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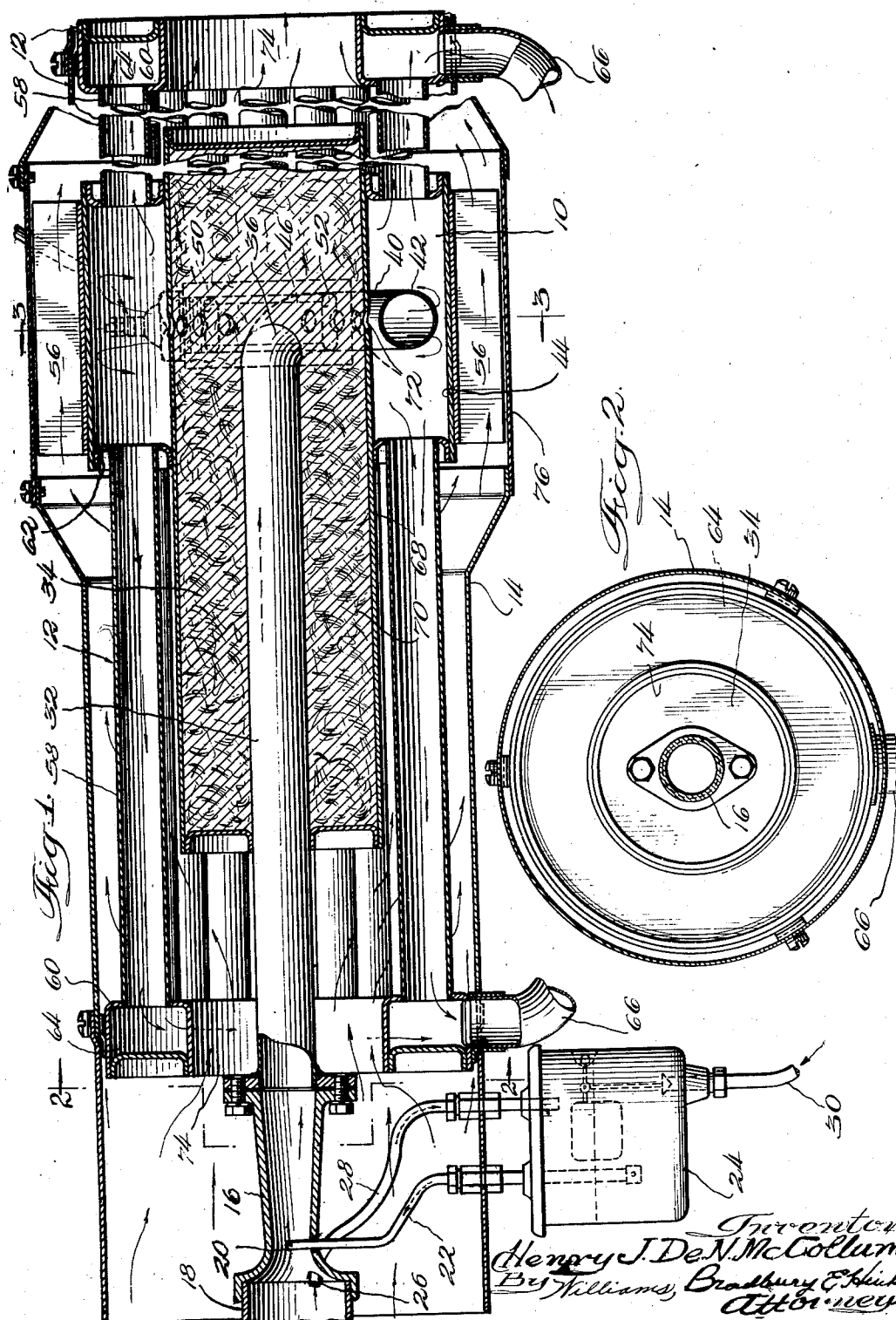
H. J. DE N. McCOLLUM

2,390,380

HEATER

Filed Feb. 25, 1943

3 Sheets-Sheet 1



Dec. 4, 1945.

