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E. G. WEEKS

LOW TEMPERATURE FUEL DISTILLATION

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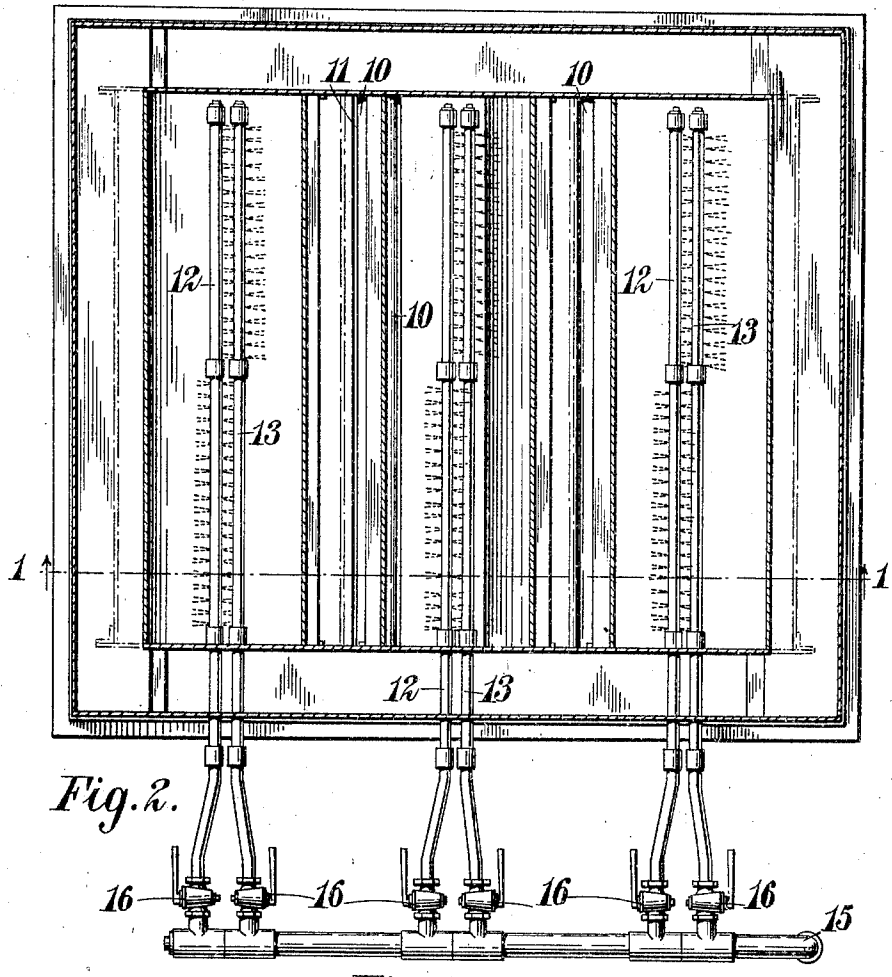

Fig. 2.

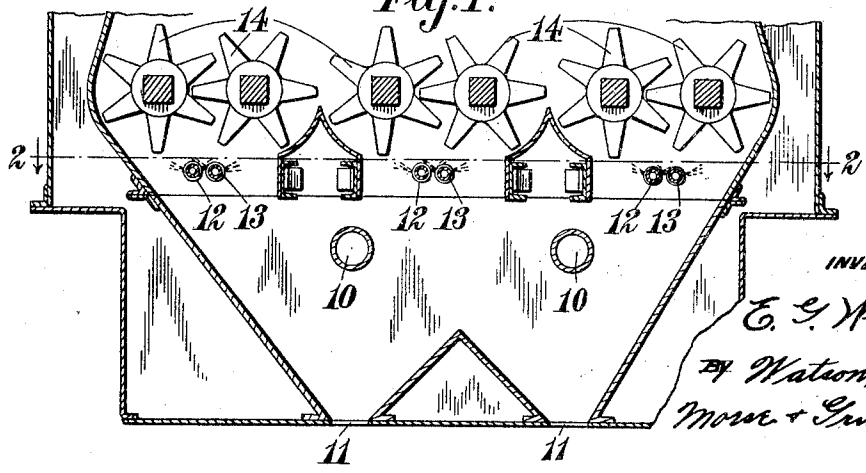

Fig. 1.

