No. 630,091. Patented Aug. 1, 1899.

A. NEWTON.

SMOKE CONSUMING STEAM BOILER FURNACE

(Application filed Oct. 17, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

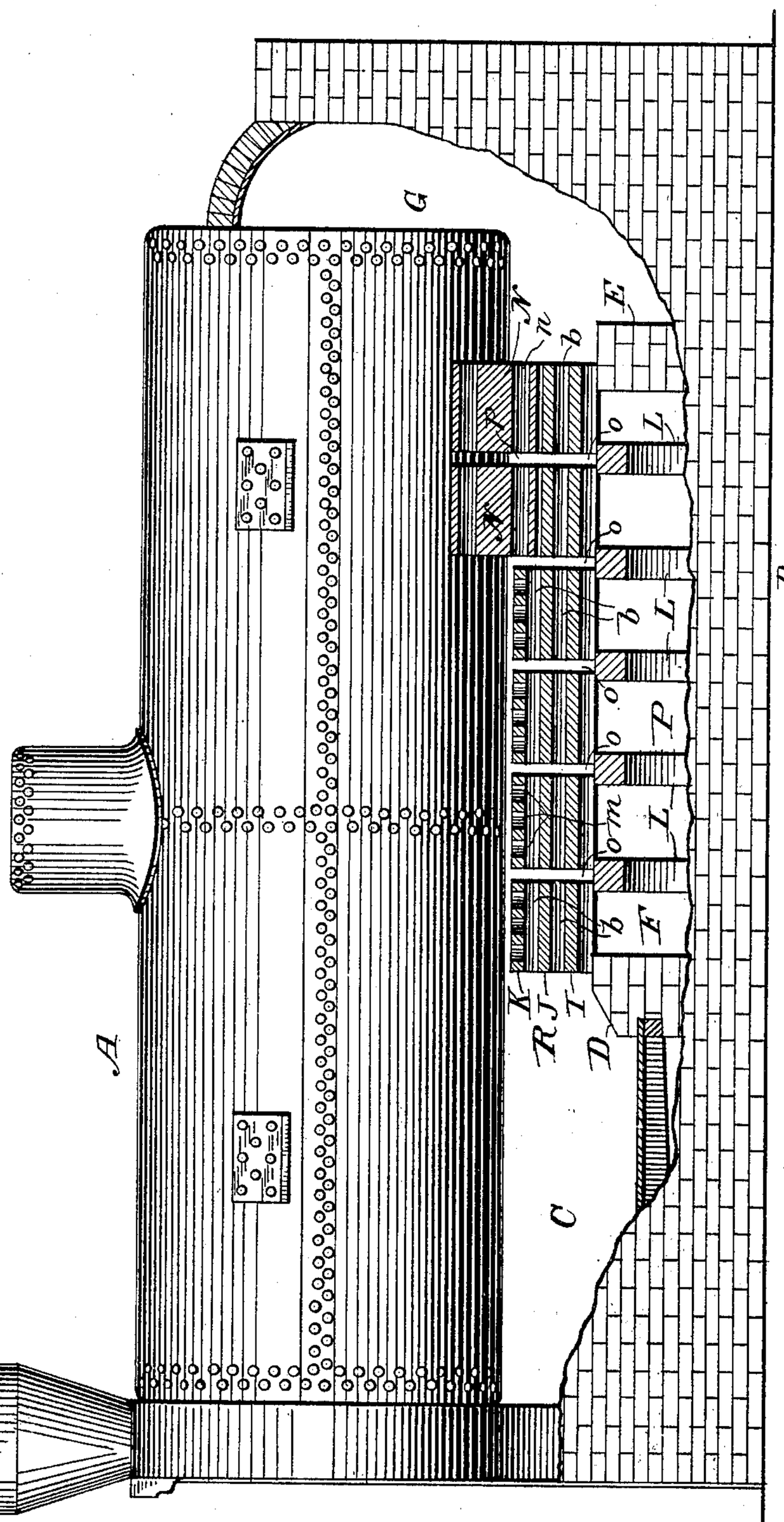
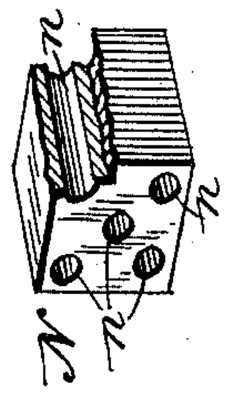


Fig. 6.