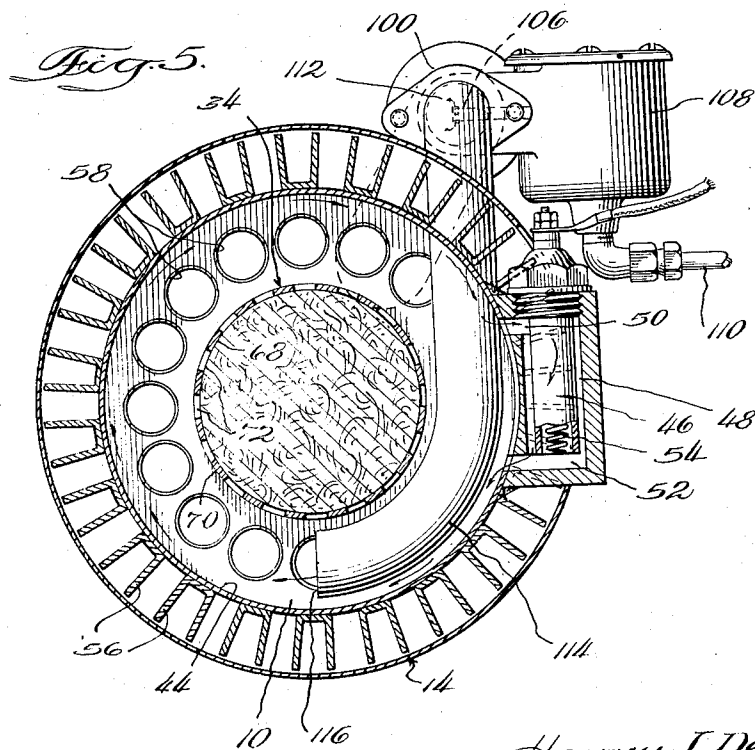
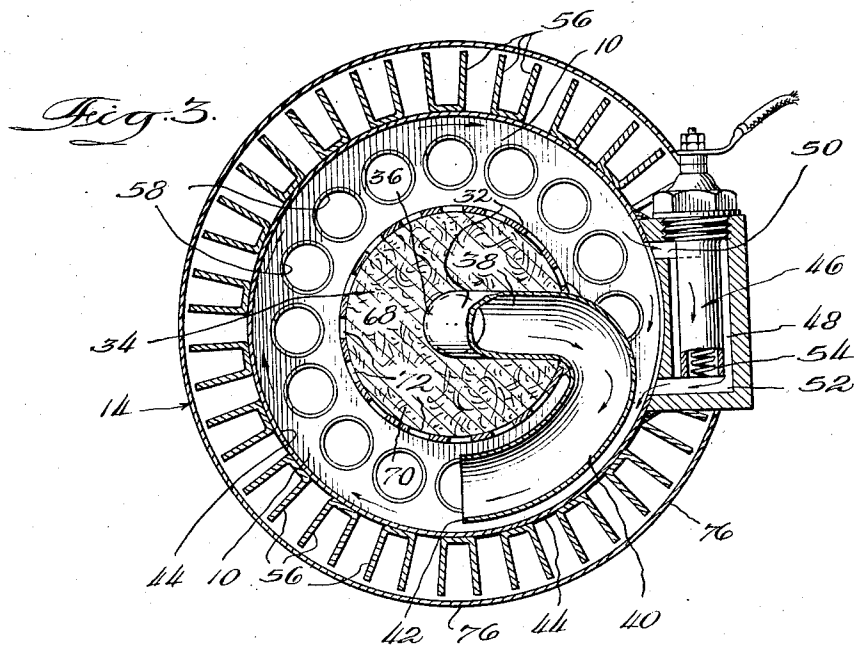
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HEATER

