

H. KOPPERS.

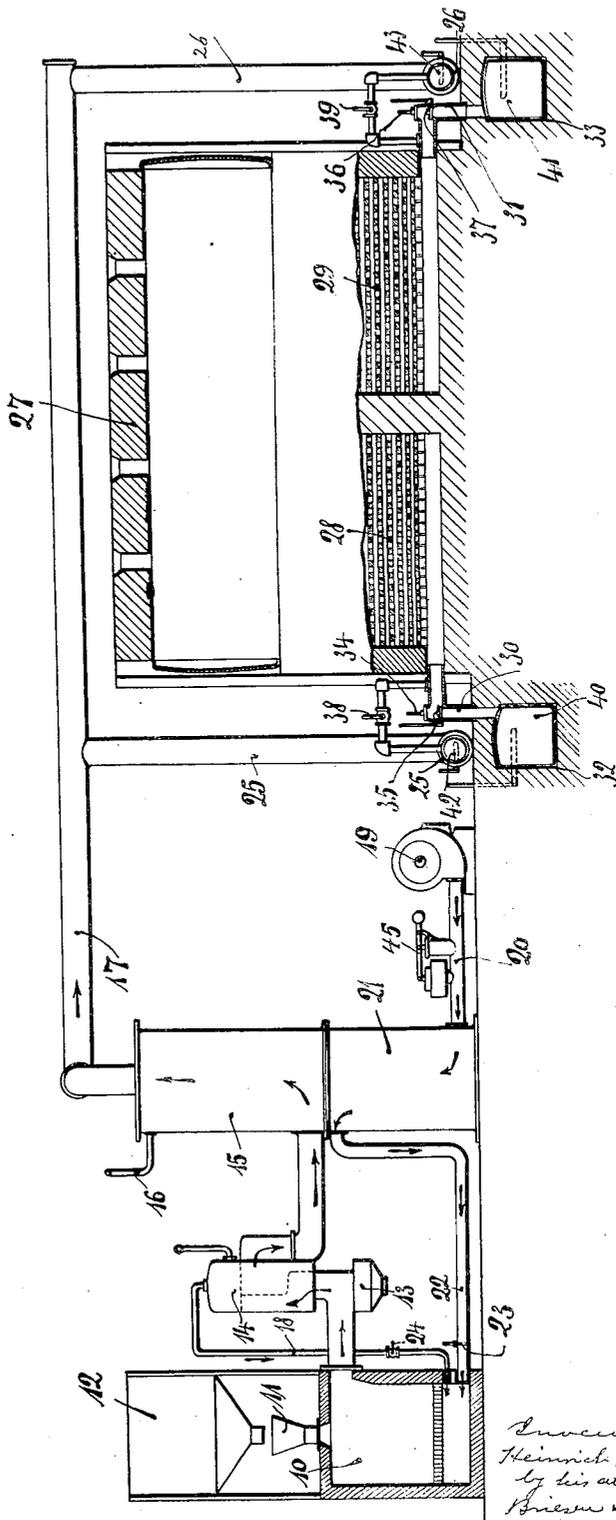
METHOD OF OPERATING FURNACE AND OVEN APPARATUS WITH RECOVERY OF HEAT.
APPLICATION FILED JULY 27, 1914.

Patented Nov. 13, 1917.

2 SHEETS--SHEET 1.

1,246,114.

