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CATHODE ASSEMBLY

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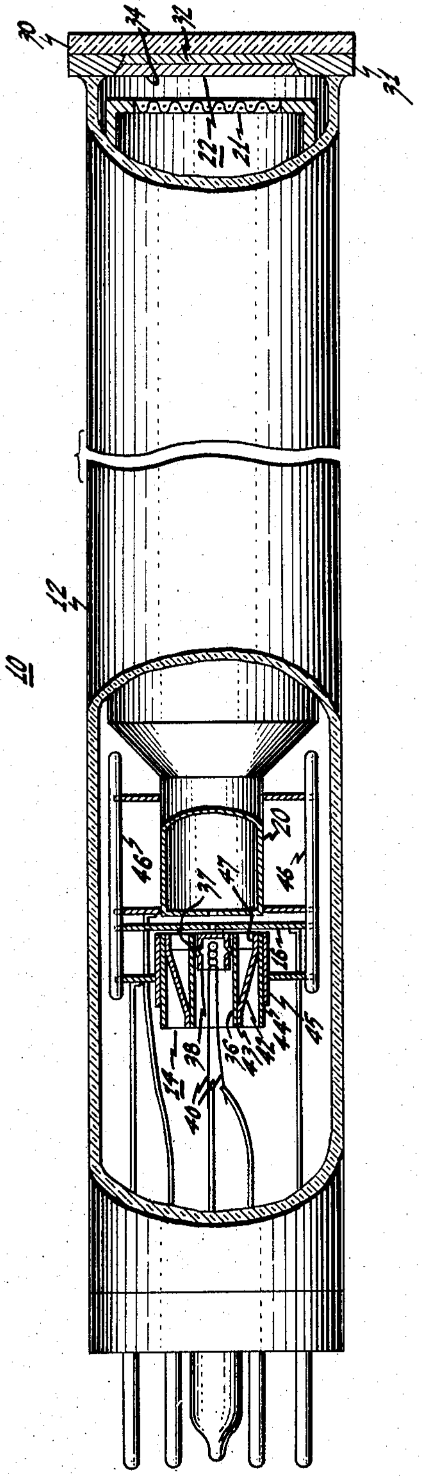

FIG. 1

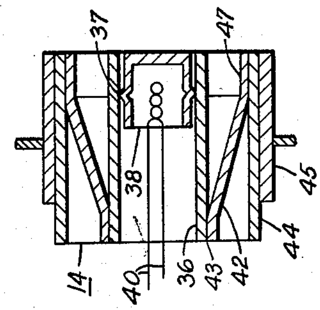

FIG. 2

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CATHODE ASSEMBLY

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This invention relates to cathodes for electron discharge devices and particularly to cathodes having extremely low input power requirements.

In the design of a cathode for a discharge device, one of the principal considerations is that of providing an efficient cathode geometry wherein the maximum amount of electron emission can be produced with a minimum amount of input power.

In some types of electron discharge devices, such as electron beam tubes, it is desirable to support a compact cathode mount within a small envelope. One such beam tube is a pickup, or camera tube which is designed to be used in a portable television camera for use in a mobile television unit. A portable camera generally uses transistorized circuit components which are light in weight and low in power consumption. In television cameras of this type, the pickup tube should also be of the efficient, low power input, miniature, lightweight type. Thus, a small, compact, low wattage cathode is an essential part of such a pickup tube.

It is therefore an object of this invention to provide a new and improved cathode structure.

It is another object of this invention to provide an improved miniature cathode mount that efficiently uses the input power.

These objects, as well as others, are accomplished in accordance with this invention by providing a tubular cathode sleeve that is supported only at an end thereof remote from the electron emissive area of the cathode. The support structure, which is in the shape of a truncated cone, compactly supports the cathode within a tubular shaped cathode shield with a maximum efficiency and minimum of heat loss.

The invention will be more clearly understood by reference to the accompanying single sheet of drawings wherein:

Fig. 1 is an enlarged plan view, partially in section, of a pickup tube utilizing this invention, and, Fig. 2 is an enlarged sectional view of the cathode mount shown in Fig. 1.

