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HEAT EXCHANGER WITH ADJUSTABLE CASING FOR VARYING RECIRCULATION

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Fig. 1.

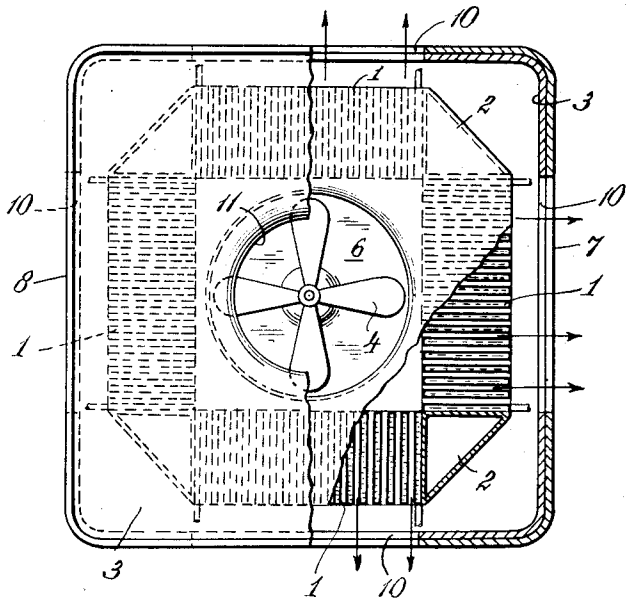
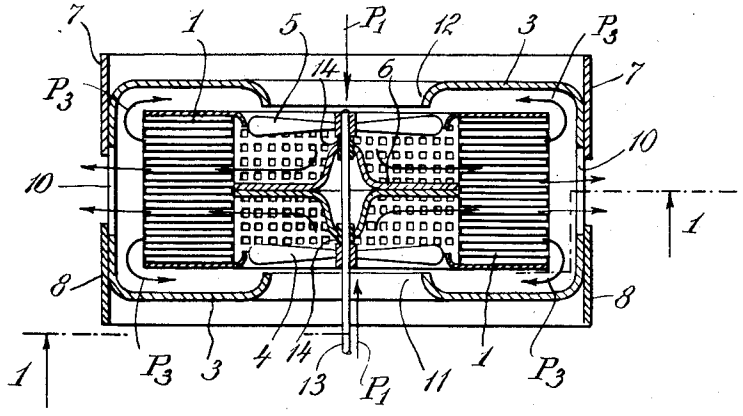


Fig. 2.



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HEAT EXCHANGER WITH ADJUSTABLE CASING FOR VARYING RECIRCULATION

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6 Claims. (Cl. 257—137)

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This invention relates to heat exchangers of the type in which air or some other gas is propelled through a finned tube or cellular radiator structure in which water or some other liquid flows through passages in order to effect an exchange of heat between the liquid and air or gas flowing over the fins or between the cells. Heat exchangers of this type are used, for example, as radiators in automobiles for cooling water that is circulated through the jackets of the motor. They are also used to transfer heat from a circulating stream of hot water to a current of air used to heat rooms or other enclosed spaces.

The present invention relates particularly to heat exchangers of the type indicated in which the radiator is of annular shape and in which a current of air or other gas is propelled radially through the radiator structure.

It is an object of the invention to provide a heat exchanger of the type described which has a particularly high efficiency of operation.

A further object of the invention is the provision of a highly efficient heat exchanger of the type described which has such a low overall physical height that it may be installed in locations where only limited height is permissible, as for example under the seats of passenger carrying vehicles.

Another object of the invention is the provision of a heat exchanger of the type described, the efficiency and output of which may be readily controlled by simple externally accessible means.

A particular object of the invention in one of its more limited aspects is the provision of a heat exchanger in which the heat exchanging unit is made up of a plurality of rectangular radiator sections arranged in substantial contact with each other in the form of a square or polygon and interconnected by intermediate angular corner members of wedge-shaped cross-section.

