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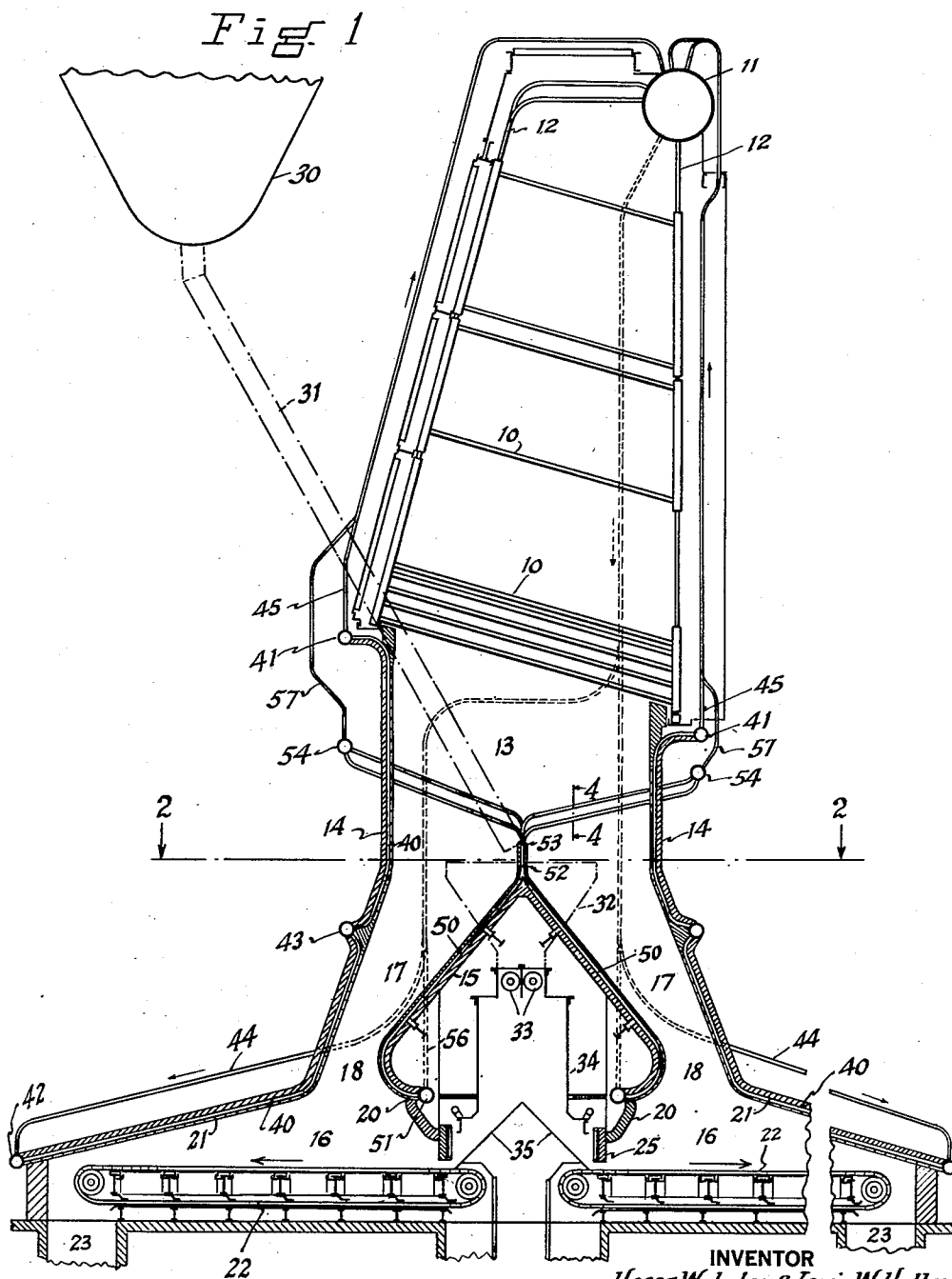
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2,057,622

