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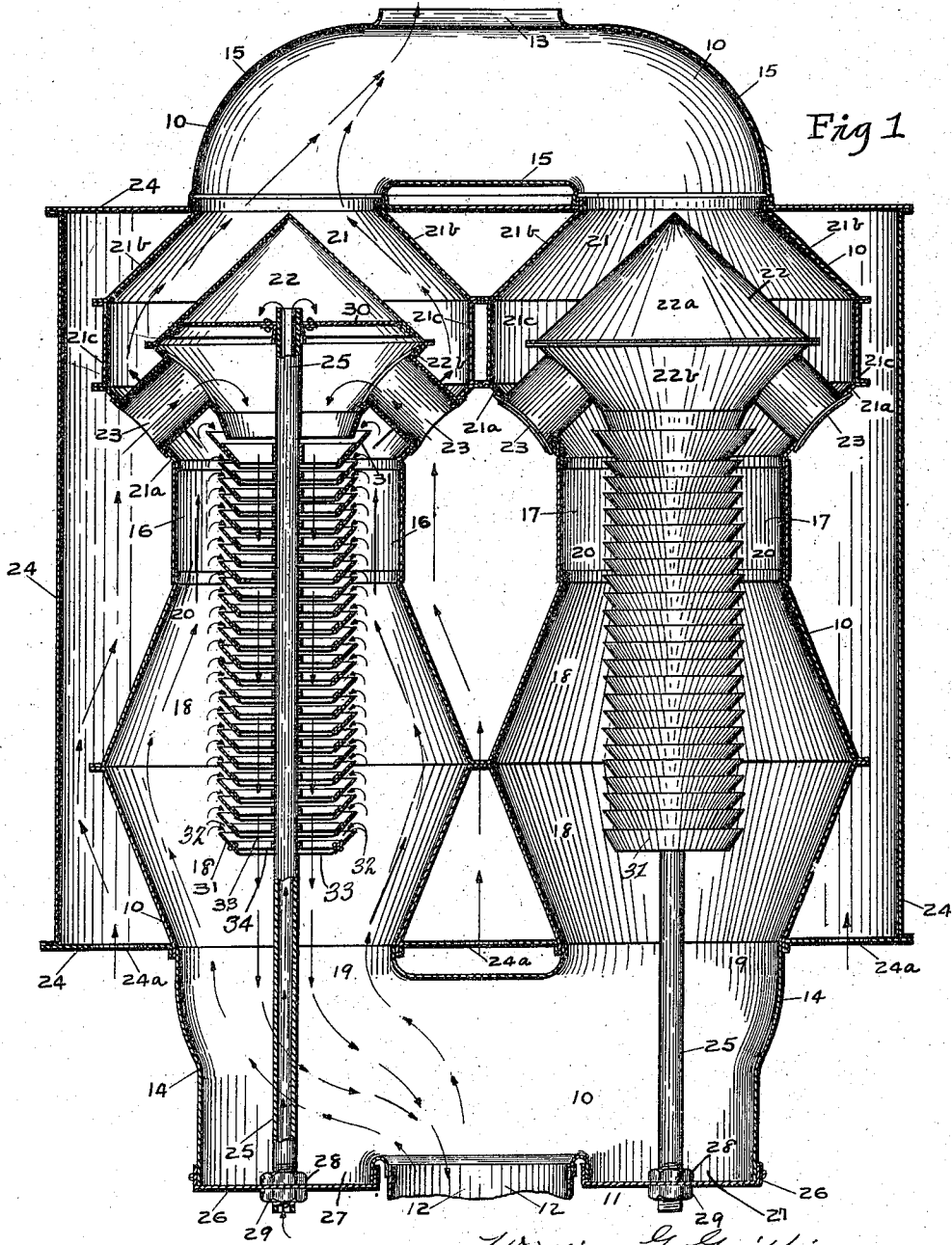
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FUEL ECONOMIZER

