Oct. 17, 1961 A. Q. MOWATT 3,005,036

TUBE SHIELD

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Fig. 2

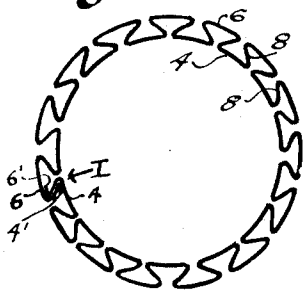


Fig. 1

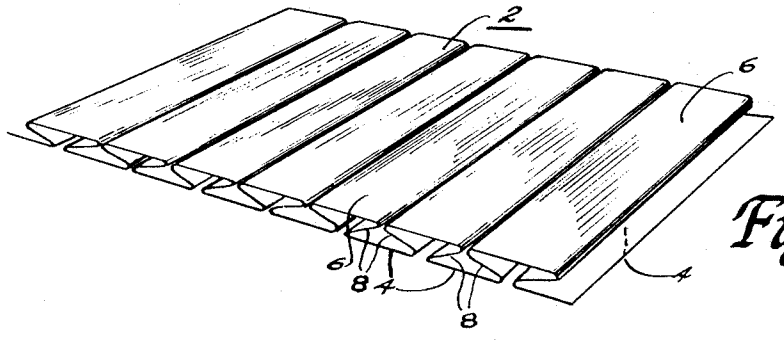


Fig. 3

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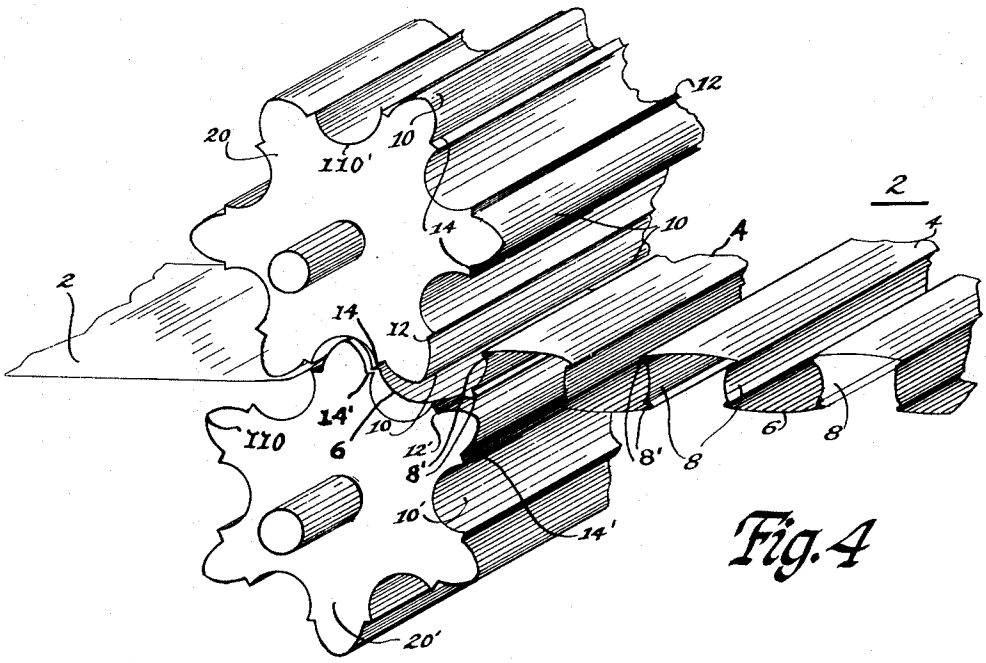


