H. A. POPPENHUSEN & J. HARRINGTON.

STEAM BOILER FURNACE.

APPLICATION FILED APR. 7, 1909.

964,053. Patented July 12, 1910.

3 SHEETS—SHEET 1.

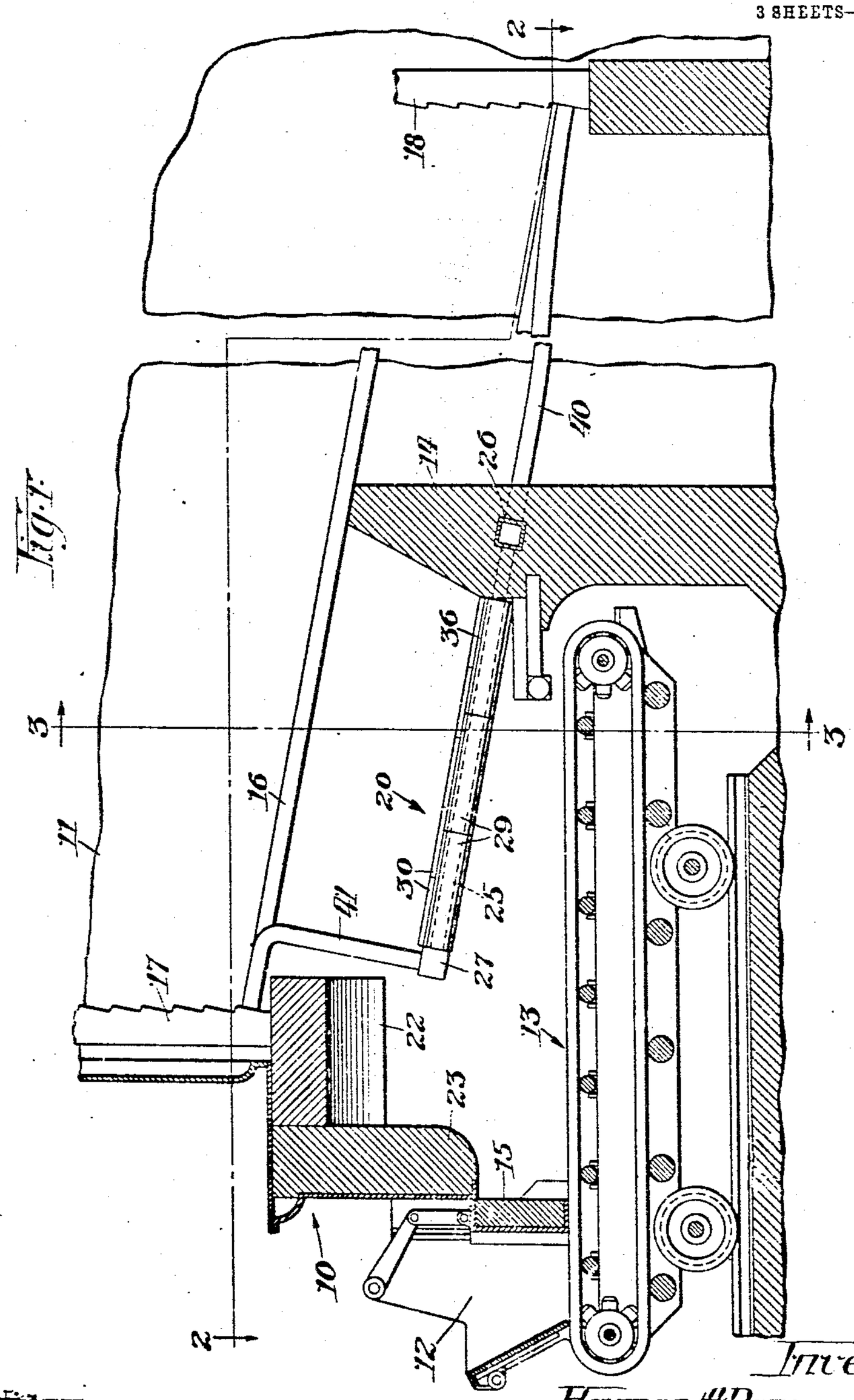

Fig. 1.