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3 Sheets-Sheet 2



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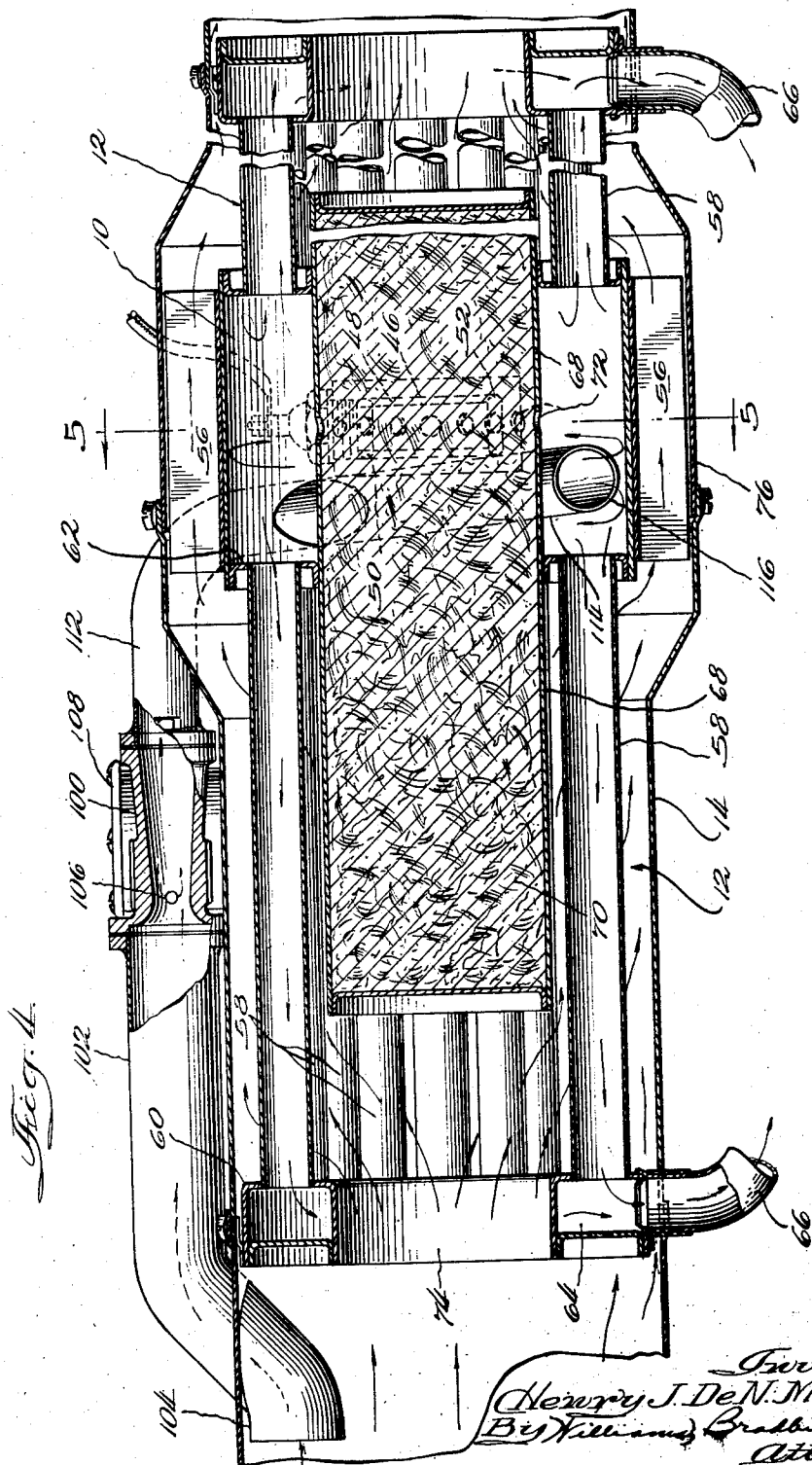
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HEATER

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UNITED STATES PATENT OFFICE

2,390,380

HEATER

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Application February 25, 1943, Serial No. 477,081

11 Claims. (Cl. 126—116)

My invention pertains to heaters, and more particularly to heaters of the internal combustion type.

In heaters of the internal combustion type it is common to provide a combustion chamber having an opening at one end through which hot products of combustion flow from the combustion chamber to one end of a heat exchanger. Where the hot products of combustion first enter the heat exchanger, the heat of these gases is at a maximum and there is a tendency to raise the temperature of this end of the heat exchanger to such a degree that the heat exchanger is burned out at this end. An object of my invention is to provide an internal combustion type of heater which is so constructed that no part of the heat exchanger will be raised to an excessive temperature.

