June 27, 1967 A. G. BUTT 3,327,776

HEAT EXCHANGER

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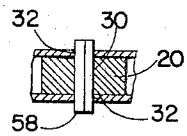


FIG. 3

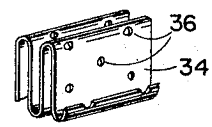
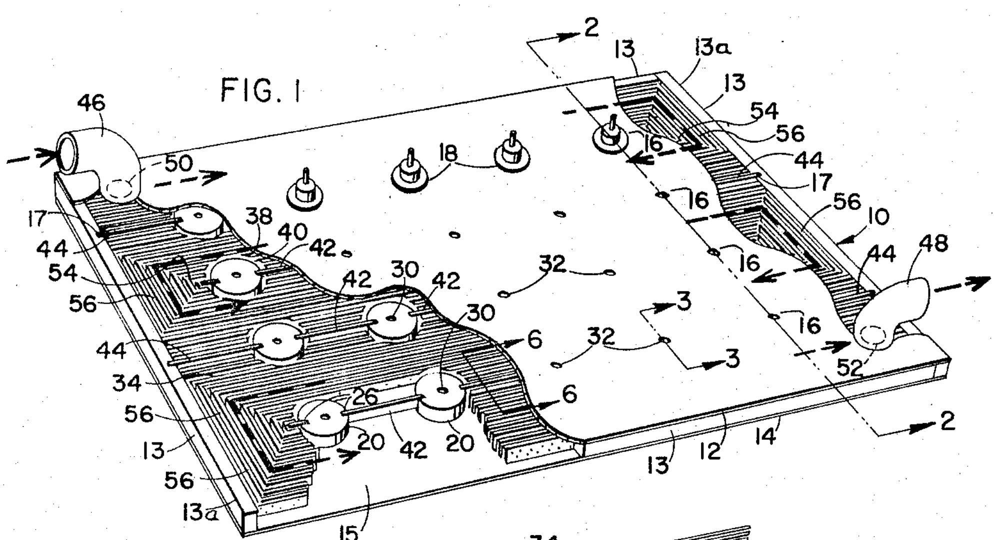


FIG. 4



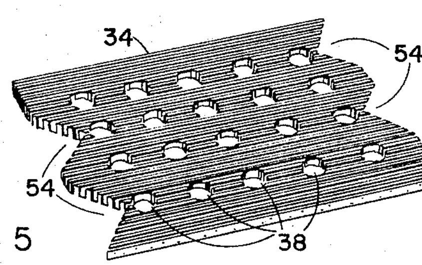


FIG. 5

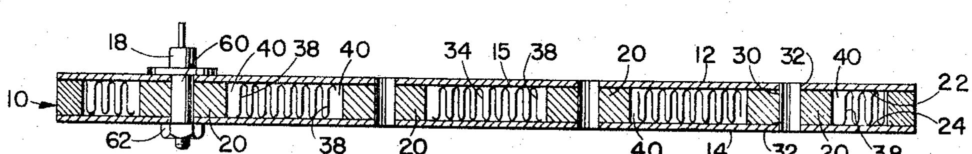


FIG. 2

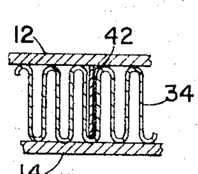


FIG. 6

INVENTOR.
ALAN G. BUTT

BY *Holmes & Andersen*
ATTORNEYS

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HEAT EXCHANGER

Alan G. Butt, La Crosse, Wis., assignor to The Trane Company, La Crosse, Wis., a corporation of Wisconsin

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ABSTRACT OF THE DISCLOSURE

A hollow cooling plate for cooling electronic components and the like mounted in columns which extend into the hollow interior thereof which is provided with a perforated corrugated fin and imperforate separator strips extending from one column to another column for directing a cooling fluid through a serpentine flow path in said hollow interior.

This invention relates to heat exchangers particularly of the plate type for cooling electronic components and the like.

One object of my invention is to provide a cooling plate with an improved mounting structure for the components to be cooled. Specifically this mounting structure permits the components to be compressed firmly against the cooling plate for favorable heat transfer therebetween without damage to the plate by the compressive forces.

Another object is to provide a cooling plate with a serpentine fluid circuit utilizing a single piece packing embracing all spans of the serpentine circuit.

A further object of this invention is to provide a cooling plate having parts which can be simply and efficiently assembled.

