No. 631,091. Patented Aug. 15, 1899.

A. NEWTON.

SMOKE CONSUMING FURNACE.

(Application filed Oct. 15, 1898.)

(No Model.) 2 Sheets—Sheet 1.

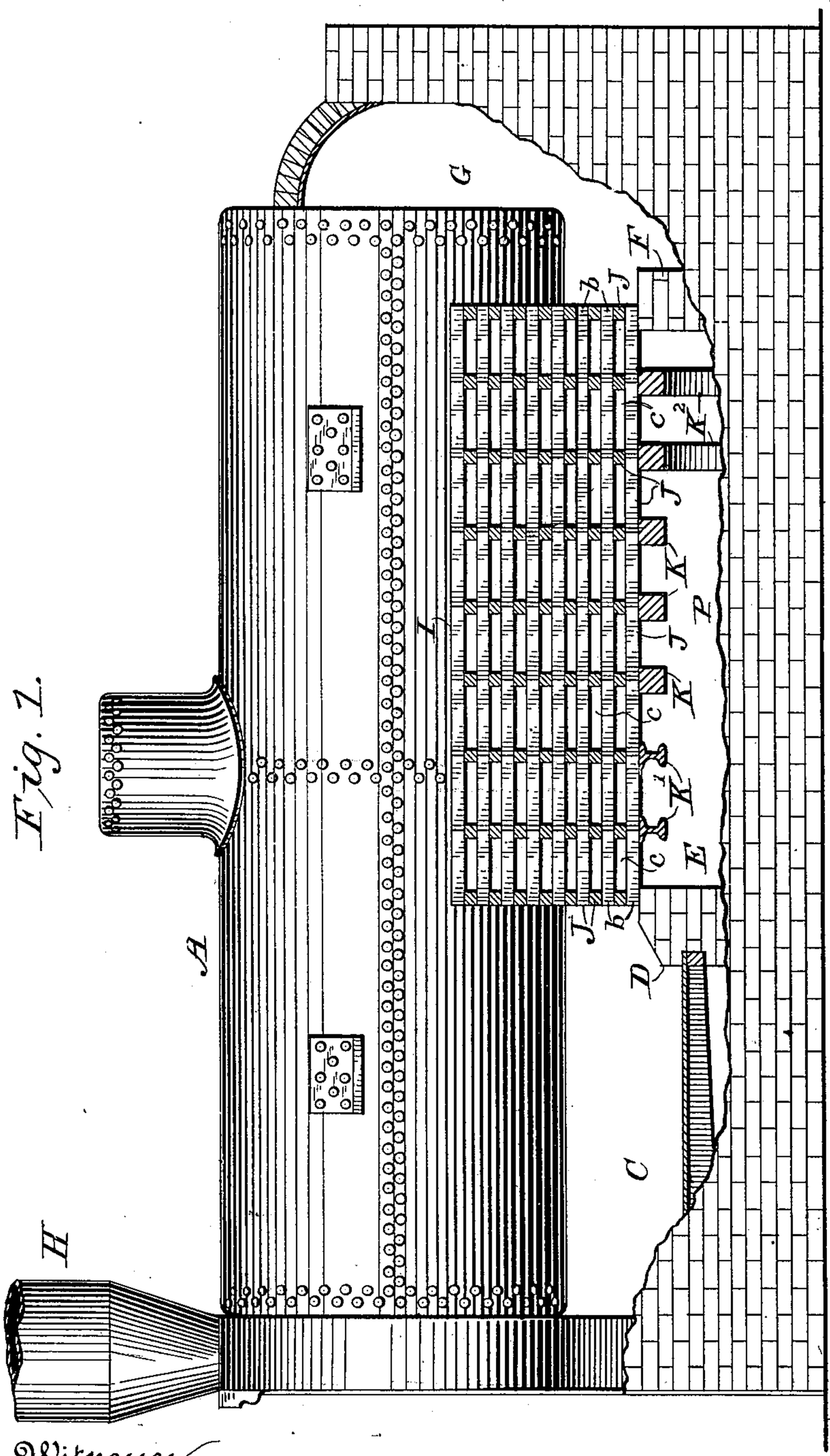

Fig. 1.