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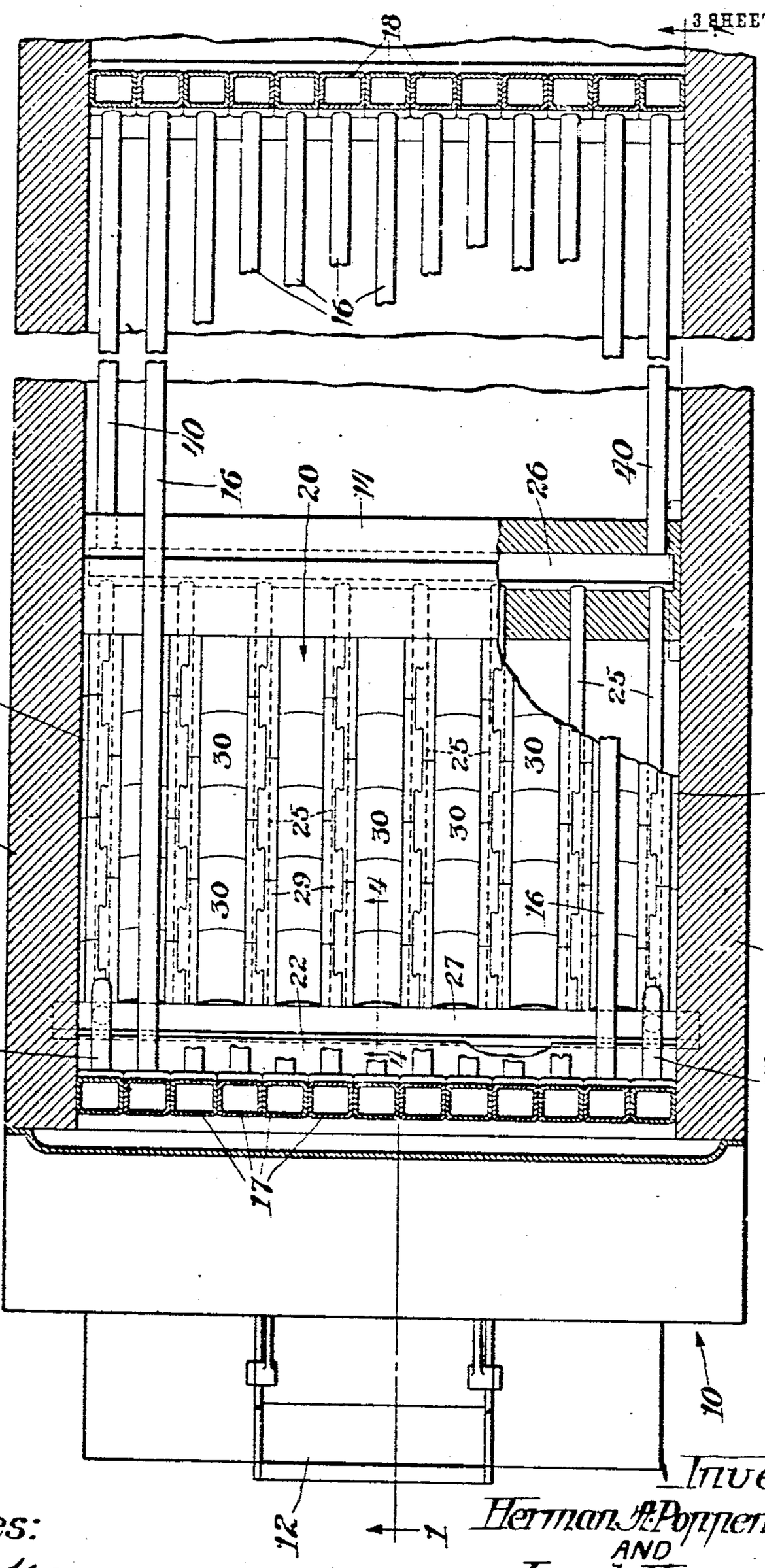
3 SHEETS SHEET 2.

