

March 9, 1926.

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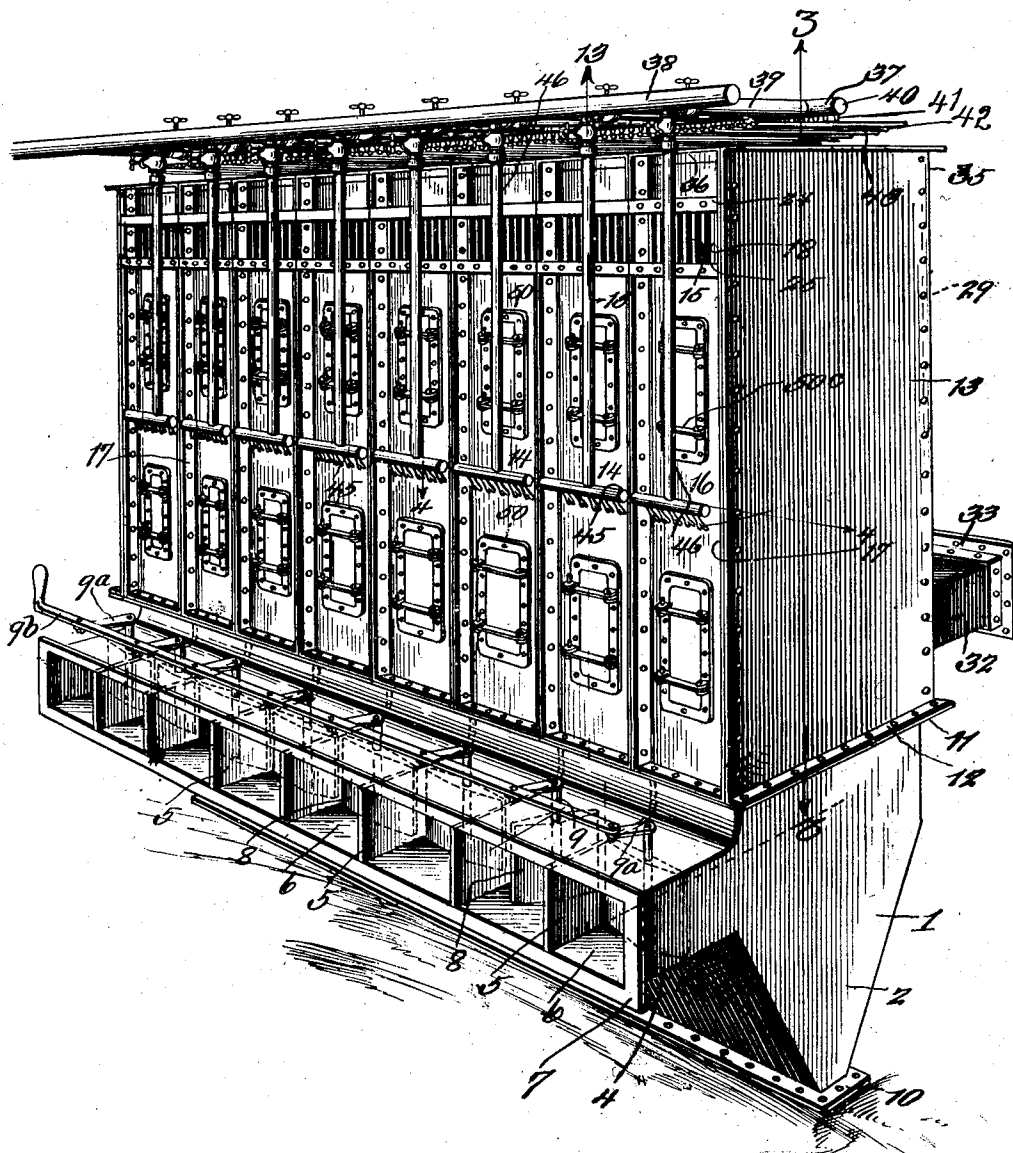
W. M. CONNERY

AIR PREHEATER FOR BOILER FURNACES

Filed May 22, 1924

7 Sheets-Sheet 1

Fig. 1.



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March 9 , 1926.

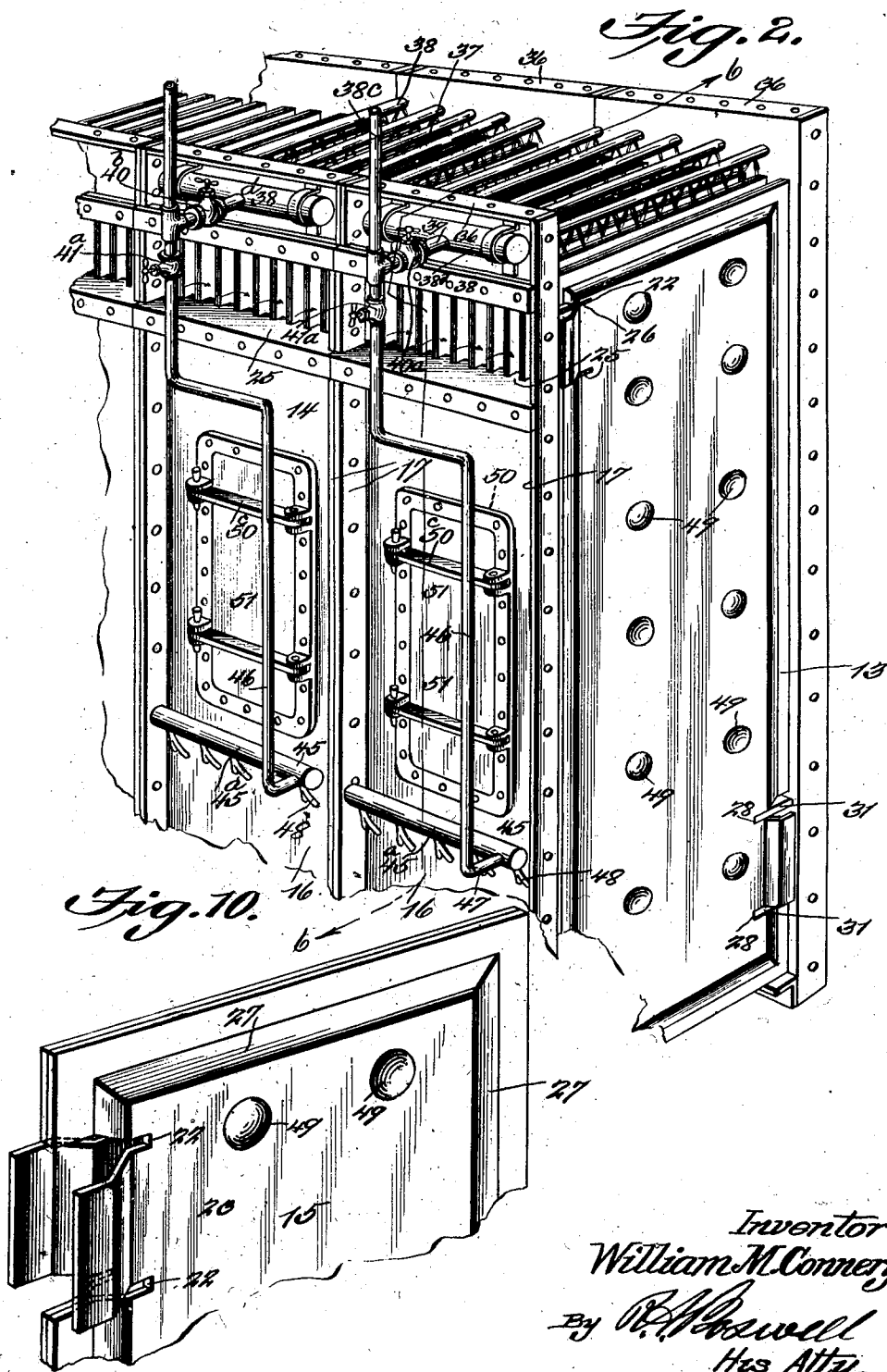
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AIR PREHEATER FOR BOILER FURNACES