Fig. 1



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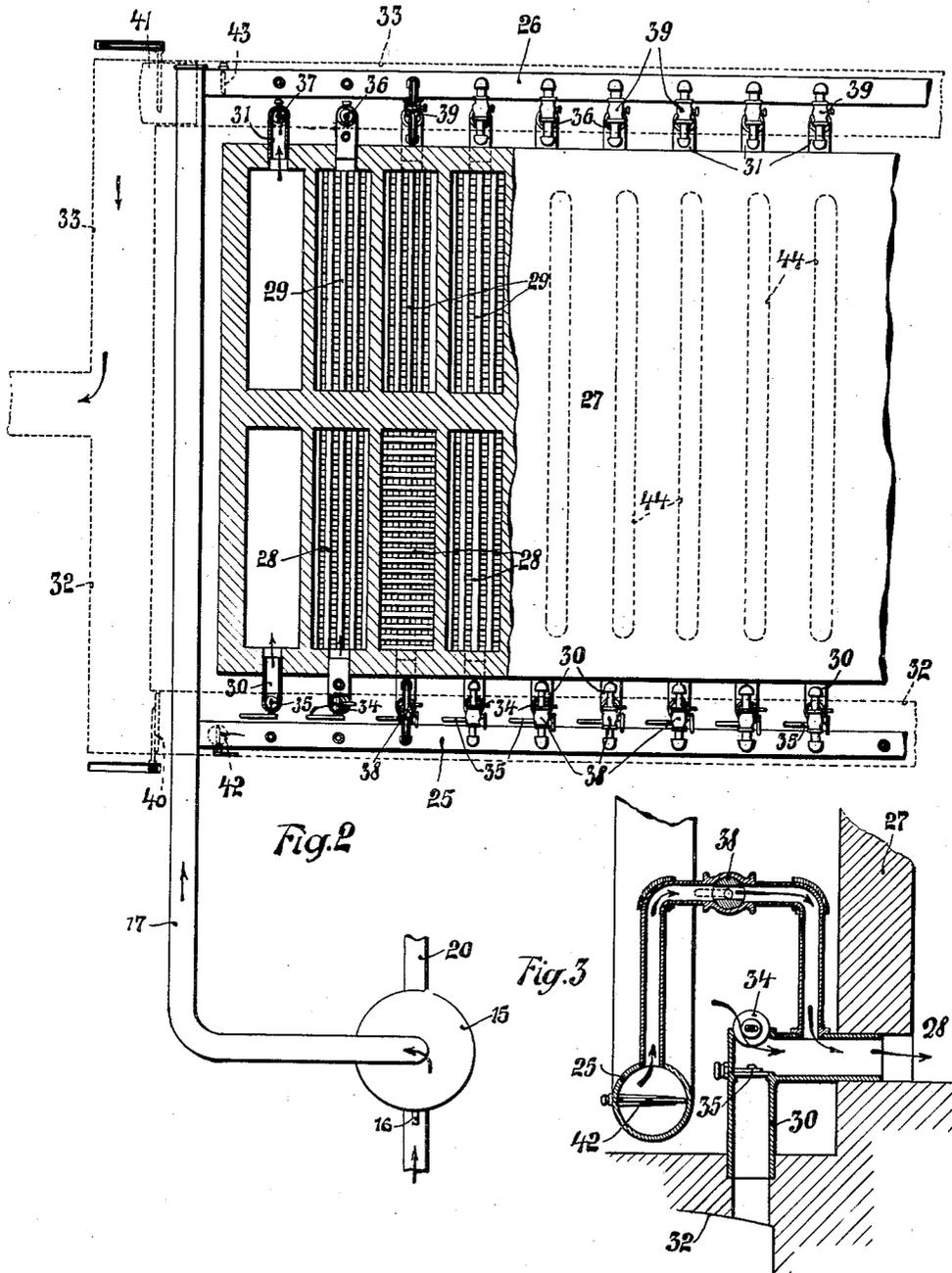
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UNITED STATES PATENT OFFICE.

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METHOD OF OPERATING FURNACE AND OVEN APPARATUS WITH RECOVERY OF HEAT.

1,246,114.

Specification of Letters Patent.

Patented Nov. 13, 1917.

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To all whom it may concern:

Be it known that I, HEINRICH KOPPERS, a citizen of the German Empire, residing at Essen-on-the-Ruhr, in Germany, have invented a certain new and useful Method of Operating Furnace and Oven Apparatus with Recovery of Heat, of which the following is a specification.

This invention relates to a method of operating the reversal in furnace and oven apparatus, for the production of glass, iron, steel, gas, coke and the like, working with recovery of heat (regeneration) and heated by gas producers directly connected thereto. During the interval arising from the operation of the valves of the regenerator apparatus the production of gas is interrupted and the chambers filled with gas are closed at both sides or ends, and thus kept filled. The gas is only generated during the period of use, and risk of explosion, due to entrance of air and escape of gas, is avoided.