Fig. 4

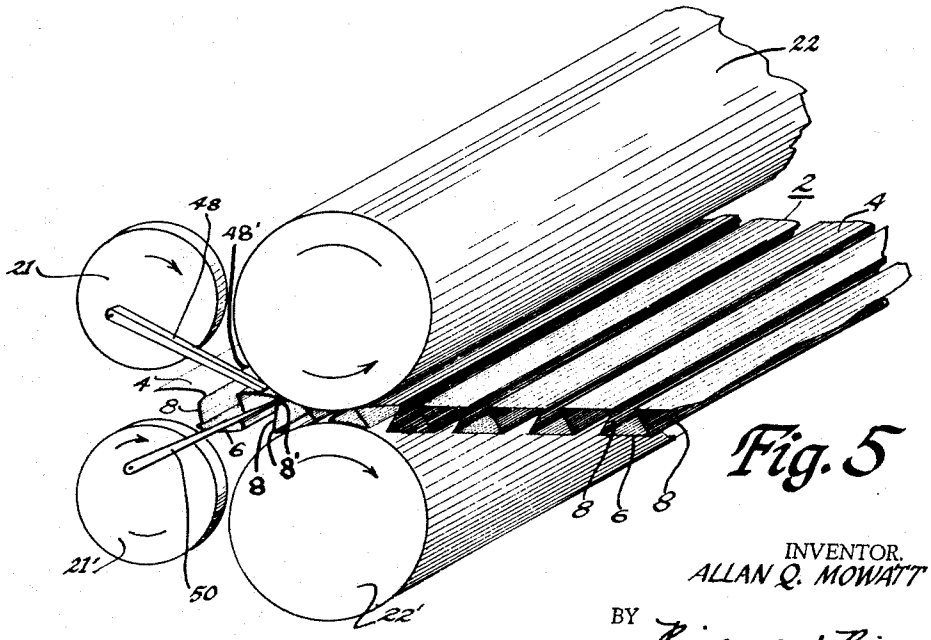


Fig. 5

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TUBE SHIELD

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Fig. 6

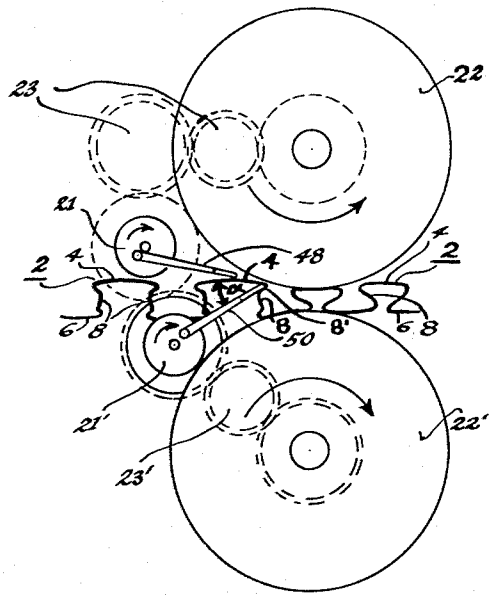
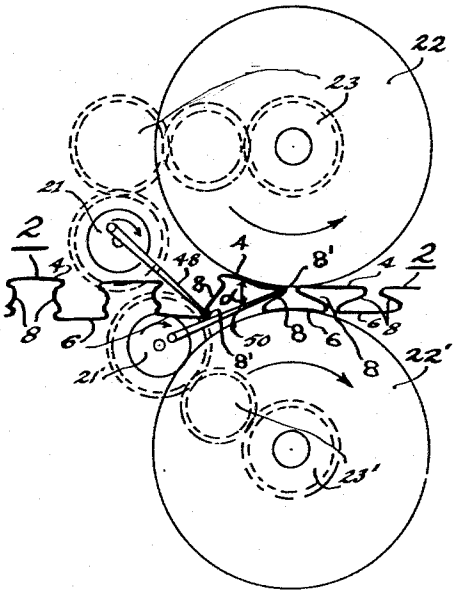


