(No Model.) 2 Sheets—Sheet 1.

S. R. THOMPSON.

FURNACE.

No. 540,563. Patented June 4, 1895.

Fig. 1.

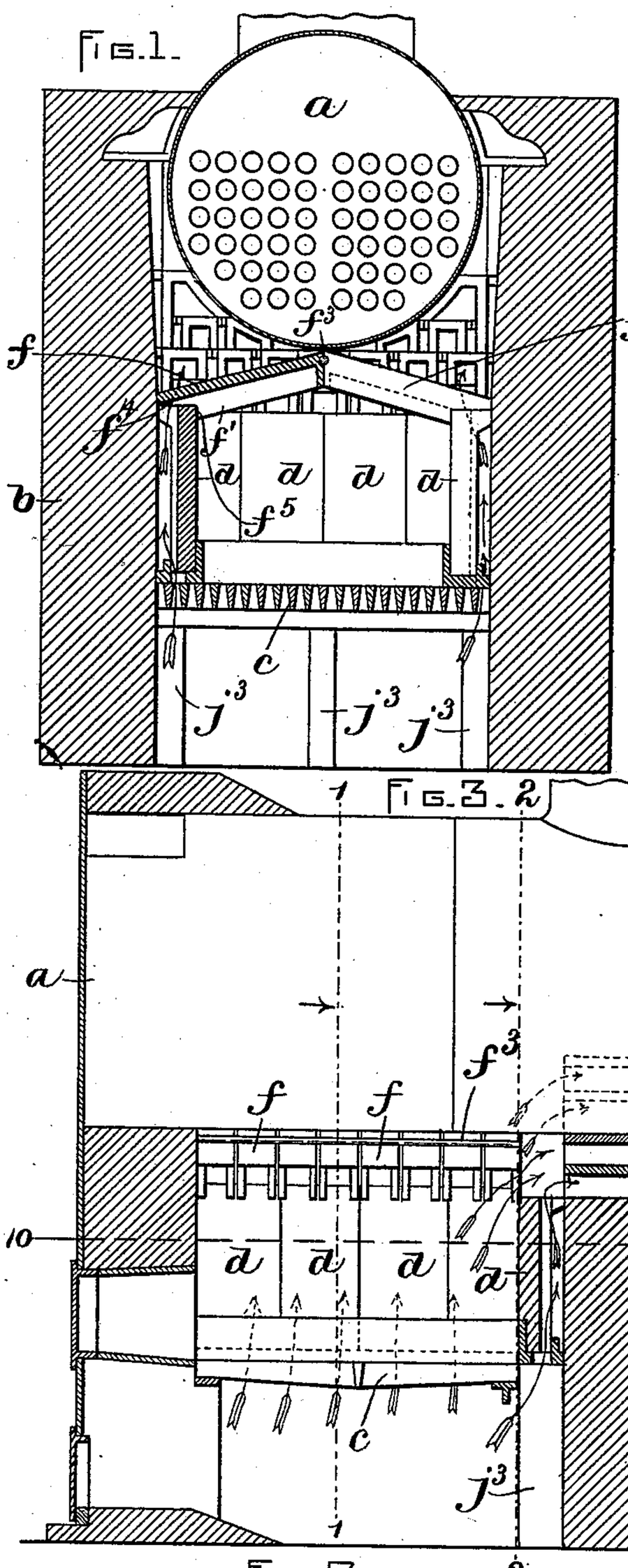

Fig. 2.

