July 2, 1946. H. J. DE N. McCOLLUM 2,402,970

HEATER

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Fig. 2

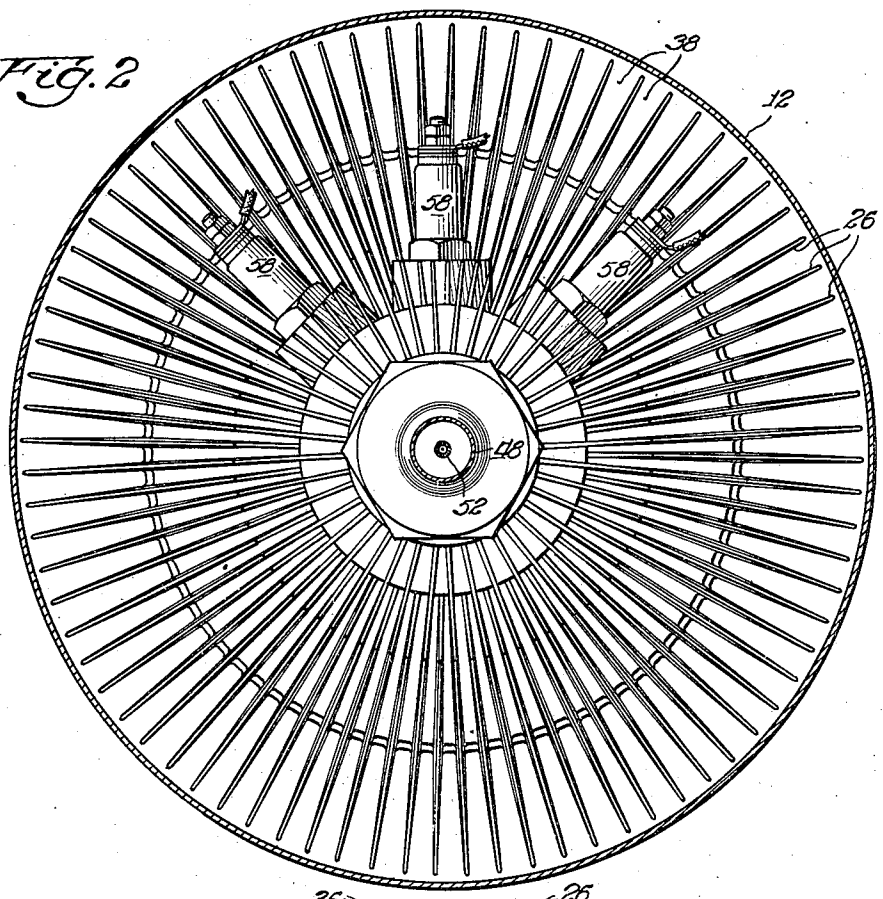
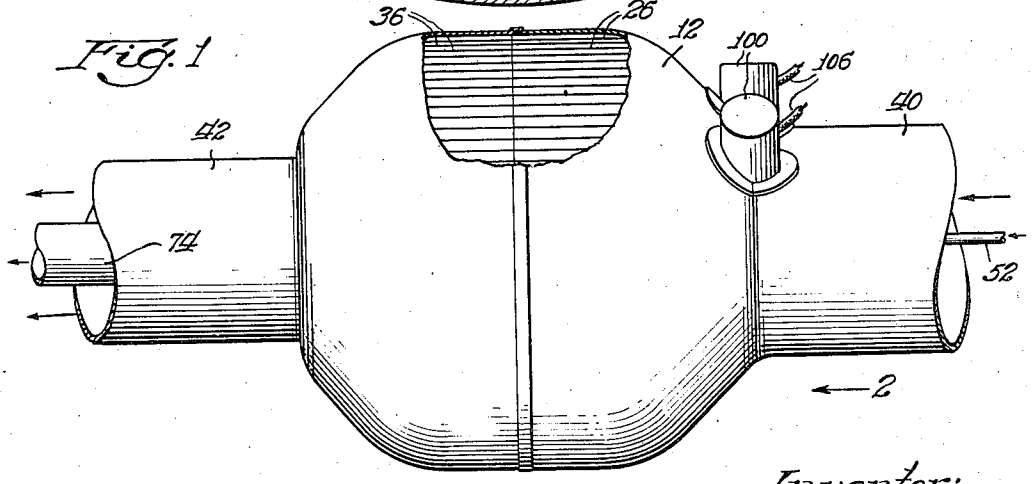


