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ELECTRICAL HEATER UNIT

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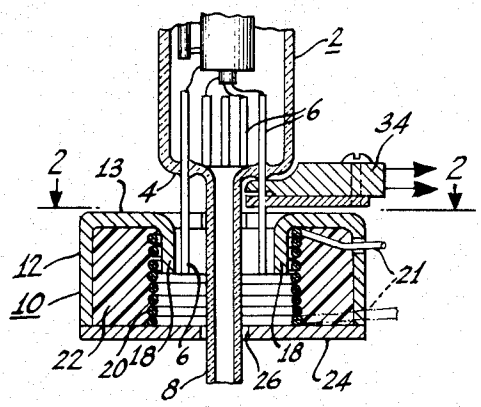

Fig. 1.

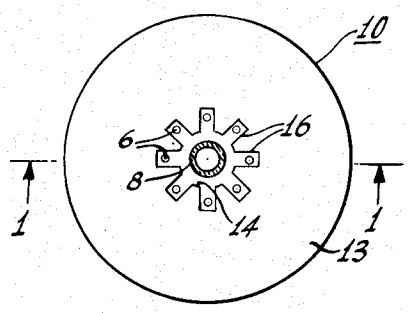

Fig. 2.

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ELECTRICAL HEATER UNIT

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This invention relates to electrical heater units of the type especially suited for use in electron tube manufacture for sealing off an electron tube envelope after exhaust.

In the manufacture of electron tubes, it is common practice to provide an envelope with a small glass exhaust tubulation. In the processing of the tube, the envelope is exhausted through the tubulation and the tubulation then heated to melt the glass and close the tubulation at a point close to the envelope wall. Such sealing of the tubulation is referred to as tip-off.

In many types of electron tubes the exhaust tubulation is provided as a part of a stem structure. The stem structure includes a glass disk or wafer having sealed therethrough a circular array of lead-in conductors. The exhaust tubulation is normally disposed centrally of and within the array of conductors.

With the desire to provide more compact electron tubes, overall size is decreased wherever possible. One way of providing a more compact tube envelope is to tip-off the tubulation closer to the glass wafer of the tube stem. It is desirable that the exhaust tubulation be tipped off a shorter distance from the glass wafer of the stem than the distance which the lead-in conductors extend therefrom.

Heaters commercially used for heating the exhaust tubulation for tip-off frequently comprise a helically wound resistance heater coil sized to fit around the tubulation and inside the circular array of lead-in conductors. However, difficulties have been encountered with this type of tip-off heater. If even a small misalignment of concentricity between the coil and the tubulation exists, or if the wall of the glass tubulation is itself nonuniform in thickness, an uneven heating of the tubulation will occur. Such uneven heating is aggravated in such heaters due to the close spacing between the heater coil and the tubulation. Uneven heating results in a nonuniform melting of the glass, which upon cooling may develop undesirable strain patterns resulting in cracked tips. Also, in the case of an implosion of the glass envelope, this prior art type heater is easily damaged by pieces of the glass envelope or fusing of the glass particles to the heater coil. Moreover, conventional type tip-off heaters produce an excessive heating of the lead-in conductors which may cause damage to the tube stem and lead-in seals.

Accordingly, it is an object of this invention to provide an electrical tubulation tip-off heater unit which avoids the problems of the conventional heaters described above.

In particular, it is an object of this invention to provide a tubulation tip-off heater unit capable of tip-off very close to the envelope wall, and yet which does not excessively heat the other parts of the tube stem.

According to the invention, an electrical heater unit comprises an apertured metal plate having a plurality of slots extending radially outward from the aperture. A heat shield strap is supported adjacent the outer end of each slot. The straps extend normally to the apertured plate to form a parallel cylindrical array of heat shields. An electrical resistance heater coil is disposed around the array of heat shield straps.

An electron tube to be tipped off is placed in the heater coil with the tube lead-ins inside the heater coil and with the heat shield straps between the lead-ins and the coil.

In the drawings:

FIG. 1 is a longitudinal section view of the electrical heater unit according to the invention showing in partial section an electron tube stem inserted for tip-off; and

FIG. 2 is a plan view of the heater unit taken along line 2—2 of FIG. 1.

In the drawings an electron tube **2** suitable for tip-off by the invention is shown. The tube **2** includes a glass wafer **4** through which a plurality of stiff lead-in conductors **6** are sealed in a circular array. A glass tubulation **8** sealed to the glass wafer **4** concentrically within the array of lead-in conductors **6** provides an exhaust passage through the wafer **4**.

