RESERVE COPY

PATENT SPECIFICATION

Application Date: July 17, 1939. No. 20705/39.

531,289

Complete Specification Accepted: Jan. 1, 1941.

COMPLETE SPECIFICATION

Continuously-operating Vertical Retort for the Production of Synthesis Gas

We, WOODALL-DUCKHAM (1920) LIMITED, a British Company, of Ebury and Allington Houses, 136 to 150, Victoria Street, London, S.W.1, do hereby declare the nature of this invention and in what manner the same is to be performed, (as communicated to us by Didierwerke Aktiengesellschaft, a German Company, of Westfälische Strasse 90, Berlin-Wilmersdorf, Germany), to be particularly described and ascertained in and by the following statement:—

The present invention relates to a continuously-operating externally-heated vertical retort for the production of synthesis gas from fuels such as coal or brown coal.

"Synthesis gas" as referred to in the present Specification and Claims is a gas consisting essentially of hydrogen and carbon monoxide in such proportions (preferably stoichiometric) as make it suitable for the production of hydrocarbons, alcohols, or ammonia by catalytic synthesis processes, the gas having been substantially freed from hydrocarbons by controlled cracking and/or reaction within the retort or the like in which the synthesis gas is generated.

It has previously been proposed to produce synthesis gas in continuously-operating externally-heated vertical retorts operating in the following manner:—The fuel in its passage down the retort is first preheated in a preheating zone, which may be an iron construction set directly on the retort proper, which latter is constructed in the customary manner of refractory brickwork. The gases generated during preheating may be withdrawn separately from the preheating zone. The preheated fuel then enters the retort proper, and passes through the carbonising zone, which comprises approximately the upper third of the actual retort. In the carbonising zone the fuel is carbonised at increasing temperatures, and the gases and vapours produced thereby flow down the retort through the descending fuel into and through the reaction zone. The reaction zone, which also occupies approximately a further third of the retort, follows directly the carbonising zone and is maintained at high temperature. In this zone the gases and vapours formed in the preceding zone or zones are converted, in contact with the residue of the fuel, into the desired synthesis gas mixture. The gas-offtake for the synthesis gas is situated at the lower end of the reaction zone. The fuel finally passes through the water-gas zone, which occupies the lower part of the retort, and in which zone water-gas is generated by steaming the fuel residue; the water-gas is withdrawn together with the converted gas from the reaction zone, through the gas-offtake, the mixed gases forming the final synthesis gas. The residue of the fuel is continuously extracted from the retort by suitable extractor mechanism.

In the present process for the production of synthesis gas, the gases generated in the preheating zone and in the carbonising zone are, for the purpose of conversion, led down through the reaction zone. This downwardly-directed gas flow requires the use of a high suction at the gas-offtake, because the buoyancy of the gases and the resistance to flow through the fuel must be overcome. However, a certain definite velocity of the gases in the reaction zone must not be exceeded if a correct conversion of the gases is to be effected therein. Insufficient conversion of the gases due to too high a gas velocity in the reaction zone results in a reduced yield of synthesis gas, and further the value of the synthesis gas is detrimentally affected on account of its incorrect composition. If this maximum gas velocity in the reaction zone is not to be exceeded, then the intensive gas formation which occurs in the upper part of the carbonising zone, and in the lower part of the preheating zone will cause a surplusage of gas at relatively high pressure in these regions. In contrast to the high pressure within the retort, however, the pressure outside the walls of the retort in this region (e.g. in the heating-flues) is comparatively low. This pressure difference therefore results in a part of the gases leaking from the retort through the retort walls into the heating system

[*Price* 1/-]

and being burnt there, which implies a loss of part of the most valuable gases.

According to the present invention, the retort is provided, at the region where such surplusage of gas occurs, (i.e. at the transition of the preheating zone to the carbonising zone, where the temperature is in the region of 300° C.), with a gas-collecting space into which the surplus gases flow. The gases collecting in the gas-collecting space are then led back into the retort below the gas-collecting space, by means of a by-pass duct or ducts connected to the gas-collecting space. The whole or a part of the carbonising zone can in this way be by-passed. The gases from the gas-collecting space can be led either into the lower part of the carbonising zone or into the upper part of the reaction zone. In the latter case, if desired, the gases can pass into the retort at various levels.