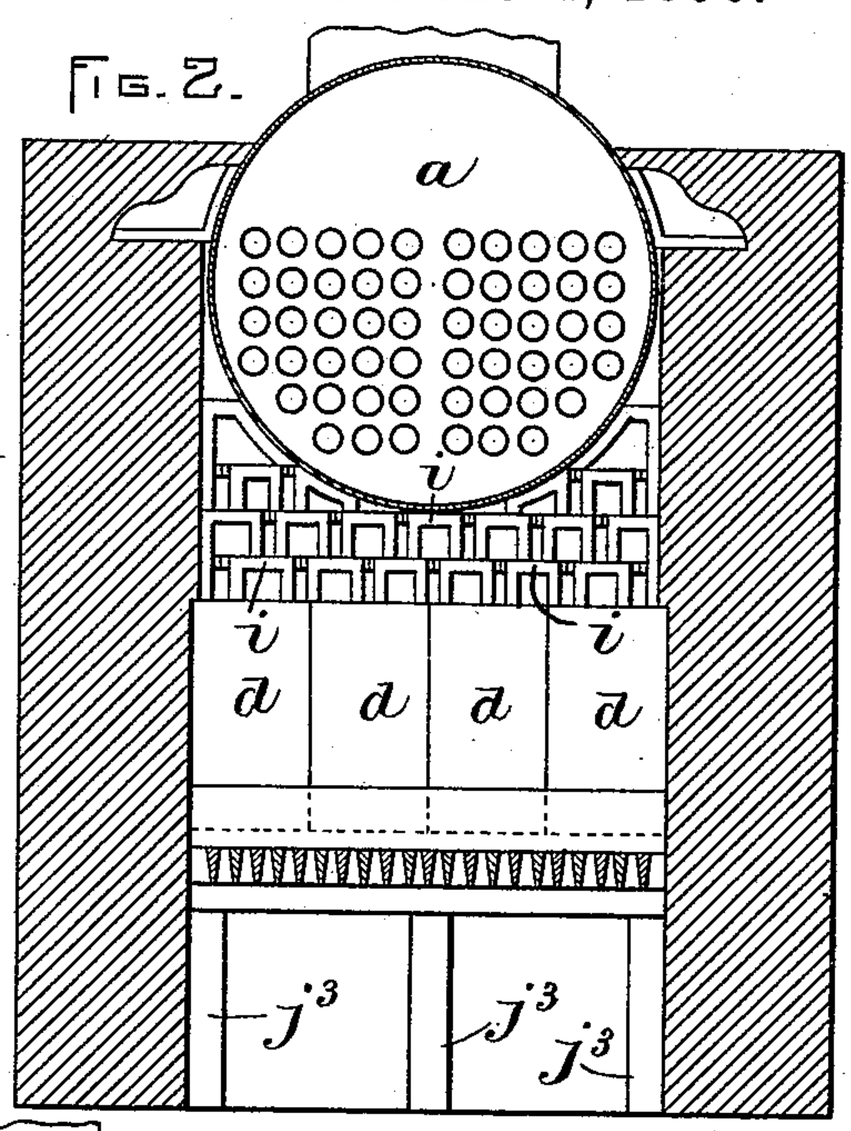

Fig. 3.

Fig. 4.

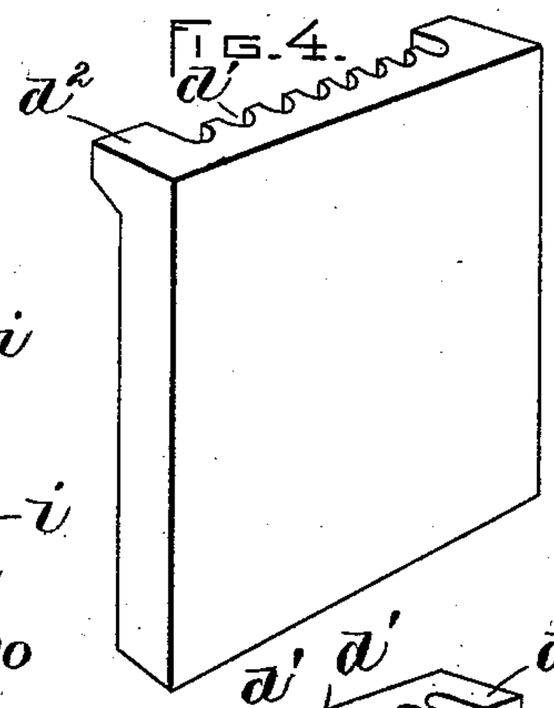

Fig. 5.