Another object of my invention is to provide a new and improved heater of the internal combustion type in which the pressure drop across the heater is reduced, whereby a low pressure source of air supply may be utilized to operate the heater.

Another object of my invention is to provide a heater in which the combustion chamber is more uniformly heated with consequent reduction in thermal stresses.

Another object of my invention is to provide a simple, light weight, efficient heater which can be inexpensively manufactured and which will give long and trouble-free service.

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

In the drawings:

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

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

Fig. 3 is a cross sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a view similar to Fig. 1 but showing a modified form of my invention; and

Fig. 5 is a transverse section taken on the line 5—5 of Fig. 4.

The heater shown in Figs. 1 to 3, inclusive, differs from the conventional heater in the location of the combustion chamber and the arrangement of this chamber with respect to the heat exchange means. In the usual internal combustion type of heater the combustion chamber is located at one end of a tubular heat exchanger into which all products of combustion formed in the combustion chamber are discharged. In the heater shown in these figures, however, the combustion chamber 10 is located centrally of the heater and delivers hot products of combustion

to a pair of identical heat exchangers 12. The combustion chamber 10 and heat exchangers 12 are enclosed in a tubular casing 14 which directs ventilating air over the heat exchangers and combustion chamber and which is supplied with air from a ram, blower or any other suitable source of supply connected to the left hand end of the casing as viewed in Fig. 1. The right hand end of the casing discharges heated ventilating air directly into an airplane cabin or other space to be heated, or into a system of ducts having outlets in the same or different spaces.

A Venturi tube 16 is located in the casing 14 to the left of the left hand heat exchanger 12 and receives a supply of combustion air through an inlet pipe 18. This inlet pipe may receive air from the ram or blower or other source of supply for the casing 14, or may be supplied from a separate ram, blower or other source. Fuel is supplied to the restricted throat of the Venturi tube 16 by a jet 20 connected by pipe 22 to the lower part of a float bowl 24. A ram 26 is connected by pipe 28 to the upper part of the float bowl 24 so that the difference in pressure between the ram 26 and throat of the Venturi tube 16 is available to force fuel from the float bowl to the jet 20 and through the openings in this jet to the interior of the Venturi tube where a combustible mixture is formed of the fuel and air. The float bowl 24 may be connected to any suitable source of fuel by a pipe 30, and as more fully hereinafter explained, this fuel may be a light fuel such as gasoline, or any of the heavier fuels such as kerosene or fuel oil.

The Venturi tube 16 delivers its combustible mixture to one end of a fuel induction pipe 32 which is preferably of uniform diameter throughout and has a smooth interior free from obstacles which would form pockets for eddy currents. The diameter of the induction tube 32 is such that the rate of flow of combustible mixture therethrough is faster than the rate of flame propagation so that no combustion takes place in this tube. The tube 32 is shown as extending axially through one end of a muffler 34 which I shall later describe in greater detail. At the longitudinal center of the muffler 34, the induction tube 32 has a bend 36 leading to a radially extending portion 38 which passes beyond the muffler 34 and into the combustion chamber 10. The radially extending portion 38 of the tube connects with a preheating portion 40 which lies in the combustion chamber and is curved about the axis thereof, as clearly shown in Fig. 3. The length of this preheating portion 40 of the in-

duction tube 32 may be as great or little as desired to adapt the heater for use with different fuels. The fuel mixture discharged from the outlet end 42 of the induction tube circles about the annular wall 44 of the combustion chamber and burns as a ring of flame, whereby a combustion chamber of very short length suffices to permit complete combustion of the fuel. Certain of the subject matter of the instant application pertaining to the construction and arrangement of the induction tube and combustion chamber are claimed more broadly in my copending application, Serial No. 477,080, filed February 25, 1943.

