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(54) GAS MANUFACTURE

(54) FABRICATION 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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- (•) Drawings Image

This invention relates to improvements in gas manufacture and is especially concerned with the manufacture of mixtures of carbon monoxide and hydrogen.

Industrial gas mixtures containing carbon monoxide and hydrogen, such as water-gas, are usually produced by passing steam through a bed of coke previously heated to a high temperature by combustion and continuing the passage of steam until the drop in temperature caused by the endothermic water-gas reaction makes it necessary to replace the current of steam by a blast of air. It is, however, possible to operate the process continuously by causing the coke to react simultaneously with oxygen and steam so that some of the coke is burnt to provide the heat for the water-gas reaction taking place simultaneously. The present invention is concerned with such a continuous water-gas process in which powdered coal, coke or other carbonaceous material is employed as starting material.

According to the invention, a vortical suspension of powdered carbonaceous material in steam is caused to react by heat from an adjacent vortex of powdered carbonaceous material burning in oxygen. In this way it has been found possible to convert carbonaceous material, such as coal, coke, and the like, into water-gas very rapidly and with a high efficiency.

In its simplest form the apparatus used for carrying out the process of the invention may comprise a furnace in which vortices are formed from the powdered carbonaceous material and steam and from the powdered carbonaceous material and oxygen, the vortices preferably being arranged alternately and one above the other and with the same direction of rotation. Such vortices may be produced by injecting the solid carbonaceous material together with the oxygen or steam

tangentially and in a horizontal or substantially horizontal direction into a furnace of circular cross-section. It is most convenient to withdraw the gases produced at or near the bottom of the furnace so that the vortices together form a helix, i.e. the burning and reacting carbonaceous particles and the gases formed or introduced follow a helical path from top to bottom of the furnace.

In practice, however, it is preferred to form more than one such helix by forming a plurality of vortices in the same plane. Thus, by providing four points of introduction in the furnace in a common plane it is possible to generate four vortices in this plane. At a lower level there may be arranged vertically below the points of introduction referred to, four additional points of introduction, so that under each vortex a further vortex is formed. Preferably, the arrangement is such that the vortices alternate in the vertical plane so that each carbonaceous material-steam vortex is adjacent one or two carbonaceous material-oxygen vortex. The vortices in each plane may be of the same type or may differ, and in the latter case they preferably alternate so that uniform heating is obtained. It will be appreciated that the use of four vortices is referred to only as an example and any number may be formed, as desired. These vortices can be produced very easily in practice by directing the jets supplied with carbonaceous material and steam or oxygen into the furnace along a path not coinciding with a radius. In this way, the jets introduced react upon each other and form a plurality of vortices.

Where a number of vortices are formed in a common plane, and even where a single vortex is formed and hence a single helical path is generated by the falling carbonaceous material, a more or less well-defined column unoccupied by the carbonaceous

solid is formed near the centre of the furnace. Thus, the central portion of the furnace may be occupied by a pillar without substantially reducing the effective capacity of the furnace and by constructing this pillar of firebrick or other suitable material the furnace may be given an increased heat capacity. Such a column may be employed for withdrawing the gases from the bottom of the furnace or by piercing the column for withdrawing the gases from other points at any desired height within the furnace. Where a plurality of co-planar vortices is formed in the furnace such a column may be of such shape as to present a concave face to each vortex the formation and maintenance whereof is thus facilitated.

The reaction between the solid carbonaceous material and steam is one which needs for efficiency a fairly high reaction temperature. Nevertheless, by operating in the manner described, it is possible to use reaction temperatures somewhat below those normally employed and considerably below the temperature to which it is usual to raise the bed of carbonaceous material used in the intermittent process during the "blow" period. In general, it is not necessary in the process of the invention to exceed temperatures of 1,000°C., temperatures of 800 - 1,000° being quite effective, although higher temperatures, e.g. up to 1,500 or 1,600°C. may be used if desired.

The gases leaving the furnace may carry with them unburnt residues from the carbonaceous material and are therefore best passed first through a settling chamber and thereupon may be used immediately or cooled, for instance, by use in waste heat boilers before being passed to further treatment, for instance desulphurisation, or removal of carbon dioxide.

Most of the unburnt residue from the powdered carbonaceous material consists of inorganic matter which will settle as a fine powder upon the floor of the furnace and can be removed from time to time or continuously by means of a mechanical stoker, rotating hearth or like device.