In a preferred embodiment of the invention, my improved heat exchanger includes a shroud or casing which encloses the annularly arranged radiator sections and is spaced therefrom to act as a guiding duct or passage which returns a part of the air passed through the radiator sections to the suction zone of a blower located within the annularly arranged sections so that the part of the air so returned is recirculated outward radially through the radiator sections that surround the blower. I have discovered that with this arrangement a given heat transfer can be obtained with the expenditure of less energy to propel the air than if the described recirculation was not provided. This result is surprising and unexpected, since it would normally be supposed that the recirculation of air through the radiator would in itself consume increased energy, and also that the preheating of some of the air would of necessity result in a drop in the amount of heat transferred at a given rate of air flow.

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A further advantage of the heater construction of the invention is that it makes possible the easy control of the amount of heat transferred by the adjustment of the amount of air that is returned for recirculation through the radiator sections. The location of the blower within the annularly arranged radiator sections provides a very compact construction. Furthermore, the device operates without substantial noise if, instead of a standard centrifugal blower, two air propellers are located to turn about the axis of the annularly arranged radiator sections, with the propellers having opposite pitch so as to force air toward each other.

In describing the invention in detail, reference will be made to the accompanying drawing, in which an embodiment thereof is illustrated.

In the drawing:

Fig. 1 is a sectional plan view of a heat exchanger embodying the invention taken along the line 1—1 of Fig. 2 and viewed in the direction of the arrows; and

Fig. 2 is a sectional elevation of the device shown in Fig. 1.

The annular radiator structure may comprise several substantially rectangular cellular or finned tube-type radiator sections 1 connected to one another at their ends by the wedge-shaped corner members 2 to form an annulus of radiator sections through which air or other gas may pass radially outward from the central open space. The annular structure shown is in the form of a regular polygon which may be a square, as illustrated, or may be a pentagon or a hexagon, as desired. Hot water or other liquid medium for heat exchange is suitably circulated through the several radiator units 1 in any known manner. A casing 3 surrounds and is spaced radially from the annulus of radiator sections 1 and is provided with side openings 10 through which a portion of the air drawn into the central casing openings 11 and 12 by the propellers 4 and 5 is expelled. The propellers 4 and 5 are of opposite pitch so as to force two streams of air inward through the openings 11 and 12 toward each other. The propellers are mounted on a central shaft 13 disposed substantially axially

of the annularly arranged radiator sections 1, which shaft is journalled in suitable bearings 14 in an air directing baffle 6. The baffle 6 is formed as shown to direct the streams of air driven by the propellers 4 and 5 radially outward through the radiator sections 1 and the side openings 10 of the casing. The shaft 13 may be driven by an electric motor or other means, not shown. The casing side walls above and below the side openings 10 limit the amount of the total air emerging from the units 1 that is expelled from the casing 3, and act with the end walls of the casing as a guiding duct system to return a substantial part of such air to the suction zones outside the propellers 4 and 5, as shown by the arrows P_3. This returned portion of the air is there mixed with the incoming fresh air drawn in through the central openings 11 and 12 in the direction of the arrows P_1, and the mixed air is then forced radially outward through the sections 1.

In order to make the output of the device adjustable without change in speed of operation of the propellers 4 and 5, the casing may be provided with cylindrical sleeves 7 and 8 which telescopically engage and may be slidably moved along the side walls of the casing. These sleeves 7 and 8 act as means for adjustably altering the area of the casing side openings 10. By sliding the sleeves 7 and 8 toward each other so as to partially close the casing side openings 10, the proportion of air from the radiator units 1 which is returned for recirculation therethrough in the direction of the arrows P_3 is increased with a corresponding reduction in the amount of air expelled from the unit between the adjacent edges of the sleeves through the openings 10.

It has been determined by test that with a constant predetermined output of the propellers 4 and 5 and a given temperature difference between the fresh air and the hot water or other medium flowing through the radiator sections 1, there is an adjusted position of the sleeves 7 and 8 in which a maximum amount of heat transfer to the air occurs. It has further been determined that this maximum amount of heat transfer substantially exceeds the highest value of heat transfer obtainable for the same output of the propellers if the casing 3 is removed from the device, even if the radial depth of the radiator sections 1 is increased. In other words, this maximum amount of heat transfer represents a value which is obtainable without the return flow feature of the present invention only by increasing the output of the propellers 4 and 5, that is, by increasing the amount of energy required to operate the device.

