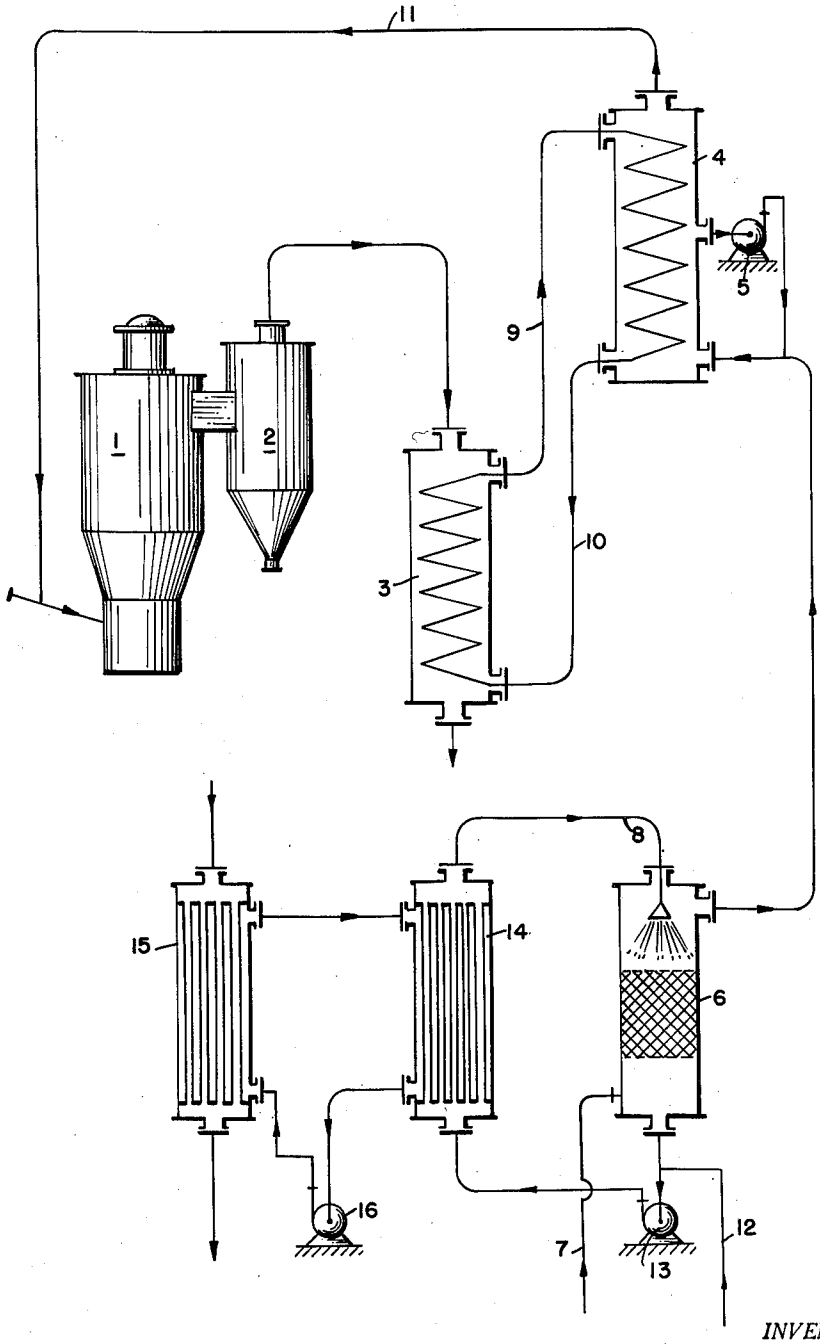
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PRODUCTION OF GAS

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# PRODUCTION OF GAS

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The present invention relates to the gasification of fuels, in particular to the gasification of solid carbonaceous fuel.

In the continuous gasification of solid carbonaceous substances, in particular for the production of synthesis gases, in which oxygen or air or both together with steam or carbon dioxide or with a mixture of both is employed as the gasifying agent, the gases leaving the gas producer have a relatively high temperature. This, for example in the case of pure dust gasification, in direct flow, amounts to 1000° to 1200° C. and, in the case of runn-off gas producers operated with coke, for example in the production of synthesis gas for the ammonia synthesis, amounts to 600° to 900° C. depending on the nitrogen content of the gas produced. In order to economise in fuel and oxygen, it is preferable to utilise the sensible heat of the gases leaving the gas producer for the heating up of the gasifying agent.