Filed Dec. 21, 1921

2 Sheets-Sheet 1



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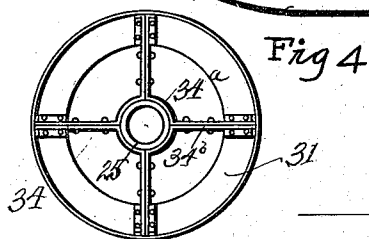
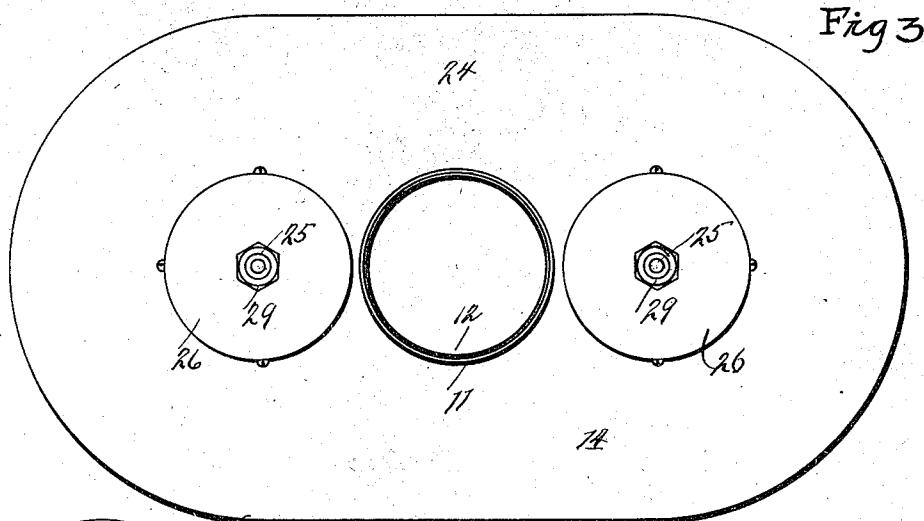
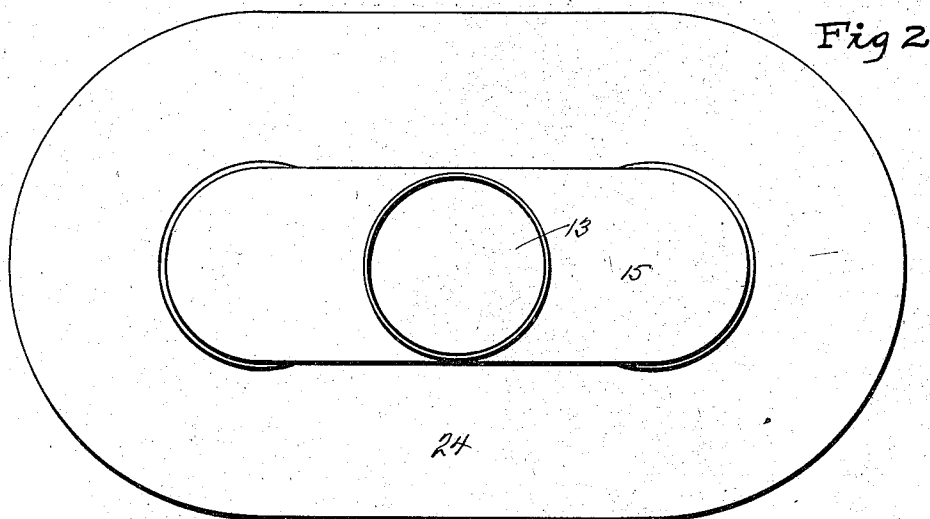
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FUEL ECONOMIZER

Filed Dec. 21, 1921

2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

WILLIAM G. GRIFFIN, OF WASHINGTON, DISTRICT OF COLUMBIA.

FUEL ECONOMIZER.

Application filed December 21, 1921. Serial No. 523,907.

