F. MEYER.

REGENERATIVE FURNACE.

APPLICATION FILED OCT. 24, 1905.

958,150.

Patented May 17, 1910.

3 SHEETS—SHEET 1.

Fig. 1.

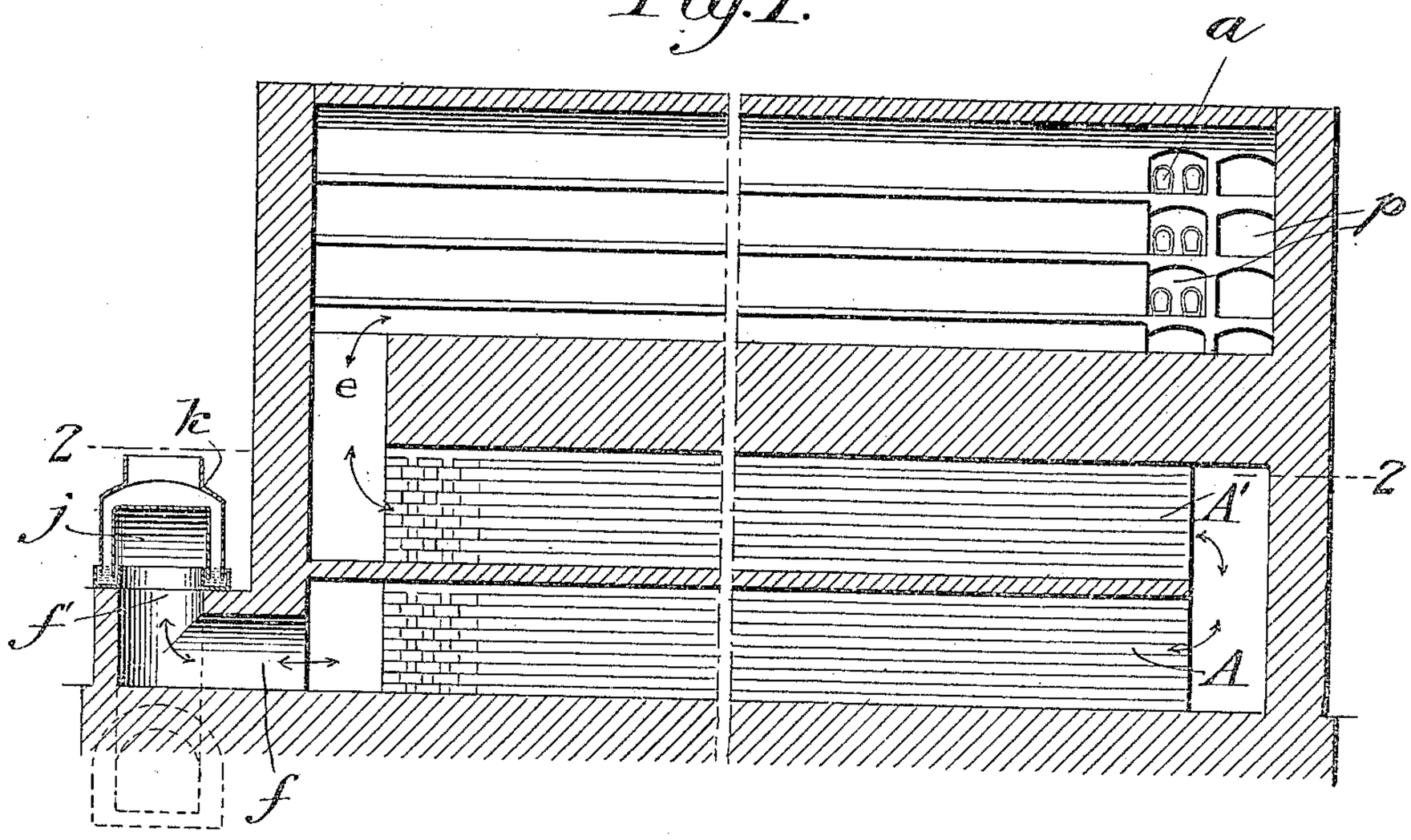
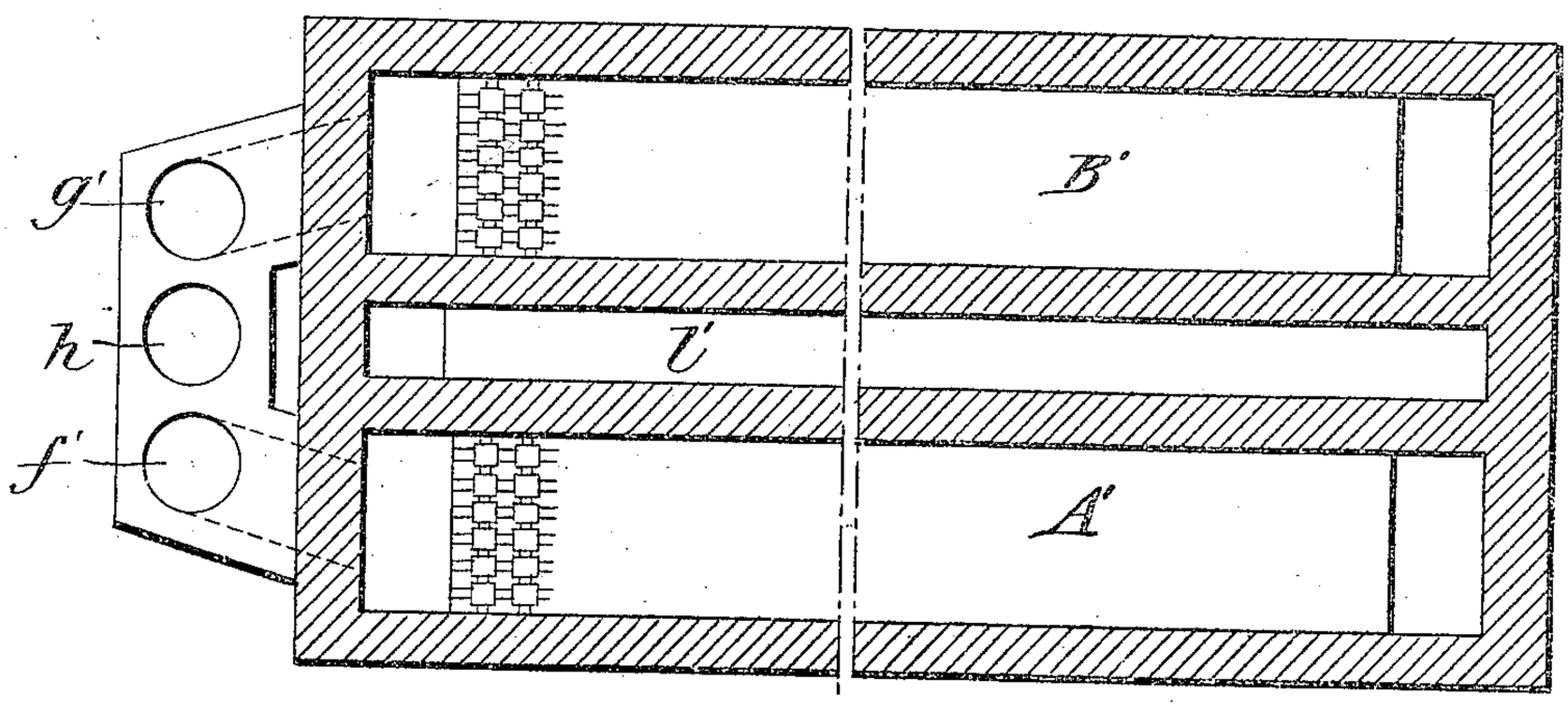