By means of the arrangement of a gas-collecting space and a by-pass duct or ducts the gases tending to accumulate at the junction of the preheating zone and the carbonising zone can flow away. The pressure in the retort is thereby reduced, an escape of valuable gas into the heating-flues of the retort is avoided, the greater part of the resistance to the gas-flow is obviated, the suction for the removal of the gases can be maintained at a lower value, and a gas velocity suitable for the conversion process can be maintained in the reaction zone, whereby the yield of a synthesis gas of the correct composition is increased.

The gas-collecting space can be arranged at different vertical levels within the region of gas accumulation.

When the gas-collecting space is located in the solid brickwork at the top of the retort above the uppermost heating-flues, the possibility of leakage of gas from or into this space is greatly reduced. If the gas-collecting space is arranged in the form of a channel in the major axis side of the retort the creation of a large gas-collecting space of relatively small cross-section is made possible.

If it is desired to introduce the gases led back to the retort into the interior of the fuel column, then the by-pass duct can be situated in the interior of the retort. In this case, a construction which forms the by-pass duct, or which contains one or more such by-pass ducts is built in the retort. The retort walls serve to support this internal construction.

The gas-collecting space itself can also be situated in a construction in the interior of the retort. This construction can at the same time carry the by-pass ducts.

Such an interior construction divides the fuel column in the retort into two parts. The thickness of the fuel column is thereby reduced, and the escape of gases from the fuel into the gas-collecting space is facilitated. If the interior construction which carries the by-pass ducts is extended downwards, a partition wall is thereby created which both renders possible a two-sided supply, and a good distribution of the returned gases in the fuel. The openings of the by-pass ducts, which preferably are closable, can also be situated at different levels in the retort in order to provide a different choice of lengths of path for the gases through the reaction zone.

The accompanying drawings show, by way of examples, various modes of carrying out the present invention.

Figures 1 and 2 show in vertical section and in plan respectively an arrangement in which both the gas-collecting space 1 as well as the by-pass ducts 3 lie in the major axis wall (i.e. the side wall) 5 of the retort 6. In this embodiment the by-pass ducts 3 can be arranged in the partitions separating the vertical heating-flues. The gas-collecting space 1 has inlet openings 2. The by-pass ducts 3 open at 4 into the retort 6.

Figures 3 and 4 show in vertical section and in plan respectively an arrangement in which the gas-collecting space 1 lies in the side wall 5 of the retort 6, whilst the by-pass ducts 3 are arranged in the minor axis walls (i.e. the end walls) 7 of the retort 6.

Figures 5 and 6 show in vertical section and in plan respectively the arrangement of the gas-collecting space 1 in the side walls 5 of the retort 6. The by-pass ducts 3 are situated in a construction 8 supported from the side walls 5 of the retort 6. 9 is the connection between the gas-collecting chamber 1 and the by-pass ducts 3. The gas-collecting space 1 is here arranged in the wall 5 on both of the major axis sides of the retort 6. The gases enter the space 1 through the inlet openings 2 and pass through the openings 4 into the retort.

Figures 7, 8 and 9 show in two vertical sections and a plan respectively the arrangement of a gas-collecting space 1 and by-pass ducts 3 in the interior of the retort 6. A construction 10 here situated in the major axis length of the retort, contains in its upper part the gas-collecting space 1, whilst in its lower part are the by-pass ducts 3. 2 are again inlet openings to the gas-collecting space and 4 the openings of the by-pass ducts 3 into the retort. The openings 4 can be regulated with dampers 11, which are accessible through the closable opening 12 in the end wall of the setting. The lower part of the construction 10 can rest on an arch as shown. The individual by-pass ducts 3 can be arranged to end at different levels, e.g. alternate ducts may terminate in the outlets 4*a* as shown in Figure 8 so that the by-passed gases can be returned to the retort at various levels by adjustment of the dampers 11.

Figures 10 and 11 show diagrammatically the whole retort. Figure 10 is a section perpendicular to the major axis, and Figure 11 is a section parallel to the major axis. In these Figures, 14 is the preheating chamber, which is connected directly with the retort 6. Between the preheater 14 and the upper part of the retort 6, at the junction of the preheating zone and the carbonising zone, gas-collecting spaces 1 are arranged in the direction of the major axis of the retort, the gas-collecting spaces 1 having inlet openings 2. The by-pass duct 3 is situated in an internal construction 8, arranged as a vertical wall across the minor axis of the retort. The by-pass duct 3 connects with the gas-collecting spaces 1 and opens at 4 into the retort 6. The wall containing the by-pass duct is extended downwards as a partition wall 16, as far as the gas-offtake 15.