Fig. 7



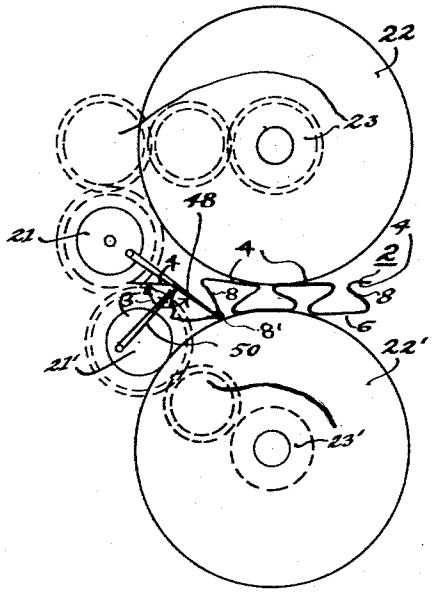


Fig. 8

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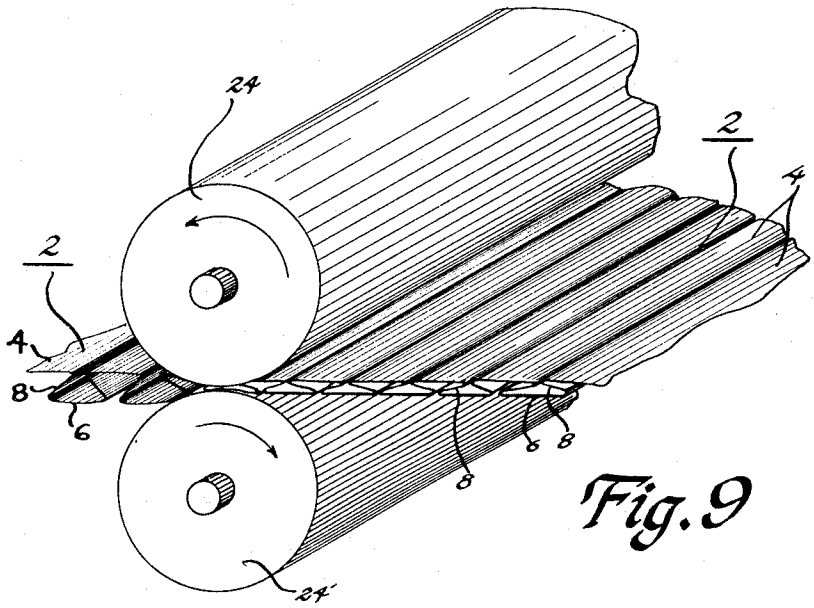


Fig. 9

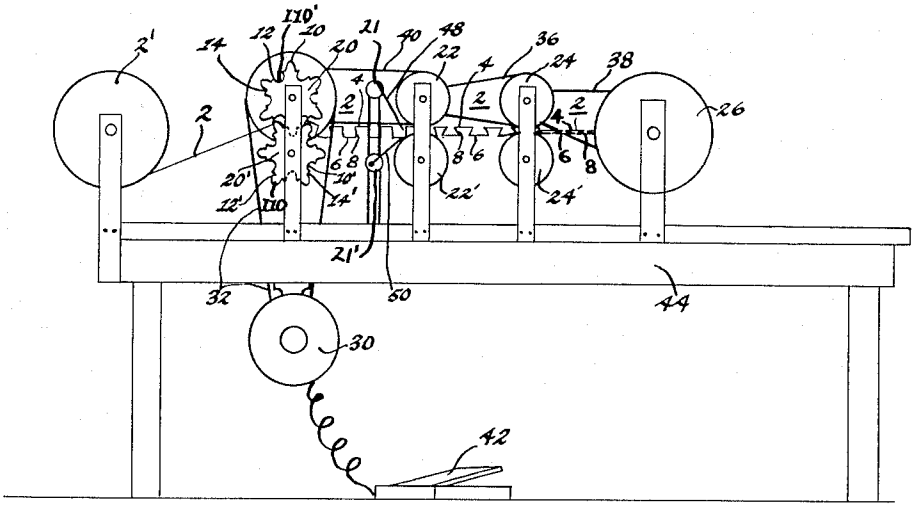


Fig. 10

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United States Patent Office 3,005,036 Patented Oct. 17, 1961

3,005,036

TUBE SHIELD

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Filed Nov. 21, 1957, Ser. No. 697,865
7 Claims. (Cl. 174—35)

The present invention relates to heat-dissipating shields, inserts and methods and, more particularly to shields and inserts adapted for use with electron tubes.

