

June 16, 1936.

G. BLUEMEL

2,044,715

AIR HEATER

Filed May 27, 1935

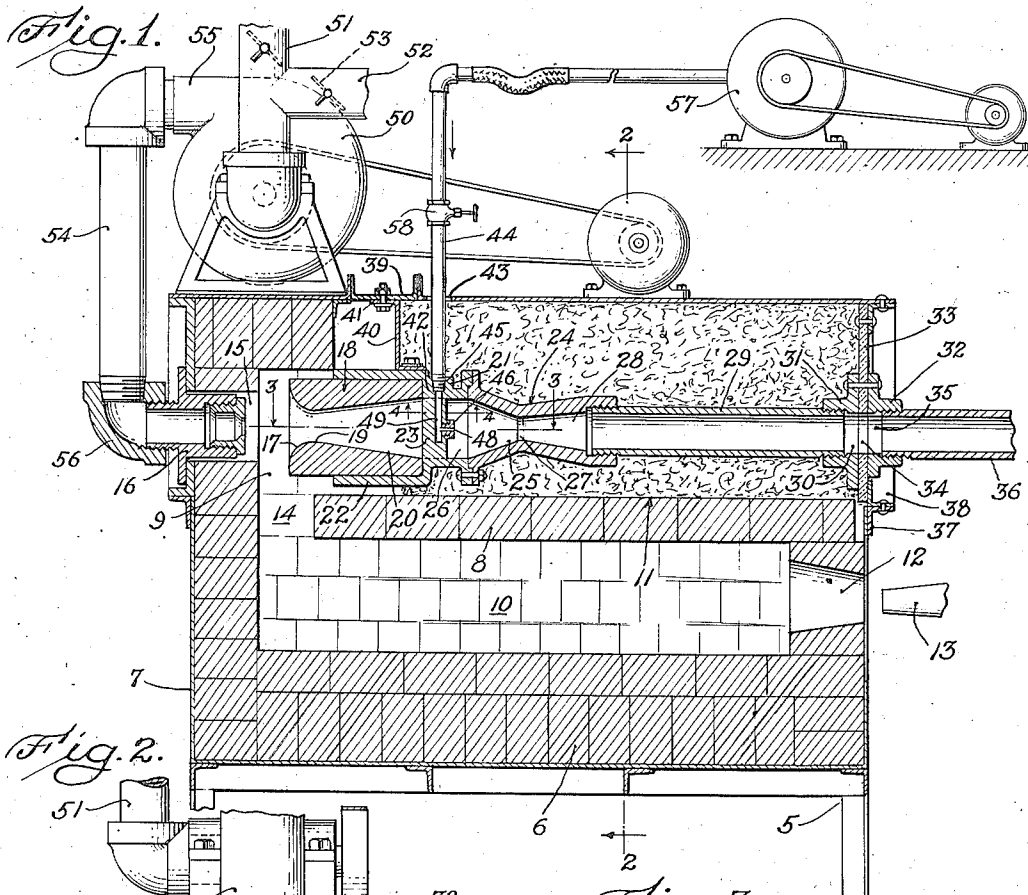
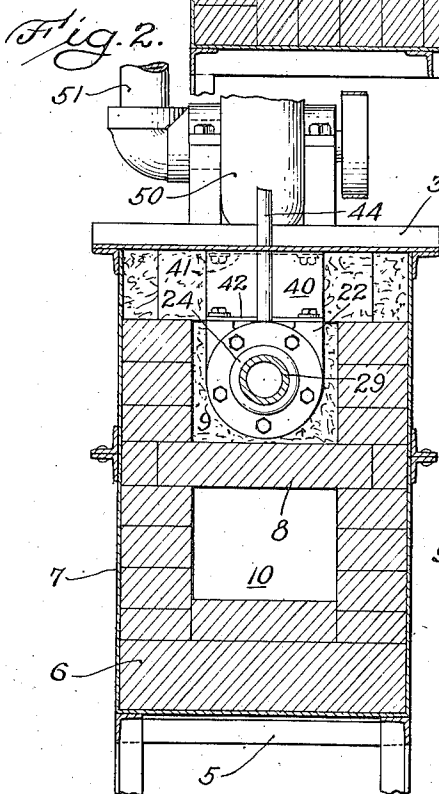
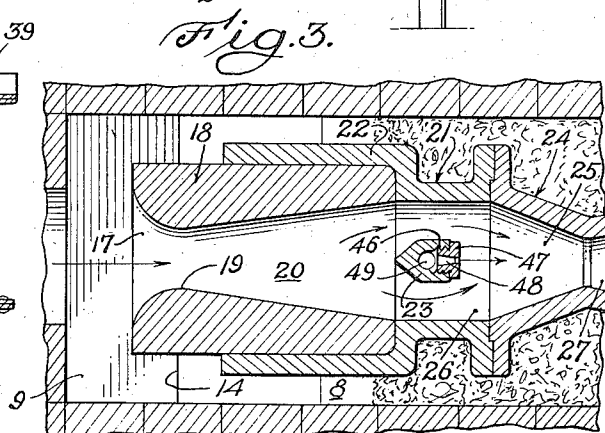
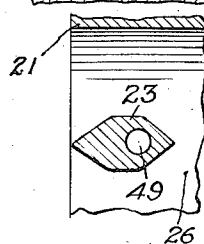