In cases where the structure of the retort and by-pass ducts conveniently allows, a second series of openings (similar to the openings 4*a* of Figure 8) can be provided from a proportion of the by-pass ducts 3 into the retort, each by-pass duct preferably being controlled by a damper-brick operated, for example, through a closable opening in the front or back wall of the battery. Such an arrangement could, for example, be applied to the construction of Figures 1, 2, 3 and 4 above.

Having now particularly described and ascertained the nature of our said invention, and in what manner the same is to be performed, (as communicated to us from abroad) we declare that what we claim is:—

1. A continuously-operating externally-heated vertical retort for the production of synthesis gas from fuels, characterised by the provision of a gas-collecting space situated in the region of the junction of the preheating zone and the carbonising zone of the retort with gas inlet openings between the interior of the retort and the gas-collecting space together with a by-pass duct or ducts leading from the gas-collecting space and opening into the retort beneath the gas-collecting space.

2. A retort as claimed in Claim 1, characterised in this, that the by-pass duct leads into the retort in the region of the lower boundary of the carbonising zone.

3. A retort as claimed in Claim 1, characterised in this that both the gas-collecting space and the by-pass duct are situated in the side wall of the retort.

4. A retort as claimed in Claim 1, characterised in this, that the gas-collecting space is situated in a side wall of the retort, and the by-pass duct or ducts is or are situated in the end wall or walls of the retort.

5. A retort as claimed in Claim 1, characterised in this, that the gas-collecting space is situated in the side wall or walls of the retort, and the by-pass duct or ducts is or are situated in a wall built in the interior of the retort.

6. A retort as claimed in Claim 1, characterised in this, that both the gas-collecting space and the by-pass duct or ducts are situated in a wall built in the interior of the retort.

7. A retort as claimed in any one of the preceding Claims, characterised in this, that the gas-collecting space extends over the whole major axis length of the retort.

8. A retort as claimed in any one of the preceding Claims, characterised in this, that the by-pass ducts open at different vertical levels into the retort by openings which are individually controllable.

9. A retort as claimed in Claim 5 or 6, characterised in this, that the wall in the retort is extended down the retort to the region of the gas-offtake for the synthesis gas.

10. A retort as claimed in Claim 5, characterised in this, that the by-pass duct opens into a distributing duct from which outlet openings lead into the retort.

11. A continuously-operating externally-heated vertical retort for the production of synthesis gas from fuels, substantially as described with reference to either Figures 1 and 2, Figures 3 and 4, Figures 5 and 6, Figures 7, 8 and 9, or Figures 10 and 11 of the accompanying drawings.

Dated this 17th day of July, 1939.

For the Applicants,
E. GEORGE LEWIN,
Chartered Patent Agent,
Ebury House,
150, Victoria Street,
London, S.W.1.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1941.

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

Fig. 1.

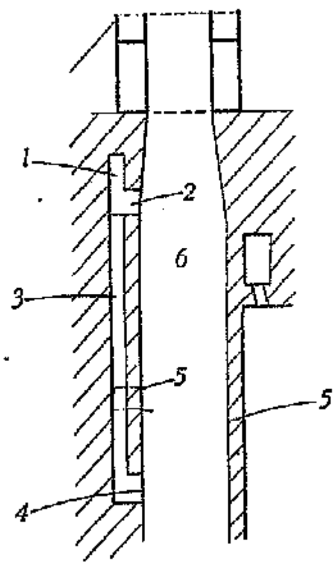


Fig. 3.

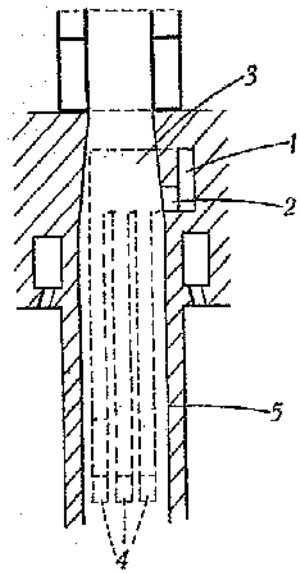


Fig. 2.