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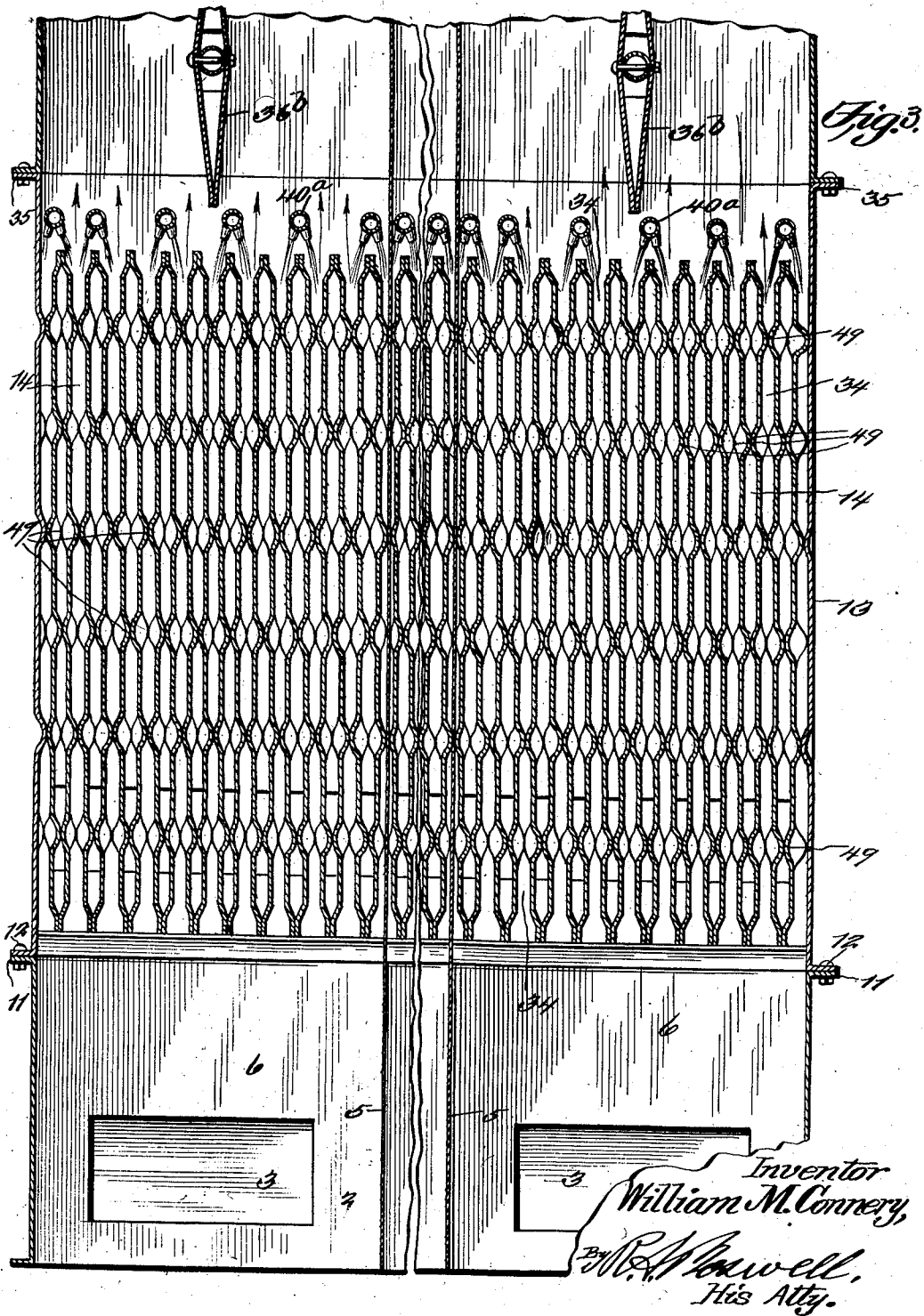
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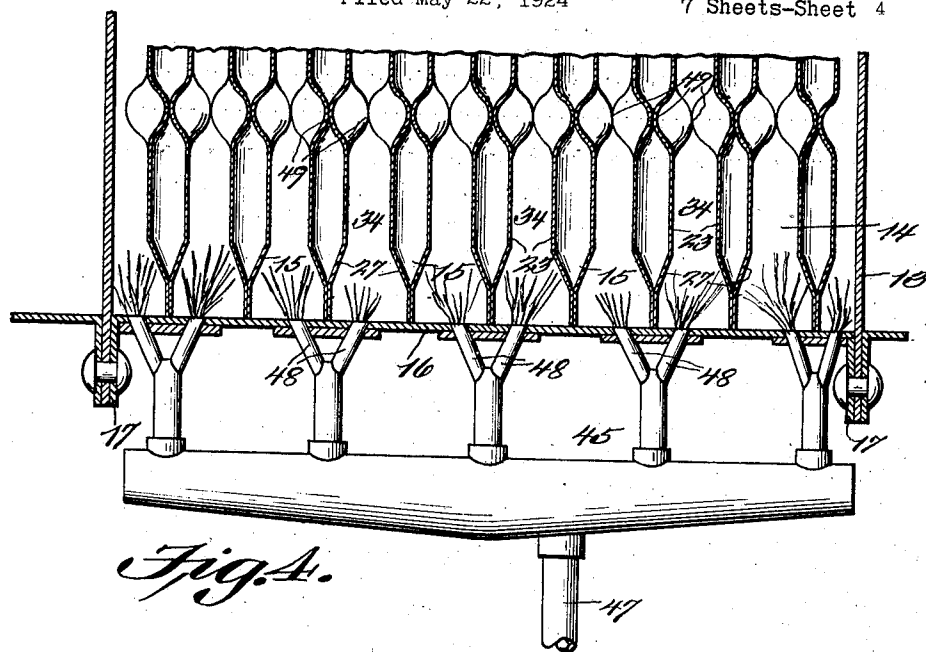


Fig. 4.

Fig. 5.

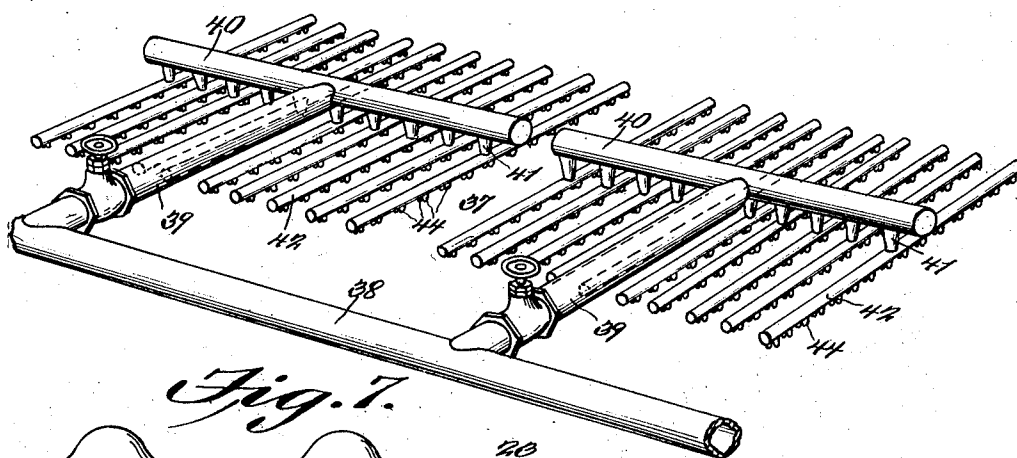
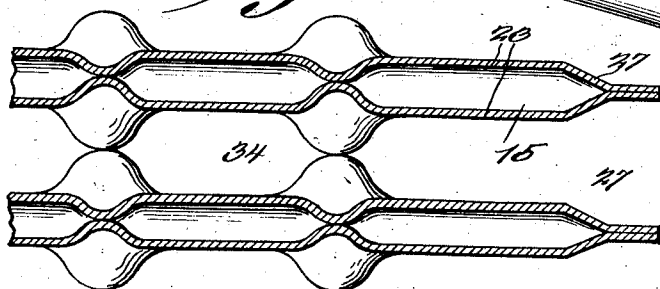


Fig. 7.