According to the invention, an electrical heater unit **10** comprises a cylindrical metal cup **12** having an aperture **14** centrally disposed through the end wall plate **13** thereof. A plurality of tube-indexing slots **16** are provided in the end wall **13** and extend radially outward from the central aperture **14**. The slots are preferably provided by a stamping operation so that the material removed from the end wall to provide the slots can be bent at right angles into the cup **12** to provide heat shield tabs **18**. An electrical resistance heater coil **20**, which comprises a plurality of helical turns, is disposed around the circular array of heat shield tabs **18**. The heater coil **20** is potted in the cup **12** by a suitable insulating, heat resistant cement **22**. A pair of leads **21** to the coil **20** are brought out through the side wall of the cup **12**. An end plate **24** may be provided for closing the open end of the cup **12**. A central aperture **26** is provided in the end plate **24** so that the tubulation **8** of the electron tube **2** may be disposed therethrough for connection to an exhaust pump (not shown). The cup **12** and end plate **24** form a heater housing for supporting the tube being processed.

To tip-off a tubulation, the tube **2** is inserted into the heater unit **10** with the tubulation **8** disposed through the aperture **14** and the lead-in conductors **6** disposed in the slots **16**.

The slots insure that the tube will be so angularly indexed that the lead-ins **6** will lie alongside the inside of the heat shield. Thus, heat can be radiated to the tubulation **8** at a point opposite the lead-in conductors **6**. At the same time, the heat shield tabs **18** serve to shield the conductors **6** from heat radiation to prevent their overheating and the possible resultant cracking of the stem.

According to the invention, the heater coil **20** is provided outside the circular array of lead-in conductors **6**. This provision avoids the critical uneven heating problems of the prior art when nonconcentricity of the coil **20** with the tubulation **8** exists or when the wall of the tubulation **8** is of nonuniform thickness. On the other hand the heat shield tabs **18** have proved capable of allowing tip-off within the region bounded by the conductors **6** and at the same time maintaining the lead-in conductors **6** approximately 100° C. cooler than is usual in tip-off heater unit without the heat shields **18**.

In commercial production of electron tubes, it is well known to activate the cathode by heating it during exhaust. For this purpose a suitable activation socket **34** may be provided in conjunction with the tip-off heater unit **10** for making electrical contact to a number of the lead-in conductors **6**.

One embodiment of the invention which has been used to tip-off cathode ray tube bulbs having 8-pin stems is illustrated in the drawings. The lead-in conductors **6** of the tube **2**, and accordingly the slots **16** of the heater housing cup **12**, are disposed equally spaced at 45° intervals about a central axis. The housing cup **12** comprises a $1\frac{9}{32}$ inch deep steel cup having a 2 inch outside diameter. The aperture **14** in the end wall is $\frac{7}{16}$ inch in diameter and the slots **16** extend approximately $\frac{1}{16}$ inch radially outward from the edge of the aperture **14**. The

slots are ⅛ inch wide. The coil **20** comprises 8½ turns of 0.051 inch Nichrome wire and has an internal diameter of ¾ inch. The coil **20** is potted in the housing cup **12** with a commercially available heat resistant cement.

Prior to insertion of the coil **20** and potting it in the housing cup **12**, the housing cup is provided with an enamel coating to prevent electrical shorting between lead-in conductors **6** which have an activation potential applied thereto. The enamel coating comprises a layer approximately 0.004 inch thick. This enamel is preferably white or other light color in order to provide good contrast with the slotted aperture for easier loading. With such a tip-off heater unit **10** it has been possible to provide excellent tip-offs no longer than 0.53 inch.

It will be appreciated that the embodiment of the heater unit illustrated is but representative of the invention. Tip-off heater units according to the invention may be designed to accommodate other size or design stems having a fewer or a greater number of lead-in conductors. Also, the heat shield tabs **18** may, if desired, be provided as separate members which extend in a cylindrical array inside the heater coil **20** from the outer ends of the slots **16**.

What is claimed is:

1. A heater unit comprising a heater coil, indexing means disposed adjacent said coil for angularly indexing the insertion of an electron tube stem having a cylindrical array of wire conductors concentrically into said coil, and a plurality of heat shield straps disposed in a hollow cylindrical array concentrically within said coil, each of said straps lying alongside a different conductor between its conductor and said coil when said stem is in its indexed inserted position.

