

Nov. 17, 1942.

F. TOTZEK

2,302,157

PROCESS FOR THE PRODUCTION OF USEFUL FUEL GAS

Filed May 20, 1940

3 Sheets-Sheet 1

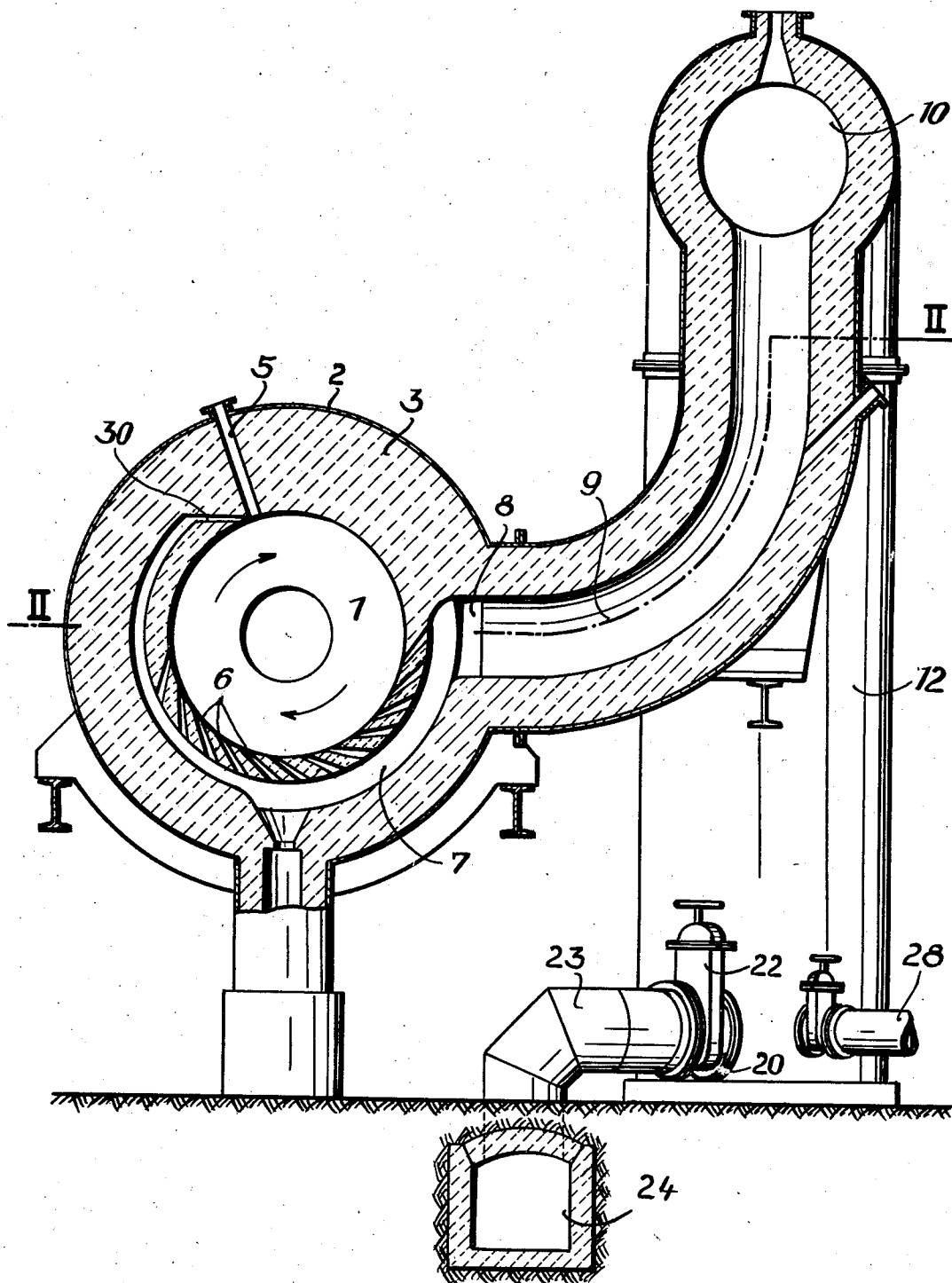


Fig. 1

