Aug. 6, 1963 F. R. JOHNSON 3,100,251

TIP-OFF OVEN

Filed Oct. 24, 1960 2 Sheets-Sheet 1

FIG.1.

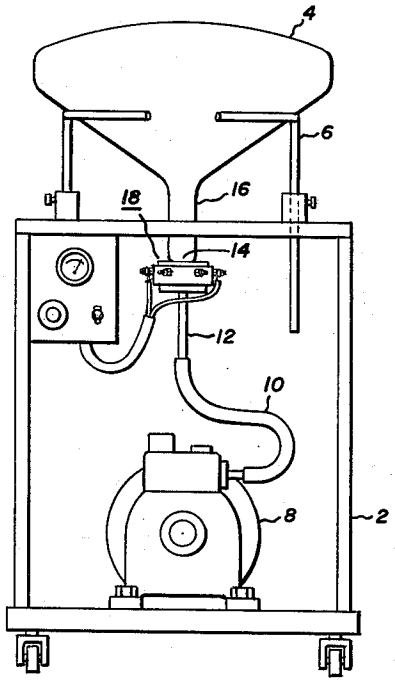
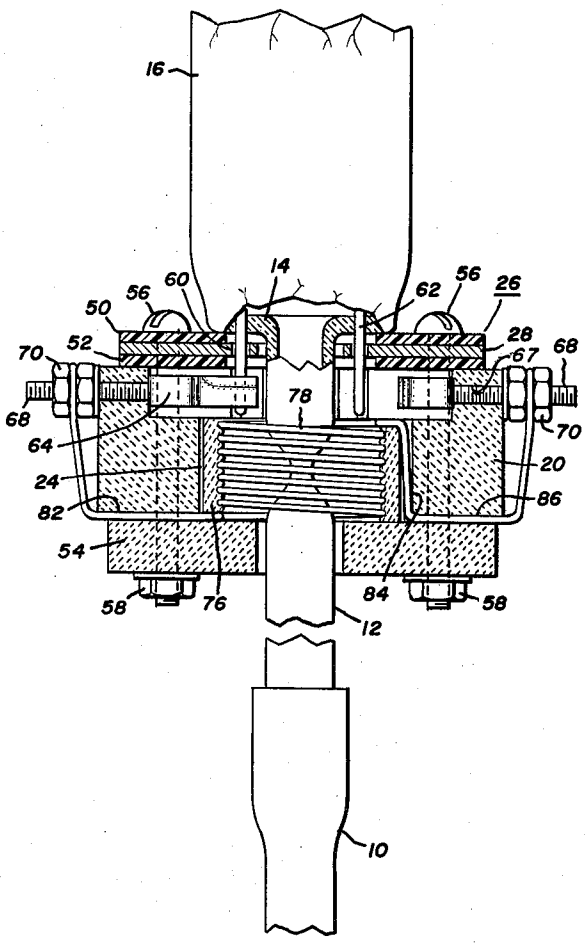


FIG.2.



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Filed Oct. 24, 1960 2 Sheets-Sheet 2

FIG.3.

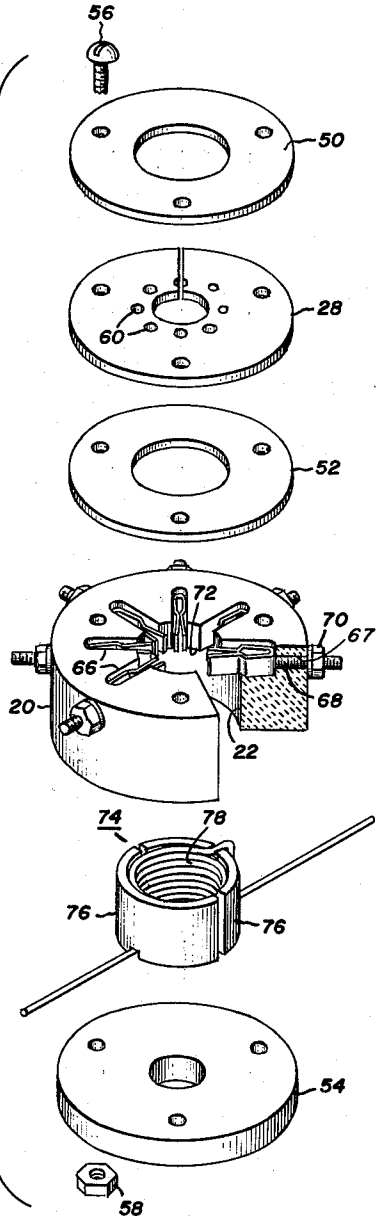
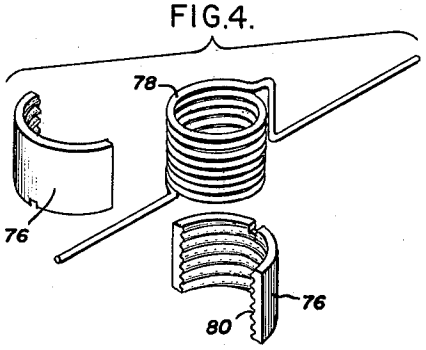


FIG.4.