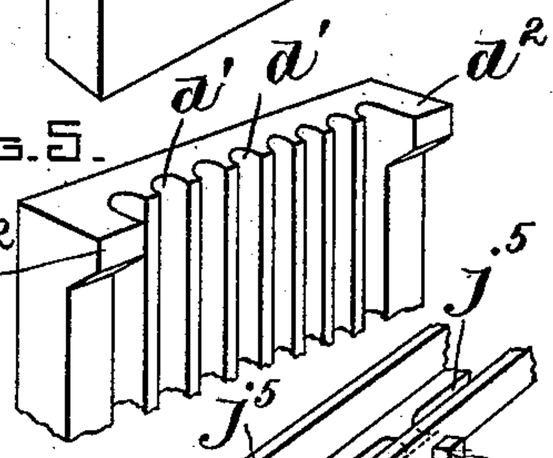

Fig. 6.

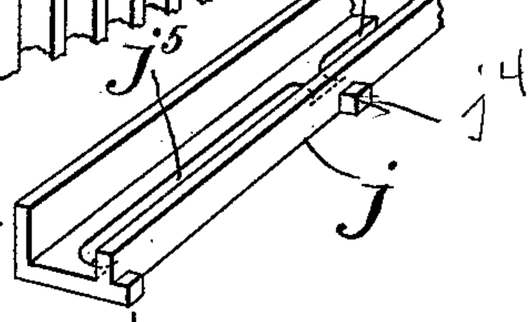

Fig. 7.

Fig. 8.

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FURNACE.

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FIG. 9.

