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(54) GAS PRODUCTION

(54) PRODUCTION DE GAZ

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ABSTRACT:

CLAIMS: Show all claims

*** Note: Data on abstracts and claims is shown in the official language in which it was submitted.

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This invention relates to improvements in the production of gases and especially carbon monoxide and industrial gas mixtures containing carbon monoxide.

Industrial gas mixtures containing carbon monoxide and hydrogen and in particular water-gas are usually produced on a large scale by the intermittent process in which steam is subjected to reaction with a bed of carbonaceous material such as coal or coke, which has previously been raised to incandescence and which, during the production of the gas mixture, cools down until gas is no longer produced at an economic rate and the gas production must be stopped until the bed of carbonaceous material has again been raised to incandescence by means of a blast of air. A number of methods of rendering this process continuous have been suggested but the difficulties met with are the danger of producing large quantities of less valuable gas, i.e. carbon dioxide thus diluting the water-gas, and also the continuous supply of the solid carbonaceous material and removal of the spent solid products.

The present invention is concerned with the production of carbon monoxide and gas mixtures containing both carbon monoxide and hydrogen starting from powdered carbonaceous materials, in particular powdered coal, and envisages a process which is of special importance in that it can be operated continuously while resulting in substantially complete utilisation of the carbonaceous starting material.

According to the invention substantially complete gasification of powdered coal, coke or like carbonaceous material is brought about by reaction between the carbonaceous material and a reactant gas or vapour while the material is suspended in a body of gas or vapour and is passing down the gasification chamber along a helical path. Part or all of

the reactant gas or vapour, e.g. steam, may be introduced in such a manner that this reactant passes upwards to meet the carbonaceous material and preferably so that it also follows a helical path which merges with that followed by the descending powdered carbonaceous material at a point above the point of introduction of the reactant gas or vapour.

By operating in the manner described it has been found possible to maintain the powdered material in the furnace or other gasification chamber for a sufficient period to effect substantially complete gasification thereof with the result that the solid products of the process consist simply of a non-carbonaceous or mineral powder which falls to the bottom of the furnace and can be removed very simply by means of a mechanical stoker, rotating hearth or like device.

The introduction of the powdered coal, coke or the like into the gasification chamber is best effected by introducing it as a mixture with a gas, injecting the mixture tangentially and in a horizontal or substantially horizontal direction, and in this way the carbonaceous material can be caused to adopt a helical path as it travels downwards through the furnace meeting the rising stream of reactant gas and forming a turbulent mixture. The carbonaceous material and reactant gas tend to concentrate near the wall of the gasification chamber and it is possible to withdraw the gases produced from the centre of the top of the furnace, a more or less well-defined column of gases near the centre of the furnace being formed. On the other hand, the gases can be withdrawn at any other convenient point, for example near the base of the furnace below the point of introduction of the reactant gas or vapour and, if desired, the centre of the furnace may be occupied by a column of firebrick or other suitable heat-resistant material. If desired, such a column

may be pierced at intervals so as to communicate with a central bore into and through which the gases produced may be drawn for removal from the furnace.

For the production of mixtures of carbon monoxide and hydrogen steam may be the sole reactant gas, the steam being highly superheated, for instance to well above 1000°C., e.g. to 1600 or 2000°C., while even higher temperatures, for instance, up to 2200°C., may be used if desired. The steam may be introduced together with the powdered carbonaceous material for the purpose of imparting to the latter the desired movement in a helical path. Preferably, however, an additional supply of the superheated steam is introduced at a lower part or parts of the furnace, the introduction being effected by means of a port or ports so arranged that the steam on entering assumes a helical path merging with that followed by the carbonaceous material. The steam necessary for this operation can conveniently be superheated by passage through one of two or more regenerative furnaces which are alternately heated and used for superheating the steam, the number and arrangement of the furnaces being such as to provide an adequate and continuous supply of superheated steam. The heating of the regenerative furnaces is most conveniently effected by furnace gases, but alternative means, such as the combustion of solid or liquid fuels, for instance the combustion of powdered carbonaceous material of the same type as that used for generating the water-gas, may also be used. It is to be noted that the gases produced in the gasification chamber will leave the same at a high temperature, which may be between 800 and 1000°C. or even higher, since it is usually best to operate the gasification chamber over a temperature range of from say 2000°C. (i.e. the temperature of the entering superheated steam) to 1000°C.

or somewhat higher e.g. 1100 or 1200°C. A considerable part of this heat can be utilised in generating and superheating the steam to be used in the process by means of waste heat boilers. When using such very high temperatures the furnace should be provided with a special heat resistant fire-brick lining such as one constructed from beryllia fire-brick.

