Feb. 28, 1928. 1,660,788

R. A. FORESMAN

AIR PREHEATER

Filed Aug. 11, 1926 3 Sheets-Sheet 1

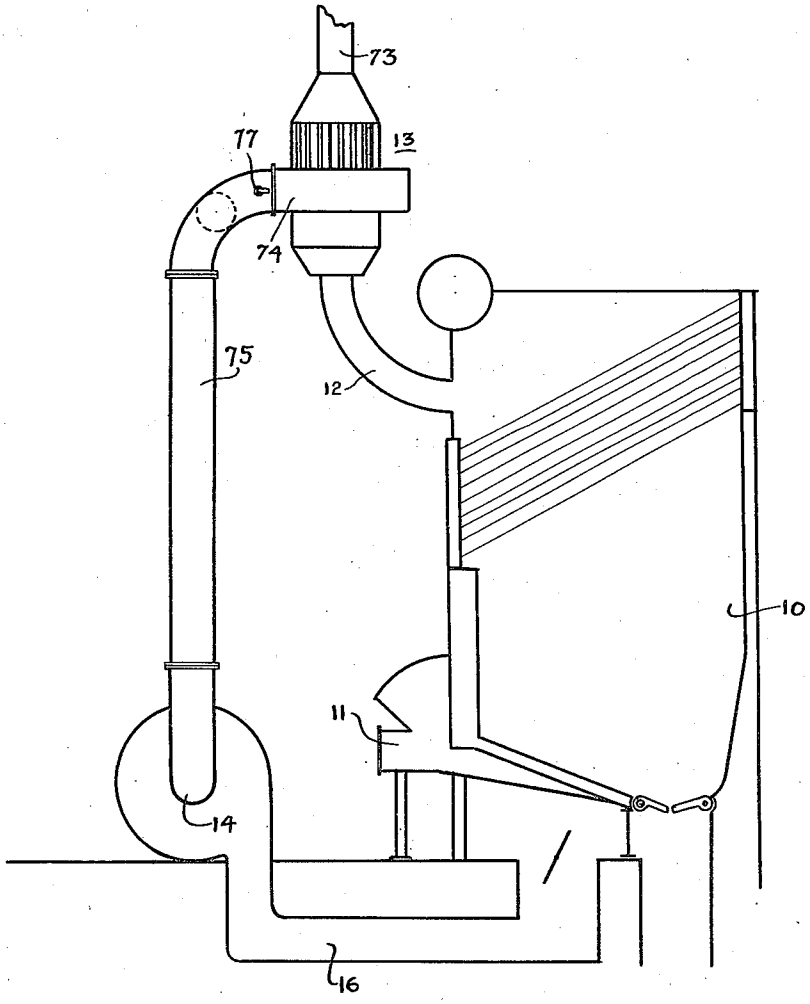


Fig. 1.

WITNESSES:

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Filed Aug. 11, 1926 3 Sheets-Sheet 2

