March 6, 1951 P. S. ROGERS ET AL 2,544,183

AIRCRAFT RADIO COOLING

Filed Aug. 7, 1948

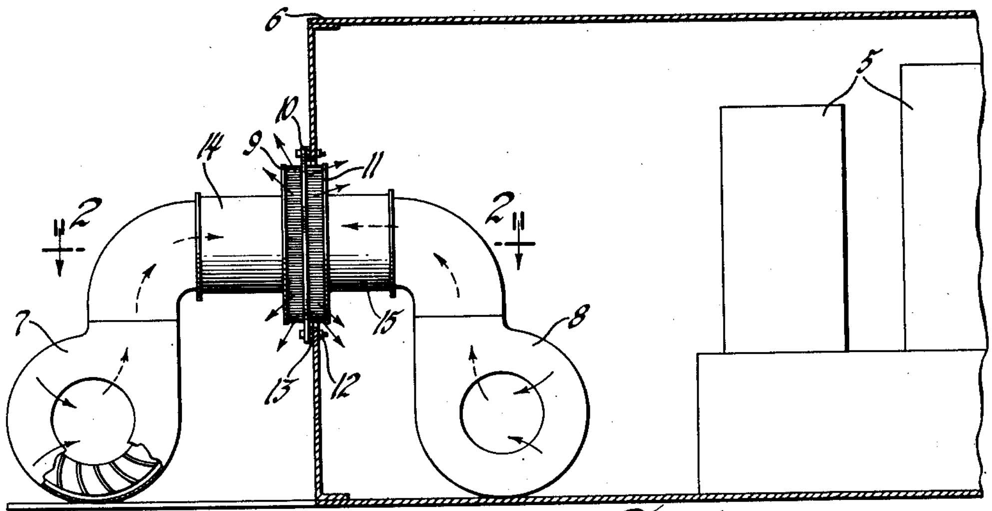

Fig. 1

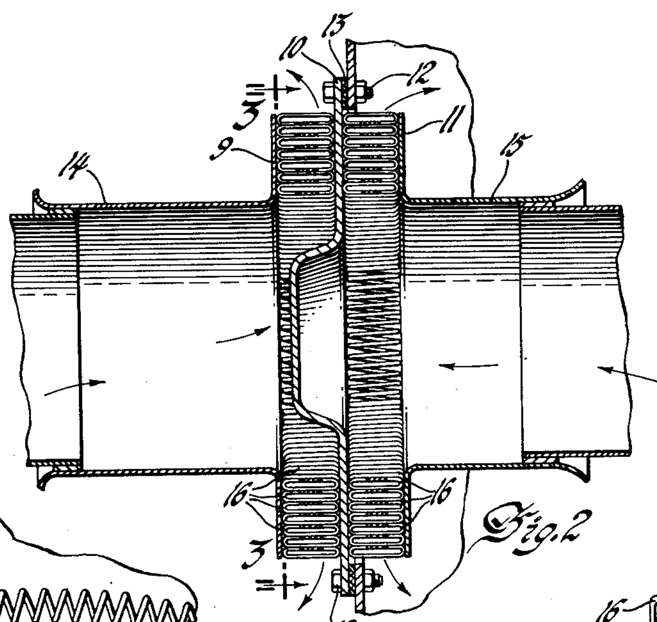

Fig. 2

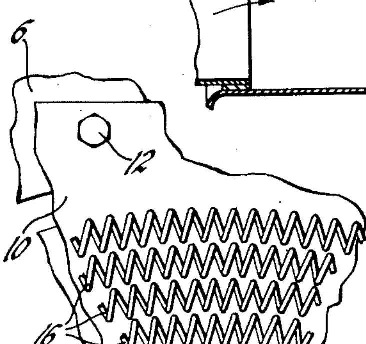

Fig. 3

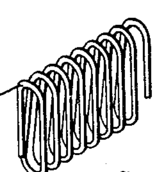

Fig. 4

Inventors

Philip S. Rogers,
Willard O. Emmons,
John W. Godfrey &
James Milton Kelso

By

Spencer, Willits, Helwig & Baillio
Attorneys

Patented Mar. 6, 1951 2,544,183

UNITED STATES PATENT OFFICE

2,544,183

AIRCRAFT RADIO COOLING

Philip S. Rogers, Willard O. Emmons, John W. Godfrey, and James Milton Kelso, Lockport, N. Y., assignors to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Application August 7, 1948, Serial No. 43,054