Fig. 4.

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Fig. 2.

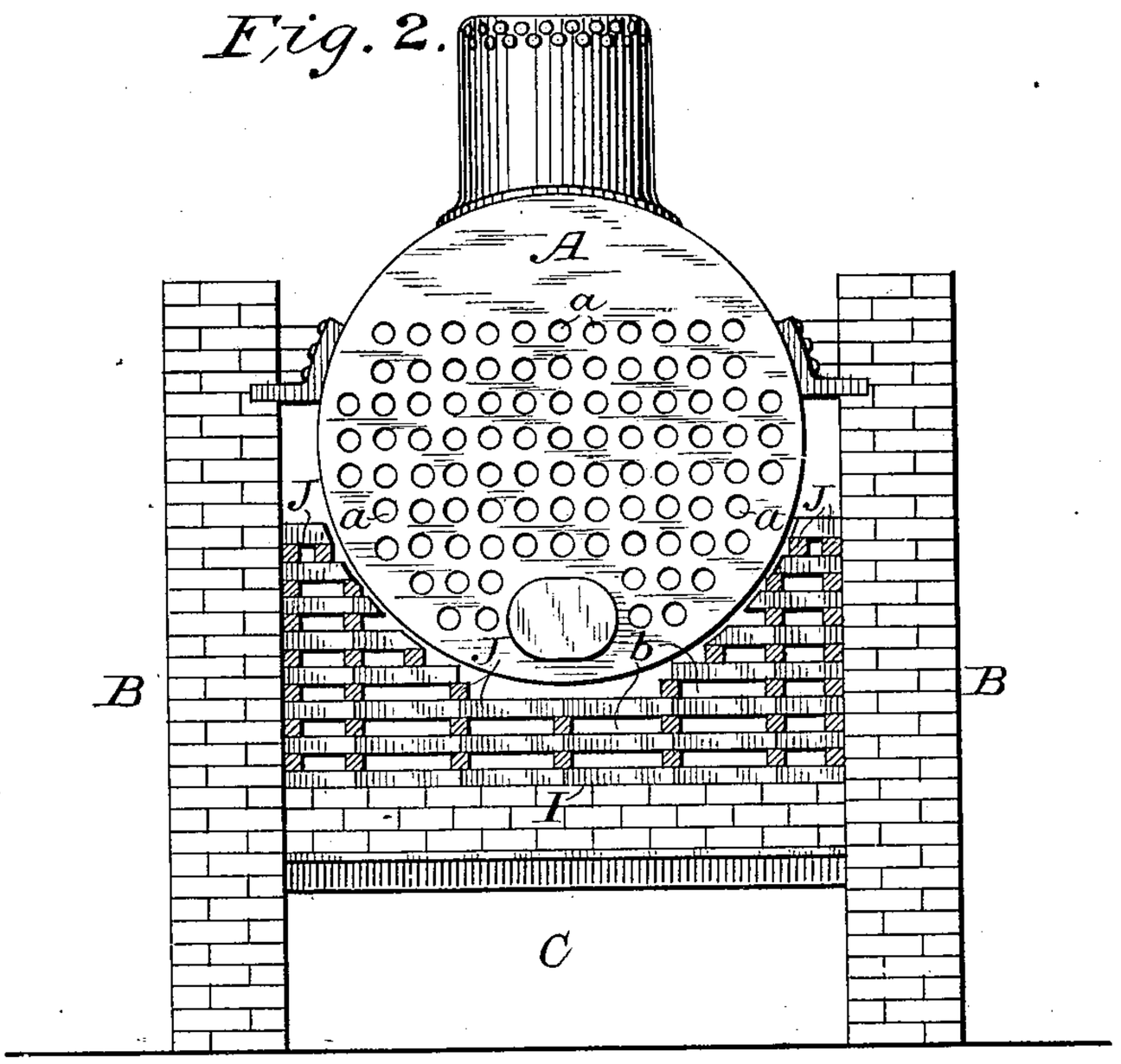


Fig. 3.