MECHANICAL STOKER

Filed June 6, 1933

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Fig. 2

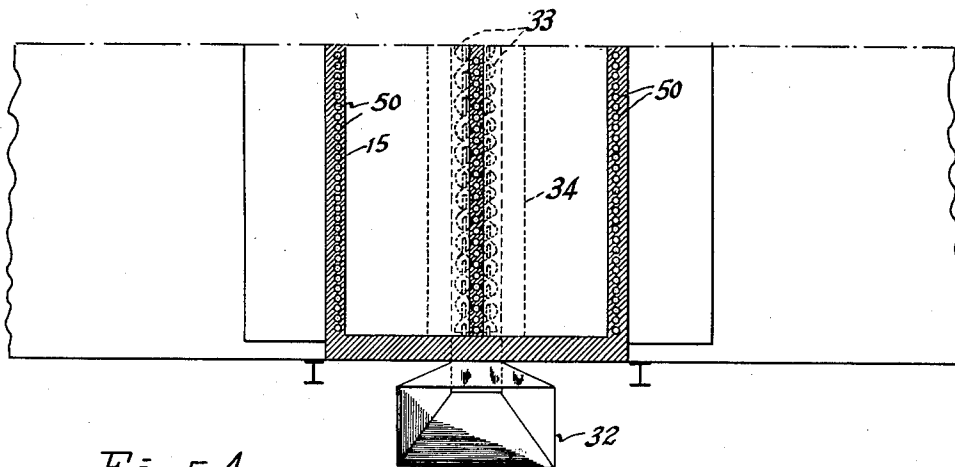
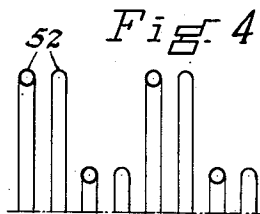


Fig. 5

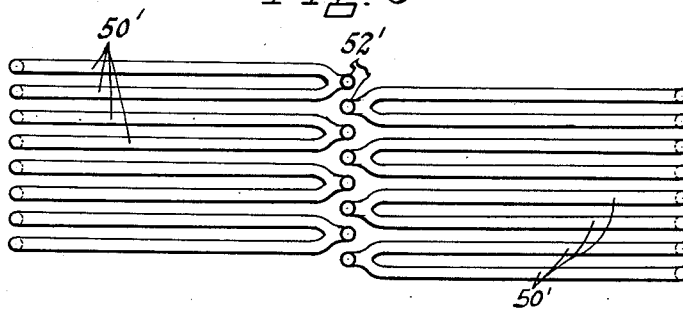
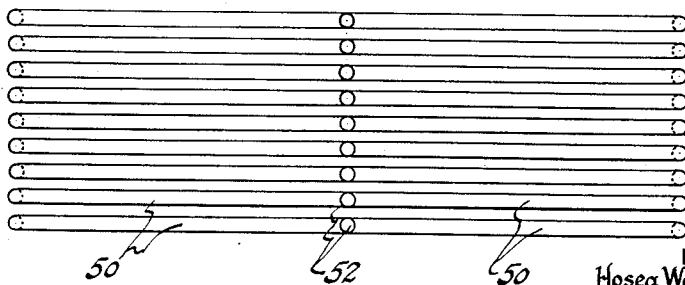


Fig. 3



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MECHANICAL STOKER

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22 Claims. (Cl. 122—235)

The present invention relates to the construction and operation of furnaces having relatively high fuel burning capacities, and more particularly to furnaces of the character described suitable for use in high capacity steam boilers of the water tube type.

Modern furnaces intended for burning solid fuels, such as bituminous coal, anthracite coal, coke breeze, or lignite, usually employ mechanical stokers of the underfeed, overfeed, or chain grate type. The fuel burning capacity of such furnaces depends primarily upon the effective grate surface in the furnace. For high capacities, a twin arrangement of underfeed stokers has been proposed. In such arrangements, the stokers are arranged at opposite sides of a common furnace chamber and independently operated, the fuel being supplied to the outer end and the ash discharged at the inner end of each stoker to a common ash pit. Underfeed stokers may be so arranged in a common furnace chamber in which high temperatures exist due to their capacity for control of the rate of movement of the fuel or residue over the discharge portion of the grate surface, allowing them to carry a thicker bed of fuel and ash residue than with chain grate stokers in which the rate of fuel travel is controlled by the speed of the chain. In the event that the operation of one underfeed stoker is disrupted in a twin arrangement of the character described, the other must also be thrown out of operation to prevent overheating of the first.