*Fig. 4.*  
Inventor;  
Gustave Bluemel  
BY  
Wm. O. Belt  
Attorney.

## UNITED STATES PATENT OFFICE

2,044,715

## AIR HEATER

Gustave Bluemel, Chicago, Ill.

Application May 27, 1935, Serial No. 23,545

3 Claims. (Cl. 126—110)

This invention relates to air heaters and more particularly to heaters for supplying air at relatively high temperatures to ovens and the like.

In practice a fan or blower has been employed to withdraw heated air, "air" being used in a generic sense, from a heater and to dilute this air, either with fresh air or air returned from an oven or the like so as to deliver air at the desired temperature to an oven or the like. However, considerable difficulty has been encountered in those instances where the temperature of the delivered air has been above 800° F. even though specially constructed fans or blowers made of an alloy steel or other temperature resisting material were employed, for the life of the fans or blowers has been rather limited, and this, particularly because of the initial high cost of the fans or blowers has proven to be quite expensive. It has been proposed to arrange the heater on the pressure side of the fan, "fan" being used herein as including kindred air moving devices, in conjunction with an inspirator receiving air from the fan so that the high velocity air issuing from the inspirator orifice would induce the hot gases from the combustion chamber in the heater to be intermixed with air from the fan. However, any resistance encountered in the system, as in the ducts, ovens or the like, tended to lower the inspirating capacity with the result that where the resistance was appreciable, very high velocities were required in the inspirator which meant the employment of high pressures and, consequently, prohibitive power consumption.

It is the primary object of my invention to position an air heater on the pressure side of a fan and thereby avoid passing excessively high temperature air through the fan and to compensate for the resistance encountered in the ducts, ovens and the like, to which the heated air is supplied, so that normal velocities may be utilized and high pressures entailing prohibitive power consumption will not be required.

More specifically, the object of my invention is to employ an inspirator to withdraw hot gases from the combustion chamber in a heater to be mixed with and raise the temperature of air flowing to and through the inspirator and to raise the velocity of the mixture ejected from the inspirator sufficiently to overcome the resistance in the circuit through which the mixture is passed.

Further objects are to force fresh air, or air returned from an oven or the like to which heated air is supplied, to an inspirator to withdraw hot gases from the combustion chamber of a heater for intermixture with the air flowing through

the inspirator and to pass the mixture into another inspirator into which fresh or returned air is admitted to raise the velocity of the mixture sufficiently to overcome the resistance in the ducts, ovens or the like to which the mixture or heated air is supplied; to provide a mounting for the inspirators which will compensate for expansion and contraction thereof and thereby avoid damage to the heater in which the inspirators are mounted; to reduce eddies and the like to a minimum in the inspirators; and to provide a device of simple and economical construction and efficient and positive operation.

