

H. A. POPPENHUSEN & J. HARRINGTON.
STEAM BOILER FURNACE.

APPLICATION FILED APR. 3, 1909.

1,064,857.

Patented June 17, 1913.

4 SHEETS—SHEET 1.

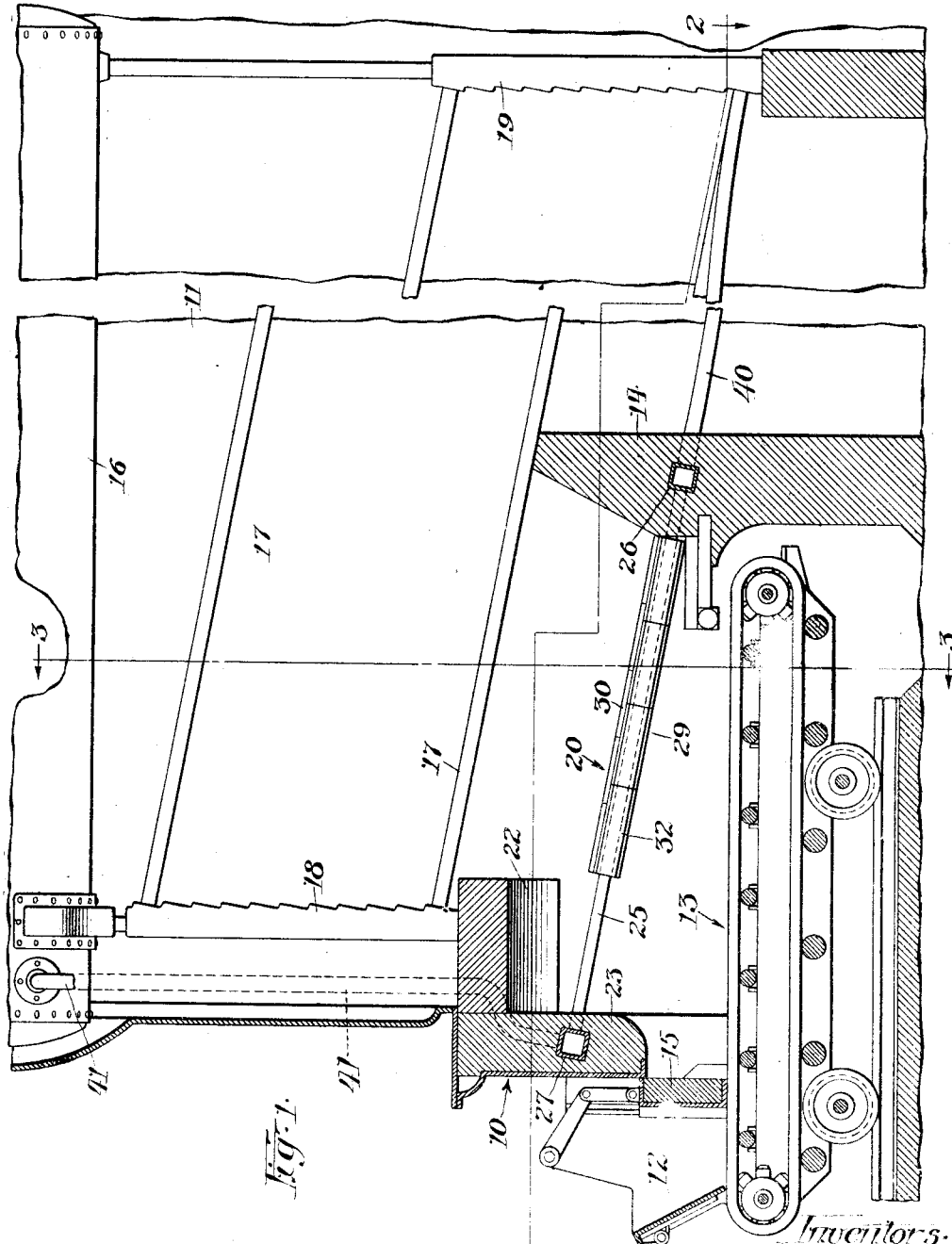


Fig. 1.

