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3,212,275 10/1965 Tillman, Jr. 62/3
3,216,496 11/1965 Katz 165/185

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[54] **HEAT EXCHANGER WITH INNER GUIDE STRIP**
4 Claims, 6 Drawing Figs.

[52] U.S. Cl. 165/121,
165/185, 317/100, 174/15
[51] Int. Cl. F28f 13/00
[50] Field of Search 165/121, 2,
184—186; 317/100, 234.1; 174/15

[56] **References Cited**
UNITED STATES PATENTS
2,894,728 7/1959 Davis 415/209 X

ABSTRACT: In a rectangular heat exchanger for electronic equipment wherein part of said equipment is placed on one end wall of the heat exchanger while air is brought into the heat exchanger by fan means located towards the other end wall and said air is channeled in the heat exchanger by a plurality of guide vanes extending generally radially outwards from a zone surrounding said fan means, the improvement therein wherein said heat exchanger includes an elongated resilient strip which has the inner end resting on a bottom wall of the heat exchanger, with the center portion thereof going around said fan means zone and the outer end extends across the mouths of flow channels which it is desired to cut off thereby increasing the air flow to the other channels to enhance the cooling to the electronic components.

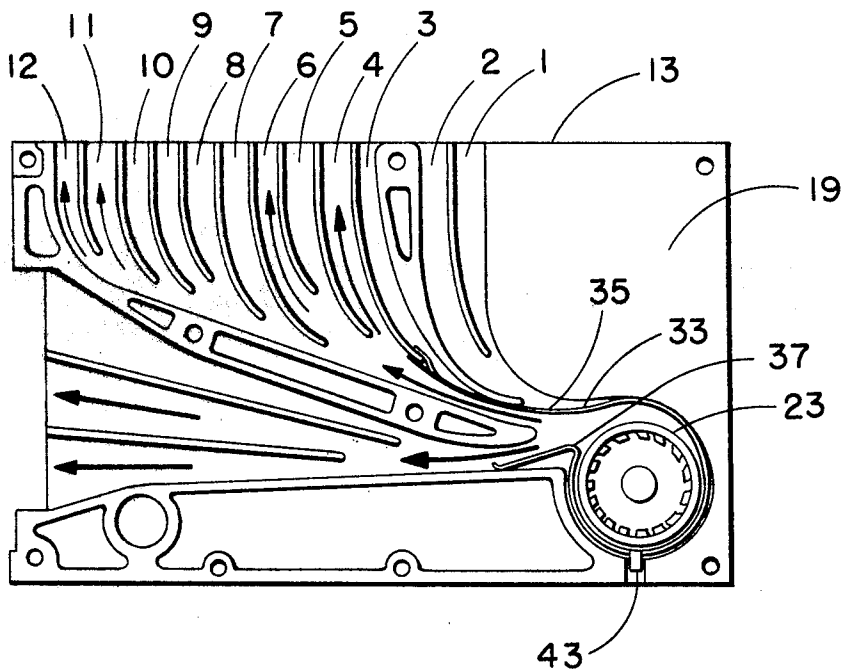


FIG. 1

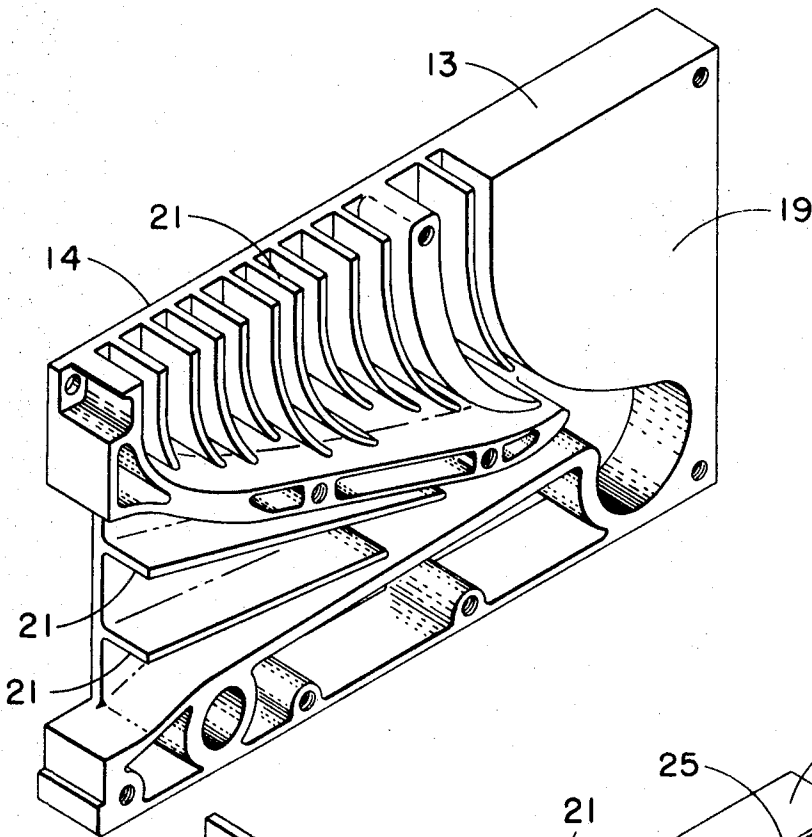
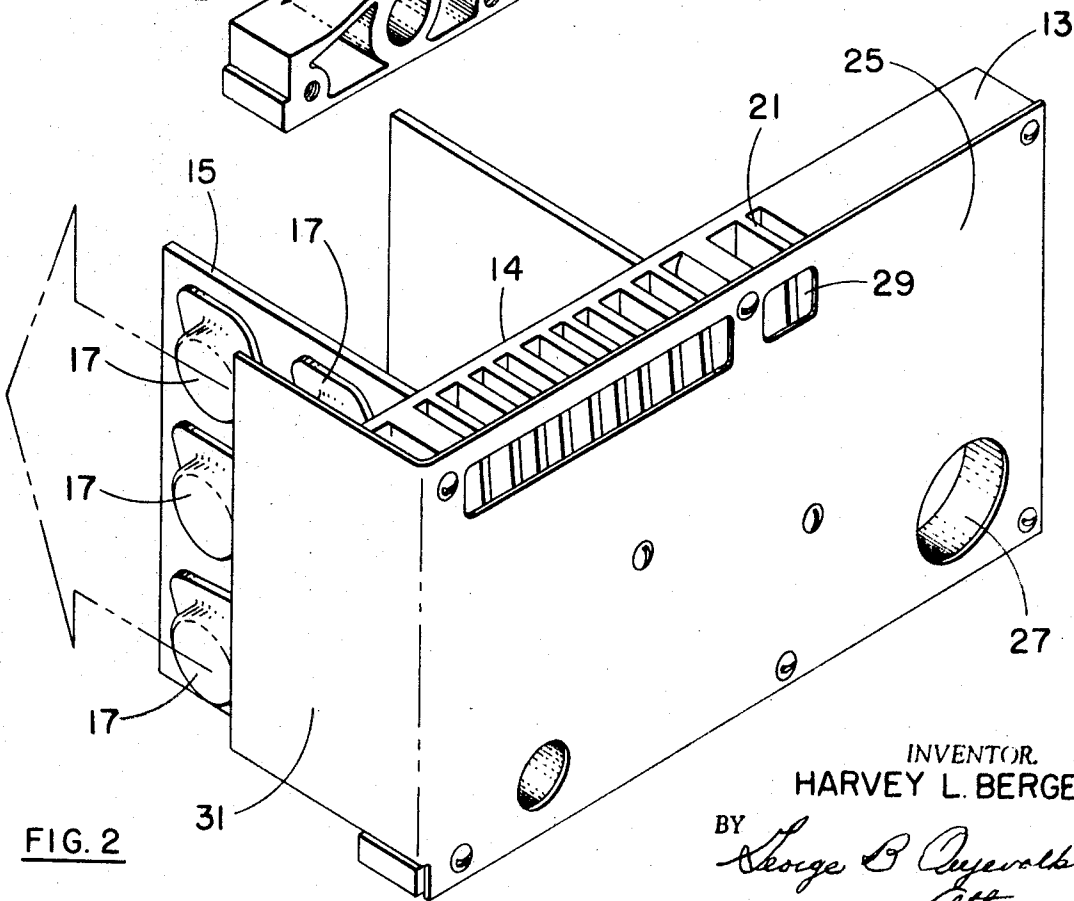