Fig. 2.



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3 SHEETS—SHEET 2.

Fig. 3.

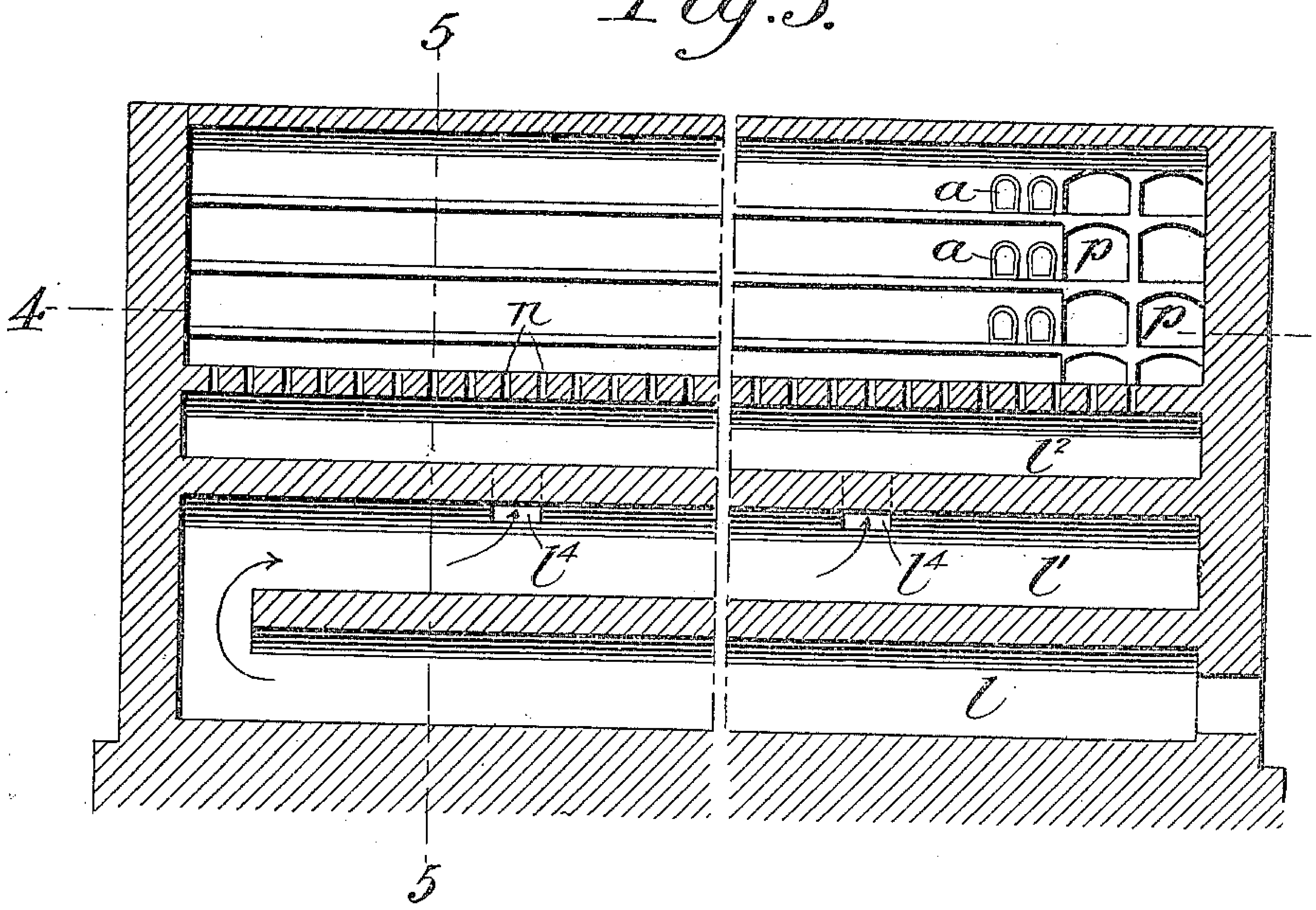
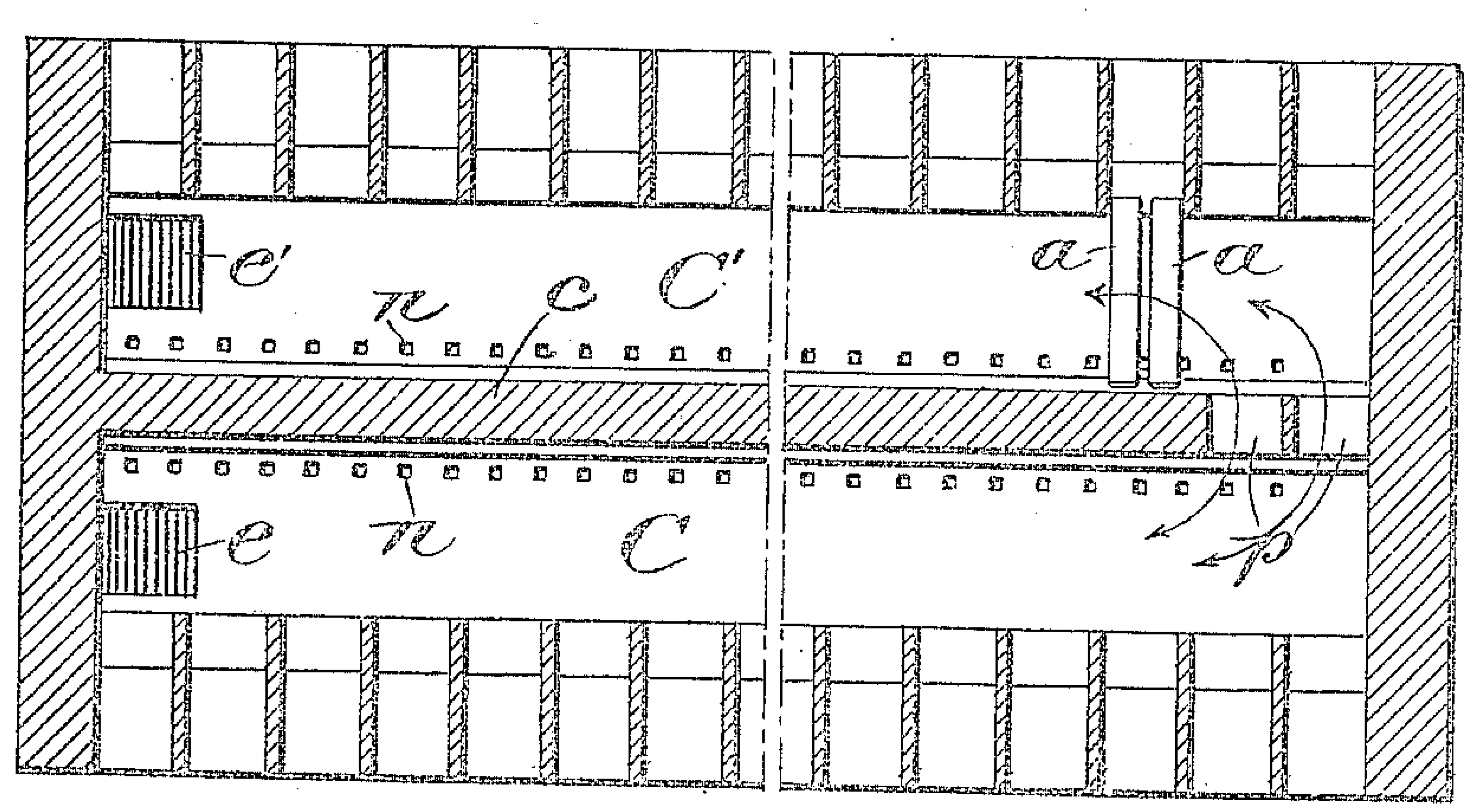