To all whom it may concern:

Be it known that I, WILLIAM G. GRIFFIN, a citizen of the United States of America, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Fuel Economizers, of which the following is a specification.

The present invention relates broadly to new and useful improvements in fuel economizers, and has particular reference to those devices of the type that are adapted especially for application to the smoke stack or other exhaust conduit from the furnace and are designed to convert the unburnt products of combustion passing through the exhaust conduit into a combustible fuel and returning the same to the fire-box of the furnace where it is ignited and consumed.

While it has heretofore been proposed, and in some instances carried into practice, to make available for combustion in the fire-box of the furnace those unburnt products, which ordinarily pass up the exhaust conduit from the furnace by thinning them out with air that is let into the conduit at an intermediate point, but so far as is known to the present inventor, all prior devices of this general character fall short of attaining the desired object of producing from the unburnt products as a base a properly combustible mixture, principally because they do not provide means for effecting a thorough and intimate mixture of the unburnt products and the air, and also fail to introduce to the fire-box the mixed air and unburnt products of combustion in sufficient quantities to achieve the consumption of the escaping products to the extent that is possible by the present invention.

It is therefore the object of this invention to make possible the utilization of the heat-producing properties of coal and other fuel by means of a method and construction, whereby highly heated air is brought into contact with the hot gases at a point after they leave the combustion chamber, and in a manner to form a readily combustible mixture that will be drawn down into the furnace and burned. While I am aware that it is not new to introduce air into these uprising gases, the introduced air heretofore used has been of the temperature of the atmosphere and cools the gases and thus

defeats the intended purpose, which must be accomplished very quickly.

It is also an object of this invention to incorporate in the fuel economizer coacting means which, while of a stationary nature, are so related to each other that they will act to produce a thorough and intimate commingling of the air, which is led into the conduit, and the heavier particles of the unburnt products passing through the conduit, so that the combustion-supporting oxygen in the mixture will be properly distributed and the oxycarbon gases and pure carbon particles maintained in suspension in the air, directed to the center of the conduit and carried into the combustion chamber by the return draft therein caused by the rarefaction of the gases in the combustion chamber.

A further object of the invention is to effect a greater admixture of air with the gases than otherwise would be possible, by causing the draft of the uprising gases from the furnace to divide and each divided draft to pass through an expanding and air-mixing chamber in order that increasing facilities may be provided for greater air introduction and more thorough mixing thereof with the products of combustion and the production of maximum results.

Another object of the invention is to relate the air inductor and the gaseous inductor to each other in such manner that the amount of air drawn into the drum will be determined by the density of the products escaping from the furnace, and will therefore at all times and under all conditions be that amount which will most efficiently support the combustion of these products which are returned to the fire-box of the furnace.

One feature of the invention resides in the method of improved combustion which consists in introducing highly heated air into the uprising unburnt products of combustion and causing the mixture of air and unburnt products of combustion to be introduced into the furnace, preferably through a return draft traveling through the uprising gases, whereby the same are drawn back for combustion with the requisite oxygen to support the same.

The apparatus for practicing the above method consists broadly in a casing or cham-

ber to form an intermediate portion of the exhaust conduit of a furnace having one or more enlarged sections to expand the gases and smoke passing therethrough and provided with air passages leading into the central portion of the casing, and means for heating the air before it is drawn into the casing.

The invention further consists in a fuel economizer which includes as the essential elements of construction a body casing to form an expansion chamber adapted to be interposed in the exhaust conduit of the furnace, a plurality of air openings through which fresh air may enter the casing, a mixing chamber which is segregated from the interior of the casing, a means for directing the air entering the opening in the mixing chamber, and a means for coincidentally drawing off from the products escaping from the furnace through the conduit those oxygen-carbon gases and pure carbon particles which will, when combined with air, produce a mixture of relatively high combustibility and of relatively high combustion temperature, so that the amount of heat rescued from what otherwise would be waste products, will be of maximum extent.