FIG. 2



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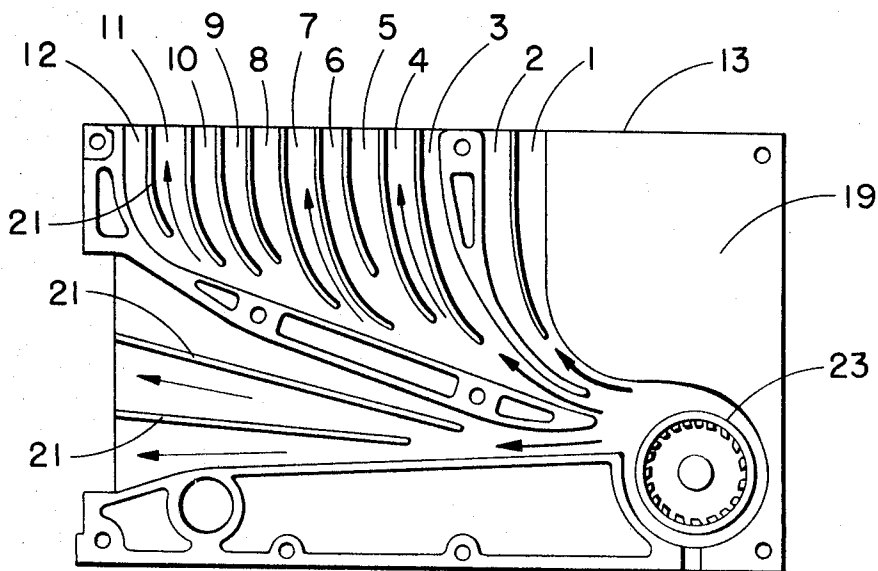


FIG. 3A

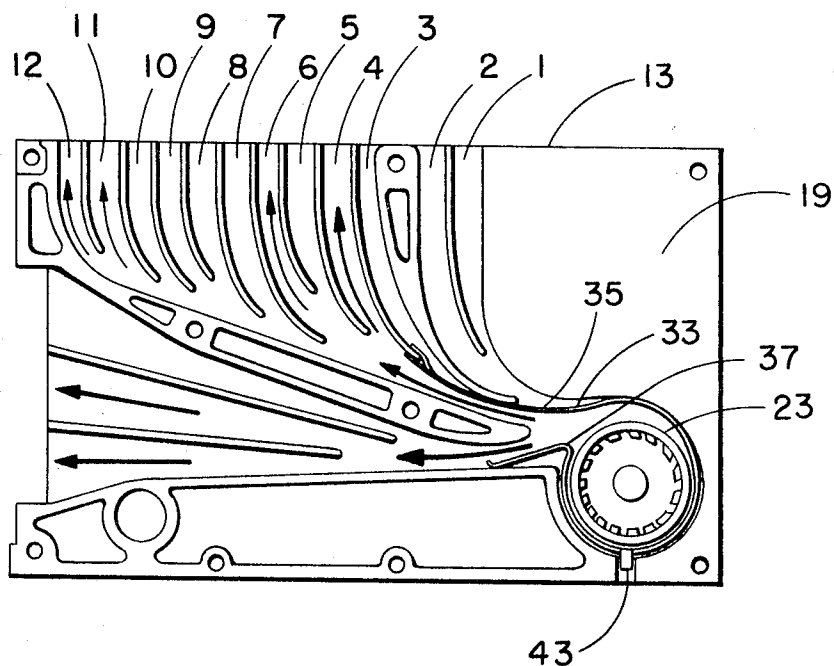


FIG. 3B

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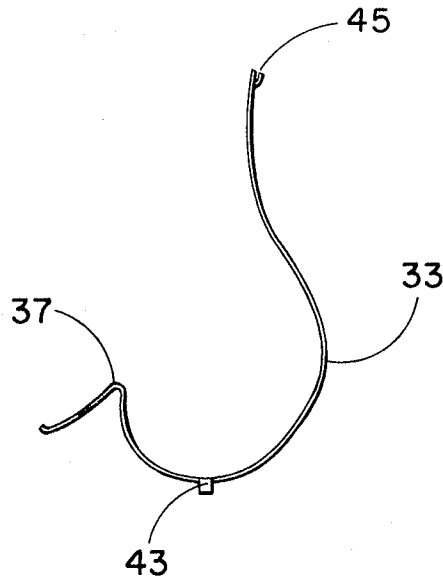