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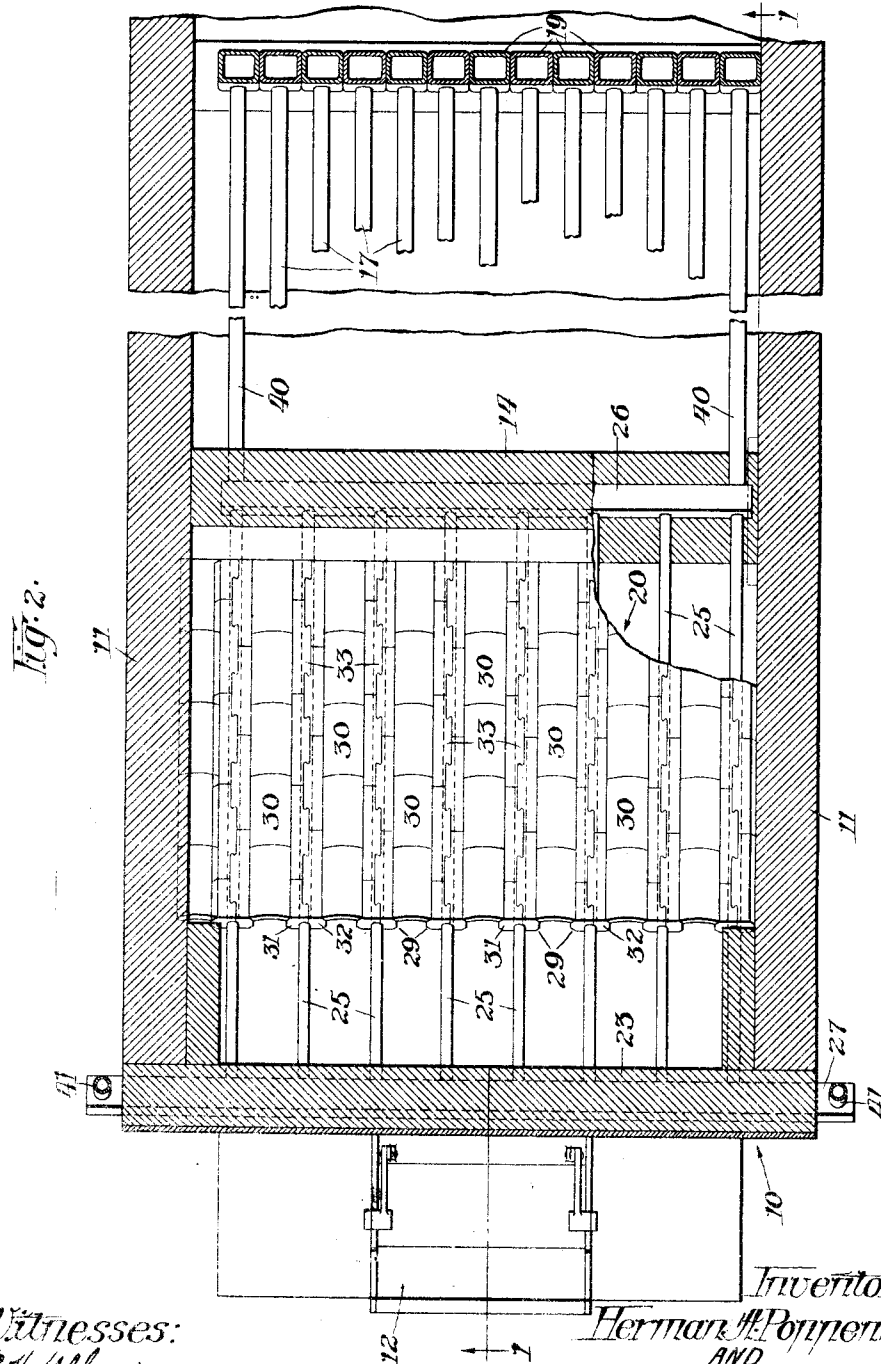
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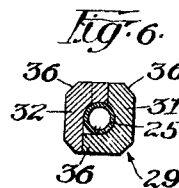
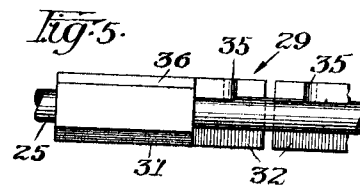
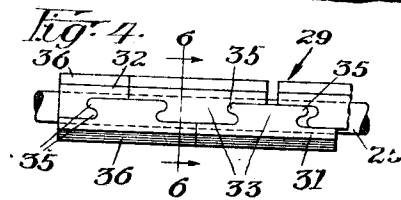
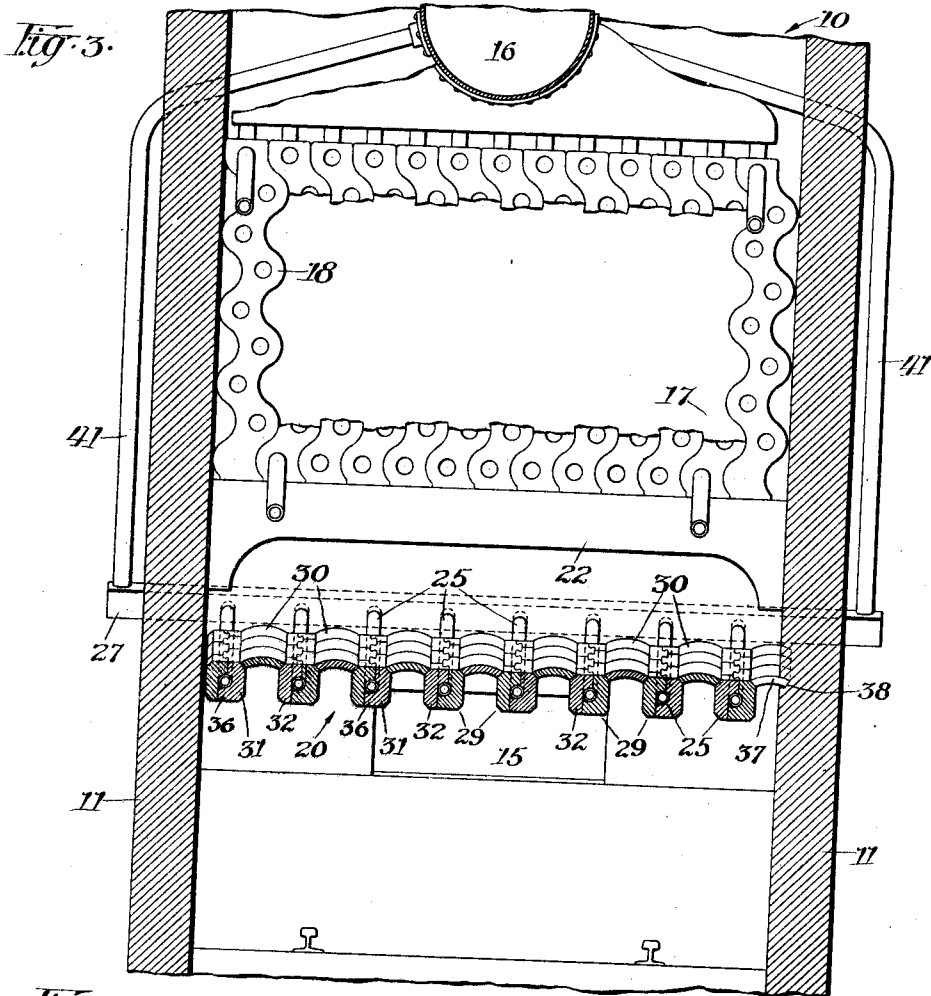
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4 SHEETS—SHEET 3.



