

Nov. 11, 1941.

V. O. BEAM

2,262,158

HEAT EXCHANGER

Original Filed Jan. 5, 1937

2 Sheets-Sheet 1

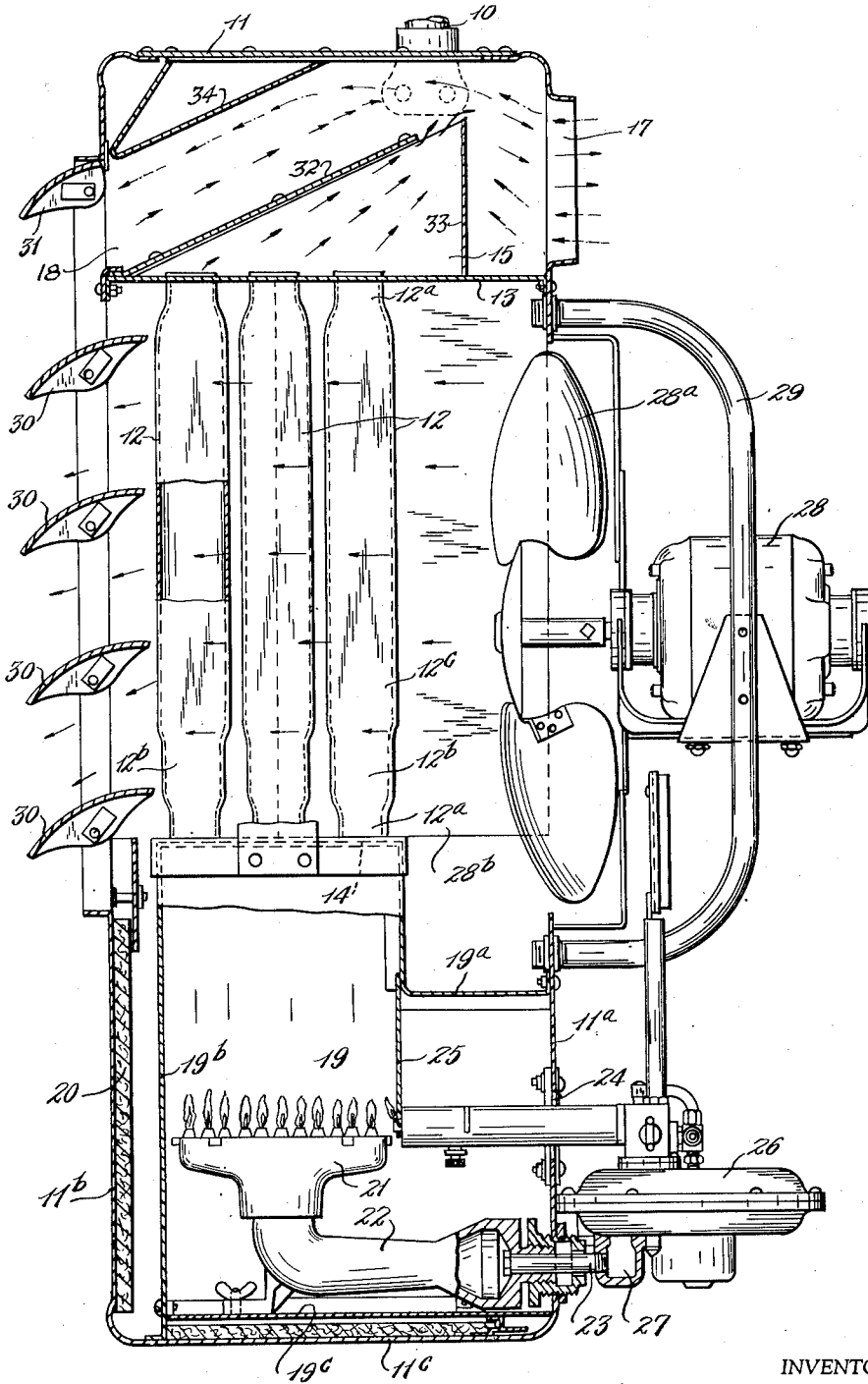


FIG. 1

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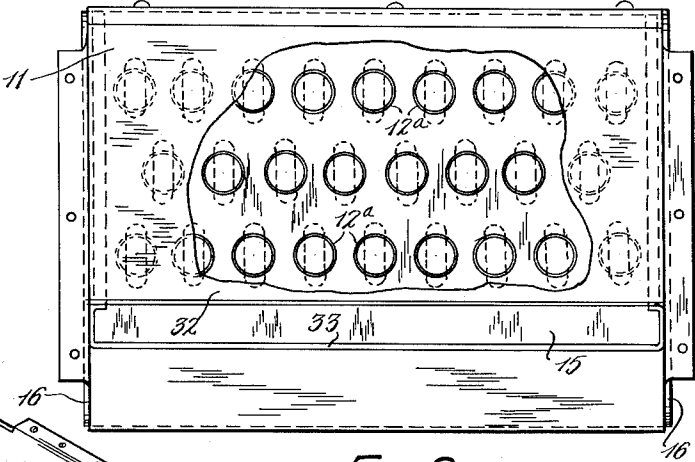