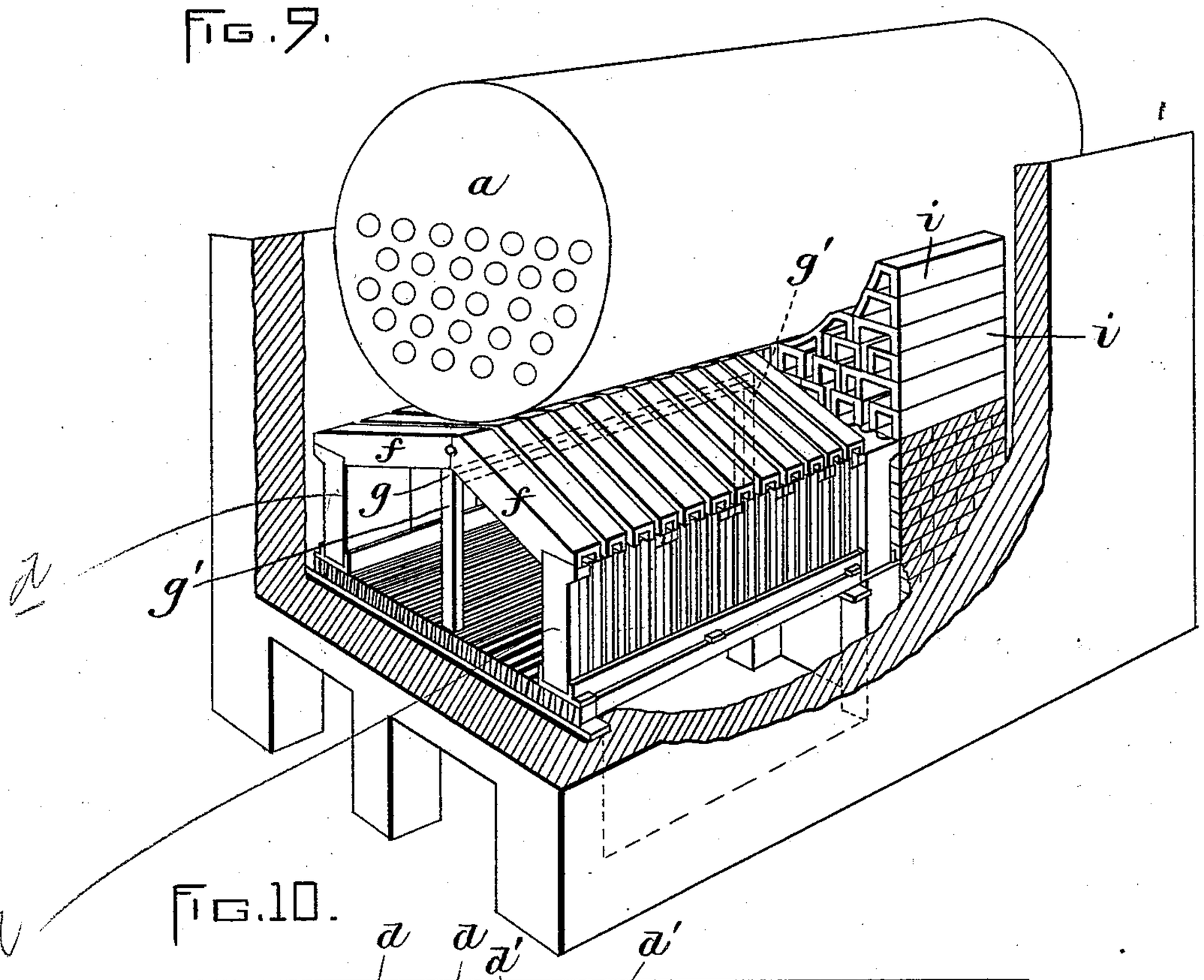
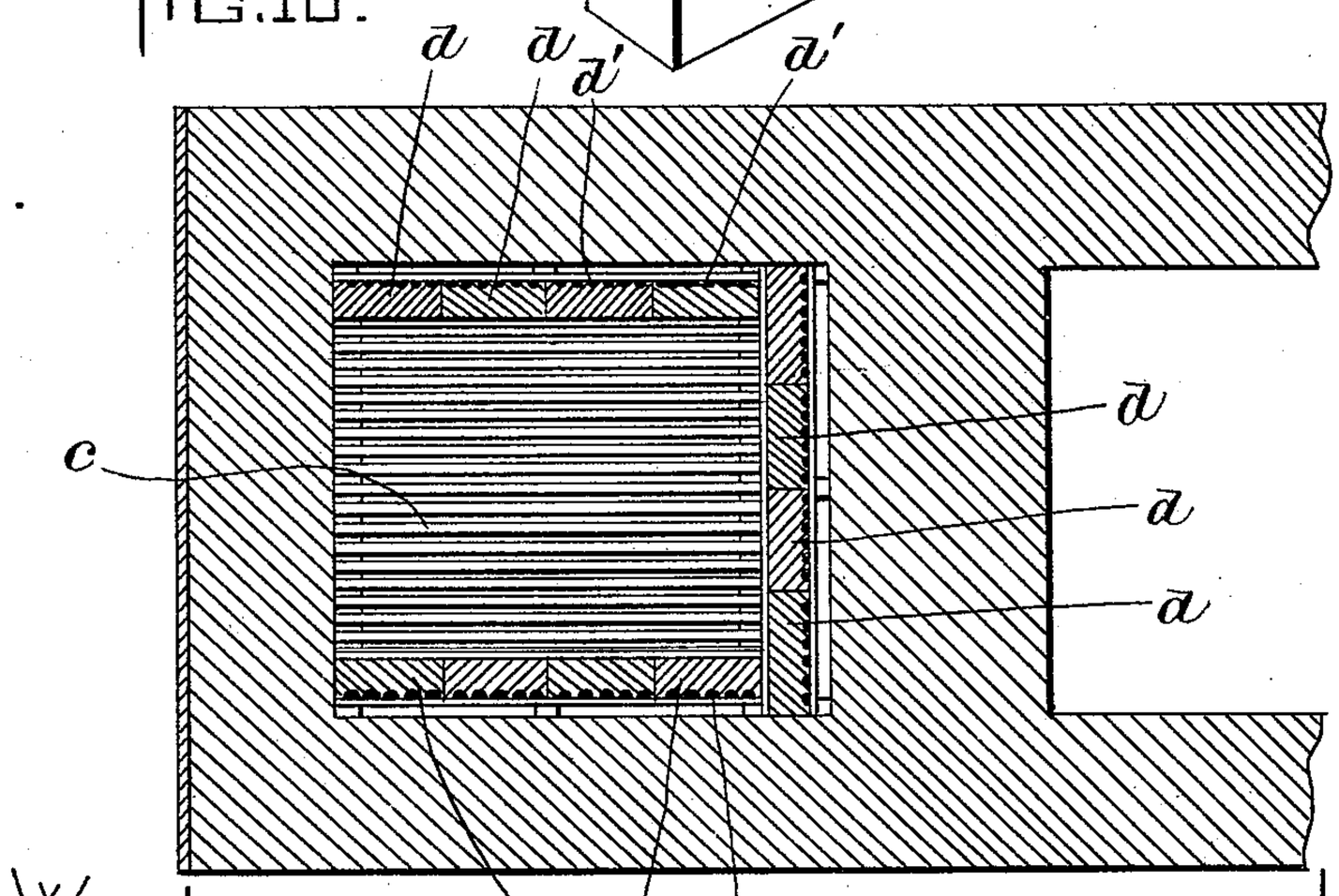