Fig. 2.



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3 SHEETS—SHEET 3.

Fig. 3.

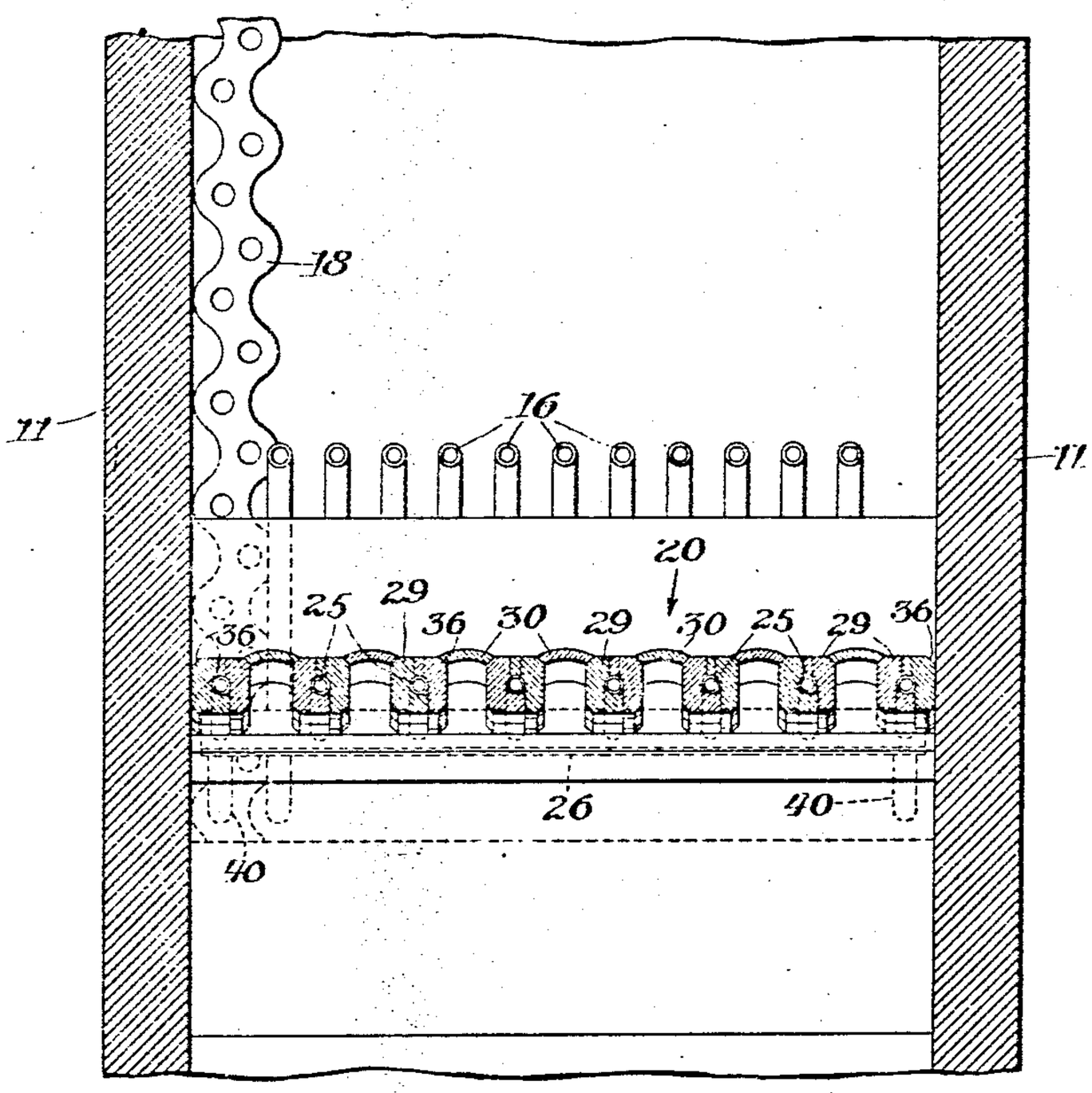
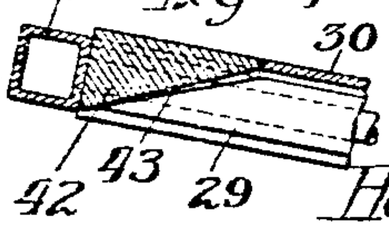