A selected embodiment of my invention is illustrated in the accompanying drawing wherein—

Fig. 1 is a vertical longitudinal sectional view through a heater embodying my invention;

Fig. 2 is a transverse sectional view taken substantially on the line 2—2 on Fig. 1;

Fig. 3 is a longitudinal sectional view taken substantially on the line 3—3 on Fig. 1; and

Fig. 4 is a detail sectional view taken substantially on the line 4—4 on Fig. 1.

In the embodiment of my invention shown in the accompanying drawing, 5 indicates a suitable base carrying a fire brick housing 6 having a metallic shell 7 thereabout. A fire brick partition 8 divides a cavity in the body 6 into a combustion chamber 10 and a compartment 11 having a pocket 9 at one end thereof. A fire opening 12 is provided in the front wall of the body 6, at one end of the combustion chamber 10, and flame from an oil or gas burner nozzle 13 or the like passes through this opening into the combustion chamber. The partition 8 ends in spaced relation with the rear wall of the body 6 and thereby provides a flue 14 through which communication is established between the combustion chamber 10 and the pocket 9.

An opening 15 is provided in the outer wall of the pocket 9 and an air inlet nozzle 16 is mounted in this opening. The nozzle 16 discharges into the inlet throat 17 of an inspirator 18 mounted in the compartment 11. The inspirator 18 has a restricted throat 19 and a discharge throat 20. The inlet throat 17 of the inspirator 18 opens into the pocket 9 above the flue 14 and in spaced relation with the nozzle 16.

A body 21 in the compartment 11 includes a sleeve 22 that is disposed about the inspirator 18 and a rib 23 in the body extends across the outer end of the discharge throat 20 of the inspirator and engages the end of the inspirator.

As best shown in Fig. 4, the rib 23 is shaped

to reduce the resistance thereof to the flow of air and to minimize the formation of eddies and the like. To these ends the sides of the rib are flattened medially in the extent thereof and are tapered both forwardly and rearwardly to converge in sharp edges at the front and rear ends of the rib and preferably these sharp edges are disposed on the center line of the rib. It is the sharp edge at the rear end of the rib 23 that engages the end of the inspirator.

Another inspirator 24 is mounted in the compartment 11 at the forward end of the body 21 and the inlet throat 25 thereof communicates with the passage 26 through the body 21, in which passage the rib 23 is disposed. The inspirator 24 also includes a restricted throat 27 and a discharge throat 28.

One end of a duct 29 in the compartment 11 is secured in the outer end of the discharge throat 28, as by being screw threaded thereinto, and the other end of the duct is connected to a passage 30 in a fitting 31, as by being screw threaded thereinto. Another fitting 32, similar to the fitting 31, is provided and a plate 33 of insulating material is disposed between these fittings and the fittings are securely joined to each other and the plate in an approved manner as by being riveted. The passage 30 in the fitting 31 is aligned with an opening 34 in the plate 33 as is the passage 35 in the fitting 32. A duct 36 is secured in the outer end of the passage 35, as by being screw threaded thereinto, and leads to the oven or the like to which the heated air is to be supplied.