FIG. 10.



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UNITED STATES PATENT OFFICE.

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FURNACE.

SPECIFICATION forming part of Letters Patent No. 540,563, dated June 4, 1895.

Application filed August 11, 1894. Serial No. 520,067. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL R. THOMPSON, of Winchester, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Furnaces, of which the following is a specification.

This invention has for its object to provide improved means for insuring the combustion of the gases and carbon in boiler and other furnaces, to the end that the fuel may be more fully utilized and the escape of smoke and unconsumed products of combustion prevented.

To these ends, the invention consists in the improvements which I will now proceed to describe and claim.

Of the accompanying drawings, forming a part of this specification, Figure 1 represents a transverse section through a boiler-furnace provided with my improvements, the section being in the plane of line 1 1, Fig. 3. Fig. 2 represents a section in the plane of line 2 2 of Fig. 3. Fig. 3 represents a longitudinal section through the fire-box. Fig. 4 represents a perspective view of one of the lining blocks or slabs, showing the inner side thereof. Fig. 5 represents a similar view of a portion of one of said blocks, showing its outer side. Fig. 6 represents a perspective view of one of the shoes which support the lower edges of the lining blocks or slabs. Fig. 7 represents a perspective view of one of the heat absorbing and radiating chambers placed over the grate. Fig. 8 represents a perspective view of one of the flue-sections placed over the bridge-wall. Fig. 9 represents a perspective view of the construction shown in the preceding figures, a portion of the casing or setting of the furnace being removed. Fig. 10 represents a section on line 10 10 of Fig. 3.

The same letters of reference indicate the same parts in all the figures.

In carrying out my invention, I arrange a heat-absorbing and radiating structure over the grate of a furnace or fire-box, said structure being constructed so that it may be readily set up and taken down in the fire-box. The said structure is composed of lining-blocks *d* detachably supported at the sides of the fire-box by fixed flanged cast-iron shoes *j*, and bars or sections *f f* of refractory material, preferably fire-brick, which are detachably supported by the lining-blocks, and are disposed to form a structure or canopy extending across the fire-box and from end to end thereof at such height above the grate as to leave a sufficient space for combustion between the fuel and the radiator. In large furnaces, I prefer to arrange the sections *f f* so as to form a roof-shaped structure, the sections being grouped in two series, the inner ends of each series being raised and abutting against the inner ends of the other series, so that when the outer ends of the sections of both series are supported by abutments along the side of the fire-box, as hereinafter described, the sections will support each other at the central portion of the fire-box, and will be free from the liability to sag and give way at that point which would exist if each section extended in one piece across the fire-box.

The meeting ends of the sections *f f* are provided with cavities f^2 which receive cylindrical keys f^3 of fire-brick or other refractory material, said keys locking the abutting ends together, so that they are not liable to be accidentally separated. The raised ends of the sections are preferably arranged so as to bear against the under side of the boiler, as shown in Fig. 1.

In smaller furnaces, the roof-shaped structure is not so essential, and may be omitted, each section extending in a single piece across the fire-box.

The sections are provided with shoulders f^5 on their under sides, which engage the upper ends of the lining-blocks and prevent lateral displacement of said upper ends.