It will be appreciated that while the heat needed in the process has been stated to be produced by powdered carbonaceous material burning in oxygen, air or air enriched in oxygen can also be used for this purpose although the water-gas then produced will contain nitrogen. The amount of oxygen needed can be reduced by preheating the steam used in the process; such preheating may be to a moderate temperature, e.g. 500°C., or to the reaction temperature maintained within the furnace or even to a higher temperature.

The accompanying drawings illustrate diagrammatically an embodiment of the invention.

In the drawings Figure 1 shows a section of a furnace and Figure 2 shows a section along the lines 2-2 of Figure 1.

Referring to the drawings, the furnace has a mild steel shell 3 with a refractory lining 4 extending over the major part of the interior of the furnace, the bottom unlined portion of the furnace being provided with a water-jacket 5 provided with supply and return pipes 6 and 7 respectively. The bottom of the furnace is closed by furnace door 8. Arranged in the centre of the furnace is a tube 9 of heat resisting steel provided with a refractory jacket 10. Inlets 11, 12 are provided round the furnace at several levels.

In operation steam and powdered fuel are introduced through the inlets 11 and air or oxygen and powdered fuel through the inlets 12 so as to produce the vortices indicated in broken lines in Figure 2. There are thus formed vortices of both steam-powdered fuel and air- or oxygen-powdered fuel

in each layer, the vortices in adjacent layers alternating in type from top to bottom of the furnace.

Spent carbonaceous material falls to the bottom of the furnace cooled by the circulation of water through the jacket 5, the water being supplied at inlet 6 and withdrawn from outlet 7, and can be withdrawn from time to time through the furnace door 8. Gaseous products are withdrawn through the pipe 9 and may be used before being passed to storage for preheating steam and/or air or oxygen being used in the process after having been freed from suspended particles, for example by means of a cyclone separator.

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

1. Method of producing industrial gas mixtures containing carbon monoxide and hydrogen, which comprises injecting carbonaceous material and steam into a furnace tangentially to form a vortex and heating the substances in the vortex to effect reaction by burning carbonaceous material injected tangentially with oxygen to form a vortex close to the first mentioned vortex.

2. Method according to claim 1 wherein the various substances are injected at a number of points to form a plurality of vortices of the two types in a single plane.

3. Method of producing industrial gas mixtures containing carbon monoxide and hydrogen, which comprises injecting powdered carbonaceous coal and steam into a furnace tangentially at a number of points to form a plurality of superimposed vortices having a common axis and direction of rotation and heating the substances in the vortices to effect a reaction by burning powdered carbonaceous material injected tangentially with oxygen to form a plurality of vortices having the same axis and direction of rotation as the first mentioned vortices, the two types of vortex alternating along their common axis and each vortex being set close to the next.

A 4. Method according to claim 3 wherein the various substances are injected at a number of points to form a plurality of vortices of the two types in a single plane.

5. Method of producing industrial gas mixtures containing carbon monoxide and hydrogen, which comprises injecting powdered carbonaceous coal and steam into a furnace tangentially at a number of points to form a plurality of superimposed vortices having a common axis and direction of rotation and heating by the substances in the vortices to effect a reaction by burning powdered carbonaceous material injected tangentially with oxygen to form a plurality of vortices having the same axis and direction

of rotation as the first mentioned vortices, the two types of vortex alternating along their common axis and each vortex being set close to the next and withdrawing gaseous products of the process from the center of the top of the furnace and passing throughout that part thereof which is occupied by said vortices.

6. Method according to claim 5 wherein the various substances are injected at a number of points to form a plurality of vortices of the two types in a single plane.

7. Apparatus for the production of industrial gas mixture containing carbon monoxide and hydrogen, comprising a refractory lined furnace having gas inlets closely spaced and tangentially directed so as to be adapted to form a plurality of closely adjacent vortices of the same axis and direction of rotation and one above the other within the furnace.

8. Apparatus according to claim 7 and provided with a plurality of inlets arranged so as to produce a plurality of vortices in each of a number of planes.

9. Apparatus for the production of industrial gas mixture containing carbon monoxide and hydrogen comprising a refractory lined furnace having gas inlets tangentially inclined and arranged at a number of levels so as to be adapted to form a plurality of vortices, having a common axis and direction of rotation and other sets of gas inlets each set arranged to form a plurality of vortices having a common axis and direction of rotation, the axis of the various sets of vortices being parallel and substantially vertical.

10. Apparatus according to claim 9 and comprising an outlet pipe the body of which is situated within the furnace and extends through that part thereof normally occupied by said vortices.