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No. 630,091. Patented Aug. 1, 1899.

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SMOKE CONSUMING STEAM BOILER FURNACE.

(Application filed Oct. 17, 1898.)

(No Model.) 2 Sheets—Sheet 2.

Fig. 2.

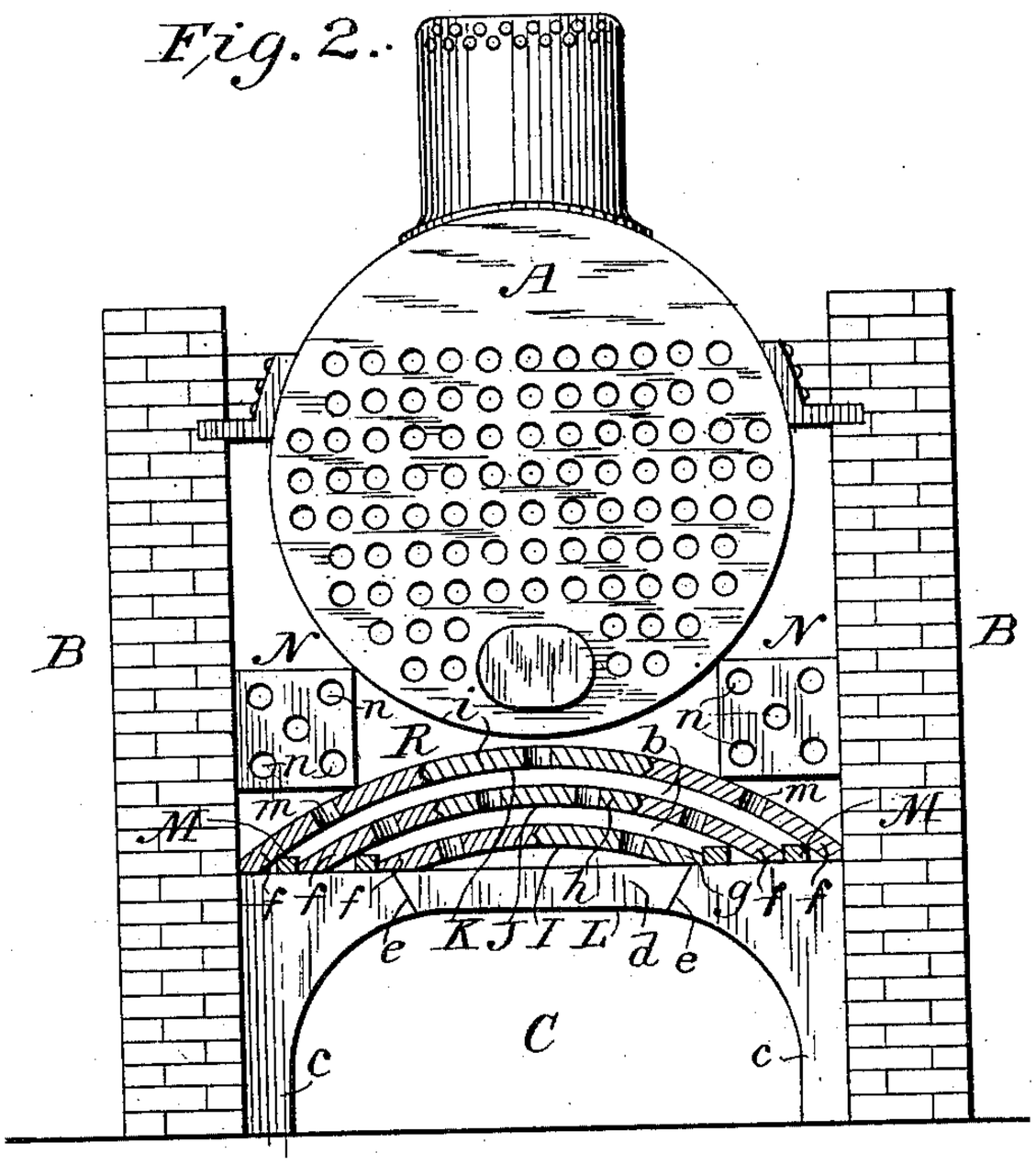


Fig. 3.