FIG. 4A

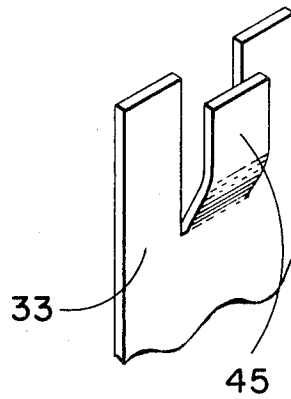


FIG. 4B

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HEAT EXCHANGER WITH INNER GUIDE STRIP

BACKGROUND OF THE INVENTION

The present invention relates to the problem of poor air circulation within an enclosure used for the purpose of cooling a piece of electronic equipment, also to the attenuation of the noise generated by the rush of air past an obstruction in the flow path. More particularly the present invention relates to the cooling off of transistors by the use of an air-cooled heat sink where the cooling air is properly channeled.

Heretofore, transistors were mounted on a metal plate, e.g., of aluminum and cooling air was fed to the back of the plate. This system was not only inefficient but also resulted in noise caused by the air flow.

SUMMARY OF THE INVENTION

Generally speaking, the present invention contemplates an improvement in a rectangular heat exchanger for electronic equipment wherein part of said equipment is placed on one end wall of the heat exchanger while air is brought into the heat exchanger by fan means located towards the other end wall and said air is channeled in the heat exchanger by a plurality of guide vanes extending generally radially outwards from a zone surrounding said fan means. The improvement contemplated includes an elongated resilient strip which has the inner end resting on a bottom wall of the heat exchanger, with the center portion thereof going around said fan means zone, and the outer end extends across the mouths of flow channels which it is desired to cut off, thereby increasing the airflow to the other channels to enhance the cooling to the electronic components.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention as well as other objects and advantages thereof will become more apparent from the following detailed description when taken together with the accompanying drawing, in which:

FIG. 1 is a perspective side view of a heat sink herein contemplated;

FIG. 2 shows the heat sink of FIG. 1, but with the cover plate thereon;

FIG. 3A is a side view of the heat sink shown in FIG. 1, but with an impeller also shown and showing the airflow;

FIG. 3B depicts the flow of air in the arrangement of FIG. 3A, but with proper guidance as provided by the arrangement contemplated herein;

FIG. 4A presents a side view of an insert tab contemplated herein; and,

FIG. 4B shows the outer end of the insert tab of FIG. 4A.

DETAILED DESCRIPTION

The cooling enclosure or heat sink consists of a rectangular aluminum plate 13 of which one surface 14 is used to mount various heat producing electronic components. The other surface 19 of the heat sink is intricately channelled by a series of aluminum struts 21 protruding perpendicular to the plate. The channels formed by these struts 21 serve the dual purpose of directing the flow of air produced by a squirrel cage type centrifugal impeller 23 mounted on the heat sink plate and also providing surface area through which heat exchange can occur.

For convenience, these aluminum struts have been labeled 1 to 12 starting from the furthest back.

Also included as part of the heat sink is a plate 15 on which are mounted various heat producing electronic components, e.g., transistors 17, located on the end wall of the unit perpendicular to the first-mentioned heat sink plate 13.

When in operation the channels are enclosed by a cover plate 25, which forms the fourth wall of the enclosure. This plate has an opening 27 for air intake at the impeller 23 and

for air exhaust 29 at the termination of the channels. The cover plate 25 is shown superimposed over the heat sink in FIG. 2. The air from the impeller is also used to cool an area of the equipment not directly mounted on the heat sink. The air is routed by the central channels and a flange 31 on the cover plate to the side of the unit where there are mounted six switching transistors 17 on a plate. This is shown in FIG. 3. The air passes over these transistors and is then exhausted through a cutout in the sidewall plate of the unit.

There are two areas of the equipment where the airflow should be maximized. One is the point of greatest heat dissipation located in the region of channels 4, 5, 6 and 7 on the heat sink. The other is the plate containing the six transistors 17. These transistors must usually be adequately cooled, for example if they are the germanium type and, therefore, subject to thermal runaway without proper heat removal. Heretofore, both of these critical areas were inadequately cooled because of a lack of sufficient airflow. Failure of units in operation occurred particularly because of the overheating of germanium transistors. The major fraction of the air (approximately 80 percent) would be directed into channels 1 and 2 on the drawing of FIG. 1. There are no sources of heat in this region that call for such a large portion of the airflow being directed there. In FIG. 4a relative magnitudes of the volume of air directed into various channels of the heat sink are indicated by the thickness of the arrows on each path.