Fig. 4.



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UNITED STATES PATENT OFFICE.

HERMAN A. POPPENHUSEN, OF EVANSTON, AND JOSEPH HARRINGTON, OF RIVERSIDE, ILLINOIS.

STEAM-BOILER FURNACE.

964,053. Specification of Letters Patent. **Patented July 12, 1910.**

Application filed April 7, 1909. Serial No. 488,446.

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, of that kind provided with automatic stoking devices or means by which the fuel is carried toward the rear end of the furnace during the progress of combustion.

The invention relates more particularly to a deflecting partition, wall or arch extending from the bridge wall of the furnace forwardly over the grate and which serves to deflect the products of combustion from the fuel at the rear end of the grate toward the forward end of the furnace, and to divide the combustion space into upper and lower chambers connected with each other at the forward part of the furnace.

Among the objects of our invention are to provide a deflecting partition, wall or arch which may be made of relatively small depth or thickness so as to occupy but little vertical space in the furnace and thereby enable the combustion space to be divided into two upper and lower compartments, or combustion chambers, without unduly increasing the height of the furnace as a whole.

Another object of the invention is to provide a construction in such a deflecting partition, wall or arch by which the same will be rendered strong and economical to manufacture, as well as durable under the great heat to which the same is subjected.

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 feeding end of the furnace rearwardly, but it will be obvious that it may be applied to furnaces having other forms of grates arranged to advance the fuel through the furnace during combustion thereof.

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 vertical transverse section, taken on line 3—3 of Fig. 1, looking forwardly. Fig. 4 is a fragmentary section taken on line 4—4 of Fig. 2.

As shown in the drawings, 10 designates the front wall of the furnace; 11, 11 the side walls thereof; 12 the fuel feeding 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 (not herein shown), a nest of tubes 16 below the same, and front and rear headers 17 and 18, respectively, adapted to be connected with the ends of the water drum in a familiar manner, and between which the tubes 16 extend; said tubes extending downwardly and rearwardly from the upper front header to the lower rear header.

20 designates as a whole the deflecting partition, wall or arch which is located over the rear end of the grate and extends forward from the bridge wall so as to form, in effect, a forward extension of the same. Said partition terminates at its forward end at a considerable distance rearwardly from the front wall of the furnace and is located between the lowermost water tubes, or water containing portions of the boiler, and said grate, so as to divide or separate the combustion space into upper or lower compartments or combustion chambers which are connected with each other at the forward end of the furnace. In connection with said partition we have shown in the accompanying drawings a coking breast or fire arch 22 which is located considerably above the level of the forward end of said partition and extends rearwardly from the fire brick front wall 23 of the furnace, above the fuel feed opening thereof. The said partition, made as hereinafter described, may be employed either with or without such coking breast or

fire arch, but when used in connection with such a coking breast or fire arch has important advantages, as hereinafter pointed out.

