(No Model.)

H. HAUG.

PROCESS OF AND APPARATUS FOR PRODUCING HEATING GAS.

No. 299,385. Patented May 27, 1884.

Fig. 1.

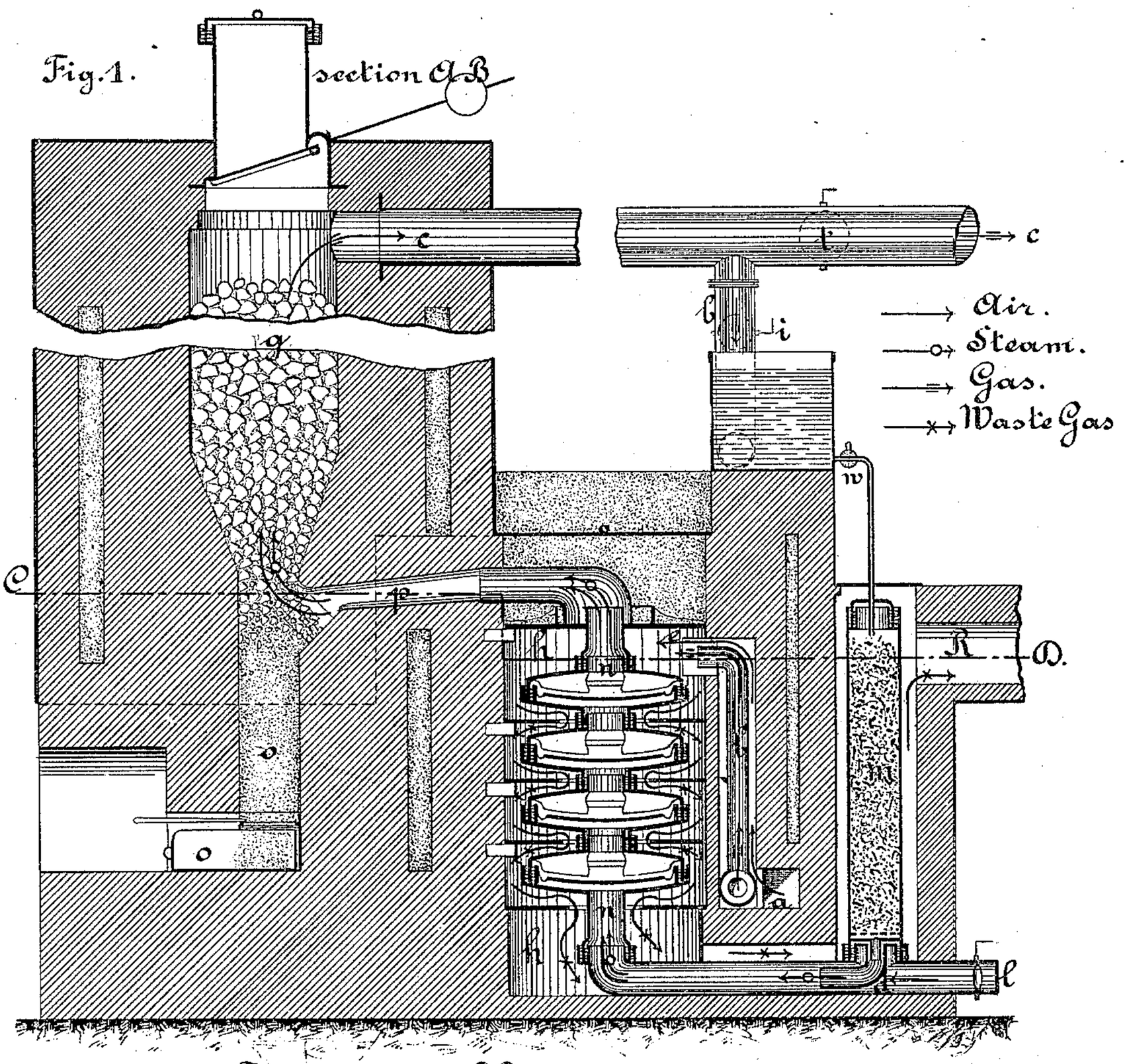
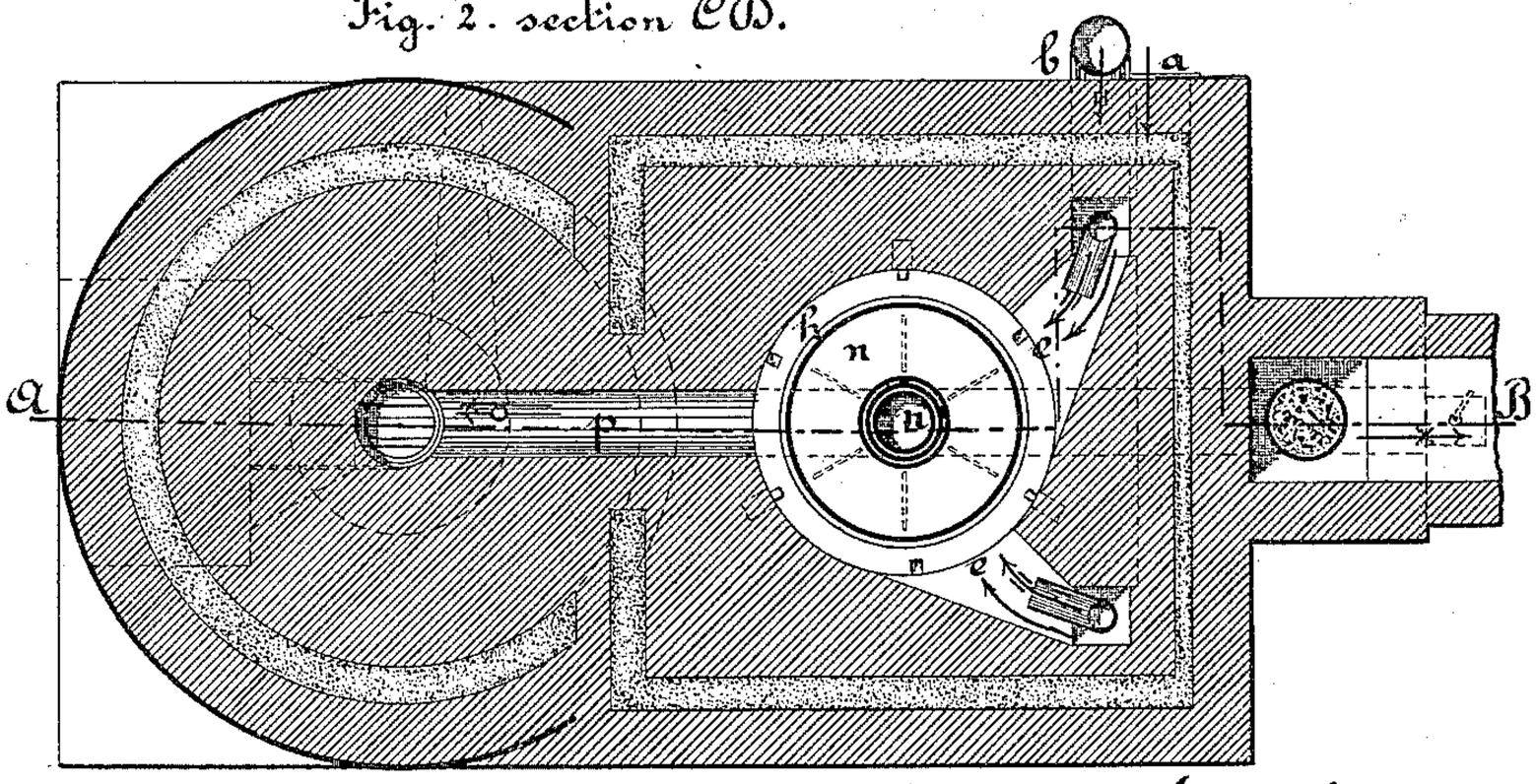


