Sept. 27, 1949. H. J. DE N. McCOLLUM 2,482,988

INTERNAL-COMBUSTION HEATER FOR HEATING AIR

Filed Sept. 27, 1943 2 Sheets-Sheet 1

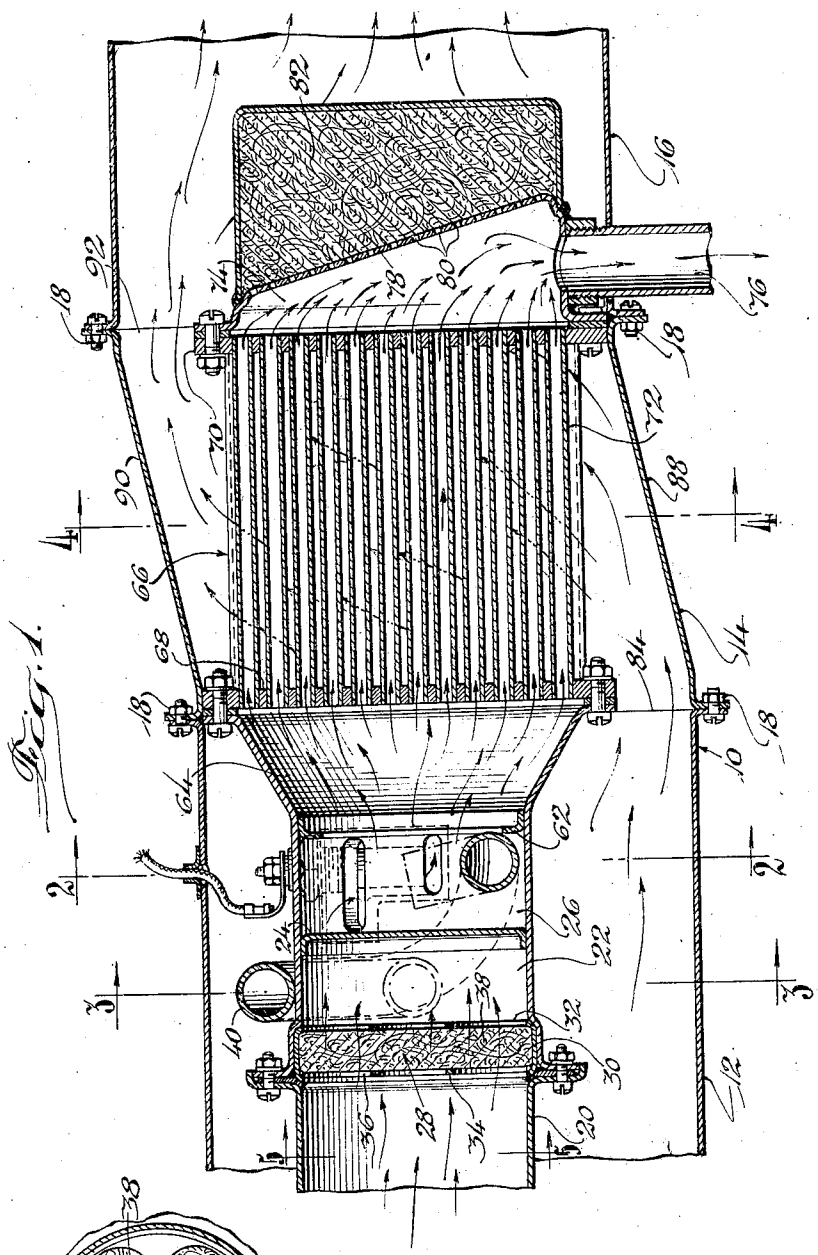


Fig. 1.

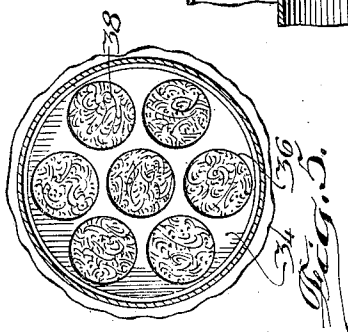


Fig. 2.