An alternative method of operating the process of the invention consists in generating the large quantity of heat needed for the endothermic water-gas reaction by combustion within the chamber in which the water-gas reaction takes place of part of the powdered fuel or of oil or gas. In view of the fact that this method of operation inevitably results in dilution of the gases produced by formation of more carbon monoxide than is perhaps needed together with some carbon dioxide it is preferred to use oxygen rather than air to effect combustion which would result in further dilution with nitrogen. The oxygen can be used as the vehicle for introducing powdered carbonaceous material to be burnt to provide heat and, although additional oxygen can be introduced at other points in the furnace, it is usually possible to introduce sufficient oxygen to provide by combustion of part of the powdered carbonaceous material all the heat needed in this way and to introduce only steam at other parts of the gasification chamber. Here again, it is preferred to introduce the steam by means of ports arranged to direct the steam tangentially so as to cause it to follow the helical path within the gasification chamber. With this method of operation the gases leaving the gasification chamber may be at an even higher temperature than is the case when the only reactant gas used is steam, and here the importance of utilising the heat contained in the gases produced is even greater and, as previously described, this heat can be utilised quite conveniently for

10

superheating the steam to be used in the process and also, if desired, for preheating the oxygen or air simultaneously employed by means of heat exchangers or regenerative furnaces.

The process of the invention may be employed not only for the production of mixtures of carbon monoxide and hydrogen such as water-gas, but also for the production of carbon monoxide containing little or no hydrogen in admixture with it. For this purpose oxygen, air, or other gases containing oxygen may be used without steam to effect the partial combustion of the coal, coke or the like and the very considerable heat produced utilised, for instance, by passing the gas produced through waste heat boilers.

The accompanying drawing illustrates diagrammatically a furnace suitable for use in carrying out the process of the invention.

Referring to the drawing, the furnace has a mild steel shell 1 with a lining 2 of beryllia firebrick and is provided with tangential inlets 3, 4, 5 supplied by conduits 6, 7, 8 from blowers 9, 10, 11. An exhaust conduit 12 is provided in the roof of the furnace while the bottom of the latter is closed by a door 13. A burner 14 provided with feed pipe 15 is situated in the inlet 5. The conduit 6 is connected to a hopper 16 via the feeder 17.

In operation the furnace is heated to a temperature of about 2000°C. by combustion of a suitable fuel supplied to burner 14 through feed pipe 15, combustion air being supplied through conduit 8 by blower 11, the flame and combustion products rising along a helical path as indicated in the drawing. Fuel and air are then cut off and the furnace purged with steam superheated to 2000°C. and supplied through inlet 3 from conduit 6 by blower 9. After a short purge

period feeder 17 is operated to supply finely powdered coal from hopper 16 into the current of steam being supplied to inlet 3. Additional superheated steam may be supplied to inlet 4 through a conduit 7 by blower 10. While only one inlet 3 and one burner 14 are shown it is preferred to employ a number of such inlets and burners arranged round the circumference of the furnace. Likewise, while only one inlet 3 for the powdered coal is shown it is preferred to provide a number of such inlets (and also of steam inlets 4 where these are employed) arranged round the circumference of the furnace.

The powdered coal in the current of steam supplied travels down the furnace along a helical path merging with the steam entering at 4 in the manner indicated in the drawing. Ash from the coal falls to the furnace door 13 and may be removed from time to time. The water-gas produced forms a column in the centre of the furnace passing upwards and being withdrawn through the exhaust conduit 12 whence, after being used to preheat steam being fed to regenerative furnaces (not shown) used for superheating the steam used in the process, it passes to a cyclone separator for removal of solid particles and can then be employed in waste heat boilers for generating the steam to be used in the process before being passed to storage or used.

Having described my invention what I desire to secure by Letters Patent is:-

1. Process for the production of gaseous mixtures containing carbon monoxide from powdered carbonaceous materials, which comprises introducing powdered carbonaceous materials into a gasification chamber in such a manner that said powdered carbonaceous materials pass down said gasification chamber along a helical path and introducing a gas or vapor to be reacted with said powdered carbonaceous materials at a point below the point of introduction of said powdered carbonaceous materials and so as to assume a helical path merging with the helical path followed by said powdered carbonaceous materials.