Fig. 2. section C D.



Witnesses
Solon C. Kemon
Chas. A. Pettit

Inventor
H. Haug
By Munn & Co
Attorney

UNITED STATES PATENT OFFICE.

HERMANN HAUG, OF DORTMUND, PRUSSIA, GERMANY.

PROCESS OF AND APPARATUS FOR PRODUCING HEATING-GAS.

SPECIFICATION forming part of Letters Patent No. 299,385, dated May 27, 1884.

Application filed March 1, 1883. (No model.) Patented in Germany August 16, 1879, No. 13,733; in France November 19, 1879, No. 133,733; in Belgium November 26, 1879, No. 49,927, and November 10, 1881, No. 56,196; in England July 19, 1881, No. 3,145, and in Austria January 15, 1882, No. 38,269.

To all whom it may concern:

Be it known that I, HERMANN HAUG, of Dortmund, in the Empire of Germany, have invented a new and useful Improvement in the Method of Producing Heating-Gases and in the Construction and Arrangement of Apparatus for this Purpose; and I do hereby declare that the following is a full, clear, and exact description of the same.

This invention relates, principally, to an improved method of generating combustible gases from crude carbonaceous materials, and to novel constructions and arrangements of apparatus for this purpose.

The essential novelty of this mode of obtaining combustible gases consists in the adoption of the following principles of working: The quantity and intensity of heat necessary for this process are produced, principally, by superheating to a high degree the converting agent, which may be steam or carbonic acid, or mixtures of them with air or with combustible gas. The crude carbonaceous material contained in a converting-chamber may at the same time be heated through the walls of this chamber. In case the above mixture with air be employed, the crude material is also heated by direct combustion. The superheating of the converting agent takes place in a separate heating apparatus heated by a portion of the gas produced in the converting-chamber by a portion of the chief product; and this is the main feature of my process, while in the Strong-Dwight apparatus merely the common generator-gas (the minor product) is employed for this purpose. The process of conversion merely starts with the production of common gas containing some seventy per cent. of nitrogen, as in Strong's apparatus; but the air required for this partial combustion is then mixed, within or out of a superheating apparatus, with a gradually-increased proportion of steam, so as to produce a gas containing less and less nitrogen. The increase of purity of the combustible gas increases the temperature of its flame within the heating apparatus, and consequently the converting agents are gradually superheated to a higher degree. This mutual increase of actions may be still more intensified by superheating the materials, air and gas, forming the flame within the heating apparatus until a maximum of effect is attained, and at last pure steam of highest temperature may be employed and a perfectly pure gas be produced. One part of the gas thus produced is consumed within the gas-furnace for carrying out the converting process, and the other part is available for external use.

The gas-furnaces adapted to the carrying out of this method of working consist of converting-chambers, the lower parts of which may be heated from the outside, and of superheating apparatus set below or beside the converters and provided with the superheated converting agents, while the combustion-chambers of the superheaters are supplied with a part of the product of the converters. The heating apparatus, "hot-blast" or "hot-steam" stoves, as they are called, for superheating the converting agents, are either of the reverse-current system acting continuously or of the heating-chamber system with two symmetrical sets of chambers, which may be filled with loose bricks, and which act alternately by means of valves, which reverse the currents of gases at regular intervals. The gas-furnaces are generally worked under low pressure or draft regulated by suitable slides or valves within the channels to the smoke-stack, and may be worked by an exhauster drawing off the gas from the converting-chambers; but the whole furnaces or their parts may also be constructed in metal casings, and they may be worked under high pressure. The gas-furnace with a reverse-current heating apparatus consists of a converting-chamber, a superheater, and a dry-steam generator instead of one of the common kind. The crude material to be treated is placed in the converting-chamber or converter, which is contracted at bottom, and may be surrounded at the contracted part and above it by a combustion-chamber or by flues. The converter is supplied with the superheated converting agent through flues or passages connected with the superheating apparatus. The upper part of the converter is in communication with a flue or passage, or with two of

them starting from the same or from different points, and from which the gas as it is produced may be drawn off by an exhauster or any other suitable device. Part of this gas is carried into the combustion chamber or chambers of the gas-furnace by one of the flues or tubes, which may be called the "branch passage," and which is provided with a valve or other suitable device. The other part of the gas is carried off for external use through the other or main passage, provided also with a suitable valve. The top of the converter is closed and provided with suitable means for supplying the crude material thereto. At the bottom of the converter there are suitable arrangements and a closed ash-pit to provide for the withdrawal of the exhausted material. The reverse-current steam-superheaters consist of two systems of tubes or passages (with walls between them common to both) of any suitable form and material. The one serves for the descending gas of the heating-flame and the other for the current of the gaseous converting agent, which enters at the coolest and leaves for the converter at the hottest part. Other pairs of such systems may serve for heating air or gas employed in forming the heating-flames for use throughout the gas-furnace. The dry-steam generators are arranged in those passages carrying the products of combustion from the superheater to the smoke-stack, and consist of vessels of metal of any suitable form charged with loose pieces of metal, or stone, or coke. Into the closed upper end water under pressure is allowed to enter in a regulated quantity. The steam thus produced with constancy and at a low pressure works an air-injector of suitable construction, and thus mixes itself with a regulated quantity of air before entering the steam-superheater, after which the heated mixture passes into the converter. Part of the steam necessary for the conversion may be generated, if desired, by the waste heat of the produced gas.