The general object of our invention is the provision of a twin arrangement of mechanical stokers for a high fuel burning capacity furnace which arrangement is characterized by a resultant high flexibility of furnace operation, high combustion efficiencies, a high fuel burning capacity per front foot of furnace, adequate protection of the stoker mechanism under all operating conditions, and simplification and lower cost of the stoker fuel feeding and driving mechanisms. A further and more specific object is the provision of a furnace construction of the character described which is especially adapted for a twin arrangement of chain grate stokers. A further specific object is the provision of a simple and effective slag screen for a furnace of the character described when associated with a water tube steam boiler. A still further specific object is the provision of an improved method of burning solid fuel at high capacities.

The various features of novelty which characterize our invention are pointed out with par-

ticularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which we have illustrated and described preferred embodiments of our invention.

Of the drawings:

Fig. 1 is a somewhat diagrammatic sectional elevation of one form of our invention;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is a plan view taken of the arch cooling provisions shown in Fig. 1;

Fig. 4 is a section on the line 4—4 of Fig. 1;

Fig. 5 is a view similar to Fig. 3 illustrating a modification; and

Fig. 6 is a view similar to Fig. 1 illustrating a modification.

In the embodiment illustrated in Figs. 1, 2, 3 and 4 of the drawings, the furnace forms the source of heat of a steam generating unit having a plurality of superposed banks of steam generating tubes 10 connected to a steam and water drum 11 by circulators 12 arranged to provide a natural circulation through the steam generating banks. The tube banks 10 extend across the upper portion of a heating gas pass 13, the lower portion of which forms the upper end of the furnace.

The lower portion of the furnace is divided by a central inverted V-shaped hollow wall or arch 15 extending transversely thereof into two separate and similar sections. The front and rear walls 14 of the furnace are so arranged relative to the arch 15 as to divide each furnace section into a lower or primary combustion chamber 16 and an upper or secondary combustion chamber 17 connected by a longitudinally restricted throat 18, each chamber progressively increasing in cross-sectional area from said throat in a plane transverse to the flow of gases through said throat and chambers. The upper combustion chambers 17 merge at their upper ends into the lower end of the heating gas pass 13. The lower side portions of the arch 15 and the opposite front and rear walls are shaped to form respectively short and long inclined ignition arches 20 and 21 for a pair of mechanical stokers 22 of the chain grate type.

Each chain grate stoker 22 is horizontally positioned in the corresponding lower combustion chamber 16 and arranged end-to-end relative to the stoker at the opposite side of the arch 15. The feed end of each stoker is advantageously

positioned below the arch 15 with its ash discharge end below the lower portion of the corresponding arch 21 and above a corresponding ash pit 23. Suitable driving mechanism is provided within the arch 15 for driving the stokers either independently or simultaneously.

At the lower end of each side of the arch 15 is arranged a vertically slideable coal gate 25 for controlling the amount of fuel supplied to each stoker. The fuel supply for the stokers is received from an overhead bunker 30 through a pipe 31 leading to a service hopper 32 at one side of the furnace. At the bottom of the hopper 32 and extending within and substantially throughout the length of the arch 15 are a pair of regulable screw conveyors 33 for conveying fuel from the hopper 32 to a central discharge hopper 34 from which inclined aprons 35 lead the fuel under the gates 25 to the feed ends of the stokers. With the foregoing arrangement, fuel may be simultaneously supplied to both stokers from the hopper 34, the supply to each stoker being separately regulable by controlling the position of the corresponding coal gate 25. The grates carry the fuel outwardly in opposite directions, air for combustion being supplied from side wall ducts below and along the upper run of the grate in a well known manner.

With the described furnace construction, the fuel supplied to each chain grate is moved outwardly from the middle of the furnace. The fuel is rapidly heated to its ignition temperature and burns freely during its travel towards the ash discharge point. Any unburned combustible gases driven off are further mixed with air at the throat 18 and combustion continues in the upper chamber 17. The restricted throat formation also causes an increase in the velocity of the gases passing therethrough. The gases passing upwardly through the adjoining chambers 17 intermingle in the heating gas pass 13, in which they pass successively over the tube banks 10 to the boiler outlet. A wide range in fuel burning capacity is obtainable while maintaining efficient combustion conditions by separately varying the amounts of fuel and air supplied to the respective stokers. The furnace construction described will permit the operation of one stoker while the other is idle, without subjecting the idle stoker to temperature conditions liable to cause overheating of the stoker mechanism.