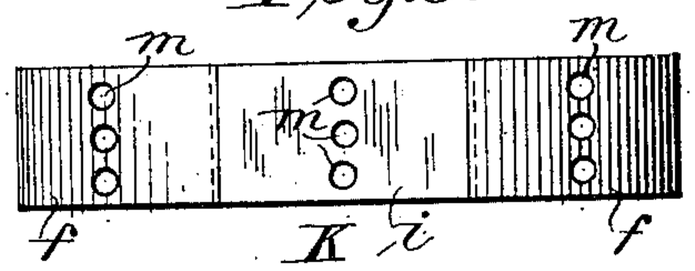


Fig. 4.

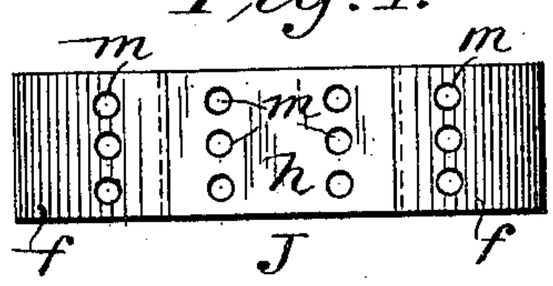
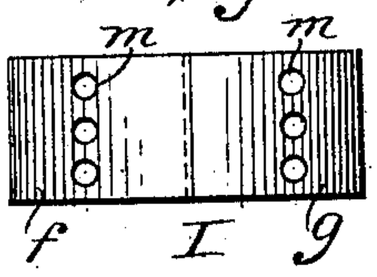


Fig. 5.



Witnesses
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UNITED STATES PATENT OFFICE.

ABRAHAM NEWTON, OF XENIA, OHIO.

SMOKE-CONSUMING STEAM-BOILER FURNACE.

SPECIFICATION forming part of Letters Patent No. 630,091, dated August 1, 1899.

Application filed October 17, 1898. Serial No. 693,755. (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 Steam-Boiler 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 blocks of refractory material located in the combustion-chamber of the furnace below and alongside the boiler and back of the front 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 combustion of nearly all of the carbon and other 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.

The present invention consists in the construction of the retort so as to form a heat-retainer and a smoke-consumer and in the location of said retort and its 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. Figs. 3, 4, and 5 are plan views of the blocks employed in the construction of the main portion of the retort. Fig. 6 is a perspective view of one of the blocks employed in the portions of the combustion-chamber which extend along the side of the boiler.

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 rear bridge-wall. F 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 and to the place where the boiler is joined to the inclosing side walls of the furnace. G is the vertical return-passage establishing communication between the combustion-chamber F and the rear ends of the return-flues 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.

R is the refractory retort, which is located in the combustion-chamber F between the bridge-walls D and E. This 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, thereby leaving the lower portion or pit P of the combustion-chamber between the bridge-walls unobstructed to provide for the ready expansion of the heated gases and to furnish a vacant subsidence space back of the bridge-wall for the reception of the unconsumed ash which passes back of the bridge-wall into the combustion-chamber. The retort extends back from the bridge-wall nearly to the rear end of the boiler and nearly to the return-passage G, thus presenting a retort of substantial capacity in close proximity to the boiler and extending throughout the greater portion of the length of the boiler back of the bridge-wall.

The main body of the retort is located beneath the lowest portion of the boiler and is composed of tiers I J K of arches of blocks of fire-brick or other suitable refractory material laid with fire-clay mortar, said tiers being spaced apart, so as to present unobstructed longitudinal flues *b*, extending longitudinally from the fire-box to the return-passage G.

The main body R of the retort is supported above the pit P of the combustion-chamber F and with its lowest portion on a level with the top surfaces of the bridge-walls D and E by means of suitable cross-supports extending crosswise of the combustion-chamber, above the pit thereof. These cross-supports may be steel rails (conveniently and economically sections of inverted old railroad-rails) or flat arches composed of blocks of refractory material of the same material as the retort itself

