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T. J. HIPSZER ETAL

3,183,394

CATHODE SLEEVE WITH FLANGES CRIMPED AGAINST CERAMIC DISC

Filed July 31, 1961

Fig. 1A

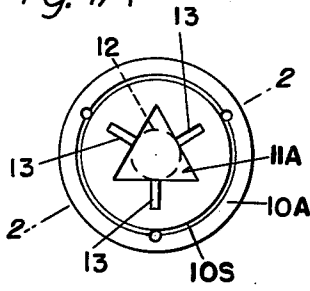


Fig. 1B

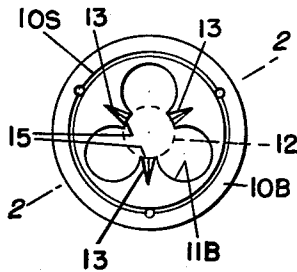


Fig. 1C

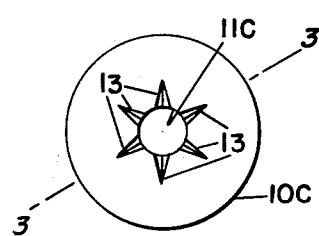


Fig. 2A

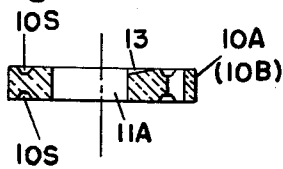


Fig. 2B

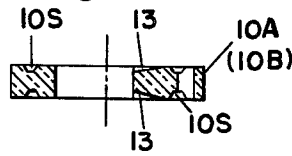


Fig. 3A

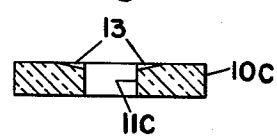


Fig. 3B

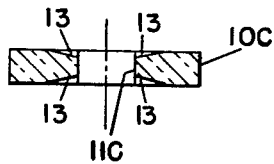


Fig. 4

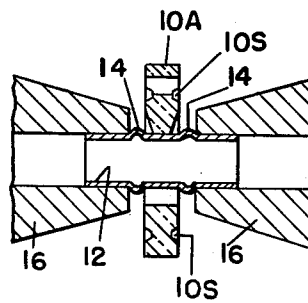


Fig. 5

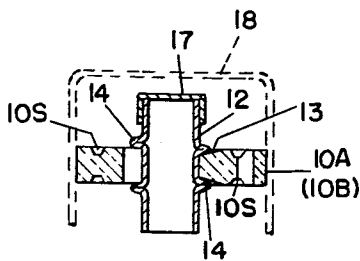
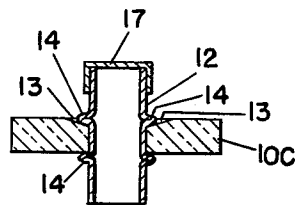


Fig. 6



1

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CATHODE SLEEVE WITH FLANGES CRIMPED AGAINST CERAMIC DISC

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3 Claims. (Cl. 313-270)

This invention relates to cathode assemblies such as used in cathode ray tubes and in other types of thermionic tubes using indirectly heated cathodes.

An extensively used cathode assembly, of type shown in Briggs Patent 2,551,871, comprises a thin walled metal sleeve extending through a ceramic disc. In the assembly operation, the sleeve is embossed to form beads or flanges which are crimped or flattened against opposite faces of the disc adjacent the ends of the hole through which the sleeve extends. In production runs of cathode assemblies of this type, a common problem is the occurrence of loose fits permitting relative rotation between the sleeves and some of the ceramic discs. Such loose fits occur because of the practical impossibility of manufacturing the ceramic discs with precise uniformity of hole and thickness and because of the economic unfeasibility of inspecting every disc before assembling it with a sleeve. As incorporated in a tube, an assembly with disc capable of rotation with respect to its supporting disc is responsible for increased microphonics and unstable cut-off characteristic. It has been found in practice that if the crimping pressure is increased to insure that there are no loose sleeves then a substantial number of the assemblies must be discarded because of cracked discs, whereas if the crimping pressure is reduced to avoid breakage of discs then there are inevitably a number of cathode assemblies with loose sleeves which if not detected and discarded before incorporated in tubes will result in degraded tube performance.