The lower and upper combustion chamber walls are advantageously provided with suitable cooling provisions. In the present construction the outer walls are lined with refractory covered tubes 40 extending between upper and lower headers 41 and 42 respectively. An intermediate header 43 may be interposed in each tube row 40, if desired. The tubes 40 are preferably connected into the boiler circulation system by downcomers 44 and riser tubes 45 connecting the respective headers with the steam and water drum 11.

The opposite walls of the hollow arch are supported and cooled by rows of refractory covered inclined tubes 50 extending upwardly along the outer side thereof from bottom headers 51. As shown particularly in Figs. 1 and 3, the tubes 50 are the lower portions of bifurcated tubes 52, bifurcated at the apex of the arch 15. The tube refractory covering is continued along the tubes 52 for a short distance above the apex of the arch, thereby protecting the junction of the tube legs and the apex of the arch, and providing a short vertical baffle 53 between the two sections

of the furnace. At the upper end of the baffle 53 adjacent tubes 52 are bent in opposite directions to extend transversely across the heating gas pass, where they are connected to external headers 54. Adjacent tubes 52 on each side are vertically and horizontally spaced throughout their transverse extent to form a highly effective slag screen across the junction of each chamber 17 with the heating gas pass 13, as shown in Figs. 1 and 4. The arch and slag screen tubes are also preferably connected into the circulation system of the boiler by downcomers 56 and riser tubes 57 connecting the headers 51 and 54 respectively, to the steam and water drum 11. Each slag screen also serves as a heat screen when the corresponding stoker is out of operation.

Instead of having the bifurcated portions of the tubes 52 lining opposite sides of the arch 15, the bifurcated portions 50' of alternate tubes 52' may be arranged to extend along the same wall of the arch, with the bifurcations of adjacent tubes extending along opposite walls, as shown in Fig. 5.

In its broader aspects, our invention is adapted for use with other types of mechanical stokers, and in Fig. 6 a twin arrangement of underfeed stokers in accordance with our invention is illustrated. The underfeed stokers 60 are of a well known construction, receiving fuel from the interior of the arch 15' and discharging into separate ash pits 23'. In this construction, the vertical throat 18 is not required and the furnace is divided into two similar combustion chambers at opposite sides of the arch 15' merging at their upper ends into the heating gas pass 13. The lower ends of the arch walls are substantially vertical, while the front and rear walls 14' are slightly inwardly inclined. The furnace wall cooling tubes 40' extend downwardly along the ash pit wall and as well as the arch cooling tubes follow the contour of the adjacent wall surface.

In both embodiments of our invention illustrated, the pair of stokers receive fuel from a common fuel supply means and their operation can be regulated to obtain the best combustion conditions for the fuel to be burned thereon. The protection afforded each stoker from the heat radiated by the fuel burned on the other stoker permits the most desirable fuel bed thickness to be maintained at the ash discharge end for burning out any carbon in the fuel residue. Only a minimum amount of excess air need be supplied for combustion as the stoker arrangement insures a central gas stream sandwiched between two air streams as the streams enter the gas pass 13, resulting in the rapid combustion of any unburned combustible gases at that point. The presence of an air stream adjacent the furnace front and rear walls reduces the slagging effect on and increases the amount of radiant heat absorbed by those walls.

While in accordance with the provisions of the statutes we have illustrated and described herein the best forms of our invention now known to us, those skilled in the art will understand that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention covered by our claims, and that certain features of our invention may sometimes be used to advantage without a corresponding use of other features.

We claim:

1. In a furnace, a pair of chain grate stokers

arranged to travel outwardly in opposite directions, a hollow arch at the center of the furnace, means for cooling the exposed surface of said arch, and fuel feeding mechanism within said arch for supplying fuel to the inner end of each of said stokers.

2. In a furnace, a pair of mechanical stokers arranged end-to-end and each having means for mechanically maintaining a fuel bed with its feed end adjacent the center of the furnace and its ash discharge end adjacent an outer wall of the furnace, a hollow arch positioned over the feed ends of said stokers and having its outer surface exposed to radiant heat, means for cooling the exposed surface of said arch, and fuel feeding mechanism within said arch for supplying fuel to the feed ends of said stokers.

3. In combination, a furnace comprising an arch arranged transversely therein, outer walls combining with said arch to form pairs of lower and upper combustion chambers at opposite sides of said arch, the chambers at each side of said arch being connected by a longitudinally restricted throat, a mechanical stoker for burning a slag-forming fuel in each of said lower combustion chambers, a common heating gas pass above and opening to said upper chambers, a water tube boiler in said gas pass, and slag screen tubes extending across the entrance of each of said upper chambers to said gas pass.

