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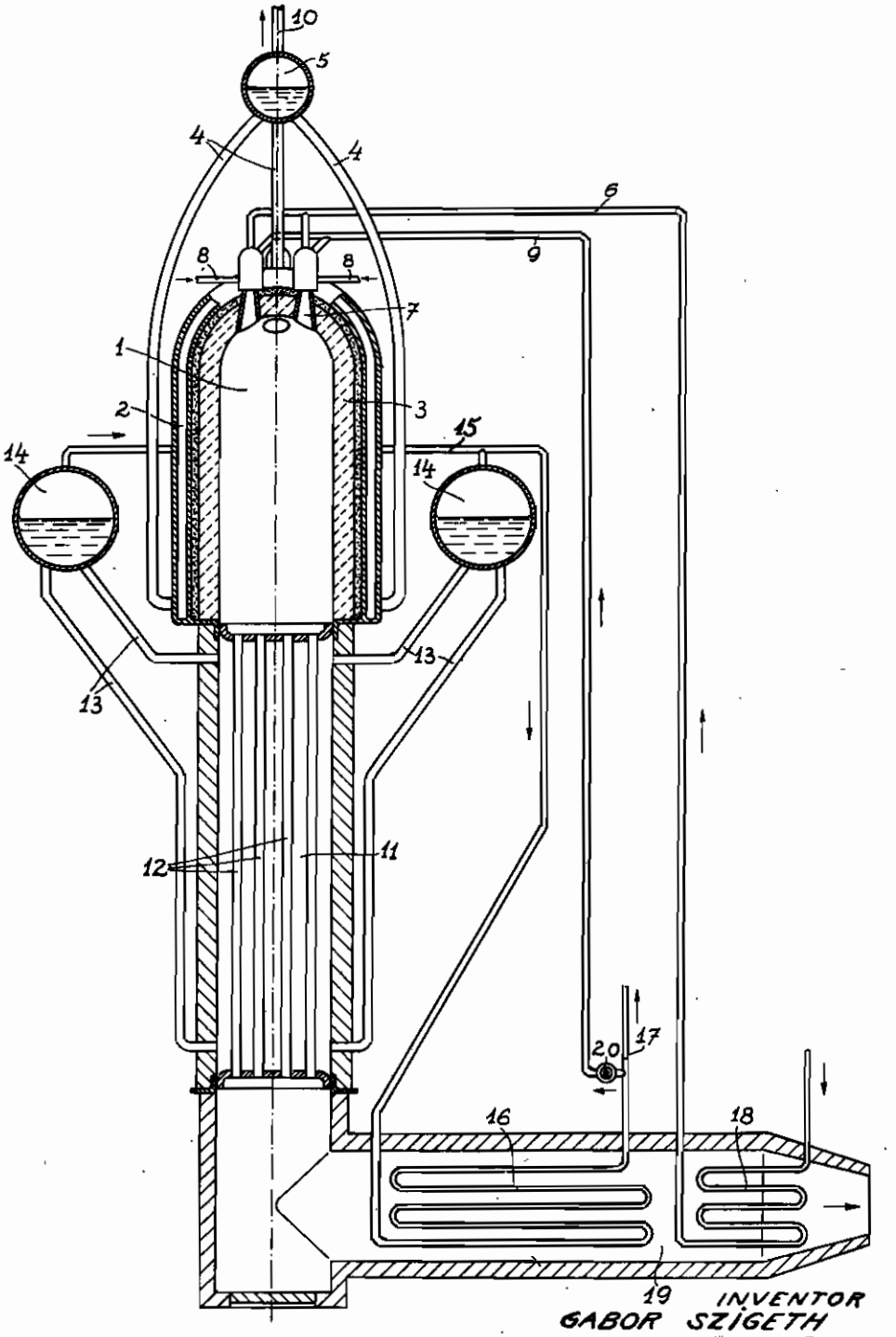

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PROCESS FOR THE PRODUCTION OF A WATER GAS PARTICULARLY SUITABLE FOR SYNTHETIC PURPOSES

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This invention relates to a process for the production of a water gas particularly suitable for synthetic purposes.