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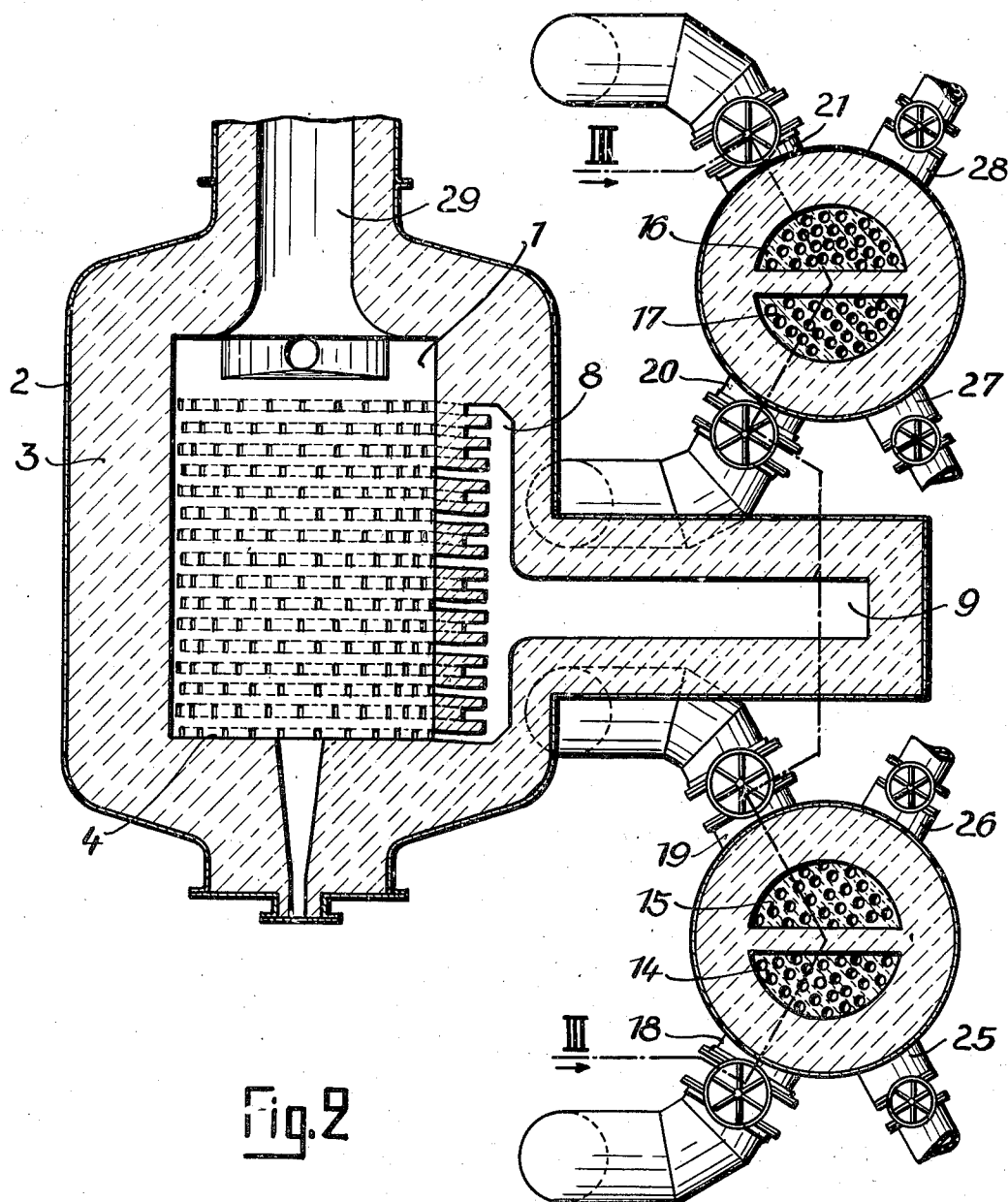
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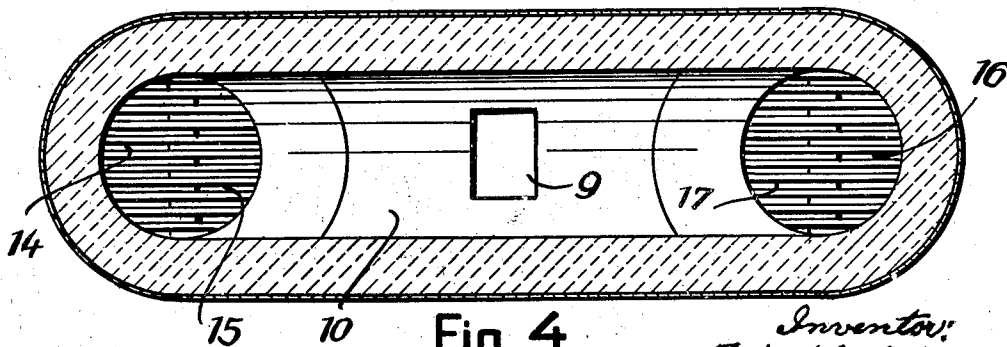
