other, and introducing them under the fuel and up through it in the presence of sufficient heat and products of combustion to raise the volatile parts of the fuel to the required temperature, and then repeatedly continuing the circulation of the volatile parts through and through the fuel.

5. The method of baking a fuel comprising solid and volatile fuel compounds and moisture, which consists in pre-heating the fuel to set free volatile matters therein, drawing the volatile substances out, mixing them
with each other and with air or oxygen, repeatedly introducing them back under the fuel and up through it in the presence of sufficient heat to raise the volatile parts of the fuel to the required temperature, and moving the fuel along in a path so that as it is gradually baked it will be subjected over and over again to the action of the heated volatile products mixed with air or oxygen.

6. The method of baking which consists in mixing air or oxygen and vapors of hydrocarbons, circulating them in a continuous stream through a moving body of solid fuel, applying heat by radiation to the fuel and the current of said mixture to raise the volatile fuel to the required temperature by said heat and cause the solid fuel to cake and harden, and introducing steam to prevent combustion and explosion.

7. The method of baking which consists in mixing air, steam and vapors of hydro-carbon oils, circulating them in a continuous stream through a moving body of solid fuel, applying heat by radiation to the fuel and the current of said mixture, and cause the solid fuel to bake and harden by circulating the current through the fuel repeatedly, and adding air to the current as needed.

In testimony whereof I have hereunto affixed my signature.

HENRY F. MAUREL.