Fig. 4.



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3 SHEETS—SHEET 3.

Fig. 5.

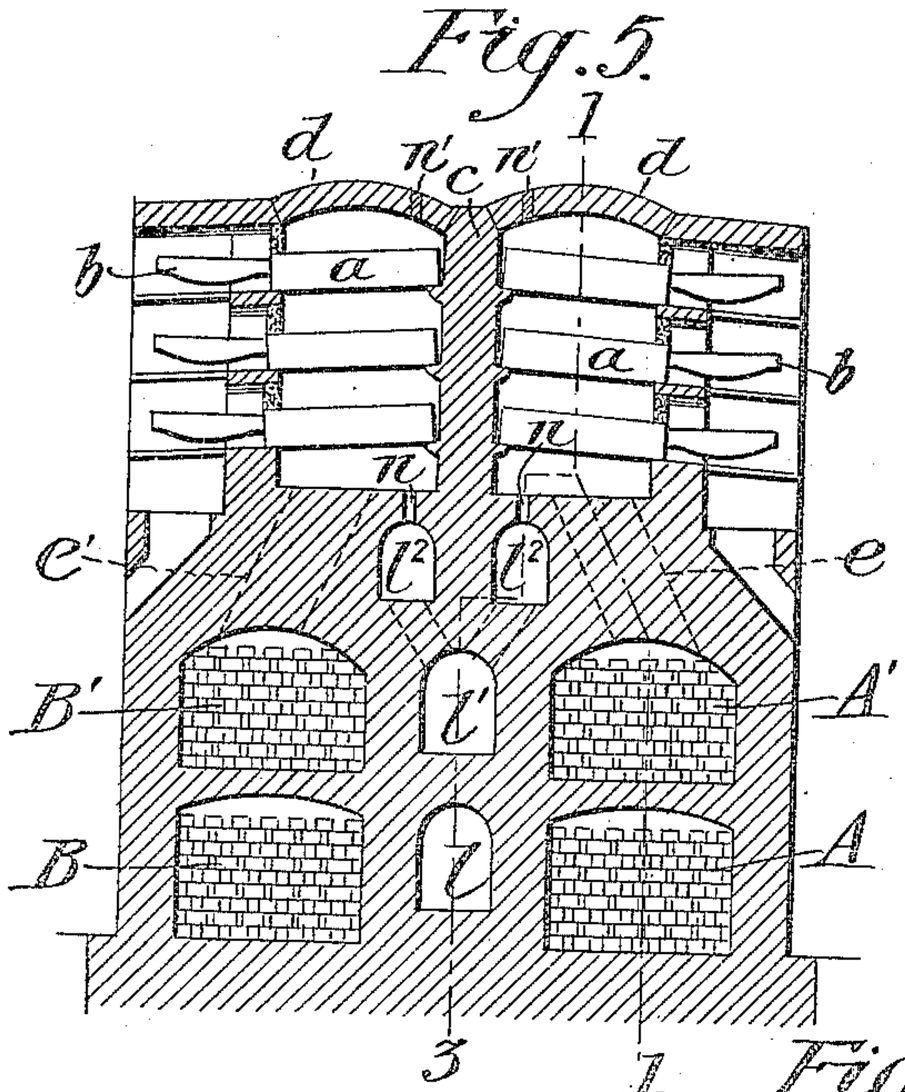


Fig. 6.