is composed, in both of which cases the cross-supports may have their ends embedded in the side walls of the furnace or supported upon brackets or buttresses themselves supported by the side walls of the furnace. The accompanying drawings, however, illustrate cross-supports L consisting of arches resting upon the floor of the combustion-chamber. Each arch is composed of two similar end pieces *c c* and a central or key block *d*, composed, preferably, of refractory material of the same sort as that of which the retort itself is composed. The end blocks *c* 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 *c* is beveled, as shown at *e*, the two end blocks thus forming an opening for the reception of the key-block *d*, which is smaller at the bottom than at the top. The key-block *d* is shaped at its ends to fit the space between the adjacent ends *e e* of the end blocks *c*, 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. These supporting-arches L are spaced apart to permit communication for the products of combustion to the lower open part or pit P of the combustion-chamber, each of the longitudinal flues *b b*, extending lengthwise of the retort, being thus in communication with the pit of the combustion-chamber.

In a furnace having the size and capacity of the illustrated furnace the body of the retort is composed of three superimposed tiers of arches I, J, and K.

The lower tier of arches I is composed of a series of similar arches arranged side by side and extending lengthwise of the retort. Each of these lower arches I is, as shown, composed of two curved blocks *f g*, plan views of which are shown in Fig. 5. The blocks *f g* are alike, except that one, as *f*, has a recess at its meeting edge, and the other, as *g*, has a projection at its meeting edge fitting the recess of the other block *f*. The two blocks thus constitute a self-sustaining arch. As shown in Fig. 2, the outer lower edges of each of the blocks *f g* are shaped so as to rest flatly upon the upper surface of the cross-supports L. Each of the blocks *f g* is preferably two inches thick and twelve inches wide—that is, in the direction which extends lengthwise of the combustion-chamber. The cross-supports L are sufficiently close together to support all of the arches I of which the lower tier of arches is composed, and hence with arches twelve inches wide the centers of the cross-supports L should be approximately fourteen inches apart, thus leaving open joints *o* two inches wide, between the successive arches of which the several tiers I J K are composed. The front and rear arches I rest upon the bridge-walls and upon the adjacent cross-supports L, spanning the spaces between the bridge-walls and the adjacent cross-supports. Each of the remaining similar arches I rests upon two of the cross-supports, spanning the space between them. This lower tier of arches I extends back throughout a distance nearly or quite as great as the length of the boiler back of the bridge-wall, and owing to its arched shape there is formed the lower longitudinal flue *b* of the retort, which leads from the fire-box to the return-passage G and is in communication with the lower part or pit of the combustion-chamber through the spaces between the several cross-supports L. The several arches I of which the lower tier is composed are preferably spaced apart with open joints between them serving as vertical flues *o*, extending toward the boiler.

The second or intermediate tier of arches J is composed of a plurality of similar arches spanning the lower tier of arches I, so as to form a longitudinal flue *b* between the tiers, this flue being preferably about two inches across. Each of the arches J rests at its outer and lower end upon the cross-supports L or upon the adjacent cross-supports L and the bridge-walls D and D, and consequently the intermediate longitudinal flue *b*, formed by the space or vacancy between the two tiers of arches I and J, communicates at its lower portions on both sides with the pit P of the combustion-chamber through the spaces between the cross-supports L. Each of the intermediate arches J, as shown, is composed of three curved blocks *f*, *f*, and *h*, each preferably two inches thick and twelve inches wide, they being shown in plan in Fig. 4. The two end blocks *f* of each intermediate arch J are substantially like the block *f* of each lower arch I. The middle or key block *h* of each intermediate arch J is a curved block having projections at both of its ends which fit the adjacent recesses at the inner ends of the two end blocks *f*, thus constituting a self-sustaining arch.

The upper tier of arches K spans the intermediate tier of arches J and is sufficiently large to constitute an upper longitudinal flue *b*, extending lengthwise of the retort between the upper and intermediate tiers K and J. This upper longitudinal flue *b* is preferably two inches wide, and at its two lower ends it communicates through the spaces between the cross-supports L with the pit of the combustion-chamber. The several arches of which the upper tier is composed rest at their lower and outer ends upon the cross-supports L, with the exception of the front and rear arches, each of which rests upon one cross-support L and upon the adjacent bridge-wall D or E. At its outer lower ends each upper arch K abuts against the side walls of the furnace. Each upper arch K comprises two curved end blocks *f*, which are similar to blocks *f f* of the other arches I J, except that they are longer and have their lower ends shaped so as to fit the angle between the side

walls and the cross-supports or bridge-wall. Each arch K has also a central or key block *i*, similar to the key-block of each intermediate arch J, except that it is longer and is differently apertured, as will subsequently be pointed out.