I provide an electrical igniter 46 for igniting the combustible mixture supplied to the combustion chamber 10. This igniter is illustrated as being located in a cylindrical passage 48 formed in the wall of the combustion chamber. This passage has an inlet 50 for admitting combustible mixture thereto, and an outlet 52 which connects the lower end of the passage 48 with the combustion chamber. Part of the combustible mixture whirling about the cylindrical wall of the combustion chamber is urged by centrifugal force to enter the inlet 50, and flows downwardly in passage 48 and is ignited by the hot wire coil 54 at the lower end of the igniter. The burning gases thus formed pass through outlet 52 into the combustion chamber and set fire to all of the combustible mixture therein. This fire takes the form of a ring of flame just inside of the cylindrical wall of the combustion chamber and is sufficient in and of itself to maintain combustion after the igniter 46 has been disconnected from its source of electrical current by the usual thermostatic switch.

The cylindrical wall 44 of the combustion chamber is heated by the combustion occurring in this chamber, and this heat is transmitted to the radially arranged fins 56 attached to the wall 44. The fins 56 are illustrated as being formed by U-shaped strips which are welded or otherwise attached to the outer surface of the wall of the combustion chamber. Ventilating air flowing through the casing 14 contacts these fins and absorbs heat therefrom as well as from that portion of the outer surface of the wall 44 which is exposed between adjacent sets of fins. In this manner an appreciable amount of heat is transmitted to the ventilating air and the wall 44 of the combustion chamber is prevented from being overheated.

Part of the hot products of combustion from the combustion chamber 10 flow into the longitudinally extending tubes 58 of the left hand heat exchanger 12, and part of the hot products of combustion from the combustion chamber 10 flow into the longitudinally extending tubes 58 of the right hand heat exchanger 12. By thus dividing the products of combustion into two parts flowing in opposite directions, excessive temperatures at the ends of the heat exchangers which connect with the combustion chamber are avoided.

Each set of longitudinally extending tubes 58 are mounted in headers 60 and 62. Each header 60 is hollow, as indicated at 64, and forms an exhaust manifold communicating with an exhaust pipe 66 through which the products of combustion are discharged to atmosphere.

The muffler 34 comprises a sheet metal shell or canister 68 containing sound absorbing material 70 such as stainless steel wool or glass wool. The central portion of the shell 68 is provided with a circumferentially arranged series of openings 72 through which sound can pass from the combustion chamber into the interior of the muffler and

be absorbed therein. I have found that practically all of the objectionable noise created in a heater of this type is created in the combustion chamber, and that by eliminating the objectionable noise created in this chamber a quietly operating heater is obtained.

The ventilating air entering the left hand end of the casing 14 passes through the central opening 74 in the left hand header 60 and then outwardly between the tubes 58 connected to this header. These tubes are spaced from each other, from the casing 14, and from the muffler 34 so that the entire outer surface of these tubes is exposed to the ventilating air as it travels from the left hand header 60 to the enlarged part 76 of the casing 14 which surrounds the combustion chamber and the fins 56 attached to the outer wall of this chamber.

The ventilating air which has passed over the left hand series of tubes 58 and has absorbed heat therefrom, absorbs additional heat from the fins 56 as it passes lengthwise thereof, and also receives some additional heat directly from the wall of the combustion chamber where it is exposed between the U-shaped members which form these fins. As the ventilating air leaves the enlarged portion 76 of the casing 14, it flows inwardly and along the right hand set of tubes 58, absorbing additional heat therefrom, and then flows radially inwardly and is discharged from the heater through the opening 74 in the right hand exhaust header 60.

The modified form of my invention shown in Figs. 4 and 5 is identical with that previously described, except for the arrangement of the carburetor and induction tube. In Figs. 4 and 5 the Venturi tube 100 is located outside of the casing 14 but receives air from the interior of this casing by way of a pipe 102 which connects the Venturi tube 100 with a ram 104 located in the left hand end of the casing 14 and positioned to receive part of the air delivered to this casing by a ram, blower or any other suitable source.

A fuel jet 106 delivers fuel to the throat of the Venturi tube 100. This jet is connected to the float bowl 108 located at approximately the level of the Venturi tube so that little suction is required to draw fuel from the float bowl into the Venturi tube. The float bowl 108 is connected by pipe 110 with any suitable source of light or heavy fuel.

