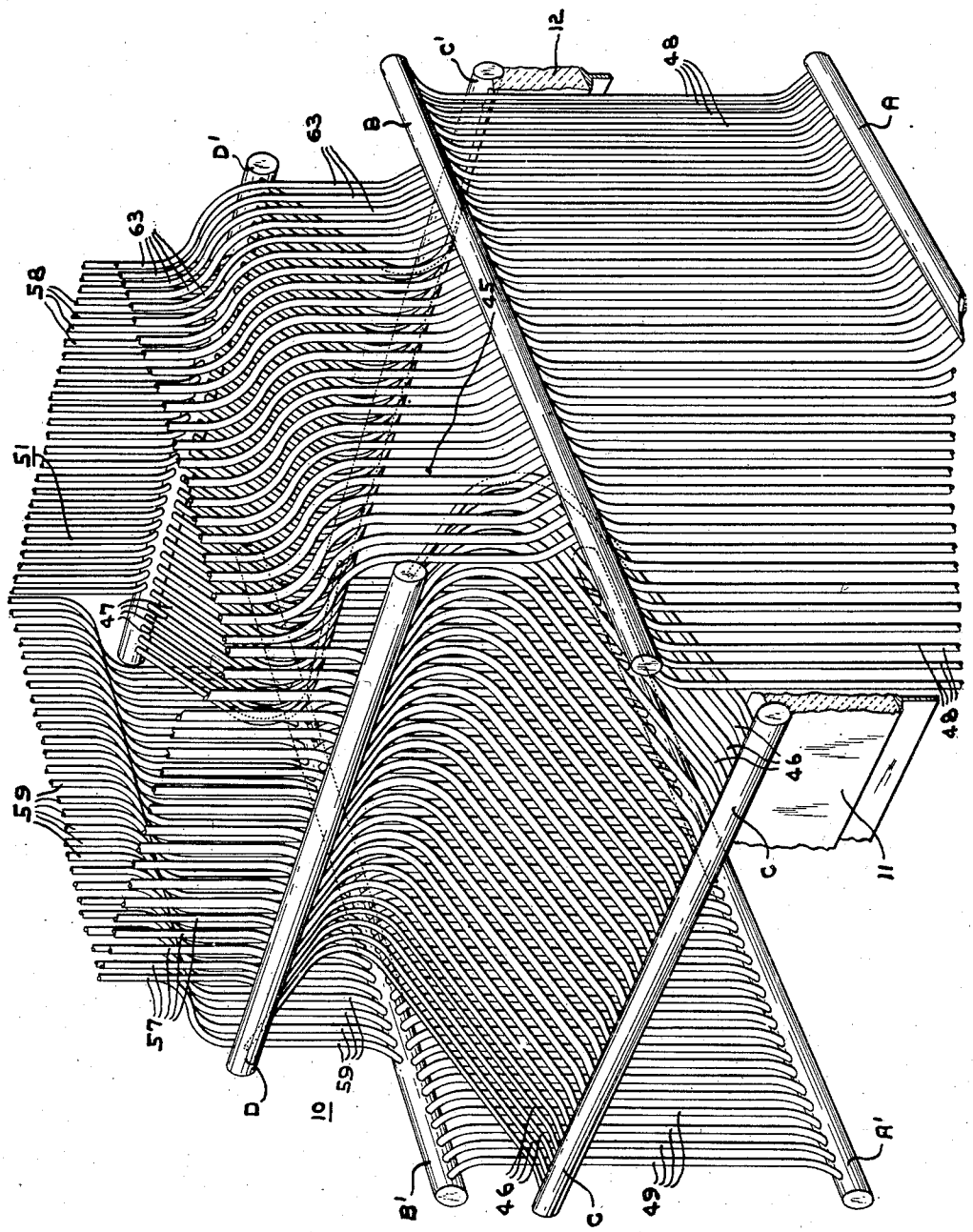
Dec. 7, 1943. R. A. FORESMAN ET AL 2,336,236

