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COOLING APPARATUS

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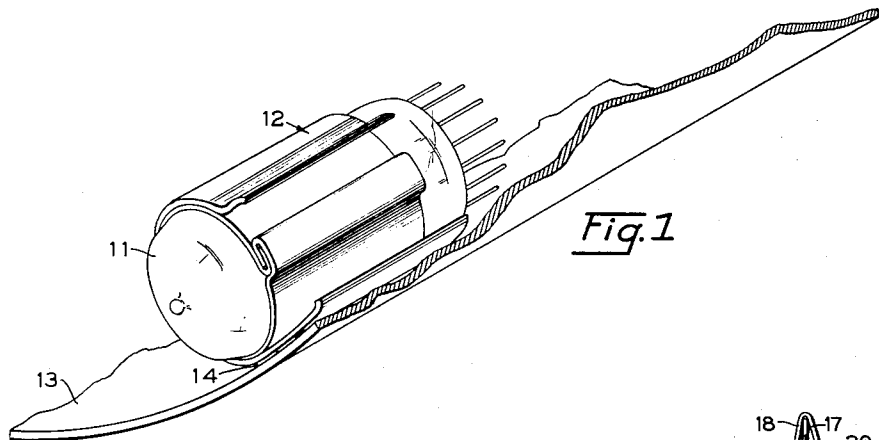


Fig. 1

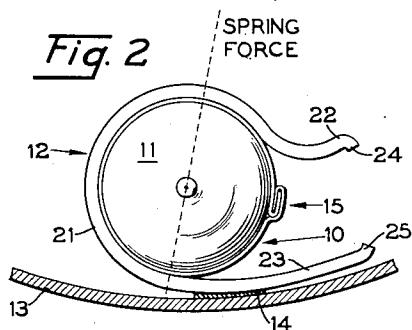


Fig. 2

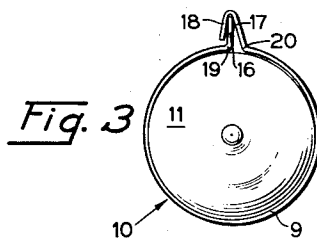


Fig. 3

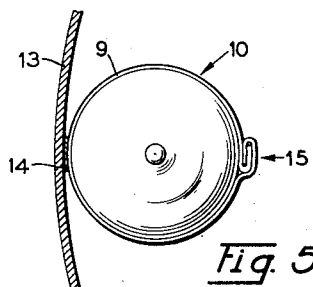


Fig. 5

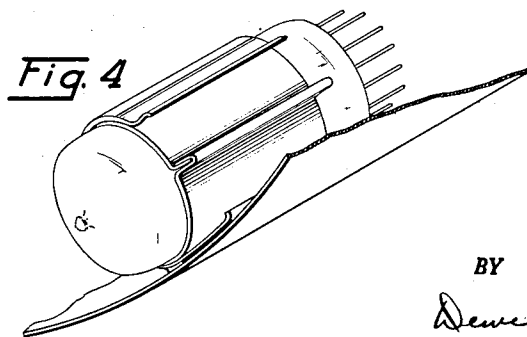


Fig. 4

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3 Claims. (Cl. 257—263)

The present invention relates to apparatus for dissipating the heat generated in electrical devices and particularly the dissipation of heat in electron tubes of the vacuum and gas type.

An object of this invention is to provide improved heat dissipation means for electrical devices.

Another object of the invention resides in the provision of improved mounting means for electronic components for efficiently dissipating the heat generated in said components during operation thereof.

Still another object of the present invention is to furnish improved mounting means for electron tubes of the thermionic type for dissipating the heat generated therein and eliminating, or reducing to a minimum, damage to the tubes caused by tube envelope hot spots.

A further object of this invention is to provide a wrap-around type of mounting means for thermionic tubes which applies sufficient pressure to the outside of said tubes for dissipating the heat therefrom by providing maximum contact between the mounting means and said tubes.

A still further object of the instant invention is to furnish a mounting clip, of the spring type, for electrical devices which dissipates the heat therefrom in an efficient manner by concentrating the points of spring force in a position such that the shortest path, and therefore least resistance to conductive heat transfer to a heat sink, will be obtained.

Another object of the invention is to provide improved means for mounting tubes of the thermionic type in a container or can without the necessity of soldering the mounting means to the container after said tubes are placed in the mounting means.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of examples, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 is a perspective view of the present invention;

Fig. 2 is an end view of the invention;

Fig. 3 is an end view of the tube shield forming a part of the present invention before it is secured to the device to be cooled;

Fig. 4 is a perspective view of the tube shield shown before it is secured to the device to be cooled; and

Fig. 5 is an end view of the tube shield showing the tube shield secured directly to a container to be cooled.