4. In combination, a furnace comprising a central upwardly tapering arch symmetrically arranged therein, outer walls combining with said arch to form similar pairs of lower and upper combustion chambers at opposite sides of said arch, the outer walls opposite said arch flaring upwardly and downwardly relative to the lower portions of said arch to cause the chambers at each side of said arch to be connected by a longitudinally restricted throat and each chamber to progressively increase in cross-sectional area from said throat portion in a plane transverse to the flow of gases through said throat portion and chambers, a mechanical stoker for burning a slag-forming fuel in each of said lower combustion chambers, a common heating gas pass above and opening to said upper chambers, a water tube boiler in said gas pass, and slag screen tubes extending across the entrance of each of said upper chambers to said gas pass.

5. In a furnace, a pair of mechanical stokers, each having means for mechanically maintaining a fuel bed with its feed end at the center of the furnace and its ash discharge end at an outer side of the furnace, a hollow upwardly tapering arch positioned over the feed ends of said stokers and having its outer surface exposed to radiant heat, means for cooling the exposed surface of said arch comprising a series of bifurcated tubes having lower bifurcated portions lining opposite walls of said arch, and fuel feeding mechanism within said arch for supplying fuel to the feed ends of said stokers.

6. In a furnace, a pair of mechanical stokers, each having means for mechanically maintaining a fuel bed with its feed end at the center of the furnace and its ash discharge end at an outer side of the furnace, a hollow upwardly tapering arch positioned over the feed ends of said stokers and having its outer surface exposed to radiant heat, means for cooling the exposed surface of said arch comprising a series of bifurcated tubes having lower bifurcated portions lining the walls of said arch and upper por-

tions extending laterally across said furnace, the upper portions of adjacent tubes being spaced to form a slag screen, and fuel feeding mechanism within said arch for supplying a slag-forming fuel to the feed ends of said stokers.

7. In a furnace, a pair of mechanical stokers, each having means for mechanically maintaining a fuel bed with its feed end adjacent the center of the furnace and its ash discharge end adjacent an outer side of the furnace, a hollow upwardly tapering arch positioned over the feed ends of said stokers and having its outer surface exposed to radiant heat, means for cooling the exposed surface of said arch comprising a row of tubes having lower inclined portions lining the walls of said arch and upper laterally bent portions extending across a portion of said furnace, the upper portions of adjacent tubes being bent in opposite directions and the said upper portions of similarly bent tubes being spaced to form slag screens extending across said furnace at opposite sides of said arch, and fuel feeding mechanism within said arch for supplying a slag-forming fuel to the feed ends of said stokers.

8. In a furnace, the combination of walls defining first and second laterally adjacent combustion chambers, walls defining a gas-passage chamber connected to both the first and to the second combustion chambers to receive the heating gases flowing therefrom, said combustion chamber-defining walls including a hollow wall separating the combustion chambers and defining within the interior thereof a relatively large space separate from the combustion and gas-passage chambers and in heat-insulated relation with respect thereto, first and second progressive-feed stokers disposed within the first and second combustion chambers respectively and arranged with their fuel-receiving ends adjacent the heat-insulated space, hopper means disposed within the heat insulated space and connected to the fuel-receiving ends of the stokers, and means for supplying fuel to said hopper means.

9. Apparatus according to claim 8 wherein the hopper means is disposed across the fuel receiving ends of the stokers and mechanical means is provided for distributing the fuel across the hopper means.

10. Apparatus according to claim 8 wherein the first and second stokers are of the chain grate type and the hopper means extends across the fuel-receiving ends of the grates.

11. Apparatus according to claim 8 wherein the separating hollow wall comprises spaced tubes through which a cooling fluid flows and refractory material disposed at least in the spaces between the tubes.

12. Apparatus according to claim 8 wherein a row of heat exchange tubes is disposed across the connection between the first combustion chamber and the gas-passage, and a second row of heat exchange tubes is disposed across the connection between the second combustion chamber and the gas-passage.

13. In a furnace, the combination of walls defining first and second laterally adjacent combustion chambers, said walls including a hollow wall separating the first and second combustion chambers, walls defining a gas-passage chamber connected both to the first and to the second combustion chambers to receive the heating gases flowing therefrom, first and second progressive-feed stokers arranged within the first

and second combustion chambers with their fuel-receiving ends adjacent the hollow wall, hopper means disposed across the fuel-receiving ends of the stokers and within the hollow wall, and
 5 mechanical means for feeding fuel to the hopper means and for distributing the fuel across the hopper means.