The plate 33 closes the opening at the front end of the compartment 11 which is filled with suitable insulating material that is packed about the inspirators 18 and 24, the body 21 and the duct 29 to reduce heat losses by radiation from these parts. An angle plate 37 is mounted on the front wall of the housing 6 at the lower end of this opening. A flange 38 extends forwardly from the plate 33 and the lower part of this flange rests on the plate 37 while the other parts of this flange engage the adjacent walls of the heater. The flange 38 is riveted to the angle plate 37 and the metallic shell 7 and affords a support for the parts connected to the plate 33. The inspirators 18 and 24, body 21 and duct 29 are all supported in the compartment 11 by a common mounting. This common mounting consists of a channel iron 39 that extends across the top of the compartment 11. A flexible plate 40 has flanges 41 and 42 at opposite ends thereof, which flanges extend in opposite directions from the plate 40. The flange 41 is bolted or otherwise suitably secured to the channel iron 39 while the flange 42 is suitably secured to the sleeve 22. Thus, while the plate 33 is fast in the heater, the inspirators 18 and 24, body 21 and duct 29 may nevertheless expand and contract when heated air flows therethrough or is shut off therefrom since the plate 40 will flex upon expansion or contraction of these parts and therefore damage to the heater by reason of such expansion or contraction is avoided.

An enlarged opening 43 is provided in the top wall of the heater and a pipe 44 extends freely through this opening. The lower end of the pipe 44 is screw threaded or otherwise suitably secured in an opening 45 in the body 21. The pipe 44 may move in the opening 43 upon expansion or contraction of the inspirators 18 and 24, body 21 and duct 29 without damage to the heater. An opening 46 is provided in the front of the rib 23

substantially midway in the extent thereof and a nozzle 47 is screw threaded into or otherwise suitably fast in the opening 46. The nozzle 47 includes a discharge orifice 48 and a bore 49 extends through the rib 23 and connects the orifice 48 and the opening 45.

A fan is provided for supplying air to the nozzle 16 and for convenience such a fan 50 is shown mounted on the top of the heater. The intake 51 of this fan may lead to a source of fresh air or to the oven or the like to which heated air is supplied through the duct 36. When the intake leads to the oven or the like the air supplied to the oven is recirculated through the heater so that any heat remaining in the air after it flows through the oven or the like may be recovered. A fresh air inlet 52 may conveniently be provided in the intake 51 and a damper 53 may be provided in this inlet to regulate the amount of fresh air admitted into the intake 51. Similar dampers may be provided in the intake and at various other places in the circuit through which the air is circulated to regulate the air flow. A duct 54 leads from the outlet 55 of the fan 50 to a fitting 56 to which the nozzle 16 is connected.

The pipe 44 may be connected to the fan 50 but for a purpose to be explained more fully hereinafter it is preferred that this pipe be connected to an independent source of air and in the present instance the pipe 44 leads to a compressor 57 although it is to be understood that the pipe 44 can be led to any suitable source of air under pressure. A valve 58 or a damper is provided in the pipe 44 to control air flow therethrough and a flexible part is provided in the pipe to permit the above described movement of this pipe in the opening 43.

When the heater is set in operation, flame from the burner 13 is admitted into the combustion chamber 10 and the fan 50 is set in operation to supply air to the nozzle 16. Air flows from the nozzle 16 into the inlet throat 17 of the inspirator 18. The flow of air through this inspirator withdraws the hot products of combustion from the combustion chamber 10 through the flue 14 and these hot products are mixed with the air flowing through the inspirator whereupon the air is heated. In this manner the air may be heated to relatively high temperatures, that is to say, temperatures in excess of 800° F. for the heated air is not circulated through the fan when supplied to an oven or the like.

The mixture of air and products of combustion flow from the inspirator 18 into the passage 26 past the rib 23 which, as stated, is so shaped that it offers minimum resistance to flow thereby and does not set up eddies and the like. The pressure set up by the fan 50 and the action of the inspirator 18 imparts considerable velocity to the mixture flowing through the passage 26 but experience has shown that resistance encountered in the circuit through which the mixture is circulated is often sufficient to render proper operation of an inspirator, such as the inspirator 18, ineffective and to prevent this, which is to say, to overcome the resistance in the circuit, the inspirator 24 is provided. The necessary flow of air to effect induction in this inspirator is supplied by the nozzle 47. Air at high velocity is ejected from this nozzle into the inspirator 24 which thereupon acts to impart sufficient velocity to the mixture or heated air flowing from the inspirator 18 and thereby resistance in the circuit to which the duct 36 leads is overcome.