The usual manner of operating the reversal, in furnaces and ovens of this class, is to cut off the supply of heating gas, then operate the valves controlling the currents of air and products of combustion, and then, after an interval during which the chambers may become filled with air, to turn on the gas again. During these operations, occupying some minutes, no supply of gas is required, and if the gas producer continued to work an increase of pressure would occur, liable to cause the gas to enter other chambers, which would not only cause loss, but would give rise to risk of explosion. It would be possible to effect a storage of gas during this period, by providing a gas holder for this purpose, but apart from the high cost involved the holder would require to be constantly watched, in order that at the time of reversal it would be ready to receive the gas, the cylinders or containers being at the ends of their paths.

The most simple manner of effecting the stoppage of gas production, for the interval of reversal, is to cut off the supply of air to the bottom of the producer, whereupon the production of gas, dependent on this supply, ceases. In order that during the interval there is no exchange of air for gas or vice versa, all the chambers filled with gas are closed, and are kept filled with gas, both in the producing and in the consuming

apparatus. This obviates all risk of explosion, because when the supply is resumed the gas in the consuming apparatus immediately ignites against the hot brickwork of the oven or furnace, and combustion takes place at the rate at which the air and gas meet; no explosion can occur. It is well known that explosions only occur if a certain volume of an explosive mixture of gas and air is formed before ignition takes place.

Apparatus for carrying the invention into effect is shown in the accompanying drawing in which—

Figure 1 is a side view partly in section of a plant embodying my invention, showing the latter applied to a retort oven for producing gas and coke;

Fig. 2 a plan partly in section of the oven proper and cooperating parts, and

Fig. 3 an enlarged section through one of the gas and air connections of the regenerators.

10 is a gas producer of any convenient type, with a hopper 11 for charging it with fuel from the fuel holder 12. 13 is a suction appliance for removing dust, and 14 a steam boiler heated by the hot gas. 15 is a washing tower, in which the gas is washed by water supplied through a pipe 16. 17 is the gas pipe leading to the consuming apparatus. From the boiler 14 a pipe 18 leads to the space below the grate of the gas producer 10. The blower 19 forces air through the pipe 20 to the saturator 21, wherein the air is saturated with moisture derived from the hot water coming from the tower 15, and the saturated air passes through the pipe 22 to the space under the grate of the producer 10. 23 and 24 are valves controlling pipes 22 and 18 respectively. The gas producer may be designed in accordance with the usual practice, and does not in itself constitute part of the invention.

To the pipe 17 are joined two branch pipes 25, 26, which extend down the sides of the retort 27. Below the latter are the regenerators 28, 29, connected by conduits 30, 31 to flues 32, 33 leading to the chimney (not shown). The conduit 30 has an air-valve 34 and a throttle valve 35, the conduit 31 having similar valves 36 and 37. The pipe 25 is connected by branch pipes to the regenerators 28, the said branch pipes being controlled by valves 38, and the pipe 26

is connected to the regenerators 29 by branch pipes controlled by valves 39. The flues are provided with dampers 40 and 41. This construction of the oven apparatus is merely
5 given as an example, and can be varied.

The manner of working the apparatus is as follows.

Air is blown by the blower 19 into the gas producer 10, charged with fuel from the holder 12, this air being mixed with steam and taking part in the production of gas in the known manner. The gas generated flows past the boiler 14 and is washed and cooled in the tower 15 before flowing
15 to the consuming apparatus. The steam generated in the boiler 14 flows with the air through the grate of the gas producer.

The heating gases flow in the oven apparatus alternately from right to left and from
20 left to right, each phase lasting about half an hour.

It will be understood that on the side on which the air and gas are admitted (say the left hand side containing the regenerators
25 28), alternate regenerators serve for preheating gas and air respectively, according to the well-known procedure. That is to say, for instance, the first, third, fifth, etc., regenerator 28 will have the corresponding
30 gas valves 42, 38 open, and the air valves 34 closed, while the intermediate (second, fourth, etc.) regenerators 28 will have their air valves 34 open and their gas valves 42, 38 closed. All the throttle valves 35 and
35 the damper 40 on this side of the oven would be closed at this stage, that is, the flue 32 is not connected with the regenerators. The air and gas pass respectively through alternate regenerators 28 and absorb some of the
40 heat stored therein from a previous operation or stage, in the usual way. The heated air and gas are then delivered to the customary heating flues (not shown) in which combustion takes place. From these heating
45 flues the combustion gases pass through the connecting channels 44 (Fig. 2) to the regenerators 29 at the other side of the oven. At this stage, the regenerators 29 have their
50 gas valves 39, 43 and their air valves 36 closed, while their valves 37 and the damper 41 are open so that the combustion gases can pass from the regenerators 29 through the conduits 31 to the flue 33 and to the stack.