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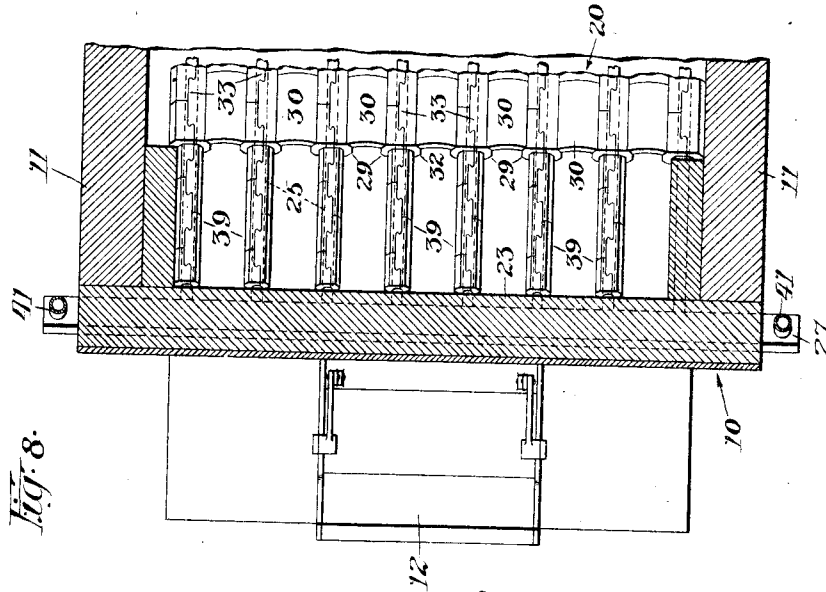