While, for purposes of illustration, the invention will be described in connection with its important application to electron tubes, moreover, it is to be understood that it is also adapted for use with other types of electrical components or other heat-generating devices wherein the hereinafter-described results obtainable with the invention may be desired. The phrase "electron tubes and the like" is therefore employed generically to connote all such devices.

Numerous proposals have been offered throughout the years for dissipating heat generated by electron tubes and the like. Where glass-envelope tubes are employed in electronic equipment, for example, it is frequently vitally important to dissipate the heat generated within the tubes during their operation in order to avoid deleterious effects to the tubes and to surrounding electrical components, particularly if such tubes and components are confined to relatively small spaces. Since the glass walls of the tube envelope cannot efficiently radiate heat to the air surrounding the same, various types of tube clamps and inserts have been evolved for conducting the heat from the walls of the tube envelope to a surrounding conductive shield housing that not only effectively radiates heat into the air, but, through contact with a conductive chassis upon which the tubes and shields may be mounted, can dissipate heat by conducting the same to the chassis. Included in such devices are complicated and relatively expensive spaced multi-finger clamps and corrugated resilient inserts, both of which, unfortunately, do not contact substantially all portions of the lateral surface area of the electron tubes and hence do not dissipate heat from substantially all such portions. In addition, since the shields are generally joined to shield-receiving sockets connected with the chassis, losses in conduction of heat from the shields to the chassis inherent in the junctions with the sockets are unavoidable, further reducing the heat-dissipating characteristics of the apparatus.

An object of the present invention, accordingly, is to provide a new and improved heat-dissipating shield and insert that shall not be subject to the above-mentioned disadvantages but that, in summary, shall provide for the conducting of heat from substantially all portions of the lateral surface area of the electron tubes and the like to the shield and shall permit of efficient heat transfer from the shield to the chassis.

A further object is to provide a new and improved shield.

An additional object is to provide a novel heat-conducting insert and method of and apparatus for manufacturing the same.

Other and further objects will be explained hereinafter and will be more particularly pointed out in the appended claims.

The invention will now be described in connection with the accompanying drawing, FIG. 1 of which is a perspective view, partly broken away, illustrating the employment of a preferred embodiment of the invention;

FIG. 2 is a top elevation of the assembled insert only of FIG. 1;

FIG. 3 is a perspective view of the said insert before assembly in the apparatus of FIG. 1;

FIGS. 4, 5 and 9 are similar views of three steps in the manufacture of the insert;

FIGS. 6, 7 and 8 are side elevations, upon a somewhat different scale, illustrating successive positions of the portion of the manufacturing apparatus of FIG. 5; and

FIG. 10 is a side elevation of the complete assembled apparatus of FIGS. 4, 5 and 9.

For illustrative purposes, a typical substantially cylindrical-envelope electron tube is shown at **17**, FIG. 1, mounted in conventional fashion with its electrode pins, not shown, received within a tube socket **15** disposed upon a conductive chassis **11**. A resilient sheet-metal heat-conductive insert **2** is disposed between the lateral outer-wall cylindrical surface of the tube envelope **17** and the inner wall of an outer conductive cylindrical shield housing **1**. The insert **2**, in accordance with the invention, is formed into a plurality of successively disposed folds. Each fold is substantially triangular in cross-section, such as the triangular fold formed by the flat base region **6** with its adjacent triangle legs **8, 8**, and the adjacent triangular fold formed by the flat base region **4** and the corresponding triangle legs **8, 8**, FIGS. 1 and 3. The term "triangular" is a convenient term generally descriptive of the shape of the folds even through the legs **8** may or may not quite touch to form a vertex, and it is intended to embrace, also, those cases where the legs **8** may approach parallelism with the base regions **4** and **6**. Adjacent folds, moreover, are oppositely oriented, the alternate-triangle flat base regions **6** being shown facing outwardly in FIG. 1 and upward in FIG. 3, and the remaining base regions **4** being shown facing inwardly toward the tube surface **17** in FIG. 1, and downward in FIG. 3.