INVENTOR

E. G. Weeks,

By Watson, Coit, Morse & Grindle,

ATTYS.

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EDMUND GEORGE WEEKS, OF DUNSTON, ENGLAND, ASSIGNOR OF ONE-HALF TO THE FIRM MERZ & McLELLAN, ENGINEERS, OF WESTMINSTER, LONDON, ENGLAND.

LOW-TEMPERATURE FUEL DISTILLATION.

Application filed January 15, 1924, Serial No. 686,395, and in Great Britain October 3, 1923.

This invention consists in improvements in or relating to low-temperature fuel-distillation and has for its object to eliminate certain difficulties which are met with in treating some kinds of fuel. These fuels possess an oil content sufficiently high for commercial distillation and include those fuels which are liable to stick together during distillation.

In distilling fuel by passing steam, for example low-pressure superheated steam, through the fuel while it is in a retort, it is found that in the case of certain classes of fuel, e. g. bituminous coals, the particles or lumps of fuel are liable to become sticky and bind together. This has the effect of preventing the charge from travelling evenly through the retort, particularly in the case of a vertical retort, and also obstructs the passage of the steam and gaseous distillates. In most cases this binding effect can be overcome by raising the temperature of the steam but it has been found in practice that the use of steam superheated above 500° C. is attended with other inconveniences. It has also been found that in the case of some highly bituminous fuels the sticking action is not altogether eliminated even at the highest practicable superheat temperatures.

It is now found according to this invention that a more efficient distillation is possible with the use of less steam and at a lower temperature if a certain amount of additional heat be generated within the retort itself by the addition to the heated steam of a regulated amount of air so as to cause the combustion of a limited proportion of the fuel within the retort. The present invention comprises, therefore, a low-temperature fuel-distillation process in which steam is passed through the fuel in a retort, characterized by supplying a regulated amount of air to the fuel in addition to the steam, and preheating the steam or the air or both so that the mixture of air and steam is raised to a temperature about at or above the ignition temperature of the fuel.

In place of steam it may be possible to employ other heating medium, such for example as an inert gas, and the term "steam" where it occurs in such connection throughout the specification, is to be understood as meaning any suitable heating or heat-conveying medium. Similarly, instead of using atmospheric air, oxygen or an oxygen-containing medium may be substituted, and the term "air" also, although used for brevity, is to be understood as including other sources of oxygen which may be found desirable for promoting partial combustion of the fuel.

The air is preferably admitted into the lower end of a vertical retort at a position therein above that at which the coke will collect before it is discharged from the retort and thus the air is prevented from coming into contact with the massed hot coke thereby eliminating as far as possible any chance of igniting the coke.

It is well known in the operation of gas producers to blow in a mixture of air and steam below the fuel bed. In such apparatus however the object is to obtain as nearly as possible, complete gasification of the fuel leaving only ash to be extracted, and at the same time to generate the maximum quantity of gas of the highest calorific value. In the operation of such apparatus the proportion of air to steam varies from about 5:1 to 3:2.5 according to the nature of the producer process, but in such processes combustion of the retort charge has always been commenced by lighting a fire in the producer and blowing it with air to heat up the fuel thoroughly.

The present invention does not contemplate the use of such quantities of air as will bring about combustion of more than a very small portion of the fuel in the retort, say from 2–4%. If more than this becomes consumed the temperature within the retort will be unduly raised and the quality of the distillates impaired.

It was at first thought that the quantity of air necessary to produce such a small fuel consumption would be insufficient to maintain such combustion, but it has been found that it is maintained provided that the steam or air or both admitted to the fuel are preheated before admission to the temperature above referred to.

