

(No Model.)

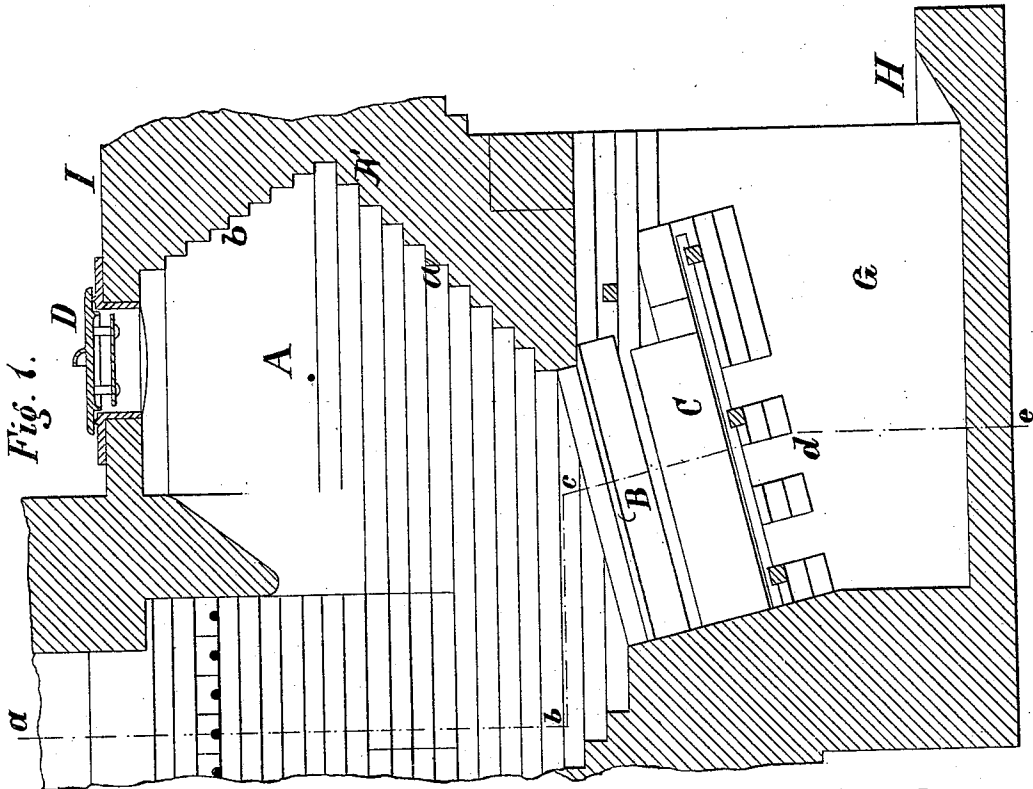
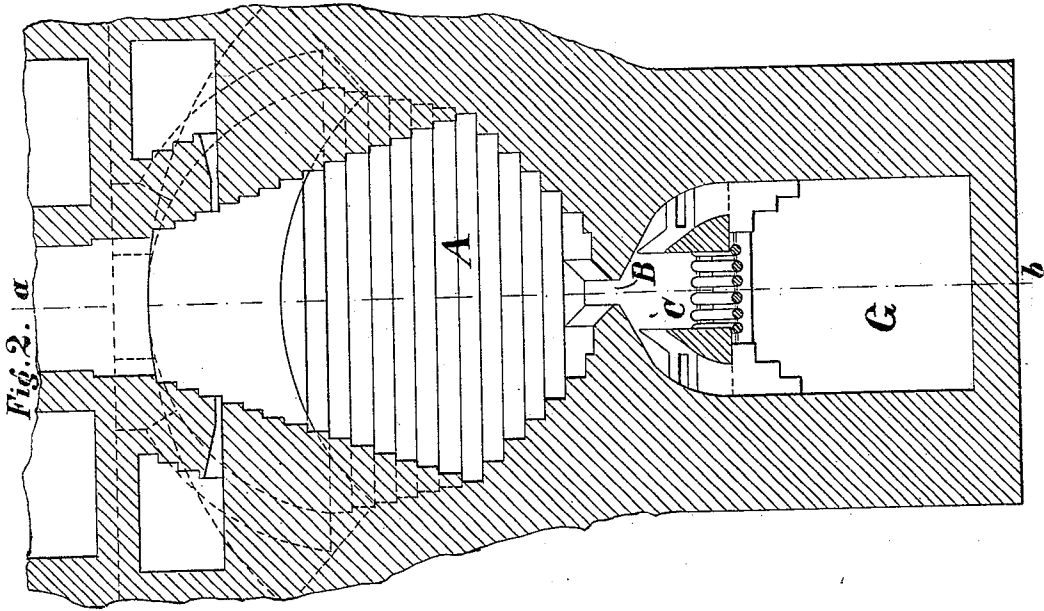
4 Sheets—Sheet 1.