The upper tier of arches K abuts against the side walls of the furnace, which withstand the lateral thrust thereof. The lateral thrust of the lower arches is supported by blocks M, inserted between the feet of the arches, and which are laid on the cross-supports and bridge-walls. The cross-supports themselves may be formed with thrust abutments.

The body of the retort is hence composed of three tiers extending lengthwise of the combustion-chamber and of arches spanning said chamber crosswise, each higher arch having a greater span than the arch beneath it, so that thereby unobstructed longitudinal flues are formed, leading directly from the fire-box to the return-passage G at the rear end of the boiler, and each arch is supported by cross-supports and the bridge-wall, which are spaced apart so that each longitudinal flue of the retort communicates with the pit of the combustion-chamber.

The construction of the retort as thus far described permits access to the boiler of the flame passing through the longitudinal flues *b* only through the open joints between the different arches of which each tier is composed. In order to increase this access, each of the several blocks *f*, *g*, *h*, and *i* of which the different arches are composed is provided with a plurality of vertically-extending apertures *m*, each of which is preferably a circular aperture two inches in diameter. As shown in Figs. 3, 4, and 5 of the drawings, each of the blocks *f*, *g*, and *i* has three of the apertures *m*, while each of the key-blocks *h* has six of the apertures *m*. As a consequence of this and of the location of the apertures *m* in the several blocks, as indicated in Fig. 2, the apertures of one arch are staggered with reference to the apertures of the arch immediately beneath, so that there is not a direct communication through any series of apertures between the pit of the combustion-chamber and the upper part of the combustion-chamber above the upper tier of arches K, which immediately surrounds the boiler. Owing to these perforations in the blocks of which these arches are composed there is full opportunity for the gases to ascend and reach the boiler, following their natural course, at the same time the apertures not affording sufficient area to prevent the the passage of some portion of the flame throughout the extent of each of the flues *b* to the rear end of the combustion-chamber.

The described construction of the body of the retort leaves unoccupied spaces in the part of the combustion-chamber extending alongside the lower part of the boiler, and the spaces thus formed are preferably partially occupied on each side of the boiler by a row, extending lengthwise alongside the boiler, of blocks N, of fire-brick or other refractory material, each of which blocks is preferably a cube twelve inches in each dimension. Each of these cubical blocks N has preferably a series of longitudinal perforations or holes *n*, each preferably three inches in diameter, and each row of the blocks N extends lengthwise of the boiler to substantially the rear end thereof, and the blocks are so arranged that their apertures *n* are in line with each other, thereby constituting unobstructed longitudinal flues extending lengthwise of the combustion-chamber. These blocks N rest upon the upper tier of arches K and against the side walls of the furnace. They are spaced apart to the same extent as are the several arches, the spaces *p* between them being in alinement with the spaces *o* between the arches.

The refractory retort as a whole is thus composed of the tiers of arches I J K and the longitudinal rows of blocks N, thus affording an extended mass in close proximity to the boiler the greater part of the length thereof back of the fire-box. The retort as a whole is located above the level of the tops of the bridge-walls, thus leaving below it the substantially unobstructed pit of the combustion-chamber to receive the unconsumed ash which is carried back of the bridge-wall.

The extended mass of which the retort is composed is traversed freely throughout its several longitudinal flues by the products of combustion and is thereby heated to incandescence or to a temperature approximating thereto. The retort thus becomes a heat-storage retort, retaining the heat and sustaining the temperature of the boiler at substantial uniformity, thus preventing any material falling of temperature and the chilling of the boiler when the fire is replenished by the addition of fuel. Unconsumed particles of carbon which pass into the retort are caught by the highly-heated surfaces of the retort and are thereby consumed, and any unconsumed combustible gases which pass into the retort have their temperature maintained by the retort, thus insuring their combustion. In this manner the maximum heating capacity of the fuel is secured, and the products of combustion emerge from the rear end of the retort at a high temperature, so as to have great heating efficiency in passing through the return-flues *a* of the boiler. The retort is thus both a smoke-consumer and a heat-retainer.