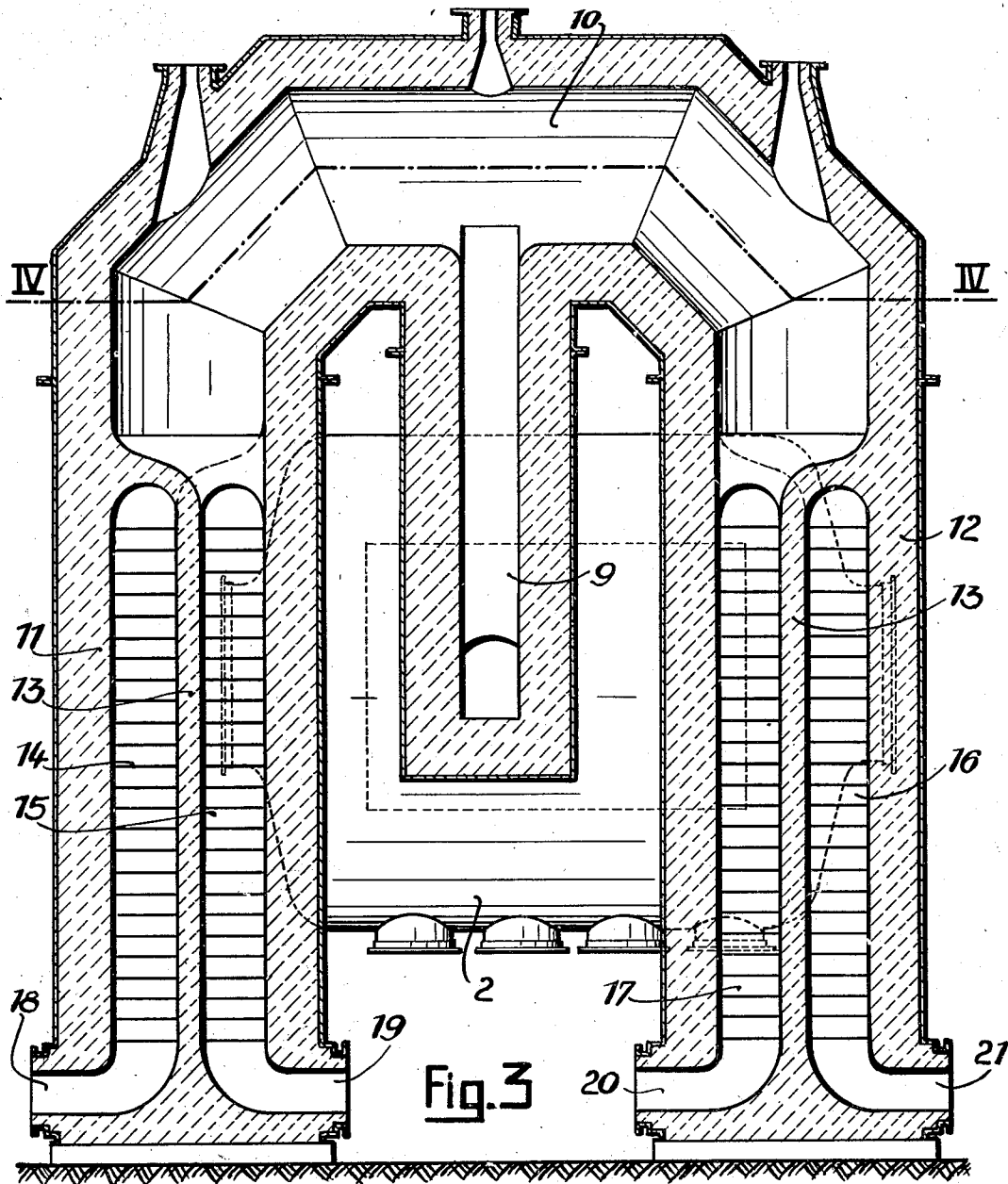
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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PROCESS FOR THE PRODUCTION OF
USEFUL FUEL GAS