G. LIEGEL.

Gas Generating Furnace.

No. 242,547.

Patented June 7, 1881.



Witnesses  
W. S. Fitch  
Henry Gilling

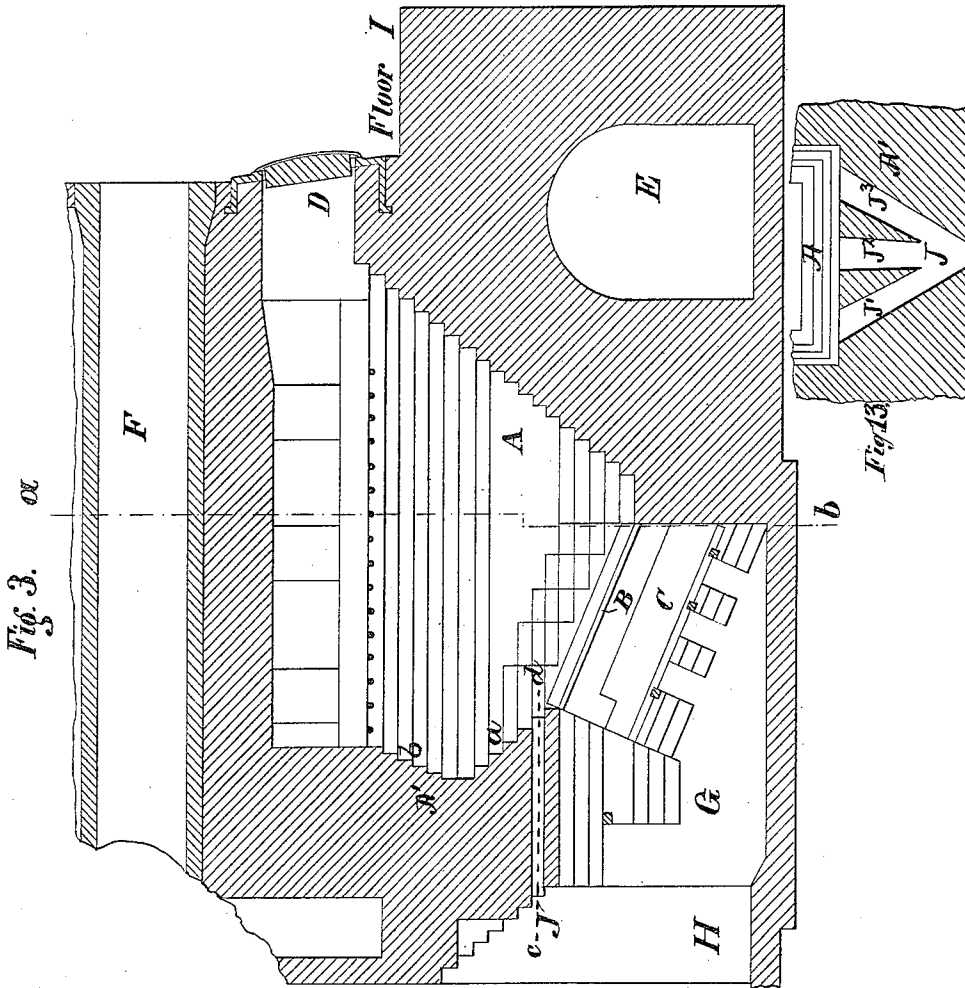