The transfer of heat from the hot gases to the gasifying agent to be heated up may be effected in a discontinuous fashion in so-called Cowper apparatus in which the hot gases give up their heat to heat-accumulating solid materials through which, after the heating up, the gasifying agent is passed and thereby heated. This method of heat transfer, however, necessitates scavenging of the Cowper apparatus with steam or carbon dioxide between every change from heating up to heat supply.

The tubular heat exchangers, operating continuously, which are also used have another drawback. Since the heating producer gas flows, for example, through the tubes and the gasifying agent to be heated up flows around the tubes, there is a risk that, in the event of leakage, the gasifying agent may enter the stream of gas, form a flame by ignition, the said flame aggravating the leakage by the evolution of heat and the heat-exchanger becoming fused together in a short time. If under the said conditions, the gasifying agent mixture does not become ignited, there will be formed behind the heat-exchanger an explosive mixture which, after separation of the steam, is very dangerous.

We have now found that the said drawbacks are avoided by carrying out the transfer of heat between the hot gas leaving the gas producer and the gasifying agent which is to be heated up, by the continuous employment, as a heat carrier, of an intermediate medium, preferably under pressure, as for example water or mercury. The gas leaving the gas producer gives up its heat, for example in a tubular heat exchanger, for example to mercury which is under pressure, the mercury is thereby vaporised and is led in the vapour phase into a second tubular heat exchanger installed independently of the first, in which it gives up its heat of condensation and part of its sensible heat to the gasifying agent which it is desired to heat up. The cooled condensate is then returned to the first tubular heat exchanger. The mercury can be heated up for example to 600° C. and the gasifying agent to 550° C., so that only two connecting pipes are needed for the passage of mercury vapour or liquid mercury between the heat-supplying and heat-absorbing tubular heat exchangers.



In order to economise in mercury, it is preferable to effect the heating up of the gasifying agent in the colder part of the heat transfer apparatus, for example up to 300° to 325° C., by means of circulatory heating operated with water or steam, the water under pressure reaching a temperature up to about 370° C., and only then to effect the further heating up of the gasifying agent in the hot part by means of mercury.

The circulatory heating can be operated either as positive circulatory heating or as a heating with a natural circulation. It is, however, advantageous to work with natural circulation because the apparatus can be completely closed and no liquid or vapour can escape through any stuffing boxes or the like.

With the said kind of heat transfer it is possible, in the gasification with air or oxygen and steam, to introduce the steam by spraying the air or oxygen with hot water, for example by means of a spray saturator, and then to heat up the gasifying agent by means of water or mercury as a heat carrier using the heat of the gases leaving the gas producer, without there being any possibility of the gasifying agent flowing into the gas path.

To minimise corrosion it is preferable to mix a part of the wholly or partly heated-up gasifying agent with the not yet heated-up gasifying agent coming from the spray saturator for the purpose of raising the temperature of the latter. In this way corrosions are avoided at the heating tubes, which could otherwise readily occur by moist oxygen or moist mixtures of air and oxygen.

The said process renders possible, while economising in gasification steam, a high preheating of the gasifying agent and avoids any possibility of the entry of gasifying agent into the gas stream.

A further modification of the process consists in saturating the gasifying agents oxygen and air, singly or in admixture, with the steam necessary for the gasification by spraying with hot water which, after giving up steam and heat to the gasifying agent and replenishment of the evaporated water, for example by boiler feed water or condensate, and after being heated up again, is pumped back again to the saturator, whereby the heating up of the saturator water pumped in circulation takes place indirectly in a tubular heat exchanger which is operated with hot water which itself originates, for example, from coolers, in particular from the gas-processing plant, and which is pumped in circulation between the heat-absorbing heat exchanger belonging to the saturator and the heat-supplying coolers. As examples of sources of heat there may be mentioned for example gas producer plant, synthesis plant for the production of ammonia, methanol or other syntheses, as for example the production of higher alcohols or hydrocarbons from carbon monoxide and hydrogen, and also pressure hydrogenation of coals, tars, mineral oils or their fractions. The waste heat arising in the conversion and compression of the synthesis gas can also be used for saturating the gasifying agent.