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3,100,251

TIP-OFF OVEN

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The present invention relates to the manufacture of electronic tubes such as cathode ray tubes, and more particularly to an improved electrically heated tip-off oven for sealing closed the exhaust tubulation of a cathode ray tube or the like.

In the manufacture of eletcronic tubes such as cathode ray tubes it is conventional to exhaust the envelope of the tube through a pipe or tubulation which extends integrally from the envelope, usually from the center of the end wall or "stem" which closes the distal end of the tube neck. The tubulation may be made of glass or other suitable heat softenable and sealable material. After the tube has been exhausted to an appropriate degree, the tubulation is sealed at a point close to the envelope wall by locally heating it to sufficient softness so that a localized portion of the wall of the tubulation collapses under atmospheric pressure and fuses to form a closed gas-tight seal for the tube envelope, after which the remainder of the tubulation is removed.

Electrically fired ovens for the purpose of producing the desired localized heating of the tubulation have been used in the past. However the ovens used heretofore have had numerous disadvantages particularly as respects the time, effort and expense involved in maintaining them in satisfactory operating condition for desirably long periods of time. The importance of the repairability and maintainability of tip-off ovens will be better appreciated if it is understood that one such oven is attached to each tube undergoing exhaust, and since it is customary for an exhaust cycle to have a substantial duration, for example about one hour in the case of television picture tubes of popular size, a factory capable of producing several hundred tubes per hour would require at least that number of tip-off ovens in use at any one time. Also, since each tube has its own individual oven temporarily affixed thereto during the exhaust cycle, such ovens are often employed, at times other than during the actual exhaust cycle, as convenient electrical sockets through which desired potentials may be applied to certain of the electrodes of the tube for such purposes as activating the cathode or testing the condition of the tube. As a consequence it will be appreciated that in a manufacturing plant having even a moderate exhaust capacity, a substantial number of such tip-off ovens is required to be continuously in operation.

Moreover, the environmental extremes to which such ovens are subjected further underscore the importance of easy repairability and maintainability. The high temperatures and frequent temperature changes of the exhaust cycle to which the tip-off ovens are subjected, and the high temperatures repeatedly generated within the tip-off ovens themselves as necessary to soften the tubulation sufficiently to seal it closed, have heretofore made necessary frequent replacement of ovens with cracked or distorted parts. Also, the tendency for molten tubulation material, particularly when the tubulation is glass, to collect on the heating elements or other part of the ovens and build up a deposit which is difficult and time consuming to remove, and which may either impair the heating efficiency of the oven or clog the interior of the oven such that the tubulation of a tube will not fit into the oven, has heretofore made frequent replacement necessary.

A principal object of the present invention is to provide an electrically fired tip-off oven having a lengthened service life in comparison with ovens of the prior art.

Another object is to provide an oven in which the heating element per se is readily removable and replaceable, quickly and inexpensively.

Another object is to provide a tip-off oven whose first cost is relatively small in comparison with ovens of the prior art.

Another object is to provide a tip-off oven which can be readily disassembled, either completely if required, or to the partial extent necessary for performing those repairs most frequently required.

Another object is to provide a tip-off oven which is particularly suitable for accommodating a wide variety of tubulation sizes and stem lead circle sizes.

These and other objects of the invention will be apparent from the following description taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 shows a cathode ray tube mounted on an exhaust cart or buggy suitable for being conveyed through an exhaust oven and fitted with an electrically fired tip-off oven constructed in accordance with the present invention;

FIG. 2 is an enlarged partially sectionalized view of a portion of the structure of FIG. 1;

FIG. 3 is an exploded perspective view, to a diminished scale, of the tip-off oven shown in FIG. 2;

FIG. 4 is an exploded perspective view of certain of the elements shown in FIG. 3.