Friedrich Totzek, Essen, Germany, assignor, by
mesne assignments, to Koppers Company, Pitts-
burgh, Pa., a corporation of Delaware

Application May 20, 1940, Serial No. 336,125
In Germany May 31, 1939

4 Claims. (Cl. 48—203)

In my copending application for Letters Patent relating to improvements in a process for the production of useful fuel gas, executed on the 30th day of April, 1940, Serial No. 336,124, filed May 20, 1940, a process is disclosed for the production of fuel gas of high calorific value out of dusty or finely granular fuels, such as black or brown coal, or coke and semi-coke made therefrom, by the conversion of the solid carbonaceous fuel at high temperature with steam and carbon dioxide and oxygen, the fuel in suspension being brought into contact with hot gases containing carbon dioxide, said gases being made by the combustion of part of the gas produced, and the hot mixture consisting of gas and fuel is treated with steam.

In order to obtain a good yield of valuable fuel gas of a high calorific value, it is necessary to keep the temperature of the media within the gas producer as high as possible. In case the useful gas produced is partly used for heating purposes, the necessary high reaction temperature can only be arrived at if the heating media (combustion air and fuel gas) are preheated to a sufficiently high degree.

The present invention, which has for its aim to obtain a simple and efficient preheating of the heating media in connection with the process according to my above mentioned patent application, now provides for preheating regeneratively the heating media serving for the production of hot reaction gases, and to conduct the waste gases generated by the combustion of the highly preheated heating media partly as reaction gas through the gas producer and partly through another regenerative gas heater which serves to store the sensible heat from this partial stream of waste gases and later to preheat the heating media in another operating period of the regenerator.

Furthermore, the regenerative gas heater which is used for preheating the heating media may be employed to preheat the steam which is suitably added either to the combustion air or to the fuel gas or to both the media in an adjustable manner. By the combustion of the preheated heating media in the presence of steam it is possible to keep the combustion temperature exactly at the desired degree so as to avoid dangerous superheatings which may occur under certain conditions when highly preheated material is burnt.

Another object of this invention is to introduce the hot mixture of combustion gases containing carbon dioxide and steam through open-

ings into the gas producer, a partial stream being preferably introduced directly at the inlet of fuel dust in such a manner that the fuel dust is distributed most favourably within the reaction chamber.

With the above and other objects and features of my present invention in view, I shall now describe a preferred embodiment thereof on the lines of the accompanying drawings, in which:

10 Figure 1 is a vertical section of a gas producer built according to my invention.

Figure 2 is a horizontal section on line II—II of Fig. 1.

15 Figure 3 is a vertical section on line III—III of Fig. 2 and

Fig. 4 is a horizontal section through the regenerative gas heater on line IV—IV of Fig. 3.

The apparatus shown on the drawings consists of a gas producer chamber 1 having substantially the shape of a horizontal cylinder, said gas producer chamber being formed by a suitable jacket 2 made of refractory brickwork 3. At the one end of the reaction chamber 1, preferably near the axial front end wall 4, a fuel delivery opening 5 is provided to which suitable feeding means outside chamber 1 are connected which means are not shown on the drawings for simplicity's sake.

In the walls of the gas producer chamber 1 either only in the lower half of the gas producer chamber as shown in Fig. 1 or distributed over the whole area of same, there is arranged a series of nozzle-like openings 6 which terminate into the gas producer chamber 1 not completely tangentially: The nozzle openings 6 extend from the ring-like or circumferential distributing channels 7 situated in the brickwork 3. The ring-like channels 7 are connected to a common connecting channel 8 from which leads a channel 9 to a combustion chamber 10 in which are produced the hot combustion gases containing carbon dioxide necessary for the gasifying process. The combustion chamber 10 is formed as a U-shaped channel connected at each end to a tower-like gas heater 11, 12. In each of the gas heaters 11 and 12 are formed two separate compartments 14, 15 and 16, 17 by central partition walls 13. These gas heater compartments are filled with chequerwork in the well known manner which serves for the heat exchange between the media which transfer and take up the heat.

At the bottom of the gas heater compartments are openings 18, 19, 20, 21. These openings are controlled each by a suitable shut-off valve 22

(see Fig. 1) to which are connected outside the pipe lines 23 leading to the waste gas collecting channel 24 which communicates with the stack. Moreover the gas heater compartments are equipped with openings 25, 26, 27, 28 (see Fig. 2) which are arranged at the bottom and serve for the introduction of the media to be heated into the gas heaters.

The working method of the contrivance shown on the drawings is as follows:

It is assumed that the gas heater compartments 14 and 15 are to serve to heat up the heating media. In this case the openings 18 and 19 are closed by manipulating the corresponding shut-off valves 22 and the pipe lines 25, 26 are opened so that the combustion air may enter from below into the gas heater compartment 14 and fuel gas into the gas heater compartment 15. The media flowing upwards through the gas heater compartments 14, 15 thus absorb heat from the chequerwork which had been heated up in the preceding operating period. The heated media then leave the gas heater compartments 14 and 15 at the upper end and mix within the one leg of the U-shaped combustion chamber 10 where the combustion takes place. The combustion chamber 10 is suitably dimensioned in such a manner that the combustion may be completed there.