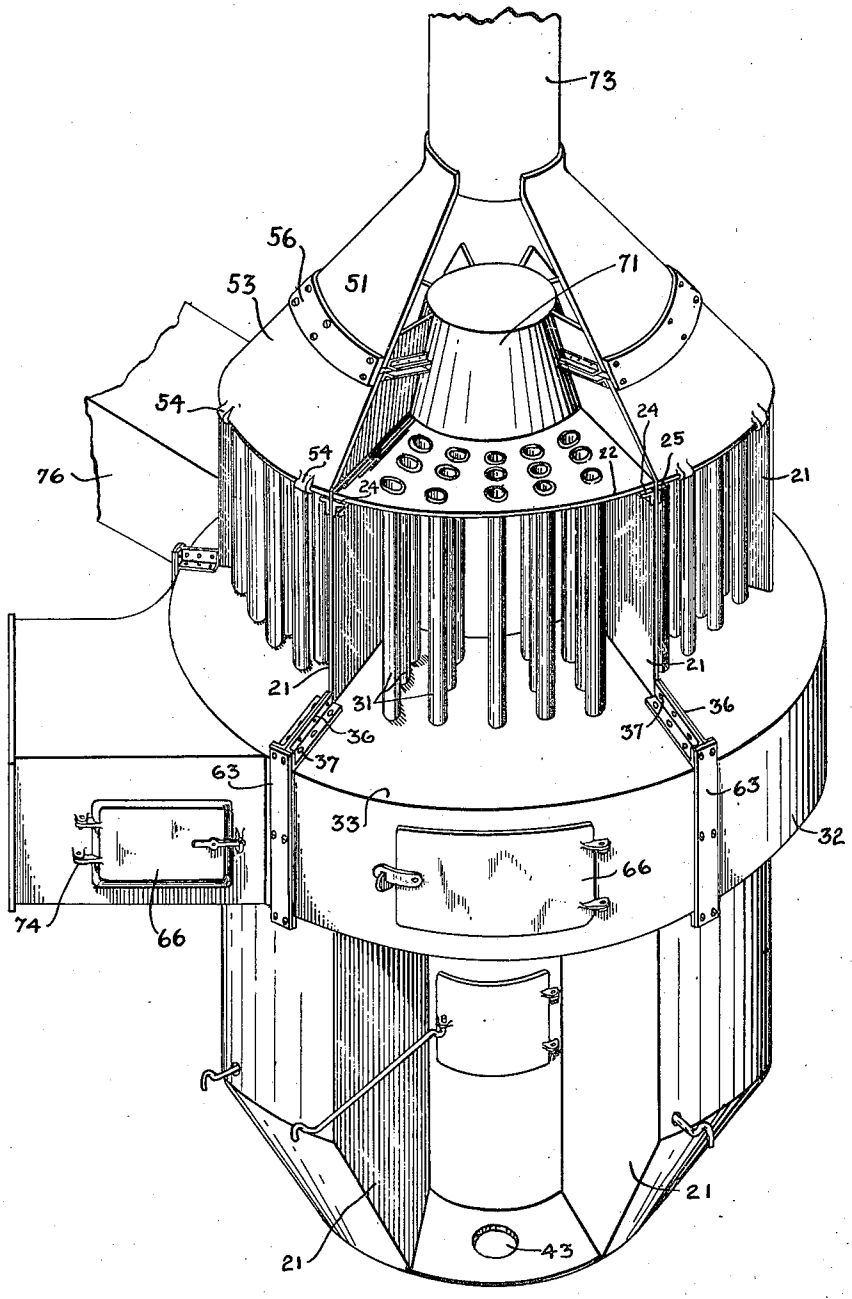


Fig. 2.

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AIR PREHEATER

Filed Aug. 11, 1926 3 Sheets-Sheet 3

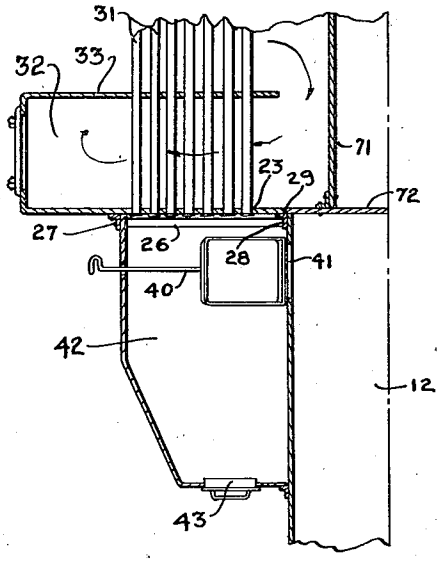


Fig. 3.

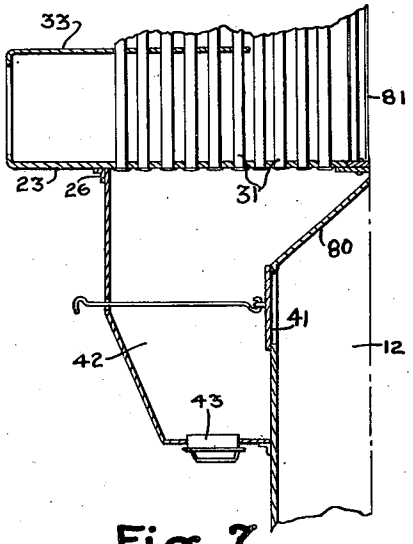


Fig. 7.