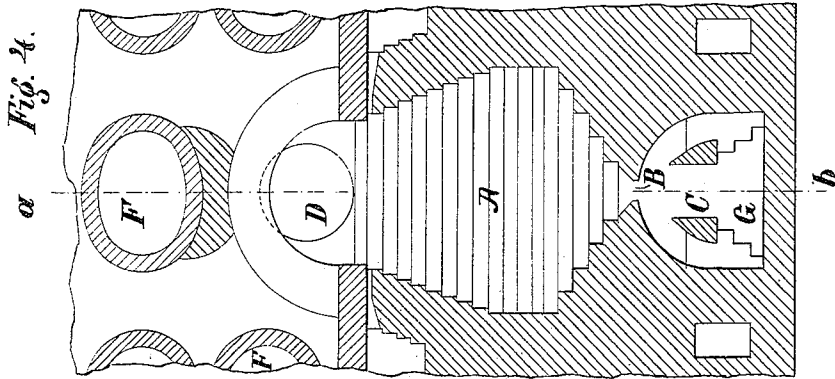
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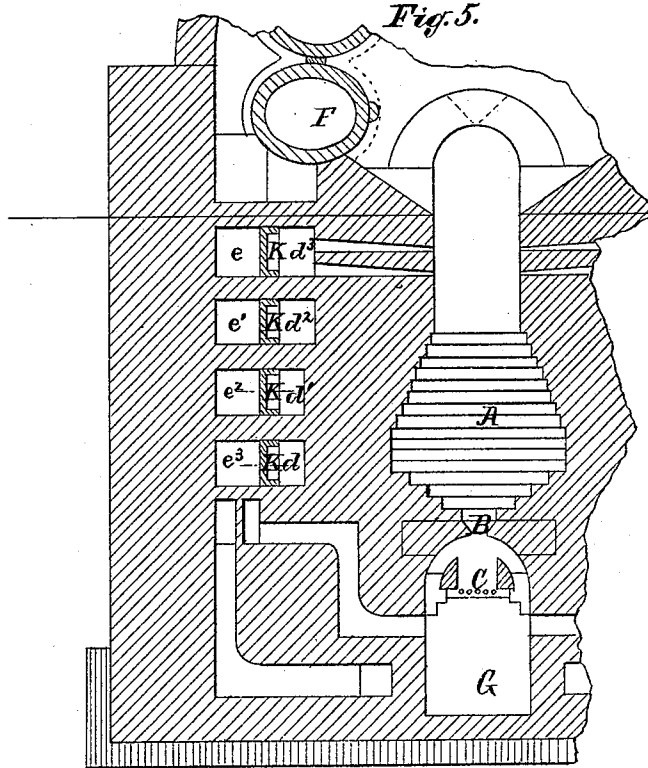