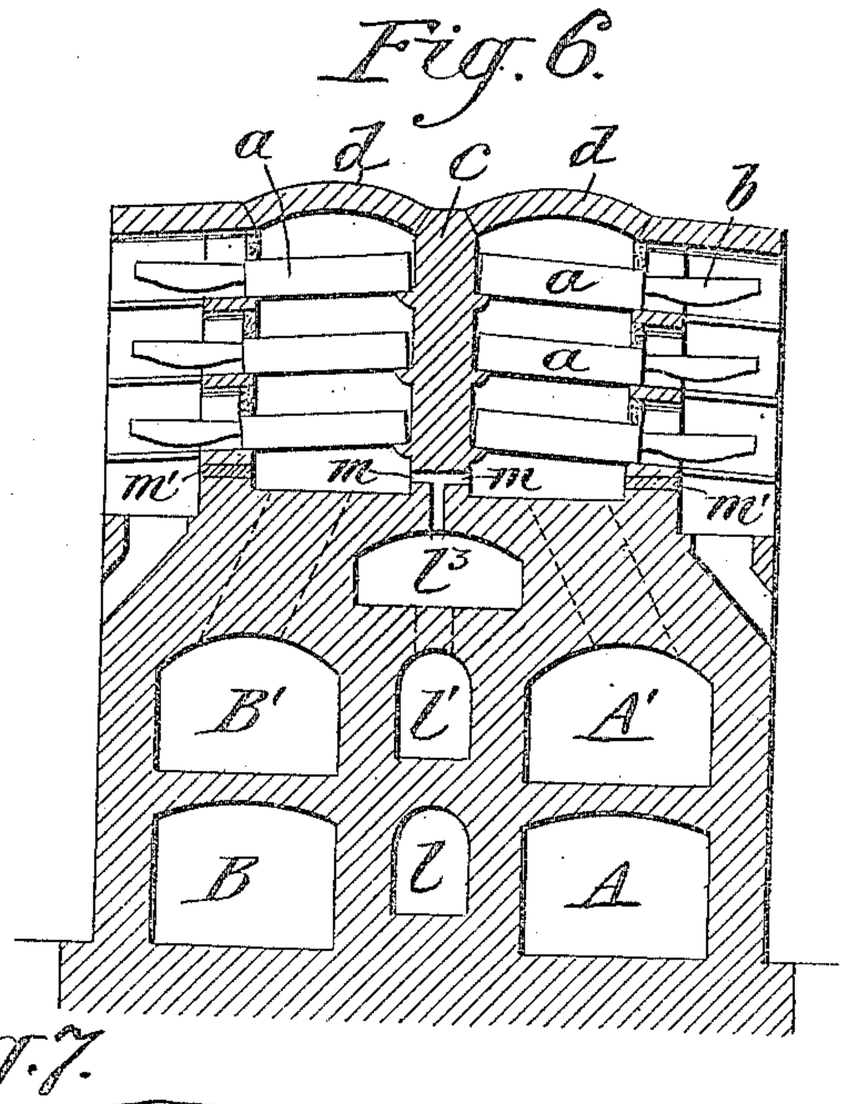
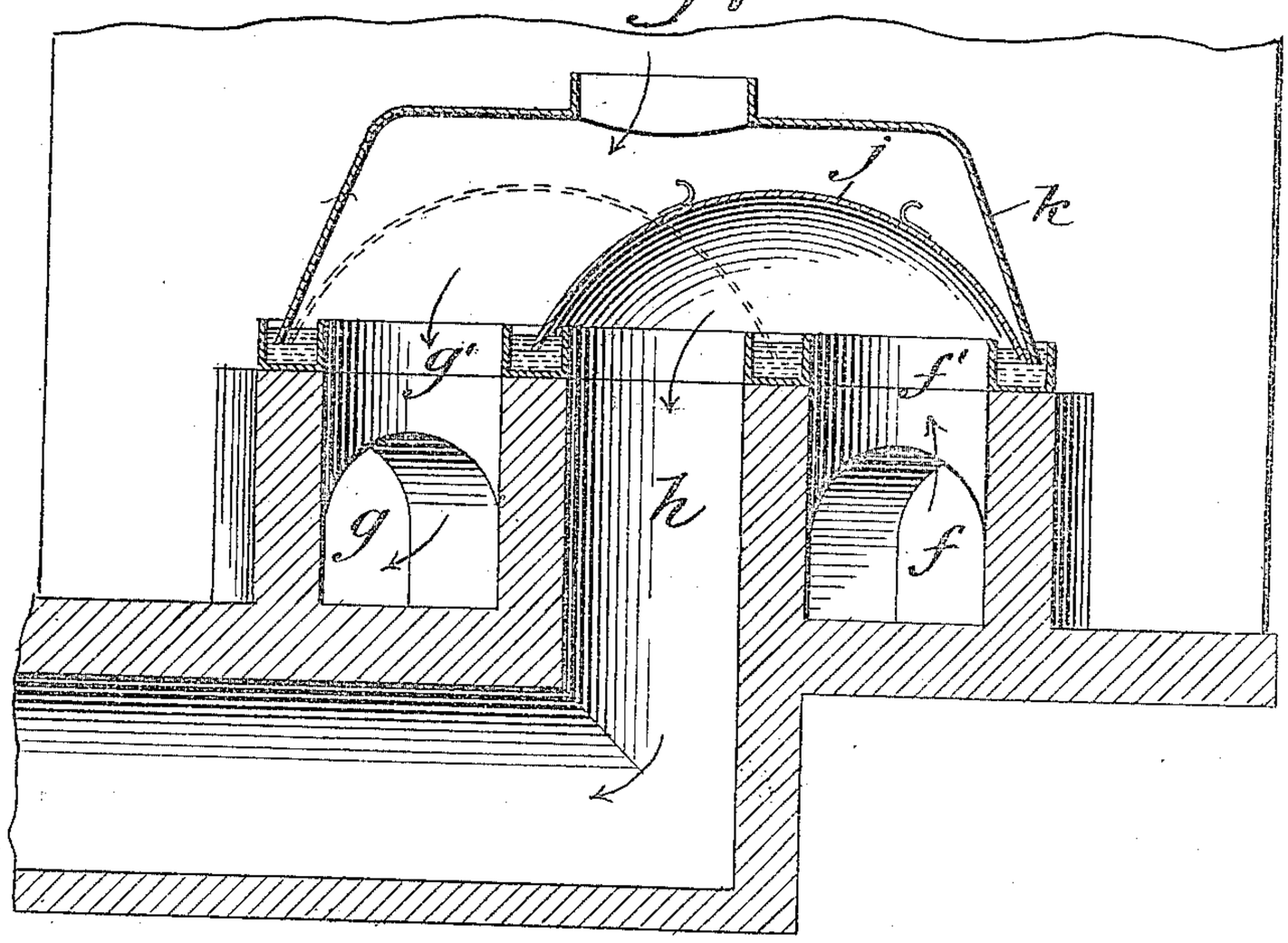