Fig. 1



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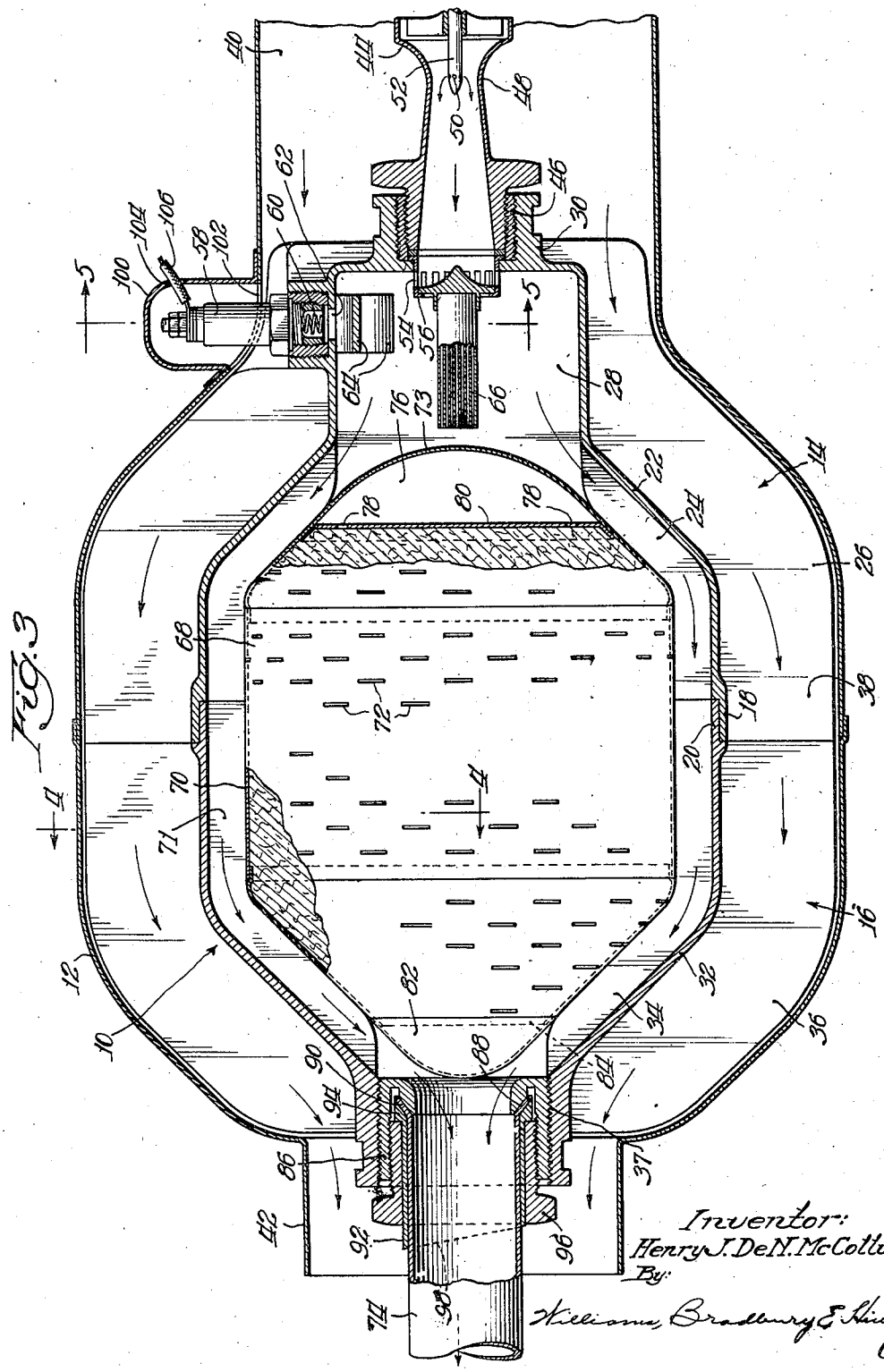