Turning now to FIGS. 1 and 2 of the drawing, a portable cart or buggy **2** is shown arranged to carry a cathode ray tube **4** in a support bracket **6**, and provided with suitable exhaust pumping means **8** connected by a hose **10** to the tubulation **12** extending integrally downward from the stem **14** at the end of the neck **16** of the tube. A tip-off oven **18** constructed according to the present invention is fitted on the tube in surrounding relation with the tubulation adjacent the stem.

The tip-off oven shown includes a one piece generally cylindrical body **20** of insulating material, which is preferably a ceramic member suitable for withstanding the thermal shock and high temperatures involved, and having an axial throughbore **22** forming a chamber **24** for accommodating the tubulation **12** of the tube to be exhausted.

Closing the upper end of the throughbore **22** is a stiff top plate **26**, shown as of sandwich construction, and as better shown in FIG. 3 consisting of a central stiff layer **28**, which may be metallic, between heat and electrically insulating layers **50** and **52**, which may be made for example of matted mica. A stiff bottom plate **54** of suitable insulating material such as asbestos fibre board closes the lower end of the throughbore. The top plate **26** and bottom plate **54** are secured to the body by bolts **56** which extend through the plates and through axial passages in the body, and are retained by nuts **58** on their lower ends. Both the top plate and bottom plate are centrally apertured to accommodate the tubulation **12**, and the top plate is also provided with additional openings **60** through which the electrode lead wire **62** extending from the envelope wall of the tube, in this case from the tube stem **14**, may extend into electrical conducting engagement with suitable electrical contacts **64** of the tip-off oven. If contact of the stem leads **62** with the top plate would result in short circuiting the stem leads, openings **60** should preferably be of sufficient size to avoid such short circuiting contact.

The throughbore **22** is enlarged at its upper end by a plurality of angularly spaced radially extending grooves **66**, each positioned opposite one of the stem lead openings **60** in the top plate. The outer ends of grooves **66** are connected through radially extending passages **67** to the exterior cylindrical surface of the body. Disposed

within the grooves are resilient forked electrical contacts **64** clamped in place by threaded electrically conductive studs **68** extending through the passages and secured by nuts **70** on their outer ends. Certain of the studs **68** and nuts **70** serve respectively as electrically conductive leads and external terminals for the contacts **64**.

The lower portion of the throughbore **22** is enlarged to form a cylindrical chamber **24** provided at its upper end with an axially facing radially extending annular shoulder **72**. Situated within the chamber **24** is a heating element support **74** of insulative material, preferably ceramic. The support **74** is relatively small and light in weight in comparison with the body, and consists of an annular sleeve formed of a plurality of parti-annular, here shown as parti-cylindrical, segments **76**. Within the support is a heating element **78** consisting of an electrical conductor of annular shape, here shown as a cylindrical spiral, and which may be made of "Nichrome" or other suitable resistance heating wire. The interior surfaces of the segments are provided with a plurality of spaced ridges or outstanding portions **80**, shown as somewhat like spiral threads. These outstanding portions **80** engage and provide the exclusive support for the heating element **78**, as well as holding the individual increments or turns of the heating element in slightly spaced non-short-circuiting relation. One end of the heating element is brought out through a radial groove **82** in the lower face of the body, and the other end is brought out through an axially extending groove **84** in the chamber and a radial groove **86** in the lower face of the body. The terminal ends of the heating element are secured to appropriate ones of the studs **68** by nuts **70**, these studs and nuts thus serving as external terminals for the heating element.

The heating element **78** and heating element support **74** are retained within the chamber merely by the bottom plate **54**, and the heating element support **74** is dimensioned to have a loose enough fit within the chamber **24** to facilitate slight radial movement of the segments such as to accommodate expansion of the heating element, while insuring continuous proper support and separation of the individual turns of the heating element by outstanding portions **80** during oven operation. This segmentation and loose fit of support **74** further facilitates removal of the heating element **78** and heating element support **74** as may be desired without disturbing the remainder of the oven.

An oven constructed as above-described has a number of advantages. First the segmented sleeve-like heating element support **74**, dimensioned to accommodate expansion of the heating element **78** during oven operation without cracking of itself or the oven body **20**, and providing continuous support exclusively of insulating material for each turn of the heating element in separated non-short-circuiting relation with its neighbor, completely avoids the major causes of oven failure, namely insulator breakage and heating element short circuiting or burn out. This provides a substantial increase in oven life. Next all that is required to remove the heating element **78** or heating element support **74** from the oven, for replacement or repair, is to remove the bottom plate and loosen the two nuts **70** holding the ends of element **78**, after which the heating element support **74** and heating element **78** readily drop out of the chamber **24**. No other parts of the oven need be disassembled to permit removal of the heating element or heating element support. Thus the heating element and heating element support, which are the parts most subjected to impairment by fouling with molten glass or other material, and which are most subject to failure mechanically or electrically during operation of the oven, may be readily replaced.