Fig. 5.

Fig. 10.

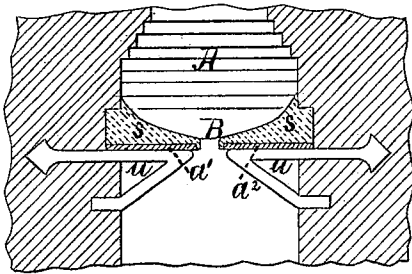


Fig. 6.

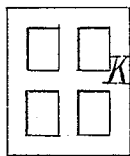


Fig. 11.

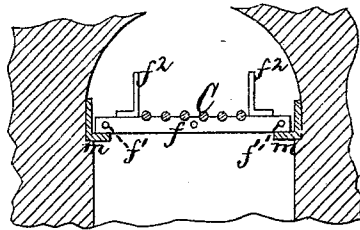


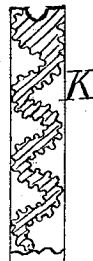
Fig. 7.



Fig. 8.



Fig. 9.



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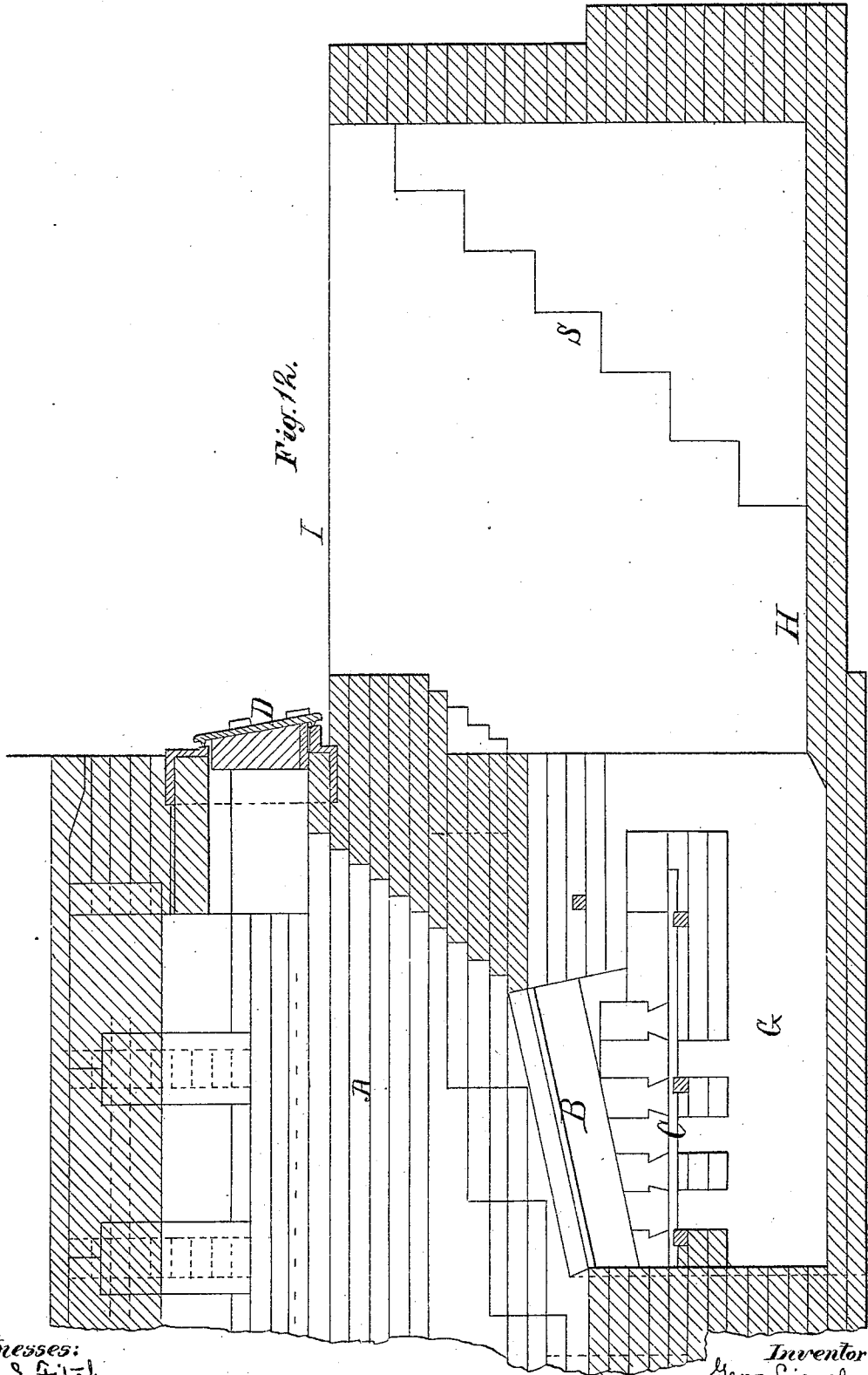
(No Model.)

4 Sheets—Sheet 4.

G. LIEGEL.  
Gas Generating Furnace.

No. 242,547.

Patented June 7, 1881.



*Witnesses:*  
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Gerrit Liegel  
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# UNITED STATES PATENT OFFICE.

GEORG LIEGEL, OF STRALSUND, PRUSSIA, GERMANY, ASSIGNOR TO WILLIAM EPPELSHEIMER AND HENRY J. HUTTNER, BOTH OF SAN FRANCISCO, CALIFORNIA.