Fig. 3

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HEATER

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Fig. 4

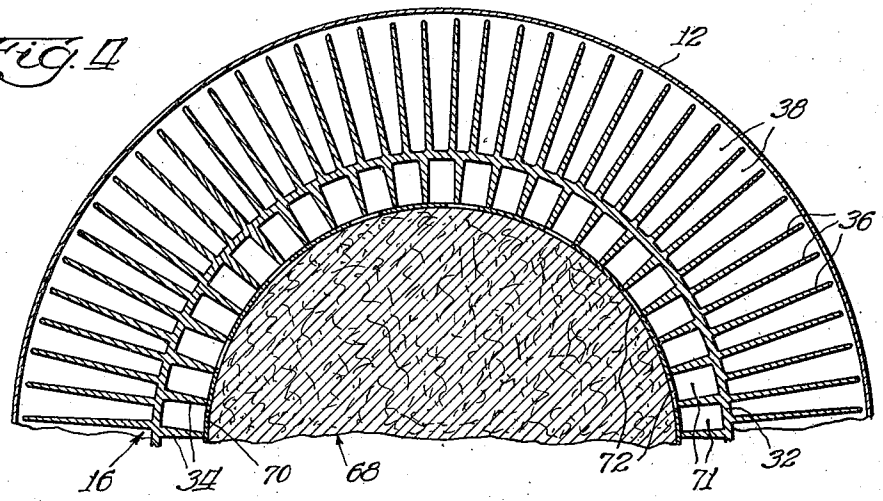
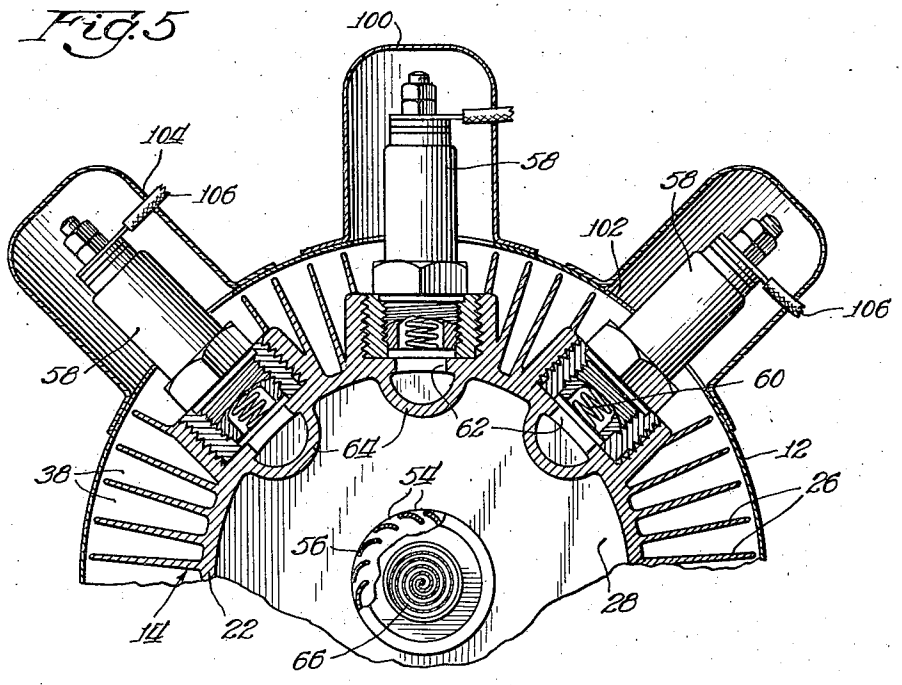


Fig. 5



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UNITED STATES PATENT OFFICE

2,402,970

HEATER

Henry J. De N. McCollum, Chicago, Ill.; Theima McCollum executrix of said Henry J. De N. McCollum, deceased

Application September 5, 1942, Serial No. 457,447

4 Claims. (Cl. 126—116)

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My invention relates to heaters and more particularly to heaters of the internal combustion type, although it is not necessarily limited to this type of heater.

In heaters of the internal combustion type, it is common to provide finned heat transfer means for transferring heat from the products of combustion to the ventilating air directed over the heat transfer means by a blower or other means for circulating air. The heated products of combustion are ordinarily directed against the fins at one end of the heat transfer means and where the hot products of combustion first come in contact with the fins, these fins are raised to a temperature which is much in excess of the temperature of other portions of the fins and particularly that portion adjacent the outlet end of the heater. There is a practical limit to the temperature to which the fins can be heated and this limits the total quantity of heat which can be given off by a heater of any given size and shape.

An object of my invention is to provide a heater wherein the heat transfer means is heated to a substantially uniform temperature throughout its length and thereby provide a more efficient heater having a higher heat output for a given size.