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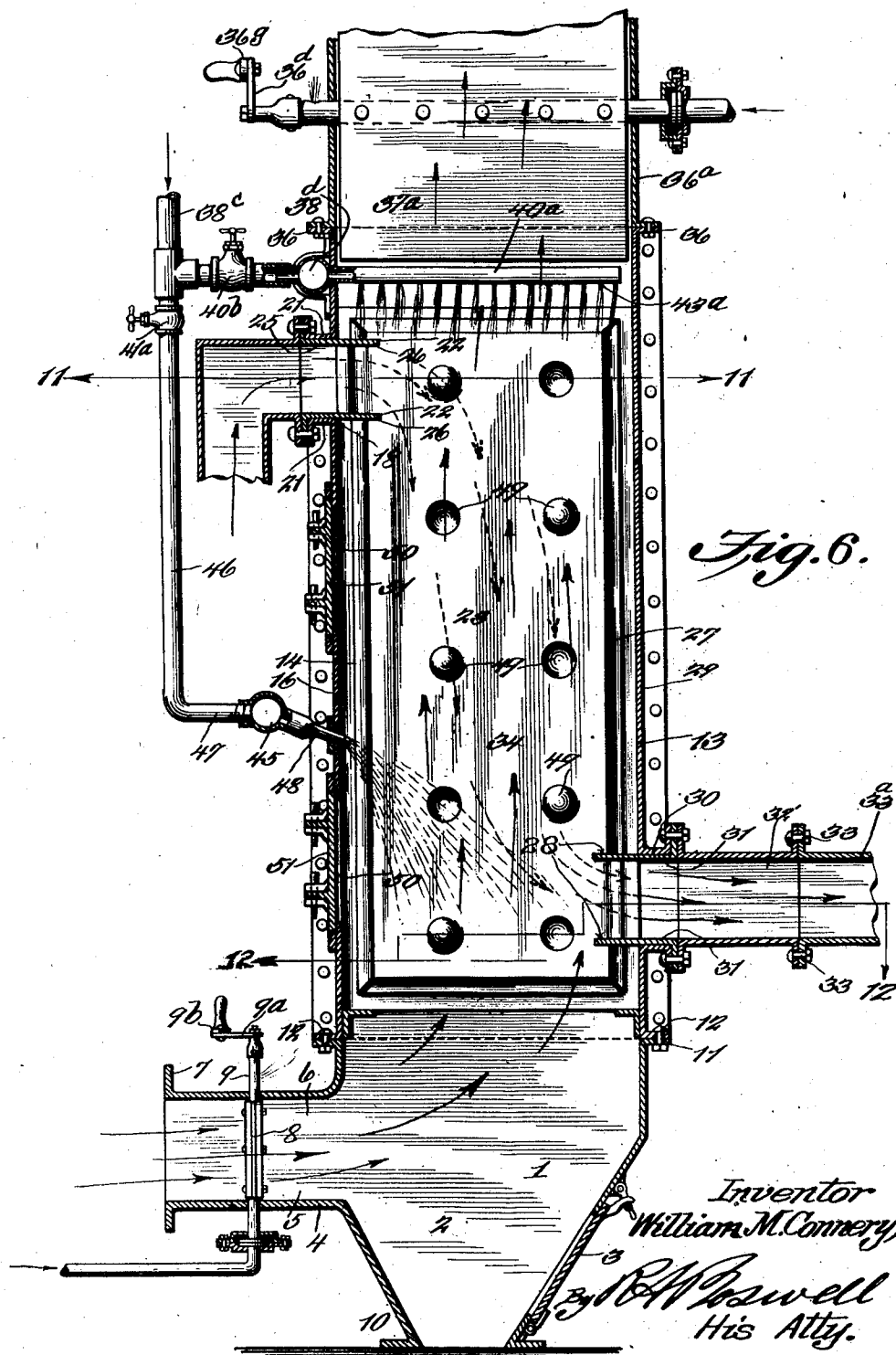
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Fig. 8.

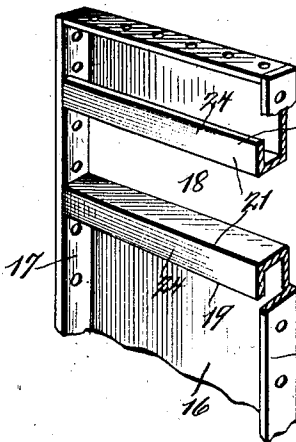


Fig. 8a.

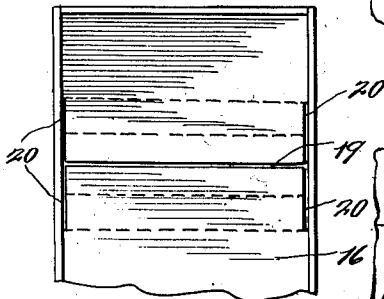


Fig. 9.

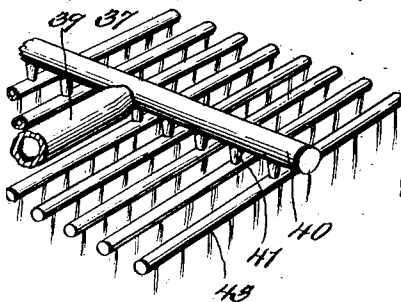


Fig. 11.

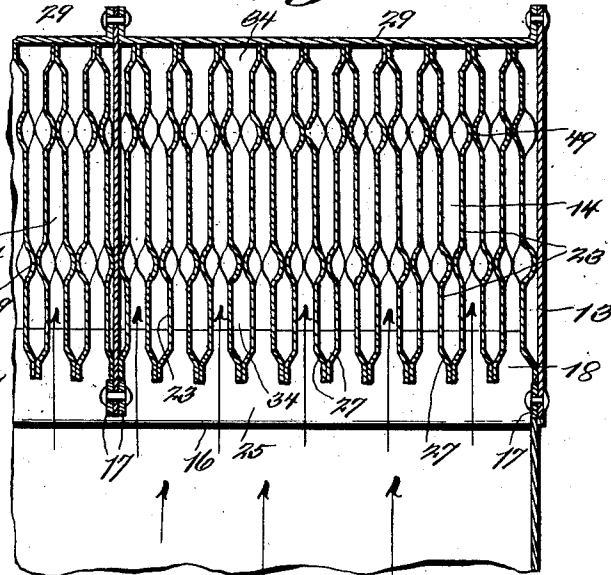
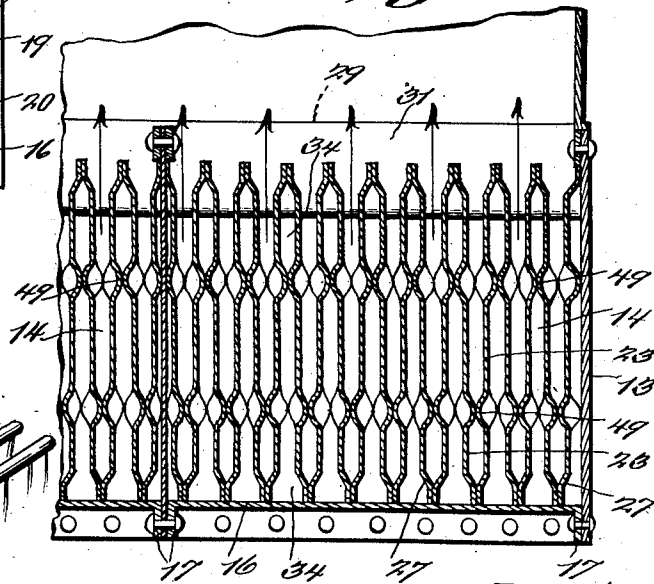


Fig. 12.