Fig. 8.

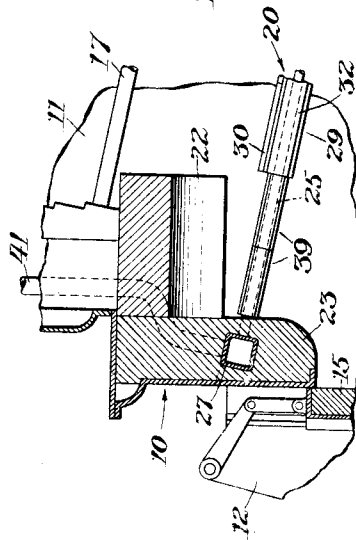


Fig. 7.

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UNITED STATES PATENT OFFICE.

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STEAM-BOILER FURNACE.

1,064,857.

Specification of Letters Patent.

Patented June 17, 1913.

Application filed April 3, 1909. Serial No. 467,630.

To all whom it may concern:

Be it known that we, HERMAN A. POPPENHUSEN and JOSEPH HARRINGTON, citizens of the United States, and residents of Evanston and Riverside, respectively, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Steam-Boiler Furnaces; and we do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to furnaces for steam boilers and other uses, and the invention relates more specifically to improvements in the deflecting partition, wall or arch located over the fire grate and arranged to direct the fuel gases over the fire bed in the grate in such a manner as to promote the combustion of the fuel gases.

The improvements constituting our invention are applicable to furnaces provided with automatic stoking devices, or means by which the fuel is advanced through the combustion chamber as it burns; and the deflecting partition, wall or arch is located above the fuel feeding or advancing grate in such manner that the burning gases are directed forwardly over the fire bed toward the fuel feeding end of the furnace in their passage from the combustion chamber to the smoke stack.

A furnace embodying our invention is provided with a deflecting partition which is made of relatively small depth or thickness, so as to occupy but little space in the furnace and which divides the combustion space above the grate and below the boiler into upper and lower compartments or spaces, in which complete combustion of the burning gases may take place before the same come in contact with any part of the boiler. Such deflecting partition embraces tubular, water cooled supporting members to which water to cool the same is supplied either from the boiler above the furnace or from an external source. The partition is so constructed that such water cooled supporting members are surrounded or covered by fire brick, so that the partition occupies little vertical space, and at the same time is adapted to act as a fire arch or coking breast, to receive heat from the

completely ignited fuel at the rear part of the grate and to transmit such heat by radiation to the fresh or partially ignited fuel, with the result of promoting rapid combustion and preventing the production of smoke.

We have herein shown our invention as embodied in the furnace having a traveling chain grate by which a layer of fuel is fed from the fuel feed end of the furnace rearwardly, but it will be obvious that it may be applied to furnaces having other forms of grates.

As shown in the drawings:—Figure 1 is a vertical, longitudinal section of a boiler furnace, taken on line 1—1 of Fig. 2, showing a deflecting partition, wall or arch embodying our invention. Fig. 2 is a horizontal section, taken on the indirect line 2—2 of Fig. 1. Fig. 3 is a transverse, vertical section taken on line 3—3 of Fig. 1, looking forwardly. Figs. 4, 5 and 6 illustrate a convenient form of sectional insulating fire brick covering for protecting the tubular supporting girders, Fig. 6 being taken on line 6—6 of Fig. 4. Fig. 7 is a fragmentary view of the front end of the furnace, showing a modification. Fig. 8 is a plan view of the parts shown in Fig. 7.