In accordance with the present invention, the problems of loose fits and cracked discs are solved by providing at least one surface of the disc with spaced grooves extending outwardly from the sleeve-receiving hole. The grooves may be formed in the molding of the discs or they may be formed by grinding the molded discs: in either case the depth of the grooves progressively decreases outwardly from the sleeve-receiving hole and the groove width may be constant or also progressively decrease outwardly from the sleeve-receiving hole. During the crimping operation, the bead or flange of the sleeve is locally deformed into these grooves so keying the sleeve to the disc in prevention of any tendency to rotate should there be a loose fit. With such grooved disc construction, the crimping pressure may be preset to a value which insures that all sleeves are firmly held against rotation in their discs and without breakage of slightly thicker discs during the crimping operation.

The invention further resides in cathode assemblies and methods of making them, having novel and useful features hereinafter described and claimed.

For a more detailed understanding of the invention, reference is made in the following description of preferred forms thereof to the accompanying drawings in which:

FIGS. 1A, 1B and 1C are plan views of grid-cathode spacer discs having specifically hole and groove arrangements;

FIGS. 2A and 2B are elevational views, in section, taken on line 2-2 of FIGS. 1A and 1B;

FIGS. 3A and 3B are elevational views in section taken on line 3-3 of FIG. 1C;

FIG. 4 is a sectional view of a disc and sleeve assembly at a crimping station; and

FIGS. 5 and 6 are elevational views, in section, of cathode assemblies made from the grooved discs of FIGS. 1A-1C.

Referring to FIG. 1A, the spacer disc 10A is provided with a triangular hole 11A dimensioned to receive a cathode sleeve or shank 12 indicated in dotted outline. Each of the three symmetrically spaced grooves or slots 13 extends radially outwardly from the hole 11A at a region of engagement between the disc 10A and the sleeve 12. Either or both faces of disc 10A may be grooved as respectively shown in FIGS. 2A and 2B.

Referring to FIG. 1B, the spacer disc 10B is provided with a trefoil hole 11B whose central portion defined by lands 15 is dimensioned to receive the cathode sleeve 12 indicated in dotted outline. Each of the three symmetrically spaced grooves 13 extends outwardly from the central portion of hole 11B and radially of a corresponding land 15. Either or both faces of disc 10B may be slotted or grooved as respectively shown in FIGS. 2A and 2B.

Referring to FIG. 1C, the spacer disc 10C is provided with a circular sleeve-receiving hole 11C of diameter corresponding with the sleeve diameter. As shown in FIGS. 1A and 1B, each of the symmetrically spaced grooves 13 extends radially outwardly from the sleeve-receiving hole. Either or both faces of disc 10C may be grooved and the number of grooves per face may be upwards of three. When a single face is grooved or when the grooves of one face are offset with respect to the opposite face, the disc section is as shown in FIG. 3A: when both faces are grooved and the grooves of opposite faces are in alignment, the disc section is as shown in FIG. 3B.

For small cathode-ray guns and tubes, the spacer discs of FIGS. 1A, 1B and 1C are made in various sizes ranging from 0.25" to 0.5".

In all of the figures of the drawing, the size of the grooves is exaggerated for clarity of illustration; in practice, a width of about 0.02" to 0.035" and a depth of about 0.01" to 0.015" affords reliable keying of the sleeve when its embossed flange 14 (FIGS. 5 and 6) is crimped or flattened as later described in connection with FIG. 4. The sleeve 12 is usually of nickel or nickel alloy, and in a typical case may have a wall thickness of about 0.002" or 0.003" with the flattened flanges 14 extending about 0.01" to 0.02" beyond the periphery of the sleeve. As indicated in FIGS. 1A and 2A, the groove width may be constant with depth decreasing outwardly from the sleeve-receiving hole of the disc: or as indicated in other figures, both the width and depth of the grooves may decrease outwardly from the sleeve-receiving hole. When, as is usual, the discs are of lava or like refractory insulating material, the grooves may be, and preferably are, formed during the molding operation or they may be later formed by a grinding operation using a wheel of small diameter and appropriately shaped edge.

The radial grooving of the spacer discs is effected prior to their assembly with cathode sleeves to form cathode assemblies later associated with a heater and other electrodes of a cathode ray or other thermionic tube. Assembling of the sleeves and discs involves sleeve-embossing and crimping operations such as disclosed in the aforesaid Briggs patent. Briefly, after an assembly has been partially formed by embossing a sleeve to form a pair of beads or flanges on opposite sides of the associated disc, the opposite projecting ends of the sleeve are inserted (FIG. 4) within the bores of a pair of axially-aligned die members 16-16. In a subsequent cycle of operation of their press, the dies are brought toward

one another to flatten the annular flanges 14 against opposite faces of the interposed spacer disc.