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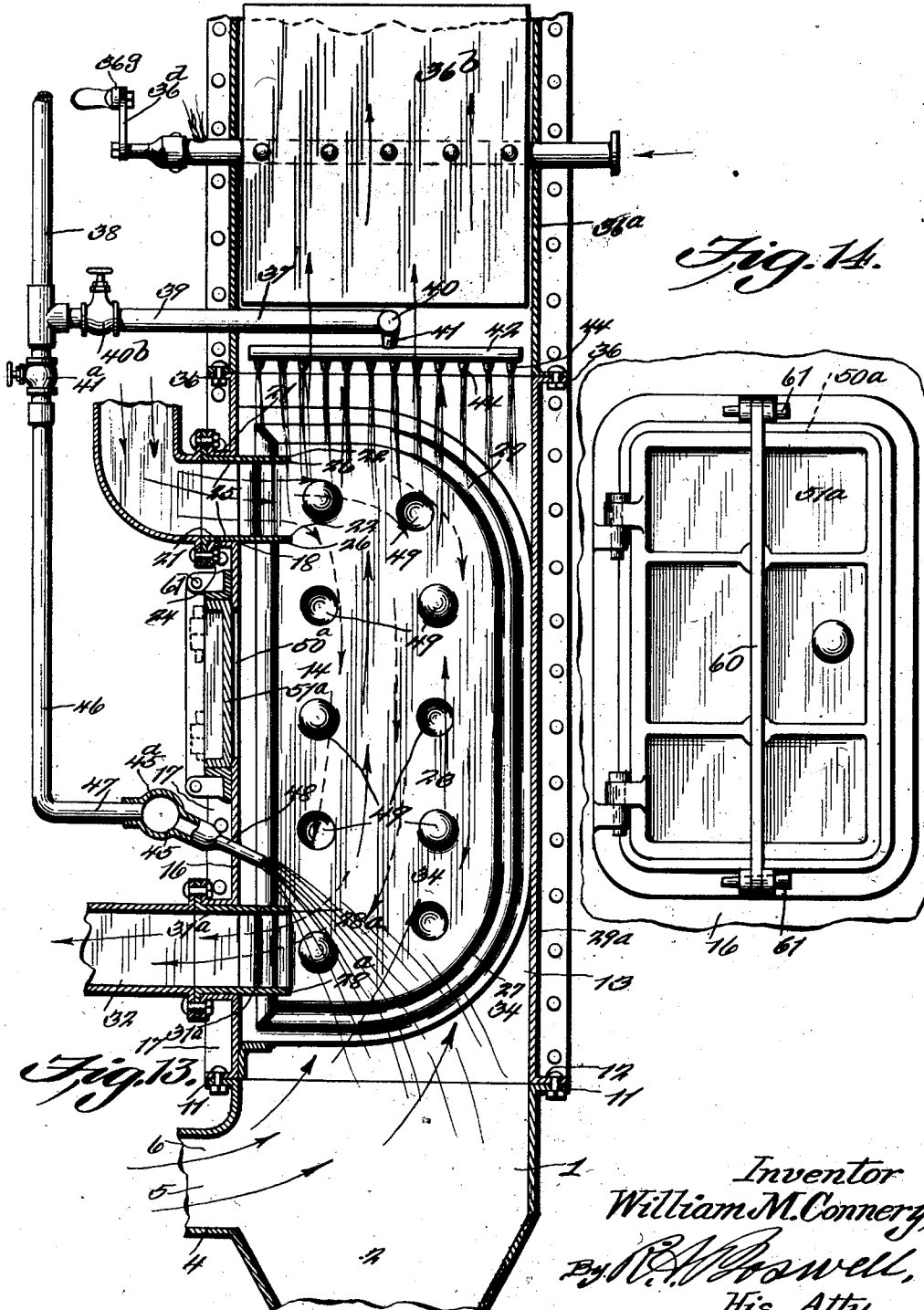
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UNITED STATES PATENT OFFICE.

WILLIAM M. CONNERY, OF PHILADELPHIA, PENNSYLVANIA.

AIR PREHEATER FOR BOILER FURNACES.

Application filed May 22, 1924. Serial No. 715,140.

To all whom it may concern:

Be it known that WILLIAM M. CONNERY, a citizen of the United States of America, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, has invented a new and useful Air Preheater for Boiler Furnaces, of which the following is a specification.

There are apparatus for preheating air which is subsequently employed as a draft and injected into boiler furnaces under, into and through the fire for creating better combustion of the fuel and thereby facilitating the heating of the boiler. These apparatus use tubes and spaced plates through which the air passes to be heated by the products of combustion, the air passing through the tubes or between certain of the plates, the products of combustion passing around and exteriorly of the tubes or between certain other of said plates. In the constructions using tubes, the tubes corrode and eventually wear away due to the corrosion, necessitating replacing of the tubes which is expensive and when being replaced necessitates the closing down of the plant, as there has been no construction permitting of the removal of tubes while the apparatus is in operation and no construction permitting the apparatus to function during the time certain of the tubes are removed. In the constructions using plates, up to the present time, no provision has been made to permit certain units or plates to be removed and permit the apparatus to function with the remaining units of plates. Furthermore, in the constructions which now employ spaced plates, no provision is present to positively avoid collapsing of the plates or partitions, even though ribs are used on the plates. The ribs or flanges or fins in these constructions, up to the present time, extend in the general direction with the passage of the products of combustion, in which case the passages for the products of combustion are simply similar to tubes, hence the plates between the ribs or flanges or fins tend to collapse. In other words, there are no interruptions or staggered relation of the ribs or flanges or fins, hence facilitating in the collapsing of the plates, and observation has shown that just so soon as the plates corrode and eat away, those portions of the plates between the ribs or flanges or fins

buckle or collapse one way or the other, in which case communication is effected between the passages for air and the passages for the products of combustion. In other words, the products of combustion enter the air passages and the air enters the passages for the products of combustion which causes a very poor operation of a plant employing boiler furnaces.

With the above in view, it is the purpose of the present invention to cure these defects and disadvantages and in general to provide not only a mechanically but a commercially practical preheating apparatus for boiler furnaces, a construction which is not only durable but one which will more thoroughly preheat the air incidental to its injection into the boiler furnace.

Another purpose is to provide an apparatus of this character using a forced draft and in connection therewith to secure a regenerative use of the lower degrees of waste heat, such as that passing off to the chimney, for preheating this forced draft so that, upon subsequent injection of the draft below, into and through the fire of the boiler furnace, it is possible to produce practically a smokeless combustion of fuel and thereby facilitate the heating of the boiler.

In producing an apparatus of this kind with an aim toward durability, it is still another purpose to provide means for cleaning the products of combustion passages and consequently provide an apparatus wherein the durability of the construction will compensate for the cost of installation which, in the first instance, is not prohibitive for the reason that considerable thought has been devoted to the present invention with the aim toward producing an apparatus constructed along practical and commercial lines.

In order to permit the preheating apparatus to be repaired without shutting down the plant entirely while repairs are being made, it is a further purpose to employ a multiple of sections making up the preheater, each section consisting of a multiple of units and in producing a construction of this kind, the invention aims to permit one or more of the sections to be easily removed for the repair of the units or to diminish the size of the plant. When a section is re-

moved for the repair of the units thereof, it is possible to control the smoke or products of combustion so as to prevent the smoke from continuing through the space
5 from which the section has been removed.

Still further, it is the aim to provide means to permit of inspection of the products of combustion passages in order to ascertain whether or not any of the units of
10 any one of the sections are defective. Due to the rivets and bolt receiving openings of the various parts used in the construction of this present type of apparatus, corresponding and registering not only in construction
15 but also in location, the end wall of such a preheater may be easily moved up when a section of units is removed.

A still further purpose is to provide, in a construction of preheating apparatus, an
20 arrangement of collapsibility preventing members upon the adjacent plates or division walls, said members being staggered and alternating or, in other words, some extending in certain directions and intermediate members extending in opposite direc-
25 tions. It has been found that a construction of this kind will prevent the spaced partitions or plates from collapsing.

In construction each section is made up of
30 a number of cellular units or cells, these units being spaced to provide passages between them for the hot products of combustion while each cell, itself, constitutes a thin flat passage for the air during the heating operation. Moreover, at each end of
35 each section there is provided a frame or boxing which includes a removable front plate and the sections, with their frames or boxings are individually removable from
40 the entire apparatus.

In preheaters heretofore devised, no provision exists for removing the soot, scale and collection of matter on the walls of the products of combustion passages, hence the present invention contemplates the provision of
45 means for injecting compressed air blasts through the products of combustion passages downwardly from above and from a point approximating closely to the lower portions of the passages. Obviously, one or
50 the other of these compressed air blast devices, preferably the lower one, may be dispensed with, if found practical for use in connection with a plant wherein the present preheater is to be used. By providing
55 means for cleaning or removing the soot, scale or the like from these passages, the walls of the passages are rendered more durable and hence gives the entire preheater a
60 longer life.

In using the compressed air blast at a point near the lower portion of the products of combustion passages, it is the aim to provide diverging branch pipes or outlets from
65 the main blast pipe (which is in front of the

preheater casing) for injecting the blast at angles into the products of combustion passages and in injecting these blasts, eddy currents of compressed air are created which act to thoroughly dislodge the ac-
70 cumulation of soot, scale and matter from the surfaces of the walls of the products of combustion passages. Certain portions of these walls are inclined or beveled, caused to be so formed due to the construction of the
75 air passages intervening the products of combustion passages, and by producing eddy currents, the soot and scale are easily dislodged, whereas should the blast be injected straight through the passages, a cer-
80 tain amount of the soot, scale or the like would remain on the sloping surfaces and eventually cause a wearing through of the metal walls.