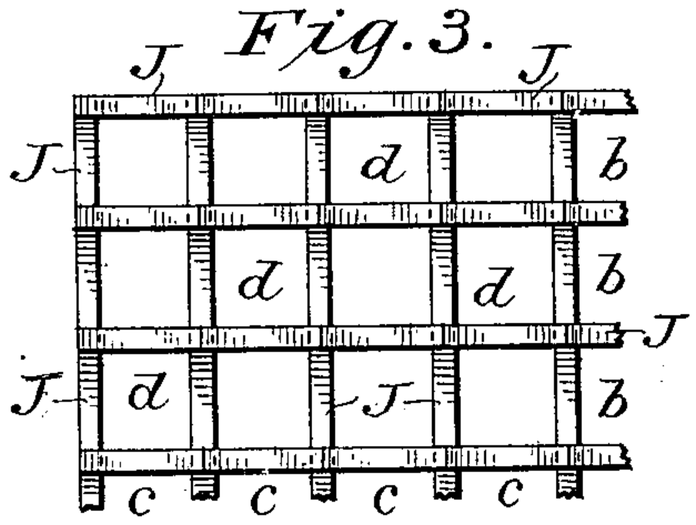


Fig. 5.

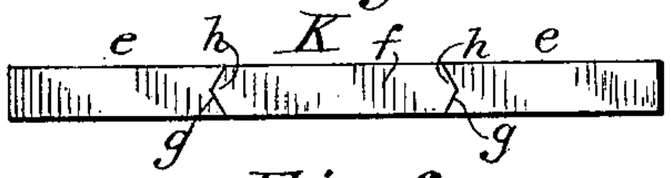
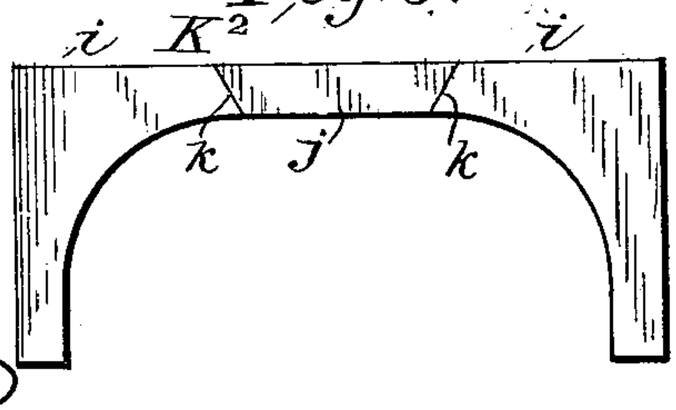


Fig. 6.



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UNITED STATES PATENT OFFICE.

ABRAHAM NEWTON, OF XENIA, OHIO.

SMOKE-CONSUMING FURNACE.

SPECIFICATION forming part of Letters Patent No. 631,091, dated August 15, 1899.

Application filed October 15, 1898. Serial No. 693,606. (No model.)

To all whom it may concern:

Be it known that I, ABRAHAM NEWTON, of Xenia, in the county of Greene and State of Ohio, have invented certain new and useful Improvements in Smoke-Consuming Furnaces, of which the following is a specification.

The object of the present invention is to equip a steam-boiler furnace with a heat-retaining and smoke-consuming retort composed of a checker-work of refractory material located in the combustion-chamber of the furnace below the boiler and back of the bridge-wall, which is in the direct line of the passage of the products of combustion to the rear end of the boiler, which will not interfere with the usual course of the flame or impede the draft, which, becoming incandescent, insures the consumption of nearly all of the carbon and unconsumed combustible gases, and which will retain and sustain the heat, thereby equalizing the temperature of the boiler, superheating the consumed gases, and increasing their efficiency in the production of steam. Heretofore checker-work of a refractory material has been interposed in steam-boiler furnaces between the fire-box and stack or between the fire-box and the rear end of the boiler for the purpose of consuming the smoke and other combustible materials which pass beyond the bridge-wall; but such checker-work when adapted to be traversed by the flame has been so located and arranged as to necessitate the passage of the products of combustion through devious, tortuous, circuitous, or zigzag courses, thus impeding the draft and sacrificing the efficiency of the furnace, or such checker-work has been so arranged and constructed as to have no material heat retaining and sustaining functions.