Another object of my invention is to provide a heater wherein the temperature range between different parts of the heater is reduced to a minimum and stresses and strains caused by great variations in temperature of the different parts are avoided.

Another object of my invention is to provide an extremely light and compact heater having a high heat output and particularly adapted for use in aircraft.

Another object of my invention is to provide a heater wherein the parts are so designed as to have a maximum strength for a minimum weight and wherein these parts may be made as strong as desired to heat the requirements of any given type of service.

Another object of my invention is to provide a new and improved heater which can be economically manufactured by conventional equipment and using conventional methods.

Another object of my invention is to provide a new and improved heater having more efficient means for transferring heat from the gases of combustion to a heat exchanger and from this heat exchanger to ventilating air.

Another object of my invention is to provide a new and improved heater which more efficiently transfers heat from a gas to a metal surface.

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Another object of my invention is to provide a new and improved heater which more efficiently transfers heat from a metal surface to a gas.

Other objects and advantages will become apparent as the description proceeds.

In the drawings:

Fig. 1 is a side elevational view of a preferred embodiment of my invention. In this view, part of the casing for the ventilating air is broken away.

Fig. 2 is an enlarged end view looking in the direction of the arrow 2 in Fig. 1. In Fig. 2, the inlet part of the casing for the ventilating air has been omitted to show more clearly the arrangement of the external fins for heating this air.

Fig. 3 is an enlarged longitudinal, sectional view of the heater of Fig. 1.

Fig. 4 is a partial, transverse, sectional view taken on the line 4—4 of Fig. 3.

Fig. 5 is a partial, transverse, sectional view on an enlarged scale and is taken on the line 5—5 of Fig. 3.

The drawings disclose an embodiment of my invention wherein the body 10 of the heater is enclosed in a casing 12 for directing ventilating air thereover. The body 10 comprises a pair of conical castings 14 and 16 of aluminum or other suitable material. The castings 14 and 16 have telescopic ends 18 and 20, respectively, and in telescoping these ends the casting 16 and its end 20 are heated and slipped over the cold casting 14 to form a shrink fit which firmly attaches the casting 16 to the casting 14 to form a unitary structure.

The casting 14 has an annular wall 22 integral with and located between a radially projecting series of interior fins 24 and a series of radially directed exterior fins 26. The forward end of the wall 22 is constructed and arranged to provide a rectangular recess or combustion chamber 28 and terminates in a threaded boss 30.

The casting 16 has an annular wall 32 integral with and located between a series of radially directed internal fins 34 and a series of radially directed external fins 36. The extreme outlet end of the wall 32 is threaded, as indicated at 37, to facilitate the attachment to the casting 16 of a suitable exhaust pipe.

As clearly shown in Figs. 2 and 3, the casing 12 closely follows the contour of the external fins 26 and 36 and cooperates therewith to form passages 38 between these fins for the ventilating air. This ventilating air is supplied to the inlet end 40 of the casing by a ram, blower, or any

other suitable means and is discharged through the outlet 42, which may communicate directly with the airplane cabin or other space to be heated or may be connected to a system of ventilating ducts for directing the heated air in any desired manner. In lieu of providing a blower or ram for forcing ventilating air into the inlet end 40 of the casing, a suction blower may be provided for the outlet 42 to create flow of ventilating air through the casing 12.

A part of the air flow in the inlet 40 enters a Venturi-tube 44, which is screwed into a bushing 46 in the boss 30 of casting 14. The Venturi-tube 44 has a restricted throat 48 to which fuel is supplied through openings 50 in a fuel supply pipe 52, which may be connected either to any suitable fuel tank or to a source for supplying an unduly rich mixture of fuel and air. The raw fuel or rich mixture of fuel and air supplied by the pipe 52 mixes with air flowing through Venturi-tube 44 and forms a combustible mixture which is delivered with a whirling motion to the combustion chamber 28 through openings 54 in a burner tube 56.