These and other objects will be more clearly understood as this specification proceeds to describe in detail the preferred embodiment of my invention shown in the drawings in which:

FIGURE 1 is a perspective view of my novel cooling plate having portions broken away to illustrate the interior structure thereof;

FIGURE 2 is a sectional view taken at line 2—2 of FIGURE 1;

FIGURE 3 is a sectional view of a detail taken at line 3—3 of FIGURE 1 as it would appear during assembly;

FIGURE 4 is an enlarged perspective view of a portion of the fin packing shown in FIGURE 1;

FIGURE 5 is a reduced perspective view of the fin packing shown in FIGURE 1; and

FIGURE 6 is an enlarged sectional view of a detail taken at line 6—6 of FIGURE 1.

Now referring to the drawings, there is shown a brazed plate type heat exchanger cooling plate **10**. Cooling plate **10** includes first and second rectangular aluminum plates **12** and **14** of similar configuration. Plates **12** and **14** are arranged in superposed spaced parallel relationship. A plurality of aluminum side closing bars **13** are interposed between plates **12** and **14** at the borders thereof for sealingly connecting plates **12** and **14** thereby defining, with said plates, a fluid conducting space **15**. Each of plates **12** and **14** is clad on inner surfaces **22** and **24** thereof with a brazing alloy, not shown. Certain of bars **13** designated as **13***a* are provided with a transverse groove **17** facing space **15** for purposes to be explained.

Each plate **12** and **14** has four rows **16** of sites for mounting elements or components to be cooled, such as electronic components **18**. For convenience of illustration, only the sites of one row are shown as having a component **18** mounted thereon.

Disposed within space **15** at each site is a circular disc or short circular column **20** of aluminum abutting at the ends thereof the inner faces **22** and **24** of plates **12** and **14**. Each of the columns **20** has at the periphery

thereof two diametrically opposed axially extending grooves **26**, the function of which will be explained hereinafter. Each column **20** further has an axially extending circular aperture **30** which is arranged in registry with a through-going circular aperture **32** of similar diameter in each of plates **12** and **14**.

Also disposed within space **15** is a single piece of fin packing **34**. Packing **34** is comprised of a corrugated metallic sheet having relatively small perforations **36** as shown in FIGURE 4. These perforations may be of various configurations and patterns and their spacing and size is preferably less than the fin height (the distance between plates **12** and **14**). These perforations may be formed in the metallic sheet prior to being corrugated.

The fin packing **34** is further provided with a plurality of relatively large circular apertures **38** (FIGURE 5) which are arranged to concentrically receive discs or columns **20** as shown in FIGURES 1 and 2. Apertures **38** are about one-eighth inch larger than columns **20** so that when assembled there remains a space **40** between the columns **20** and packing **34** as seen in FIGURES 1 and 2. The rows of apertures **38** for the rows **16** of cooling sites are parallel to the hills and valleys of the corrugated packing **34**. Apertures **38** may be accurately formed by filling the fin packing **34** with a temporary supporting material and drilling the apertures in a fixture for proper location after which the supporting material is removed.

An imperforate separating strip **42** extends between each adjacent pair of columns **20** of each row **16** of cooling sites. Each row **16** is further provided with an imperforate end separator strip **44** which extends from a bar **13***a* to a column **20** at one end of the row. Each of the imperforate separator strips **42** and **44** lie within a loop or valley of the corrugated packing **34** and extend laterally to one of the plates **12** and **14** as shown in FIGURE 6. The grooves **26** at the sides of columns **20** and the grooves **17** in bars **13***a* receive the ends of strips **42** and **44**. End strips **44** are placed at opposite ends of adjacent rows thereby restricting passage of cooling medium within space **15** to a serpentine path as designated by the heavy dashed arrows in FIGURE 1. This serpentine flow path is provided with inlet and outlet conduits **46** and **48** which are connected with inlet and outlet apertures **50** and **52** respectively in plate **12** for receiving and discharging a cooling fluid.

The end turns of the serpentine flow path may be formed by providing recessed portions **54** of packing **34** with corrugated fin sections **56** of triangular configuration having the hills and valleys thereof extending perpendicularly to the hills and valleys of packing **34**.

In constructing the cold plate **10**, the parts thereof are assembled as shown in FIGURE 1. A peg **58** (FIGURE 3) formed from brazing wire of square or rectangular cross-section is inserted snugly into each of the holes formed by apertures **30** and **32** to accurately locate the discs or columns **20** during assembly. The square or rectangular configuration of peg **58** within the circular bores permits brazing flux to enter the bores for a subsequent brazing operation. It will be evident that separating strips **42** and **44** also assist via grooves **17** and **26** in retaining the packing **34** in proper location with respect to columns **20** and thus in respect to plates **12** and **14**.

The assemblage is then heated to a sufficiently high temperature in a furnace or bath to fuse the brazing alloy and then allowed to cool for bonding the parts together as an integral unit. The clad inner faces **22** and **24** of plates **12** and **14** thus become brazed to the sides of bars **13**, the hills of packing **34** and fin sections **56**, the lateral edges of separating strips **42** and **44** and the end surfaces of columns **20**. Pegs **58** melt away leaving through-going holes in plate **10** for receiving the studs **60** of components **18**.