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INTERNAL-COMBUSTION HEATER FOR HEATING AIR

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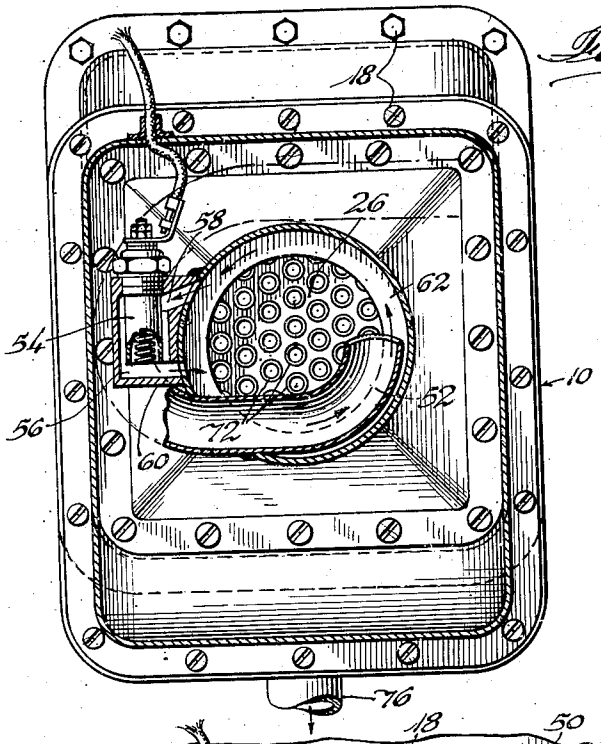


Fig. 2.

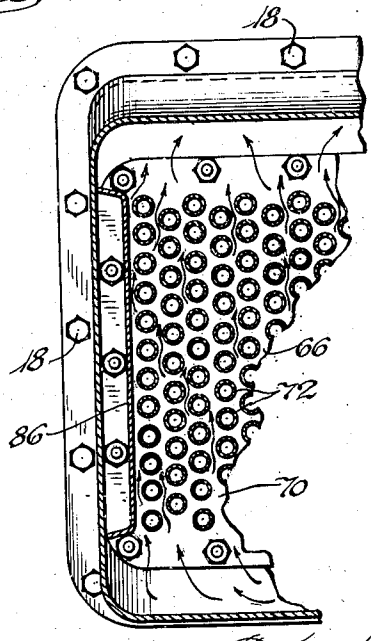


Fig. 4.

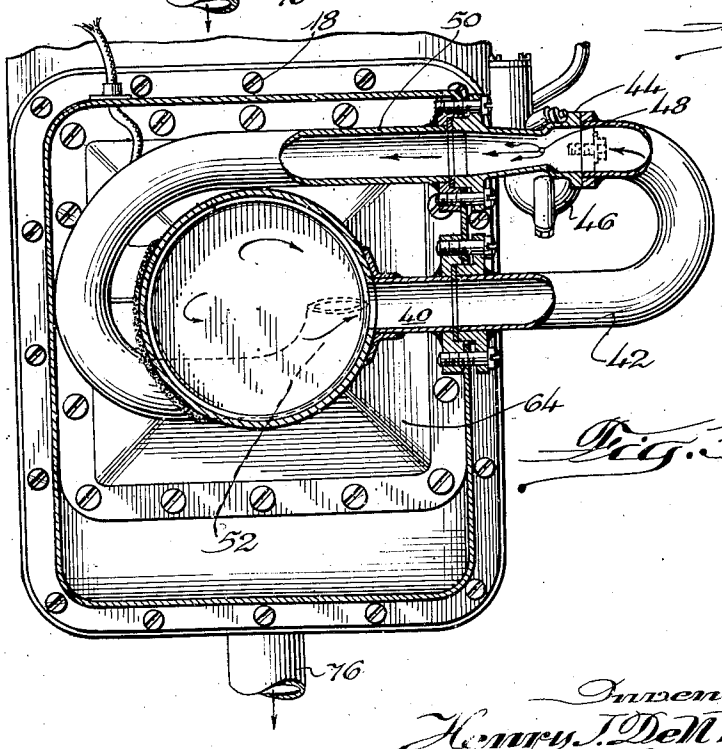


Fig. 3.

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UNITED STATES PATENT OFFICE

2,482,988

INTERNAL-COMBUSTION HEATER FOR HEATING AIR

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Application September 27, 1943, Serial No. 503,924

5 Claims. (Cl. 126—116)

1

My invention relates to heaters and more particularly to heaters of the internal combustion type for heating ventilating air.

An object of my invention is to provide a new and improved heater which is simple, compact, inexpensive, light weight, quiet and efficient.

Another object of my invention is to provide a heater having new and improved means for transferring heat from hot products of combustion to ventilating air.

Another object of my invention is to provide a heater having a new and improved muffler.

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

In the drawings:

Fig. 1 is a longitudinal, sectional view through a heater embodying a preferred form of my invention;

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

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

Fig. 4 is a partial, transverse, sectional view taken on the line 4—4 of Fig. 1; and

Fig. 5 is a partial, transverse, sectional view taken on the line 5—5 of Fig. 1.

