March 12, 1968 D. B. KAISER ET AL 3,372,741

HEAT DISSIPATOR

Filed April 29, 1966

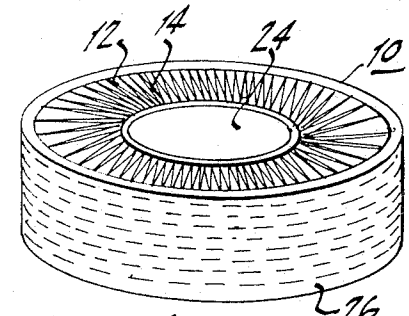


Fig. 1.

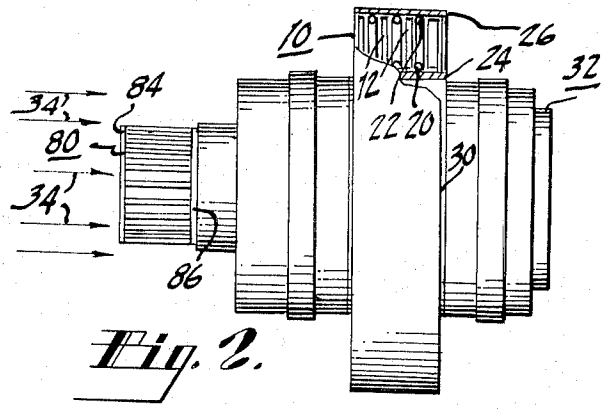


Fig. 2.

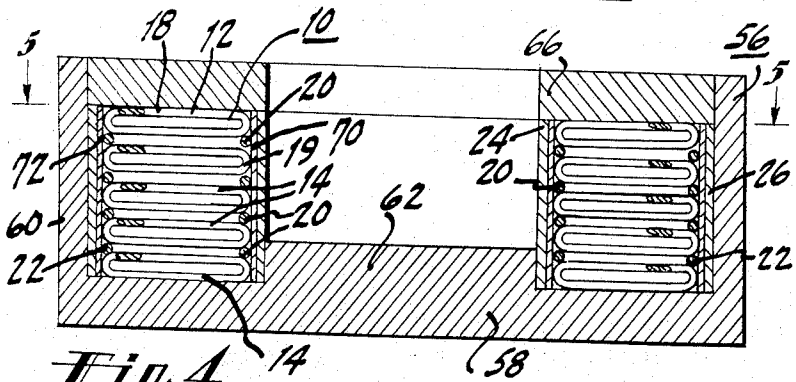


Fig. 4.

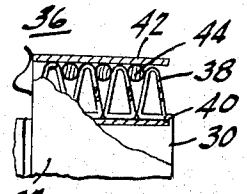


Fig. 3.

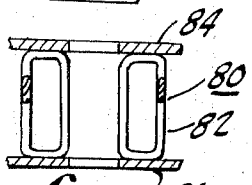


Fig. 6.