The velocity of the air flow through the circuit may be nicely adjusted in an arrangement of this kind. For example, variations in the primary air supplied by the fan 50 will vary the velocity throughout the system, that is to say, it will not only vary the velocity in the circuit but will also vary the induction of hot gases from the combustion chamber 10. But even nicer control may be effected by adjusting the secondary air ejected from the nozzle 47 because slight variations in the pressure of the secondary air effects sharp differences in the velocity of the heated air flow to and through the duct 36. Moreover, the temperature of the air may be nicely adjusted either by varying the primary air supply or the temperature in the combustion chamber 10.

My invention avoids difficulties heretofore encountered when an air heater has been arranged on the pressure side of a fan for I am enabled to so adjust the air velocities that high resistances in the circuit through which the heated air is circulated may be overcome. Furthermore, since the heated air is not passed through the fan the difficulties heretofore encountered when high temperature air was passed through fans are, of course, avoided. Moreover, the device will operate with equally efficacious results when fresh air or air returned from an oven or the like to which the heated air is supplied is admitted into the heater. Likewise, damage to the heater by reason of expansion and contraction of the metallic parts through which the heated air flows is avoided by the manner in which the parts are mounted. The device offers minimum resistance to the air flow therethrough and the formation of eddies and the like is avoided by properly shaping the parts past which the air flows. And in addition to the foregoing advantages the regulation of the velocity and temperatures of the air may be easily and nicely effected.

While I have illustrated and described a preferred form of my invention it is to be understood that this is capable of variation and modification and I therefore do not wish to be limited to the precise details set forth but desire to avail myself of such changes and alterations as fall within the spirit and scope of the following claims:

I claim:

1. In an air heater having a combustion chamber and two inspirators arranged in series and a passage establishing communication between the combustion chamber and the intake of the first of said inspirators, means for supplying a relatively large volume of air at relatively low pressure to the first of said inspirators to withdraw hot products of combustion from the com-

bustion chamber through said passage and eject the mixture of air and products of combustion toward the intake of the second inspirator, and means for supplying a relatively small regulated volume of air at relatively high pressure to the second inspirator to accelerate the velocity of the mixture ejected from the first inspirator and thereby insure a constant flow of the mixture against a given resistance in the circuit through which the mixture is passed.

2. In an air heater for delivering a mixture of returned air, hot products of combustion and fresh air at a fixed temperature in a fixed volume against a fixed resistance, a combustion chamber, two inspirators arranged in series, inlet means through which communication is established between the combustion chamber and the intake of the first inspirator, means for supplying a relatively large volume of returned air at relatively low pressure to the first inspirator to withdraw products of combustion from the combustion chamber for intermixture with the returned air, the intermixed returned air and products of combustion being ejected from the first inspirator into the second inspirator, and means for supplying a relatively small regulated volume of air at relatively high pressure to the second inspirator to actuate said inspirator, the air supplied to the second inspirator being intermixed with the intermixed returned air and products of combustion ejected from the first inspirator, actuation of the second inspirator accelerating the velocity of the intermixture ejected from the first inspirator.

3. In an air heater having a combustion chamber and two inspirators arranged in series and a passage establishing communication between the combustion chamber and the intake of the first of said inspirators, means for supplying a relatively large volume of air at relatively low pressure to the first of said inspirators to withdraw hot products of combustion from the combustion chamber through said passage and eject the mixture of air and products of combustion toward the intake of the second inspirator, means for supplying a relatively small volume of air at relatively high pressure to the second inspirator to accelerate the velocity of the mixture ejected from the first inspirator and thereby insure a constant flow of the mixture against a given resistance in the circuit through which the mixture is passed, and means for regulating the air supply to the second inspirator whereby the flow of the mixture from said heater may be maintained constant relative to the resistance in the circuit through which the mixture is passed.

GUSTAVE BLUEMEL.