Referring to Fig. 1, it will be seen that I have disclosed therein an internal combustion type of heater having a sheet metal casing 10 illustrated as being formed of the three sections 12, 14 and 16 secured together by bolts 18, or in any other suitable manner. The lefthand end of the casing 12 is connected to a ram or blower or other suitable source of ventilating air and the righthand end of the casing may lead directly into an aircraft cabin or other space to be heated, or may communicate with a duct system having a plurality of outlets in the same or different compartments.

My novel heater has a combustion air pipe 20, whose lefthand end may communicate with the interior of the section 12 of the casing 10 for receiving air therefrom, or may be connected with a separate ram or blower for supplying only combustion air. The combustion air pipe 20 delivers the combustion air to a preheating chamber 22 having a sheet metal wall 24 which separates this preheating chamber from a combustion chamber 26.

A filtering cartridge 28 is preferably interposed between the combustion air pipe 20 and the preheating chamber 22, so that the air entering this chamber is first cleaned of all dirt or other impurities. The cartridge 28 comprises a sheet metal cup 30, having a base provided with perforations 32. The free edge of the cup 30 is

2

crimped over a retaining plate 34, provided with similar perforations 36. Filtering material 38 is confined between the retaining plate 34 and the base of the cup 30 and serves to remove impurities from the air passing therethrough. This filtering material may be glass wool or stainless steel wool, or any other suitable material.

Air entering the preheating chamber 22 absorbs heat from the walls of this chamber and then passes into pipes 40 and 42 leading to the Venturi tube 44 of a carburetor 46. A fuel jet 48 delivers gasoline, or other suitable fuel, to the throat of the Venturi tube 44, where this fuel mixes with the air supplied through pipes 40 and 42. The mixture of fuel and air formed in the Venturi tube passes into an induction tube 50, having an inclined and curved end 52 located in the combustion chamber 26. The combustible mixture delivered to the combustion chamber by the induction tube 50 is initially ignited by an electric igniter 54 located in a pocket 56 communicating with the combustion chamber at its upper and lower ends by way of passages 58 and 60, respectively. The righthand end of the combustion chamber is provided with an inwardly directed flange 62, which serves to prevent discharge from the combustion chamber of unburned liquid fuel.

The hot products of combustion formed in the combustion chamber flow through the opening provided by the annular flange 62 into a flared passage 64 leading to the inlet end of a heat exchanger, indicated generally by reference character 66. This heat exchanger comprises a pair of headers 68 and 70 and heat transfer tubes 72 connecting these headers. The particular design of heat exchanger shown herein forms the subject matter of my co-pending application, Serial No. 516,648, filed January 1, 1944 and now Patent No. 2,451,851 issued October 19, 1948. The hot products of combustion flow through the passages in the tube 72 of the heat exchanger and give up their heat to this heat exchanger. These cooled products of combustion then pass into an exhaust chamber 74 and are discharged to atmosphere through an exhaust pipe 76.

The exhaust chamber 74 is of tapered cross-section, as clearly shown in Fig. 1 of the drawings, and has an inclined wall 78 provided with perforations 80 which form acoustic-couplings between the exhaust chamber 74 and a muffling chamber 82, which is illustrated as being filled with sound absorbing material, such as stainless steel wool or glass wool. The heat exchanger 66 is extremely efficient in removing heat from the hot products of combustion, so that the tem-

perature of these gases is reduced to 250° or 300° F. before they are discharged into the exhaust chamber 74. The sound absorbing material in the muffler chamber 82 is, therefore, never exposed to a high temperature and this feature is of great importance in preventing deterioration of this sound absorbing material. The inclined wall 78 of the exhaust chamber 74 is also common to the muffling chamber 82 and provides a muffling chamber of varying depth, which is particularly efficient in absorbing a wide range of objectionable noises.

The ventilating air flowing through the casing 10 first passes around the combustion chamber 26 and tapered passage 64 and absorbs some heat from the annular walls thereof. This ventilating air then flows through an opening 84 beneath the header 68 and thence upwardly between the heat transfer tubes 72. The arrangement of these tubes and the direction of air flow therethrough is best shown in Fig. 4, which also shows one of the two baffles 86 located on opposite sides of the tube bundle and serving to prevent appreciable quantities of air from bypassing the tube bundle by flowing upwardly around the sides thereof. The lower wall 88 of the casing section 14 is inclined upwardly, as clearly shown in Fig. 1, to produce a smooth flow of ventilating air into the lower side of the tube bundle and the upper wall 90 of this casing section is similarly inclined to permit a smooth flow of the heated ventilating air from the upper end of the tube bundle through opening 92 above header 70 into the righthand section 16 of the heater casing. As the ventilating air passes upwardly between the heat transfer tube 72, it absorbs great quantities of heat from these tubes and attains a temperature which is substantially that of the exhaust gases.