Moreover, the fact that the heating element itself may be readily separated from the segments of the heating element support, and the fact that the heating element support **74** is small, light in weight and of relatively easily moldable shape, means that any of these individual parts may be readily discarded and replaced as individual items at very modest cost without requiring replacement of any other parts of the oven. Additionally, the one piece ceramic body **20**, serving as the container for both the heating element **78** and stem lead contacts **64**, minimizes first cost of the oven and simplifies assembly and disassembly. Further the partial radial grooves **66** enables contacts **64** to be clamped in place by studs **68** without the expense of providing any threaded holes in body **20**.

It will also be evident that since the heating element is of larger diameter than that of the stem lead circle or "pin circle" defined by the stem leads of the tube, tubes having pin circles of different diameters may be readily accommodated in the oven by merely changing the spacing of the openings in the top plate. And thus it will be evident that the oven is readily adaptable for use with a variety of tube types having different pin circle diameters.

It will be appreciated by those skilled in the art that the invention may be carried out in various ways and may take various forms and embodiments other than those illustrative embodiments heretofore described. It is to be understood that the scope of the invention is not limited by the details of the foregoing description, but will be defined in the following claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electronic tube tubulation tip-off oven comprising a body having a central chamber through which the exhaust tubulation of a tube is adapted to extend, a heating element of annular coil form situated within said chamber and dimensioned to surround an exhaust tubulation extending therethrough, a removable and replaceable heating element support situated between the heating element and the wall of said chamber, said support having on the interior surface thereof a plurality of electrically insulative outstanding portions respectively engaging and continuously supporting in non-short-circuiting relationship respective successive increments of said heating element, and retaining means at least partially closing the bottom of said chamber for releasably securing said heating element support in said chamber to permit said support, upon release, to fall freely from said chamber.

2. An electronic tube tubulation tip-off oven comprising a body having a central chamber through which the exhaust tubulation of a tube is adapted to extend, a heating element of annular coil form situated within said chamber and dimensioned to surround an exhaust tubulation extending therethrough, a removable and replaceable sleeve of electrically insulating material situated within said chamber in surrounding relation with said heating element, said sleeve having on the interior surface thereof an outstanding portion of continuous coil configuration providing the exclusive support for said heating element within said chamber to permit said support, upon release, to fall freely from said chamber, and retaining means for releasably securing said heating element support sleeve in said chamber.

3. In an electronic tube tubulation tip-off oven including a body having a central chamber through which the exhaust tubulation of a tube is adapted to extend, and a heating element of annular coil form situated within said chamber and dimensioned to surround an exhaust tubulation extending therethrough, a removable and replaceable heating element support of electrically insulating material situated between the heating element and the wall of said chamber, said support being dimensioned to accommodate heat expansion of said heating element during oven operation and having on the interior surface thereof a plurality of outstanding portions of continuous coil form respectively engaging and continuously supporting in non-short-circuiting relationship respective successive increments of said heating element, and retaining means at least partially closing the bottom of said chamber for releasably securing said heating element support

in said chamber to permit said support, upon release, to fall freely from said chamber.

4. In an electronic tube tubulation tip-off oven including a body having a central chamber through which the exhaust tubulation of a tube envelope is adapted to extend, a heating element of annular coil form situated within the central chamber and dimensioned to surround an exhaust tubulation extending therethrough, an annular heating element support situated between the heating element and the wall of said chamber, said support including a plurality of removable and replaceable parti-annular segments of insulating material dimensioned to accommodate heat expansion of said heating element during oven operation, each of said segments having on the interior surface thereof a plurality of outstanding portions of coil form engaging and supporting in spaced relationship from each other the respective turns of said heating element, and retaining means at least partially closing the bottom of said chamber for releasably securing said segments in said chamber to permit said support, upon release, to fall freely from said chamber.

5. An electronic tube tubulation tip-off oven comprising an insulative body having a central axially extending throughbore providing a chamber through which the exhaust tubulation of a tube envelope is adapted to extend, an axially facing shoulder at one end of said chamber, a heating element of cylindrical helical coil form situated within said chamber and dimensioned to surround an exhaust tubulation extending therethrough, a removable and replaceable cylindrical heating element support situated between the heating element and the wall of said chamber, said support including a plurality of parti-cylindrical segments of insulating material, each of said segments having a plurality of spaced outstanding portions engaging and continuously supporting in spaced relationship from each other the respective turns of said heating element, and releasable retaining means for securing said heating element support in said chamber.