2. An electrical heater unit comprising a metal plate having therein an aperture and a plurality of slots extending outward from said aperture, a plurality of heat shield tabs connected to said plate adjacent outer ends of said slots and extending normally from said plate on one side thereof in a hollow cylindrical array, and a resistance heater coil disposed concentrically around said array of tabs.

3. A heater unit for tipping off electron tube glass exhaust tubulations, said unit comprising a plate having an aperture therein and a plurality of slots extending outwardly from the periphery of said aperture, a resistance heater coil disposed adjacent said plate coaxially of said aperture, and a heat shield strap extending from the outer end of each of said slots parallel to the axis of said coil.

4. An electrical heater unit adapted to heat a glass tubulation of an electron tube stem without excessively heating a plurality of stiff, parallel lead-in conductors of said stem disposed in a cylindrical array concentrically surrounding said tubulation, said heater unit comprising a heating coil whose inside diameter is slightly larger than the outside diameter of said array of conductors, a plurality of heat shield tabs disposed parallel to each other in a cylindrical array concentrically within said coil, said heat shield tabs being disposed so that a different one of said tabs is aligned parallel to and between a different one of said conductors and said coil when said tube stem is inserted within said coil, and means for angularly indexing the insertion of said stem within said coil to provide said aligned disposition relative to said heat shield tabs.

5. An electrical heater unit adapted to heat a glass tubulation of an electron tube stem without excessively heating a plurality of stiff, parallel lead-in conductors of said stem disposed in a cylindrical array concentrically surrounding said tubulation, said heater unit comprising a heating coil whose inside diameter is slightly larger

than the outside diameter of said array of conductors, a plurality of heat shield tabs disposed parallel to each other in a cylindrical array concentrically within said coil, said heat shield tabs being disposed so that a different one of said tabs is aligned parallel to and between a different one of said conductors and said coil when said tube stem is inserted within said coil.

6. An electrical heater unit comprising a metal plate having therein an aperture and a plurality of slots extending outward from said aperture, said slots being formed by a plurality of tabs stamped from said plate, said tabs being integral with said plate at the outer ends of said slots and bent at said outer ends to dispose said tabs in a parallel array on one side of said plate, and a resistance heater coil disposed around said array of tabs axially parallel therewith.

7. A heater unit for tipping off electron tube glass exhaust tubulations, said unit comprising a cup-shaped housing having an aperture in the end wall thereof and a plurality of equal length slots extending radially outward from the periphery of said aperture, a resistance heater coil comprising a plurality of helical turns defining a hollow cylinder, said coil being disposed within said cup coaxially with said aperture, said coil having an inside diameter slightly larger than the diameter of the circle defined by outer ends of said slots, and a different one of a plurality heat shield strap extending from the outer end of each of said slots parallel to the axis of said coil longitudinally along the inside thereof.

8. A heating unit for tipping off the exhaust tubulation of an electron discharge device having a stem, an exhaust tubulation extending from said stem and lead-ins positioned around said exhaust tubulation, said heating unit comprising a support having an aperture therein for receiving said exhaust tubulation and said lead-ins, heating means on said support concentric with the axis of said aperture and adapted to surround said tubulation and lead-ins, and heat shielding means extending from said support and adapted to extend between said heating means and said lead-ins whereby said lead-ins during heating operations are shielded from said heating means while permitting direct exposure of said tubulation to said heating means.

9. A heating unit for tipping off glass tubulation of an electron discharge device having a stem comprising a disk and an exhaust tubulation extending from said stem and lead-ins positioned around said exhaust tubulation, said heating unit including a housing having a central aperture therein and a plurality of slots extending therefrom for receiving said exhaust tubulation in said central aperture and said lead-ins in the outer ends of said slots and a heating coil within said housing surrounding and concentric with the axis of said aperture, and heat shielding means supported on said housing at the outer ends of said slots and between said heating coil and said lead-ins whereby said lead-ins during heating operations are shielded from said heating coil while permitting direct exposure of said tubulation to the radiant heat from said heating coil.

References Cited in the file of this patent

UNITED STATES PATENTS

1,600,675	Kaye	Sept. 21, 1926
2,606,990	Akeley	Aug. 12, 1952
2,729,733	Heron	Jan. 3, 1956

FOREIGN PATENTS

733,683	Great Britain	July 20, 1955