4 Claims. (Cl. 257—244)

1

For aircraft installation of radio, radar and other electronic tube equipment it becomes important to use airtight enclosures to seal against moisture and change of barometric pressure. This introduces the problem of dissipating heat produced upon operation of the equipment in excess to that radiated through the box by natural convection since overheating causes functional failure of the equipment. For temperature control the air contained or trapped within the box may be caused to circulate over the tube equipment and through a cooler for transferring heat from the interior of the sealed enclosure to outside atmosphere. Suitable motor driven fans blow both inside and outside air through the cooler and may be controlled either manually or by a thermostatic switch in response automatically to temperature requirements.

A convenient, simple and inexpensive cooler arrangement can be built into and constitute a part of the sealed enclosure and according to a preferred embodiment of the present invention the cooler will involve passages for air circulation with a multitude of fine gauge wires or pins bridging the passage space. The pins assist in increasing the rate of heat transfer through the passage wall between the hot and cold fluids and the smaller the bulk or diameter of individual pins in relation to the exposed surface area the more effective will be the working of the pin material and the greater the number of wire pins within the limit of permissible fluid flow resistance the greater will be the rate of transfer.

To eliminate difficulties of fitting individually formed pins within the flow passages it is here proposed greatly to simplify the manufacture of a pin type heat exchanger by the preformation from a single piece of wire of a group of joined together pins arranged so that the connecting portions between the successive pins also provide seating abutments and joining parts with the passage walls. To that end a small diameter wire is helically wound about a mandrel or otherwise formed into a continuous succession of narrow elongated or flattened coils in which the pins are afforded by the straight wire lengths between return bends or end loops and a series of the pins and a number of rows of coiled pins may be handled as a unit and in the assembling operation they are placed between adjacent wall surfaces of a stack of flat plates with the spaced apart wall surfaces of each passage abutting opposite end loops of the wire coil and with the wire lengths between the end loops extending straight across the passage space. The parts while so located temporarily in a holding fixture may be brazed or otherwise secured together at the several abutment points and the result is a rugged cooler assembly with the pins tying together and spacing apart the flat wall plates.

2

To suit installation requirements a number of plates and the grouping and character of the pins may be embodied in various arrangements within the scope of this invention to be further described in connection with the accompanying drawing wherein Figure 1 is a side elevation of a heat exchanger in operative relation with electronic tube equipment; Figure 2 is a section taken on line 2—2 of Figure 1; Figure 3 is a fragmentary elevation as viewed on line 3—3 of Figure 2 and Figure 4 is a detail perspective view of the coil wire pin detail.

Referring to the drawing the electronic tube equipment is illustrated generally at 5 within a sealed contained 6 having a wall carried cooler unit to which heat transfer fluids are delivered by suitable motor driven fan devices 7 and 8. While air will be a convenient medium for absorbing and conveying heat from the tube to the outside it will be understood that other fluids may be used and thus the sealed interior of the container may be considered as being filled with a moisture free nonoxidizing gas.

The cooler unit shown includes three spaced apart and parallel flat plates or walls 9, 10 and 11 with wire pins in annular array extending across the space between and joining the two end walls 9 and 11 with the central division wall 10. It is of a circular type in that incoming air enters at the center and flows radially outwardly over and around the annular bank of spaced pins within the wall passages and discharges at the circumference or periphery of the end walls 9 and 11. The intermediate division wall 10 is imperforate and forms a part of the sealed compartment wall. Conveniently it fits over and closes an opening in one of the compartment walls and its marginal edge extends beyond the opening to provide a mounting flange secured by clamp bolts 12 and sealed by a gasket 13. Additional spaced walls arranged side by side may be used to provide more passages if a relatively heavy heat load needs attention, but in the present embodiment the end walls 9 and 11 are in the nature of annular rings or flanges on the adjacent ends of a pair of tubular conduits 14 and 15 which project in opposite directions away from the central division wall 10 and are coupled respectively with the delivery outlets of the blowers 7 and 8.