FURNACE STRUCTURE

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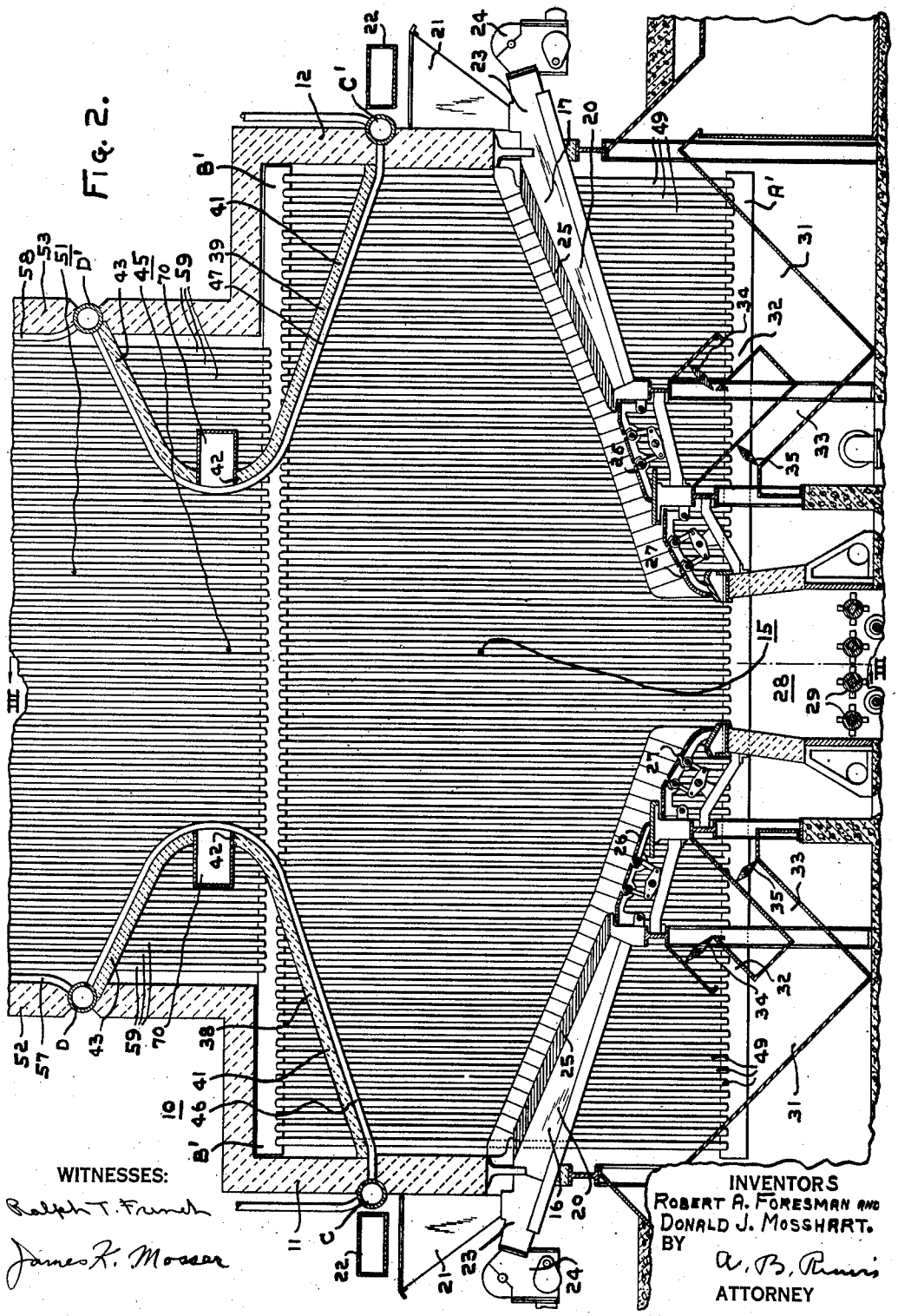
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FURNACE STRUCTURE

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Fig. 2.

