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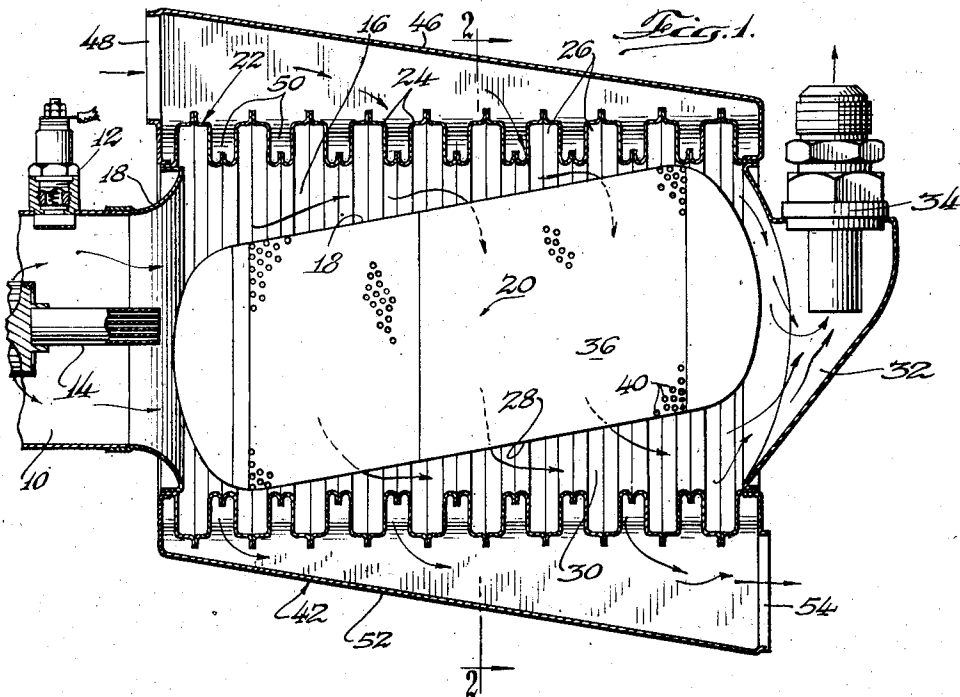
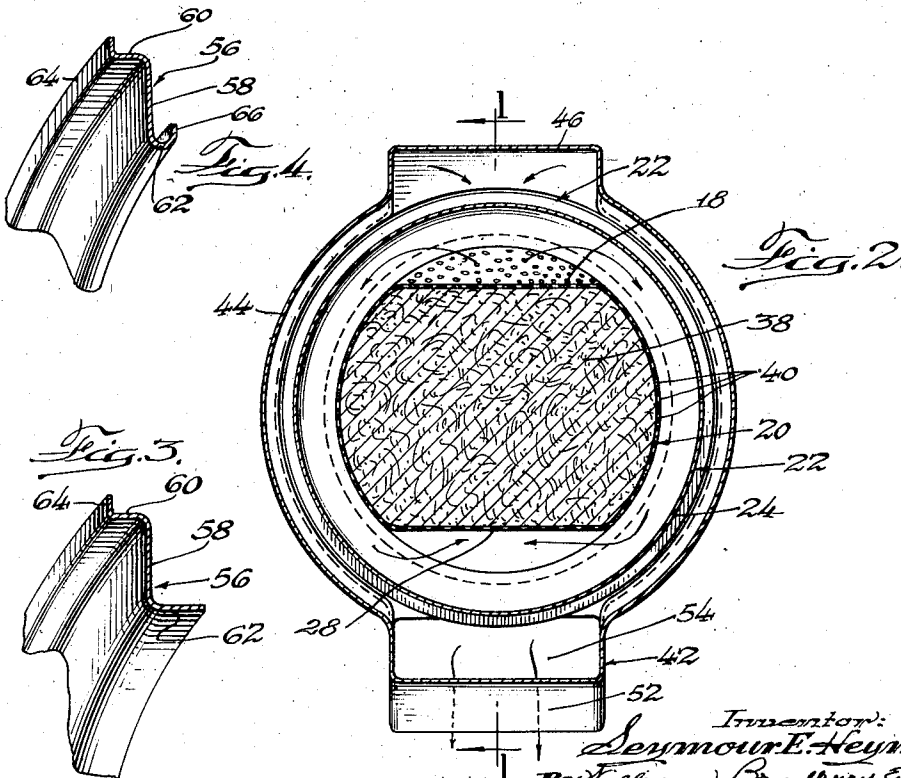
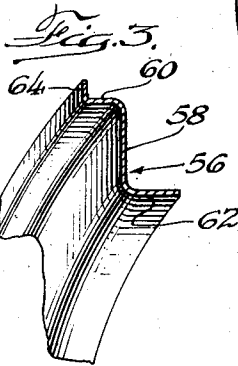
S. E. HEYMANN

2,362,271

HEATING APPARATUS

Filed Nov. 16, 1942

2 Sheets-Sheet 1



Inventor:
Seymour E. Heymann
By Frederick, Bradbury & Hinkle
Attorneys.