In the drawings is shown a furnace in which is combined a converter, a counter-current steam-superheater acting continuously, and a dry-steam generator, in which—

Figure 1 is a vertical section through the line A B of Fig. 2, and Fig. 2 a horizontal section through the line C D of Fig. 1. These figures show one way of constructing a gas-furnace of this kind.

g is the converting-chamber with ash-pit *o*, and upper appliances for supplying the crude material thereto. This converter may be provided with combustion-chambers at its lower part and heated from outside. The produced gas is allowed to pass off through the tube *c*, a branch, *b*, of which carries part of the gas into the combustion-chamber *h* of the steam-superheater. The gas-main, as well as the branch passage, is provided with suitable devices, *t* and *i*, for regulating or cutting off the current of the gas. The steam-superheater is a tube, *n*, of metal or fire-clay, with hollow projections containing baffle-plates and radial ribs. The converting agent is allowed to enter from below and pass through the passage *p* into the converter *g*. The parts of the tube may be jointed in any well-known suitable way. This tube *n* is situated within a chamber, *h*, from the walls of which plates reach between the projections of the tube *n*, in order to cause the heating-flame to pass close to its surfaces. The gas-branch *b* carries the gas into this chamber at *e*, while the air for its combustion passes in through the passages *a*. The descending flame passes into a horizontal passage and into the lower part of the smoke-stack R, within which the dry-steam generator *m* is placed. The water is supplied thereto by the drip-pipe *w*. The generated steam of low pressure works the injector *d*, which sucks the air past *l*, at which point its quantity can be regulated.

Such gas-furnace is worked in the following manner: The converter *g*, being filled with crude combustible material, is ignited from below. The ash-pit *o* and valve *t* of the gas-main *c* are closed and the valve *i* of the gas-branch *b* is opened. The draft of the smoke-stack then causes some air to pass from *l* around the injector *d*, (as yet inoperative,) through the tube *n* and the passage *p* into the crude material, to sustain its partial combustion. The resulting gas, containing some seventy per cent. of nitrogen, passes through *b* into the combustion-chamber at *e*. The descending flame first heats the tube *n*, then ascending heats the dry-steam generator *m*, and the waste gases escape at R into the smoke-stack. When the dry-steam generator has become hot enough, some water is let into it by the drip-pipe *w*. The generated steam works the injector *d*, and thereby is mixed with a quantity of air less than before was entering at *l*. The mixture of steam and air is superheated within the tube *n*, and, passing through *p* into the converter, produces a gas containing less nitrogen than before. This gas gives a flame of higher temperature within the combustion-chamber *h*. The previous heating of the air and gas within the walls of the furnace or within similar separate heaters causes also an increase of the temperature of the flame within the combustion-chamber. Now, successively more water is supplied to the dry-steam generator, and less air is allowed to enter at *l* and mix with the resulting steam until the maximum of the working capacity of the furnace in regard to quantity and purity of the gas is attained. At the same time the valve *t* of the gas-main *c* is gradually opened and the surplus of gas allowed to pass off for external use.

By cutting off the water-supply to the steam-generator, regulating the quantity of air entering at *l*, and closing the valve *t* of the gas-main *c* the production of gas for external use may be suspended.

What I claim as new is—

1. The process of producing heating-gases from crude carbonaceous materials, which consists, first, in starting the production of gas by the partial combustion of the crude material with cold air; second, in starting the heating of the superheaters by the combustion of the resulting gas, as a minor product, with some air; third, in replacing part of the air for the combustion of the crude material by steam (or its equivalent, carbonic-acid gas) and carrying this mixture (or merely the steam) through the superheater in order to superheat it before it enters the crude material, to produce from it a gas containing more combustible matter than before; fourth, in continuing to use part of this purer gas now turning to be chief product within the combustion-chambers of the superheaters, whereby their temperature and the temperature of the converting material to be superheated in them will increase, and will allow of the admixture of an increasing amount of steam to a diminished amount of air, so as to give a still more concentrated heating-gas, whereby there results a circle of chemical and physico-mechanical actions in which the increase of the purity of the converting agent being at last pure steam, (or carbonic acid, or mixtures of both,) the increase of the purity of the produced heating-gas, the increase of temperature of its flame within the superheaters, and the increase of temperature and degree of dissociation of the converting agent will react mutually until the maximum of effect as to purity of the heating-gas and as to the quantity of it available for external purposes be attained, the said steps being conducted in continuous operation, as described.

2. The combination of the following elements: the generator *g*, provided with pipe *c*, and branch pipe *b*, the continuously-acting counter-current steam-superheater *n*, opening at the top into the generator *g*, the surrounding chamber *h*, having communication with the branch pipe *b*, and air-inlets at the top, and the dry-steam generator *m*, placed in the smoke-stack, and provided with a water-supply above, and an air-injector below communicating with the interior of the steam-superheater *n*, substantially as and for the purpose described.

HERMANN HAUG.

Witnesses:
E. H. OSTENDORFF,
FRIEDR. FLÜGEL.