The invention also consists in other novel features of arrangement and construction of parts all as hereinafter described, and as specifically pointed out in the appended claims.

In the accompanying drawings:—

Figure 1 is a longitudinal sectional view of the fuel economizer, showing the same in a preferred form of dual construction, in which view one of the duplicate air and gas inductors is shown in full line;

Figure 2 a top or plan view of the device;

Figure 3 a bottom view thereof; and

Figure 4 a detail showing a top view of one of the hoops constituting a part of the gas-inducting means and showing the supporting spider therefor.

Referring to the drawings for a detailed description thereof, 10 indicates a casing preferably constructed of sheet metal and designed to be interposed in the smoke pipe or exhaust conduit of a furnace, and to form a chamber that constitutes a part of the draft passageway and into which the uprising products of combustion exiting through the conduit must enter and be expanded, and for the purpose of connecting it up in the conduit, it is formed with a central, flanged opening 11 at the furnace end to receive and make a union with the section of pipe 12 leading directly from the furnace, or if desired, the union can be made directly with the flanged pipe provided on furnaces for the exhaust conduit. On the opposite or top end the casing is provided with a flanged exit opening 13 to make a union with that portion of the conduit or smoke pipe (not shown)

which completes the same to a chimney or stack. In the preferred form shown, in which a double form of the device is present, a double elbow 14 forms the means of dividing the draft passage and permits the application of the invention separately to each draft to further amplify the economic results in applying the principles of the invention, which are present and complete in each part and may be practiced with but one of the duplicate parts connected up singly in the exhaust conduit. For the purpose of the dual form shown, the double elbow 15 unites the divided draft passing through the sections 16 and 17 which form the connections between the double elbow, and permits the united draft to continue through the remaining portion of the exhaust conduit.

The sections 16 and 17 each includes an expansion chamber 18 of larger cross section than the exhaust conduit, and which at its ends is commensurate with each opening 19 of the double elbow 14 and forms at one end a juncture with the said elbow. This expansion chamber 18 is outwardly flared to an intermediate point thereof and then contracted to receive a short waist section 20, preferably of the cross sectional size of the opening 19, which waist section unites with another expanded chamber 21, which in turn connects with the elbow 15; the said chamber 21 having sides 21^a and 21^b of tapering form and an intermediate cylindrical portion 21^c; the purpose of the chamber 21 being to provide sufficient space therein for a part of the air inductor now to be referred to in detail, and not interfere with the draft through the chamber.

The air inductor consists of a sheet metal chamber 22 disposed concentrically within the chamber 21, having a conical top 22^a and base portion 22^b of inverted frusto-conical form and in open relation at its lower end with the chamber 21. From the base portion of the chamber 22 air ducts 23 extend into open relation with the air on the exterior of the chamber 21, the piping forming these ducts extending through the sides 21^a and being flanged down on the exterior thereof, so that the air entering the openings will be solely directed into the interior chamber 22. In order that the air entering the chamber 22 may be heated to a temperature that will permit it to readily mix with the gases and unburnt products of combustion, there is provided a heating drum 24, which surrounds the sections 16 and 17 as made up of the parts constituting it, which drum is provided with openings 24^a at the bottom thereof to permit the entrance of air, which as indicated by the arrows, is heated as it rises to the upper part of the interior of the drum where it is drawn into the chamber 22 being of such a degree of temperature as to readily mix with the products of combustion.

As a further means of inducing heated air into the chamber 22, a tube 25 is centrally disposed longitudinally through the casing or section (16 and 17) and through the elbow 14, the same extending through and being supported at its lower end on a cap 26 closing a side opening 27 to permit ready removal of the tube with its associated parts for cleaning, the tube being secured to the cap 26 by nuts 28 and 29, and being removably centered in a spider 30 secured within the air chamber 22 so that with the removal of the cap 26 the tube will be withdrawn from the central opening of the spider support.