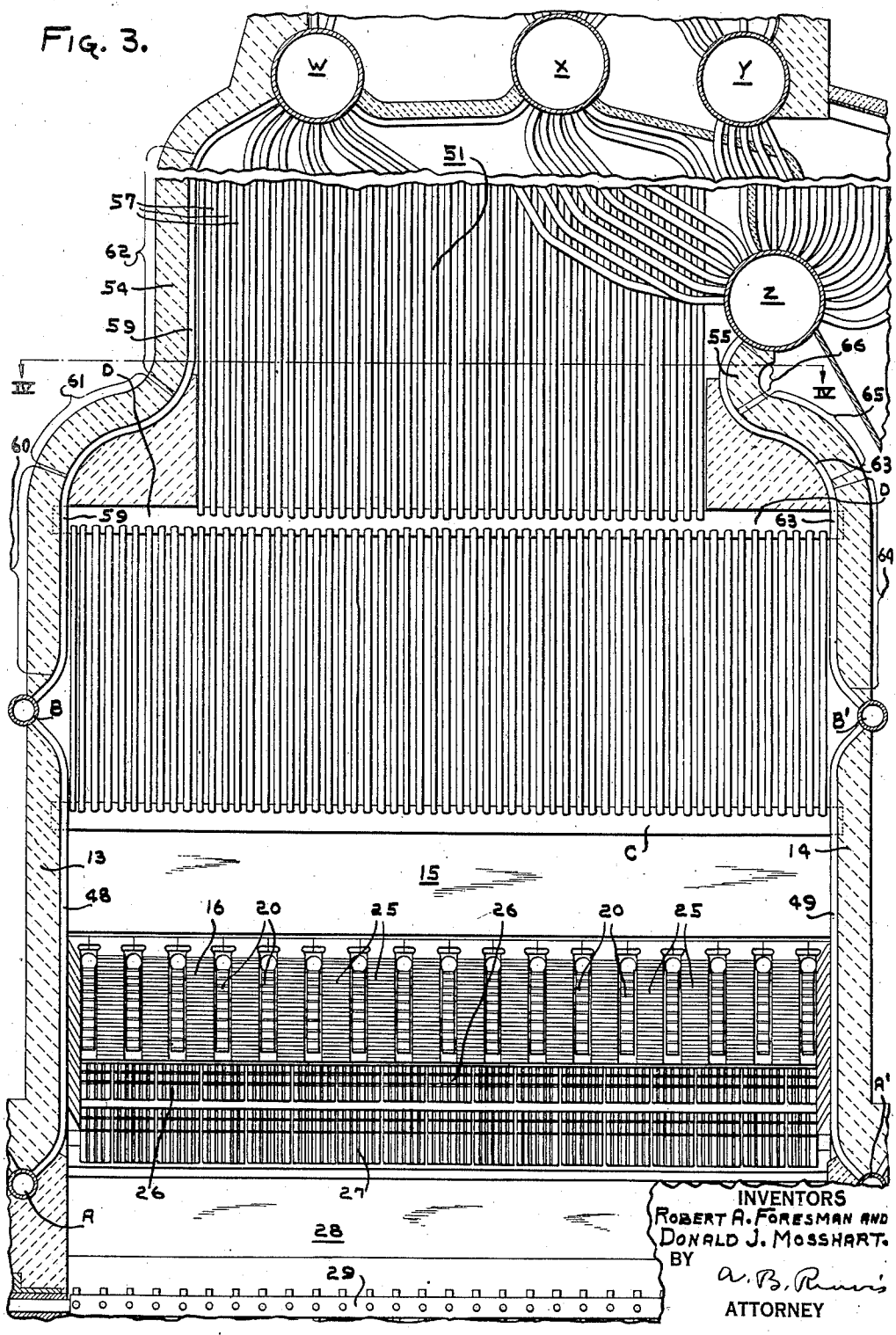


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Fig. 3.



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FURNACE STRUCTURE

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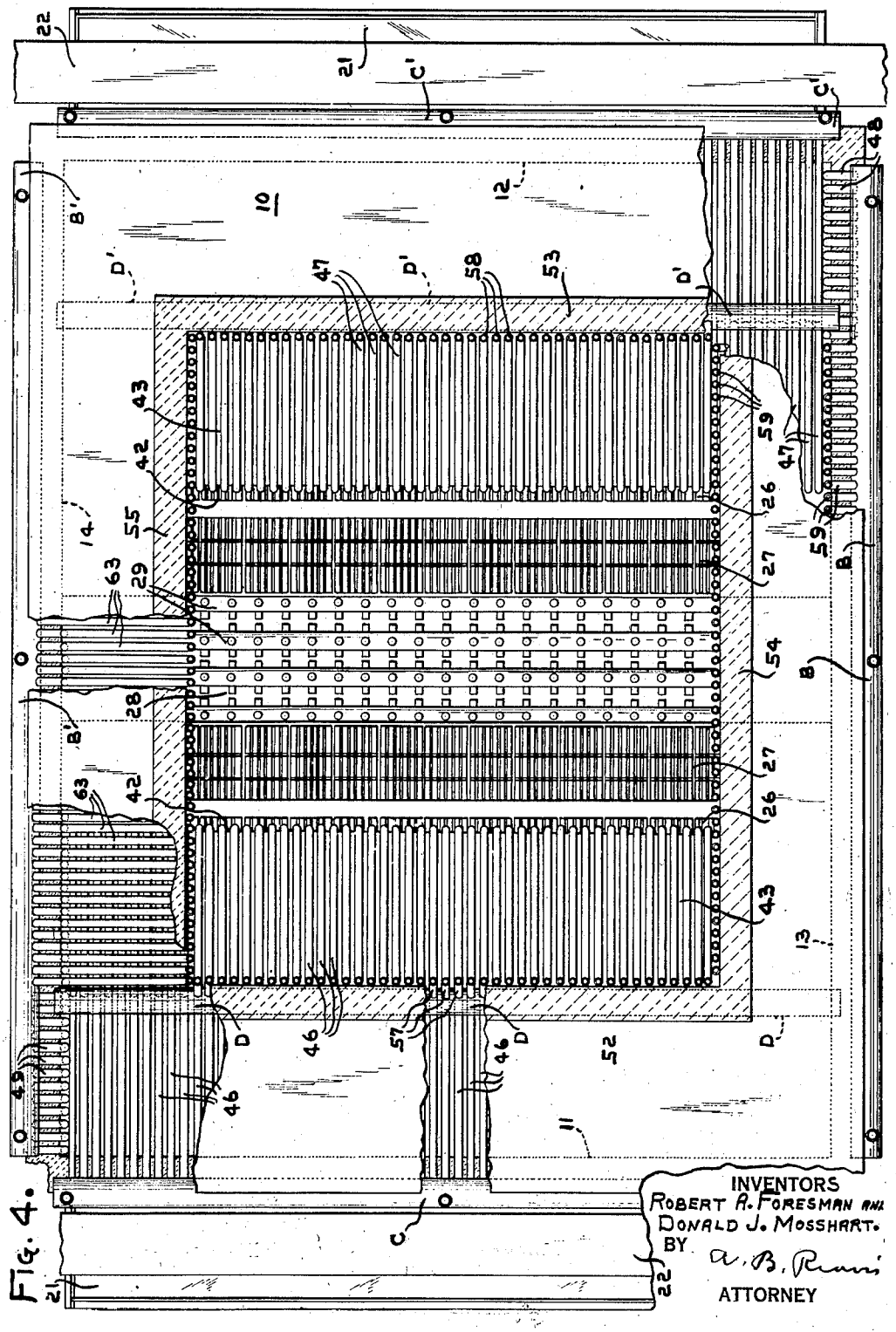