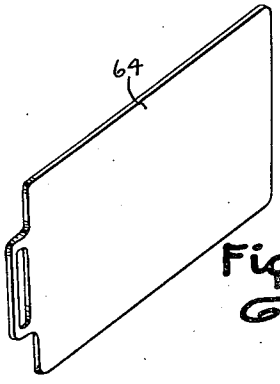


Fig. 5.

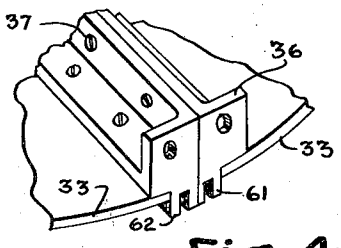


Fig. 4.

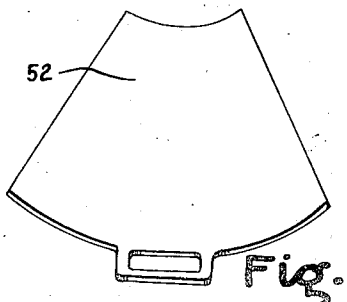


Fig. 6.

WITNESSES:

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Patented Feb. 28, 1928. 1,660,788

UNITED STATES PATENT OFFICE.

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AIR PREHEATER.

Application filed August 11, 1926. Serial No. 128,638.

My invention relates to air preheaters for furnaces more particularly to preheaters employing the waste gaseous products of combustion as a heating medium and has for its object the provision of apparatus of the character designated which shall be simple of design and economical of operation and maintenance.

A further object of my invention is to provide an air preheater employing as a heating medium the waste gaseous products of combustion escaping through the up-take, wherein means are provided for precipitating the soot and other suspended matter in the heating gases before they pass through the heating tubes of the preheater.

A further object of my invention is to provide an air preheater for a furnace wherein improved means are embodied permitting cleaning of the preheater while in operation.

A still further object of my invention is to provide an air preheater made up in sections and wherein a section may be readily removed and replaced without disturbing the working of the other sections.

Apparatus embodying features of my invention is illustrated in the accompanying drawings forming a part of this specification, wherein

Fig. 1 is a diagrammatic view of my improved preheater as applied to a furnace;

Fig. 2 is a perspective view of the preheater, with parts removed, so as to show the interior construction;

Fig. 3 is a vertical sectional view through one side of the preheater showing the path of the gases and of the air being heated;

Fig. 4 is a perspective view of a detail of the preheater;

Fig. 5 is a perspective view of a closure member employed when a section is removed for cleaning;

Fig. 6 is a view of a different closure member; and

Fig. 7 is a view similar to Fig. 3 showing a modified form of my invention.

Air preheaters employing the waste gaseous products of combustion, as heretofore known to me, have encountered certain difficulties of operation and maintenance. The waste gaseous products of combustion, as they leave the furnace, contain a considerable percentage of suspended matter in the form of soot and fine ash. As the gases travel through the preheater giving up their heat to the air being preheated, the soot and suspended matter precipitates and adheres to the walls of the heating elements. The adherence of this soot and other suspended matter to the walls of the heating elements forms, after a time, a heat insulating layer of incrustating solids thereover and quickly cuts down the efficiency of the apparatus as a heat transfer device. The accumulations of this solid matter in the preheater further obstructs the ready flow of heating gases therethrough and makes necessary the employment of additional power in order to bring about the required draft through the furnace.

In addition to the adherence of the suspended matter in the gases to the heating elements, serious difficulties are encountered with this character of apparatus in the adherence of suspended matter contained in the air being preheated to the air tubes or passages of the preheater. The accumulation of this suspended matter on the tubes or passages impairs the efficiency of the apparatus and also entails the employment of additional power in order to force the air through the preheater.