Part of the hot gases produced then flows through the channel 9 and the adjacent connecting channel 8 into the distributing channels 7 of the gas producer from where they enter through the openings 6 into the gas producer chamber 1. The openings 6 are arranged in such a way that a spiral-like movement is effected within the gas producer by means of which the gases flow gradually from the front wall 4 where is situated the fuel inlet 5 to the other front wall in which is disposed the outlet 29 for useful gas. Finely granular or dusty fuel is sprayed through the opening 5 into the gas producer chamber. The fuel dust falling through the opening 5 into the gas producer chamber is taken up by a partial stream of hot media which is introduced through the remote opening 30 into the gas producer chamber 1. The opening 30 is situated in front of the fuel dust inlet 5 in direction to direct a stream of gas into the fuel from 5 so that the fuel dust, in well distributed form, is added to the gases passing through the gas producer chamber from the openings 6.

Steam is added through special channels or it is added to the media flowing through the opening 6 into the gas producer chamber 1. The steam may be introduced with one or both the heating media into the gas heater so that the combustion takes place within the chamber 10 in the presence of steam.

Part of the hot waste gases produced in the combustion chamber 10 is led through the other end of the U-shaped chamber 10 into the regenerator compartments 16, 17. During this operating period, the gas heater compartments 16, 17 are in connection with the waste heat flue 24 by means of openings 20, 21. The openings 27, 28 of the gas heater compartments 16, 17 are closed during this period.

As soon as the gas heater 11 is cooled down, the heating direction is reversed i. e. the gas heater 12 which has just been heated up during the preceding operating period is now used for preheating the heating media and the gas heater 11 is heated up anew by a partial stream of the hot combustion gases.

I have now above described in my present invention on the lines of a preferred embodiment thereof, but my invention is not limited in all its aspects to the mode of carrying it out as described and shown; since the invention may be variously embodied within the scope of the following claims.

I claim:

1. In a process for the production of fuel gas of high calorific value from dusty or finely granular fuels, such as black or brown coal, or coke or semi-coke made therefrom, by the conversion of the carbonaceous fuel at high temperature with steam and carbon dioxide, which comprises:
 - contacting the fuel to be treated with hot combustion gases and steam in a conversion zone to convert them to fuel gas rich in hydrogen and carbon monoxide; effecting combustion of fuel gas and air in a combustion zone apart from the carbonaceous conversion zone; flowing fuel gas and air in alternation through preheated regenerative heat exchange media of one and then the other of two sets of separate regenerative heat exchange media for fuel gas and air and thereby preheating the gases to be used in the combustion step to provide hot combustion gases with accompanying cooling down of the regenerator heat exchange media of the respective sets, when operable for preheating said gases; flowing one part of the hot combustion gases from the combustion zone into the aforesaid carbonaceous fuel conversion zone for the conversion therein; and flowing another part of the hot combustion gases from the combustion zone in alternation through the regenerator heat exchange media of each of the two sets concurrently with flow of the preheated gases to the combustion zone from the other of the two sets, and thereby heating up the heat exchange media of the respective sets in alternation for preheating of the gases for the combustion zone during the next regenerative operating period of the process.

2. A process as claimed in claim 1 and in which the steam for use in the conversion in the conversion zone is added to one of the combustion media aforesaid before the preheating thereof.

3. A process as claimed in claim 1, and in which the steam and hot combustion gases for the conversion zone are introduced in mixture into contact with the carbonaceous fuel in the conversion zone as a semi-circumferential series of jets and in such manner as to impart a spiral like current movement to the hot gas and carbonaceous fuel during their contact in the conversion zone.

4. A process as claimed in claim 1, and in which the steam and hot combustion gases for the conversion zone are introduced in mixture into contact with the carbonaceous fuel in the conversion zone as a semi-circumferential series of jets at a region remote from the region at which the carbonaceous fuel is introduced into the conversion zone and in such manner as to impart a spiral like current movement to the hot gas and carbonaceous fuel during their contact in the conversion zone and in which another portion of the hot combustion gas is let into the conversion zone directly in front of the fuel being introduced so as to set the fuel into spiral motion in the conversion zone in advance of its contact with the semi-circumferential series of jets of hot combustion gas.

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