Nov. 8, 1960 R. J. PAYTON 2,959,035

AIR CONDITIONING APPARATUS

Filed Dec. 21, 1959

FIG. 1

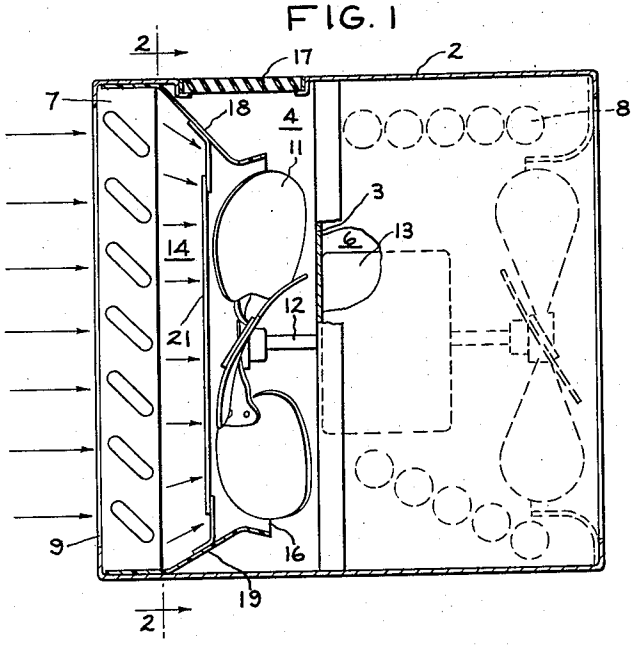
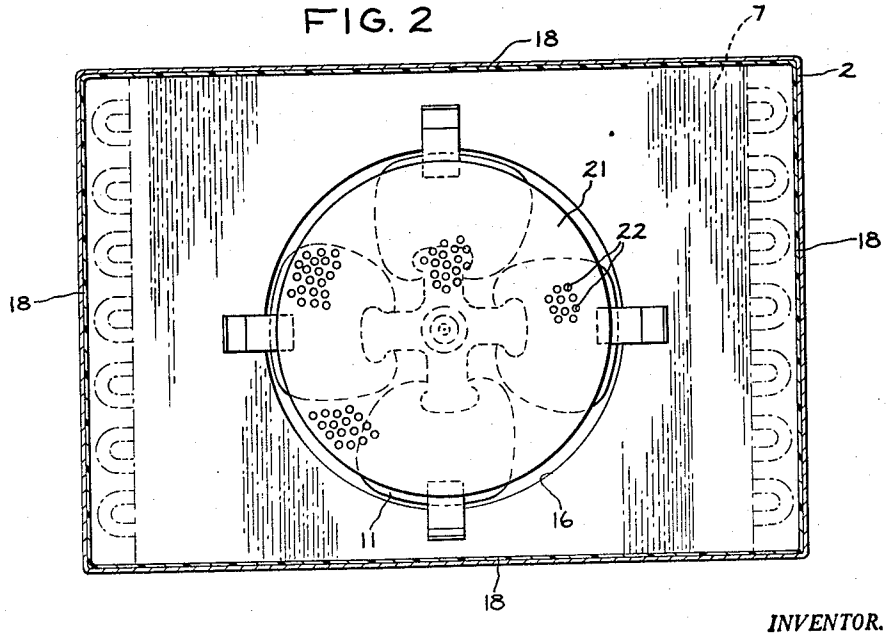


FIG. 2



INVENTOR.

ROBERT J. PAYTON

BY Gerd L. Mellhoff

HIS ATTORNEY

United States Patent Office 2,959,035 Patented Nov. 8, 1960

2,959,035

AIR CONDITIONING APPARATUS

Robert J. Payton, Louisville, Ky., assignor to General Electric Company, a corporation of New York

Filed Dec. 21, 1959, Ser. No. 860,813

1 Claim. (Cl. 62—426)

The present invention relates to and has for its principal object an improved arrangement in an air conditioning apparatus for providing uniform distribution of air flowing over the heat exchanger surfaces.