In view of these difficulties, it is apparent that the most desirable design of an air preheater is one wherein the accumulation of solid matter on the heating elements thereof is prevented to the greatest possible extent and wherein ready means are available for removing any accumulation of such solid material once it has been deposited.

In accordance with my invention, I provide an air preheater employing the waste gaseous products of combustion as a heating medium and incorporate, in association with the preheater, an expansion chamber wherein the velocity of the heating gases is greatly reduced before their passage through the preheater. By reducing the velocity of the gases the suspended matter contained therein is, to a great degree, precipitated in the chamber before the gas is employed in the heating elements or the preheater. By this means, I greatly reduce the possibility of the accumulation of any great amount of soot or other suspended matter in the heating elements. In addition to this arrangement, I form the preheater in sections and provide means whereby a section may be cut out of operation without disturbing the op-

eration of the other sections and so form each of the sections that it is readily accessible for cleaning when out of service. I furthermore provide means whereby a section of the preheater may be bodily removed therefrom for the purpose of cleaning or repairing.

Referring now to the drawings for a better understanding of my invention, I show a furnace 10 in Fig. 1 supplied with fuel by a stoker 11 and having an up-take for the escaping waste gases of combustion at 12. Incorporated in the uptake is my improved air preheater 13. Air is drawn through the air preheater by means of a suitable blower 14 from whence it is discharged through a conduit 16 to the furnace 10 in a manner well understood in the art to which my invention relates.

Referring now to Figs. 2 and 3, it may be seen that my improved preheater is formed in segmental sections divided by radially extending walls as 21—21. Inserted in each of the segments is an upper tube plate 22 and a lower tube plate 23 (Fig. 3). The tube plates 22 and 23 are of a shape to conform to the segments and fit snugly therein.

Beneath the sides of each of the tube plates 22 are a pair of radially extending angle irons 24—24 which are secured to the walls 21—21. Between each of the angle irons 24 and its cooperating tube plate may be inserted suitable packing 25 to prevent leakage of the heating gases thereby. An angle iron 26 (Fig. 3) is similarly disposed beneath the tube plate 23 at each side thereof and may be similarly packed to prevent leakage. The weight of the tube plates 22 and 23 and their associated tubes is carried by a pair of angle irons 27 and 28, secured to the outer shell of the preheater and to the uptake 12, respectively, and upon which the tube plate 23 rests. It will be observed that the tube plate 23 ends at 29 above the angle iron 28 so that it may be removed by pulling outwardly in a manner to be more particularly described later. Joining the tube plates 22 and 23, are a plurality of tubes 31—31 through which the waste gaseous products of combustion pass through the preheater.

Interposed between the tube plates 22 and 23 in each of the segments of the preheater is an air box 32 which may be formed as an integral part or joined to the lower tube plate 23 and the upper portion of which, as seen in the drawing, is formed by a baffle member 33 which extends well into the tube nest 31—31, between the tube plates 22 and 23. The adjacent air boxes 32—32 are held together by suitable angle irons 36—36 and bolts 37—37.

Referring now particularly to Fig. 3, I show the gas up-take 12 as ending at the lower tube plate 23. In order to afford communication between the gas up-take 12 and the tube nest 31—31 I provide doors such as 41 which communicate with each of the segments of the preheater. The doors 41 may be operated exteriorly from the preheater, as by means of a rod 40 whenever it is desired to cut out anyone of the sections. Gas or the products of combustion passing through a door 41 enters an expansion chamber 42 formed beneath each of the segments of the preheater. The combined cross sectional areas of the expansion chambers 42 is very much greater than the cross sectional area of the gas up-take 12 so that when the heating gases enter the chamber 42 their velocity is very much decreased. Furthermore the abrupt change in direction of the gases occasioned by the abrupt ending of the uptake 12 is a contributing factor toward decreasing the velocity of the gases. Inasmuch as the velocity of the gases is a contributing element toward the carrying of soot and other suspended matter thereby, the soot and other matter is precipitated in the expansion chamber 42 from whence it may be readily removed by means of openings, such as 43, provided in the bottoms of the expansion chambers.

