Jan. 10, 1939. H. KOPPERS 2,143,017

WATER-GAS GENERATOR

Filed March 2, 1937

Fig. 1

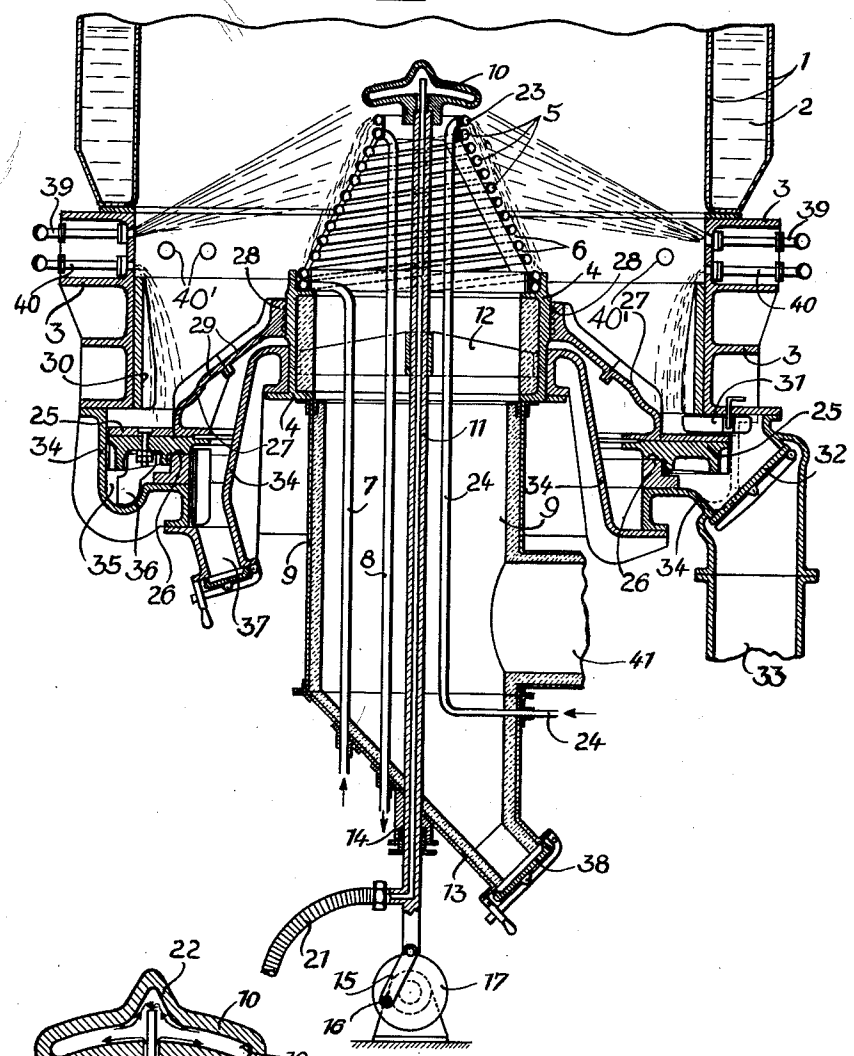


Fig. 2

Inventor:
Heinrich Koppers,
By Henry Lowe Clarke
his attyp

Patented Jan. 10, 1939

2,143,017

UNITED STATES PATENT OFFICE

2,143,017

WATER-GAS GENERATOR

Heinrich Koppers, Essen, Germany, assignor, by mesne assignments, to Koppers Company, Pittsburgh, Pa., a corporation of Delaware

Application March 2, 1937, Serial No. 128,576
In Germany March 4, 1936

6 Claims. (Cl. 48—66)

The invention relates to water-gas generators, arranged for intermittent alternate operation, at which during one operating period the fuel is highly heated (blown hot) in the producer shaft by the introduction of air and in the following working period, the producer shaft is traversed by the steam which reacts with the highly heated fuel with the formation of water-gas. My invention comprehends in particular such types of water-gas generators, in which the air for the hot blast is introduced from below upwardly into the fuel column and the water-gas developed in the producer shaft may be withdrawn at the bottom from the producer shaft, the unburnt residues (slag) being discharged in solid form from the bottom of the gas producer shaft.