Fig. 7.



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UNITED STATES PATENT OFFICE.

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REGENERATIVE FURNACE.

958,150. Specification of Letters Patent. Patented May 17, 1910.

Application filed October 24, 1905. Serial No. 284,204.

To all whom it may concern:

Be it known that I, FRANZ MEYER, a subject of the Emperor of Germany, residing in Englewood, county of Bergen, State of New Jersey, have invented certain new and useful Improvements in Regenerative Furnaces; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to regenerative furnaces for heating retorts, muffles, crucibles, and other vessels for the distillation of zinc or for other purposes, and has for its object to provide means for heating the vessels in an even and continuous manner.

The main features of the construction may be briefly identified as follows; the combustion chamber of the furnace is made up of two long flue-like compartments, separated from each other by a central dividing wall or partition, except at one end, where the two compartments communicate with each other. The fuel gas rises into these compartments through openings arranged between the vertical rows of the vessels on opposite sides of the central wall. The gas burns completely with air, which is admitted alternately into one or the other of the two compartments, at one end thereof. The products of combustion from the first compartment, together with the requisite excess of air, pass into the second compartment, and having traversed the second compartment, from end to end thereof, pass out, together with the additional products of combustion, due to the burning of the gas in the second compartment. On their way to the chimney stack, the products of combustion pass through regenerator chambers, having the usual checker-work filling of fire brick or the like, and give up their heat to the fire brick filling. The regenerator chambers are arranged in two different sets or pairs, and a single reversing valve is so located with respect to the passages leading into and out of these regenerator chambers that, in one position of adjustment of the valve, the incoming air is conducted through one set of regenerator chambers and thence into one of the combustion chamber compartments, and after traversing that compartment from the inlet end to the opposite end thereof, traverses the second combustion chamber compartment in the opposite direction, burning the gas in the two compartments, and then passing through the other regenerator chambers, finally enters the flue leading to the chimney stack. By reversing the valve, the course of the air and the products of combustion will be correspondingly reversed with respect to the sets of regenerator chambers, and the combustion chamber compartments.

The main characteristic feature of the invention consists in dividing the combustion chamber into two compartments, these compartments communicating with each other at one end and having suitable fuel gas inlets disposed along their length on opposite sides of the central wall, and each having an air inlet at or near the end opposite to that at which they communicate, these air inlets serving also alternately as outlets for the waste products of combustion, according to the location or adjustment of a reversing valve which determines the course of flow of the air and products of combustion into and from two sets of regenerators connected respectively to the said compartments.