Referring now to Fig. 1, there is shown a pickup tube 10 embodying a cathode structure in accordance with this invention. It should be understood that the invention is equally applicable to other types of tubes, such as electron beam tubes, wherein small, efficient cathodes are desired, and the pickup tube 10 is shown merely as an example of a type of tube wherein this invention has been found to be especially useful. The tube 10 comprises an evacuated glass envelope 12 having an electron gun 14 in one end thereof. The electron gun 14, which will be explained in detail hereinafter, is for the purpose of providing a beam of electrons which is controlled and/or accelerated down the tube by a control electrode 16, and an accelerating electrode 20 toward a target electrode 22. One end of the accelerating electrode 20 is covered by a fine mesh screen 21 that is closely spaced adjacent to the target electrode 22. The electron beam

is focused onto, and deflected over, the target electrode 22 in any well-known manner, such as by means of a focus coil and a deflection yoke, neither of which is shown for simplicity of illustration.

The target electrode 22 comprises a transparent support member 30, such as glass, which is shown as the end or face plate of the envelope 12. On the inner surface of the transparent support member 30 there is a transparent conductive coating 32 which may comprise a coating of tin chloride or tin oxide. On the surface of the transparent conductive coating 32 there is a layer of photoconductive material 34, which may be a material such as antimony trisulphide and antimony oxisulphide. The face plate 30 is joined to the end of envelope 12 by being sealed to a metal ring 31 which in turn is sealed to the end of the tubular glass envelope 12. The sealing ring 31 is used as a lead-in for the conductive coating 32 during the operation of the tube 10.

The electron gun 14, as shown more clearly in Fig. 2, includes a hollow, tubular cathode sleeve 36 which is made of a material having low heat conduction properties, such as a cobalt-nickel-iron alloy. Press fitted into and closing one end of the cathode sleeve 36 is a cathode cap 38, which is of a high heat conductivity metal, such as nickel. The cathode cap 38 has a coating of electron emissive material on the surface thereof toward the target 22. The electron emissive material may be a material such as barium oxide and/or strontium oxide. The cathode cap 38 contacts the cathode sleeve 36 only in a relatively small area 37, which comprises a protuberance on the cap member 38 that is press fitted into the cathode sleeve 36. The protuberance may be one or more small indentations or, in the alternative, a bead extending completely around the cap member 38. The small contact area 37 results in heat conduction paths from the cathode cap 38 to the cathode sleeve 36 of an extremely high thermal resistance.

Within the tubular cathode sleeve 36, and closely spaced from the inner surface of the cathode cap 38, is a heater wire 40 which is formed of any material which has an appropriate electrical resistance to produce relatively large amounts of heat for a relatively small amount of input power. Examples of such resistance materials are tungsten and/or molybdenum. The turns of the heater wire 40 are within the cap 38 in order to concentrate the heat in this region.

The cathode sleeve 36 is supported only at the end thereof that is remote from the cathode cap 38. The support for the cathode sleeve 36 is a funnel shaped member 42, i.e. a truncated cone having coaxial end sections 43 and 47. The support member 42 contacts the cathode sleeve only at the smaller diameter 43 of the funnel shaped member 42. The cathode sleeve 36 may be spot welded or press fitted to the cathode support 42. The funnel shaped support member 42 is made of a material, such as a cobalt-nickel-iron alloy, having low heat conduction properties to minimize the heat losses to the other cathode support structures. The funnel shaped member 42 is supported, such as by press fitting, at an end 47, that is opposite to the end 43 that contacts the cathode member 36, by a tubular shaped cathode shield 44. The cathode shield 44 is also made of a material having low heat conduction properties, such as a cobalt-nickel-iron alloy, to minimize heat losses. The cathode shield 44 substantially encloses the funnel shaped member 42 and the cathode 36. The cathode shield 44 is press fitted into another tubular shaped member 45 for the purpose of adding rigidity to the cathode mount. The tubular shaped member 45 may also be a cobalt-nickel-iron alloy to minimize heat losses. Another reason for the presence of the tubular shaped member 45 is that of tube salvage. As an example, if an inferior cathode should be inserted within a tube, the cathode shield **44**, with the balance of the cathode assembly or mount, could be withdrawn and replaced by another cathode assembly.