The combustible mixture supplied to the combustion chamber 38 is ignited by electrical igniters 58 which are supplied with current from any suitable source. In the drawings, I have illustrated a heater having three igniters 58 closely grouped, but my heater is not limited to this number and arrangement and any other desired number and arrangement of these igniters may be utilized. The hot wires 60 of these igniters are in communication with the combustion chamber 28 through openings 62 which are protected from the direct flow of relatively cold mixture into the combustion chamber 28 by semi-circular shields 64, which are open at both ends and which are illustrated as forming integral parts of the casting 14. It will be understood by those skilled in the art that the igniters 58 may be provided with the usual thermostatic switch for breaking the electrical circuit of these igniters when the heater attains normal operating temperature and I have provided the usual re-igniter 66 to maintain combustion after the igniters 58 have been cut out.

A muffler 68 is confined between the internal fins 24 and 34 of the two castings and has a sheet metal shell 70 which abuts the inner edges of these fins and cooperates therewith to form passages 71 through which the burned gases flow from the combustion chamber 28 to the exhaust pipe 74. The interior of the shell 70 is filled with glass wool or stainless steel wool, or other suitable heat resisting and sound absorbing material and elongated slots 72 in the shell 70 provide acousti-couplings between the passages 71 and the interior of the muffler.

That end of the muffler shell which is adjacent the combustion chamber 28 is rounded as indicated at 73 and serves to direct the burned gases into the passages 71 with a minimum of resistance to the flow of these gases. This end of the muffler is provided with an air space 76 which protects the glass wool against the intense heat occasioned by the combustion chamber 28. Openings 78 in a partition 80 form acousti-couplings between the space 76 and the portion of the muffler shell in which the glass wool is located. The other end of the muffler shell is illustrated as being provided with a rounded cap 82, which forms an air space to the left of the partition 84 defining the lefthand end of the compartment containing the glass wool.

A tubular abutment 86 is screwed into the threads 37 at the outlet end of wall 32 and has a tapered portion 88 forming an abutment for the flared end 90 of the exhaust pipe 74. A sleeve 92 surrounds the pipe 74 and has a tapered end 94 which engages the flared end 90 of the exhaust pipe and clamps it against the abutment 88 under the force exerted by a tubular nut 96. The lefthand end of the sleeve 92 is inclined, as indicated at 98, as I have found that this inclination reduces the tendency of the exhaust pipe 74 to break off adjacent the end of the sleeve 92 under continued vibration.

In the operation of my invention, a portion of the air flowing in the inlet 40 enters Venturi-tube 44 and mixes with fuel supplied through pipe 52 to form a combustible mixture which is delivered to the combustion chamber 28 with a whirling motion through openings 54 in burner tube 56. This combustible mixture is ignited by the igniters 58. The heat thereby created in the combustion chamber 28 is partially absorbed by the walls of this combustion chamber and transmitted to the adjacent portions of the fins 14. The hot gases of combustion flow from the combustion chamber 28 to the outwardly flaring portions of the passages 71 located between the internal fins 24. The gases leaving the combustion chamber 28 are at a maximum temperature and give up part of their heat to the adjacent portions of the fins 24 and the wall 22.

The rate of heat transfer from the gas to a metal surface varies greatly with the direction at which the gas strikes the metal surface and is highest when the gas scours the surface by being projected substantially vertically against this surface. The hot gases of combustion are not directed against the outwardly flaring wall 22 and in fact tend to hug the adjacent wall of the muffler shell so that relatively little heat is transferred directly from the gases to the outwardly flaring portion of the wall 22 and most of the heat received by this wall is conducted to it by the adjacent portions of the internal fins 24.

On the other hand, the ventilating air is directed against the outwardly flaring wall 22 and scours this wall to remove great quantities of heat therefrom. In other words, the heat transfer directly between the hot gases of combustion and the outwardly flaring portion of wall 22 is relatively inefficient, whereas the heat transfer from the outwardly flaring portion of this wall to the ventilating air is highly efficient, with the result that this outwardly flaring portion of the wall 22 and the adjacent portions of the internal fins 34 and exterior fins 26 are maintained at substantially the same temperature as other portions of this wall and these fins at the same temperature as the corresponding wall and fins of the other casting.

The products of combustion pass from the outwardly flaring portions of the passages 71 to the straight or cylindrical portions of these passages and then to the entrained portions of these passages leading to the exhaust pipe 74. As these gases flow through the passages 71, they give up their heat to the interior fins and to casting walls and when these gases reach the inwardly directed portions of the passages 71 these gases are approaching their minimum temperature. The heat transfer between these gases and the inwardly directed portion of the casting wall 32, however, is a maximum, since the gases of combustion are directed against and tend to scour this entrained portion of the wall. At the same

time the heat removed from this entrained portion of the wall **32** by the ventilating air is a minimum and the resulting balance maintains the conical portion of casting **32** at substantially the same temperature as the conical portion of casting **14** and the connected cylindrical portions of both of these castings. In other words, my novel structure provides a heater wherein the heat transfer means is maintained at substantially uniform temperature throughout its entire length and an extremely lightweight, compact and efficient heater can be provided by designing the heater so that all parts of the heat transfer means operate at maximum temperature.