The deflecting partition, wall or arch and the means supporting the same are constructed and arranged as follows: The deflecting partition, wall or arch consists of a plurality of metal supporting members or girders 25, 25 and fire brick members 30, 30 which extend 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 water cooled by circulation of water or other cooling medium through them. 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 toward the front wall of the furnace. The said tubular girders or supporting members open at their rear ends into a transverse distributing header 26 which is built or embedded in the bridge wall 14. The forward ends of said tubular girders likewise open into a collecting header 27 which extends transversely across the furnace, below and slightly in rear of the coking breast or arch 22. The said distributing header 27 is supported at its ends in the side walls of the furnace, in the manner indicated in Fig. 2. 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 extend and in which they are adapted to be expanded to constitute water tight joints. In the present construction the distributing header 26 is contained wholly within the bridge wall. The girders or supporting members are thus supported at their rear ends by the bridge wall and at their forward ends by the side walls of the furnace, through the medium of the forward collecting header. The tubular girders may be covered by fire brick coverings 29, 29. Said fire brick coverings 29 have the form of a plurality of laterally separable members which are applied to the sides of the girders and are supported by the same. Said laterally separable members are provided at their upper sides with interlocking extensions which overlap each other above the girders. As illustrated, the abutting joints between the ends of the members 29 at one side of each girder are out of line with the joints between the members at the other side thereof, and each member is formed with a centrally arranged interlocking extension; the ends of said interlocking extension being provided with lugs which interfit with correspondingly shaped notches at the adjacent ends of the joining members. At their lower parts said fire brick members at one side of each girder extend horizontally beneath the girder, and meet the lower parts of the members on the opposite side of the girder so as to entirely cover or protect the same.

The fire brick members 30 which span the spaces between and are supported upon the tubular supporting members or girders may be made either flat or curved, and are suitably formed at their side margins to engage with supporting surfaces on the supporting members, or on the fire brick coverings therefor, if such coverings be employed. As herein shown, said fire brick members are of curved or arched form and are beveled at their side edges to fit correspondingly beveled or inclined seats 36 on the insulating coverings 29. The arrangement shown places the arch members and the supporting parts of the insulating coverings under compression. By reason of the friable character of fire brick, the same are better adapted to withstand the strains or stresses to which they are subjected, and are rendered more durable by being so placed under compression.

Referring now to the means illustrated for maintaining the circulation of cooling water through the tubular supporting members 25 of the deflecting partition, the same is made as follows:

40, 40 designate tubes which are located one at each side of the furnace and extend forwardly from the lower side of the rear or lower boiler header 18 to and communicating with the opposite ends of the distributing header 26 that is embedded in the bridge wall 14.

41, 41 designate tubes within the forward end of the furnace, one at each side thereof, which communicate at their lower ends with the collecting header 27 near their ends and at their upper ends with the lower side of the upper, front boiler header 17.

The tubes 40, 40 constitute supply tubes to supply cooling water to the distributing header 26, from whence it is distributed to the various tubular girders or supporting members 25 to cool the same. The heated water is directed from the upper ends of the tubular girders to the collecting headers 27 from whence it passes upwardly through the return tubes 41 to the forward upper boiler header 17.

It will thus be seen that the cooling water is circulated at boiler pressure through the tubular girders or supporting members, and is taken from the lowest or coolest part of the boiler and passed upwardly through the hollow girders to the upper or hotter part of the boiler in the direction which the water tends to rise due to the heating thereof, in its passage through said tubular girders. Thus a positive circulation of the water is maintained through the tubular girders, supplied to one end of the set of girders from

the lower or rear header of the boiler, and discharged from the other end of said set of girders to the upper or front header of the boiler. The water passes directly from the distributing header 26 through the tubular girders to the collecting header 27 and, therefore, flows through the length of but a single girder. Thus the resistance to the flow of water through the tubular girders is relatively small, resulting in a rapid flow of the cooling water and a consequent promotion of the cooling effect on the tubular girders or supporting members.

The arch members 30 at the front end of the deflecting partition, are shown as provided on their lower sides, between adjacent supporting members or girders, with extensions 42, as shown in Fig. 4, having downwardly and rearwardly inclined surfaces 43, beneath which the gaseous products of combustion pass from the under side of the deflecting partition, upwardly around the front end thereof to its upper side. The presence of said inclined arch member extensions avoids the formation of pockets at the front ends of the longitudinal spaces between the tubular supporting members or girders, and serves to direct the gaseous products of combustion around the front end of the partition, wall or arch without the retardation which would result by the impingement of said gaseous products of combustion against the rear side of the collecting header.