As shown in the drawings, 10 designates the front wall of the furnace; 11, 11 the side walls thereof; 12 the fuel hopper at the front wall; 13 the traveling or chain grate by which the fuel is advanced through the combustion chamber, and 14 designates the bridge wall of the furnace located at the rear part of the combustion chamber. A vertically movable gate 15 controls the feed of the fuel from the hopper 12 upon the traveling grate.

The boiler herein shown is of that type comprising an upper water drum 16, a nest of tubes 17 below the same, and front and rear headers 18, 19, respectively, connected with the water drum, in a familiar manner, and between which the tubes 17 extend.

20 designates, as a whole, the deflecting partition of the furnace. Said partition is located over the rear portion of the grate and extends forwardly from the bridge wall to a point near the front wall of the furnace and divides the space between the lowermost water tubes and the grate into upper and lower spaces or compartments. An opening is left between the forward end of

the deflecting partition, wall or arch and the front wall to constitute an outlet for the upward passage of the products of combustion from the lower to the upper compartment. In connection with such a partition, 20, may be employed a coking breast or fire arch 22 which extends rearwardly from the front wall 23 of the furnace, above the fuel feed opening thereof.

The deflecting partition, wall or arch and the means for supporting the same are constructed and arranged as follows: The deflecting partition, wall or arch consists of a plurality of supporting members or girders 25, 25 and fire brick arch members 30, 30 which span between and are supported at their sides on said supporting girders or members. The supporting members or girders are tubular and are designed to be cooled by circulation of water or other cooling medium therethrough. As herein shown, said girders or supporting members are parallel and are arranged side by side over the grate, and extend from the bridge wall 14 upwardly and forwardly to the front wall of the furnace. The said tubular girders open at their rear ends into a transverse distributing header 26 which is built or embedded in the bridge wall 14. The front ends of said tubular girders likewise open into a collecting header 27 which is embedded in the front refractory wall 23 of the furnace. The said headers 26 and 27 may consist of elongated steel box-like structures and are provided with openings into which the ends of the tubular girders or supporting members are expanded. In the present construction the distributing header 26 is contained wholly within the bridge wall. The collecting header 27 may, however, extend at its ends laterally beyond the side walls of the furnace for connection with circulatory return tubes outside of the furnace, as will hereinafter more fully appear. The portions of the tubular girders embodied in the deflecting partition, wall or arch may be covered by a fire brick insulating covering designated as a whole by 29.

The insulating coverings for the supporting members or girders, as herein shown, comprise laterally separable members 31, 32, of convenient lengths, which are applied to the lateral sides of the girders and are supported on the upper sides thereof. Said lateral members are provided at their upper sides with interlocking extensions 33 which overlap each other above the girders. As herein shown, the abutting joints between the ends of the covering members at one side of each girder are out of line with the joints between the covering members at the other side of the girder; and each member is formed with a centrally arranged interlocking extension 33, the ends of which are provided with lugs 35 which interfit with

correspondingly shaped notches in the adjacent ends of overlapping extensions of adjoining members. The latter members 31 of said coverings are provided at their lower sides with flanges 36 which extend horizontally beneath the tubular girders, and said flanges meet at their free margins the inner sides of the other members 32, substantially in the planes of the sides of the girders which the members 32 cover. Thus the members 32 may be vertically dropped into place on the girders, which is an advantage when a girder is located closely adjacent to the side wall of the furnace, as shown at the left hand side of Fig. 3. Where there is ample room at both sides of the girders to fit the covering members laterally to the girders, the members for each side of each girder may be made duplicate and the lower sides thereof may meet beneath the girders.

The fire brick members 30 which extend between the tubular girders or supporting members are shown as made of arched form and as beveled at their side edges to fit correspondingly beveled or inclined seats 36 on the insulating coverings 29, to afford the proper bearing for the said members. The arrangement described places the fire brick members and the supporting parts of the insulating coverings under compressive strains only, the fire brick of which they are made being best adapted to withstand such strains. In constructions where the spacing of the girders is such that one of the side girders is spaced a distance from the adjacent side wall, the space between the insulating covering for that girder and the side wall may be spanned by narrow arch sections 37, as shown at the right hand side of Fig. 3. In such arrangement the furnace wall will be provided on its inner side with shoulders or seats 38 to support said narrow arch sections.