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 rear bridge-wall near the rear end of the boiler; 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 fire-box to the return-passage; a series of spaced cross-supports extending across the combustion-chamber, the top surfaces of which are on a level with the top surfaces of the bridge-walls, said cross-supports leaving a pit at the bottom of the combustion-chamber between the bridge-walls; and a heat-retaining smoke-consuming retort composed of refractory material, the body of the retort being composed of a plurality of tiers of spaced arches extending lengthwise of the combustion-chamber from the fire-box to near the rear end of the boiler, and spanning the combustion-chamber widthwise, each upper tier of arches having a greater span than the tier of arches beneath, and the arches of each tier resting at their lower ends upon the cross-supports (including here the bridge-walls as cross-supports), whereby a series of unobstructed longitudinal flues are formed each extending lengthwise of the retort from the fire-box to the rear end of the combustion-chamber, and each communicating with the pit of the combustion-chamber through the spaces between the cross-supports, and vertical flues are formed by the spaces between the arches, and each arch being composed of self-sustaining blocks of refractory material each having perforations therethrough whereby the several longitudinal flues are in communication with each other and with the portion of the combustion-chamber which surrounds the boiler, and the retort further including longitudinally-extending rows of longitudinally-perforated spaced blocks in the combustion-chamber alongside the boiler, the perforations in said blocks forming unobstructed longitudinal flues extending from the fire-box to the rear end of the combustion-chamber, and the spaces between said blocks constituting vertical flues, 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 front bridge-wall located back of the fire-box; a rear bridge-wall near the rear end of the boiler; 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 fire-box to the return-passage; a series of spaced cross-supports extending across the combustion-chamber, the top surfaces of which are on a level with the top surfaces of the bridge-walls, said cross-supports leaving a pit at the bottom of the combustion-chamber between the bridge-walls; and a heat-retaining smoke-consuming retort composed of refractory material, the body of the retort being composed of a plurality of tiers of spaced arches extending lengthwise of the combustion-chamber from the fire-box to near the rear end of the boiler, and spanning the combustion-chamber widthwise, each upper tier of arches having a greater span than the tier of arches beneath, and the arches of each tier resting at their lower ends upon the cross-supports (including the bridge-walls as cross-supports), whereby a series of unobstructed longitudinal flues are formed each extending lengthwise of the retort from the fire-box to the rear end of the combustion-chamber, and each communicating with the pit of the combustion-chamber through the spaces between the cross-supports whereby also a series of vertical flues are formed above the respective cross-supports, and each arch being composed of a plurality of self-sustaining blocks of refractory material each having perforations therethrough whereby the several longitudinal flues are in communication with each other and with the portion of the combustion-chamber which surrounds the boiler, substantially as set forth.

3. 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 rear bridge-wall near the rear end of the boiler; 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 fire-box to the return-passage; a series of spaced cross-supports extending across the combustion-chamber, and leaving a pit at the bottom of the combustion-chamber between the bridge-walls; and a heat-retaining smoke-consuming retort composed of refractory material and comprising a plurality of tiers of arches extending lengthwise of the combustion-chamber from the fire-box to near the rear end of the boiler, and spanning the combustion-chamber widthwise, each upper tier of arches having a greater span than the tier of arches beneath, and the arches of each tier resting at their lower ends upon said cross-supports, whereby a series of unobstructed longitudinal flues are formed each extending lengthwise of the retort from the fire-box to the rear end of the combustion-chamber, and each communicating with the pit of the combustion-chamber through the spaces between the cross-supports, and each arch being composed of self-sustaining blocks of refractory material each having perforations therethrough whereby the several longitudinal flues are in communication with each other and with the portion of the combustion-chamber which surrounds the boiler, substantially as set forth.

4. 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 rear bridge-wall near the rear end of the boiler; 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 fire-box to the return-passage; a series of spaced cross-sup-

ports extending across the combustion-chamber, and leaving a pit at the bottom of the combustion-chamber between the bridge-walls; and a heat-retaining smoke-consuming retort composed of refractory material and comprising a plurality of tiers of arches extending lengthwise of the combustion-chamber from the fire-box to near the rear end of the boiler, and spanning the combustion-chamber widthwise, each upper tier of arches having a greater span than the tier of arches beneath, and the arches of each tier resting at their lower ends upon the cross-supports, whereby a series of unobstructed longitudinal flues are formed each extending lengthwise of the retort from the fire-box to the rear end of the combustion-chamber, and each communicating with the pit of the combustion-chamber through the spaces between the cross-supports, and each arch being composed of blocks of refractory material, substantially as set set forth.