The construction and arrangement of the parts of the deflecting partition, wall or arch is such as to provide a practical minimum depth or thickness of the arch, while affording means for firmly supporting the arch in position over the furnace grate. 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 the furnace construction and contributing to compactness. The constructions described possess important practical advantages over the massive deflecting arch structures heretofore 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 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 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 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 members, one at each side of the supporting members or girders to be removed and replaced.

In a boiler furnace, such is shown in the accompanying drawings, and which embraces a traveling chain grate or equivalent means for producing movement of the fuel in a rearward direction in the furnace, the burning gases arising from the partially consumed fuel at the rear end of the grate are deflected by said partition forwardly and by their contact with the lower surface of the partition, maintain the same at a high temperature; the heat radiated from the said partition serves to aid in the preliminary heating or coking of the fresh fuel, as it enters the furnace at the forward end of the grate; such coking being also aided by the coking breast or fire arch 22. The burning gases from the rear part of the grate, when deflected forwardly as stated, not only serve to transmit heat to the partition, but also serve to promote rapid combustion of the more volatile gaseous constituents of the fuel which are driven off from the fresh fuel, such burning gases from the rear part of the furnace becoming mixed to a greater or less extent with the gases which result from the preliminary heating or coking of the fresh fuel. It is, moreover, important for the most economical results and avoidance of smoke production that the intermingled products of combustion from the partially consumed and fresh fuel shall not come immediately into contact with the water tubes or water-cooled surfaces of the boiler, but shall pass into the upper combustion space or compartment above the partition, wherein a high temperature is maintained and in which complete combustion of the burning gases may take place before the same are subjected to the cooling action of said water tubes or water-cooled surfaces. Applicants are enabled to obtain the results stated by the use of a deflecting partition located and constructed as described inasmuch as the same occupies a small vertical space only in the furnace and affords the necessary upper and lower compartments or combustion spaces between the grate and the water tubes or water cooled surfaces of the boiler, without making the height of the furnace so great as to render such partition impracticable for general use.

It will be understood that a deflecting partition made as described and shown, by reason of having its water-cooled metal supporting members entirely surrounded or covered by the fire brick members, not only

serves to deflect or direct forwardly the gaseous products of combustion in the furnace, but also serves the same purpose as the fire arch or coking breast which is indicated by 22 in the drawings. That is to say, the lower fire brick surface of said partition is always kept at a high temperature by absorption of the heat from the burning gases which arise from the burning fuel at the rear part of the grate, and which pass forwardly beneath and around the front edge of said partition, and being thus maintained at a high temperature serves to aid in effecting the preliminary heating or coking of the fresh fuel, and to promote the rapid combustion of the volatile constituents driven off from the fresh fuel in the coking process, thereby preventing the production of smoke. By reason of the lower surface of the partition being formed of fire brick, an entirely different effect is produced than arises in cases where water tubes or water-cooled members form in whole or in part the top wall or roof of the combustion chamber, or extend through the upper part of 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 constant cooling of said burning gases, with consequent retardation of combustion and liability of the production of smoke.

While a deflecting partition made as hereinbefore set forth may be used in a furnace which is without any coking breast 22 at its forward or receiving end, yet such a partition has special advantages when employed in connection with such a coking breast, for the reason that the deflecting partition and the coking breast together form fire brick surfaces extending over the entire area of the grate and the fuel thereon, and which are adapted to retain and radiate heat, and thereby promote combustion, not only of the fresh fuel as it is fed to the forward end of the furnace, but also of the burning gases arising from the fully ignited portion of the layer of fuel at the rear end of the grate.