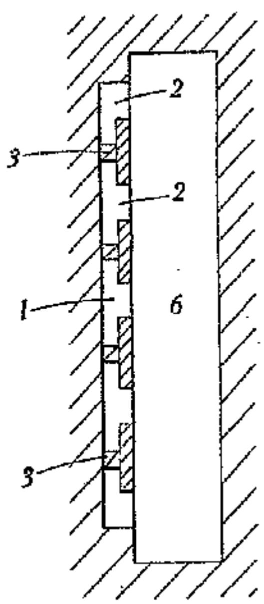


Fig. 4.

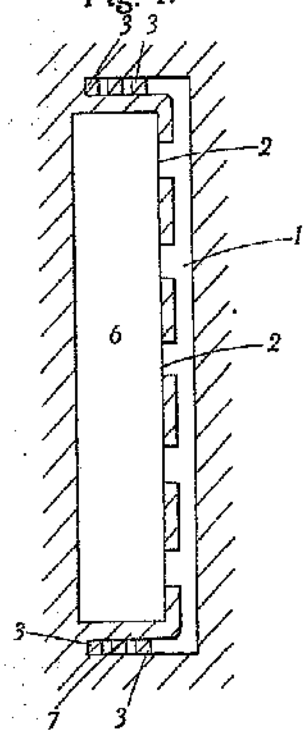


Fig. 5.

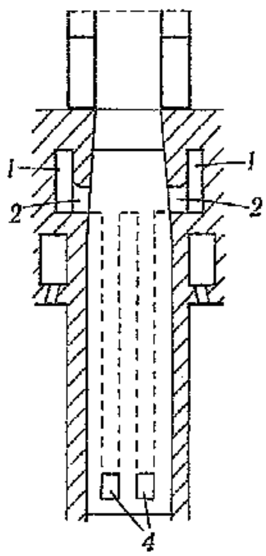


Fig. 6.

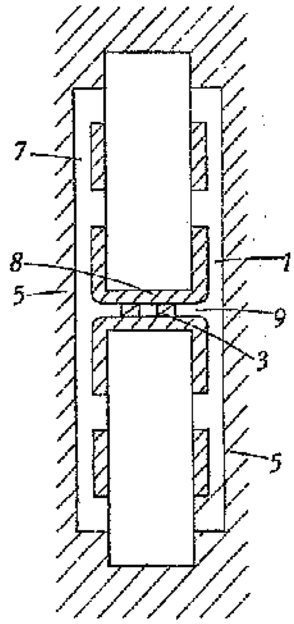


Fig. 9.

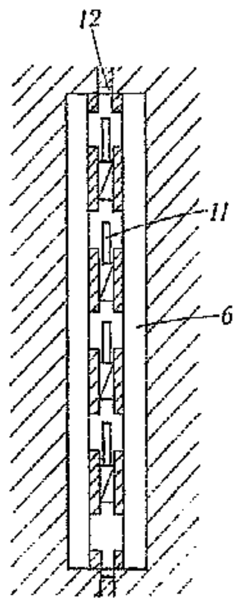


Fig. 7.

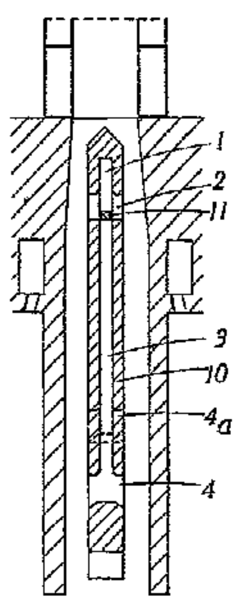


Fig. 8.

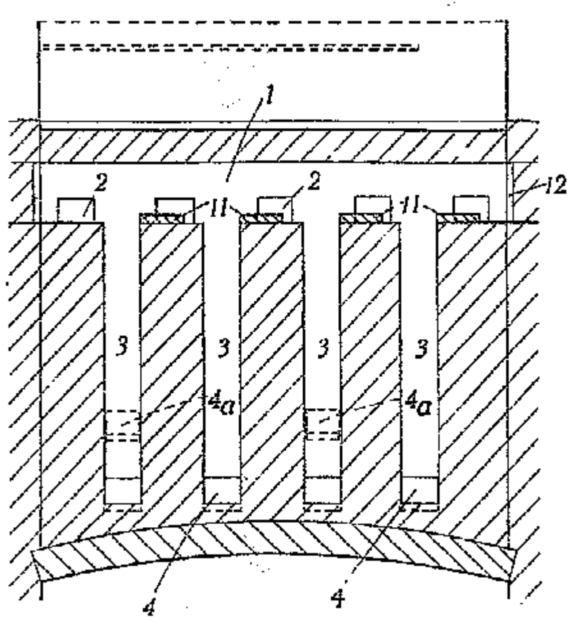


Fig. 1.