The purpose of the process according to the invention is the production of water gas, in particular for synthetic purposes, by complete gasification by a continuous method, of liquid combustibles, such as mineral oils or their distillation residues, gas oils, tars of any origin and so on. According to the process of the invention the liquid combustibles are gasified with the application of a relatively small excess of steam, without the assistance of catalysts, at temperatures of above 1100° C, advantageously 1200–1300° C and at high pressures of more than 10 atmos., advantageously between 15 and 20 atmos.; the high reaction temperature is maintained by direct combustion by means of oxygen of a portion of the liquid combustible introduced into the reaction chamber.

Liquid combustibles were employed hitherto in gas production at the most for carburation of the water gas admixed with the town gas. It has indeed already been proposed to subject heavy oils at temperatures of 700–1100° C, at ordinary or reduced pressure or also with slight excess pressure, to a cracking operation and then to pass the cracking products for the purpose of their conversion into permanent gases, through likewise heated catalysts, as for example a catalysis chamber filled with metallic iron, metallic nickel, iron oxide, manganese dioxide and so on at a similar high temperature and for the purpose of maintaining the temperature to burn a portion of the oil in the cracking chamber; this proposal directed essentially to the production of oil gas has however not proved successful in practice, among other reasons because the catalysts employed tended to become sooted up.

A process which has been put into practice is also known for the production of a town gas rich in methane in the case of which the gasification is carried out with the application of high pressures of about 20 atmos. This process is however only directed to the gasification of solid combustibles, in particular such lignites from which a reactive coke can be produced; the pressure-tight reaction chamber is filled with granulated lignite of the described kind and into the lignite mass an oxygen-steam mixture is blown at a pressure of about 20 atmos, the temperature being maintained relatively low at about 750° C. The composition of the gas rich in methane produced in a continuous operation, after washing out the considerable quantities of carbon dioxide contained therein, corresponds substantially to the customary town gas composition.

Finally gas producers fed with oxygen with internal heating are known in which in a continuous operation coal dust is worked up. In these plants the gasification takes place at ordinary pressure with the application of a large excess of steam and at relatively low temperatures.

The purpose of the process according to the invention is to produce from liquid combustibles a gas intended in particular for synthetic purposes, the methane content of which amounts to less than 1%, that is to say which is practically free from methane, which also contains carbon dioxide in quite inconsiderable quantities and consists essentially of carbon monoxide and hydrogen. A particularly important feature of the process is the simultaneous application of high pressures and high temperatures. By these reaction conditions in fact the velocity of the reactions taking place is essentially increased. The application of the high pressure further allows of an essential reduction of the dimensions of the plant and a particularly favorable utilisation of the waste heat. It is to be recommended to adjust the pressure so high that the impurities contained in the crude gas (for example carbon dioxide and hydrogen sulphide) can be easily washed out with water. Also from the point of view of the carbon monoxide conversion which may be necessary according to the purpose of application of the gas, it is advantageous to work with previously compressed gas.

The application of high pressures appears to be in contradiction to that object of the process according to the invention according to which from the liquid combustibles a practically methane free gas is intended to be produced, since as is known in reactions which are linked up with a change of the number of the molecules, an increase of the pressure has for its result a displacement of the reaction in the direction of a reduction of the number of molecules. From the known equation of the methane equilibrium

$$CO+3H_2 \rightleftarrows CH_4+H_2O+48.9 \text{ Cal}$$

it is seen that by the increase of the pressure the reaction is displaced towards the right and thus the methane synthesis, that is to say a process undesired in accordance with the present invention, is favored. The methane formation is, however, in the process of the invention, restrained by the high temperatures employed; at temperatures in the neighborhood of 1100° C and

above, the gas contains in spite of the high pressure no noteworthy quantity of methane.

