PATENT SPECIFICATION

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Complete Specification Left: Nov. 26, 1942.

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3645

PROVISIONAL SPECIFICATION

Improvements in Gas Manufacture

I, EDWARD ERIC STIMSON, a British subject, of the Works of British Celanese Limited, Spondon, near Derby, do hereby declare the nature of this invention to be as follows:—

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 vertical 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 materials 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 toward the centre of the furnace. Preferably, the arrangement is such that the gas or vapour and solid are directed along a path parallel to, but not quite 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 1,800° 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.

Dated this 19th day of January, 1942.
STEPHENS & ALLEN,
Chartered Patent Agents,
Wykeham House, Gordon Avenue,
Stanmore, Middlesex.

COMPLETE SPECIFICATION

Improvements in Gas Manufacture

I, Edward Eric Stimson, a British subject, of the Works of British Celanese Limited, Spondon, near Derby, 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:—

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 vertical 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 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 furnaces 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 adjacent vortices being caused to rotate in opposite senses. 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 pillar may be employed for withdrawing the gases from the bottom of the furnace or by piercing the pillar 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 pillar 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 1,800° 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, along the lines 1—1 of Figure 2, 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 adjacent vortices in each plane rotating in opposite senses as shown. There are thus formed vortices of both steam-powdered fuel and air- or oxygen-powdered fuel in each plane the vortices in adjacent planes alternating in type from top to bottom of the furnace, each vortex in the lower planes rotating in the same sense as the vortex immediately above it.

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 particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. Method of producing industrial gas mixtures containing carbon monoxide and hydrogen, wherein 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.

2. Method according to Claim 1, wherein alternate vortices of powdered carbonaceous material and steam and powdered carbonaceous material and oxygen or air are formed in the furnace alternately one above the other and with the same direction of rotation.

3. Method according to Claim 1 or 2, wherein a plurality of vortices of the two types are formed in a single plane.

4. Method according to any of the preceding claims, wherein the gaseous products of the process are withdrawn from the centre of the top of the furnace through a central duct provided for that purpose and extending within the furnace throughout that part thereof which is occupied by said vortices.

5. Method of producing industrial gas mixtures containing carbon monoxide and hydrogen substantially as hereinbefore described.

Dated this 25th day of November, 1942.

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[This Drawing is a reproduction of the Original on a reduced scale.]

FIG. 1

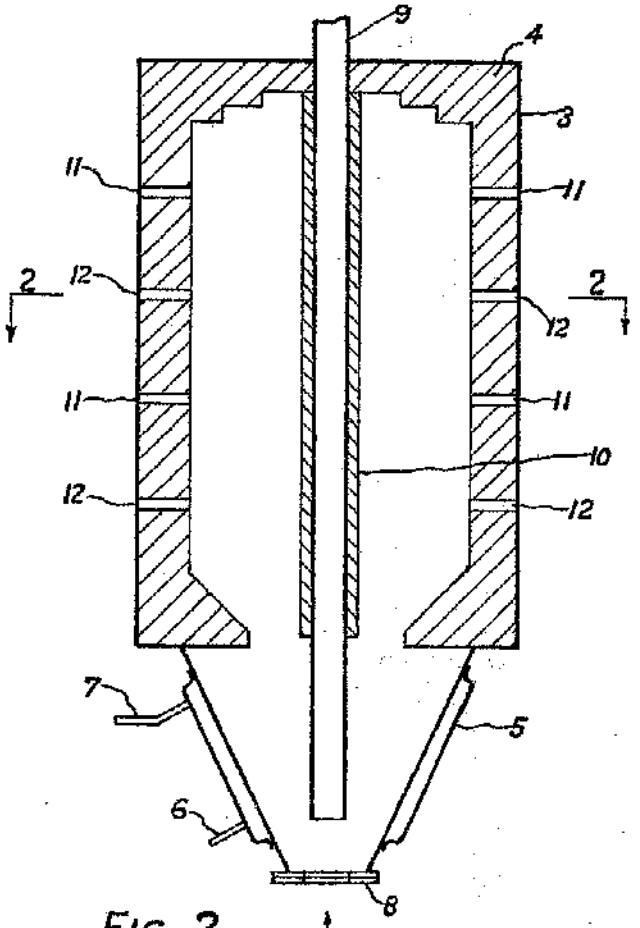
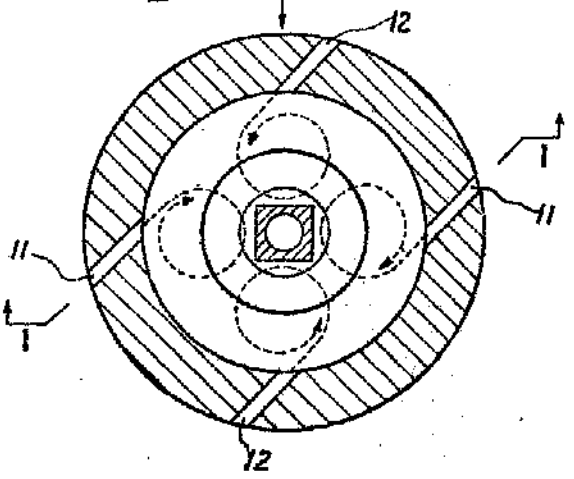


FIG. 2



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