The present invention consists, therefore, in the construction of the checker-work so as to form a heat-retaining and smoke-consuming retort and in the retort so formed having a proper location and relation to the steam-boiler and fire-box.

The present improvements are illustrated in the accompanying drawings, wherein—

Figure 1 is a side view of a steam-boiler furnace, partly in vertical longitudinal section, embodying the present improvements. Fig. 2 is a vertical cross-section of the same, the boiler itself being shown in end elevation. Fig. 3 is a plan view, partly in section, of a portion of the checker-work retort. Fig. 4 is a perspective view of one of the bricks of which the checker-work retort is composed. Figs. 5 and 6 are views illustrating modifications of the means for supporting the checker-work retort.

The drawings illustrate an ordinary horizontal return-flue tubular boiler A, set in brickwork B in the usual manner. C is the fire-box, located at the front end of the boiler. D is the front bridge-wall. E is the combustion-chamber, located beneath the boiler and back of the bridge-wall and extending upwardly to embrace the boiler at its major diameter. F is the rear bridge-wall. G is the vertical return-passage, establishing communication between the combustion-chamber E and the rear ends of the return-flues *a*, extending longitudinally through the boiler, and H is the smoke-stack at the front of the boiler, communicating with the front ends of the boiler return-flues. These several parts thus far referred to are or may be of the construction usual in return-flue steam-boiler furnaces.

I is the checker-work retort, which is located in the combustion-chamber E between the two bridge-walls D and F and which conforms on its upper side as closely as practicable to the contour of the lower half of the boiler, as shown in Fig. 2, the checker-work extending well up toward the middle of the boiler, where it is joined to the side-inclosing walls. This checker-work retort, it will be noted, does not extend below the bridge-walls, being located entirely above the same, the ends of the retort resting on the bridge-walls themselves. The retort extends continuously back from the front bridge-wall nearly to the rear end of the boiler and nearly to the return-passage G, thus presenting a retort of substantial capacity embracing the greater portion of the length of the boiler back of the bridge-wall. The retort is composed of blocks J, of fire-brick or other suitable refractory material, laid with fire-clay mortar, and the bulk of the retort is built up of refractory blocks, each of which is of a length materially greater than its other dimensions,

being preferably twelve inches long and two inches in each of its other dimensions, one of the blocks being shown in detail in Fig. 4. Smaller blocks may be and are used in piecing out the retort where full-length blocks would not fit. As illustrated in Fig. 1, the checker-work retort between the bridge-walls is supported upon spaced cross-supports K, which extend crosswise of the combustion-chamber E, with their upper faces preferably flush with the top edges of the bridge-walls, their opposite ends being supported upon the exterior brickwork B. Conveniently and economically these cross-supports may be composed of sections of old railroad-rails, as shown at K'. These cross-supports are preferably spaced apart, with a distance between their centers equal to the length of the blocks J.

The retort is located entirely above the bridge-walls, thus leaving an open space or pit P beneath it. This pit, between the two bridge-walls and beneath the retort, is below the line of draft and constitutes a heated subsidence chamber or receptacle for any incombustible ash which escapes from the fire-box. It also affords an expansion-chamber for the gases.