Fig. 4.

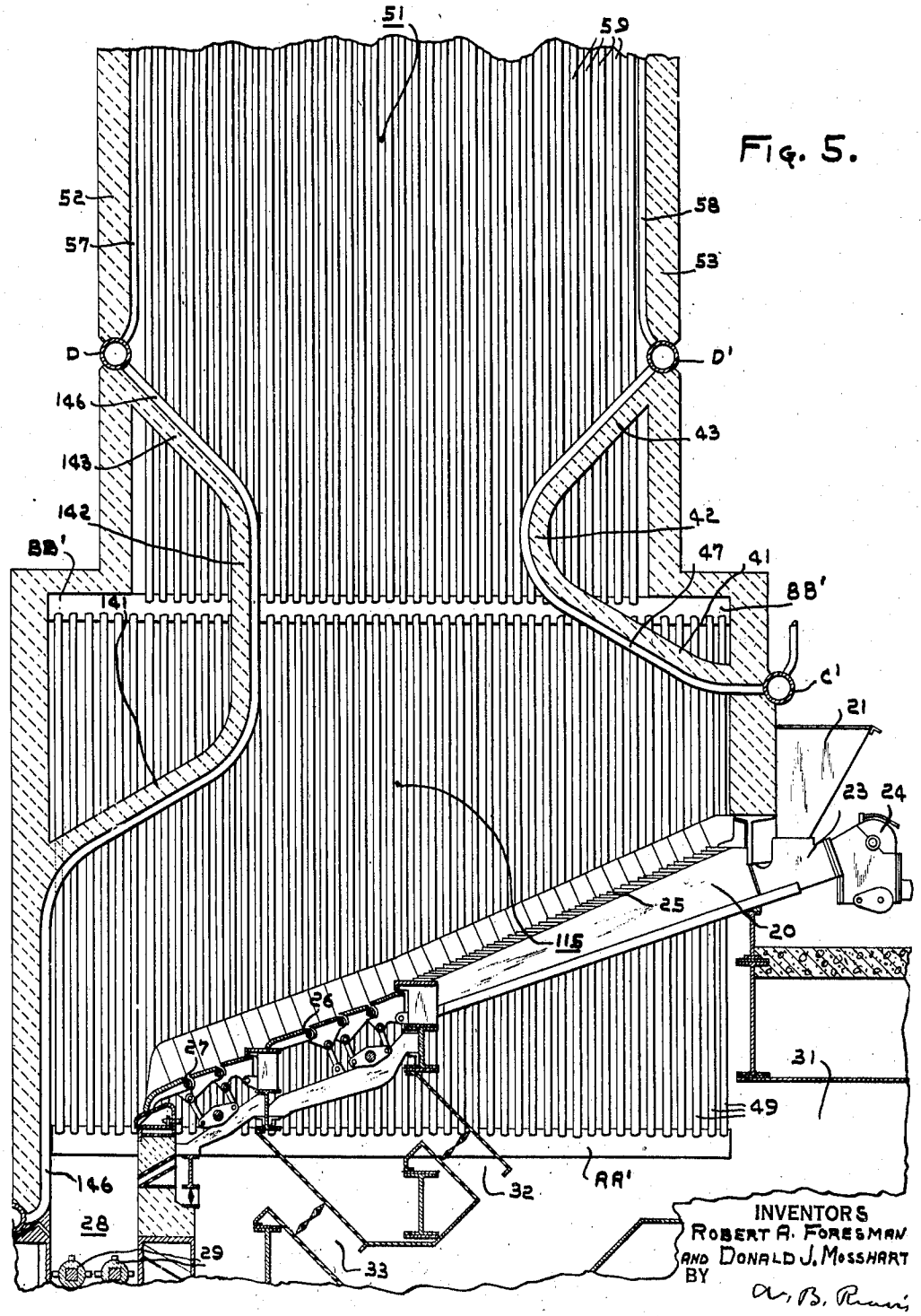
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Fig. 5.