The sections *f* have cavities *f'* in their under sides, forming air chambers and increasing the heat-absorbing and radiating area of the sections. The walls of said cavities, becoming highly heated, superheat the air contained in the cavities and in the space below, so that a body of super-heated air always exists between the sections and the fire, which greatly promotes combustion.

Air is admitted at various points contiguous to the sections, to promote combustion, the air co-operating with the heated surfaces of the sections in consuming the products of combustion, and particularly the carbon, which would otherwise escape unconsumed.

The most important points for the introduction of air are at the outer ends of the sections and below the same, to insure perfect combustion in the space between the sections and the fuel. To this end, air ducts are provided outside of the refractory lining-blocks or slabs *d* which extend along the sides of the fire-box, said ducts being preferably between the lining-blocks and the inner surfaces of the setting *b* and the bridge-wall *e*. The ducts are or may be composed of vertical grooves *d'* formed in the outer surfaces of the blocks *d*, said grooves communicating at their upper ends with the chambers *f'* in the sections and at their lower ends with the ash-pit through orifices *j'* in the iron shoes *j* which support the lining-blocks, said shoes being here shown as supported by the grate at the sides of the fire-box and by piers j^3 at the inner side of the bridge-wall. The shoes may be provided with ears or lugs j^4 which bear against the surfaces of the casing and bridge-wall and form additional air-spaces. The lining-blocks *d* also have lugs or ears d^2 for the same purpose.

The sections are raised above the bridge-wall at its central portion, as shown in Fig. 1, so that a contracted outlet is formed at the rear end of the fire-box for the escape of the products of combustion.

The sections *f* are separated by narrow spaces or crevices, which permit the passage of a portion of the gases to the space above the sections. The outer ends of said crevices communicate with the air ducts above described, so that air is admitted to the space above the sections and co-operates there with the heated surfaces of the sections in consuming any combustible matter that may pass through said crevices.

To insure the complete combustion of the products of combustion that are not consumed in the fire-box, I provide a series of flue sections or partitions *i* which are made of fire-brick or other refractory material and are placed at the rear of the fire-box and preferably upon the bridge-wall, and practically fill the space between the bridge-wall and the under side of the boiler, as shown in Figs. 1, 2, and 3, each section being preferably a trough-shaped piece forming a passage which is open at both ends. The flue sections or partitions are packed closely into the space through which the products of combustion pass from the fire-box, and subdivide said space into a plurality of flues the walls of which present large areas of surface to the escaping products of combustion, and become highly heated so that they act to promote the combustion of the escaping gases, and particularly the carbon. These flue sections are found to be particularly advantageous in that they cause a much more thorough consumption of the smoke than would otherwise be possible.

In practice, I find that about ninety per cent. of the smoke is consumed by my improved apparatus; and this result I believe to be due largely to the flue sections arranged in the space through which the products of combustion escape from the fire-box. I do not limit myself, therefore, to the use of the said flue-sections in connection with the radiator over the fire-box, and may use said sections independently of the radiator. In other words, I may apply the flue sections to the outlet passage of any fire-box, whether provided with heat-radiating devices over the fire or not. By thus subdividing the space through which the products of combustion pass from the fire-box, I am enabled to deliver the products of combustion to the tubes of the boiler at a higher temperature than would be the case if the said products were left free to pass through the usual large and irregular spaces over the bridge-wall and behind it, where their temperature must of necessity be considerably reduced by radiation and by mingling with air at a relatively low temperature. The flue sections or partitions prevent radiation of heat from the products of combustion passing along their surfaces, so that they prevent much of the loss of heat heretofore experienced between the bridge-wall and the point where the products of combustion are delivered to the boiler, it being obvious that said flue sections or partitions may be made of any desired length and extended, if desirable, to the rear end of the boiler. I prefer to provide the outer sides of the flues with lugs or ears *i'* which prevent direct contact between the sections and insure narrow spaces between them.