## GAS-GENERATING FURNACE.

SPECIFICATION forming part of Letters Patent No. 242,547, dated June 7, 1881.

Application filed January 6, 1881. (No model.)

To all whom it may concern:

Be it known that I, GEORG LIEGEL, of the city of Stralsund, Kingdom of Prussia, Empire of Germany, have invented new and useful Improvements in Furnaces for Gas-Retorts, and other purposes, in which coal, coke, or other solid fuel is consumed, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

My invention relates to the furnaces for burning coal, coke, or other solid fuel, for the purpose of generating heat for the manufacture of gas or other purposes, for which Letters Patent of the United States have been granted to me, No. 208,106, dated September 17, 1878, and No. 219,165, dated September 2, 1879; and my present invention consists in certain improvements in the form and construction of said furnaces and parts thereof, whereby the heat generated is more perfectly conserved and utilized, and the facilities for operating the furnaces are greatly improved and the entire action is bettered, and which improvements are hereinafter particularly described, and are more at length recited in the claims.

Figure 1 is a vertical longitudinal central sectional view on the line *a b* of Fig. 2 of the front or breast end or portion of a furnace embodying some of my improvements. Fig. 2 is a vertical sectional view of the same on the irregular line *a b c d e* of Fig. 1. Fig. 3 is a vertical longitudinal central sectional view of a modified form of the furnace on the line *a b* of Fig. 4. Fig. 4 is a vertical sectional view of the same on the line *a b* of Fig. 3. Fig. 5 is a vertical lateral sectional view of the furnace, in part showing the arrangement of the flues through which the products of combustion pass off, and of the flues through which the air technically termed "secondary air" passes to the combustion-chamber, and more particularly the arrangement of the tiles which constitute the dividing-walls between these two sets of flues. Figs. 6, 7, 8, and 9 are views in detail of the forms which are given to these said tiles. Figs. 10 and 11 are vertical sectional views in detail of parts of my furnace, showing modifications hereinafter particularly described. Fig. 12 is a vertical longitudinal

central sectional view of a modified construction of my improved furnace, as hereinafter specified. Fig. 13, Sheet II, is a section in detail of the part J on the line *c d*, Fig. 3.

The furnace herein shown and described is in the form particularly adapted for heating retorts for gas-making, but it is evident that my furnace is adaptable for use as a heat-generator for other purposes.

The general form and construction of my furnace being fully and at length described in the Letters Patent hereinbefore named, on which the herein-described invention is an improvement, I shall not describe such general construction in detail, but refer to said patents for such description, merely naming herein the principal parts.

Similar letters of reference indicate similar parts.

A is the fuel-chamber. B is the central bottom slot. C is the auxiliary fire bed or grate, which serves to keep the fuel residue—such as slag and clinker—in and near the slot in a state of fusion, to prevent incrustation on the slot and to heat the air termed technically "primary air" passing into the fuel. D is the furnace-charging hole. E is the main flue leading to the chimney. F are gas-making retorts. G is the ash-pit. H is the floor from which the slot and auxiliary grate are cleaned and attended to. I is the floor from which the furnace is fed or the retorts are drawn. J is a flue or opening in the breast-wall of the furnace, through which air may be admitted into the fuel when the full operation of the furnace is checked, but it is desired that the incandescence of the fuel at a slow rate should be preserved.

It will be noticed that my furnace is constructed with the side walls of the fire-bed of the combustion-chamber sloping downward and inward to the central bottom slot, B.