6. An electronic tube tip-off oven comprising a body having a central axially extending throughbore providing a chamber through which the exhaust tubulation of a tube envelope is adapted to extend, a coaxial annular axially facing shoulder within said chamber, a heating element of cylindrical helical coil form situated within said chamber and dimensioned to surround an exhaust tubulation extending therethrough, a removable and replaceable heating element support of insulating material situated between the heating element and the wall of said chamber, said support including a plurality of parti-cylindrical segments, each of said segments having on the interior surface thereof a plurality of respective spaced ridges supporting and maintaining in spaced relationship from each other the respective turns of said heating element, external terminals on said body to which the ends of said heating element are attached, a bottom plate removably secured to said body and covering the mouth of said chamber for holding said support in said chamber and against said shoulder, and an apertured top plate secured to said body and covering the end of said throughbore remote from the mouth of said chamber.

7. An electronic tube tubulation tip-off oven comprising an annular ceramic one piece body having a central chamber through which the exhaust tubulation of an electronic tube is adapted to extend, a plurality of grooves in one end face of said body each terminating at its outer end in spaced relation with the marginal edge of said end face, electrical contacts in said grooves for engaging the electrode leads of a tube having its tubulation extending through said chamber, means for securing each of said contacts in its respective groove including a stud extending through the portion of said body between the outer end of the respective groove and the exterior surface of said body, a heating element of annular coil form situated within the central chamber and dimensioned to surround an exhaust tubulation extending therethrough, a removable and replaceable heating element support situated between the heating element and the wall of said chamber, said heating element support having on the interior surface thereof a plurality of outstanding insulative portions engaging and supporting in spaced relationship from each other the respective turns of said heating element, and retaining means for releasably securing said heating element support in said chamber.

8. An electronic tube tubulation tip-off oven comprising a one-piece annular ceramic body having a central chamber through which the exhaust tubulation of an electronic tube is adapted to extend, a plurality of grooves in one end face of said body extending radially from said central chamber and terminating in spaced relation with the marginal edge of said end face, electrical contacts in said grooves for engaging the electrode leads of a tube having its tubulation extending through said chamber, means for securing each of said contacts in its respective groove including a stud extending through the portion of said body between the outer end of the respective groove and the exterior surface of said body, a fastener on the outer end of each of said studs, a heating element of annular coil form situated within the central chamber and dimensioned to surround an exhaust tubulation extending therethrough, a removable and replaceable annular heating element support situated between the heating element and the wall of said chamber, said heating element support having on the interior surface thereof a plurality of outstanding portions engaging and supporting in spaced relationship from each other the respective turns of said heating element, and retaining means for releasably securing said heating element support in said chamber.

9. An electronic tube tubulation tip-off oven comprising a one-piece annular ceramic body having a central chamber through which the exhaust tubulation of an electronic tube is adapted to extend, a plurality of grooves in one end face of said body extending radially from said chamber and terminating in spaced relation with the marginal edge of said end face, electrical contacts extending radially in said grooves and adapted to engage the electrode leads of tubes having pin circles of different diameters, means for securing each of said contacts in its respective groove including a stud extending through said body to the exterior surface thereof, a heating element of annular coil form situated within the central chamber dimensioned to surround an exhaust tubulation extending therethrough and connected to a pair of said studs, a removable and replaceable annular heating element support situated between the heating element and the wall of said chamber, said heating element support having on the interior surface thereof a plurality of outstanding portions engaging and supporting in spaced relationship from each other the respective turns of said heating element, and retaining means for releasably securing said heating element support in said chamber.

10. An electronic tubulation tip-off oven comprising an annular ceramic one-piece body having a central axially extending throughbore providing a chamber through which the exhaust tubulation of an electronic tube is adapted to extend, a heating element of coaxial annular coil form situated within said chamber and dimensioned to coaxially surround an exhaust tubulation extending therethrough, a removable and replaceable coaxial annular heating element support situated between the heating element and the wall of said chamber, said heating element support having on the interior surface thereof a plurality of outstanding portions of continuous annular coil form dimensioned for loosely engaging and supporting in spaced relation from each other the respective turns of said heating element so as to prevent said turns from sagging into short-circuiting contact with each other, terminals for said heating element on the exterior of said body, said body having grooves in one end thereof through which end portions of said heating element may extend

to said terminals, and retaining means for releasably securing said heating element support in said chamber and covering said grooves.

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