Since the temperature of the spraying water is high and this water comes into contact with oxygen, it absorbs oxygen, even if only to a slight extent, so that corrosion readily occurs in the coolers of the source of heat which are usually constructed of iron of very high quality. In order to avoid these difficulties, two water circulations and an indirectly operating tubular heat exchanger can be introduced by interposing, besides the one water circulation between the heat-consuming saturator and the heat-supplying places, a second so-called saturator-water circulation. The water coming from the saturator, after replenishment of the evaporated water by condensate or boiler feed water, is heated up in an indirectly operating

tubular heat exchanger by the water of the first circulation.

The tubular heat exchanger between the two circulations is preferably constructed of special materials, as for example high-alloy steel or tinned brass. In this way the highly valuable cooler of the source of heat can be operated always without loss of water with the same water in circulation without the deposition of boiler scale and without the occurrence of corrosion.

The invention will now be described by way of example with reference to the accompanying drawing which diagrammatically illustrates an apparatus for the production of water-gas to be used in the ammonia synthesis.

Referring to the drawing, the water-gas produced in a run-off gas producer **1** by the gasification of coke with an oxygen-steam-air mixture flows through a dust collector **2** into a heat exchanger **3** at a temperature of 600° to 650° C. and thence, after having surrendered its heat, to the point of collection or use. Mercury, for example, is evaporated in the tube system of the heat exchanger **3**. The mercury vapour flows through pipe **9** into a heat exchanger **4** in which the mercury vapour gives up its heat of condensation and a part of its sensible heat to the gasifying agent which is to be heated up; the mercury then flows through pipe **10** back into the heat exchanger **3**. The mixture of oxygen and air entering at **7** is saturated with steam in a saturator **6** by contact with hot water entering through pipe **8**, is then heated up in the heat exchanger **4** and led through pipe **11** into the run-off gas producer. In order to avoid corrosion in the heat exchanger **4**, part of the gasifying agent heated up in this heat exchanger is mixed by a blower **5** with the saturated gasifying agent (mixture of air, oxygen and steam) coming from the saturator **6**. To the water flowing away from the saturator **6**, fresh water is added through pipe **12** and it is then led by means of a pump **13** through a heat exchanger **14** wherein it is heated and then returned to the saturator **6** through pipe **8**. The saturator-water circulation is thus through **6**, **13**, **14** and **8**.

In the ammonia synthesis the gas coming from the reaction chamber is cooled with water in the heat exchanger **15**, the water being thus heated to about 100° C. The hot water is passed to the heat exchanger **14** in which it surrenders its heat to the water circulating in the saturator, and thence is returned by pump **16** to the heat exchanger **15**. There is thus a circulation of water also between **15**, **14** and **16**. This latter technique affords the advantage that the gasification can be conducted in the absence of fresh steam and that the gasifying agents pass to the run-off gas producer at a temperature of, for example, 300° to 400° C.



What we claim is:

1. In a process for the production of an inflammable gas by gasification of a carbonaceous fuel wherein the sensible heat contained in the inflammable gas produced is employed to preheat an oxygen-containing gasifying agent, the improvement which comprises: transferring heat from the hot inflammable gas produced to liquid mercury by indirect heat exchange in a first heat exchange zone and thereby vaporizing said liquid mercury; saturating the oxygen-containing gasifying agent with steam by spraying with hot water in a saturator; passing the steam saturated oxygen-containing gasifying agent through a second heat exchange zone; passing said vaporized mercury from the first heat exchange zone through the second heat exchange zone in indirect heat exchange relation to the steam saturated oxygen-containing gasifying agents and thereby condensing said mercury; recirculating the condensed liquid mercury to said first heat exchange zone; circulating the water not absorbed by the gasifying agent during said spraying in the saturator to a third heat exchange zone provided with a corrosion-resistant heat-transfer material; transferring waste heat from a fluid heat carrier to the circulated water by indirect heat exchange in said third heat exchange zone to produce hot water for said spraying; and adding fresh water to said circulated water to replace water absorbed by said gasifying agent during said spraying.

2. The process as defined in claim 1 wherein the fluid heat carrier which transfers waste heat to the circulated water in the third heat exchange zone is circulated in a closed system between said third zone and a fourth heat exchange zone, and waste heat from a fluid source of the waste heat is initially transferred to said circulated fluid heat carrier by indirect heat exchange in said fourth heat exchange zone.

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