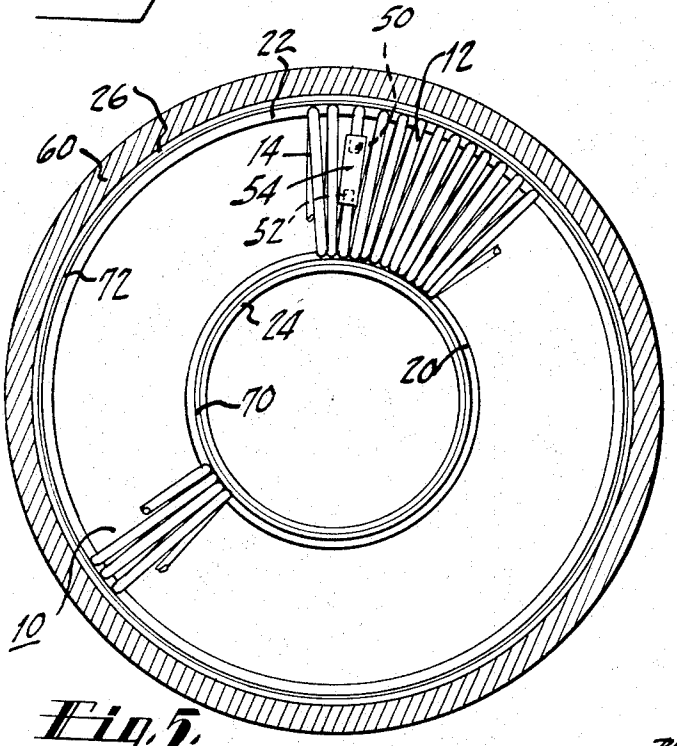


Fig. 5.

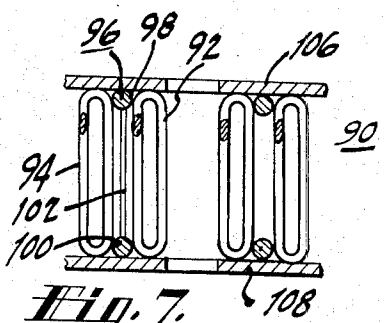


Fig. 7.

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United States Patent Office 3,372,741
Patented Mar. 12, 1968

3,372,741

HEAT DISSIPATOR

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Filed Apr. 29, 1966, Ser. No. 546,254
5 Claims. (Cl. 165—80)

ABSTRACT OF THE DISCLOSURE

Heat dissipator comprising helices of wire formed into stacked closed loops and confined in an annular space defined by outer and inner concentric metal sleeves. The turns of each helix adjacent to the inner sleeve are in substantially mutual contact relation.

This invention relates to heat dissipators of the type used for cooling electronic devices such as electron discharge tubes.

An object of this invention is to provide novel and improved heat dissipators which are inexpensive and easy to fabricate, and which may be readily and rigidly mounted on the object to be cooled.

For achieving this object, a heat dissipator is provided comprising a closed loop formed from an elongated helix of wire. For directing the flow of a cooling medium through the dissipator, as well as for imparting greater strength thereto, impervious stiffening means joining various turns of the helix to one another is provided. In a preferred embodiment, the dissipator comprises a plurality of loops rigidly joined together in stacked, coaxial relation.

In the drawings:

FIG. 1 is a view in perspective, and partly schematic, of the heat dissipator;

FIG. 2 is a side elevation, partly broken away, of an electron tube having the heat dissipator shown in FIG. 1 and a further heat dissipator shown in FIG. 6 mounted thereon;

FIG. 3 is a fragmentary view of a different embodiment of a dissipator mounted on an electron tube;

FIG. 4 is a sectional view of an assembly jig containing the various parts of the heat dissipator shown in FIG. 1 mounted therein;

FIG. 5 is a sectional view along line 5—5 of FIG. 4;

FIG. 6 is a sectional view of a further embodiment of a heat dissipator; and

FIG. 7 is a sectional view of a still further embodiment of a heat dissipator.

With reference to FIGS. 1, 4 and 5, a heat dissipator **10** comprises a plurality of wire helices **12** each formed into a closed, circular loop **14**. The loops **14** are in stacked, coaxial relation. The turns of the helices are in the shape of elongated rectangles having long sides **18** and short sides **19**, with the long sides **18** extending substantially perpendicular to the axis of the loops. The loops **14** are maintained in spaced apart relation by means of spacer rings **20** and **22** disposed between and bonded to adjacent pairs of loops. Bonded to the inner and outer portions of the loops are inner and outer stiffening cylindrical sleeves **24** and **26**, respectively. One purpose of the sleeves **24** and **26** is to provide a rigid assembly which may be readily and rigidly mounted on an object to be cooled, as described hereinafter.

The helices **12** and the sleeves **24** and **26** are made from good thermal conductivity materials such as copper and copper clad steel, respectively.