At this point it should be explained that the products of combustion entering the exhaust conduit in their outward passage travel along the walls of the conduit, there being a tendency to hug the wall, leaving along the axial path of the conduit a return current. This condition is due mainly to the rarefaction of the air and gases within the furnace, which rarefaction is making a demand always for more air, and this air which seeks entrance along an axial path within the conduit forms a part of the returning current. In the present invention this condition is taken into consideration and is augmented by the expansion given the gases in the present device, the effect of the expansion starting in the elbow section 14 and further taking place in expansion chambers 18 acts, not only as a retardant to the outgoing current by rarefaction, but increases the return current so that the air introduced into and along the axial path by the air inductor assists materially in building up this return current especially in that the air is heated so that it will unite with the outgoing gases and much of the unburnt products of combustion returned and consumed.

As a means to give a nozzle effect within the device of the induced air and at the same time induce the gases along a considerable path therein to mix with the heated air and become a part of this return current, there has been provided a nozzle structure that is built up of a multiplicity of frusto-conical hoops 31 horizontally supported upon the heated air tube 25 with the flare thereof upward, so that each hoop will extend well within the next adjacent lower hoop and leave the sides of adjacent hoops spaced apart to form the gas-inducing openings 32 through which the unburnt products of combustion are drawn, these hoops being also spaced apart from the tube 25 to form a nozzle passage or mixing chamber 33 surrounding the said tube for the heated air from chamber 22 and the indrawn gases through the opening 32 to thoroughly commingle and be carried along the axial path of the device and exhaust conduit into the

combustion chamber of the furnace. It will be noticed that the mixing chamber or nozzle formed by the series of flanged hoops 31 is arranged to receive the heated air from the air inductor chamber 22, the discharge opening of that chamber being within the initial or top hoop, and that this mixing chamber or nozzle extends axially with the expansion casing and well within the expansion chamber 18, so that the current of the products of combustion which will be more or less retarded at this point of greatest expansion as well as rarefied, assists in causing the unburnt or more volatile products to seek the return current through the gas inductor openings, the surface of the flared walls of the gas inductor hoops tending also to arrest the outward current and deflect it downward and inward.

As a means of supporting the flared hoops 31 of the inductor nozzle, a spider 34 is employed which consists of a hub portion 34^a to receive the tube 25 and clamp the tube therein, and arms or spokes extending from the hub portion and secured at their ends to the hoop, the hub and arms being formed preferably as shown in Figure 4 in which four strips of sheet metal are so bent and united as to form a simple and inexpensive spider construction for the purpose.

From the foregoing it will be seen that the present device has not merely proceeded on the principle that atmospheric air may be let into the exhaust conduit at a point where the same is expanded to promote fuel consumption in some part, but that the invention has sought in a very substantial way to extend this principle so that a very considerable quantity of air will not only be properly combined with the escaping products of combustion but delivered with the products of combustion to the furnace and consumed. This result has proceeded, as above stated, from the heating of the air introduced, as cold air does not as readily mix with the gases as preheated air and the heating by contact with the gases of the introduced atmospheric air does not take place quickly enough to effect thorough commingling of air and gas to secure the benefit present when heated air is introduced and is objectionable in that it lowers the ignition point of the gases. Further the presence of the axial return current is made use of when cold air is introduced only slightly, if at all, and must be amplified as it is in the present invention by the boosting current of heated air and the counteracting of the outward bound current which is retarded by the general expansion of the gases and which are given a further expansion and retardation in the expansion chamber 18, where the conditions are present for the induction of the unburnt products into

the boosted axial current, as indicated by the arrows, as the gas inductor nozzle extends from the heated air supply to and through the zone of least outward current and more rarefied gases present in the expansion chamber.

What I claim is:—

1. The combination with the exhaust conduit of a furnace, of an expansion chamber forming a part thereof for the passage of the products of combustion, means contained within the chamber for supplying fresh air in combustion-supporting quantities to the products of combustion exiting through the conduit, said means being further adapted to initiate a return current of such mixture through the conduit to the furnace along a path axially related to the conduit.