The advantages offered by the blowing up from below and by the steaming from the top downwards are especially noticeable if a gas, suitable for the synthesis of hydrocarbons is to be produced. The benefits thus obtained could, however, not be fully utilized in the gas producers known hitherto. The hot blast air is introduced in the usual water-gas generators through a grate into the fuel column, by which in the subsequent steaming period the useful gas is also withdrawn in case the steam flows from the top downwards through the fuel column. The very hot useful gas flowing through the grate transfers a great quantity of its heat unto the metallic grate which, during the steaming period is heated to such temperatures, at which the grate no longer shows the requisite strength. The well known water-gas generators are therefore usually operated in such a way, that during the steaming period the steam is alternatively introduced from the bottom and from the top into the gas producer and the temperature of the grate is thus kept below that point above which the grate could be damaged.

Another disadvantage adherent to the water-gas generators, known hitherto, consists in that the removal of slag which due to the high temperature is baked into larger lumps, cannot be carried out in a practical way by mechanical means. The water-gas generators, known hitherto, still require quite a good deal of poking to be done by the attending people.

The present invention now provides means for the elimination of the above-mentioned difficulties, arising in connection with water-gas generators, known hitherto. The improvements now consist in the provision of a stationary pipe coil, wound in the shape of a cone, and which is water-cooled, as a conical grate in the lower part of the gas producer shaft and an annular extractor arranged for rotation around the base of this grate cone. The extractor is provided with crushing jaws or the like, similar to a centrifugal crusher. At the lower end of the gas producer shaft, these jaws work together with the corresponding stationary crushing jaws.

Another feature of the gas generator according to my invention consists in that the grate cone formed by the pipe coil is covered at the top by means of a water-cooled cap, which contrary to the water-cooled cone grate can be lifted, lowered and rotated, if necessary.

Further important objects of my invention include the extraction of ash, which falls on the annular rotary extractor on the one hand and on the other hand between the base of the stationary grate cone and the extractor casing. Furthermore, the invention relates to a special arrangement of inlets for steam and, if necessary, of water, in the walls of the gas producer shaft, in a zone lying opposite the cone grate.

Further objects and advantages of my invention will be in part obvious from and in part specifically pointed out in the description contained hereinafter, which taken in conjunction with the accompanying drawing, discloses a preferred embodiment thereof. Such embodiment, however, is to be considered merely as illustrative of the principles of the invention.

The lower part of a water-gas generator as constructed according to my invention is illustrated on the drawing in Figure 1.

Figure 1 shows a vertical section of the apparatus and Figure 2 shows on an enlarged scale the hood covering the top of the cone grate.

According to the drawing, the water-gas generator is formed by a double shell 1, the interior 2 of which is filled with a suitable cooling liquid, for instance water. The double shell 1 of the gas producer is carried by a supporting ring 3, suitably made from cast steel, said carrying ring being fastened to the supports, not shown on the drawing.

A cylindrical casing 4 is likewise firmly fastened on the lower frame of the gas producer. This cylindrical casing is situated in the center line of the gas producer shaft. A conically twisted pipe coil 5, the individual tubes of which are arranged at a certain distance from one another, as shown in Figure 2, extend from the upper end of the casing 4. Gaseous or vapour-like media can be blown into and withdrawn from the producer shaft through the spaces 6 between the individual convolutions of the pipe coil.

The pipe coil forming the grate cone is connected to a water delivery 7 and to a water discharge 8, which extend in a gas-tight way through a lower extension 9 of the grate supporting casing 4.

A hood 10 fitted with a water-cooling arrangement is placed above the last upper convolution of the grate coil cone which is arranged above the grate casing 4 said hood being situated at the top of a vertical suport 11.