The heated ventilating air flowing through the casing outlet **42** may be discharged directly into the airplane cabin or other space to be heated, or may flow through a suitable duct arrangement for dividing up this heated air and delivering it to specific locations. The cooled gases of combustion are discharged to atmosphere through the exhaust pipe **74**.

The muffler **70** absorbs sounds entrained in the gases of combustion. This muffler also cooperates with the walls **22** and **32** to direct the flow of the gases of combustion and directs the relatively cool gases of combustion against the conical portion of wall **32** while permitting the extremely hot gases of combustion to flow along the conical portion of wall **22** in such a way as to give up relatively little heat to this wall.

In the embodiment of my invention shown in the drawings, the several igniters **58** are provided with individual housings **100** which are attached to the casing **12** and have open lower ends communicating with openings **102** formed in this casing. The housings **100** have openings **104** through which the igniter wires **106** extend and while a small amount of ventilating air may escape through these openings **104**, the provision of the housing **100** forms a convenient means for preventing the igniters **58** from reaching unduly high temperatures and at the same time preventing the escape of large quantities of air from the casing **12** around these igniters.

My novel, double cone heat exchanger is not limited to use in a heater having a combustion chamber therein. This double cone or opposed cone type of heat exchanger may also be utilized in a heater which is supplied with exhaust gases from an internal combustion engine or which is supplied with heated fluid from any other suitable source.

While I have illustrated and described only a single embodiment of my invention, it is to be understood that my invention is not limited to the details shown and described, but may assume numerous other forms. My invention is to be construed as including all modifications and variations coming within the scope of the appended claims.

I claim:

1. In a heater of the class described, wall means forming a cylindrical combustion chamber and a tubular exhaust passage in substantially axial alignment therewith, inner and outer wall means forming a flow passage for conducting the hot products of combustion from said combustion chamber to said exhaust passage, said flow passage being of annular cross section, the inner and outer walls of said passage adjacent the combustion chamber flaring outwardly at an abrupt angle to the axis of said chamber, and said walls of said flow passage adjacent the exhaust end of the heater converging toward the axis of the exhaust passage at an abrupt angle to said axis, a jacket spaced at an approximately uniform distance from the outer wall of said flow passage throughout its length, forming a passage for ventilating air between said outer wall and said jacket, said air passage being of annular cross section with its walls flaring outwardly from the end adjacent the combustion chamber and converging at the other end adjacent the exhaust passage so that the air passage substantially follows the contour of the flow passage, and means delivering ventilating air so as to flow through said passage in the same direction as the combustion gases move through their said flow passage, whereby said ventilating air impinges forcibly against the flaring outer wall of said flow passage near the combustion chamber and the combustion gases impinge forcibly against the converging surface of said wall adjacent the exhaust end of the heater.

2. In a heater as defined in claim 1, said outer wall of the flow passage for combustion gases being of relatively thin metal and having integral fins circumferentially spaced, extending substantially throughout the length of the passage and projecting radially inward and substantially across it, subdividing said passage into a plurality of longitudinal channels to which the flow of hot gases is confined, said wall having also a series of outwardly projecting radial fins extending substantially throughout the length of the ventilating air passage and substantially across it to the said jacket, subdividing said passage into a plurality of longitudinal channels confining streams of ventilating air and transferring thereto the heat absorbed by said wall and its inwardly projecting fins.

3. In a heater as defined in claim 1, the inner wall of said flow passage for the combustion gases comprising a hollow metallic shell filled with sound absorbent material and having small perforations distributed over its lateral area.

4. In a heater as defined in claim 1, the walls of said flow passage for the products of combustion intermediate said outwardly flaring portions and said converging portions being substantially parallel to the common axis of the combustion chamber and exhaust passage, whereby said products of combustion experience an abrupt change of direction in passing from the outwardly flaring portion of the flow passage into said intermediate portion and impinge forcibly against the outer wall thereof.

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