Under circumstances where electrical devices must operate in structures where the heat generated by the devices cannot be readily dissipated by air contact therewith, cooling of the devices is required. For example, if an amplifier is mounted in a container, which may be referred to as a can, there is little or no opportunity for the heat generated by the vacuum tubes, transformers, resistors, etc., making up the circuit to be dissipated except through the can wall. This results in varying tem-

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peratures inside the can. These varying temperatures change the operating characteristics of the circuit to such an extent that it is unreliable.

Various types of mounting devices or clips have been suggested in the past. Deficiencies arise in these prior art devices in a number of ways. When dealing with tubes, by way of example, difficulty is experienced in obtaining firm contact between the mounting means and the tube without fear of breaking the tube. In other cases the mounting means fails to surround the tube so that the tube temperature varies from one portion to another. Hot spots may be generated at points not covered by the mounting means resulting in permanent injury to the tube. A number of prior art mounting means may provide acceptable heat dissipating qualities but when subjected to vibration provide a structure which is unable to maintain contact with the electrical device it is holding.

The present invention proposes to overcome the deficiencies of the prior art structures in a manner which will be apparent as the description proceeds.

Referring to the drawings, the heat dissipating apparatus is seen to comprise a cylindrical shield 10 which is adapted to surround a device to be cooled. The last-named device may take many forms and is shown by way of example only as a thermionic tube 11. The tube shield may be soldered directly to the wall of a container, such as is shown in Fig. 5, or it may be mounted in a clip which is secured to the wall of a container, such as is shown in Figs. 1 and 2.

Referring to Figs. 1 and 2, the tube shield is mounted to fit a spring clip which is constructed in a manner to tightly grip a major portion of the tube shield. The clip is adapted to be secured to the wall 13 of a container by soldering, or some other suitable technique, as illustrated at 14. The wall 13 is shown only partially, it being understood that the container may be a means for mounting a plurality of the components in a package. The container may be secured to a cold plate or other apparatus for cooling the container surface. The container itself may be considered a cold plate since it may be cooled by appropriate means such as air circulation.

The shield 10 is constructed from a rectangular sheet of material. The material used may vary but it should have good heat transfer characteristics. Standard annealed copper having a thickness of approximately .008" has been found to be satisfactory. An open loop 9 is initially formed. The seam for binding the ends of the loop together and for securing the device to be cooled within the loop is of a construction such that a pressure fit is obtained between said device and said shield. The seam is illustrated generally by reference numeral 15. Referring to Figs. 3 and 4, the seam is shown in its formative stages. One end of the loop has a flange 16 formed thereon whereas the other end of said loop has a U-shaped or V-shaped flange having legs 17 and 18 formed thereon. The arrangement is such that when the seam is in its formative stage flange 16 is adapted to fit between legs 17 and 18. At this time the junction of flange 16 with the loop, illustrated by numeral 19, and the junction of leg 17 with the loop, illustrated by numeral 20, are spaced apart such that the loop 9 is slightly larger than the electrical device to be cooled. As shown in Fig. 3, a space exists between tube 11 and the portions of loop 9 adjacent the flanges. In this manner, insertion of the tube in the loop is facilitated. Tube envelope tolerances are taken care of by the spacing apart of junctions 19 and 20. For tubes with tolerances on the high side, junction 20 tends to straighten and a tight fit is still obtained.

With tube 11 in place within loop 9, any convenient means may be provided to grip flange 16 between legs

17 and 18 and then bend them over against the portion of the loop adjacent junction 19. The use of the term loop is intended to include configurations other than one which is strictly arcuate. For example, a square or octagonal configuration would be included by the term. It will be seen that intimate contact can still be obtained by the shield and the clip in these configurations. When the aforementioned gripping action occurs junction 19 and 20 are brought closer together and then forced even closer together when the flanges are bent over against the loop, as shown in Fig. 5. As the two flanges are brought together a pressure fit is formed on tube 11. The pressure applied to the tube is even throughout and forces the shield to the tube surface regardless of surface irregularities, except, of course, for the small space at the seam where the shield does not contact the tube.

A procedure which may be followed in producing the shield will be outlined in detail. The rectangular sheet out of which the shield is constructed has the flanges, previously described, formed at each end thereof. Using a cylindrical object as a form, loop 9 is formed. At this time, if it is desired to mount the shield directly to the can wall as shown in Fig. 5, a middle portion of the shield is soft soldered silver brazed or spot welded to said wall. Thereafter the end flanges are arranged as shown in Figs. 3 and 4 so that tube 11 may be inserted therein. The apparatus is then ready for the final operation of securing the tube in the shield with a pressure fit, as previously described.