After about half an hour conditions are reversed by a proper manipulation of the valves, so that alternate regenerators 29 will serve for preheating gas and air respectively, while the combustion products will
60 pass through the regenerators 28 and conduits 30 to the flue 32 and the stack. This manipulation will be effected in regular order, so as to first close the gas supply pipe 25, and then attend to the air valves and
65 throttle valves. After a period during

which the oven becomes filled with fresh air the gas supply pipe 26 is opened, and the gas supplied by the same is preheated in some of the regenerators 29, while the air is preheated in the other regenerators 29, and
70 the mixture is burnt in the heating flues of the oven, as usual.

During the period of a few minutes elapsing between the closing of the pipe 25 and the opening of the pipe 26 the production
75 of gas is interrupted, for which purpose the valve 23 in the pipe 22 is closed. The blower 19 may continue to work, but it is advisable to provide the pipe 20 with a discharge valve 45, which is opened when the valve 23
80 is closed. This discharge valve may be an automatic valve, which opens at a predetermined pressure. In order that the air space between the fuel layer producing gas, and the valve 23, is as small as possible, to
85 reduce the risk of producing an explosive mixture, the valve 23 is placed close to the producer 10.

Generally speaking the production of gas is proportional to the supply of air to the
90 producer, but after the supply of air is cut off the producer continues for a short period to supply gas. In order to prevent excessive pressure in the closed receptacles, due to this production of gas, it is advisable to cut
95 off the air supply as quickly as possible, but not to close the gas outlet until after an interval corresponding to that during which the production of gas continues.

With this method of operation gas is only
100 supplied when it can be usefully employed for heating, that is to say after the whole oven system has become filled with pure air after the reversal. The interval between the cutting off of the gas supply, and the
105 assumption thereof, can without risk or loss be made sufficiently long to allow the system to be washed out, as it were, with pure air, so that when the gas is turned on perfect combustion thereof can at once take
110 place. This interval does not constitute an interference with the heating of the oven; on the contrary, the heating efficiency or economy is increased. At the end of the heating period of about 30 minutes the re-
115 generators which have been receiving products of combustion are so hot that some of their heat can flow to the material to be heated, in the example given, coal. In this way gas is saved, and the products of combustion pass to the chimney at a somewhat
120 lower temperature, so that a saving of heat is effected.

I claim:

1. In operating a regenerative furnace
125 with the alternate connection of the same producer with two groups of regenerators, the method of effecting a draft reversal which consists in interrupting the production of gas within the gas producer during
130

the change of the position of the gas valves, air valves and waste gas valves.

2. In operating a regenerative furnace with the alternate connection of the same
5 producer with two groups of regenerators, the method of effecting a draft reversal which consists in interrupting the air supply to the gas producer to stop the production of gas therein, and changing the position
10 of the gas valves, air valves and waste gas valves during such stoppage of gas-production.

3. In operating a regenerative furnace heated by producer gas, the method of effecting a draft reversal which consists in
15 interrupting the air supply to the gas producer to stop the production of gas therein, then cutting the furnace off from the gas producer, changing the position of the air valves
20 and waste gas valves of the furnace, and reconnecting the furnace and the air supply to the gas producer.

4. In operating a regenerative furnace heated by producer gas, the method of effect-

ing a draft reversal which consists in inter- 25 rupting the air supply and steam supply to the gas producer to stop the production of gas therein, cutting the furnace off the gas producer, changing the position of the air
30 valves and waste gas valves of the furnace, and reconnecting the furnace and the air and steam supply to the gas producer.

5. In operating a regenerative furnace heated by producer gas, the method which consists in producing a continuous current 35 of air, directing said current periodically to the producer and between said periods diverting the air current from the producer so as to stop the production of gas therein, then cutting the furnace off from the gas
40 producer, changing the position of the air valves and waste gas valves of the furnace, and thereupon reconnecting the furnace and the air-supply to the gas producer.

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