Furthermore, the design of the apparatus is preferably such that the combined cross sectional area of the tubes 31—31 is also greater than the cross sectional area of the gas up-take 12 so that the gases are utilized in the preheater at their reduced velocity thus giving more time for the giving up of heat to the air in its passage through the preheater.

In the upper portion of each of the segments of the preheater are provided guides or slots such as 51—51 whereby, when it is desired to take a section out of operation, a closure member such as shown at 52 in Fig. 6 may be inserted and thus prevent a leakage of air into the gas up-take or a leakage of gas outwardly therefrom from above the preheater. The space immediately above each of the tube sheets 22 is normally closed by segmental cover members 53. The segmental members 53 may be held in place by any suitable means. By way of example, I show hook-like members 54—54 which hook over the upper tube sheets 22. The upper portion of each of the cover members is held in place at its upper end by means of a segmental band 56. Whenever it is desired to clean the tubes and the chamber 42 of a segment of the preheater while in operation the door 41 is closed, the appropriate segment of the band 56 is removed, the closure member 52 is inserted in place, and the segmental cover 53 is removed. That segment of the preheater is then accessible both from above and below for the purpose of cleaning.

In order to cut out a segment of the pre-

heater with respect to air flow, I provide in the baffle members 33 and the lower tube plate 23 suitably formed guides such as shown at 61 and 62, in Fig. 4. These guides are provided in the edges of each of the segments of the baffle member. Normally when all of the segments of the preheater are in operation, the segments of the air box 32 are joined together by means of plate members 63—63 which cover the guides 61 and 62. Whenever it is desired to take a segment out of operation these plate members are removed and closure members, such as shown at 64 in Fig. 5 are inserted in the guides of adjacent sections at each side of the segment to be removed. The plate members 64 are of sufficient length to over-lap the radial dividing walls 21—21 so as to effectually prevent air from flowing into a segment which has been cut out. If a segment is cut out, accessibility to the tube nest in the air box is attained by means of suitable doors such as 66—66 provided on each of the segments of the air box, or in a duct leading to the air box.

The radially extending dividing walls 21—21 are joined, in accordance with the showing of Fig. 3, with a central tube-like member 71 which forms a dead space within the interior of the preheater. In the operation of this particular embodiment, gases passing through the up-take 12 strike a plate 72 extending across the upper end of the uptake and to which the tube member 71 is joined. After striking this plate member, they pass through the doors 41 into the expansion chambers 42 having their velocity greatly decreased and, at the same time, are changed in their direction of flow. The sudden change in direction of flow, together with the decrease in velocity of the gases greatly facilitates the precipitation of the soot and suspended matter in the gases.

From the chamber 42 the gases pass upwardly through the tubes 31—31 at a reduced rate of flow and thence up over the tubular member 71 to the stack or chimney 73. At the same time air is drawn into the preheater through the exposed part of the tubes 31—31 and pass inwardly of the preheater around the baffle member 33 and into the air box 32. The air box 32 is joined by a suitable duct 74 leading to a conduit 75 (Fig. 1) which is connected to the blower 14. It will be apparent that unless some provision is made to withdraw air from the preheater through more than one segment, that the particular segment to which the duct 74 is joined could not be taken out of operation without rendering the rest of the preheater inoperative. I accordingly show in Fig. 2 a second duct 76 which may also be connected to the conduit 75 leading to the blower 14. The ducts 74 and 76 are detachably connected to the conduit 75 and means are provided in each, such as a damper 77 (shown in Fig. 1), whereby the flow of air from either segment may be cut off.

Whenever it is desired to remove any segment of the preheater for repair, cleaning or other purposes, the bolts 37, and the plates 56, 53 and 63 are all removed. The dampers 52 and 64 are then inserted in place and the door 41 closed. The segment may then be bodily removed from the preheater without disturbing the operation of the remaining segments. If the segment to be removed happens to be one of those connected to a duct leading to the blower 14, the duct must be disconnected and the damper 75 closed in addition to the above described operations.