The retort is built up in the following manner, as shown in the drawings: First, a series of longitudinal rows of the refractory blocks is laid extending lengthwise of the combustion-chamber, each block spanning the space between two cross-supports or between the front and rear cross-supports and the bridge-walls. The first horizontal layer of blocks is exclusively composed of longitudinally-extending blocks arranged in rows, each row being composed of blocks arranged end to end. In case the retort is built up of blocks of the stated dimensions—that is, twelve inches long and two inches in each of the other dimensions—the longitudinal rows of the blocks are arranged ten inches apart, thus making a series of direct straight uninterrupted longitudinal flues *b*, extending throughout the length of the retort directly from the fire-box to the rear end of the combustion-chamber. This lower layer of longitudinally-extending blocks arranged in parallel rows rests upon the cross-supports K and on the bridge-walls D and F. The second layer of blocks rests upon the first layer and is composed exclusively of parallel rows extending laterally, each row being composed of blocks arranged end to end, the longitudinal extents of which are arranged laterally or crosswise of the combustion-chamber. Each crosswise-extending block (of which the second layer is composed) rests with its opposite ends upon two of the longitudinal rows of which the first layer of blocks is composed. These laterally-extending parallel rows of crosswise-extending blocks are spaced the same distance apart—that is to say, ten inches apart where blocks of the recited dimensions are used—as are the longitudinal rows of which the first layer is composed. There are thus formed straight unobstructed lateral flues *c*, extending entirely across the combustion-chamber between the rows of blocks constituting the second layer throughout the entire retort, and these lateral flues intersect the longitudinal flues which are formed by the first layer.

The entire retort is built up in the same manner as are the first two layers, the odd-numbered layers being composed of longitudinal rows of longitudinally-extending blocks arranged end to end and forming unobstructed longitudinal flues, while the even-numbered layers are composed of laterally-extending rows of blocks extending crosswise and arranged end to end and forming unobstructed lateral flues intersecting the unobstructed longitudinal flues.

It is to be noted that it is not essential that the first or lowest layer should be composed of longitudinal rows and the second layer of lateral rows of blocks, since the first layer might have been composed of lateral rows, it being only of importance that the lateral and longitudinal rows should alternate. Of course when the rows of blocks reach the level of the lowest portion of the boiler the lateral rows above this point do not extend entirely across the combustion-chamber, but extend only from the side wall of the furnace to the shell of the boiler, and in this upper portion of the combustion-chamber many short-length blocks are necessarily employed in order to fill up the space between the boiler and the side walls of the furnace as far as practicable, and the longitudinal flues extending through the retort are not all of full width. As a consequence of this manner of building up the retort with refractory blocks the length of which is considerably greater than the other dimensions the retort is supplied with a large number of straight unobstructed longitudinal flues *b*, extending from the fire-box to the rear end of the combustion-chamber. The retort is likewise furnished, by reason of the way it is built up, with a large number of straight unobstructed laterally-extending flues *c*, which extend in the lower part of the retort from side to side of the furnace and in the upper part of the retort from the side walls of the furnace to the boiler-shell. Owing to the intersection of these longitudinal and lateral flues *b* and *c* the retort is also furnished with a large number of unobstructed straight vertical flues *d* of large area extending from the unoccupied portion or pit P of the combustion-chamber E, which is below the level of the bridge-walls, to the shell of the boiler and communicating with the pit through the spaces between the cross-supports. As the result of this construction of the retort with unobstructed longitudinal, lateral, and vertical flues full and free passage is furnished for the products of combustion from the fire-box to pass in their natural course to the rear end of the boiler without being diverted into tortuous or circuitous paths. The flames are free to follow their natural upward course

through the vertical flues and into contact with the under side of the boiler. The retort therefore, while presenting an extended area of surface of the refractory material of which the blocks J are composed, does not interfere with the current of heat or deflect it from its natural course. At the same time the retort affords just sufficient obstruction to the passage of the flame to insure its even and thorough distribution throughout all portions of the combustion-chamber, and it is thereby brought into contact with every exposed portion of the boiler-shell.

Owing to the employment of the elongated blocks and the manner in which they are built up, the longitudinal and vertical flues properly fulfil their offices. The longitudinal flues are wide as compared with their height, (ten by two inches with the stated dimensions of the blocks,) thus permitting the flame to travel in sheets. At the same time the vertical flues *d* have an extended area (ten by ten inches with the blocks of the stated dimensions) much greater than that of the longitudinal flues, so that there is free upward passage for the flames to the boiler.