In addition to the high thermal resistance materials used in the cathode mount members, the members of the cathode mount are machined so as to be as thin as possible, and still provide suitable strength, in order to further increase the thermal resistance of the heat conduction paths away from the cathode cap **38**. Also, due to the geometry of the cathode mount, the heat conduction paths are long, while still within a compact volume, and therefore the thermal resistance of the heat conduction paths from the cathode cap is further increased. As an example, the cathode support **42** is joined to the cathode sleeve **36** only adjacent to the end of the sleeve **36** remote from the electron emissive area, and, the other end of the cathode support **42** is the only area of the cathode support **42** that contacts the cathode shield **45**. Thus, the materials, thickness and geometry of the cathode mount are such as to provide an efficient, miniature, heat conserving cathode structure.

The cathode mount assembly shown in Fig. 1 is highly efficient from a heat radiation standpoint also, in that the funnel shaped support member **42** and the cathode shield member **44** are heat reflectors and are provided with bright inner surfaces to reflect as much heat as possible back toward the cathode cap **38**.

The balance of the electron gun **14** is conventional in that the first control electrode **16** is positioned adjacent to the cathode cap **38**. The elements of the gun structure **14** are supported by means of glass side rods **46** which are fixed to the particular electrodes in a well-known manner.

The cathode mount is extremely small and compact and is highly efficient, as was explained, in that the heat generated by the heater wires **40** is conserved by the compact structure whereby a maximum of electron emission is obtained with a minimum heat loss. This efficient, compact structure is readily adaptable for use in portable television camera tubes, such as the ½" Vidicon type tube.

When the cathode is assembled, the cathode may be fabricated by concentric, self-jigging parts, since the parts are substantially coaxial, and thus can easily be assembled in a few steps. The junctions of the various cathode parts may be formed by press fitting or by spot welding.

A particular example of materials and sizes for use in the cathode mount described is an follows:

Cathode cap **38**:

Material		Nickel
Length	inch	.040
Width	inch	.045
Thickness	inch	.002

Funnel shaped support member **42**:

Material		Nickel-cobalt-iron alloy
Length	inch	.177
Large diameter	inch	.178
Small diameter	inch	.048
Thickness	inch	.001
Length of top and bottom parallel walls	inch	.019

Cathode sleeve **36**:

Material		Nickel-cobalt-iron alloy
Length	inch	.177
Width	inch	.046
Thickness	inch	.001

Cathode shield **44**:

Material		Nickel-cobalt-iron alloy
Length	inch	.275
Width	inch	.191
Thickness	inch	.005

Cathode member **45**:

Material		Nickel-cobalt-iron alloy
Length	inch	.216
Diameter	inch	.201
Thickness	inch	.005

It should be noted that the cathode mount assembly is free of any insulating members, such as mica, which is often found in the prior art structures. The insulating members may tend to cause loose particles within the tube **10** by flaking of the insulator during tube processing or operation. The loose particles are particularly harmful in a pickup tube if they should land on the photoconductor or on the screen of the final accelerating electrode. Also, it should be noted that the cathode mount assembly is made only of metal which may actually be made more heat insulating than materials that are electrical insulators, due to the fact that the metal may be machined to extremely fine thicknesses. On the other hand, electrical insulators, e.g., mica, cannot be machined to these fine thicknesses and still provide adequate support for the cathode mount.

The particular cathode assembly described produces an electron beam suitable for operation of a television pickup tube with an input power of approximately 0.6 of a watt. Thus, the low power, compact cathode assembly is extremely useful as a cathode in a pickup tube in portable television cameras.

What is claimed is:

1. A cathode mount assembly comprising a hollow metallic cylindrical cathode sleeve member, a metallic cathode cap member closing one end of said sleeve member, electron emissive material on said cap member, a hollow metallic truncated conical support member, the smaller end of said support member engaging the other end of said sleeve member, the larger end of said support member being arranged around said sleeve member adjacent to said one end of said sleeve member, a hollow cylindrical metallic cathode shield spaced concentrically around said support member, one end of said cathode shield engaging said larger end of said support member, a cathode lead-in connected to said shield adjacent to the other end of said shield, and a heater coil within said sleeve member, the turns of said heater coil being concentrated adjacent to said one end of said sleeve member.

2. A cathode mount assembly as in claim 1 wherein said metallic members have a thickness not greater than .005 inch whereby the heat conduction paths of said members are of high resistance.

References Cited in the file of this patent

UNITED STATES PATENTS

2,740,913	Majkrzak	Apr. 3, 1956

FOREIGN PATENTS

499,532	Great Britain	Jan. 25, 1939
759,944	Great Britain	Oct. 24, 1956