It will be seen that the radiator presents large areas of heat-absorbing and radiating surfaces to the fire. Said surfaces, becoming highly heated and supplied with fresh air at numerous points, become efficient agents in consuming the carbon and other products of combustion, the result being the reduction to the minimum of the escape of carbon and other unconsumed products, and the complete utilization of the fuel. This result I believe to be due to the superheating of the air, as already described, and to the fact that the outlet passages through which the unconsumed products of combustion can pass are narrow or contracted and have highly heated walls or surfaces to which air is admitted freely at such a large number of points that there is practically no opportunity for the gases to avoid contact with surfaces sufficiently heated to co-operate with the oxygen of the air in insuring practically complete combustion.

My improvement enables an effective fire to be maintained with a much lighter draft than with furnaces of ordinary construction. Hence the waste attending the continued employment of a strong draft is avoided.

The flanged shoes *j* enable the lining-blocks to be applied and held in place without the use of mortar or cement, said shoes holding the blocks detachably, so that it is only nec-

essary to insert the lower edges of the blocks in the shoes, no other support or fastening being required.

I claim—

1. The combination of a furnace or fire-box, a stationary boiler above the same, fixed shoes or supports extending along the sides of the fire-box, a heat absorbing and radiating structure adapted to be set up and taken down in the fire-box and composed of lining-blocks supported by said shoes, and a series of refractory bars or sections supported by said blocks, a bridge-wall at one end of said structure and separated from the rear bars or sections by an outlet or opening, and means for admitting air into the space inclosed by said structure and bridge-wall.

2. The combination of a furnace or fire-box, a stationary boiler above the same, fixed shoes or supports extending along the sides of the fire-box, lining-blocks detachably supported by said shoes and provided with vertical air ducts, a series of refractory bars or sections supported by said blocks, the blocks and sections constituting a structure which is adapted to be readily set up and taken down in the fire-box and receives air through the ducts of the lining-blocks, and a bridge-wall the top of which is separated from the section at the rear of the series by an outlet, said bridge-wall having air ducts communicating with said outlet.

3. The combination of a furnace or fire-box, a stationary boiler above the same, fixed flanged shoes or supports extending along the sides of the fire-box, lining-blocks detachably supported and held in place laterally at their lower ends by said shoes and provided with vertical air ducts, a series of refractory bars or sections detachably supported by said blocks and preventing lateral displacement of the blocks at their upper ends, said bars being separated by narrow openings constituting outlets between the bars, and a bridge-wall the top of which is separated from the section at the rear of the series by a narrow outlet, said bridge-wall having vertical air ducts communicating with said outlet, the said lining-blocks and sections constituting a structure which is adapted to be readily set up and taken down in the fire-box and furnishes outlets for the products of combustion not only at numerous points above the fire between the highly heated surfaces of the sections but also at one end of the fire-box over the bridge-wall, the lining-blocks and bridge-wall supplying air which mingles with the products of combustion at said outlets.

4. The combination, with a furnace or fire-box, of fixed flanged shoes or supports, lining-blocks resting on said shoes and confined against lateral displacement at their lower ends thereby, and refractory heat-radiating sections resting on the upper ends of said blocks and having shoulders engaging the inner sides of the blocks and preventing lateral displacement of the blocks at their upper ends.

5. The combination, with a furnace or fire-box, of fixed shoes or supports, lining-blocks resting on said supports, a series of refractory sections supported by said blocks and extending across the fire-box, each section being composed of parts placed end to end and having their meeting ends socketed to receive keys and their outer ends shouldered to engage the upper ends of the lining-blocks, the said meeting ends being elevated above the shouldered outer ends.

6. The combination, with a furnace or fire-box and a boiler above the same, of fixed supports or shoes, lining-blocks resting on said supports, and a series of refractory sections supported by said blocks and extending across the fire-box, each section being composed of separate parts, the abutting ends of which are raised and bear against the boiler, whereby said sections are confined against upward displacement, the outer ends of the sections having shoulders which are engaged with the upper portions of the lining-blocks.

7. A furnace or fire-box having fixed shoes extending along its walls, said shoes having air openings; refractory lining-blocks or slabs supported by said shoes and provided with air ducts communicating with said openings; and a refractory heat radiator supported by said linings above the grate and provided with chambers communicating with said ducts.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 1st day of August, A. D. 1894.

SAMUEL R. THOMPSON.

Witnesses:

WALLACE G. WEBBER,

A. D. HARRISON.