In the use of the heat dissipator **10**, the dissipator may be mounted on, for example, the cylindrical anode **30** of a commercial electron tube **32**, shown in FIG. 2, such as an RCA 7213 or RCA 8437. Preferably, for good heat

transfer between the tube anode **30** and the dissipator **10**, the inner sleeve **24** of the dissipator is soldered to the anode. Although not shown, the tube **32** can be mounted in apparatus providing a forced flow of air, as by a blower, in the direction of the arrows **34**. The sleeves **24** and **26** direct the air longitudinally through the dissipator **10**. The elongated rectangular shape of the helix turns provides a high ratio of cooling area (the surface area of the long sides **18** and the outer short sides **19** of the helix turns) to heated area (the surface area of the short sides **19** bonded to the inner cylinder **24** engaged, in turn, with the object being cooled). Preferably, the loop helices have a small turns pitch so that the inner short sides **19** of the helix turns practically touch one another and provide a substantially continuous surface contact of the loops **14** with the inner sleeve **24**. The dissipator **10** structure possesses great strength, whereby exceptionally large cooling to heated area ratios may be provided for large capacity heat dissipation.

In another embodiment, shown in FIG. 3, a heat dissipator **36** comprises loops **38** formed from wire helices having triangular-shaped turns. The loops **38** are bonded between inner and outer sleeves **40** and **42**, respectively. Preferably, the loop helices are wound with such a small turns pitch that the helix turns touch one another and form a substantially continuous surface in contact with the inner sleeve **40**. The close turns winding prevents penetration or entanglement of the base portions of the helix turns of adjacent loops with one another during manufacture of the dissipator. Spacer rings are thus not required between adjacent loops adjacent to the inner sleeve **40**. Spacer rings **44** are used between adjacent loops **38** adjacent to the outer sleeve **42** to maintain the apex portions of the helix turns in proper spaced relation during fabrication of the dissipator **36**, and to provide a more rigid dissipator assembly.

For manufacturing the heat dissipator **10**, a wire of a good heat conductive material, such as copper, is wound in an elongated helix **12** around and along an elongated rectangular mandrel, not shown. To manufacture the heat dissipator **36**, a triangular mandrel is used. Preferably, the mandrel is built-up of three dovetailing tapered members which are slidable relative to one another. Thus, upon completion of the winding, the mandrel may be collapsed to facilitate removal of the helix therefrom. Mandrels of the type described and means for winding a helix thereabout are known in the art.

After the wire is wound into a helix **12** on the mandrel, the wound mandrel may then be pressed into a forming die, not shown, to closely conform the helix turns to the shape of the mandrel. An advantage of the use of copper wire is that it is quite ductile. After the pressing operation, the wire helix **12**, while still on the mandrel, may then be machined, as by grinding, to provide the helix with accurate external dimensions. These pressing and machining steps provide an accurate fit of the helix loops **14** within the sleeves **24** and **26** in the completed dissipator assembly, with the short sides **19** of the helix turns in full surface contact (through an intermediate layer of solder) with the sleeves **24** and **26**.

The winding mandrel is then collapsed and the helix **12** removed therefrom. The helix **12** is then formed into a closed loop **14** by fixing the end turns of the helix to one another. A simple means to accomplish this, as shown in FIG. 5, is to insert the two ends **50** and **52** of the helix wire into the opposite ends of a metal tubing **54**, and then pinch the tubing onto the wire ends.

For assembling a number of helix loops **14** into a dissipator **10**, an assembling jig **56**, as shown in FIG. 4, can be used. The jig **56** comprises a base member **58**, an outer wall **60**, a central platform **62**, and a removable annular top plate **66**.