5. A smoke-consuming steam-boiler furnace having, in combination, a horizontal return-flue tubular boiler; a fire-box located at the front end of the boiler; 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 fire-box to the return-passage; a series of cross-supports extending across the combustion-chamber; and a heat-retaining smoke-consuming retort composed of refractory material comprising a plurality of tiers of arches extending lengthwise of the combustion-chamber from the fire-box to near the rear end of the boiler, and spanning the combustion-chamber widthwise, each upper tier of arches having a greater span than the tier of arches beneath, and the arches of each tier resting at their lower ends upon said cross-supports, whereby a series of longitudinal flues are formed each extending lengthwise of the retort from the fire-box to the rear end of the combustion-chamber, and each arch being composed of blocks of refractory material, substantially as set forth.

6. A smoke-consuming steam-boiler furnace having, in combination, a horizontal return-flue tubular boiler; a fire-box located at the front end of the boiler; 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 fire-box to the return-passage; and a heat-retaining smoke-consuming retort composed of refractory material and located in the combustion-chamber, the body of the retort being composed of a plurality of superimposed tiers of arches each tier of arches extending lengthwise of the combustion-chamber from the fire-box to near the rear end of the boiler, and spanning the combustion-chamber widthwise, said superimposed tiers of arches being spaced apart whereby a series of longitudinal flues are formed beneath the boiler each extending lengthwise of the retort from the fire-box to the rear end of the combustion-chamber, substantially as set forth.

7. A smoke-consuming furnace having, in combination, a combustion-chamber; a series of spaced cross-supports extending across the combustion-chamber and leaving a pit at the bottom of the combustion-chamber; and a heat-retaining smoke-consuming retort composed of refractory material and comprising a plurality of tiers of arches extending lengthwise of the combustion-chamber and spanning the combustion-chamber widthwise, each upper tier of arches having a greater span than the tier of arches beneath, and the arches of each tier resting at their lower ends upon the cross-supports whereby a series of unobstructed longitudinal flues are formed each extending lengthwise of the retort and each communicating with the pit of the combustion-chamber through the spaces between the cross-supports, and each arch being composed of self-sustaining blocks of refractory material each having perforations therethrough whereby the several longitudinal flues are in communication with each other, substantially as set forth.

8. A smoke-consuming furnace having, in combination, a combustion-chamber; and a heat-retaining smoke-consuming retort composed of refractory material located in the combustion-chamber, and comprising a plurality of superimposed tiers of arches each tier extending lengthwise of the combustion-chamber and spanning the combustion-chamber widthwise, said tiers of arches being spaced apart whereby a series of longitudinal flues are formed beneath the boiler each extending lengthwise of the retort, substantially as set forth.

9. A smoke-consuming steam-boiler furnace having, in combination, a horizontal return-flue tubular 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 heat-retaining smoke-consuming retort composed of refractory material and including longitudinally-extending rows of longitudinally-perforated spaced blocks in the combustion-chamber alongside the boiler, the perforations in said blocks forming unobstructed longitudinal flues extending from the fire-box to the rear end of the combustion-chamber, and the spaces between said blocks constituting vertical flues, substantially as set forth.

10. A smoke-consuming steam-boiler furnace having, in combination, a horizontal boiler; a fire-box at the front end of the boiler; a combustion-chamber beneath the boiler extending backward from the bridge-wall; a series of spaced cross-supports extending across the combustion-chamber and leaving a pit at the bottom of the combustion-chamber; and a heat-retaining smoke-consuming retort composed of a plurality of tiers of arches each tier extending lengthwise of the com-

bustion-chamber from the fire-box to near the rear end of the boiler, and spanning the combustion-chamber widthwise, each upper tear of arches having a greater span than the tier of arches beneath, and the arches of each tier resting at their lower ends upon the cross-supports, whereby a series of unobstructed longitudinal flues are formed each extending lengthwise of the retort from the fire-box to the rear end of the combustion-chamber, and each communicating with the pit of the combustion-chamber through the spaces between the cross-supports, and each arch being composed of refractory material, 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,

F. P. CUNNINGHAM.