Moreover, the provision of the compressed
85 air blast at a location near the bottom of the passages of the preheater causes an injector action in connection with the air blast from above, thereby enabling the soot and scale to be blown to the bottom of the pre-
90 heater into a soot hopper, from which the soot may be removed in any convenient manner.

Also, the invention aims to provide improved air-cooled dampers operatively
95 mounted in the lower horizontal portions of the products of combustion passages for the purpose of controlling such products, it being possible to operate any one or more of the dampers. In fact, the dampers are se-
100 lectively operable so that one or more may be closed should a section become defective.

It is to be borne in mind that this preheater is adapted for use in connection with
105 boiler furnaces of large capacity where superheat flues are employed and where forced draft apparatus are used for sending a draft through super flues, the principal aim being to preheat this forced draft, hence the foregoing comparison between the old
110 appliances and the present construction herein disclosed.

It is to be understood that the particulars herein given are in no way limitative and that, while still keeping within the scope of
115 the invention, any desired modifications of detail and desired proportions may be made in the apparatus according to the circumstances.

The invention comprises further features
120 and combinations of parts to be hereinafter set forth, shown in the drawings and claimed.

In the drawings:

Figure 1 is a view in perspective of the
125 improved super preheating apparatus constructed in accordance with the invention.

Figure 2 is a perspective view of two of the sections with the end wall plate removed, showing the boxings or frames of the sec-
130

tions and illustrating the arrangement and construction of the plates or walls forming the air passages and the products of combustion passages and illustrating a modified construction of air blast for cleaning the products of combustion passages.

Figure 3 is an enlarged sectional view on line 3—3 of Figure 1 near the top of the preheating apparatus, showing the construction and arrangement of the compressed air blast.

Figure 4 is a sectional view on line 4—4 of Figure 1, showing the construction and arrangement of the compressed air blast near the bottom of the preheating apparatus.

Figure 5 is an enlarged detail perspective view of one end of the compressed air blast at the top, showing the arrangement of the pipes.

Figure 6 is a sectional view on line 6—6 of Figure 2.

Figure 7 is an enlarged sectional view of parts of the air and products of combustion passages, showing the alternate protuberances or buttons which act to prevent undue collapsing of the passage walls.

Figure 8 is a perspective view of a part of one of the front plates.

Figure 8^a is a detail view of one of the front plates 16, more clearly showing the nuts 19 and 20.

Figure 9 is a detail view of one form of spray nozzle, such as shown in Figures 1 and 5, but showing the openings 43 instead of the branch nozzles 44.

Figure 10 is an enlarged perspective view of one of the units, showing the cuts or slits 22 for the reception of the plates 26 more clearly shown in Figure 6.

Figure 11 is a sectional view through one of the sections of the preheater and a portion of an adjacent section, showing the inlets for the cold air.

Figure 12 is a sectional view transversely of the preheater showing the outlets for the cold air passages.

Figure 13 is a vertical sectional view of a preheater modified to that disclosed in Figure 6, and wherein the units are curved at their upper and lower rear portions, with a modified form of air blast device disclosed.

Figure 14 is a view in elevation of the form of door shown in Figure 13.

Referring to the drawings, 1 designates the base of the preheating apparatus which may be any proportions and any shape suitable for the plant with which the apparatus is to be used. This base is constructed preferably of plate metal, though other material may be used, and preferably the lower part has its longitudinal walls converged downwardly, providing a suitable hopper 2 for the soot and scale. The rear wall of the hopper may be provided with any suitable means, such as doors or the like 3, through

which access may be had to the hopper for the purpose of conveniently removing the soot and scale.

Adjacent the upper part of the base 1, it is laterally extended, affording an extension 4 which may be any proportions and any shape. This lateral extension is sub-divided by the plate metal division walls 5, causing products of combustion passages 6 to be formed. The extension 4 has a marginal terminal flange 7 which may be bolted or otherwise secured to the products of combustion flues from the furnace for the purpose of carrying off these products to the stack. However, these products of combustion in passing to the stack act to preheat a forced draft, as will be hereinafter understood.

Mounted in the passages 6 are air cooled dampers 8, the journals 9 of which have lateral arms 9^a which are connected by a bar 9^b provided with a handle at one end so that all the dampers may be operated simultaneously. The construction of these dampers constitute the subject-matter of a co-pending application filed the 22nd day of May, 1924, whose Serial Number is 715,139, allowed October 3, 1924, which has matured into a patent issued June 23, 1925, Patent No. 1,542,989, and it is to be understood that such construction of dampers may be used in other places than herein disclosed. It is obvious that when it is desired to remove a section of the preheater for repairs, the damper which controls the products of combustion passing through the products of combustion passages of the section may be closed. This may be done by disconnecting the arm of the journal of the damper which is to be closed from the operating bar 9^b by removing the connecting bolt. Obviously, the other dampers may be opened and permit the preheater to operate as usual.

The lower portion of the hopper 2 is provided with a terminal marginal flange 10 which may be bolted to a base or foundation for the purpose of supporting the preheater in proper position. The upper part of the base or hopper 2 has a marginal flange 11 which may be bolted, riveted or otherwise secured at 12 to the marginal flanges of the removable sections of the smoke flue which, in the present instance, constitutes the preheater 13 for the forced air draft.

This preheater comprises a plurality of sections 14 and each section contains a plurality of units 15. Each section also consists of a front plate 16 which is marginally flanged, as at 17, and cut to provide an opening 18. Referring to Figure 8 of the drawings (wherein a detail view of the front plate is disclosed), it will be seen that the front plate is cut, as at 19, in a transverse direction and then in a vertical direction, as at 20 (see Fig. 8^a), at both ends of the

transverse cut. The parts caused to be formed by these cuts are bent to provide flanges 21.

As previously stated, the front plates have marginal flanges 17 and portions of certain of these flanges are riveted together, especially those extending vertically, and the vertical flanges 17 at the ends of the preheater are riveted or otherwise secured to the end plates or walls. The flanges 21 are outwardly bent and then again bent the one upwardly and the other downwardly to provide flanges 24. The portions of the marginal flanges 17 at the longitudinal edges of the front plate are outwardly bent and are riveted together, that is, between adjacent outwardly bent flanges 21.

Secured on the flanges 24 are metal plates 25 which are interposed between the outwardly bent flanges 17 of the front plates. The plates 25 have vertical flanges which extend downwardly and upwardly, that is, the flanges of the plates 25 at the lower portion of the frames or boxings extend downwardly and the flanges of the upper plates 25 extend upwardly. These plates have their portions 26 secured by welding or otherwise in the cuts 22 of the opposed plates or walls 23 of the units 15. In tearing down a section for the purpose of repairing a unit, it is necessary to sever the welding or other connection of the parts 26 from the cuts 22 whereby the front plate may be removed, in which case the units of the sections may be removed and plates similar to the front plates installed for the purpose of closing the passages of the adjacent section. However, it is not necessary to install substitute plates for the reason that the division walls 5, as in Figure 3, may extend the full height of the preheater which would prevent the products of combustion from passing into the furnace or boiler room. By the provision of the plates 25, a frame or boxing is provided around the opening in the front plate, reinforcing the opening, and since the flanges 21 are outwardly disposed, they afford means to which the forced air flues may be secured by riveting or otherwise, as in Figures 6 and 13.

In order to construct the units, the opposed walls of each unit are dished in opposite directions. The margins of the dished parts of these walls or plates slope or bevel toward each other, as shown at 27, and the portions of the plates beyond the bevels or sloping parts are preferably welded. It will be noted that the cuts 22 are positioned adjacent the top of the preheater at one side thereof while similar cuts 28 are formed at the bottom on the opposite side of the preheater, there being back plates 29 similar to the front plates, hence provided with openings 30 with surrounding frames consisting of outwardly extending flanges and plates

31. In other words, the back plates are cut the same as the front plates and the plates 31 are fixed in position similar to the plates 25. The plates 31 are welded in the cuts 28 and riveted to the flanges which are cut and bent from the back plates 29.

In Figure 13, the back plates 29^a are solid throughout the height of the preheater and, furthermore, the front lower portions of the unit walls have cuts 28^a to receive plates 31^a similar to the plates 31 in Figure 6. Referring to Figure 13, it will be noted that the upper and lower rear portions of the units are rounded off so that the forced air draft through the units will traverse a curved course, thereby preventing pocketing of the air in the corners of the units as in Figure 6. However, the pocketing of the air in the upper and lower diametrical corners of the units in Figure 6 enables the air to be more thoroughly heated as it is detained at these points, therefore will receive a greater amount of heat.