2. The combination with the exhaust conduit of a furnace, of an expansion chamber forming a part thereof for the passage of the products of combustion, means contained within the chamber for supplying fresh air in combustion-supporting quantities to the products of combustion exiting through the conduit, said means being further adapted to strengthen a return current present along a path axially related to the conduit due to rarefaction of air within the combustion chamber and induce the mixing with the air and return to the furnace, of a substantial portion of the products of combustion exiting through the conduit.

3. The combination with the exhaust conduit of a furnace, of an expansion chamber forming a part thereof for the products of combustion, means contained within the chamber for supplying fresh air in combustion-supporting quantities, and means for heating the air before it is introduced into said air supplying means.

4. The combination with the exhaust conduit of a furnace, of an expansion chamber forming a part thereof for the passage of the products of combustion, means within the expansion chamber for directing a current of air therein in a direction opposite to the normal exiting draft thereof, and means exterior to said conduit for heating the air introduced therein.

5. The combination with the exhaust conduit of a furnace, of an expansion chamber forming a part thereof for the passage of the products of combustion, means within the expansion chamber for heating and directing a current of air therein in a direction opposite to the normal exiting draft thereof, and means exterior to said conduit for preheating the air before it is admitted to the heater within the conduit.

6. The combination with the exhaust conduit of a furnace, of an expansion chamber forming a part thereof for the passage

of the products of combustion, a chamber within the expansion chamber for heating and discharging air therein, means for furnishing preheated air to said heating chamber disposed within the conduit, and further means for furnishing preheated air to the heating chamber from a source exterior to the conduit.

7. The method of improving the combustion of fuels, which consists in expanding the products of combustion while exiting through the exhaust conduit of a furnace, introducing into the said expanded products heated air that has received its heat before it is conducted within said conduit, and causing the mixture of heated air and products of combustion to enter the furnace through the said conduit and be consumed.

8. The method of improving the combustion of fuels, which consists in expanding the products of combustion while exiting through the exhaust conduit of a furnace, introducing into the said expanded product heated air that has received its heat before it is conducted within said conduit, further heating said air within the conduit by the heat from the products of combustion and before its commingling therewith, and causing the mixture of heated air and products of combustion to enter the furnace through the said conduit and be consumed.

9. The combination with the exhaust conduit of a furnace, of an expansion chamber forming a part thereof for the passage of the products of combustion, and an air inductor disposed thereon extending in a direction opposite to the normal draft of the conduit, and having a discharge opening at its inner end, said inductor having side openings for the induction into the inductor of the surrounding products of combustion.

10. The combination with the exhaust conduit of a furnace, of an expansion chamber for the products of combustion, an air inductor open to the atmosphere for supplying a current of fresh air to the chamber, and a coacting inductor disposed to effect a deflection of a substantial portion of the products of combustion passing through the conduit from the normal path and to convey them to the path of the air current immediately adjacent to the exit of the air inductor.

11. The combination with the exhaust conduit of a furnace, of an expansion chamber for the products of combustion, an air inductor communicating with the atmosphere for supplying a current of fresh air to the chamber, a gas inductor coacting with the air inductor and disposed to effect the deflection of a portion of the gaseous products passing through the conduit from their normal path to the path of air current exiting from the air inductor.

12. The combination with the exhaust

conduit of a furnace, of an expansion chamber for the products of combustion, an inductor communicating with the atmosphere for supplying a current of fresh air to the chamber, a gas inductor coacting with the air inductor and disposed to effect the deflection of a portion of the gaseous products passing through the conduit from their normal path to the path of air current exiting from the air inductor, the deflection of gaseous products from their normal path, their conveyance to the path of the air current attained by means of an induced current set up in the gas inductor in response to the exit of the air current from the air inductor into the gas inductor.