The entire mass of the retort becomes heated to an incandescent state or to a condition approximating thereto, and consequently the smoke in its passage to the rear is superheated, so that substantially all of the unconsumed particles and gases which pass over the bridge-wall are consumed before they reach the rear end of the boiler, thus not only preventing the escape of objectionable smoke into the atmosphere, but also securing a greater amount of heat from the coal or the other solid fuel which is employed. Particles of unconsumed carbon passing through the retort are caught by the refractory blocks, and thus coming in contact with their highly-heated surfaces are consumed and their heating capacity utilized.

The entire mass of the retort is brought into close proximity with the boiler, so that the boiler is subjected to a substantially uniform temperature throughout its length, and the heat-retaining capacity of the retort is utilized in sustaining the temperature of the boiler, thus preventing the chilling of the boiler when the fire is replenished by the addition of fuel. The retort extending substantially the entire length of the boiler back of the front bridge-wall affords an extended mass of heat-retaining material, and consequently the smoke is subjected to its action throughout a very considerable distance, thus insuring the combustion of the greater part thereof.

The products of the initial combustion in the fire-box not only are thoroughly consumed when they reach the rear end of the boiler, but they also reach this point at a temperature not materially less than that of the fire-box, and consequently are of much greater heat-imparting utility in passing from the return-passage G through the return-flues *a* of the boiler to the stack H.

It is not necessary that the checker-work retort should be supported upon the cross steel rails K′, and Figs. 5 and 6 illustrate modified forms of cross-supports. Fig. 5 illustrates a flat arch K, composed of blocks *e*, *e*, and *f*, made, preferably, of the same refractory material as are the blocks J. The two end blocks *e e* rest at their outer ends either by being embedded in the brick side walls of the furnace or upon buttresses or brackets carried thereby. Each of the end blocks *e* has at its inner end a reëntering recess or groove *g*. The middle or key block *f* has its outer ends *h* projecting, so as to fit the recesses *g* of the end blocks. In this manner a strong substantially flat arch is formed for supporting the retort. Sufficient of these flat arches are employed to afford substantial support for the entire retort. These flat arches K are shown in Fig. 1 of the drawings and are spaced apart, so as to permit free access to the lower unobstructed portion or pit of the combustion-chamber.

Fig. 6 shows a modified form of arch K^2 which may be employed as one of the supports for the retort. This arch is composed of two similar end pieces *i i* and a central or key block *j*. In this modification the end blocks *i* are supported upon the bottom of the furnace and are suitably arched upon their inner faces to provide ample space within the combustion-chamber beneath the retort. The inner end of each of the end blocks *i* is beveled, as shown at *k*, the two end blocks *i* thus forming an opening for the reception of the key-block *j*, which is smaller at the bottom than at the top. The key-block *j* is shaped to fit the space between the ends *k k* of the end blocks *i*, being wider at its top than at its bottom. In this manner a strong and substantial arch is formed, and sufficient arches are employed to afford a firm foundation for the retort. The blocks *i j* of this modification are likewise preferably made of the same refractory material as the blocks J. These arches K^2 when employed are likewise spaced apart to permit communication to the lower unobstructed part or pit P of the combustion-chamber.

I claim as my invention—

1. A smoke-consuming steam-boiler furnace having, in combination, a horizontal return-flue tubular boiler; a fire-box and stack located at the front end of the boiler; a front bridge-wall located back of the fire-box; a return-passage at the rear end of the boiler communicating with the return-flues of the boiler; a combustion-chamber beneath the boiler extending from the bridge-wall to the return-passage; inclosing walls; a checker-work retort located within the combustion-chamber wholly above the level of the tops of the bridge-walls, whereby a pit is formed beneath the retort, said retort embracing the

boiler, and extending the greater part of the length of the boiler from the front bridge-wall to the rear end thereof, said retort being composed of alternating longitudinal and lateral parallel rows of refractory blocks arranged end to end, each of said blocks being of a length greater than its other dimensions, and said rows being spaced apart so as to form straight unobstructed intersecting longitudinal, lateral and vertical flues throughout the extent of the retort; and laterally-extending cross-supports for said retort above the pit of the combustion-chamber, and spaced apart, whereby the said vertical flues communicate with said pit, substantially as set forth.