Should it be desired to remove the back plates instead of the front plates, it is necessary to sever the welding where the plates 31 or the plates 31^a are secured in the cuts of the units. An air draft flue 32 is provided as in Figures 1, 6 and 13, for carrying off the heated fresh air, and such flue 32 has connected to it, as at 33, as in Figure 6, a flue 33^a which may conduct the heated air to a boiler furnace for aiding in the combustion of the fuel.

The walls 23 of the units are spaced due to their opposed dishing, and the units themselves are spaced, thereby providing products of combustion passages 34 which communicate with the passages 6. These passages 34 extend vertically and carry off the products of combustion to the stack. It will be noted that the end plates are flanged at their upper ends, as at 35, and the front and back plates 16, 29 and 29^a are flanged at their upper ends, as at 36, affording means for attaching by welding or riveting suitable flues 36^a for carrying off the products of combustion to the stack. These flues 36^a are also provided with air cooled dampers 36^b, similar in construction to the dampers 8, with the exception that the dampers 36^b are larger. When a section of the preheater is to be removed for repairs, the damper 36^b of the section to be removed is closed. This may be accomplished by disconnecting the arm 36^d from the operating bar 36^c. Obviously, the remaining dampers may be closed or opened at will.

Referring to Figures 1 and 13, it will be noted that a compressed air blast device 37 is mounted in the flue 36^a. Referring to Figures 1 and 13, the compressed air blast device 37 is connected to a main pipe 38 which is disposed preferably in front of the preheater. In Figure 1, the main pipe ex-

tends horizontally whereas in Figure 13, it extends vertically. However, projecting from the main pipe are branch pipes 39 which have at their inner ends terminal transverse pipe sections 40 closed at their opposite ends.

Depending from the pipe sections 40 by means of the connectors 41 are pipes or tubes 42. The pipes or tubes 42 are in parallelism, as in Figures 1, 13, 5 and 9. However, the pipes or tubes 42 in Figures 5 and 13 have nozzles 44 while the tubes or pipes 42 in Figures 1 and 9 have openings or orifices 43 which act to inject sprays of air downwardly through the combustion passages formed between the units. The branch nozzles 44 extend in directions from the sloping surfaces of the dished parts of the opposed walls of the units, acting to dislodge the soot, scale and the like and carry it down through the passages. The main pipe 38 may be connected to any suitable air blast supply (not shown).

Referring to Figures 2 and 6, the air blast device 37^a is modified to that shown in Figures 1 and 13. In Figures 2 and 6, the main pipe 38^c extends vertically and is connected to a drum 38^d which is fastened in any suitable manner, preferably by straps, to the preheater. Projecting from the drums are tubes 40^a which have openings or orifices 43^a which, as well as the orifices 43 in Figure 9, are positioned to direct the blasts of air divergently so as to pass through the products of combustion passages and insure the removal of the scale and soot. The pipes which connect the main pipes 38 and 38^c to the pipes 40 and the drums 38^d have valves 40^b which may be closed for shutting off the air blasts through the products of combustion passages. Connected to the main pipes 38 in Figures 1 and 13 and to the main pipe 38^c by means of valves 41^a are vertical pipes 46 which connect with compressed air blast devices 45 employed in connection with the preheater. The compressed air devices 45, as in Figures 1, 2, 4, 6 and 13, consist of drums 45^a which have branch nozzles 48 connected thereto. These branch nozzles 48 diverge and extend through the front plates of the sections and act to inject sprays of compressed air into the products of combustion passages of the preheater. As the sprays from the lower branches 48 are injected into the passages at points approximating the bottom of the preheater, they, in addition to creating eddy currents in these passages, also act to produce an injector action on the sprays directed downwardly from the upper part of the preheater, assisting materially in forcing the compressed air downwardly and to thoroughly remove the soot and scale. The eddy currents created where the branches 48 inject the compressed air into the pas-

sages act to remove the scale from the sloping surfaces of the passages.

The opposed walls of the units are provided with depressed buttons or protuberances 49. Certain of these buttons or protuberances are extended in one direction and certain others in the opposite direction. Certain of those of the walls of the air passages engage, preventing the walls from collapsing toward each other, while those which extend from each other contact with similar protuberances on the walls of an adjacent unit, thereby preventing the air passage walls from collapsing away from each other. In this latter case, the walls of the products of combustion passages are prevented from collapsing inwardly. In other words, the protuberances are constructed in directions of staggered relation, hence providing units for a section, of which the walls are prevented from distortion due to defects caused from the collection of corrosion and the like. These protuberances permit of a more complete passage of air from the forced air draft and also a more complete passage of the products of combustion, the latter acting to heat the former which is subsequently injected into a boiler furnace beneath the fire-bed, the primary purpose being to facilitate the more thorough combustion of the fuel.

The front plate of each section of the flue unit or preheater is provided with upper and lower inspection openings 50 closed by the doors 51. Obviously, the doors may be opened to permit of inspection of the products of combustion passages in order to ascertain any defect that may have occurred due to the collection of soot and scale and should there be any defects, it is possible to tear down a section and permit of the repair of the units 15. Also, inspection may be made for the purpose of determining when to turn on the compressed air blast. However, it is possible to permit the compressed air blast to operate continuously to insure the prevention of the collection of soot and scale. This compressed air blast, however, need not operate to its full capacity.

Referring to Figures 1 and 6, it will be noted that the inspection doors are held closed by transverse bars 50^c which are hinged to swing horizontally when the doors are opened. The doors move with the bars. However, in Figures 13 and 14, the doors 51^a are held closed by vertical bars 60 hinged to swing downwardly or upwardly by means of the pins 61. In other words, the removal of either one of the pins will permit the bar 60 to be swung upwardly or downwardly, allowing the door 51^a to swing open to permit of inspection through the door openings 50^a.

As clearly shown in Figures 4 and 7, it will be noted that the products of combustion

tion passages are wider than the air passages through the units. This feature is emphasized considerably in Figure 7 to insure thorough heating of the air passing through the units. In other words, the greater the area of heat as compared with the area of the air to be heated, the more the air receives heat.

The invention having been set forth, what is claimed is:

1. In a preheater for boiler furnaces, a casing, means spaced therein forming products of combustion passages and air passages in alternating parallel succession, the walls between the passages having parts of their margins deflected laterally forming air inlets and outlets respectively to remote portions of the air passages, the deflected parts being connected between the air passages with means connecting the upper and lower portions of the deflected parts for closing the products of combustion passages to the air passages, and air draft conductors connected to the casing and communicating with the pluralities of air inlets and outlets respectively.

2. In a preheater for boiler furnaces, a flue casing, means spaced therein and thereby forming in parallel succession alternate products of combustion and air passages, the latter at remote ends of the casing having air inlets and outlets, the walls forming said passages being marginally dished and inwardly from the dished margins having protuberances in the flat portions and extending alternately in opposite directions, thereby preventing collapsing of the walls, and air draft conductors connected to the casing and communicating with the pluralities of air inlets and outlets respectively.

3. In a preheater for boiler furnaces, a casing, means spaced therein and thereby forming products of combustion and air passages, the latter alternating with the former in parallelism therewith and having air inlets at one side of the section to receive a forced air draft, and air outlets at remote portions of the air passages, means connecting the air inlets of the air passages with a boiler furnace, the forced air draft being preheated from the heat of the products of combustion, the walls forming said passages having protuberances therein extending alternately in opposite directions, thereby preventing collapsing of the walls.

4. In a preheater for boiler furnaces, a casing, means spaced therein and thereby forming in parallel succession alternate products of combustion and air passages, the latter being connected to a forced air draft supply at one side of the casing and provided with means for connection with a boiler furnace at the opposite side of said casing, said casing being made up of a plurality of sections, each section capable of

being ruptured at its point of connection within the casing, whereby the sections may be removed and each section comprising a plurality of elements, which are capable of rupture at their points of connection, permitting the elements to be removed, and thereby permitting any one of the sections to be removed for diminishing the size of the preheater casing.

5. A preheater for boiler furnaces, comprising a casing, means spaced therein forming in parallel succession alternate products of combustion and air passages, the products of combustion passing through the former acting to heat a forced air draft passing through the latter, means adjacent the top of the casing, and means adjacent the bottom of the casing, for injecting a compressed air blast into and through the products of combustion passages for carrying off the soot and scale downwardly.