Referring now particularly to Fig. 7 I show a modification of my invention, wherein a greater tube space is provided within the same area as that shown in Figs. 1 to 3 inclusive. The showing of this modification is very similar to the showing previously described and the same numerals apply to like parts. For that reason, a detailed description will not be made.

In accordance with this modification, the gas uptake 12 is closed short of the tube plate 23 by a conically shaped member 80 and a smaller central member, such as shown at 81 is provided from whence the radially extending dividing walls of the preheater may project. Thus a good portion of the space above the gas up-take may be utilized for the heating tubes 31—31 which is not utilized in accordance with the showing of Figs. 2 and 3.

From the foregoing it will be apparent that I have devised an improved preheater for furnaces wherein means are incorporated for the precipitation and ready removal of suspended matter in the heating gases and wherein readily accessible means are provided for the cleaning or repair of a section of the preheater without disturbing the operation of adjacent sections.

While I have shown my invention in two forms, it will be obvious to those skilled in the art that it is not so limited but is susceptible to various other changes and modifications without departing from the spirit, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:—

1. An air pre-heater for a furnace having an up-take for the waste gases of combustion and arranged in series as to gas flow with the up-take, comprising a jacket surrounding the up-take and forming therewith an expansion chamber of relatively large area, cooperating tube plates with a plurality of tubes therein forming a tube space disposed transversely of the chamber for the

passage of gases therethrough, means deflecting the gases into the expansion chamber radially of the uptake to reduce their velocity and to deposit solid matter in suspension therein, air inlet and outlet means provided in the tube space, a blower mechanism for passing air through the tube space and into the furnace, radially extending dividing walls disposed longitudinally through the tube space and the expansion chamber and dividing the pre-heater into a plurality of segments, damper means for shutting off the flow of gases into or out of any one of the segments, means for closing off the flow of air through any one of the segments, and means giving access to each of the segments for cleaning purposes.

2. An air pre-heater for a furnace having an up-take for the waste gases of combustion and arranged in series as to gas flow with the up-take, comprising a jacket surrounding the up-take and forming therewith an expansion chamber of relatively large area, cooperating tube plates with a plurality of tubes therein forming a tube space disposed transversely of the chamber for the passage of gases therethrough, means deflecting the gases into the expansion chamber radially of the up-take to reduce their velocity and to deposit solid matter in suspension therein, air inlet and outlet means provided in the tube space, a blower mechanism for passing air through the tube space and into the furnace, radially extending dividing walls arranged longitudinally through the tube space and the expansion chamber and dividing the pre-heater into a plurality of segments, damper means for shutting off the flow of gases into or out of any one of the segments while the pre-heater is in operation, means for closing off the flow of air through any one of the segments while the pre-heater is in operation, and means giving access to each of the segments for cleaning purposes.

3. The combination with an uptake for the waste gases of combustion from a furnace, of an air preheater surrounding the uptake; the preheater comprising a plurality of separate segmental-shaped sections distributed about the uptake; each section comprising a chamber communicating with the side of the uptake and adapted to receive waste gases of combustion therefrom, and a heat transfer device in communication with each of the chambers and adapted to receive the waste gases therefrom; means for passing air over each of the heat transfer devices; and means for shutting off one section both as to gas flow and air flow while a remaining section or sections are in operation.

4. The combination with an uptake for the waste gases of combustion from a furnace, of an air preheater surrounding the uptake; the preheater comprising a plurality of separate segmental-shaped sections distributed about the uptake; each section comprising a chamber communicating with the side of the uptake and adapted to receive waste gases of combustion therefrom, cooperating tube plates with a plurality of tubes therein forming a tube space disposed transversely of the chamber for the passage of gases therethrough, and air inlet and outlet means provided in the tube space; means for passing air through the tube space in each of the sections; and means for shutting off one segment both as to gas flow and air flow while a remaining section or sections are in operation.

In testimony whereof, I have hereunto subscribed my name this 15th day of July, 1926.

ROBERT A. FORESMAN.