FIG. 2

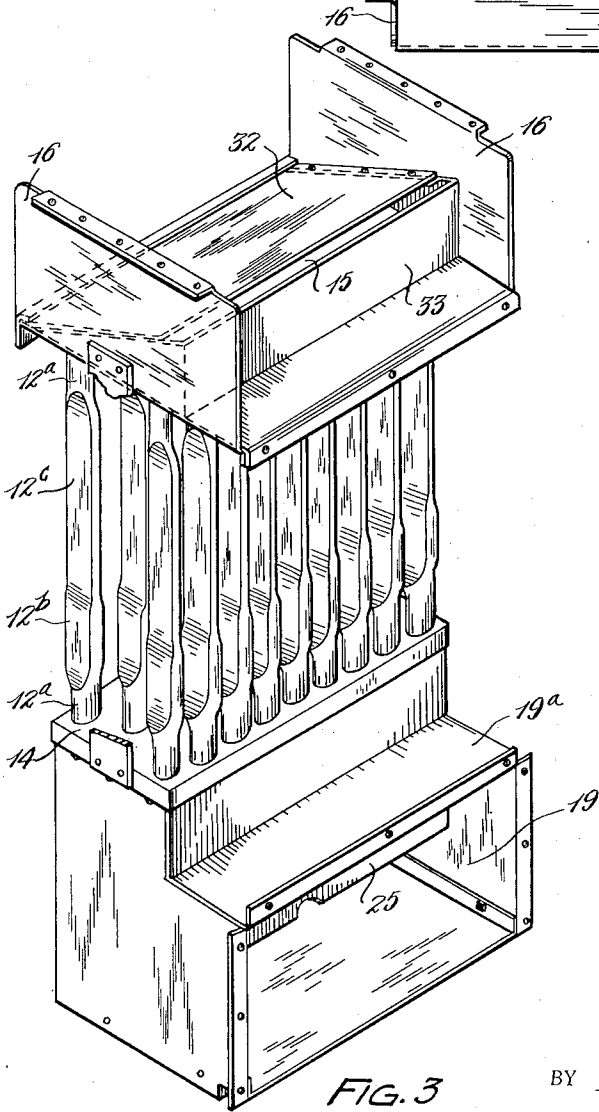


FIG. 3

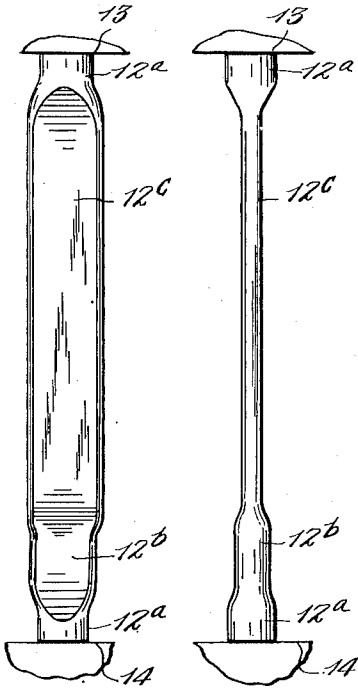


FIG. 4

FIG. 5

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2,262,158

HEAT EXCHANGER

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Original application January 5, 1937, Serial No. 119,119. Divided and this application August 1, 1939, Serial No. 287,763

5 Claims. (Cl. 257-262)

This invention relates to a heat exchanger intended primarily for use in gas heating equipment. It is illustrated herein as applied to what is known in the art as a unit heater. The present application is a division of my copending application Serial No. 119,119, filed January 5, 1937, which has matured into Patent 2,190,349, issued February 13, 1940.

One of the objects of the invention is the provision of a heat exchanger in the form of a flattened or stream-lined tube so shaped as to be highly efficient in the transfer of heat from hot gases passing through the tube to the walls thereof and from the walls of the tube to a stream of air passing over or around the tube.

Another object is the provision of a heat exchanger tube of the character stated of such form that the scrubbing action of the hot gases and the wiping action of the outside air shall increase as the temperature of the gases in their flow through the tube decreases.

A further object of the invention is the accomplishment of the above stated objects by the simple deformation of a cylindrical tube in its intermediate portions, the end portions being left round so as to facilitate mounting in headers.