The support 11 of the grate hood 10 is movably arranged in a bearing arm 12, and runs through a stuffing box 14 in the inclined bottom 13 of the casing extension 9. Its lower end is movably connected by means of an intermediate crank-link 15, to the lugs or crank-pin 16 of a crank-wheel 17, which is rotated by a power unit, not shown on the drawing. As clearly shown, the hood support 11, together with the hood 10, are lifted and lowered, as the crank-wheel 17 is rotated.

A baking-together of the slag within the gas producer with the formation of bridges is thereby prevented and a uniform sinking-down of the slag is attained in the gas producer.

Figure 2 shows the grate hood 10 fitted with a hollow space 18. A longitudinal channel 19 of the hood support 11 reaches into this space. A back-flow channel 20 is likewise provided the channel 19. Underneath the bottom 13 of the casing, the longitudinal channel 19 of the hood support is connected with a water-supply by means of a flexible pipe 21. The cooling water rises upwards in the longitudinal channel 19, is distributed in the hollow space 18 of the grate hood 10, as shown by the arrows and finally flows from the projecting point 22 of the hood 10 through the backrun channel 20, the lower end of which similar to the longitudinal channel 19, is connected with the water-discharge by means of a flexible pipe or the like. As may also be seen from Figure 2, the back-run 20 reaches up to the top 22 of the grate hood 10, so that the under side of the said top of the grate hood 10 is flushed with cooling water.

Above the last convolution 5 of the grate cone is also arranged a special tubular winding 23, which on the outside is provided with holes and is connected above the grate with a water supply 24. The water supplied into the tubular winding 23 finds its exit through the pipe openings into the slag layer above the cone grate 5 and cools down the slag to a good extent, whereby any larger lumps of slag which may have been formed, are broken-up.

For the discharge of the slag from the gas producer there serves an annular extractor 25, which rotates over an annular sliding face 26 around the stationary cone grate. The extractor ring 25 is fitted above with a conical extension 27 which terminates in a guide ring 28 in rotary engagement with the supporting casing 4 of the grate. Ring grooves fixed to the guide rings 28 serve for the distribution of the lubricating means over the sliding face.

The conical extension 27 of the extractor ring is equipped with a multitude of crushing jaws 29, which operate together with the crushing jaws of crushing-ring 30, provided on at the supporting walls 3 of the gas producer shell. The crushing ring 30 and the conical extension 27 of the extractor ring work similar to a centrifugal crusher. The slag lumps descending from the top of the fuel chamber into the downwardly tapered ring space between the extension 27 and the crushing ring 30 are crushed by the crushing jaws 29 and 30.

The crushed slag finally is collected upon the horizontal extractor ring 25 and is cut off from the extractor ring 25 by suitable scrapers 31, which are adjustably supported from the annular wall 3 of the gas producer shaft. Preferably, several scrapers 31 are arranged around the circumference of the gas producer shaft. The slag separated from the ring falls into an ash pit 33, which is suitably closed by a cover 32.

The extractor ring 25 is arranged inside a casing 34, which forms a gas-tight seal for the space between the supporting casing 4 of the cone grate and the gas producer shaft casing 3. The casing 34 is provided underneath the extractor ring 25 with an extension 35, in which are collected all those proportions of the ash, which fall through the space between the extractor ring 25 and the casing 34. A special scraper 36 is fitted to the lower side of the extractor ring 25 and will push the ash from the collecting trough 35 into the ash pit 33. The casing 34 is fitted with ash pockets 37 for the ash which falls between the guide ring 28 of the crusher cone 27 and the grate casing 4.

Finally, there is provided for an ash cover 38, to be used for the ash which may fall through the spaces between the pipe coils 5 of the cone grate.