The deflecting partition, wall or arch terminates just inside of the inner end of the fire arch or coking breast 22, and the girders 25 which extend beyond said partition, wall or arch to the front wall of the furnace may or may not be provided with an insulating covering. As shown in Figs. 1, 2 and 3, the portions of the girders in front of the deflecting partition, wall or arch are uncovered. As a further improvement, we have shown in Figs. 8 and 9 said extended ends of the girders as provided with fire brick coverings 39, which may be made like the fire brick covering 29 before referred to, which constitute parts of the partition, wall or arch proper. Such fire brick coverings 39 will be used in cases where the contact of the heated or burning gases with the uncovered tubular supporting members, forward of the partition, would so cool such gases to such extent as to unduly retard the

combustion thereof and produce smoke. By the use of the said coverings 39 the burning gases are permitted to reach the boiler without substantial diminution of temperature.

5 Devices are illustrated for maintaining the circulation of a cooling medium through the hollow girders or tubular supporting members 25, as follows: 40, 40 designate distributing tubes, located one at each side 10 of the furnace, which extend forwardly from the lower side of the rear or lower boiler header 19 to and communicate with the opposite ends of the distributing header 26 that is embedded in the bridge wall 14. 41, 41 designate collecting tubes which communicate at their lower ends with the ends 15 of the collecting header 27, outside of the side walls of the furnace. They extend upwardly at each side of the furnace and are turned inwardly toward the water drum, to 20 which they are connected below the water line thereon. The tubes 40, 40 constitute supply tubes to supply the cooling water to the distributing header 29 from whence it is distributed to the various hollow girders 25 25 to cool the same. The heated water is directed from the hollow girders to the collecting header 27 from whence it passes upwardly through the return tubes 41 to the drum 16. It will thus be seen that the cooling water is circulated at boiler pressure 30 through the hollow girders and is taken from the lowest or coolest part of the boiler and is directed upwardly through the hollow girders to the upper or hotter part of the boiler in the direction which the water 35 tends to rise by reason of the heating of the water in its passage through the hollow girders. The water passes directly from the distributing header 26 through the hollow 40 girders to the collecting header and therefrom flows through the length of but a single girder. Thus the resistance to the flow of the water through the hollow girders 45 is comparatively small, with the result of maintaining a rapid flow of the cooling water and a consequent promotion of the cooling effect on the hollow girders.

The construction and arrangement of the 50 parts of the deflecting partition, wall or arch is such as to provide a practical minimum depth or thickness of said arch, while affording means for firmly supporting the arch in position over the furnace grate. 55 The diminution of the depth or thickness of the partition, wall or arch makes it possible to materially decrease the height of the furnace, with the result of correspondingly decreasing the cost of construction, and contributing to compactness.

The construction described possesses important practical advantages over the massive deflecting arch structures heretofore 60 employed in furnaces which bridge between and are supported on the side walls of the

furnace, not only because of the saving of space in the furnace and the lessening of the height of the furnace, but also because the arch is not so liable to break down by its own weight, and while comparatively light 70 its construction is such as to amply support it. Moreover, our improved arch is capable of being more readily and economically repaired than the prior massive arch structures. This is obvious from a consideration 75 of the fact that the arch members are so supported on the girders or supporting members as to be readily removed and replaced without the necessity of disturbing the structure of the whole, or any part thereof 80 except the arch members to be removed and replaced. Moreover, the construction makes it possible to remove one or more of the supporting members or girders to repair or replace the same without the necessity of disturbing more than two rows of the arch 85 members, one at each side of the supporting member or girder to be removed and replaced.

In a furnace constructed as described, the 90 space between the fire grate and the deflecting partition, together with the space above said partition and below the water tubes of the boiler, together constitute a combustion chamber in which a high temperature is 95 maintained, as necessary for the rapid and complete combustion of the burning gases. The feature of construction, by which there is provided an open space, free from water tubes, above the deflecting partition, affords 100 important advantages, because giving ample space in which combustion of the burning gases may take place before such gases come in contact with and are largely reduced in 105 temperature by the water tubes or other part of the boiler containing the water to be heated. An important advantage is gained by applicants' construction in the deflecting partition, for the reason that by reason of its small vertical thickness, it becomes possible to provide such a partition and in connection with combustion spaces or chambers 110 both above and below the same, without the necessity of occupying a larger amount of vertical space below the water tubes or 115 lowermost members of the boiler than is practically available for the purpose.