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FURNACE STRUCTURE

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Application February 5, 1941, Serial No. 377,416

10 Claims. (Cl. 122—235)

This invention relates to furnaces, more particularly to furnaces for use with boilers, and has for an object the provision of an improved furnace of this character.

Heretofore, it was considered necessary that the boiler be as wide as the stoker in order that the side walls of the furnace would not overhang the stoker. The objection to such overhanging was that the overhanging structure would be rapidly destroyed if it were not water-cooled, and a suitable water-cooled overhanging structure had not been devised which would permit all four walls of the furnace surrounding the stoker to be brought inward to meet a boiler, both of whose horizontal dimensions were of lesser extent than the corresponding horizontal dimensions of the stoker.

Therefore, an object of the invention is the provision of a furnace with which a stoker of any desired size may be applied to a boiler of any desired size.

Furthermore, in prior practice, it had been considered necessary that width dimensions of a progressive feed stoker should lie parallel to the width dimension of the boiler. The assumption in this case was that combustion is uniform across the width of the stoker but is not uniform along the length of the stoker. It being recognized that the products of combustion entering the boiler should be of a uniform quality and velocity across the width of the boiler, it was considered necessary that the width of the stoker and boiler be parallel.

Therefore, another object of the invention is the provision of a stoker furnace having a restricted gas outlet, the restriction being made in both the width and length dimensions, so that it becomes immaterial whether the boiler is parallel or transverse to the stoker.

As pointed out above, it has heretofore been necessary to have a particular arrangement or design of boiler for a given stoker, with the result that the design of stokers and boilers has been dependent. As the cost of boilers varies to a large extent with the length of the boiler drums, this has constituted a serious limitation on the use of large stokers because of costly boilers with stokers of great width. The present invention contemplates divorcing the boiler design from the stoker arrangement so as to make possible a less costly boiler for a given size of stoker, this result being achieved largely by the use of shorter drums, that is, drums which may be relatively much shorter than the stoker width. In general, the stoker has water-cooled walls cooperating therewith to define a combustion chamber, but the walls have been modified from prior practice to provide a throat or orifice through which all of the combustion gases must flow to the heating surface of the boiler proper, the throat or orifice assuring of uniform distribution of gases to the boiler. Due to the throat or orifice, it becomes possible to provide boilers of varying width and length dimensions and with satisfactory supply of heating gases thereto as long as the boiler cross-sectional area is suitable to that of the combustion chamber. The width and length of the throat are selected to suit the boiler and the latter may have the drums thereof extending transversely of the stoker retorts, as heretofore, or parallel thereto. That is, the design of the boiler is made independent of the stoker and the boiler drums may be made relatively much shorter, thereby reducing the cost of the boiler.

Therefore, another object of the invention is the provision of a combination of stoker, furnace and boiler, wherein the boiler may be arranged either parallel to or transversely of the stoker.

Yet another object of the invention is the provision of a furnace having a rectangular outlet of smaller dimensions than the main part of the furnace, the furnace comprising four water-cooled walls which join together at the corners of what is, in effect, a truncated rectangular pyramid.

A further object of the invention is the provision of a rectangular furnace having a first combustion chamber for stoker apparatus, a second combustion chamber adapted to cooperate with a boiler, and a restricted throat between the two chambers, the throat restriction in one horizontal dimension being in a different horizontal plane than the restriction in the horizontal dimension normal to the first-named dimension.