Although the invention is not in any way dependent upon the accuracy of any theory herein expressed, it is believed that the increased operating efficiency of my improved heat exchanger arises from the following considerations. The amount of heat transferred is proportional to the product of the radiator surface area and the amount of air moved through the radiator in a given time interval. In order to move a given quantity of air through a radiator of given cross-section, a certain input air velocity is required. The air flow energy consumed in passing this air through the radiator rises with the third power of the air velocity. By moving the air at a relatively low velocity and recirculating part of this air through the radiator sections several times, the flow energy consumed in passing the air through the radiator sections is kept

at a low value, while the amount of heat transferred between the radiator sections and the air is maintained at the desired value by recirculation.

The heat exchange device of the present invention has proved to be highly successful both as a heating device for heating the air in rooms and other enclosed spaces and particularly in vehicles, and as a cooling device for cooling gas or liquid and particularly as a cooler of water used in internal combustion engines. The device is useful as a heat exchanger for other purposes as well.

I claim:

1. A heat exchanger comprising an annular radiator surrounding a central space, a casing surrounding and spaced from the annular radiator and having at least one central opening adjacent the central space of the annular radiator and at least one side opening adjacent and radially aligned with the outer face of the annular radiator, and an air propeller disposed within said central space of the radiator for forcing air drawn through said central opening and air returned by said casing radially outward through said annular radiator.

2. A heat exchanger comprising an annular radiator surrounding a central space and made up of a plurality of straight radiator sections arranged end to end in the form of a regular polygon, a casing surrounding and spaced from the annular radiator and having central openings adjacent said central space and side openings radially aligned with and adjacent a part of the outer face of the annular radiator, said casing acting to return a part of the air propelled outward through the annular radiator to said central space, and an air propeller disposed within said central space of the radiator for forcing air drawn in through said central openings and air returned by said casing radially outward through said annular radiator.

3. A heat exchanger comprising an annular radiator surrounding a central space, a casing surrounding and spaced from the annular radiator and having central openings adjacent the central space of the annular radiator and side openings adjacent and radially aligned with the outer face of the annular radiator, said casing acting to return a part of the air propelled outward through the annular radiator to said central space adjacent said central opening, and two spaced propellers of opposite pitch rotatably mounted coaxially within said central space of the radiator and respectively disposed adjacent said central casing openings for forcing air drawn in through said central openings and air returned by said casing radially outward through said annular radiator.

4. A heat exchanger comprising an annular radiator surrounding a central space, a casing surrounding and spaced from the annular radiator and having central openings adjacent the central space of the annular radiator and side openings adjacent and radially aligned with the outer face of the annular radiator, said casing acting to return a part of the air propelled outward through the annular radiator to said central space adjacent said central openings, two spaced propellers of opposite pitch rotatably mounted coaxially within said central space of the radiator and respectively disposed adjacent said central casing openings for forcing air drawn in through said central openings and air returned by said casing radially outward through

said annular radiator, and an air baffle disposed in said central space between said propellers for directing air from said propellers radially outward from said central space.

5. A heat exchanger comprising an annular radiator surrounding a central space, a casing surrounding and spaced from said radiator and having central openings adjacent the ends of said central space and side openings adjacent and radially aligned with the outer face of said annular radiator, said casing acting to return a part of the air propelled radially outward through said annular radiator to said central space adjacent said central openings, at least one air propeller disposed within said central space of said radiator for forcing air drawn in through said central openings and air returned by said casing radially outward through said annular radiator, and means for adjustably altering the area of said casing side openings.

6. A heat exchanger comprising an annular radiator surrounding a central space, a casing surrounding and spaced from said radiator and having central openings adjacent the ends of said central space and side openings adjacent and

radially aligned with the outer face of said annular radiator, said casing acting to return a part of the air propelled radially outward through said annular radiator to said central space adjacent said central openings, at least one air propeller disposed within said central space of said radiator for forcing air drawn in through said central openings and air returned by said casing radially outward through said annular radiator, and sleeves slidably disposed on said casing and adjustably movable over said casing side openings to adjustably alter the area thereof.

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