The Venturi tube 100 delivers a combustible mixture to an induction tube 112 which projects through the cylindrical wall of the combustion chamber 10 and has a curved preheating portion 114 located in the combustion chamber. This preheating portion of the induction tube is located at one side of the longitudinal center of the combustion chamber, but is inclined as clearly shown in Fig. 4 so that the outlet end 116 of the induction tube is closer to the longitudinal center of the combustion chamber than is any other portion of this tube which is in the combustion chamber. The fuel and air mixture delivered by this induction tube whirls about the axis of the combustion chamber, and at the same time tends to move toward the right in this chamber in a helical path.

This mixture is ignited by the electrical igniter 46 and burns as a ring of flame in the combustion chamber. In order for any of the products of combustion to enter the tubes 58 of the left hand heat exchanger 12, these gases must reverse their direction of flow to overcome the initial direction imparted to them by the inclination of the

preheating portion of the induction tube. This prevents any gas from leaving the combustion chamber until all fuel has been completely consumed, and thereby ensures efficient burner operation. As in the previous embodiment, the burned products of combustion divide, and half of these products pass through the tube of the left hand heat exchanger 12 and the other half pass through the tubes 58 of the right hand heat exchanger 12 before these products of combustion are discharged to atmosphere through exhaust pipes 66.

In each of the two embodiments shown, the combustion chamber is located centrally of the heat exchange means and the hot products of combustion formed therein flow in opposite directions from this chamber through heat exchangers located on opposite sides thereof. This division of the hot products of combustion prevents burning out of those portions of the heat exchangers which are immediately adjacent the combustion chamber, and thus ensures longer life for the heater. This two-way flow of the products of combustion from the combustion chamber also provides substantial uniformity of temperature throughout the walls of the combustion chamber and eliminates temperature stresses in these walls. Both of these embodiments of my invention also provide large passageways for the products of combustion whereby the pressure drop across the heater is reduced and a low pressure ram, blower or other source of air supply may be utilized for effective heater operation. The foregoing advantages are accomplished by a simple, inexpensive, light-weight structure which is rugged and sturdy and capable of affording long and trouble-free service.

While I have illustrated and described only two embodiments of my invention, it is to be understood that my invention is not limited to the particular details shown and described but may assume numerous other forms, and that the scope of my invention is defined in the following claims. I claim:

1. A heater of the class described, comprising a combustion chamber having a cylindrical wall, a heat exchanger communicating with each end of said combustion chamber to receive hot products of combustion therefrom, a muffler located in said combustion chamber and said heat exchangers, an induction tube of uniform diameter extending through one of said heat exchangers and part of said muffler, said induction tube having a curved end in the longitudinal center of said combustion chamber and delivering combustible mixture tangentially of the wall thereof, an igniter communicating with the interior of said combustion chamber, and a casing enclosing said combustion chamber, heat exchangers and muffler and directing ventilating air thereover, said casing having an inlet opening adjacent the free end of one of said heat exchangers and an outlet opening adjacent the free end of the other heat exchanger.

2. A heater of the class described, comprising walls forming a cylindrical combustion chamber, a heat exchanger attached to each end thereof, each of said heat exchangers comprising an annular series of tubes receiving products of combustion from said combustion chamber, a muffler extending through said combustion chamber and surrounded by the series of tubes on each side thereof, said muffler comprising a shell containing sound absorbing material and having a circumferential series of sound receiving openings

located centrally of said combustion chamber, and an induction tube for supplying a combustible mixture to said combustion chamber, said induction tube being surrounded by one of said series of tubes and extending through part of the length of said muffler.

3. A heater of the class described, comprising walls forming an annular combustion chamber, an induction tube for supplying combustible mixture thereto, said induction tube having a portion curved about the axis of said annular chamber and an outlet delivering mixture tangentially to the walls of said chamber, said outlet being located in the longitudinal center of said chamber, means for igniting said mixture, and a heat exchanger associated with each end of said annular chamber and receiving hot products of combustion therefrom.

4. A heater of the class described, comprising walls forming an annular combustion chamber, an induction tube for supplying combustible mixture thereto, said induction tube having a portion curved about the axis of said annular chamber and an outlet delivering mixture tangentially to the walls of said chamber, said outlet being located in the longitudinal center of said chamber, means for igniting said mixture, a heat exchanger associated with each end of said annular chamber and receiving hot products of combustion therefrom, and a muffler extending through said combustion chamber and into the heat exchangers associated therewith.