These and other objects are effected by the invention as will be apparent from the following description and claims taken in connection with the accompanying drawings forming a part of this application, in which:

Fig. 1 is a perspective view of the water-cooling structure for the walls of the furnace;

Fig. 2 is a longitudinal sectional view through a furnace constructed in accordance with the invention;

Fig. 3 is a transverse sectional view taken along the line III—III of Fig. 2, looking in the direction of the arrows;

Fig. 4 is a horizontal sectional view taken along the line IV—IV of Fig. 3, looking in the direction of the arrows; and,

Fig. 5 is a vertical sectional view illustrating a modified form of the invention.

Referring now to the drawings more in detail, there is shown, at 10, a furnace comprising lower end walls 11 and 12, and lower side walls 13 and 14, the four walls cooperating to define a primary combustion chamber 15, generally rectangular in cross-section and serving to house stoker apparatus.

In the modification illustrated in Figs. 1 to 4, the stoker apparatus comprises a pair of multiple retort underfeed stokers 16 and 17 arranged in end-to-end relation with their feed ends adjacent the lower end walls 11 and 12, respectively, and their discharge ends adjacent the center of the primary combustion chamber 15.

Each of the stokers comprises a plurality of longitudinally-extending retorts 20 adapted to receive from the hopper 21 fuel supplied to the latter by the conveyor 22. A suitable ram structure 23, operated by the stoker gear box 24 serves to advance fuel from the hopper 21 to and along the retorts 20, all in a well-known manner. Fuel, spilling out of the retorts over the tuyère rows 25, moves downwardly onto the two overfeed sections 26 and 27 of the stoker, from the latter of which the ash and refuse is discharged into the single ash pit 28, common to the two stokers and extending transversely of the primary combustion chamber 15. Suitable means, such as the conventional clinker grinder rolls 29 may be provided in the ash pit 28 for reducing the refuse therein to a size suitable for discharge from the pit. Each stoker may be provided with suitable means for providing air thereto, for example, the plenum chamber 31 supplying air to the underfeed section of the stoker and having passages 32 and 33 leading therefrom and controlled by dampers 34 and 35, respectively, and through which passages air is supplied in measured quantities to the two overfeed sections 26 and 27, respectively.

A pair of arches 38 and 39 extend inward reentrantly toward each other from the lower side walls 11 and 12, respectively. Each arch comprises a section 41 extending upwardly and inwardly, a section 42 extending upwardly and a section 43 extending upwardly and outwardly, the adjacent upwardly-extending intermediate sections 42 defining therebetween a restricted throat for the exit of gases from the primary combustion chamber 15.

Suitable means are provided for water cooling the inner surfaces of the furnace; the means for cooling the arch 38 comprising bent tubes 46 extending along the inner surface of the arch and interconnecting a lower horizontal straight header C and upper horizontal straight header D. In like manner, the arch 39 is cooled by means of bent tubes 47 lying along the inner surface thereof and interconnecting the lower horizontal straight header C' and the upper horizontally-disposed straight header D'. The side walls 13 and 14 of the primary combustion chamber 15 are likewise provided with vertically-extending closely-spaced water tubes 48 and 49, respectively, the tubes 48 interconnecting a lower horizontally-disposed straight header A and upper horizontally-disposed straight header B, while the tubes 49, in like manner, interconnect a lower horizontally-disposed straight header A' and an upper horizontally-disposed straight header B'.

The throat 45 provides for flow of heating gases from the primary combustion chamber 15 therebelow to a secondary combustion chamber 51 disposed thereabove and defined by cooperating upper end walls 52 and 53 and upper side walls 54 and 55.

The upper end wall 52 is cooled by means of vertically-disposed tubes 57 extending upwardly from the header D to the boiler proper comprising drums W, X, Y and Z and their interconnecting tubes. In like manner, the upper end wall 53 is cooled by the vertically-disposed tubes 58 extending upwardly from the header D' to the boiler proper.

The upper side wall 54 of the secondary combustion chamber 51 is cooled by a plurality of tubes 59 extending upwardly from the header D to the boiler drum W or any other suitable portion of the boiler proper. These tubes may be considered as having three sections, there being a first section 60 extending upwardly, a second or intermediate section 61 extending inwardly over the re-entrant portions of the arches 38 and 39, and a third section 62 extending upwardly to the boiler proper. In like manner, the upper side wall 55 is cooled by tubes 63 having a first section 64 extending upwardly, a second or intermediate section 65 extending inwardly over the re-entrant portion of the arches 38 and 39 and a third section 66 extending upwardly to the boiler drum Z, or to any suitable portion of the boiler proper.