In accordance with the present invention there is provided an air conditioning apparatus of the self-contained type arranged within a casing disposed in an outer wall of an enclosure. The apparatus includes a refrigeration system having at least one heat exchanger over which an air stream is circulated by a fan positioned a short distance downstream from the heat exchanger. The cross-sectional area of the heat exchanger normal to the air stream is substantially greater than the overall area of the fan normal to the air stream. In order to promote a more uniform distribution of air flow through the heat exchanger, a perforated panel is positioned directly across the air stream between the fan and the heat exchanger. The panel promotes a substantially uniform pressure drop in the region just downstream from the heat exchanger thereby creating uniformity of air flow through the heat exchanger.

For a better understanding of the invention reference may be had to the accompanying drawing in which:

Fig. 1 is an elevation view partially in cross-section of an air conditioning apparatus incorporating the present invention; and

Fig. 2 is a cross-sectional view of the conditioner taken along line 2—2 of Fig. 1 with the heat exchanger superimposed in phantom lines to illustrate the relative areas of the fan and the heat exchanger normal to the flow of air through the conditioner.

Referring now to Fig. 1, there is shown a room air conditioner of the self-contained type, adapted to be mounted in a wall of a room for conditioning the air within the room, and embodying the fan and heat exchanger arrangement of the present invention in its preferred form. It will be understood that, although the fan arrangement is particularly well adapted for use in room air conditioning units, this is only one of many possible applications for the arrangement and it is not intended to be limited to such use. The air conditioner includes a casing 2 divided by a barrier 3 into inner and outer compartments 4 and 6 respectively. The casing is adapted to be mounted in an opening in the wall of an enclosure with the inner compartment 4 facing toward the enclosure and with the outer compartment 6 facing the outdoors. The unit is provided with an air conditioning system including a pair of heat exchangers 7 and 8 over which room air and outside air is passed for the purpose of conditioning the air within the enclosure. In the illustrated air conditioner, the inner compartment 4 is provided with an opening 9 in the front thereof through which air from the enclosure is circulated into the inner compartment 4.

In order to circulate air through the inner compartment 4, there is provided a fan 11 which is mounted for rotation about a horizontal axis by a shaft 12. The shaft 12 is driven by a motor 13 mounted on the barrier 3.

The fan 11 is adapted to draw air from the room through the opening 9 and over the heat exchanger 7. Air is directed into the fan 11 through the orifice 16 which forms the air outlet from the plenum chamber 14. The fan 11 forces the air stream rearwardly against the barrier 3 where it is diverted radially outward into other portions of the inner compartment 4 and finally discharged from the inner compartment 4 through the outlet grille 17 arranged in the top of the compartment. Obviously, the air does not have to be discharged through an outlet grille 17 in the top of the compartment 4. It could be discharged, for example, through an opening arranged on the front of the unit which faces the enclosure. The plenum chamber 14 is formed by walls 18 extending from the bell mouth orifice 16 to the four sides, or to the periphery of the heat exchanger 7. As may be clearly seen in Fig. 2, the walls 18 extend from the orifice 16 and are attached to all four sides of the case.

The design concept in recent years has been to make the air conditioning unit smaller and smaller and, because of this, it has been necessary to "crowd" the components of the unit closer and closer together within the casing 2. The crowding of the air moving means and the heat exchangers has resulted in an undesirable distribution of air flow through the heat exchanger which results in a reduced heat transfer capacity. In units where the fan 11 is placed as closely as 8 inches from the heat exchanger 7, there is a tendency for air flowing over the heat exchanger 7 to be pulled to a greater extent through the center portions of the heat exchanger than through the outer extremities of the heat exchanger. This is because the center portions of the heat exchanger are more directly in front of the projected area of the fan or in the air stream upon which the pressure drop created by the fan has its greatest effect. That is, for a short distance ahead of the fan most of the impelling force on the air is in the region substantially defined by the projected area of the fan. Thus, as seen more clearly in Fig. 2, there is a tendency for the air to be drawn to a much greater extent through that portion of the heat exchanger directly ahead or upstream from the fan. The uneven flow of air through the heat exchanger 7 does not take advantage of the full cooling capacity or heat transfer capacity of the heat exchanger. Also, when the heat exchanger is an evaporator, cold spots are formed in those portions of the evaporator having reduced air flow thereover and these might possibly result in an air obstructing build-up of frost.