6. A preheater for boiler furnaces, comprising a casing divided into a plurality of sections, a plurality of elements with passages therethrough spaced in and composing each section, the spacing of the elements, together with the passages in the elements, constituting alternate products of combustion and air passages in parallel succession, the latter being connected with a forced air draft supply at one side of the casing and provided with means for connection with a boiler furnace at the opposite side of said casing, the elements adapted to be ruptured at their points of connection with the walls of said passages, thereby permitting any one of the sections to be removed for diminishing the size of the preheater casing.

7. A preheater for boiler furnaces, comprising a casing divided into a plurality of sections, a plurality of elements with passages therethrough spaced in and composing each section, the spacing of the elements, together with the passages in the elements, constituting alternate products of combustion and air passages in parallel succession, the latter being connected with a forced air draft supply at one side of the casing and provided with means for connection with a boiler furnace at the opposite side of said casing, the elements capable of being ruptured at their points of connection with the walls of said passages, thereby permitting any one of the sections to be removed for diminishing the size of the casing, and means adjacent the top of the casing and means adjacent the bottom thereof for injecting a compressed air blast into and through the products of combustion passages for carrying the soot and the scale downwardly.

8. A preheater for boiler furnaces including a casing divided into a plurality of sections, a plurality of cellular units in spaced relation and composing each section,

the spacing of the units and their cells forming alternate products of combustion and air passages in parallel succession, each unit comprising opposed marginally outwardly dished walls, said walls inwardly of the dished margins being flat and the walls beyond the dished margins being marginally connected, certain parts of the remote portions of the connected margins at the remote ends of each unit having air inlets and air outlets.

9. A preheater for boiler furnaces including a casing divided into a plurality of sections, a plurality of cellular units in spaced relation and composing each section, the spacing of the units and their cells forming alternate products of combustion and air passages in parallel succession, the products of combustion passing through the former passages acting to heat a forced air draft passing through the latter passages, and means adjacent the top of the casing and means adjacent the bottom thereof, for injecting a compressed air blast into and through the products of combustion passages for dislodging the soot and scale.

10. A preheater for boiler furnaces including a casing divided into a plurality of sections, a plurality of cellular units in spaced relation and composing each section, the spacing of the units and their cells forming alternate products of combustion and air passages in parallel succession, the products of combustion passing through the former passages acting to heat a forced air draft passing through the latter passages, and means adjacent the top of the casing and means adjacent the bottom thereof, for injecting a compressed air blast into and through the products of combustion passages for dislodging the soot and scale, the compressed air blast injecting means near the bottom creating an injector action on the compressed air blast from above for creating a through passage of the compressed air blast through the products of combustion passages.

11. A preheater for boiler furnaces including a casing divided into a plurality of sections, a plurality of cellular units in spaced relation and composing each section and thereby forming parallel alternate products of combustion and air passages, the products of combustion passing through the former acting to heat a forced air draft passing through the latter, means adjacent the top of the casing and means adjacent the bottom, for injecting compressed air blasts into and through the former passages for dislodging the soot and scale, and a hopper at the bottom of the casing for the reception of the soot and scale.

12. A preheater for boiler furnaces including a casing divided into a plurality of sections, a plurality of cellular units in

spaced relation and composing each section and thereby forming parallel alternate products of combustion and air passages, the products of combustion passing through the former acting to heat a forced air draft passing through the latter, means adjacent the top of the casing and means adjacent the bottom, for injecting compressed air blasts into and through the former passages for dislodging the soot and scale, a compressed air blast injecting means near the bottom creating an injector action on the compressed air blast from above for creating a through passage of the compressed air blasts through the products of combustion passages, and a hopper at the bottom of the casing for the reception of the soot and scale.

13. A preheater for boiler furnaces including a casing divided into a plurality of sections, a plurality of cellular units in spaced relation and composing each section and thereby forming parallel alternate products of combustion and air passages, the products of combustion passing through the former acting to heat a forced air draft passing through the latter, means adjacent the top of the casing and means adjacent the bottom thereof for injecting compressed air blasts into and through the former passages for dislodging the soot and scale, each compressed air blast means having diverging air injecting branches forcing the air blasts against the walls of the products of combustion passages, creating eddy currents for dislodging the soot and scale.

14. A preheater including a casing divided into a plurality of sections, a plurality of cellular units in spaced relation and composing each section and forming therein a series of parallel alternate products of combustion and air passages, the heat passing through the former acting to preheat a forced air draft passing through the latter, the points of connection of said units capable of being ruptured, whereby said units may be removably supported in each section, each section having a removable front plate to permit the units to be removed.

15. A preheater including a casing divided into a plurality of sections, a plurality of cellular units in spaced relation and composing each section and forming therein a series of parallel alternate products of combustion and air passages, the heat passing through the former acting to preheat a forced air draft passing through the latter, the points of connection of said units capable of rupture at their points of connection in each section, whereby the sections are removably adapted to be removed, each section having a front plate capable of rupture at its point of connection in the section to permit the units to be removed, the remote ends of the units, of which the interiors con-

stitute the air passages, having means for attachment with forced air draft and boiler furnace flues, thereby permitting the preheated forced draft to be conducted to the boiler furnace.

16. A preheater including a casing divided into a plurality of sections, a plurality of cellular units in spaced relation and composing each section and forming therein a series of parallel alternate products of combustion and air passages, the heat passing through the former acting to preheat a forced air draft passing through the latter, said units capable of rupture at their points of connection in each section, whereby the sections are removably supported, each section having a front plate capable of rupture at its point of connection in the section to permit the units to be removed, the remote ends of the units, of which the interiors constitute the air passages, having means for attachment with forced air draft and boiler furnace flues, thereby permitting the preheated forced draft to be conducted to the boiler furnace, means for injecting compressed air blasts into the products of combustion passages for blowing the soot and scale to the bottom of the casing, and a hopper at the bottom of the casing to receive the soot and scale.

17. A preheater including a casing divided into a plurality of sections, a plurality of cellular units in spaced relation and composing each section and forming therein a series of parallel alternate products of combustion and air passages, the heat passing through the former acting to preheat a forced air draft passing through the latter, the points of connection of said units capable of rupture at their points of connection in each section, whereby the sections are removably supported, each section having a removable front plate to permit the units to be removed, means at the top and means near the bottom of the products of combustion passages for injecting compressed air blasts into said passages for blowing the soot and scale to the bottom of the casing, the means at the bottom creating an injector action on the blasts from the top to insure removal of the soot and scale, and a hopper at the bottom of the casing to receive the soot and scale.

18. A preheater including a casing divided into a plurality of sections, a plurality of cellular units in spaced relation and composing each section and forming therein a series of parallel alternate products of combustion and air passages, the heat passing through the former acting to preheat a forced air draft passing through the latter, the points of connection of said units capable of rupture at their points of connection in each section, whereby the sections are removably supported, each section having a

front plate capable of rupture at its point of connection in the section to permit the units to be removed, and air blast means at the top and air blast means near the bottom, of the products of combustion passages for blowing the soot and scale to the bottom of the casing, said air blast means including blast injector nozzles which are divergent to direct sprays against the walls of the products of combustion passages, creating eddy currents to insure the removal of the soot and scale.

19. A preheater including a casing divided into a plurality of sections, a plurality of cellular units in spaced relation and composing each section and forming therein a series of parallel alternate products of combustion and air passages, the interiors of the units acting as the air passages, the spaces between the units constituting the products of combustion passages, the opposed walls of the units being secured together marginally and having certain portions of their margins at diagonally opposite points separated and spaced, with plates above and below the edges of the separated and spaced portions, thereby forming openings leading to the air passages, said openings being connected to forced air draft flues for conducting the preheated air to a boiler furnace.

20. A preheater including a casing divided into a plurality of sections, a plurality of cellular units in spaced relation and composing each section and forming therein a series of parallel alternate products of combustion and air passages, the interiors of the units constituting the air passages, remote ends of the units having inlet and outlet passages for a forced air draft, the walls of the elements being inwardly dished and being flat inwardly from such dished margins and being secured together marginally beyond such dished margins, and means for preventing collapsing of the elements in either direction.

21. A preheater including a casing divided into a plurality of sections, a plurality of cellular units in spaced relation and composing each section and forming therein a series of parallel alternate products of combustion and air passages, the interiors of the units constituting the air passages, remote ends of the units having inlet and outlet passages for a forced air draft, the walls of the elements being inwardly dished and being flat inwardly from such dished margins and being secured together marginally beyond such dished margins, means for preventing collapsing of the elements in either direction, and means for supporting the elements in each section of the casing.