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Fig. 6.

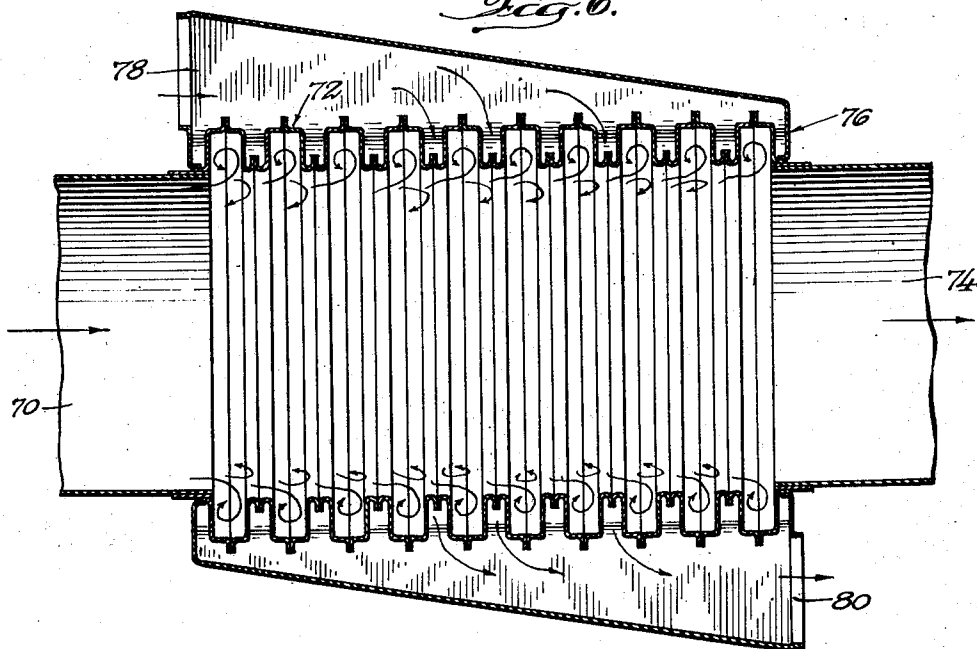
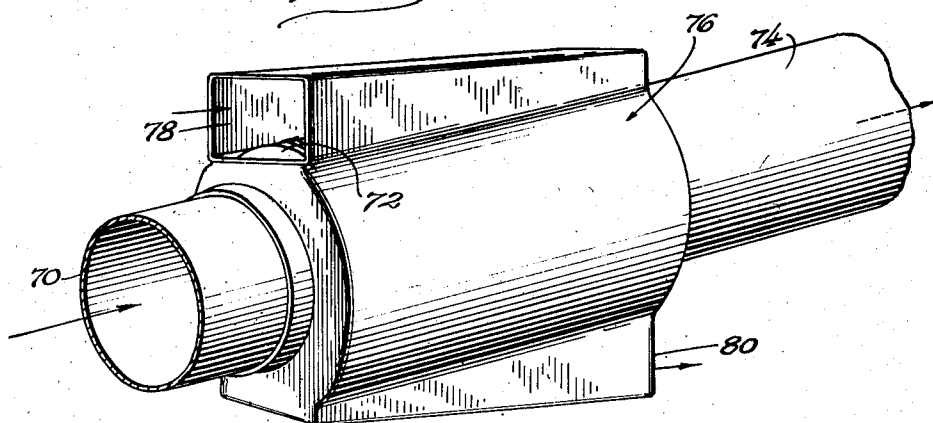


Fig. 5.



Inventor:
Seymour E. Heymann
By *Williams, Bradbury & Shultz*
Attorneys.

UNITED STATES PATENT OFFICE

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HEATING APPARATUS

Seymour E. Heymann, Chicago, Ill., assignor to
Stewart-Warner Corporation, Chicago, Ill., a
corporation of Virginia

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5 Claims. (Cl. 257—241)

My invention relates to heating apparatus and more particularly to a hollow fin type of heat exchanger adapted for use either as part of an internal combustion heater or as part of an exhaust heater which is supplied with hot gases of combustion from an internal combustion engine or other source.

In exhaust heaters and 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 ram, blower or any other means for circulating air. The hot gases of combustion come in more intimate contact with the bases of the fins and create hot spots therein, which are at a temperature greatly in excess of the temperature of other portions of the heat exchanger. There is a practical limit to the temperature to which the fins can be heated and since the hot spots can not be raised above this practical limit, the greater portion of the heat exchanger is maintained at a temperature considerably below this limit.