It is to be noted that the passages in the tube 72 through which the products of combustion flow are of small diameter and these small passages retard the rate of flame propagation and thus soften any explosion which may take place in the heater. Furthermore, the combustion chamber 26, passage 64, discharge chamber 74 and muffling chamber 82 are each of relatively small volume, so that no violent explosions of unburned gases can occur and the parts need not be made especially strong to withstand such heavy explosions. The design of my novel heater is such that it is extremely quiet in operation and a small muffling chamber 82 is sufficient to absorb any undesirable noises even where the heater is operated with an exhaust pipe 76 of appreciable length.

It will be understood by those skilled in the art that my new and improved heater may be provided with the usual thermostatic control for cutting out the electrical igniter 54 when the heater attains normal operating temperature. It is to be further understood that my heater may be provided with other usual or suitable controls for regulating the supply of ventilating and combustion air and the quantity of fuel consumed in the combustion chamber. My heater may also be provided with the usual overheat controls which I have not deemed it necessary to show in the drawings.

From the foregoing description taken in connection with the accompanying drawings, it will be seen that I have invented a novel heater which is compact and which may be easily and inexpensively manufactured of conventional materials utilizing conventional machinery and processes. This heater is highly efficient and is particularly suitable for heating the cabins and other enclosed spaces of aircraft. It is to be understood, however, that my novel heater is not limited to such use and may be also used for general heating purposes.

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 particular details shown and described, but may assume numerous other forms and that my invention includes all modifications, variations and equivalents coming within the appended claims.

I claim:

1. A heater of the class described, comprising a burner having a tubular wall, a heat exchanger connected to one end of said wall, means for supplying ventilating air to said heat exchanger, means for supplying a combustible mixture to said burner, said burner serving to furnish hot products of combustion to said heat exchanger, means forming an exhaust chamber communicating with said heat exchanger, said exhaust chamber having an inclined wall spaced from said heat exchanger, and a muffler communicating with said exhaust chamber through perforations in said inclined wall, said perforations forming an acoustic coupling between said muffler and said exhaust chamber.

2. A heater of the class described, comprising a casing having one end adapted to be connected to a source of ventilating air, said casing having an intermediate section provided with opposing inclined walls, a heat exchanger located in said intermediate section and cooperating therewith to form a ventilating air passage transversely of said heat exchanger, means forming a combustion chamber for supplying hot products of combustion to said heat exchanger, means forming an exhaust chamber connected to said heat exchanger, means forming a muffling chamber separated from said heat exchanger by said exhaust chamber, and means whereby said muffling chamber is acoustically coupled to said exhaust chamber.

3. A heater of the class described, comprising a casing having one end connected to a source of ventilating air, said casing being of rectangular cross section and being of greater height than width, a tubular burner located in said casing, means for supplying a combustible mixture to said burner, a heat exchanger located in said casing and having a rectangular tube bundle, means connecting said burner and heat exchanger whereby products of combustion from said burner flow to said heat exchanger, said heat exchanger and casing being so constructed as to direct ventilating air transversely of said tube bundle, means forming an outlet for gases leaving said heat exchanger, and a muffler of substantially the same cross section as said heat exchanger and in communication therewith, said muffler being located in said casing and being separated from said burner by said heat exchanger.

4. A heater of the class described, comprising a tubular casing having one end adapted to communicate with a source of ventilating air, said casing having offset ends and an inclined intermediate portion connecting said ends, means forming a combustion chamber located in said first-mentioned end, a heat exchanger located in said intermediate portion and so constructed and arranged therein that the inclination of said intermediate portion directs ventilating air transversely of said heat exchanger, means connecting

said combustion chamber and heat exchanger whereby the latter receives products of combustion from the former, and means forming an exhaust chamber and muffler connected to said heat exchanger and located in the other end of said casing.

5. A heater of the class described, comprising a tubular casing of rectangular cross-section, said casing having end portions and an intermediate portion provided with upper and lower walls inclined at an angle of less than 45° to the end portions of said casing, a heat exchanger located in said intermediate portion, said heat exchanger having a bundle of straight, heat-transfer tubes extending parallel to the axes of the end portions of said casing, the tubes of said bundle being spaced apart and so arranged that said bundle is rectangular in cross-section, said bundle having one end closely adjacent one end of one of said inclined walls and said bundle having a second end closely adjacent the opposite end of the other inclined wall, said tube bundle and one of said inclined walls forming a triangular entrance for ventilating air flowing transversely of said tube bundle and said bundle and the other inclined wall forming a triangular outlet for said air, said triangular inlet and outlet flaring in opposite directions, and means for supplying hot products of combustion to said heat exchanger.

HENRY J. DE N. McCOLLUM.

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