Other objects and features of novelty will appear as I proceed with the description of that embodiment of the invention which, for the purposes of the present application, I have illustrated in the accompanying drawings, in which

Fig. 1 is an elevational view partly in vertical section of a unit heater embodying the invention.

Fig. 2 is a plan view with a portion of the upper header broken away.

Fig. 3 is a perspective view of a series of heat exchanger tubes assembled with a combustion box or casing and a flue collector, and

Figs. 4 and 5 are side front views respectively of a tube embodying the invention.

In the drawings I have illustrated one unit only of what may be employed either as a single unit or as a multiple unit heater, depending upon the requirements of the premises to be heated. Heaters of this kind are generally, although not necessarily, suspended from the ceiling or from some other overhead support, and in this instance suspension rods 10 at either side of the heater are shown attached to the upper ends of the sheet metal casing 11, which casing may enclose either one or a plurality of joined units and may in part at least be composed of the casing walls of individual sections or units.

A multiple section heater of two or more sections includes heat exchangers which are the

same for all of the sections, each section including a series of heat exchanger tubes, provided at the top and bottom with headers, and including further a combustion chamber at the bottom and a flue collector at the top, as will be seen by reference to Figs. 1 and 3. These parts of the heater form a self-contained unit two or more of which may be arranged side by side to form a multiple section heater.

Each section of the heater includes a plurality of rows of similar tubes 12 of novel form. These tubes may be said to be stream-lined. In other words they are flattened in the direction of air flow. However they are flattened between their ends only, their ends being round as shown at 12a and being fitted into and secured in round holes in the upper header 13 and the lower header 14, thus greatly facilitating assembly. Furthermore they are not uniformly flattened, but the flattening is done so as to obtain diminishing interior cross sectional area and consequently diminishing interior volume toward the upper end of the tubes. The flattening is preferably in two or more stages, the two-stage flattening being shown at 12b and 12c and the portion 12c being flattened to a greater degree and therefore having its interior cross sectional area decreased with respect to that of the lower flattened portion 12b. Hence as the temperature of the products of combustion decreases in their upward flow through the tubes the internal cross section of the tube is decreased by the increased flattening, thereby increasing the so-called scrubbing action within the tube and at the same time providing a form which exteriorly obtains the most effective wiping action of the cooling air currents passing around the flattened surfaces of the tube and therefore affording maximum heat transference from the heated products of combustion to the tube and from the tube to the air which is blown by the fan or blower at the rear of the casing forwardly across the surfaces of the tubes. The tubes of the several rows are preferably staggered so as to further increase the efficiency of the heat transference.

The upper header 13 forms the bottom wall of a flue collector 15 constituting an outlet chamber for the products of combustion flowing upwardly through the tubes 12. The ends 16 of the chamber 15 are preferably formed by bending upwardly the ends of the sheet metal plate forming the upper header 13, and the top, front and rear walls of the compartment enclosing chamber 15 are formed by portions of the outer casing 11, the rear wall being provided with an outlet or flue

opening 17 for the products of combustion, this opening being generally round and the front wall of the compartment being provided with a relief opening 18 and being horizontally elongated and extending substantially entirely across the front of the section.

At the bottom of the unit is a combustion chamber 19 which also, as previously stated, constitutes a part of the unit, the lower header 14 forming the top of the combustion chamber. This combustion chamber when viewed from the side is L-shaped in cross section, being provided with a rearward extension 19a which is attached to the rear wall of the casing, which wall is preferably composed of a series of plates 11a, one for each section. The front wall 19b of the combustion chamber is spaced from the front 11b of the casing 11 and may be separated therefrom by insulation 20. Likewise the bottom wall 19c of the chamber 19 is spaced from the bottom 11c of the casing and may be separated therefrom by insulation.

In the lower part of each combustion chamber there are one or more main burners 21 to each of which is connected a mixing tube 22 to which gas is supplied by a spud 23, the primary air being supplied to the tube in the usual manner. Secondary air is supplied through suitable grilles 24 fitted into the rear wall of the casing, there being a vertical baffle 25 extending downwardly from the upper part of the combustion chamber across the same so as to direct the secondary air downwardly to a level beneath the burner openings.

A valve, preferably in the form of a diaphragm valve 26, controls the flow of gas to the burner or burners 21. In the case of a multi-section heater this valve discharges gas into a manifold 27 to which the spuds 23 are connected.