In the assembly of the dissipator **10**, the two sleeves **24** and **26** are first inserted into the jig **56** into engagement with the outer wall **60** and the platform **62** of the jig, respectively. Two thin walled cylinders **70** and **72** of a solder material are then placed in the jig in engagement with the inner and outer sleeves **24** and **26**, respectively. A helix loop **14** is then placed in the bottom of the jig **56** between the cylinders **70** and **72**. Preferably, the helix loop **14** fits snugly therebetween. Two spacer rings **20** and **22** are then dropped into the jig into engagement with the helix loop **14** adjacent to the inner and outer portions thereof. Further helix loops **14** and spacer rings **20** and **22** are then alternately loaded into the jig to build up the dissipator to the desired size, as shown. The top plate **66** is then loaded into the jig into engagement with the top loop **14** to press the various members in the jig into firm engagement with one another. The loaded jig is then passed through a furnace to melt the solder cylinders **70** and **72** to solder the loops **14**, the spacer rings **20** and **22**, and the sleeves **24** and **26** to one another at their contacting points.

Using a copper wire and copper clad steel sleeves **24** and **26**, a solder known as BT solder and comprising a copper-silver eutectic can be used. The jig **56** is made of a material non-wettable by the solder, such as a chrome-iron alloy which has been surface oxidized.

With reference to FIG. 6, a heat dissipator **80** is shown comprising a helix of wire formed into a circular closed loop **82**. For strengthening and stiffening the dissipator **80** and for directing the flow of a cooling medium therethrough, annular plates or washers **84** and **86** lying in planes substantially perpendicular to the axis of the loop **82** are bonded to opposite sides of the loop.

In use, the dissipator **80** can be mounted, for example, on one end of the tube **32** shown in FIG. 2 by soldering the washer **86** to the tube envelope. Cooling air passes into the dissipator **80** through the central opening of the end washer **84** and then radially outwardly through the dissipator.

In the manufacture of the dissipator **80**, an elongated helix **82** may be wound in the same manner as described in connection with the winding of the helices **12** for the dissipator **10**. A jig of the type shown in FIG. 4 may be used. A first washer **84** is first dropped into the bottom of the jig, a closed helix loop **82** then placed in the jig on top of the washer **84**, and the second washer **86** then placed on top of the helix loop **82**. Solder is provided, for example, by means of a solder cladding on the washers **84** and **86**. A jig cover plate is used to maintain the parts in engagement, and the jig is heated to melt the solder to solder the parts together.

With reference to FIG. 7, a heat dissipator **90** comprises two concentric loops **92** and **94** spaced apart by a spacer assembly **96**. The spacer assembly comprises two rings **98** and **100** maintained in coaxial, spaced apart relation by spaced apart brace members **102**. The loops **92** and **94** are mounted between stiffening annular plates or washers **106** and **108**.

The manufacture of the dissipator **90** is similar to the manufacture of the dissipator **80** except that the two loops **92** and **94**, and the spacer assembly **96** are loaded into the jig between the two washers **106** and **108**.

What is claimed is:

1. A heat dissipator comprising:

(a) inner and outer concentric metal sleeves defining an annular space therebetween, and

(b) a plurality of helices of wire formed into closed loops stacked concentrically with said sleeves in said annular space and lying in planes normal to the axis of said sleeves, each turn of said helices being bonded to said inner and outer metal sleeves.

2. A heat dissipator as in claim **1** and wherein adjacent turns of said helices are substantially in mutual contact adjacent to said inner sleeve for forming a substantially continuous contact of said helices with said inner sleeve.

3. A heat dissipator as in claim **1** including:

two closed wire helix loops, and

spacer means bonded to each and between adjacent ones of said loops for maintaining said loops in spaced apart relation.

4. A heat dissipator as in claim **3** wherein said loops are circular and are in coaxial side-by-side relation, and said stiffening means comprises a tubular sleeve bonded to the radially inner portions of said loops and a tubular sleeve bonded to the radially outer portions of said loops.

5. A heat dissipator as in claim **1** wherein the turns of said helices are triangular in shape with the base portions of said turns engaged with the inner one of said sleeves.

References Cited

UNITED STATES PATENTS

3,217,392	11/1965	Roffelsen	165—184
3,327,779	6/1967	Jacoby	165—80

FOREIGN PATENTS

479,887	2/1938	Great Britain.

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