In general terms the temperature of ignition of coal for example, is between 400°–450° C. so that it will be necessary in carrying out the process to preheat the steam or air or both so that the mixture of steam and air is at least at a temperature of 400° C. and preferably to 450° C. to ensure the requisite combustion.

In one convenient form of apparatus for carrying out the present invention as applied

to a vertical retort, there is provided in combination, means to supply steam and air to the interior of the retort and preheating means for the steam or the air or both.

One construction of apparatus embodying the features of the invention will now be described by way of example only with the aid of the accompanying drawings, in which—

Figure 1 shows somewhat diagrammatically a vertical section through the lower end of a retort, on the line 1—1 of Figure 2, and

Figure 2 is a section on the line 2—2 of Figure 1.

Like reference numerals indicate like parts in both figures of the drawings.

Steam is admitted in the usual manner through the transversely arranged steam-pipes 10, the steam passing out therefrom through orifices spaced at intervals along the sides of the pipes. Below the pipes 10 the retort is formed with a hopper-like chamber having discharge outlets 11. The coke collects in the chamber prior to its transference to trucks or other conveyors, on which it is removed.

Air-admission pipes 12 and 13 are also arranged transversely of the retort above the steam-pipes 10 and below coke extractor devices such as coke extractor rollers 14. Alternatively the air-pipes 12 and 13 may be situated above the coke extractor rollers in order to maintain the combustion zone well above said rollers and so protect them from the effect of the high temperature. The air-admission pipes are grouped in pairs side by side, a pipe 12 and a pipe 13 being shown in each pair. All the pipes 12 and 13 are supplied with air from a single main 15 and control cocks 16 are provided to regulate the supply of air to each of the pipes.

One pipe of each pair is formed with laterally discharging orifices at intervals along its length and on both sides of it for a portion only of its length. As will be seen from Figure 2, the pipes 12 are each formed with orifices extending over half the length of the pipe. The companion pipe 13 is similarly formed with discharge orifices along only that portion of its length corresponding to the portion of the pipe 12 which is imperforate. Thus by means of the control cocks air may be admitted to any desired portion of the retort and regulation thereby obtained so as to control the combustion within the retort. Generally all the pipes 12 and 13 will be supplied with air and the control cocks will only need to be operated to adjust for any unequality in combustion which may occur.

It is preferable to preheat both the steam and the air to the temperature required, in which case the main 15 will be understood as leading from an air-heater so that hot air is supplied to the main. Similarly also, the steam-pipes 10 lead from a superheater, but as air heaters and steam superheaters are known in themselves there is no need to illustrate them in the accompanying drawings.

The present invention has the following advantages:—

(1) The temperature of the superheated steam need not, generally speaking, exceed that necessary to raise the temperature of the mixed steam and air above 450° C.

(2) Any desired distillation temperature may be obtained by admitting more or less air and thus increasing or decreasing the combustion. This will enable the range to be extended of coals which may be used, as coals which require relatively high temperatures cannot be conveniently distilled with pure steam distillation.

(3) The quantity of steam used with pure steam distillation amounted to some 1 lb. per 1 lb. of fuel distilled. When using air in the proportion, for example, of 5 of air to 7 of steam, the quantity of steam per 1 lb. of fuel will be reduced to between .4 and .6 lbs. By substituting a certain percentage of air for steam the total cost of providing the gaseous heating medium for the retorts is thus considerably reduced.

(4) The heat generated in the retort by the partial combustion of the fuel undergoing distillation is utilized at about 100 per cent efficiency since it is generated in the retort itself.

(5) The volume of the gases passing through the retort is increased when air is used, whereby the oil vapours are more rapidly carried away with less risk of condensation and re-distillation, and the fuel is more uniformly carbonized.

