July 26, 1927. 1,637,276

J. FORGAN-POTTS

HEAT EXCHANGING APPARATUS

Filed Aug. 8, 1925

Fig. 1.

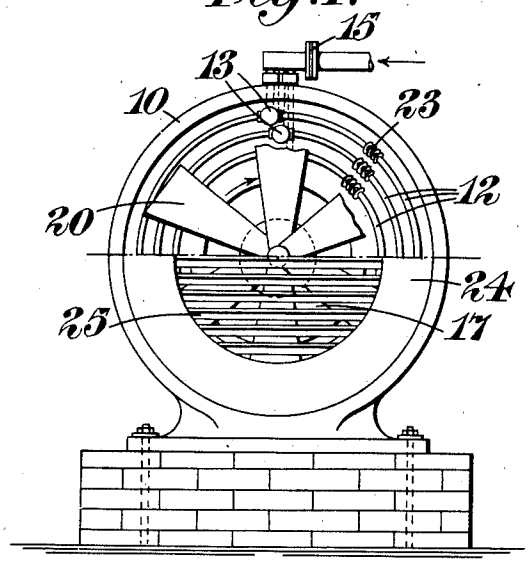


Fig. 3.

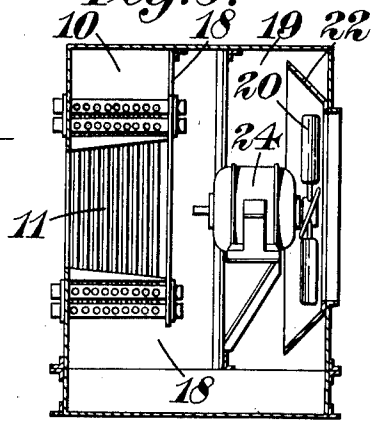
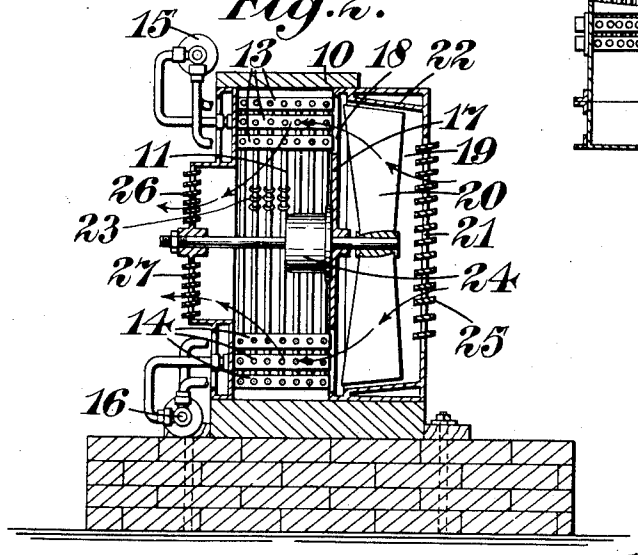


Fig. 2.



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HEAT-EXCHANGING APPARATUS.

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This invention is for improvements in or relating to heat-exchanging apparatus in which heat is to be transferred to or from a gas, such as air, and another fluid, such for example, as steam or hot water. The object of the invention is to provide a construction of apparatus in which the maximum heat-transferring surface is contained within the smallest space whilst maintaining at the same time a low resistance to the flow of the gas. Other advantageous features of the construction as hereinafter described are low first cost, simplicity, accessibility and small number of working parts, and that the apparatus as a unit can work in any position.

According to this invention, there is provided in heat-exchanging apparatus, the combination of a casing, a bank of circularly bent tubes disposed in a cylindical formation therein, heat-transmitting vanes secured on the said tubes and each inclined to the axis of its tube and also inclined to the axis of the bank of tubes so as to lie in substantially spiral formation about the latter axis, a fan situated at one end of the bank of tubes and delivering air thereto through a casing which is conical about the axis of the fan, and an outlet for the air at the other end of the tube-containing casing.

According to another feature of this invention the fan aforesaid is mounted in a chamber adjacent to and coaxial with the tube-containing casing and communicates therewith by an annular opening in the wall separating them.

According to yet another feature of this invention, the power unit for the fan may be mounted in such a position, for example, inside the bank of tubes, that the air flows over it and cools it.

Preferably, also, the inlet and/or the outlet openings for the air are provided with controlling valves, for the purpose hereinafter set forth; these valves may take the form of louvres arranged to direct the air in its desired path of flow.

In the accompanying drawings, which illustrate diagrammatically two arrangements in accordance with this invention—

Figure 1 is an end view partly in section of a heat-exchanging unit,

Figure 2 is a longitudinal section of Figure 1, and

Figure 3 is a similar view of a modified construction.

Referring first to the construction illustrated in Figures 1 and 2, the apparatus comprises a cylindrical casing 10 within which there is arranged a bank of tubes indicated generally by the reference 11. This bank is made up of three co-axial cylindrical layers of circularly-bent tubes 12; the tubes of each layer are connected to headers 13 at the top of the bank and to similar headers 14 at the bottom of the bank. The respective groups of headers are connected to supply- and delivery-mains 15, 16 respectively, so that steam or other heating or cooling medium can be circulated through the bank of tubes. It will be seen that the semi-circular bending of the individual tubes between the headers accommodates any expansion or contraction of the tubes which may take place, rendering unnecessary the provision of any expansion joints or the like.