The walls of the gas producer shaft at the height of the grate cone, are provided with steam inlets 39 and water inlets 40, which are in connection with the steam and water pipeline by means of a shut-off or regulating valve. During the run period, steam is preferably blown into the slag layer through the steam pipes 39. The slag layer formed during the operation reaches approximately up to the height of the cone grate in the producer shaft, thus counteracting an excessive heating of the pipe coil 5 of the grate cone. The water nozzles 40 serve to spray water against the slag lumps, collecting in the extractor device, in order to crush the lumps by the sudden cooling down.

According to my invention, there are also provided nozzles for the introduction of combustion air, situated at the height of the inlets 39 and 40, to ensure that a continuous or intermittent delivery of air during the run period takes place, so that the height of the slag bed can be controlled or that the coke pieces contained in the slag are burnt as far as possible. These nozzles are shown diagrammatically at 40' on the drawing.

The air, which serves for the hot-blasting of the gas-producer-charge is introduced into the grate casing 9, 4 and the water-gas is, likewise, withdrawn therefrom through the pipeline 41, during the steaming period of the gas producer.

I have now described 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. A water gas generator for intermittent operation alternately by up air-blasts and down-steam runs comprising, a generator shell having a fuel chamber; a grate for the lower portion of the fuel chamber comprising a stationary lower central conduit and a stationary upper conical gas diffusion member therefor; an annular rotatable ash extractor mounted for rotation around the base of the central conduit; a crushing ring having jaws thereon mounted for rotation with the ash extractor; and crushing jaws on the shell

for cooperation with the jaws on the crushing ring; said lower central conduit constituting a stationary support for the stationary upper conical grate and being adapted for inflow of up-blast air to, and outflow of downflow water-gas from the fuel bed through the conical grate; said stationary conical grate being constituted as a conically coiled water-cooled conduit stationarily secured on the stationary lower central conduit therefor, and having its convolutions spaced from each other for diffusion of gas therethrough; said crushing ring being disposed between the extractor and the central conduit so as to rotatably bear on the outer surface of the central conduit near the upper part thereof; a bottom closure casing extending from the generator shell and the central conduit below the bearing for the crushing ring and enclosing the crushing ring and ash extractor for closing the space between the shell and central conduit against gas flow therethrough; means for introducing the air for up-blasting to the central conduit for delivery to the interior of the conically coiled water tube diffusion member for diffusion thereby to the fuel chamber and for withdrawing gas therefrom, and means for circulating cooling water through the conically coiled water-cooled conduit.

2. A water-gas generator as claimed in claim 1, and in which a separate water cooled chambered hood is centrally mounted at the apex of the conically coiled water cooled conduit for up and down movement with respect thereto, and means are provided for circulating cooling water into and out of the chamber therefor.

3. A water-gas generator as claimed in claim 1, and in which a separate water cooled chambered hood is centrally mounted at the apex of the conically coiled water cooled conduit for up and down movement with respect thereto, and means are provided for circulating cooling water into and out of the chamber therefor, said means comprising an outer conduit communicating with the chamber at the lower part of the hood for inflow of water to the chamber and also adapted to elevate the hood on vertical reciprocation of the conduit, and an inner conduit for outflow of water extending in spaced relation to the inner conduit through the same and terminating in the chamber near the upper part of the hood.

4. A water-gas generator as claimed in claim 1, and in which ash discharge devices are provided on the annular ash extractor underneath the same for removing ash from underneath the annular ash extractor in the chamber between the same and the bottom closure casing.

5. A water-gas generator as claimed in claim 1, and in which inlets for steam, air and water are provided in the generator shell opposite the conically coiled water-cooled conduit for introducing air and water to the ash flowing alongside the same and introducing steam towards the same.

6. A water-gas generator as claimed in claim 1, and in which an auxiliary stationary water-cooled coil is mounted at the apex of the conically coiled water-cooled conduit, said auxiliary coil having ports for spraying liquid therefrom downwardly over the coils of the conically-coiled water cooled conduit.

HEINRICH KOPPERS.