An object of my invention is to provide new and improved heating apparatus which eliminates these hot spots and which makes it possible to operate the heat exchange means at a more uniform and higher average temperature to 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 heat exchanger which can be manufactured by a novel and simplified method.

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

In the drawings:

Fig. 1 is a longitudinal, sectional view through an internal combustion type of heater embodying a preferred form of my invention. This view is taken on the line 1—1 of Fig. 2.

Fig. 2 is a transverse, vertical section taken on the line 2—2 of Fig. 1;

Fig. 3 is a perspective view of a preliminary step in forming the rings from which my new and improved heat exchanger is made;

Fig. 4 is a view similar to Fig. 3, but showing the completed ring;

Fig. 5 is a perspective view of an exhaust heater embodying my invention; and

Fig. 6 is a view showing a longitudinal section through a portion of the exhaust heater of Fig. 5.

In Figs. 1 and 2 of the drawings, I have illustrated an internal combustion type of heater having a combustion chamber 10 supplied with a combustible mixture from any suitable source and forced into the combustion chamber with sufficient pressure to create the necessary flow of combustible mixture into the heater and gases of combustion therefrom. The combustible mixture supplied to the combustion chamber 10 is ignited by one or more electrical igniters 12 which may be provided with the usual thermostatic switch for disconnecting these igniters from their source of current when the heater has attained normal operating temperature. A re-igniter 14 thereafter serves to maintain combustion of the mixture supplied to the combustion chamber.

The hot products of combustion flow from the combustion chamber 10 into the tapered passage 16 formed between the inclined upper wall 18 of a muffler 20 and the upper portion of a tubular heat exchanger 22. The heat exchanger 22 has a plurality of annular hollow fins 24 having internal gas passages 26. The hot gases flowing from the combustion chamber into the inclined passage 16 are distributed among the interior passages 26 in the hollow fins and divide to flow downwardly through opposite sides of these passages, as indicated by the arrows in Fig. 2. The muffler 20 is provided with a lower inclined surface 28 providing a tapered passage 30 which receives the cooled gases discharged from the lowermost portions of the passages 26 and conducts these gases to an outlet chamber 32 which is connected by means of an outlet fitting 34 to any suitable exhaust pipe leading to atmosphere.

The muffler 20 has a shell 36 of sheet metal or other suitable material which encloses sound absorbing and heat resistant material 38, such, for example, as stainless steel wool or glass wool. The shell 36 is provided with a multiplicity of small openings 40 connecting the interior of the muffler shell with the gas passages 26 and forming acoustic couplings through which sound may pass from the gas into the interior of the muffler and there be absorbed by the glass wool or other material 38.

The heat exchanger 22 is enclosed in a casing 42 having a cylindrical body 44 closely fitting about the exterior of the heat exchanger. The

casing 42 has an inclined inlet 46 provided with an inlet opening 48 which is adapted to project into the air stream flowing along the wall of an airplane cabin or similar surface and acts as a ram to produce a flow of ventilating air through the casing 42. The ventilating air directed into the inlet 46 is distributed among the air passages 50 formed between the hollow fins 24 and flows downwardly in the opposite sides of these passages to the tapered outlet duct 52 from whence the heated air is discharged through an outlet opening 54 into the airplane cabin or other space to be heated. The casing 42 may be made of thin sheet metal or other relatively light and inexpensive material which can easily be fabricated to assume the form shown in the drawings.

The heat exchanger 16 is formed of a plurality of rings 56 having the configuration best shown in Fig. 4. Each of these rings has a side 58, a tip portion 60, and a base portion 62. The tip portion is provided with a radially extending flange 64 and the base portion is provided with a similar flange 66. The heat exchanger is formed by juxtaposing a plurality of rings 56 in the arrangement shown in Fig. 1 and securing adjacent flanges to each other by seam welding or in any other suitable manner.

The individual rings 56 are preferably formed of sheet metal such, for example, as stainless steel or any other suitable material and are formed by cutting and stamping annuli of sheet metal into the form shown in Fig. 3. The end of the base portion 62 is then turned outwardly by a spinning operation to form the reversely directed flange 66. The ring is then in condition for assembly with other similar rings to form a tubular heat exchanger of any desired length.

The outwardly directed base flanges 66 increase the dissipation of heat from the bases of the hollow fins and prevent these bases from attaining temperatures materially higher than the temperatures attained by the other portions of the heat exchanger. The flanges 64 also increase the dissipation of heat from the tips of the fins and I have shown the fin tips as being broader than the bases to provide a more uniform temperature throughout the heat exchanger. The shape of the fins and the sizes of the flanges 64 and 66 may be varied to satisfy different conditions of operations. The tip flanges 64 and base flanges 66 also increase the rigidity of the heat exchanger and make it possible to form this heat exchanger of extremely thin material which is highly efficient in the transfer of heat from the burned gases to the ventilating air.