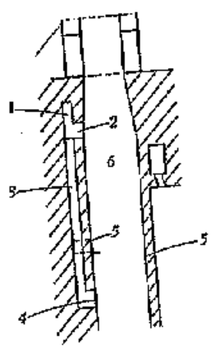


Fig. 3.

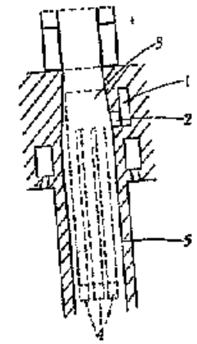


Fig. 2.

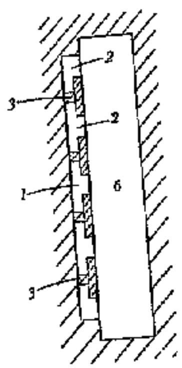


Fig. 4.

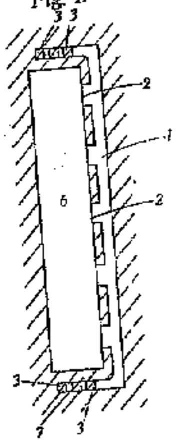


Fig 5.

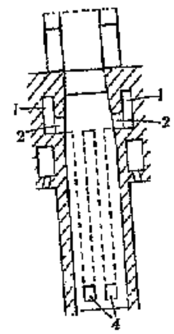


Fig. 6.

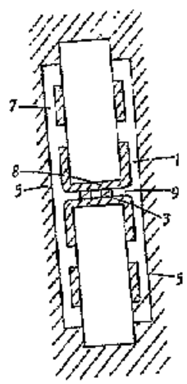


Fig. 9.

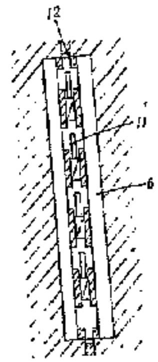


Fig. 7

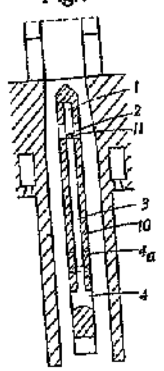
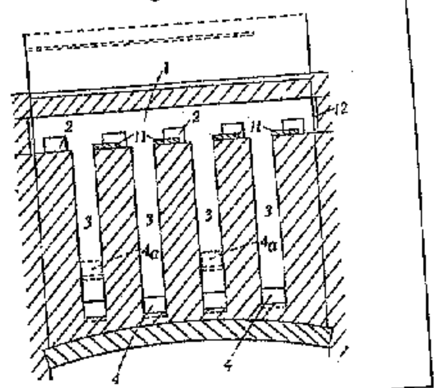


Fig. 8.



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

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

Fig. 10.

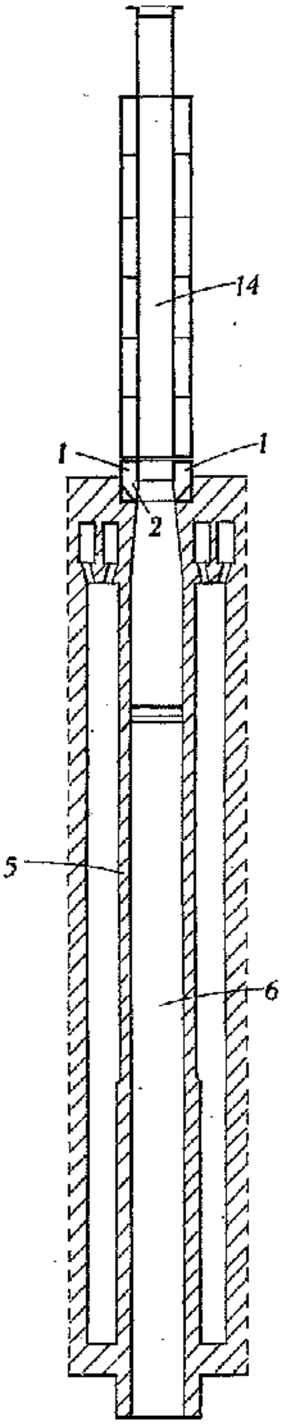


Fig. 11.