Because of this substantially triangular construction, as contrasted with prior-art rectangularly corrugated inserts, when the resilient insert **2** is compressed and disposed between the tube **17** and the outer shield housing **1**, the flat base regions **6** of alternate folds become almost contiguous with one another, as do the flat base regions **4** of the remaining folds. An almost contiguous cylindrical heat-conductive surface formed by the base regions **4** thus contacts substantially all of the lateral cylindrical surface area of the tube envelope **17**. A similar almost contiguous cylindrical surface formed by the inert base regions **6** contacts substantially the complete surface area of the inner wall of the shield **1**. Heat is thus effectively conducted from substantially all points of the lateral surface of the tube **17** to the shield **1**, dissipating more heat than the before-described prior-art clamps or inserts which do not provide heat-conducting paths from so much of the tube surface area as is provided by the present invention.

As an illustration of the effectiveness of the novel substantially full-surface-area heat-conductive insert **2**, as compared with rectangular-corrugated inserts, type 5687WA tubes have been found to operate at from about 15° to 20° centigrade less maximum temperature over a sink temperature range of from 20° to 70° centigrade. At a sink temperature of about 60° centigrade, for example, the tubes will achieve a maximum temperature of about 126° centigrade with the prior-art inserts, but a lesser maximum temperature of about 109° centigrade with the insert **2** of FIG. 1.

The insert is preferably formed by passing a flat sheet **2** of resilient bronze or other similar material through cooperating scalloped steel rolls **20** and **20'**, FIGS. 4 and 10. The sheet material **2** may be fed from a roll **2'**, as shown in FIG. 10. The scalloped roll **20** is provided with a periodic major ribs **10**, that cooperate with major depressions **10'** of the roll **20'**, and, on one side, adjacent minor ledges **12** cooperating with corresponding regions **12'** on the roll **20'**. On the other side of the

ribs 10, the roll 20 is provided with another ledge 14, similar to the ledge 12, for cooperating with a ledge 14' on the roll 20'. The roll 20' similarly is provided with major ribs 110 between the depressions 10' for cooperating with corresponding depressions 110' in the roll 20. In passing through the rolls 20 and 20', therefore, the sheet 2 is periodically depressed by the ribs 10 within the depressions 10' to form a substantially flat neck of a lower U-spaced fold 6, and, by the ribs 110, within the depressions 110', to form a substantially flat neck of an upper U-shaped fold 4. The ledges 12—12', 14—14' serve to bow or set the side walls 8 outward for a purpose later explained, and form slight upper and lower transverse recesses 8'.

The resulting U-shaped corrugated sheet is then fed through upper and lower preferably rubber rolls 22 and 22', FIGS. 5 through 8, and are acted upon by upper and lower arms 48 and 50, mounted eccentrically upon cam shafts 21 and 21' which may be driven in the same direction and synchronously with the oppositely rotating rolls 22 and 22' through the medium of gear trains, shown dotted at 23 and 23' in FIGS. 6, 7 and 8. The arms 48 and 50 have blades extending transversely of the sheet 2, as more particularly shown at 48' in FIG. 5. As illustrated in FIG. 6, the relative positioning of the arms 48 and 50 upon the cam shafts 21 and 21' is such that the arm 50 will engage the upper transverse recess 8' of a side wall 8 to the right of a flat neck region 4, while the arm 48 rides over the region 4. Rotation of the cam shaft 21' clockwise, in the direction of the arrow illustrated thereupon, causes the arm 48 to press upwardly at an acute angle α, FIGS. 6 and 7, against the upper recess 8' of the outwardly set or bowed wall 8, so that the rolls 22 and 22' will form the left-hand inwardly inclined leg 8 of the triangular fold 8—6—8. Meantime, the arm 48 has dropped, FIG. 7, engaging the lower transverse recesses 8' of the wall 8 to the left of the flat neck region 4. Further rotation of the cam shafts 21, 21', FIG. 8, results in the arm 48 pressing downward against the lower transverse recess 8' at an obtuse angle β, forcing the same inward to form the left-hand leg 8 of the triangular fold 8—4—8.