The chamber 10 containing the bank of tubes is provided with an end wall 17 in which there is an annular opening 18 by which communication is provided with a second chamber 19 which is coaxial with the chamber 10. Within this chamber 19 there is provided a fan 20 which is of the propeller or axial-flow type; it is arranged to draw in air through an opening 21 in the end wall of the chamber 19 and to deliver it through the opening 18 into the tube-containing chamber 10. This propeller type of fan is used on account of its ability of dealing with large volumes of air at a comparatively low delivery pressure for a small amount of power expenditure. With such fans, however, the delivery is not purely axial, for there is a centrifugal component present. There is therefore provided around the fan a guide or casing 22 which is conical about the axis of the fan with its larger end on the delivery side thereof. This arrangement provides an easy path of flow of air leaving the fan, so that it is directed into the tube-containing chamber 10 without shock or violent change of direction, retaining its normal rotary and axial movement.

The path of air-flow from the fan may be described as a spiral one about the axis of the fan, and it is with relation to this spiral path of flow that heat-transmitting vanes are disposed on the tubes 12 as shown in Figure 2. The vanes are each secured on the tubes so as to lie in substantially spiral formation about the axis of the bank of tubes, or of the fan, in the same way as the spiral path of flow of the air, so that the vanes present only an edge to the air-flow and thereby offer the minimum resistance thereto, some of these vanes being shown at 23 in Figure 1.

The fan 20 is conveniently driven by an electric motor 24 which is situated in such a position that it is more or less in the path of flow of the air from the fan, so that it is effectively cooled thereby. As shown in Figure 2, it is situated inside the bank of tubes 11.

The inlet-opening 21 to the fan-chamber 19 is provided with controlling louvres or shutters 25, and the outlet-opening 26 at the other end of the tube-containing chamber may be similarly provided with shutters 27 so that the flow of air through the apparatus can be controlled in accordance with the requirements. For example, if it is required to be heated to a considerable extent, it can be retained in contact with the tubes 12 by partial closing of the shutters 27 on the outlet. The shutters 25 may if desired be so disposed as to direct the entering air along a path which facilitates its entry into the zone swept by the fan blades, for the purpose of reducing the power required in driving the fan.

In the modified arrangement shown in Figure 3, the general construction is the same, but there are shown only two layers of tubes in the bank of tubes 11, and the fan 20 is spaced somewhat further from the annular opening 18 communicating with the tube-containing chamber 10. The fan-motor 24 is situated in the fan-chamber 19, so that the air flows across it to cool it prior to passing through the opening 18 aforesaid. Also, in this case the conical casing 22 is shown as of a more acute angle of conicity.

It is to be understood that the invention is not limited to the exact shapes and arrangement of parts illustrated, for these are obviously capable of modification within the scope of the present invention, and it will be seen that the invention provides a heat-transferring unit which is capable of a high volumetric efficiency owing to the very low resistance offered to the flow of air through it.

Other advantages which may be noted are that if the fan-blades are made symmetrical, the direction of flow of air may be reversed without complicated reversing dampers, merely by reversing the direction of rotation of the motor. The design, from a commercial point of view, is simplified, in that a unit can be arranged to deal with largely differing volumes of air simply by varying the number of blades on the fan, and this feature also simplifies the design when the fan speeds are limited by other factors, such for example, as the driving of the fan by a polyphase motor. The high volumetric efficiency of the unit is assisted by the cylindrical formation of the bank of tubes, with the annular opening thereto, since the path of flow of the air is completely symmetrical with respect to the fan. Finally, the unit is complete in itself, and need not necessarily be arranged with its axis horizontal, for it can be suspended or mounted in any position to suit any particular circumstances. The casing need not necessarily be cylindrical as to its external form, for if it is desired to attach it to columns or wall-brackets, a rectangular shape may be more convenient.

What I claim as my invention and desire to secure by Letters Patent is:—

1. In heat-exchanging apparatus the combination of a casing, a bank of circularly-bent tubes disposed in a cylindrical formation therein and occupying a circumferential space between the internal periphery of the casing and the internal periphery of the bank of tubes, which casing has at one end a wall having an annular opening that registers with one end of said circumferential space, and at the other end a wall that closes the other end of the said circumferential space and has an outlet registering with said bank of tubes, a fan of the propeller or axial-flow type situated at the first end wall outside the casing, a second casing which surrounds said fan and is conical about the axis of rotation of the fan and is arranged to direct a whirling current of air delivered by the fan through the said annular opening to said circumferential space, and heat-transmitting vanes provided on said tubes and inclined each to the axis of its tube and also inclined to the longitudinal axis of the bank of tubes so as to lie in substantially spiral formation about the latter axis, substantially as described.

2. In heat-exchanging apparatus the combination of a casing, a bank of circularly-bent tubes disposed in a cylindrical formation therein and occupying a circumferential space between the internal periphery of the casing and the internal periphery of the bank of tubes, which casing has at one end a wall having an annular opening that registers with one end of said circumferential space, and at the other end a wall that closes the other end of the said circumferential space and has an outlet registering with said bank of tubes, a fan of the propeller or axial-flow type situated at the first end wall outside the casing, a second casing which sur-

rounds said fan and is conical about the axis of rotation of the fan and is arranged to direct a whirling current of air delivered by the fan through the said annular opening to said circumferential space, a power unit for driving the fan situated, for the purpose described, at the same side of the fan as the said bank of tubes is situated, and heat-transmitting vanes provided on said tubes and inclined each to the axis of its tube and also inclined to the longitudinal axis of the bank of tubes, substantially as described.

In testimony whereof I affix my signature.

JOHN FORGAN-POTTS.