It will be understood that a deflecting partition made as described and shown serves to deflect the burning gases from the partially consumed portion of the fuel on the 120 rear part of the grate, forwardly to a point where they will become to a greater or less extent mixed with the more volatile constituents of the fuel, which are driven off 125 from the fresh fuel fed to the forward end of the grate. Moreover, such a partition, by reason of having its water-cooled metal supporting members entirely surrounded or covered by the fire-brick members, not only 130

serves to divide the space in which takes place the combustion of the gases into upper and lower, connected chambers, as described, but also serves the same purpose as the fire arch or coking breast 22 in aiding in the preliminary heating or coking of the fresh fuel as the same is fed into the front of the furnace and in maintaining a high temperature in the space immediately above the grate, thereby tending to promote the combustion of the burning gases from the fresh and partially consumed fuel and prevent the production of smoke.

In a furnace made as set forth, the lower surface of the deflecting partition is always kept at a high temperature by the passage along or over the same of the burning gases from the partially consumed fuel on the rear part of the grate, and the heat radiated from said partition aids in producing combustion both of the fuel and the gases arising therefrom, and in this respect producing an entirely different effect than that obtained in cases where a set of parallel water tubes or water-cooled members form, in whole or in part, the top wall or roof of such space or extend through the same. In this latter construction, the contact of the burning gases with the water-tubes, results in the rapid absorption of heat from and consequent cooling of said burning gases, and the consequent retarding of combustion, while the fire-brick surfaces of an arch or partition made as described has no cooling effect, but stores up heat communicated thereto by the burning gases from the rear part of the layer of fuel on the grate and by radiation transmits such heat to the fresh fuel, to aid in the preliminary heating or coking of the same, and in securing complete combustion of the burning gases, by which the production of smoke is prevented.

While a deflecting partition made as described may be used in a furnace which is without any coking breast 22, yet such a partition has special advantages when employed in connection with a coking breast arranged as illustrated in the drawings, for the reason that the deflecting partition and the coking breast together afford fire-brick surfaces, extending over the entire area of the grate and the fuel thereon, adapted to retain and radiate heat produced by the burning of the more completely ignited fuel, and to thereby promote the combustion not only of the fresh fuel as it is fed to the forward end of the furnace, but also the burning gases arising from the fully ignited

part of the layer of fuel on the rear or inner part of the grate.

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We claim as our invention:—

1. A furnace embracing a grate and a deflecting partition over the grate, comprising a plurality of tubular, metal, water cooled supporting members, fire brick coverings on said supporting members, the covering for each member comprising lateral sections interlocked with each other at the upper sides of the members, and fire brick members extending between and supported at their side margins upon said fire brick coverings.

2. A furnace provided with a deflecting partition, embracing a plurality of tubular, metal, water cooled supporting members, fire brick coverings on said supporting members, the covering for each member comprising lateral sections interlocked with each other, and fire brick arch members spanning the spaces between and supported on said coverings, said arch members having inclined side edges and the coverings being provided with inclined supporting seats which are engaged by the inclined side edges of the arch members.

3. A furnace provided with a deflecting partition embracing a plurality of tubular, metal, water cooled supporting members, fire brick coverings on said supporting members comprising laterally separable parts which are fitted to the supporting members, said lateral parts being provided at their upper margins above the supporting members with overlapping, interlocking extensions, and fire brick arch members spanning the spaces between and supported on said coverings.

4. A furnace provided with a deflecting partition embracing a plurality of tubular, metal, water cooled supporting members, fire brick coverings upon said supporting members and fire brick arch members spanning the spaces between and supported on said coverings, the said coverings embracing a plurality of laterally separable tiles which are interlocked at their margins at the upper sides of the supporting members.

In testimony, that we claim the foregoing as our invention we affix our signatures in the presence of two witnesses, this 29th day of March A. D. 1909.

HERMAN A. POPPENHUSEN.
JOSEPH HARRINGTON.

Witnesses:

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