The wire pins referred to are the straight portions extending between the end loops of a flat coil 16 of helically wound wire. In each air space several rows of pins may be all of one continuous piece of wire, which after being wound into narrow elongated coil form, as seen in Figure 4, may be placed upon a spindle whose diameter substantially corresponds to the tubular members 14 and 15 and wrapped around the spindle and upon itself several times to build up the desired number of substantially concentric rings or convolutions. Seven of such convolutions are shown in Figure 2 with the end loops between succeeding pins abutting the passage walls. Optionally each ring or convolution of the coil wire may be separate from the others, in which case each ring would be a length of wire coil joined end to end in annular form to be nested successively within or upon one another with succeeding rings having progressively more coils as the ring diameter increases.

For good heat transfer it is proposed that the wire pins, and at least the imperforate separator wall 10, be formed of aluminum and that the several pieces be preformed and then bought together and held in a fixture to be brazed by dipping in a molten salt bath.

There is thus provided in an economical manner a strong structure usable in a small space and employing wire pins having a high coefficient of heat transfer and which eliminates the fabrication and handling troubles and expense which would be encountered with an assembly of individually placed pins between flat wall surfaces.

We claim:

1. For the dissipation of heat from electronic equipment enclosed within an airtight container for installation on aircraft, a heat exchanger including a central plate for closing and sealing attachment over an opening in the container wall, a pair of end plates on opposite sides of and spaced from the central plate with oppositely projected tubular formations constituting incoming conduits for connection with air blowers placed inside and outside the container and for directing blower air for outward flow through the respective spaces between opposite faces of the central plate and said end plates and a succession of circular runs of helically coiled wire within each of said spaces, each run being closely fitted to its neighbor run and having narrow elongated coils, whose opposite end loops are fixedly joined to the space defining plates and whose flat sides extend as finely separated straight pins across the spaces.

2. For use with a sealed container enclosing apparatus which generates heat upon operation, means to transfer such heat to the outside atmosphere including a container wall, sets of wire pins

on both faces of said wall, each set comprising in radial succession a series of circular rows of helically wound wire having flat sides and opposite end loops with the loops at one end fixed to said wall, a pair of tubular members on opposite sides of said wall terminating in radial flanges fixed to the other end loops and spaced from the wall to afford therebetween air flow passages bridged by multitudinous pins provided by the flat sides of the helically wound wire, said tubular members constituting conduits for air flow through said means.

3. In a heat exchanger of the character described, a separator wall common to two air flow passages on opposite faces thereof, inner and outer ring-like plates on opposite sides of said wall and cooperating therewith to form said air flow passages, said ring-like plates having tubular projections extending centrally thereof in opposite directions to one another, and a series of space bridging pins in the passages on both sides of said wall, said pins being the straight portions of flat narrow coils of helically wound wire, whose end loops are fixedly secured to the wall and the plates and which are arranged in circular formation peripherally beyond said tubular projections and in radially successive rows.

4. In a heat exchanger of the character described, a pair of tubular conduits arranged substantially end to end and terminated at adjacent ends in radially outward flanges spaced from each other, an imperforate wall intermediate and spaced between both flanges, and a series of substantially concentric rings of helical wire coils spanning each of the spaces between opposite faces of said wall and said flanges, each coil being fixedly secured to the wall and an adjacent flange.

PHILIP S. ROGERS.
WILLARD O. EMMONS.
JOHN W. GODFREY.
JAMES MILTON KELSO.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
231,485	Gold	Aug. 24, 1880
493,721	Holden	Mar. 21, 1893
1,559,180	Prat	Oct. 27, 1925
1,716,743	Still	June 11, 1929
2,093,256	Still	Sept. 14, 1937
2,445,582	Melville	July 20, 1948
2,460,752	Jacobsen	Feb. 1, 1949

FOREIGN PATENTS

Number	Country	Date
486,435	Great Britain	Nov. 25, 1937