Each section of the heater has its own fan or blower and motor for driving the same. The motor is designated 28 and is individually supported by brackets 29 on each rear plate 11a of the casing, and on the forward end of each motor shaft is a fan or blower 28a which is adapted to rotate in a circular opening provided in the corresponding rear casing plate 11a directly behind the tubes of the heat exchanger unit so that the air will be blown across the same and will be heated in the manner already explained and driven out through a large rectangular opening at the front of the section. This opening is traversed by a plurality of adjustable curved louvres 30 which are pivoted at their ends so that the direction in which the heated air is delivered to the room may be varied. In order that cross currents may not occur inside the casing and so that each blower will impel the air forwardly across the heat exchanger tubes the tubes of different sections are separated by vertical partitions 28b which extend the full length of the tubes and from the rear wall of the casing forwardly toward the front of the casing, but preferably they terminate a short distance from the front of the casing.

Directly above the louvres 30 of each section and immediately above the relief opening 18 there is a fixed or false louver 31 which matches the louvres 30, thus substantially concealing the relief opening 18 at the front of the heater.

It will be seen particularly from Fig. 1 that extending across the chamber 15 above the outlet openings of the tubes 12 of each heat exchanger there is an inclined baffle 32 which ex-

tends upwardly and rearwardly from the lower front part of the chamber 15. Likewise it will be seen that rearwardly of the outlet openings of the tubes 12 is an upright baffle 33, the upper end terminating slightly to the rear of and slightly above the upper rear edge of the baffle 32, leaving at the top an outlet opening for the products of combustion which normally flow out through the outlet or flue opening 17, and at the same time the draft is relieved by air flowing into the front opening 18 over the baffle 32, the flow of air from the opening 18 and the flow of the products of combustion being indicated by the solid arrows of Fig. 1. However, should a down-draft occur, it will be relieved so far as any effect on the burners is concerned by passing downwardly and forwardly in the direction of the broken line arrows of Fig. 1 and out through the relief opening 18 at the upper front part of the heater. There is preferably provided at the upper front corner of the chamber 15 an inclined guide 34 to direct the air out through the relief opening 18, this in effect forming a continuation of the false louver 31 and being parallel to the baffle 32 so as to form an unobstructed downwardly and forwardly extending passageway for the relief of the down draft.

As the heated products of combustion pass upwardly through a tube 12 they gradually lose heat, but with applicant's construction there is a maximum amount of heat transference to the air passing crosswise of the exterior of the tube because, more or less in conformity with the loss of heat in the products of combustion, the rate of exchange is accelerated by gradually, or in stages, reducing the cross sectional area of the tube without decreasing the exterior surface and at the same time increasing the effectiveness of the wiping action of the air currents passing crosswise of the tube. As the products of combustion lose their heat in passing upward a larger portion of the products of combustion is caused to contact with the interior walls of the tube, due to the gradual change in tube shape, and at the same time a greater proportion of the exterior surface of the tube is subjected to the wiping action of the air being heated. The latter effect is due to the fact that dead air space behind a round tube is much greater in extent than that behind a flattened tube.

Having thus described my invention, I claim:

1. A heat exchanger tube through which hot gases are adapted to be passed from the lower to the upper end thereof and across which air to be heated is adapted to be blown, said tube having round ends adapted to be fitted into headers and having stream-lined intermediate portions flattened so as to provide diminishing cross sectional area from the lower round part to the upper flattened part and increasing flattened surface areas from the lower flattened part to the upper flattened part, the perimeter of the tube at all heights being of uniform length.

2. A heat exchanger tube through which hot gases are adapted to be passed from the lower to the upper end thereof and across which air to be heated is adapted to be blown, said tubes having round ends adapted to be fitted into headers and having stream-lined intermediate portions flattened in a plurality of stages, each stage above the first having a cross sectional area smaller than that of the stage next below and a greater flattened surface area, and the

perimeter of the tube in the different stages being of the same length.

3. A heat exchanger tube through which hot gases are adapted to be passed and across which air to be heated is adapted to be blown, said tube being flattened in the direction of air flow, the degree of flattening varying lengthwise of the tube in such manner that the volumetric capacity of the flattened portion of the tube is greater at one end than at the other end while the exterior surface for a given length of flattened portion remains the same.

4. A heat exchanger tube through which hot gases are adapted to be passed and across which air to be heated is adapted to be blown, said tube being formed from cylindrical tubing of constant diameter flattened intermediate its

ends in the direction of air flow, the degree of flattening at one end of the flattened portion being greater than that at the other end thereof.

5. A heat exchanger tube through which hot gases are adapted to be passed and across which air to be heated is adapted to be blown, said tube being formed from cylindrical tubing of constant diameter flattened intermediate its ends in different stages progressively, the degree of flattening of the stage adjacent the entrance end of the tube being less than the degree of flattening of the stage adjacent the exit end thereof, whereby the heating effect upon the air stream flowing over the tube may be substantially equalized over the length of the flattened portion thereof.

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