13. The combination with the exhaust conduit of a furnace, of an expansion chamber for the products of combustion, an inductor communicating with the atmosphere for supplying a current of fresh air to the chamber, a gas inductor coacting with the air inductor and disposed to effect the deflection of a portion of the gaseous products passing through the conduit from their normal path to the path of air current exiting from the air inductor, and a mixing chamber located at the point when the said deflected products of combustion enter the path of the air current.

14. The combination with the exhaust conduit of a furnace, of an expansion chamber for the products of combustion, an air inductor communicating with the atmosphere, and a coacting gas inductor, concentrically disposed with respect to the air inductor.

15. The combination with the exhaust conduit of a furnace, of an expansion chamber for the products of combustion, an air inductor communicating with the atmosphere, and a coacting gas inductor, concentrically disposed with respect to the air inductor and partially enveloping the air inductor.

16. The combination with the exhaust conduit of a furnace, of an expansion chamber for the products of combustion, an air inductor communicating with the atmosphere, and a coacting gas injector concentrically disposed with respect to the air inductor and surrounding the inner end of the air inductor.

17. The combination with the exhaust conduit of a furnace, of an expansion chamber for the products of combustion, an air inductor communicating with the atmosphere, and a coacting gas injector concentrically disposed with respect to the air inductor and surrounding the exit mouth of the air inductor.

18. The combination with the exhaust conduit of a furnace, of an expansion chamber for the products of combustion, an air inductor axially disposed therein, and a gas

inductor concentrically disposed with respect to the air inductor and surrounding the inner end thereof.

19. The combination with the exhaust conduit of a furnace, of an expansion chamber for the products of combustion, an air inductor axially disposed within the chamber, a series of annular exhaust passages for conducting products of combustion from the chamber, and a gas inductor.

20. The combination with the exhaust conduit of a furnace, of an expansion chamber for the products of combustion, an air inductor, axially disposed within the chamber, and means for forming a series of exhaust passages for conducting products of combustion from the chamber, said series of passages being concentrically disposed with respect to the inductor.

21. The combination with the exhaust conduit of a furnace, of an expansion chamber forming a part thereof for the expansion of the products of combustion, means for inducing heated air into the chamber along an axial path therein, and means for inducing the products of combustion to be drawn into the induced air along said axial path, whereby the mixture is returned to the furnace through the conduit for consumption.

22. The combination with the exhaust conduit of a furnace, of an expansion chamber forming a part thereof for the expansion of the products of combustion, means for inducing air into the chamber along an axial path therein, and a gas inducing nozzle coacting with the air inducing means, said nozzle having openings along its length for inducing the products of combustion therein and directing the mixture into the furnace through the conduit.

23. The combination with the exhaust conduit of a furnace, of an expansion chamber forming a part thereof, means within the chamber for inducing air therein, means for directing the induced air along an axial path therein, said means comprising a series of flared hoops arranged to extend in spaced relation one with the other to deflect the outgoing products of combustion within the hoops to mix with the induced air and direct the mixture to the fire-box of the furnace along the return path of the conduit.

24. The combination with the exhaust conduit of a furnace, of an expansion chamber comprising a portion in which the maximum expansion of the products of combustion is present, means for inducing a current of air to said maximum expansion portion in opposite directions to the exiting current and along the axial path of the chamber, and means for inducing the expanded and retarded products to be drawn into the axial current and mixed with the air and returned by said current to the furnace.

25. The combination with the exhaust con-

duit of a furnace, of an expansion chamber comprising a plurality of passageways for the products of combustion, each passageway consisting of an expansion chamber for
5 expanding and retarding an exiting current therein, means for inducing air within the expanded chamber along the axial path

thereof, and means for inducing the products of combustion to mix with the induced air along the axial path and be directed
10 along said path to the fire-box of the furnace.

In testimony whereof I affix my signature:
WILLIAM G. GRIFFIN.