Referring to Fig. 2, it will be noted that the lower headers C—C' are spaced much farther apart than are the upper headers D—D', the spacing of the lower headers C—C' being determined by the overall length of the stoker structure, whereas the space of the upper headers D—D' is determined by the length of the boiler drums W, X, Y, and Z. Similarly, as shown in Fig. 3, the spacing of the headers A—A', and B—B' is determined by the width of the stokers, whereas the spacing of the upper side walls 54 and 55 is determined by the width of the boiler proper. Thus it will be seen that the arches 38 and 39 serve to reduce the effective area of the flow path of heating gas from the stoker apparatus to the boiler proper in one horizontal direction, while the side arches provided by the inwardly-extending sections 61 and 65 of the tubes 59 and 63, respectively, of the upper side walls serve to similarly reduce the flow path transversely of the stoker.

While the constructions herein illustrated have the boiler drums extending transversely of the stoker retorts, it will be apparent to those skilled in the art that with the throat restricted in both horizontal dimensions, the boiler drums may be arranged longitudinally of the stoker retorts if desired.

Not only does the restricted throat permit the use of a boiler of shorter dimensions than those of the stoker apparatus, but also provides for thorough mixing of all gases arising from the various sections of the stoker apparatus so that all portions of the boiler will be uniformly heated. Under some operating conditions, it may be desirable to add a certain amount of air to the combustion gases rising from the primary combustion chamber 15, and to this end there are provided air ducts 70 at the innermost portions 42 of the arches 38 and 39, these ducts opening through the arches into the throat 45.

While it should generally be preferable to use a double stoker arrangement as illustrated in Figs. 1 to 4, inasmuch as a balanced structure is

thereby possible, as well as one which is less expensive, there may be situations where a single stoker of suitable size may be installed to better advantage. Fig. 5 shows one arrangement of arches where a single stoker is used. In this furnace, the structure differs from that just described mainly in that the rear arch is somewhat flattened on its innermost face, being relatively narrower and higher and having a lower upwardly and inwardly-extending portion 141, an intermediate upwardly-extending portion 142 and an upwardly and outwardly-extending portion 143. Otherwise, the structure is substantially the same as that previously described and illustrated in Figs. 1 to 4, the side walls extending upwardly from the lower header AA' to the upper headers BB' and thence upwardly, inwardly over the re-entrant portions of the end arches, and then upwardly to the boiler proper.

It will be noted that in the arrangement of Fig. 5, while the rear wall of the primary combustion chamber 115 is water-cooled by the tubes 146, the front wall of the chamber is not illustrated as water-cooled. Likewise, in the modification of Figs. 1 to 4, the end walls of the primary chamber are not cooled. However, it will be obvious to those skilled in the art that these walls may be cooled in any suitable manner, this cooling means being omitted in the structures illustrated due to the relatively low height of these walls.

While the invention has been shown in several forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof, and it is desired, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What we claim is:

1. For use with a steam boiler, a furnace comprising mechanical stoker structure, vertical side and end walls enclosing said stoker structure, closely-spaced water tubes at the inner faces of said side walls, end arches overlying the stoker structure and providing therebetween a passage restricted longitudinally of the stoker structure for flow of heating gases, side arches overlying said end arches and restricting said passage transversely of the stoker structure, and closely spaced water tubes at the inner faces of said end and side arches.

2. In a furnace, the combination with a mechanical stoker, of lower side and end walls surrounding said stoker and providing a primary combustion chamber, said side walls comprising series of substantially vertical tubes; first upper and lower headers for said tubes; opposed end arches disposed between the planes of the side walls and comprising series of tubes extending upwardly and inwardly and then upwardly and outwardly; second upper and lower headers for the tubes of said arches, said second upper headers being disposed a material distance inwardly of said second lower headers; upper side and end walls extending upwardly from the first side walls and the end arches, respectively, and providing a secondary combustion chamber adapted to receive hot gases from the first combustion chamber, said upper end walls being of materially less width than the lower end walls and comprising a series of substantially vertical tubes having their lower terminal portions carried by the second upper headers, and said upper side walls being of materially less length than the lower side walls and comprising series of tubes extending vertically from said first upper headers past the second upper header, then inwardly to the edge of the upper side walls and then upwardly.

3. For use with a boiler, a furnace comprising mechanical stoker structure, and four water-cooled walls defining an enclosure for said stoker structure, said enclosure extending upwardly to a boiler and being restricted in one horizontal dimension in one selected plane and being restricted in the horizontal dimension normal to the first-mentioned horizontal dimension in another and higher plane.