In order to redistribute the air leaving the impeller there is inserted a thin-shaped spiral strip 33 with an inner hairpin bend of either a metal, plastic or other flexible material into certain channels of the heat sink. The form of the strip is shown in FIG. 5 and its position of insertion in the heat sink in FIG. 6. The strip is formed oversized with respect to its dimensions in the heat sink so that it must be compressed upon insertion to achieve the proper shape. This is clearly shown in FIG. 6. The springiness of the strip then acts to hold it in place against the walls. The strip is to be made wide enough so that one edge, the bottom-edge, rests on the heat sink plate and the other edge, the top edge, extends so that it terminates at the same height as do the aluminum struts. The insert strip thereby effectively behaves as if it were a strut and acts to channel the air. The insert strip top end 35 begins at the termination of the aluminum strut which separates channels 3 and 4 the insert strip extends across the inlet mouths of the channels labeled 1, 2 and 3, then continues as a spiral in contact with the wall of the impeller scroll, goes completely around the scroll and past the original cutoff point of the scroll while still part of the spiral. A sharp hairpin bend 37 forming a new scroll cutoff point is made and the strip end 39 is then terminated against the channel wall 41 as shown in FIG. 6.

A locating tab 43 is provided on the top edge of the spiral portion of the strip which fits into the water drain hole. A three pronged tab 45 is provided to join the strip end to the aluminum strut separating channels 3 and 4. The insert is snugly held against the scroll and other areas of contact with the heat sink by means of the restoring force of the springy material. Since the aluminum heat sink is generally a casting, there is an allowable draft of 1° on the walls perpendicular to the major plane of the heat sink. To compensate for this a 1° taper is incorporated into the insert strip on the side in contact with the casting walls. Additionally there is a fillet at the junction of the perpendicular walls and the major plane of the heat sink. Where the strip bottom edge must rest on this fillet (e.g. at the scroll) suitable reduction of the total strip width must be made.

The portion of the insert strip 33 extending across the inlets of channels 1, 2 and 3 acts to prevent air from entering these channels, thereby increasing the airflow in channels 4 through 12 and also increasing the flow to the switching transistor plate on the side of the equipment. The relative magnitude of the volume of air directed into various areas of the heat sink are shown in FIG. 4b for a unit utilizing the insert strip. In particular, the airflow to channels 4, 5 and 6 and to the switching transistor plate is substantially improved relative to the

original equipment with a resulting reduction in the thermal loading in these critical areas.

The portion of the strip forming the cutoff is designed to efficiently develop a pressure head across the impeller. The cutoff on equipment without the strip is quite shallow allowing recirculation of air around the impeller and also an excessive noise level. The cutoff in the present invention eliminates recirculation and reduces air noise. To this end it is necessary that the arm of the cutoff returning to the channel wall which forms the termination of the strip be at such an angle that its major plane, if extended to the impeller wheel, would intersect the wheel in a tangent at its periphery. This arrangement optimizes the airflow through the equipment.

The portion of the insert strip within the scroll serves to connect the two functional ends of the strip.

What I claim is:

1. In a rectangular heat exchanger for electronic equipment wherein part of said equipment is placed on one end wall of the heat exchanger while air is brought into the heat exchanger by fan means located towards the other end wall

and said air is channeled in the heat exchanger by a plurality of guide vanes extending generally radially outwards from a zone surrounding said fan means, the improvement therein wherein said heat exchanger includes an elongated resilient spiral strip which has the inner end resting on a bottom wall of the heat exchanger, with the center portion thereof going around said fan means zone and the outer end extends across the mouths of flow channels which it is desired to cut off thereby increasing the airflow to the other channels to enhance the cooling to the electronic components.

2. In a heat exchanger as claimed in claim 1, including a lower outlet in said zone to allow water to drip therethrough, a tab in the center portion of said strip designed to fit in said outlet.

3. In a heat exchanger as claimed in claim 2, said strip outer end having a three-pronged grip to engage one of said guide vanes.

4. In a heat exchanger as claimed in claim 3, said strip inner end having a hairpin bend to increase the resilient effect.

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