Heretofore it has been my custom to construct the front or breast wall of the interior of my furnace so that it rose vertically throughout its whole height, or for a portion of its height; and my first improvement consists in the said breast-wall A', so constructed that it slopes outward or recedes, as seen at *a*, from the bottom, at the line of the slot B, to a point

about midway of the height of the fuel-chamber, and then slopes inward, as seen at *b*, to the line of the roof, so that the interior face of said wall is formed with a deep angular recess, the whole of said face of the wall being preferably stepped or otherwise broken or roughened, as shown. By means of this construction of said breast-wall the air passing in through the slot diffuses itself through the fuel more perfectly, and the generated flames and gases become more thoroughly mingled and the combustion is more perfect than when the said wall, or any portion of it, is vertical and plane. When the said wall is made vertical the air entering through the front part of the slot does not distribute itself properly through the fuel, but hugs the wall so closely as to destroy the effect it should have in aiding combustion equally throughout the mass of fuel, while the heat generated by the combustion concentrates along the wall and becomes so intense as to melt away and destroy the surface of the wall, so that constant repairs thereof are required, and also the combustion of the mass of fuel in the middle or body of the chamber being retarded, the heat is lessened in degree and the slag or debris from the fuel incrustates on the slot. All these objectionable features are obviated by my improved construction of the breast-wall, as set forth.

My second improvement consists in the peculiar construction and arrangement of the slot *B*, which is as follows: I construct the slot *B* so that it inclines downward from the end which is toward the mouth of the ash-pit rearwardly to the end which is at the back of said ash-pit, as shown plainly in the drawings. It is preferable, I find, that the grate *C* should be so constructed and arranged that it has an inclination coincident with that given to the slot, as seen in Fig. 1. By means of this construction the fireman can more readily observe the condition of the slot and grates, and can with far greater facility clean and give them proper attention than when they are placed horizontally under the furnace, as has been the custom heretofore.

In Figs. 1 and 2, the furnaces shown embodying my described improvements are what are known as "deep" furnaces—that is to say, they have two floors, the floor *I* above, from which the charging of the furnace is done, and the floor *H* below, from which the slots and grates are attended to; but in some instances it is not convenient or desirable to construct deep furnaces, owing either to the nature of the soil, the pressure of water below the surface of the ground, or other causes, and in such cases I give to my furnace the modified form shown in Figs. 3 and 4, namely, the charging-floor *I* is on the front end of the furnace, and the ash-pit and inclined slot and grate on the rear end, so that the wall *A'* becomes the breast-wall in its relation to the slot. It is thus possible to erect furnaces of a less vertical depth. Sometimes it is found convenient to arrange the fur-

naces as shown in Fig. 12, when the floor *I* is provided with movable sections or gratings, so that the same gang of men who charge the furnaces on the floor *I* may descend by steps *s* to the floor *H*, and attend to the slots and grates from that floor. This construction also renders possible the construction of furnaces of reduced vertical depth.

At *J*, Figs. 3 and 13, is shown a flue or opening in the breast-wall of the furnace, the mouth of which may be provided with a suitable cap for closing it, and which may be bifurcated, as shown in Fig. 13, or may be constituted as one or more distinct passages through the walls. At times it may be desirable to allow the full operation of the furnace to be checked by permitting the slot *B* to clog with the slag. Then if the slot be not opened by raking out the incrustated slag the fire in the furnace will decrease; but to prevent the extinction of the fire *I* provide the flue or flues *J*, which on being opened will supply air to the fuel, and thus, while the full operation of the furnace is checked the combustion of the fuel at a slow rate is maintained.

In Fig. 5, at *e e' e<sup>2</sup> e<sup>3</sup>*, are shown the flues and return-flues, through which the products of combustion pass to the main flue of the chimney, while at *d d' d<sup>2</sup> d<sup>3</sup>* are shown the flues through which the air passes which is supplied to the combustion-chamber, in which chamber the carbonic oxide produced in the fuel-chamber is burned, the heat of the gases in the flues *e e'*, &c., being utilized to raise the temperature of the air passing through the flues *d d'*, &c.

My improvement consists in the tiles *K*, which constitute the separating-wall between each of the series of adjoining flues *e* and *d*, *e'* and *d'*, &c., as shown in Fig. 5. By means of these tiles placed to form these separating-walls, as shown, I am enabled to heat the secondary-air supply very efficiently. The said tiles are preferably recessed on their exposed faces, as shown at Figs. 6 and 7, or these faces are fluted or corrugated or otherwise broken up, as seen in Figs. 8 and 9, so as to present to the flues *e e'*, &c., as great a heat-absorbing surface, and to the flues *d d'*, on their opposite sides, as great a radiating-surface, as possible.