In Figs. 5 and 6, I have illustrated a modified form of my invention wherein my novel heating apparatus is utilized to transmit heat from the exhaust gases of an internal combustion engine to ventilating air. In this form of my invention, the engine exhaust pipe 70 is connected to the inlet end of my finned heat exchanger 72, which may be of the same construction as the heat exchanger 22 of the previous embodiment. The outlet end of this heat exchanger is connected to a tail pipe 74 through which the cooled exhaust gases are discharged to atmosphere. The heat exchanger 72 is enclosed in a casing 76 having an inlet ram 78 and an outlet opening 80 communicating with the exterior of the cabin or other space to be heated. This casing 76 may correspond in all respects with the casing 42 of the previous embodiment.

The embodiment of Figs. 5 and 6 is not provided with a muffler and the entire interior of the tubular heat exchanger forms a passage for the exhaust gases which flow therethrough longitudinally of the heat exchanger. As the exhaust gases travel through the heat exchanger eddy currents are formed in the interiors of the hollow fins, as shown by the curved arrows in Fig. 6, and the existence of these eddy currents insures efficient heat transfer from the exhaust gases to the heat exchanger which, in turn, transfers this heat to the ventilating air.

While I have illustrated and described my novel heating apparatus as being utilized only in connection with internal combustion types of heaters and with exhaust heaters, my invention is not limited to such use but may be utilized to transfer heat between any fluids having different initial temperatures. My invention is also not to be construed as limited to the details herein shown and described, since it may assume numerous other forms and is to be considered as including all variations and modifications falling within the scope of the appended claims.

I claim:

1. Heating apparatus, comprising a tubular heat exchanger, means connected to one end of said heat exchanger for supplying hot gases to the interior of said heat exchanger, and a casing surrounding said heat exchanger and providing a passage for ventilating air therebetween, said casing having a tapered inlet terminating in an opening at one end of the casing and an oppositely tapered outlet terminating in an outlet opening at the other end of said casing, said heat exchanger comprising a plurality of annularly arranged hollow fins having tips and bases and annularly arranged radially extending flanges intermediate said hollow fins and integral with the bases thereof.

2. Heating apparatus, comprising a tubular heat exchanger having one end connected to an engine exhaust pipe for supplying hot gases to the interior of said heat exchanger, a casing surrounding said heat exchanger and providing a passage for ventilating air therebetween, said casing having a tapered inlet terminating in an opening at one end of the casing, and an oppositely tapered outlet terminating in an outlet opening at the other end of said casing, said heat exchanger comprising a plurality of annularly arranged hollow fins having tips and bases and annularly arranged radially extending flanges intermediate said hollow fins and in heat transmitting relation with the bases thereof.

3. Heating apparatus comprising a combustion chamber, a tubular heat exchanger into which said combustion chamber discharges hot gases of combustion, said heat exchanger having annular hollow fins, a muffler located in said heat exchanger and having inclined upper and lower portions forming, respectively, a passage for admitting hot gases from said combustion chamber to the interior of said hollow fins and for discharging gases from said hollow fins to atmosphere, said muffler and hollow fins providing a plurality of semi-circular passages for the gases of combustion, and a casing enclosing said heat exchanger, said casing having a tapered inlet passage for ventilating air tapering in the same direction as said gas inlet passage, said casing also having a tapered outlet passage for ventilating air tapering in the same direction as said gas outlet passage, said casing and heat ex-

changer providing a plurality of arcuate passages for ventilating air between said fins.

4. Heating apparatus comprising a combustion chamber, a tubular heat exchanger into which said combustion chamber discharges hot gases of combustion, said heat exchanger having annular hollow fins provided with flanges at their tips and bases, a muffler located in said heat exchanger, said muffler and hollow fins providing a plurality of semi-circular passages for the gases of combustion, and a casing enclosing said heat exchanger, said casing having a tapered inlet passage for ventilating air and a tapered outlet passage for ventilating air, said casing and heat exchanger providing a plurality of arcuate passages for ventilating air between said fins.

5. Heating apparatus comprising a combustion chamber, a tubular heat exchanger into which

said combustion chamber discharges hot gases of combustion, said heat exchanger having annular hollow fins with annular flanges integral with their bases, a muffler located in said heat exchanger and having inclined upper and lower portions forming, respectively, a passage for admitting hot gases from said combustion chamber to the interior of said hollow fins and for discharging gases from said hollow fins to atmosphere, said muffler and hollow fins providing a plurality of semi-circular passages for the gases of combustion, and a casing enclosing said heat exchanger, said casing having inlet and outlet passages for ventilating air, said casing and heat exchanger providing a plurality of arcuate passages for ventilating air between said fins.

SEYMOUR E. HEYMANN.