It has been discovered that a more effective distribution of air flow over the heat exchanger 7, can be obtained by placing a perforated panel 21 upstream from the fan 11 in the plenum chamber 14. The panel is arranged in a plane normal to the air stream in the preferred embodiment of the invention. It is believed that the panel 21 produces a uniform distribution of the pressure drop in the plenum chamber 14 thereby effecting a more uniform impelling force on the air being drawn through the heat exchanger 7. In this manner the forces acting on the air stream in the heat exchanger 7 are equalized over the entire cross-sectional area of the heat exchanger thereby causing a more uniform flow thereover. The perforated panel 21 is mounted in front of the fan and slightly ahead of of the orifice opening 16. The panel may be attached to the walls 18 of the plenum chamber in any manner well known in the art, such as by welding. In the embodiment of the invention shown, the panel comprises a circular, planar member having a plurality of small perforations or holes 22 distributed uniformly throughout the entire surface area of the panel. The perforations permit some air flow in the direction

axially to the fan or through the region defined by the projected area of the fan but actually reduce the force exerted on the air directly in this region. This has the effect of increasing the air flow through other regions of the plenum **14** toward the fan **11** since the overall air flow into the fan remains substantially the same. Thus, there is created a more even distribution of flow through the heat exchanger **7**.

It should be noted that, in the preferred embodiment of the invention, the fan is arranged no greater than 8 inches downstream from the fan and the panel is positioned ahead of the fan no greater than ¼ of the distance between the fan **11** and the heat exchanger **7**. Furthermore, it has been found desirable to make the diameter of the panel **21** slightly less than the diameter of the fan. The percentage of perforation of the panel **21** can be increased or decreased between 10% or 90% of the total panel area according to the type of distribution desired in the airstream flowing over the heat exchanger.

Another arrangement would be to arrange the perforations in the panel so that the perforations form particular patterns of air flow thereby creating particular types of distribution in certain areas of the air stream flowing toward the fan. For example, the percentage of perforation in the panel **21** could be gradually increased toward the outer extremities of the panel so that the resistance to air flow is less in these portions of the panel. This, of course, could be carried into the design of the panel by making the outer portions of the panel with greater or larger perforations **22** while making the perforations closer to the center of the panel somewhat smaller so that the air flow is increased as one gradually approaches the outer extremities of the panel.

By the present invention there is provided a simple means for creating a uniformly distributed air flow through a heat exchanger of relatively large cross-sectional area which air is being drawn by a fan disposed a short distance downstream from the heat exchanger and having a relatively smaller cross-sectional area. This simple arrangement greatly improves the heat transfer between the air stream and the heat exchanger and helps to eliminate hot or cold spots therein.

While in accordance with the patent statutes there has been described what at present is considered to be the preferred embodiment of the invention, it will be understood by those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is therefore, the aim of the appended claim to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

An air conditioning unit of the self-contained type comprising a casing adapted to be mounted in an outer wall of an enclosure, a refrigeration system in said casing including at least one heat exchanger, a fan in said casing for circulating a stream of air through said heat exchanger and said casing, said fan being positioned a distance no greater than 8 inches downstream from said heat exchanger, a plenum enclosing the region between said heat exchanger and said fan, said plenum including a fan orifice for directing air into said fan, said heat exchanger having an area normal to said air stream substantially greater than the area of said fan normal to said air stream, and a perforated panel disposed across said air stream flowing to said fan, said panel being positioned upstream from said fan a distance no greater than one-fourth of the distance between said fan and said heat exchanger, said panel creating a substantially uniform pressure drop across the downstream face of said heat exchanger thereby to promote a uniform flow of air through said heat exchanger for increasing the overall heat transfer efficiency between said heat exchanger and said air stream.

References Cited in the file of this patent

UNITED STATES PATENTS

2,692,481 Schweller ---------- Oct. 26, 1954