2. A smoke-consuming steam-boiler furnace having, in combination, a horizontal return-flue tubular boiler; a fire-box and stack located at the front end of the boiler; a bridge-wall located back of the fire-box; a return-passage at the rear end of the boiler communicating with the return-flues of the boiler; a combustion-chamber beneath the boiler extending from the bridge-wall to the return-passage; inclosing walls; and a checker-work retort located within the combustion-chamber wholly above the level of the top of the bridge-wall, embracing the boiler, and extending the greater part of the length of the boiler from the bridge-wall to the rear end thereof, said retort being composed of alternating longitudinal and lateral parallel rows of refractory blocks arranged end to end, each of said blocks being of a length greater than its other dimensions, and said rows being spaced apart so as to form straight unobstructed intersecting longitudinal, lateral, and vertical flues throughout the extent of the retort, substantially as set forth.

3. A smoke-consuming steam-boiler furnace having, in combination, a horizontal boiler; a fire-box located at the front end of the boiler; a bridge-wall located back of the fire-box; a combustion-chamber beneath the boiler extending back from the bridge-wall; and a checker-work retort located within the combustion-chamber wholly above the level of the top of the bridge-wall, embracing the boiler, and extending the greater part of the length of the boiler from the bridge-wall to the rear end thereof, said retort being composed of alternating longitudinal and lateral parallel rows of refractory blocks arranged end to end, each of said blocks being of a length greater than its other dimensions, and said rows being spaced apart so as to form straight unobstructed intersecting longitudinal, lateral and vertical flues throughout the extent of the retort, substantially as set forth.

4. A smoke-consuming steam-boiler furnace having, in combination, a tubular boiler; a fire-box located at the front end of the boiler; a bridge-wall located back of the fire-box; a combustion-chamber beneath the boiler extending back from the bridge-wall; and a checker-work retort located within the combustion-chamber, embracing the boiler, and extending the greater part of the length of the boiler from the bridge-wall to the rear end thereof, said retort being composed of alternating longitudinal and lateral parallel rows of refractory blocks, said rows being spaced apart so as to form unobstructed intersecting longitudinal and vertical flues throughout the extent of the retort, substantially as set forth.

5. A smoke-consuming steam-boiler furnace having, in combination, a boiler; a fire-box located at the front end of the boiler; a combustion-chamber beneath the boiler extending back from the fire-box; and a checker-work retort located within the combustion-chamber, and embracing the boiler, said retort being composed of alternating longitudinal and lateral parallel rows of refractory blocks, said rows being spaced apart so as to form unobstructed intersecting longitudinal and vertical flues throughout the extent of the retort, substantially as set forth.

6. A smoke-consuming furnace having a checker-work retort composed of alternating longitudinal and lateral parallel rows of refractory blocks arranged end to end, each of said blocks being of a length greater than its other dimensions, and said rows being spaced apart so as to form straight unobstructed intersecting longitudinal, lateral and vertical flues throughout the extent of the retort, said longitudinal flues being wider than they are high, and said vertical flues being of greater cross-sectional area than said longitudinal flues, substantially as set forth.

7. A smoke-consuming steam-boiler furnace having, in combination, a boiler; a combustion-chamber; a fire-box; a front bridge-wall located back of the fire-box; a rear bridge-wall located near the rear of the boiler, the space between said bridge-walls constituting the pit of the combustion-chamber; and a refractory smoke-consuming and heat-retaining checker-work retort located in the combustion-chamber between the two bridge-walls and above the pit, said retort having intersecting longitudinal and vertical flues, the longitudinal flues being traversed by the flame on the way from the fire-box to the rear of the boiler, and the vertical flues communicating with the pit and extending therefrom to the boiler, substantially as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

ABRAHAM NEWTON.

Witnesses:
HORACE D. SABIN,
FRANK P. CUNNINGHAM.