In the accompanying drawings, Figure 1 represents a longitudinal vertical section of a furnace embodying my invention, taken on a plane indicated by the line 1—1 of Fig. 5. Fig. 2 represents a longitudinal horizontal section, taken on a plane indicated by the line 2—2 of Fig. 1. Fig. 3 represents a longitudinal vertical section, taken on a plane indicated by the line 1—3 of Fig. 5. Fig. 4 represents a horizontal longitudinal section taken on a plane indicated by the line 4—4 of Fig. 3. Fig. 5 represents a vertical cross section taken on a plane indicated by the line 5—5 of Fig. 3. Fig. 6 represents a like view, showing certain minor modifications in the arrangement of the fuel gas passages. Fig. 7 represents, on a somewhat larger scale, the location of the reversing valve with respect to the passages which it controls.

Similar letters of reference indicate similar parts throughout the several views.

Referring to the drawings, it will be noted that they represent the application of the invention to the heating of retorts *a* of the kind used in the ordinary "Belgian" retort furnaces for the distillation of zinc, the retorts being shown in the customary inclined position and with the usual con-

densers *b* at their ends. As is not unusual in Belgian furnaces of this type, the retort furnace is divided into two compartments by a central wall or partition *c*, which is provided with the customary ledges for supporting the inner ends of the retorts, the outer edges of the retorts being supported upon the outer walls of the two compartments, as fully appears in the drawings. The retort chambers or compartments are spanned by vaulted roofs *d*, as shown in Figs. 5 and 6, or these individual vaulted roofs may be replaced by a single vaulted roof, as will be evident. The condensers may be provided with the usual prolongs, and as indicated in Figs. 5 and 6, the retorts or muffles are to be luted at their outer ends to prevent the ingress of air, in the manner customary to the working of Belgian furnaces for the metallurgy of zinc, and they may be of any preferred length and cross section.

At one end of each of the compartments of the retort furnace is located an opening or passage *e*, *e'*, communicating respectively with the regenerator chambers A, A' and B, B', these regenerator chambers being preferably, though not necessarily, below or subjacent to the retort furnace chambers. The set of regenerators A, A', communicates with a passage *f*, forming a continuation of the passage *f'*; and, in like manner, the set of regenerators B, B', communicates with a passage *g* forming a continuation of the passage *g'*. The passages *f'* and *g'* are arranged adjacent to a flue *h* which leads to the chimney stack, and the upper ends of the several passages *f'*, *g'* and *h* are controlled by a reversing valve *j*, which preferably dips at its edges into a body of water, so as to make a gastight joint. A cap *k*, similarly sealed at its lower edges, is in free communication at its top with the open air. The details of construction of this reversing valve are indicated in Fig. 7, and are not, of themselves, of my invention, being well known to the art under the name of the Forter gas reversing valve. It will, therefore, be understood that instead of employing this particular kind of reversing valve for controlling the three passages *f'*, *g'* and *h*, I may employ any equivalent reversing valve having like functions.

As will be hereinafter more fully pointed out, the location of the reversing valve *j*, either in the adjustment shown in full lines or in the adjustment shown in dotted lines, determines whether the incoming air shall enter the one set of regenerators A, A', or the other set of regenerators B, B' and consequently whether the passage *e* or *e'* is to be the air inlet. The fuel gas (see Fig. 3), enters from the producer main into tortuous passages *l*, *l'* located between the two sets of regenerators, and, by reason of its location, is somewhat preheated before entering the retort chamber. From *l'*, the gas may be received into two separate chambers l^2, l^2, as shown in Fig. 5, or into a single chamber l^3, as shown in Fig. 6, appropriate openings or passages l^4 (see Fig. 3) serving as means of communication from *l'*. On each side of the dividing wall is located a longitudinal series of fuel gas inlet openings *n* (Fig. 5) or *m* (Fig. 6), as the case may be. The openings *n* are arranged so as to be in line with the space between the retorts, in which position they may be readily kept clear by means of a tool inserted through corresponding openings *n'* (normally plugged) in the top roof or vault of the furnace. Where, as in Fig. 6, the openings *m* issue laterally from the base of the dividing wall, they may be kept clear by a tool inserted through the normally plugged openings *m'* in the outer walls of the furnace. The compartments C, C', at the end opposite to the passages *e*, *e'*, communicate freely with each other, preferably by means of a series of vaulted openings *p*, this vaulted construction being adopted for the purpose of enabling the vaulted portions of the openings or passage-ways to sustain the weight of the inner ends of retorts, as indicated in Fig. 1, so that the capacity of the furnace, and consequently its output, may not be cut down, which would be the case if the series of small openings *p* were supplanted by a single large opening extending from top to bottom of the dividing wall.