2. Process for the production of water-gas, which comprises introducing powdered coal into a gasification chamber, containing steam, tangentially so that said powdered coal passes down said gasification chamber along a helical path and introducing steam at a point below the point of introduction of said powdered coal and so as to assume a helical path merging at a point above the point of introduction of said steam with the helical path followed by said powdered coal.

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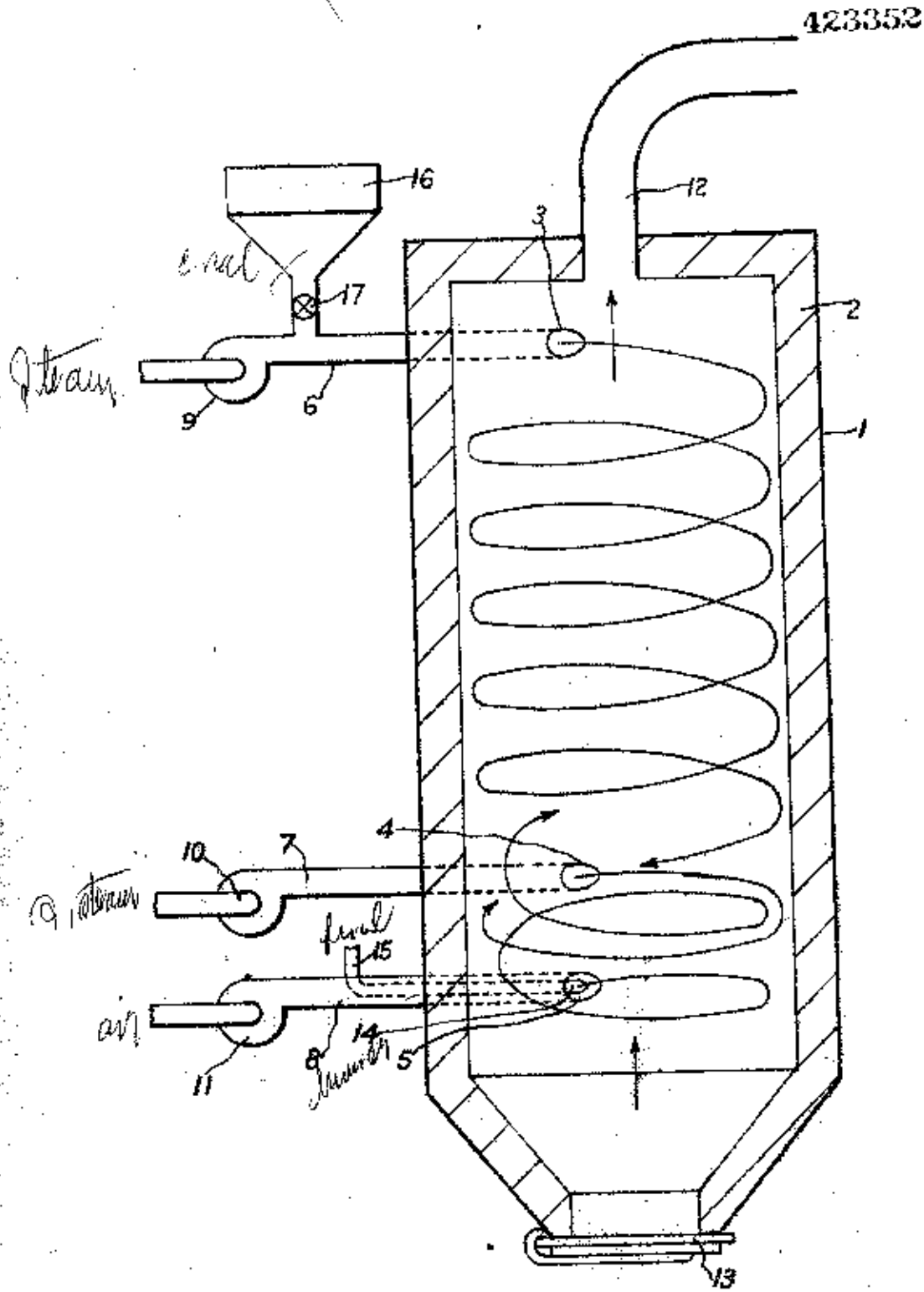

Certified to be the drawings referred to in the specification hereunto annexed
Signed at New York, N.Y. this 14th
day of DECEMBER, 1942.

H. Dreyfus Inventor

By Watson & Coleman Attorneys