22. A compressed air blast apparatus for a plurality of products of combustion pas-

sages, said apparatus consisting of a main supply pipe for the compressed air provided with lateral branches having terminal pipe sections, and a plurality of spray pipes connected to each terminal pipe section and provided with a plurality of air blast nozzles diverging for injecting sprays against the walls of the products of combustion passages, creating eddy currents to remove the soot and scale therefrom.

23. In a preheater as set forth, a casing divided into a plurality of sections, means spaced in each section and thereby forming products of combustion and air passages, the former alternating with the latter in parallelism therewith having air inlets at one side of the casing for receiving a forced air draft, said inlets being connected with a boiler furnace, air outlets at remote portions of the air passages, the forced air draft being preheated by the heat from the products of combustion, and means at remote portions of the products of combustion passages for directing cleansing fluids there-through to insure removing the soot and similar matter that collects in the passages.

24. A compressed air blast apparatus for a plurality of products of combustion passages, said apparatus comprising main supply pipes, one with branches located adjacent the ends of the passages, the other with branches adjacent the sides of the passages in advance of the first set of branches, both sets of branches having spray outlets directed toward the walls of the passages creating eddy currents, the currents of the latter branches creating an injector action on the currents from the outlets of the former branches.

25. In a preheater, a series of cellular units arranged side by side in spaced relation and their interiors forming air passages, the spaces between said units forming passages for products of combustion, air inlets communicating with the interior of said cellular units, air outlets leading from said cellular units, an inlet beneath said units for supplying products of combustion to the spaces between the units, outlets communicating with the spaces between the units at the upper end thereof, and means to inject jets of compressed air between said units and against the walls thereof.

26. In a preheater, a series of cellular units arranged side by side in spaced relation and their interiors forming air passages, the spaces between said units forming passages for products of combustion, air inlets communicating with the interior of said cellular units, air outlets leading from said cellular units, an inlet beneath said units for supplying products of combustion to the spaces between the units, outlets communicating with the spaces between the units at the upper end thereof, and means

at the top of said outlets for directing jets of compressed air downwardly between said units against the passages of the product of combustion through the spaces between the units.

27. In a preheater, a series of cellular units arranged side by side in spaced relation and their interiors forming air passages, the spaces between said units forming passages for products of combustion, air inlets communicating with the interior of said cellular units, air outlets leading from said cellular units, an inlet beneath said units for supplying products of combustion to the spaces between the units, outlets communicating with the spaces between the units at the upper end thereof, means at the top of said outlets for directing jets of compressed air downwardly between said units against the passages of the product of combustion through the spaces between the units, and other means positioned below the last mentioned means for directing the jets of compressed air downwardly and across the lower parts of the spaces between said units.

28. In a preheater, a series of cellular units arranged side by side in spaced relation and their interiors forming air passages, the spaces between said units forming passages for products of combustion, air inlets communicating with the interior of said cellular units, air outlets leading from said cellular units, an inlet beneath said units for supplying products of combustion to the spaces between the units, outlets communicating with the spaces between the units at the upper end thereof, and compressed air pipes extending horizontally in the central planes of the spaces between said units and having jet outlets in their bottom portions, said compressed air pipes being located above said units.

29. In a preheater, a series of cellular units arranged side by side in spaced relation and their interiors forming air passages, the spaces between said units forming passages for products of combustion, air inlets communicating with the interior of said cellular units, air outlets leading from said cellular units, an inlet beneath said units for supplying products of combustion to the spaces between the units, outlets communicating with the spaces between the units at the upper end thereof, compressed air pipes extending horizontally in the central planes of the spaces between said units and having jet outlets in their bottom portions, said compressed air pipes being located above said units, and other compressed air pipes located at the front of the lower portion of the heater and terminating in nozzles directed inwardly and downwardly into the spaces between said units.

30. In a preheater, a series of cellular units arranged side by side in spaced rela-

tion and their interiors forming air passages the spaces between said units forming passages for products of combustion, air inlets communicating with the interior of said cellular units, air outlets leading from said cellular units, an inlet beneath said units for supplying products of combustion to the spaces between the units, outlets communicating with the spaces between the units at the upper end thereof, compressed air pipes extending horizontally in the central planes of the spaces between said units and having jet outlets in their bottom portions, said compressed air pipes being located above said units, and other compressed air pipes located at the front of the lower portion of the heater and terminating in nozzles directed inwardly and downwardly into the spaces between said units, the last mentioned nozzles diverging to direct the air issuing therefrom against the outer surfaces of the walls of said units.

31. In a preheater, a series of cellular units arranged side by side in spaced relation and their interiors forming air passages, the spaces between said units forming passages for products of combustion, air inlets communicating with the interior of said cellular units, air outlets leading from said cellular units, an inlet beneath said units for supplying products of combustion to the spaces between the units, outlets communicating with the spaces between the units at the upper end thereof, means at the top of said outlets for directing jets of compressed air downwardly between said units against the passages of the product of combustion through the spaces between the units, and a soot receiving hopper located below the bottom of said units.

32. In a preheater, a series of cellular units arranged side by side in spaced relation and forming air passages, the spaces between said units forming passages for products of combustion, air inlets communicating with the interior of said cellular units, air outlets leading from said cellular units, an inlet beneath said units for supplying products of combustion to the spaces between the units, outlets communicating with the spaces between the units at the upper end thereof, means at the top of said outlets for directing jets of compressed air downwardly between said units against the passages of the product of combustion through the spaces between the units, other means positioned below the last mentioned means for directing the jets of compressed air downwardly and across the lower part of the spaces between said units, and a soot receiving hopper located below the bottom of said units.

33. In a preheater, a series of cellular units arranged side by side in spaced relation and forming air passages, the spaces

between said units forming passages for products of combustion, air inlets communicating with the interior of said cellular units, air outlets leading from said cellular units, an inlet beneath said units for supplying products of combustion to the spaces between the units, outlets communicating with the spaces between the units at the upper end thereof, compressed air pipes extending horizontally in the central planes of the spaces between said units and having jet outlets in their bottom portions, said compressed air pipes being located above said units, other compressed air pipes located at the front of the lower portion of the heater and terminating in nozzles directed inwardly and downwardly into the spaces between said units, and a soot receiving hopper located below the bottom of said units.

34. In a preheater, a series of cellular units arranged side by side in spaced relation and forming air passages, the spaces between said units forming passages for products of combustion, air inlets communicating with the interior of said cellular units, air outlets leading from said cellular units, an inlet beneath said units for supplying products of combustion to the spaces between the units, outlets communicating with the spaces between the units at the upper end thereof, compressed air pipes extending horizontally in the central planes of the spaces between said units and having jet outlets in their bottom portions, said compressed air pipes being located above said units, other compressed air pipes located at the front of the lower portion of the heater and terminating in nozzles directed inwardly and downwardly into the spaces between said units, the last mentioned nozzles diverging to direct the air issuing therefrom against the outer surfaces of the walls of said units, and a soot receiving hopper located below the bottom of said units.

35. In a preheater for boiler furnaces, a casing comprising a plurality of sections, a plurality of cellular units spaced side by side and composing each section, the spaces between the units constituting products of combustion passages, the interiors of the units constituting air passages, air inlets and outlets leading to and extending from the air passages of the units, inlets at one end of the casing connecting with the products of combustion passages respectively, outlets at the other end of the casing and communicating with the products of combustion passages, respectively, the sections being capable of rupture at other points of connection in the casing, whereby the sections may be removed, the units capable of rupture at their connections in each section, thereby rendering the sections capable of disassembling.

36. In a preheater, a casing comprising a

plurality of sections supported therein, a plurality of cellular units composing each section and being spaced therein, the spaces between the units forming products of combustion passages, while the interiors of the units constitute air passages, the former alternating with the latter, air inlets and outlets leading to and from remote ends of the air passages of the units, a passage communicating with the products of combustion passages of each section to conduct the products of combustion therethrough, a passage leading from the products of combustion passages of each section to carry off the prod-

ucts of combustion, the sections and the units capable of rupture at the points of their connections in the casing and in the sections, whereby the sections and the units may be disassembled, and means in the individual passages extending to and from and communicating with the products of combustion passage for shutting off the products of combustion when any one or more of the sections are disassembled.

In witness whereof the inventor's signature is hereunto affixed.

WILLIAM M. CONNERY.