Suitable nuts **62** may be secured upon the ends of studs **60** for drawing components **18** into compressive relationship with the outer surfaces of the cooling plate **10** thereby enhancing the heat transfer from the components to the cooling plate. Columns **20** function to resist the compressive forces exerted by the components thus avoiding deformation of the cooling plate surface. Columns **20** also function to conduct heat from the cooling sites to the inner portion of the cooling plate in contact with the cooling fluid.

In operating the cooling plate, a cooling fluid is passed into inlet conduit **46**, through inlet aperture **50**, through the serpentine path as designated by the dashed arrows in FIGURE 1, out outlet aperture **52** and outlet conduit **48**. The fluid flowing within the serpentine path comes in direct contact with columns **20** to conduct heat therefrom. The spaces **40** function to conduct cooling fluid along the side surfaces of columns **20**, thus enhancing this heat transfer between the columns and the cooling fluid.

Although I have described in detail the preferred embodiment of my invention, I contemplate that many changes may be made without departing from the scope or spirit of my invention and I desire to be limited only by the claims.

I claim:

1. A cooling plate comprising first and second metallic plates of similar configuration disposed in superposed spaced relationship; sealing means sealably connecting said plates along the borders thereof whereby a fluid conducting space is defined by the inner faces of said plates and said sealing means; said first plate having an outer face thereof a plurality of rows of cooling sites for cooling a plurality of elements; each one of said sites having adjacent thereto a metallic column abutting the inner face of said first plate in alignment with said one site; each of said columns extending into said fluid conducting space; a perforated fin packing disposed within said fluid conducting space circumscribing said columns; said packing having a plurality of apertures of sufficient size to receive said columns; a substantially imperforate separator strip extending substantially from one column to the other column of each pair of columns within each row; each row of columns having at one end thereof a substantially imperforate end separator strip extending substantially from said sealing means substantially to a column at one end of each row; said end separator strips being arranged at remote ends of adjacent rows thereby defining a serpentine fluid flow path; and a fluid inlet and outlet disposed at opposite ends of said serpentine fluid flow path for receiving into and discharging from said cooling plate a cooling fluid whereby elements positioned at said cooling sites are cooled.

2. The apparatus defined by claim **1** wherein said columns are provided with grooves at the sides thereof for receiving the ends of said imperforate separator strips.

3. The apparatus defined in claim **1** wherein said packing is comprised of a single piece which traverses said separator strips and is disposed in several spans of said serpentine fluid flow path.

4. A cooling plate comprising first and second plates of similar configuration disposed in superposed spaced relationship; sealing means sealably connecting said plates along the borders thereof whereby a fluid conducting space is defined by the inner faces of said plates and said sealing means; said first plate having on the outer face thereof a plurality of rows of cooling sites for cooling a plurality of elements; each one of said sites having associated therewith a metallic column bonded at one end thereof to the inner face of said first plate in alignment with said one site; each of said columns extending through said fluid conducting space to the inner face of said second plate; a corrugated perforated fin packing disposed within said fluid conducting space circumscribing said columns and having the hills and valleys thereof extending in parllel relationship to said rows; said packing having a plurality of apertures of sufficient size to receive said columns in spaced relationship thereby defining a space between said packing and each of said columns; a substantially imperforate separator strip extending substantially from one column to the other column of each pair of columns within each row; each row of columns having at one end thereof a substantially imperforate end separator strip extending substantially from said sealing means substantially to a column at one end of each row; said end separator strips being arranged at remote ends of adjacent rows thereby defining a serpentine fluid flow path; and a fluid inlet and outlet disposed at opposite ends of said serpentine fluid flow path for receiving into and discharging from said cooling plate a cooling fluid whereby elements positioned at said sites are cooled.

5. The apparatus as defined by claim **4** wherein said imperforate separator strips are disposed within the loop portion of said fin packing.

6. The apparatus as defined by claim **5** wherein said columns are provided with grooves at the sides thereof for receiving the ends of said imperforate strips.

7. The apparatus as defined by claim **4** wherein said packing is comprised of a single piece which traverses said separator strips and is disposed in several spans of said serpentine fluid flow path.

8. The apparatus defined by claim **4** wherein each of said columns is provided with an axially extending through-going aperture in registry with apertures in said first and second plates for compressive mounting of elements to be cooled.

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MEYER PERLIN, *Primary Examiner.*

ROBERT A. O'LEARY, *Examiner.*

A. W. DAVIS, *Assistant Examiner.*