In our application, Serial Number 487,630, filed April 3rd, 1909, a deflecting partition of the same general character as that herein illustrated is formed by means of fire brick member applied to parallel tubular supporting members which extend between and are supported by the bridge wall and the front wall of the furnace. The construction herein illustrated, in which the tubular supporting members are connected at their forward ends with a transverse header located at the forward margin of the said partition and approximately beneath the rear end of the coking breast 22, has the advantage of enabling the supporting members of the partition to be made only slightly longer than the length of the partition itself, and of leaving a free and unobstructed space, forward of the deflecting partition and between the same and the front wall of the furnace, for the upward passage of products of combustion. This construction also has the advantage, in connection with the said coking breast 22, of affording an unobstructed space between the said coking breast and the fuel beneath it, permitting the heat radiated by the coking breast to act with full effect on the fresh fuel supplied to the forward end of the grate.

We claim as our invention:—

1. The combination with the masonry bridge wall, front wall and side walls of the furnace, and a grate, of a deflecting partition extending forwardly from the bridge wall and dividing the combustion chamber into upper and lower compartments connected with each other at the front of the furnace, said partition embracing a plurality of tubular, water-cooled supporting members, the rear ends of which are embedded in the bridge wall and which extend forwardly from said bridge wall toward the front of the furnace, a transverse header connected with the forward ends of said supporting members, said header being located at a distance rearwardly from the front wall and being supported at its ends by the side walls, and fire brick members which surround, completely cover and span the spaces between the said tubular supporting members, said fire brick members extending continuously between the bridge wall and said header.

2. The combination with the masonry bridge wall, front wall and side walls of the furnace, and a grate, of a deflecting partition extending forwardly from the bridge wall and dividing the combustion chamber into upper and lower compartments connected with each other at the front of the furnace, said partition embracing a plurality of tubular, metal, water-cooled supporting members, the rear ends of which are embedded in the bridge wall and which extend forwardly from said bridge wall toward the front of the furnace, a rear, transverse header connected with the rear ends of said water-cooled members and which is located at the rear of the front face of the said bridge wall and is supported by the same, a transverse header connected with the forward ends of said supporting members; said header being located at a distance rearwardly from the front wall of the furnace and being supported at its ends by the side walls thereof, and fire brick members which surround, completely cover and span the spaces between the said supporting members and which extend continuously between said bridge wall and the said forward header.

3. The combination with the masonry bridge wall, front wall and side walls of a

furnace, and a grate, of tubular, metal, water-cooled supporting members, the rear ends of which are embedded in the bridge wall and extend from said bridge wall forwardly toward the front of the furnace, a transverse header connected with the forward ends of said supporting members and which is located at a distance rearwardly from the front wall of the furnace and is supported at its ends by the side walls thereof, fire brick coverings completely surrounding and covering said supporting members, and fire brick members separate from said coverings which rest on said coverings and span the spaces between the same.

4. The combination with the masonry bridge wall, front wall and side walls of a furnace, and a grate, of a plurality of tubular, metal, water-cooled supporting members extending from said bridge wall forwardly toward the front of the furnace, a transverse header connected with the forward ends of said supporting members, said header being located at a distance rearwardly from the front wall of the furnace and supported at its ends by the side walls thereof, fire brick members which surround and completely cover said tubular supporting members, other fire brick members which rest upon and span the spaces between said fire brick covering members, said fire brick members adjacent to the front header being provided between the covering members with downwardly extending parts which have forwardly and downwardly inclined under surfaces.

5. The combination with the masonry bridge wall, front wall and side walls of the furnace, a masonry coking breast extending between the side walls at the forward end of the furnace, and a grate, of a deflecting partition extending forwardly from the bridge wall and dividing the combustion chamber into upper and lower compartments connected with each other at the front of the furnace, said partition embracing tubular, metal, water-cooled supporting members, the rear ends of which are embedded in the bridge wall and extend from said bridge wall forwardly toward the front of the furnace, a transverse header connected with the forward ends of said supporting members, said header being located at a distance rearwardly from the front wall and below the rear part of said coking breast and having its ends supported in the side walls, and fire brick members which surround, completely cover and span the spaces between, said tubular 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:
GEORGE R. WILKINS,
GUY M. CAMPBELL.