5. A heater of the class described, comprising walls forming a centrally located combustion chamber, a heat exchanger on each side of said combustion chamber, each of said heat exchangers comprising a circumferentially arranged series of tubes receiving hot products of combustion from said combustion chamber and a hollow annular header forming an outlet manifold for said tubes, a casing enclosing said combustion chamber and heat exchangers and having inlet and outlet openings adjacent said headers, said casing being adapted for connection to a ram, blower, or other suitable source of air supply and directing air between said tubes and over said combustion chamber, and means for supplying a combustible mixture to said combustion chamber.

6. A heater of the class described, comprising walls forming a centrally located combustion chamber, a heat exchanger on each side of said combustion chamber for receiving hot products of combustion from said chamber, a carburetor at an end of one of said heat exchangers remote from said combustion chamber, an induction tube of uniform diameter connected to said carburetor and extending through one of said heat exchangers and into said combustion chamber, and a casing enclosing said carburetor, combustion chamber and heat exchangers, said casing having an inlet opening surrounding said carburetor and an outlet opening at the opposite end of the second heat exchanger.

7. A heater of the class described, comprising a combustion chamber having a cylindrical wall, fins projecting outwardly from said wall, means for supplying a combustible mixture to said combustion chamber, a series of tubes connected to each end of said combustion chamber and receiving hot products of combustion therefrom, a casing enclosing said combustion chamber and tubes and serving to direct air over said fins and around and between said tubes, said casing having inlet and outlet openings at opposite ends of

the heater, and means for supplying a combustible mixture to said combustion chamber.

8. A heater of the class described, comprising walls forming a combustion chamber, means for supplying a combustible mixture thereto, a circumferentially arranged series of tubes receiving hot gases from one end of said combustion chamber, an annular exhaust manifold for said tubes through which said products of combustion are discharged to atmosphere, said manifold providing a ventilating air inlet for said tubes, and a casing enclosing said tubes, manifold and combustion chamber and having inlet and outlet openings adjacent said exhaust manifolds, said tubes being spaced apart to provide air passages therebetween and said casing being spaced outwardly of said tubes whereby ventilating air entering said inlet flows outwardly between and longitudinally of said tubes.

9. A heater of the class described, comprising walls forming a centrally located combustion chamber, a heat exchanger at each end of said chamber for receiving hot products of combustion therefrom, a casing enclosing said combustion chamber and heat exchangers and having inlet and outlet openings adjacent the remote ends of said heat exchangers, a carburetor located outside of said casing, an air inlet for said carburetor extending into said casing, and an induction tube connecting said carburetor with said combustion chamber, said induction tube having a helical portion located in one end of said combustion chamber and having an outlet end located closer to the opposite end of said combustion chamber than any other part of said portion.

10. A heater of the class described, comprising walls forming a centrally located combustion

chamber, a heat exchanger at each end of said chamber for receiving hot products of combustion therefrom, a casing enclosing said combustion chamber and heat exchangers and having inlet and outlet openings adjacent the remote ends of said heat exchangers, a carburetor located outside of said casing, an air inlet for said carburetor extending into said casing, an induction tube connecting said carburetor with said combustion chamber, said induction tube having a helical portion located in one end of said combustion chamber and having an outlet end located closer to the opposite end of said combustion chamber than any other part of said portion, and a muffler located in the center of and extending the full length of said combustion chamber.

11. A heater of the class described, comprising walls forming a centrally located combustion chamber, said combustion chamber having a cylindrical wall, a heat exchanger at each end of said chamber for receiving hot products of combustion therefrom, a casing enclosing said combustion chamber and heat exchangers and having inlet and outlet openings adjacent the remote ends of said heat exchangers, a carburetor located outside of said casing, an air inlet for said carburetor extending into said casing, and an induction tube connecting said carburetor with said combustion chamber, said induction tube having a helical portion located in one end of said combustion chamber and having an outlet end located closer to the opposite end of said combustion chamber than any other part of said portion.

HENRY J. DE N. McCOLLUM.