(6) When using air and steam with consequent partial combustion in the retort, it is found that the retort gases are at a higher temperature than previously possible with pure steam distillation. The result of this is that it is now possible to extract the coal dust from the retort gases by means of a cyclone dust extractor. It has been found that with the higher temperatures the dust can be extracted without any appreciable loss of oil. When using steam alone a considerable quantity of oil was extracted with the dust, and the subsequent separation of the oil and dust presented inconveniences. Since using the air and steam method of working, the oils are very much more free from dust and appear to be of better quality.

It will be understood that though the invention has been described in detail with reference to the addition of air to steam, the method is equally applicable in the case of heated gaseous heating media other than superheated steam. For example, instead of superheated steam (which operates substantially only as a carrier of heat to the fuel) any other inert gas might be used and heated to a suitable moderate temperature the requi-

site higher distillation temperature within the retort being obtained by the admixture with the inert gas of the correct proportion of air or oxygen to cause the requisite combustion within the retort. The inert and active gases might be heated to or above the ignition temperature of the fuel either separately or together.

The invention may be carried out in many ways, the apparatus hereinabove described in detail being an example only of one form that has been found suitable in practice.

What I claim as my invention and desire to secure by Letters Patent is:—

1. A process for low temperature distillation of carbonizable solid fuel for the recovery of highly volatile oils and the accompanying partial carbonization of the remaining fuel without gumming, which comprises, partially carbonizing the material by passing steam and atmospheric air in regulated amounts to an enclosed body of the fuel, having one component of said fluid medium preheated to a temperature such that the temperature of the mixture of steam and air while being injected is at least as high as the temperature of ignition of the fuel, whereby a portion of the fuel is ignited, and having the quantity of atmospheric air thus admitted limited to that necessary for the combustion of a small percentage only of the enclosed body of fuel.

2. A process for low temperature distillation of carbonizable solid fuel for the recovery of highly volatile oils and the accompanying partial carbonization of the remaining fuel without gumming, which comprises, partially carbonizing the material by passing steam and atmospheric air in regulated amounts to an enclosed body of the fuel, having the steam which is injected preheated to a temperature such that the temperature of the mixture of steam and air while being injected is at least as high as the temperature of ignition of the fuel, whereby a portion of the fuel is ignited, and having the quantity of atmospheric air thus admitted limited to that necessary for the combustion of a small percentage only of the enclosed body of fuel.

3. A process for low temperature distillation of carbonizable solid fuel for the recovery of highly volatile oils and the accompanying partial carbonization of the remaining fuel without gumming, which comprises, partially carbonizing the material by passing steam and atmospheric air in regulated amounts to an enclosed body of the fuel, having the steam and air preheated to a temperature such that the temperature of the mixture of steam and air while being injected is at least as high as the temperature of ignition of the fuel, whereby a portion of the fuel is ignited, and having the quantity of atmospheric air thus admitted limited to that necessary for the combustion of a small percentage only of the enclosed body of fuel.

4. A process for low temperature distillation of carbonizable solid fuel for the recovery of highly volatile oils and the accompanying partial carbonization of the remaining fuel without gumming, which comprises, partially carbonizing the material by passing steam and atmospheric air in regulated amounts to an enclosed body of the fuel, having one component of said fluid medium preheated to a temperature such that the temperature of the mixture of steam and air while being injected is at least as high as the temperature of ignition of the fuel, whereby a portion of the fuel is ignited, and having the quantity of atmospheric air thus admitted limited to that necessary for the combustion of from two to four per cent of the enclosed body of fuel.

5. A process for low temperature distillation of carbonizable solid fuel for the recovery of highly volatile oils and the accompanying partial carbonization of the remaining fuel without gumming, which comprises, partially carbonizing the material by passing steam and atmospheric air in regulated amounts to an enclosed body of the fuel, having one component of said fluid medium preheated to a temperature such that the temperature of the mixture of steam and air while being injected is at least as high as the temperature of ignition of the fuel, whereby a portion of the fuel is ignited, and having the quantity of atmospheric air thus admitted limited to that necessary for the combustion of less than five per cent of the enclosed body of fuel.

In testimony whereof I affix my signature.

EDMUND GEORGE WEEKS.