The requirement of the process of the invention as regards heat is provided for by combustion by means of oxygen of a corresponding portion of the liquid combustible atomised in the high pressure reaction chamber. The temperature of the reaction chamber which according to the invention should be at least about 1100° C, suitably, however, about 1200–1300° C, is adjusted according to the desired composition of the synthesis gases to be produced. In this case there is no need to discuss the otherwise known relations between temperature and gas composition. Obviously for the production of a gas always of the same composition the temperature in the reaction chamber must be maintained constant; any variations can be compensated by regulation of the oil, steam or oxygen supply without difficulty. The steam necessary for the water gas reaction is according to the invention employed in a slight excess, suitably such as is only a little above the theoretically necessary quantity. Accordingly the steam content of the crude gas leaving the gas producer is also very small, varying for example between 1 and 5%. The distillation residues, for example the masut advantageously applicable for the purpose of the process according to the invention usually contain several per cent of water, so that the quantity of the water contained in the liquid combustible must be accounted for in the water gas reaction.

With the high reaction temperatures employed in the process according to the invention the organic sulphur compounds contained in the liquid combustibles will be subject to decomposition under the action of the steam; the formed hydrogen sulphide can be easily removed subsequently, for instance by washing with water.

According to the process of the invention masut was gasified in an experimental plant, the temperature being maintained at 1200° C; the gas had the following composition expressed in volumes per cent

CO_2	0.5
CO	49.2
H_2	48.7
CH_4	0.4
H_2O	1.2

In the drawing is illustrated diagrammatically in section an example of an apparatus applicable for carrying out the process of the invention.

The reaction chamber 1 is surrounded by a pressure tight double walled boiler 2 including a water chamber, which boiler is provided in the interior with a heat resistant lining 3. The water chamber of the boiler is connected by the tubes 4 with the steam collecting drum 5. The liquid combustible passed through the tube 6 under high pressure enters into the reaction space 1 through the nozzles 7; immediately prior to its entry into the reaction space, to the liquid combustible through the tube 8 oxygen and through the tube 8 steam are supplied. A portion of the combustible burns with the oxygen in chamber 1 and here maintains the high temperature permanently; the lining 3 impedes losses of heat. With the quantity of heat which does, however, traverse the lining, in the boiler 2 low pressure steam is produced which is taken off through the tube 10 and can be usefully employed.

The hot gases passing out of the reaction chamber 1 under high pressure and streaming through the fire tubes 12 of the boiler 11 produce high pressure steam which by way of the connecting tubes 13 collects in the collecting drums 14 and streams through the collecting tube 15 to the superheater 18, then through the pipe line 17 to the place of employment. The quantity of the steam supplied to the mixing nozzles 7 through the tube 9 branched from the pipe 17 can be regulated by the valve 20.

The gases passed through the draught tubes of the boiler 11 pass through the channel 19 enclosing the steam super-heater 16 and the oil preheater 18 and then pass to purification devices not illustrated in the drawing.

It is to be recommended to introduce the liquid combustible into the reaction chamber in finely atomised form. A preferred method of carrying out the atomisation, which can, however, be effected in other ways, consists in that the liquid combustible for example masut is emulsified with some water and supplied to the atomiser in as far as possible preheated condition under high pressure for example at 80–100 atmos; the pressure is now suddenly reduced to that prevailing in the reaction chamber which is considerably lower, for example 20 atmos, whereby an extraordinarily fine atomisation of the oil is effected owing to the water emulsified therewith being immediately converted into steam.

Since according to the invention the complete gasification of the liquid combustibles takes place without the assistance of catalysts, obviously all the disadvantages inherent in the application of catalysts are avoided, such as their sooting up, the necessity for regeneration and so on. A further advantage of the gasification of liquid combustibles is due to the very low ash content of these combustibles, whereby difficulties of operation on account of slag formation are likewise avoided.

A further advantage consists in that the introduction of the liquid combustible into the reaction chamber can be easily and accurately regulated and accordingly also the requirements of oxygen and steam to be determined by preliminary experiments can be accurately adjusted whereby a uniform operation of the gas producer is rendered possible.

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