14. Apparatus according to claim 13, wherein the hollow wall comprises spaced tubes through
 10 which a cooling fluid flows and refractory material disposed at least within the spaces between tubes.

15. Apparatus according to claim 13 wherein a plurality of heat exchange tubes are disposed
 15 across the connection between the heating gas passage and the first combustion chamber, and a plurality of heat exchange tubes are disposed across the connection between the heating gas passage and the second combustion chamber.

20 16. In a furnace the combination of walls defining first and second laterally adjacent combustion chambers, said walls including a hollow wall separating said combustion chambers, walls defining a gas-passage chamber connected both
 25 to the first and to the second combustion chamber to receive the heating gases flowing therefrom, means for supplying fuel into the interior of the wall and from such interior into the first and second combustion chambers, the side of
 30 the hollow wall exposed to the first combustion chamber and the side of the hollow wall exposed to the second combustion chamber each comprising a plurality of spaced tubes through which
 35 a cooling fluid flows, and refractory material disposed at least within the space between tubes.

17. In combination, a furnace, a group of vertically extending fluid heating tubes arranged to divide said furnace into laterally adjacent sections, means for burning slag-forming fuel in
 40 each of said furnace sections, a common heating gas pass above and opening to said furnace sections, and the upper portions of said tubes being bent laterally in opposite directions and arranged to form staggered rows of slag screen
 45 tubes extending across the upper end of each of said furnace sections.

18. In combination, a furnace, a group of vertically extending fluid heating tubes arranged to divide said furnace into laterally adjacent
 50 sections, means for burning slag-forming fuel in each of said furnace sections, a common heating gas pass above and opening to said furnace sections, and the upper portions of alternate tubes being bent laterally in opposite
 55 directions and arranged relative to similarly bent tubes to form staggered rows of slag screen tubes extending across the upper end of each of said furnace sections.

19. In combination, a furnace having a dividing wall structure arranged transversely therein,
 60 outer walls combining with said wall structure to form a pair of combustion chambers at op-

posite sides thereof, means for burning slag-forming fuel in each of said combustion chambers, a common heating gas pass above and opening to said combustion chambers, and staggered rows of slag screen tubes extending across
 5 the upper ends of said combustion chambers.

20. In a furnace, a dividing wall structure arranged transversely thereof, outer walls combining with said wall structure to form combustion
 10 chambers at opposite sides thereof, means for protecting the exposed surface of said dividing wall structure comprising tubes having lower vertically extending portions lining said dividing wall structure and upper laterally bent portions
 15 extending across said combustion chambers and arranged to form slag screens extending across the upper ends of said combustion chamber at opposite sides of said dividing wall structure, and means for burning slag-forming fuel in each
 20 of said combustion chambers.

21. In a furnace, a dividing wall structure arranged transversely thereof, outer walls combining with said wall structure to form combustion
 25 chambers at opposite sides thereof, means for cooling the exposed surface of said dividing wall structure comprising a row of tubes having lower inclined portions lining at least one exposed surface of said dividing wall structure and upper
 30 laterally bent portions extending across the upper ends of said combustion chambers, the upper portions of alternate tubes being bent in opposite directions and adjacent similarly bent tube portions being arranged to form staggered
 35 rows of slag screen tubes extending across the upper ends of said combustion chambers at opposite sides of said dividing wall structure, and means for burning slag-forming fuel in each of said combustion chambers.

22. In a furnace, the combination of walls enclosing a first combustion chamber and a second
 40 combustion chamber separated from the first, walls defining a gas-passage chamber above and connected to both the first combustion chamber and to the second combustion chamber for receiving the heating gases flowing upwardly therefrom, regulable means providing for the combustion of slag-forming fuel in each of said combustion
 45 chambers, a group of fluid heating tubes having lower portions extending vertically between said combustion chambers and upper portions disposed across the connection between the gas-passage chamber and the first combustion chamber, and a second group of fluid heating tubes having lower portions extending vertically
 50 between said combustion chambers and upper portions disposed across the connection between the gas-passage chamber and the second combustion chamber, the upper portions of each group of fluid heating tubes being arranged to form a slag screen.
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