The preferably isosceles triangular folds 8—4—8, 8—6—8 are thus formed and, as shown in FIGS. 9 and 10, they may be further flattened for ultimate use by passing the same through presser rolls 24, 24'. The formed material 2 may be wound on reels 26, FIG. 10, and then cut to the desired insert size. The present construction, moveover, provides for easy assembly in ring form with the triangle ends of the cut-insert interlocking as at I, FIG. 2, where, preferably, a little section 6' at the cut is interlocked within a triangular fold 8—6—8, and a similar fragmentary section 4' is interlocked within an adjacent fold 8—4—8. A preferred driving mechanism is illustrated in FIG. 10, wherein a motor 30, electrically operated as by a foot-pedal switch 42, may drive the rolls 20—20', 22—22', 24—24' and 26, mounted upon a machine chassis or table 44, through the medium or belts or chains 32, 40, 36 and 38, respectively. Any other well-known gear or other drive mechanism may also, of course, be employed.

When the preferred shield 1 is employed, furthermore, additional heat-dissipating efficiency is obtained since the shield 1 is directly secured with an excellent heat-transfer junction to the conductive chassis 11, FIG. 1. This result is obtained by having an integral base upon the shield 1 provided with an indented region 3 the lower portion of which extends outwardly at the lip 5 and then downwardly at 7. The outwardly and downwardly extending lip portion 7—5 is resiliently clamped tightly along the periphery 7' against the chassis 11 by means of screws 13 passing through apertures 9—9' in opposite sides of the lip 7 and secured to the chassis 11. The portion 9 of the aperture 9—9' is large enough to receive the screw-head 13 so that slight rotation of the shield 1 clockwise will cause the screw head 13 to clamp over the reduced aperture portion 9', resiliently compressing the periphery 7' of the lip 7—5 downwardly tightly against the chassis 11. An excellent heat-transfer junction between the shield 1 and the chassis 11 is thereby achieved, obviating the losses inherent in separate shield and shield-socket or shield-base constructions.

With the same 5687WA type tubes, for example, about 25° centigrade less temperature has been attained by the tubes if employed with the integral shield 1, as compared with prior-art separate shield and shield-base constructions, over sink temperatures ranging from 20° to 70° centigrade.

Further modifications will occur to those skilled in the art and all such are considered to fall within the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. Apparatus of the character described for use with an electron tube and the like that is to be mounted within a socket upon a chassis, comprising an outer conductive shield housing for encasing the electron tube in the socket and provided with an integral indented base region the lower portion of which extends outwardly and then downwardly to contact the chassis in the region surrounding the tube socket, the outwardly and downwardly extending portion being resilient to permit of its becoming clamped tightly along its periphery to the chassis upon the application of pressure at one or more securing points along the said region of the chassis.

2. Apparatus as claimed in claim 1 and in which the said outwardly and downwardly extending portion is of cross-dimension larger than that of the shield housing.

3. Apparatus as claimed in claim 1 and in which the said housing and the said outwardly and downwardly extending portion are of substantially circular cross-section.

4. Apparatus as claimed in claim 3 and in which the diameter of the said portion is greater than that of the said housing.

5. Apparatus of the character described for use with an electron tube and the like that is to be mounted within a socket upon a chassis, comprising an outer conductive cylindrical shield housing for encasing the electron tube in the socket and provided with an integral indented base region the lower portion of which extends outwardly and then downwardly to contact the chassis in the region surrounding the tube socket, the outwardly and downwardly extending portion being resilient to permit of its becoming clamped tightly along its periphery to the chassis upon the application of pressure at one or more apertured securing points along the said lower portion, the apertured securing points comprising openings for receiving a screw head and locking the same upon rotation of the housing.

6. Apparatus as claimed in claim 5 and in which the said points are disposed at least partly within the said indented region under the said housing.

7. Apparatus as claimed in claim 6 and in which the said outwardly and downwardly extending portion extends outward beyond the said points.

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