FIG. 1

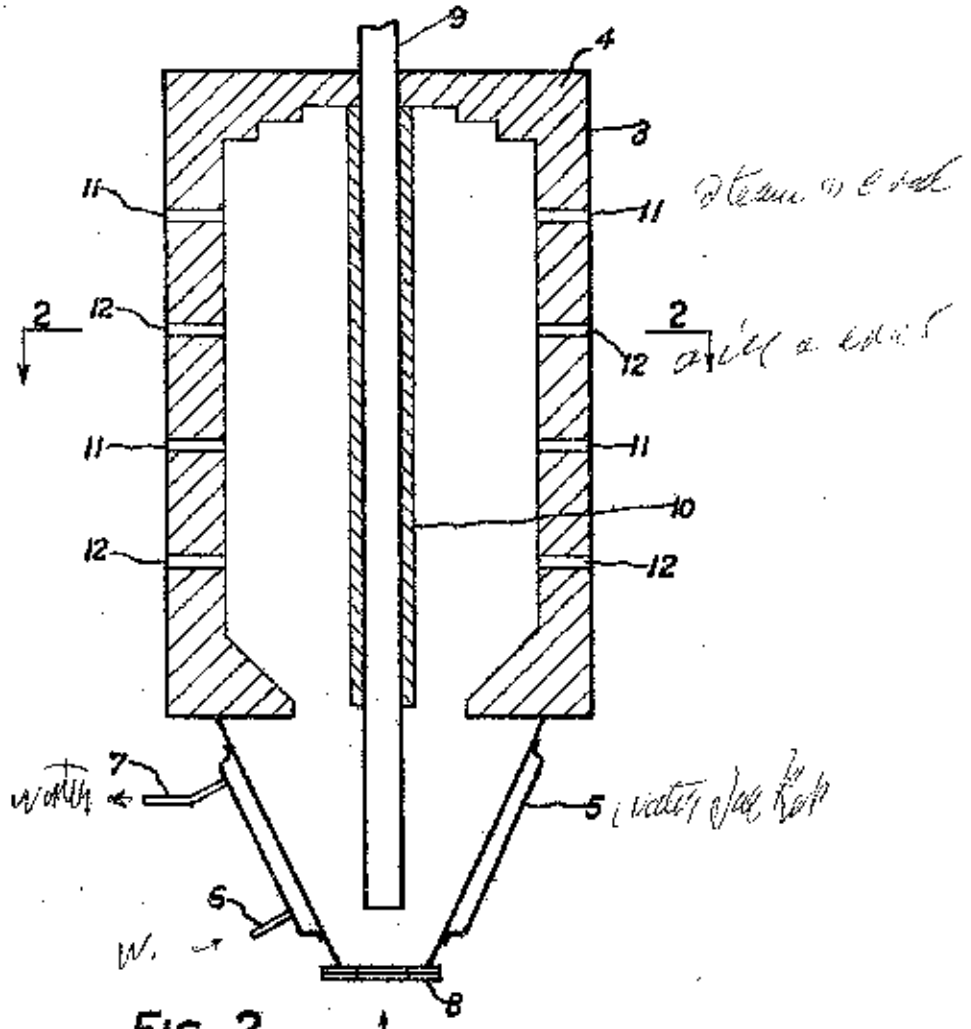
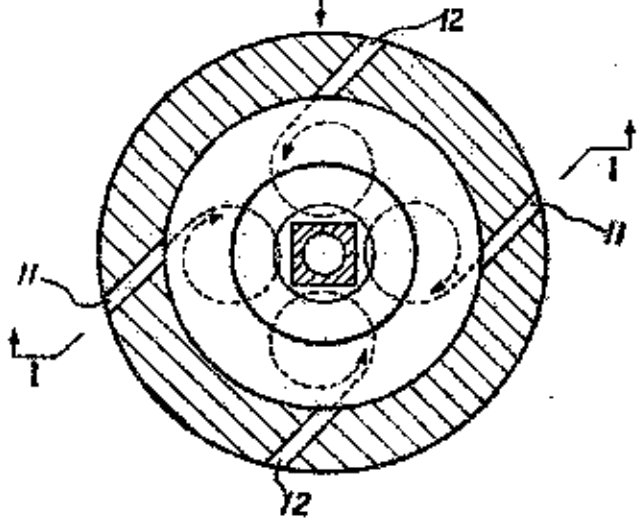


FIG. 2



Certified to be the drawings referred to in the specification hereunto annexed
Signed at New York N.Y. this 4th day of January, 1943.

E. E. Stimson, Inventor

Attorneys