It has been usual to construct the sides or edges of the slot *B* of fire-brick; but I find it desirable, in some instances, to construct the bottom of the fire-bed constituting the slot as shown in Fig. 10—that is to say, of two iron plates, *a' a<sup>2</sup>*, with a space or slot between them, as seen, and resting upon supports *u*, which are anchored in the wall of the furnace-structure, as shown. The under sides of these plates are thus exposed to the air, and the plates are kept comparatively cool, causing the slag to form a hard coating or covering (shown at *s*) on their upper surface, whereby the plates are thus protected from the full heat of the furnace. An inexpensive and desirable slot is thus constituted, and one which is preferable

in construction in cases where the fuel employed produces a slag in which lime is present.

I find it sometimes desirable to construct the auxiliary fire bed or grate C as shown in Fig. 11—that is to say, of two or more transverse bars, *f*, which are held together by longitudinal rods *f'*, and which support the grate-bars, as shown, and which rest upon ways *m* fixed to the furnace-wall. Angle-irons or guards *f*<sup>2</sup> are preferably set longitudinally on the bars at the sides of the grate-bars to confine the fuel to a heap on said bars. By means of this general construction of grate, when the fire thereon under the slot is hotter than desirable the grate may be readily slid outward on its ways and air thus admitted freely to the rear of the slot for a greater or less extent of its length and the slot thus more or less cooled.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a gas-retort furnace, the side walls of the fire-bed of the combustion-chamber sloping downward and inward to a central bottom slot, B, in combination with the front breast-wall, A', of the said chamber, the inner face of which slopes outward with receding steps from the said slot to about half-way to the top, and then continues with a reverse slope inward to the top, whereby the inner surface of said breast-wall is protected from a too intense heat and the distribution of the air through the mass of the fuel in the combustion-chamber is promoted, as described.

2. In a furnace having a fuel-bed sloping downward from the sides, the bottom of said bed sloping backward and downward from the front of the furnace and having the central slot, B, whereby the under side of the slot may be more conveniently seen and the slot more easily cleaned, substantially as described.

3. A furnace having a fuel-bed that slopes downward from the sides to a central bottom, set at an angle sloping back and downward from the front of the furnace, and having slot B, as described, in combination with the auxiliary fire-bed C, set underneath the said slot at an angle corresponding to that of the slot, as specified.

4. In a gas-retort furnace a fuel-bed, A, having sides converging downward to a central bottom—that is, set at an angle sloping back and downward from the front—and having slot B, and the breast-wall having a fuel-hole at the top of the fire-bed, all constructed and combined to operate as and for the purpose described.

5. In a furnace, the bottom of the fire-bed A, consisting of two plates, *a' a*<sup>2</sup>, of iron, having a central space or slot between them, resting upon supports *u* and exposed to the air on the under side, whereby they are kept cool, thereby causing the slag to form a hard covering on their upper surfaces, whereby they are protected from the full heat of the furnace, as and for the purpose specified.

6. In a gas-retort furnace, the combination, with the fire-bed having the central bottom slot, B, of the air flue or flues J, extending through the front wall of the furnace and opening into the fire-place at a point to communicate with the mass of the contained fuel, whereby, when the slot B is allowed to clog and close up with slag and the supply of air to support combustion from that source is cut off, air to maintain a moderate or slow combustion may be supplied to the mass of fuel through said flue and the entire cessation of the operation of the furnace prevented, substantially as and for the purpose specified.

7. In a furnace having the sloping side and breast walls and the central bottom slot, substantially as described, the combination, with the flues *e e' e*<sup>2</sup> *e*<sup>3</sup> leading from the combustion-chamber to the chimney, and the adjacent air-heating supply-flues *d d' d*<sup>2</sup> *d*<sup>3</sup>, of the partition separating said sets of flues from each other, composed of the tiles K, constructed with the irregular surfaces specified, and arranged to operate as and for the purpose set forth.

Witness my hand this 22d day of November, A. D. 1880.

GEORG LIEGEL.

Witnesses:

PAUL MÖLLER,  
HEINRICH SCHRADER.