During this crimping operation, the metal flange is locally depressed or expanded into the grooves 13 so providing a series of flange keys locking the sleeve against rotation even though the unembossed sleeve may be a loose fit in the sleeve-receiving hole of the spacer disc. This locking engagement is maintained during the expansions and contractions of the sleeve incident to intermittent use of the tube in which the cathode assembly is later incorporated. There is thus avoided degradation of tube performance which results when a cathode can rotate in its spacer disc.

It has been found in practice that even when only one face of the discs is grooved, FIG. 6, such locking engagement is reliably and reproducibly obtained with discs differing slightly in thickness and hole size within feasible tolerance limits of manufacture. The thickness tolerance may be $\pm 0.005''$ and the hole tolerance within $+0.005''$ and preferably not exceeding $+0.002''$. In fact, when both sides are grooved, the locking engagement usually occurs on only one side of the disc: grooving of both sides, however, has the advantage that it is not necessary to orient the assembly in the crimping press.

Although a single groove in one face of the disc can provide a locking engagement between the sleeve and disc, there is a possibility that because of the dissymmetry of crimping strains in the sleeve, the face of the subsequently attached cathode cap 17 will not remain perfectly parallel to the disc. With a symmetrical arrangement of three or more grooves 13, such as shown in FIGS. 1A, 1B and 1C, the crimping strains incident to expansion of the flange 14 into grooves 13 are balanced. It is thus insured that the emissive face of the cathode cap will be and remain parallel to the opposed face of the grid or focusing electrode 18 (FIG. 5) with which the assembly is subsequently associated in a tube.

As will be understood by those skilled in the art, with the assembly incorporated in an electronic tube, the cathode cap 17 is heated to emission temperature by heat conducted to it by the sleeve 12 in which is disposed the usual heater element (not shown). An additional benefit of the grooved disc assembly is a substantial decrease in the contact area between the sleeve and disc with resultant decrease in the heat losses and a shortening of the warm-up time of the tube.

In brief résumé, so far as the tube manufacturer is concerned, the use of grooved ceramics in the cathode assemblies provide uniformity of cut-off characteristic, minimization of microphonics and reduced heater input; and so far as the cathode manufacturer is concerned, the use of grooved ceramics affords superior cathode assemblies with substantial elimination of financial losses due to cracked ceramics.

It is to be understood that either or both faces of the ceramic discs may also have annular "shadow" ridges or grooves 10S to prevent formation of leakage paths

by deposits sublimed from the cathode sleeve. In such case and as shown in certain figures, the annular shadow grooves or ridges are beyond the outer ends of the radial grooves 13. Also shown are openings intersecting the grooves 10S.

What is claimed is:

1. A cathode assembly comprising a ceramic spacer disc having an opening extending therethrough between its opposite faces, at least one of said faces having symmetrically angularly spaced grooves extending outwardly from said opening, and a cathode sleeve extending through said opening, said sleeve having a pair of embossed flanges respectively engaging the opposite faces of said disc adjacent the opposite ends of said opening, at least one of said flanges being locally depressed into said angularly spaced grooves of the corresponding face of the disc to provide a series of flange keys which preclude rotation of said sleeve.

2. A cathode assembly comprising a ceramic spacer disc having an opening extending therethrough between its opposite faces, at least one of said faces having symmetrically angularly spaced grooves of progressively decreasing depth and each extending outwardly from said opening, and a cathode sleeve extending through said opening and having a pair of embossed flanges crimped against said opposite faces of the disc and into interlocking engagement with said grooves.

3. A method of making cathode assemblies from cathode sleeves and ceramic spacer discs varying slightly in thickness and in size of their sleeve-receiving hole which comprises forming in at least one face of the discs symmetrically angularly spaced grooves extending outwardly from the sleeve-receiving hole, embossing said sleeves to form for each of them a pair of flanges respectively engaging opposite faces of the associated disc adjacent the ends of its sleeve-receiving hole, and applying crimping pressure to each pair of flanges to expand at least one of them into the angularly spaced grooves of the corresponding face of the associated spacer disc.

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ROBERT SEGAL, *Acting Primary Examiner*,
ARTHUR GAUSS, *Examiner*.