4. A furnace comprising a pair of opposed multiple retort stokers; a centrally-disposed ash pit adapted to receive ash and refuse discharged from said stokers; a vertical lower end wall at the front of each stoker; a pair of vertical lower side walls cooperating with said lower end walls to provide a first combustion chamber common to the two stokers; arches extending re-entrantly toward each other from the end walls to define a throat restricted lengthwise of the stokers; upper end walls extending upwardly from said arches; upper side walls extending upwardly from the lower side walls and inwardly above the re-entrant portions of the arches and serving to restrict the throat transversely of the stokers, said upper end and side walls defining a second combustion chamber adapted to cooperate with a boiler and to receive from the first combustion chamber heating gases generated by the stokers.

5. In a furnace; a first pair of end walls and a first pair of side walls cooperating to define a primary combustion chamber; a pair of mechanical stokers within said chamber arranged end-to-end and each having means for mechanically maintaining a fuel bed with its feed end adjacent an end wall of the chamber and its ash discharge end adjacent the center of the chamber; a pair of arches extending re-entrantly toward each other from the end walls in overlying relation to major portions of the fuel beds and defining between their adjacent edges a throat extending transversely of the chamber; a second pair of end walls and a second pair of side walls cooperating to define a secondary combustion chamber overlying the primary combustion chamber and associated with a boiler and adapted to receive through the throat heating gases from the primary chamber, said second pair of side walls extending upwardly from the top of the first pair of side walls and inwardly above the re-entrant portions of the arches and serving to restrict the throat transversely of the primary chamber.

6. In a furnace; a first pair of end walls and a first pair of side walls cooperating to define a primary combustion chamber; a pair of mechanical stokers within said chamber arranged end-to-end and each having means for mechanically maintaining a fuel bed with its feed end adjacent an end wall of the chamber and its ash discharge end adjacent the center of the chamber; an ash pit extending transversely of the chamber midway of the end walls and adapted to receive ash and refuse discharged from said pair of stokers; a pair of arches extending re-entrantly toward each other from the end walls in overlying relation to major portions of the fuel beds and defining between their adjacent edges a throat extending transversely of the chamber; a second pair of end walls and a second pair of side walls cooperating to define a secondary

combustion chamber overlying the primary combustion chamber and associated with a boiler and adapted to receive through the throat heating gases from the primary chamber, said second pair of side walls extending upwardly from the top of the first pair of side walls and inwardly above the reentrant portions of the arches and serving to restrict the throat transversely of the primary chamber.

7. In a furnace; a first pair of end walls and a first pair of side walls cooperating to define a primary combustion chamber, said first pair of side walls comprising first pairs of lower and upper horizontally-disposed headers and simple tube connections therebetween; a pair of stokers within said chamber arranged end-to-end and each having means for maintaining a fuel bed with its feed end adjacent an end wall of the chamber and its ash discharge end adjacent the center of the chamber; a pair of arches extending re-entrantly toward each other from the end walls in overlying relation to major portions of the fuel beds and defining between their adjacent edges a throat extending transversely of the chamber, said arches comprising second pairs of lower and upper horizontally-disposed headers and connecting bent water tubes extending from the last-mentioned lower headers inwardly and then outwardly to the last-mentioned upper headers; and a second pair of end walls and a second pair of side walls cooperating to define a secondary combustion chamber overlying the primary combustion chamber and adapted to receive heating gases through the throat from the primary combustion chamber, said second pair of end walls comprising water tubes extending upwardly from the second pair of upper horizontally-disposed headers, and said second pair of side walls comprising water tubes extending upwardly from the first pair of upper horizontally-disposed headers and then inwardly above the re-entrant portions of the arches and serving to restrict the throat transversely of the primary chamber.

8. Structure as specified in claim 7, wherein the second pair of upper horizontally-disposed headers are materially closer together than are the second pair of lower horizontally-disposed headers, whereby the secondary combustion chamber is materially shorter than the primary combustion chamber.

9. A furnace comprising first vertical side and end walls defining a combustion chamber, means for continuously burning fuel within said chamber and thereby generating heating gases, arches extending inwardly from the upper edges of the side and end walls and defining a restricted outlet for heating gases from the combustion chamber, the inwardly-extending arches of one pair of opposed walls being disposed at a greater height than the inwardly-extending arches of the other pair of opposed walls.

10. For use with a boiler, a furnace having four water-cooled walls defining an enclosure for fuel combustion, said walls extending upwardly to a boiler and being restricted near the top of said enclosure in one horizontal dimension in one selected plane and being restricted in the horizontal dimension normal to the first-mentioned horizontal dimension in another and higher plane.

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