Assuming that gas is supplied in proper quantity from the producer, it enters the passage *l*, and, following the course indicated by the arrows in Fig. 3, it passes into the passage *l'*, and thence through the exit openings l^4 into the two distributing chambers l^2 (Fig. 5), or into the single distributing chamber l^3 (Fig. 6). In traversing these passages and the distributing chamber or chambers referred to, the gas becomes more or less preheated by conduction from the brickwork of the regenerator, and finally issues into the compartments of the retort chamber through the fuel gas inlets *n* or *m*, as the case may be. In the meantime, air entering through the cap *k*, and passing the reversing valve *j*, enters one or the other of the two sets of regenerator chambers, as, for instance, the set of regenerator chambers B, B', finally issuing through the up-take passage *e'* into the corresponding compartment C', where it meets the gas issuing from the series of fuel gas inlets *n*, and supplies oxygen for its combustion. The amount of air supplied is in appropriate excess, and the products of combustion from the compartment C', pass through the openings *p* into the compartment C, together with a sufficient quantity of air to effect the combustion of the gas issuing from the gas inlet openings

in said second compartment. The complete products of combustion thereupon pass downwardly through the passage *e*, and thence through the regenerator chambers A, A′, and finally through the passages *f*, *f*′, into the down-take *h* leading to the chimney stack. When the brickwork of the regenerators B′, B, has parted, to the desired degree, with the heat stored therein, the valve *j* is reversed. The course of the entering air and of the products of combustion is, therefore, reversed correspondingly, the air entering the regenerator chambers A, A′, and passing through the up-take *e* into the compartment C. Thence the products of combustion from the compartment C pass into the compartment C′, together with an excess of air, as before, and the combined products of combustion thereupon pass downward through the passage *e*′ into the regenerators B′, B, and thence through the passages *g*, *g*′ to the down-take *h*, and finally to the chimney stack. The double pointed arrows, in Figs. 1, 3 and 4, indicate the alternate direction of flow of the air and gases during these successive periods of the operation. In like manner, the operation of the furnace continues, with alternate reversals of the valve, until the distillation of the material in the retorts or muffles is completed to the desired degree.

For convenience, and to avoid repetition, I have just described the application of the invention to the heating of retorts or muffles used in the metallurgy of zinc. It will be understood, however, that it is equally applicable to the heating of retorts or muffles used for other purposes, and to the heating of similar vessels or receptacles used for metallurgical and like purposes, as, for instance, crucible of various kinds.

Having thus described my invention, what I claim is:—

1. A regenerative furnace for heating retorts, muffles, crucibles and other vessels, consisting of a combustion chamber divided into two compartments having fuel-gas inlets, said compartments being arranged side by side and communicating with each other at one end, and each communicating at the other end with a corresponding regenerator, and means for alternating the direction of flow of air and products of combustion with respect to the regenerators and consequently with respect to the compartments of the combustion chamber; substantially as described.

2. A regenerative furnace for heating retorts, muffles, crucibles, and other vessels, consisting of a combustion chamber divided into two compartments by a partition wall and having a series of gas inlets on each side of said wall, said compartments communicating with each other at one end, and each communicating at the other end with a corresponding regenerator, and means for alternating the direction of flow of air and products of combustion with respect to the regenerators and consequently with respect to the compartments of the combustion chamber; substantially as described.

3. A regenerative furnace for heating retorts, muffles, crucibles, and other vessels, consisting of a combustion chamber divided into two compartments by a partition wall and having fuel gas inlets, said compartments communicating with each other at one end by means of a series of vaulted apertures which serve to support some of the vessels, and each compartment communicating at the other end with a corresponding regenerator, and means for alternating the direction of flow of air and products of combustion with respect to the regenerators and consequently with respect to the compartments of the combustion chamber; substantially as described.

4. A regenerative furnace for heating retorts, muffles, crucibles, and other vessels, consisting of a combustion chamber divided into two compartments by a partition wall, and having fuel gas inlets, said compartments being arranged side by side and communicating with each other at one end, and each communicating at the other end with a corresponding regenerator through down-takes which serve alternately as up-takes for the admission of air to said compartments respectively, and a reversing valve by means of which each of said regenerators can be connected either with the chimney flue or with the atmosphere; substantially as described.

5. A regenerative furnace for heating retorts, muffles, crucibles and other vessels consisting of a combustion chamber divided longitudinally into two compartments communicating with each other at one end, a corresponding regenerator connected to each compartment at the opposite end, means for admitting fuel gas to said combustion chamber and means for alternating the direction of flow of the products of combustion with respect to the regenerators and consequently with respect to the compartments of the combustion chamber.

In testimony whereof I affix my signature, in presence of two witnesses.

FRANZ MEYER.

Witnesses:
F. G. Hartmann,
C. M. Hart.