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PATENT SPECIFICATION

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COMPLETE SPECIFICATION

An Improved Process for obtaining Water Gas

We, THEODOR LICHTENBERGER of Hohenstaufenstrasse 15, Stuttgart, Germany, and Dr. LUDWIG KAISER, Schlosstrasse 4, Herbede-Ruhr, Germany, both of German nationality, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

It is known to degas fuels in a salt fusion bath and to gasify them by blowing in superheated steam, the gases formed rising in countercurrent to the fuels introduced and being drawn off.

It is also known from U.S.A. Specification No. 1921711 to produce water gas by passing carbonaceous fuel down an exteriorly heated shaft, which has an outlet at the top for the vapours and gases extracted from the fuel by dry distillation and which dips at the bottom into a salt melt, the fuel on introduction into the latter being subjected to the action of steam introduced into the salt melt in its proximity.

On the other hand it is known not to allow the gases to ascend which are formed by heating fuels in an exteriorly heated shaft generator but to force them through the fuels under their own pressure so that all the gases with the aid of steam enter into further interaction with the still undecomposed fuels.

This last process has the disadvantage that the heat necessary for initiating the interaction must be supplied from the exterior, which is possible only when the shaft generator has quite a small diameter, since the wall of the shaft and the fuel itself, being bad heat conductors, are capable of transmitting the heat necessary for the reaction only with difficulty, and on the other hand the material of the shaft wall does not stand up to the high temperature presented.

The present invention relates to the production of water gas from solid, liquid or gaseous fuel of the kind in which the fuel is heated in a salt melt bath in the presence of steam, and is characterised by the feature that the fuel is heated to a high temperature in the presence of steam in a shaft which dips into the salt melt bath, and the resulting gaseous products are then subjected together with the fuel residue to a steam and heat treatment in the salt melt bath.

During the forced passage through highly heated salt melt on the one hand the carbonic acid is reduced to carbon monoxide and on the other hand the heavy hydrocarbons and the methane are split up into hydrogen and carbon monoxide. The conditions are particularly favourable for the reduction of the carbonic acid and the decomposition of the higher hydrocarbons and of the methane since the gas mixture during its passage through the column of fuel and the salt melt is brought to higher and higher temperatures owing to the fact that the salt melt as a heat transferrer always has a higher temperature than the column of fuel situated in the shaft generator.

In the case of the known salt melt process mentioned in the introduction, inasmuch as coke is employed as carbon, a gas is obtained consisting chiefly of carbon monoxide and hydrogen, apart from the gas contained in the coke itself. In the case of fuels which have not been coked, however, somewhat large quantities of other gases have to be reckoned with as well which are expelled by the heat of the salt bath. The process of the present invention differs from this known salt melt process in that the fuels are not only degassed and gasified, but that the resulting gases are converted with the fuel and with addition of steam into other gases, that is to say carbon monoxide and hydrogen.

Since the fuel residue particules remain suspended in the salt melt or float on it, whilst the impurities of the fuel being heavier than the melt, sink down therein, the fuel residue particles are freed from the impurities and made accessible to attack by the gases.

In the case of the known process carried out in a shaft generator without salt melt, the lower layers of fuel become covered over by the impurities remaining behind from the gasified upper layers, and thereby are rendered inaccessible. Since the temperature cannot be the same in all parts, as in the case of the salt melt process, there can be no assurance that a uniform gas will be obtained.

The separation of the attackable from

the unattackable particles brought about by the salt melt in the present process renders possible a practically complete conversion of the produced gases, tar vapours and of the steam. Not only are the hydrocarbons and the steam decomposed by the coked fuel particles but the carbonic acid is reduced as well. In this way a mixture of carbon monoxide and hydrogen which is free from carbonic acid is formed.

This pure mixture of carbon monoxide and hydrogen is suitable for the so-called synthesis gas for the production of benzine. On account of the importance of obtaining benzine from coal or the gases produced therefrom the process according to this invention represents a significant advance as compared with the gasifying process in the salt melt which was hitherto known, in which indeed a water gas is produced but which is not free from carbonic acid and hydrocarbons.

The accompanying drawing shows by way of example a schematic vertical section through an example of a plant suitable for carrying out the process.

The plant consists of a retort with a heating chamber *a* and a reaction chamber *b*, these two chambers communicating with one another through a channel *c*. The lower part of the chambers *a* and *b* contains a salt melt *d*. In the chamber a shaft generator *e* is placed which ends at a certain distance from the bottom of the reaction chamber *b*, dipping into the salt melt *d*. At the top end of the shaft generator *e* there is attached an intermediate bunker *f* which is provided with a introducing sluice *g*, above which there is a supply bunker *h*. In the cover of the reaction chamber *b* is provided a gas withdrawal conduit *i*. Below the lower end of the shaft generator *e*, and above the upper end thereof, there are steam inlets *k* and *l*.

The fuel passes from the supply bunker *h* through the introducing sluice *g* into the intermediate bunker *f* and the shaft generator *e*. As the shaft generator has no outlet at the upper end all gases evolved in the shaft generator are forced under the pressure of the gases together with the fuel residue through the salt melt; as a result the carbonic acid is reduced by the carbon to carbon monoxide, and the heavy hydrocarbons and the methane are converted into carbon monoxide and hydrogen by the steam, so that a pure mixture of carbon monoxide and hydrogen remains.

The plant described is intended more particularly for solid fuels such as brown coal, mineral coal, peat and the like. Liquid and gaseous fuels, however, may also be worked up according to the new process, and without altering the apparatus. For converting the gases a temperature of at least 900°C. is necessary. The liquid or gaseous fuel (e.g. tar or methane) is forced into the shaft *e* together with the steam through the steam inlet *l* under a pressure which exceeds that necessary for forcing a way through the salt melt into which the shaft *e* dips, the introducing sluice *g* of course being closed. Conversion to water gas then takes place in the gaseous phase in the presence of steam (liquid fuel introduced being first converted to gas at the high temperature within the shaft *e*): $CH_4 + H_2O = CO + 3H_2$; $C_2H_4 + 2H_2O = 2CO + 4H_2$.

If the fuel to be used has a water content which suffices for the gasifying reaction, such as for example in the case of raw brown coal, the supply of steam and the apparatus necessary therefor may be saved and the process simplified to an extraordinary extent as a result.

Having now particularly described and ascertained the nature of our said invention, and in what manner the same is to be performed, we declare that what we claim is:—

1. A process for producing water gas from solid liquid or gaseous fuel of the kind in which the fuel is heated in a salt melt bath in the presence of steam, characterised by the feature that the fuel is heated to a high temperature in the presence of steam in a shaft which dips into the salt melt bath, and the resulting gaseous products are then subjected together with the fuel residue to a steam and heat treatment in the salt melt bath.

2. The improved process for obtaining a pure mixture of carbon monoxide and hydrogen substantially as hereinbefore described with reference to the accompanying drawing.

3. The improved plant for carrying out the process hereinbefore described and claimed substantially as hereinbefore described with reference to the accompanying drawing.

4. Mixture of carbon monoxide and hydrogen when made by the process hereinbefore described and claimed.

Dated this 3rd day of July, 1936.

MARKS & CLERK.

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