Insofar as the arrangement shown in Fig. 5 is concerned, the heat transfer from the thermionic tube to the can wall is facilitated by the pressure fit between the tube and the shield. This prevents the formation of hot spots on the tube envelope which are injurious to tube operation. For example, with subminiature tubes such as type 5902, the tube button is constructed of a soft leaded glass in order to match the thermal expansion of the lead wires which pass therethrough to the tube elements. At elevated temperatures, for example temperatures above 160° C., the soft leaded glass electrolyzes when a voltage gradient is present between the lead wires. This electrolysis results in oxygen being given off at one lead and lead plating occurring at the other lead. Any water vapor which may be present in the tube combines with the oxygen and causes rapid burn-out of the heater filaments and/or low emission. It is thus important to maintain the tube button at or below the critical temperature, for long life.

The tube button is elevated in temperature in the type 5902 since the heater filaments are somewhat shielded from the tube envelope, causing a concentration of the heat at the filament lead wires which are mounted in the button.

With the present invention used on subminiature tubes of the type mentioned, laboratory experimentation has shown it possible to provide small differences in temperature between the hot spot on the tube, which is adjacent the filament lead wires on the button, and the hot spot on the can wall 13 upon which the tube is mounted. By way of example, a tube of the type afore-mentioned which dissipates seven watts, can be said to operate safely with a 10° C. per watt input differential between the tube hot spot and the can wall hot spot, the can wall hot spot being allowed to go as high as 100° C. All of the measurements were made by surface measuring techniques.

When the instant invention is utilized with miniature tubes, such as type 5686, a tube dissipating fourteen watts was operated with a 4.5° C. per watt input differential between the tube hot spot and the can wall hot spot, the wall hot spot being allowed to go as high as 100° C. as with the subminiature tubes. The hot spot on the particular type 5686 miniature tube was on the envelope adjacent the plate.

There are times when it is inconvenient to mount the shields directly to the can wall. It may be that the tubes are not to be inserted into the shields until after the latter have been placed inside a can. Under this condition it may be difficult to insert a tool inside the can which is capable of gripping the flanges together and bending them over adjacent the loop. For production purposes it may be desirable to wrap all tubes with shields during one stage of the operation and later mount them in devices such as clip 12. This clip has an arcuate loop portion 21 which is adapted to receive the shield therein in a complementary manner. While loop portion 21 is shown to be arcuate, it is intended that it be complementary to the surface of the shield for greatest heat conduction. The clip is open and has extensions 22 and 23 provided at each end thereof, the end edges of said extension being bent over toward each other to provide lips 24 and 25, respectively. It will be seen that insertion of a tapered tool between the extensions will expand the size of the loop so that the tube with its wrap-around shield may easily be inserted therein. Removal of the tool allows the clip to engage a major portion of the shield. The dotted line shown in Fig. 2 indicates the points of maximum pressure. It is at these points where maximum heat conduction occurs. One of these two points is adjacent to the solder connection 14, such that a short path of heat conduction exists between the point of contact of the clip to the shield and the solder connection. Therefore the greatest temperature drop can be obtained between tube hot spot and can wall.

From the above it will be apparent that I have provided an apparatus for dissipating the heat generated in electrical devices in an efficient manner, thereby reducing the hot spots in said devices to a safe operating temperature. The wrap-around shield provides a pressure fit on the device to be cooled so that rapid heat transfer is possible. The pressure fit is obtained by the formation of the seam for holding the electrical device in the shield. There has also been provided an improved means for mounting said electrical device in a can. The can may be secured to a cold plate or subjected to some other form of cooling. The mounting means facilitates assembly of the electrical devices in said can.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. An apparatus for cooling electrical devices, a wrap-around shield including a loop portion which is adapted to receive an electrical device to be cooled, complementary flange means at the ends of said loop portion, said flange means being adapted to be bent over so that they lie adjacent said loop portion to furnish a pressure fit for said electrical device in said loop portion.

2. In apparatus for cooling electrical devices, a wrap-around shield including a loop portion which is adapted to receive an electrical device to be cooled, U-shaped flange means on one end of said loop portion, flange means on the other end of said loop portion adapted to fit within said U-shaped flange in complementary fashion, both said flange means being adapted to be bent over against the part of said loop portion adjacent said other end of said loop portion, said device to be cooled having a pressure applied thereto by said shield as the flange means are bent over against said loop portion.

3. In apparatus for cooling electrical devices, a wrap-around shield including a loop portion which is adapted to receive an electrical device to be cooled, U-shaped flange means on one end of said loop portion, flange means on

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the other end of said loop portion adapted to fit within said U-shaped flange in complementary fashion, both said flange means being adapted to be bent over against the part of said loop portion adjacent said other end of said loop portion, said device to be cooled having a pressure applied thereto by said shield as the flange means are bent over against said loop portion, clip means mounted on a cold plate and including an open loop portion adapted to receive a major portion of said shield in intimate contact therewith, and extension means on at least one end of said open loop in substantial parallelism with said cold plate so that a tapered tool may be inserted between said extension means and said cold plate to open the loop from its normal size to facilitate insertion or removal of said tube shield therein.

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