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E. ATTI ETAL

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ELECTRON GUN STRUCTURE

Filed June 23, 1960

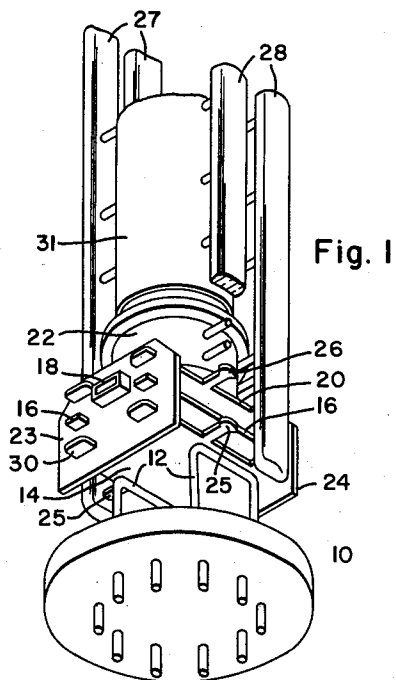


Fig. 1

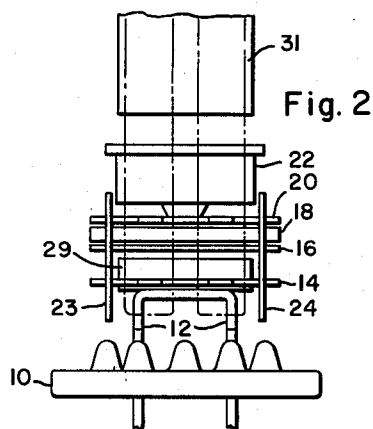


Fig. 2

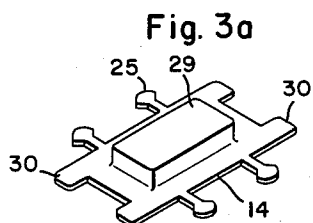


Fig. 3a

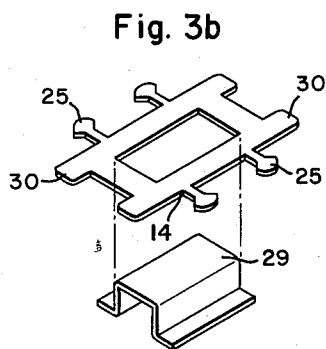


Fig. 3b

WITNESSES

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ELECTRON GUN STRUCTURE

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This invention relates generally to electron guns and, more particularly, to an electron gun structure which may incorporate a multi-electrode amplifier. The invention is applicable to cathode ray tubes of various types and provides precise beam forming electrode alignment under both normal and severe environmental conditions.

In accordance with U.S. Patent 3,065,368, filed December 27, 1957, entitled "Electron Device," by E. Atti and assigned to the same assignee as the present invention, an electron gun is provided having a high transconductance. Within the gun structure, there is included a triode amplifier. A video signal is applied to the grid of the amplifier. The triode plate and the first accelerating anode or screen grid of the electron gun are electrically connected. Since these two electrodes operate at the same potential, a large change in beam current can be effected by a small change in applied signal. This provides means of making guns of greatly increased transconductance. Additional structures for high transconductance guns are provided in U.S. Patents 3,065,375 and 3,065,376, filed July 14, 1958, by E. Atti and assigned to the same assignee as the present invention.

In the structure disclosed in U.S. Patent 3,065,368, mechanical support of the various gun electrodes is provided by beading them to strong, rigid insulating rods, usually of glass. The gun screen grid and triode plate are constituted of a metallic member which substantially encircles the cathode and the grid of the triode amplifier and forms a box-like support member for a pair of insulating spacers at the sides of the gun. The control grids of both the gun and the amplifier and the cathode are supported in turn by extensions through the insulating spacers. Of this unitary structure comprising the screen grid, control grids, cathode and plate only the gun screen grid and plate are directly and rigidly joined to the remaining gun electrodes. The gun control grid, whose aperture should be accurately aligned with the screen grid aperture, is not directly joined. Therefore, the gun control grid is not provided the same rigidity of structure and exact aperture positioning as is afforded the gun screen grid.

Under even moderately severe environmental conditions of shock and vibration it is quite possible that the insulating spacers, generally of mica or the like on account of the excellent machinability properties of this type of material, can flex or slightly change their location upon the box-like support member to which they are fastened. As a result the three electrodes which are indirectly supported, namely the gun control grid, the cathode and the triode amplifier grid, may change their position in relation to the gun screen grid and consequently to the remaining part of the gun rigidly associated with said screen grid as explained above.

As far as the cathode and triode amplifier grid are concerned, this displacement would not be objectionable in general since these electrodes are not subject to critical alignment requirements. This is not true however of the gun control grid. A lateral displacement of an insulating spacer perpendicular to the gun's axis of only a few thousandths of an inch would cause the control grid aperture to move with respect to the screen grid aperture by substantially the same amount thereby introducing misalignment between these two apertures causing unfavorable effects upon the electron optics of the

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gun. In the case of very fine spot guns, misalignment of these two apertures by as little as one thousandth of an inch can cause serious degradation in the resolution capability of the gun.

In order to provide a gun structure capable of maintaining the alignment carefully built into the gun during manufacture, it is desirable to rigidly secure both the screen grid and the gun control grid to the remaining gun electrodes.

Any modification in the previously disclosed structure should preferably make use of basic components applicable to both a new high transconductance gun and to a conventional low transconductance gun which does not include the triode amplifier. While it is a problem to design a gun structure wherein the screen grid and control grid are accurately aligned when the structure is to be used in only one type of gun, either with a triode amplifier or without a triode amplifier, the problem is magnified when versatility as well as ruggedness is desired.

It is, therefore, an object of the present invention to provide an electron gun wherein precise alignment between the apertures of the gun control grid and the screen grid may be maintained under severe environmental conditions as well as in ordinary use.

Another object is to provide an improved electron gun-amplifier combination wherein planar electrodes of the triode amplifier and cylindrical electrodes of the gun electron optical system are combined in a monolithic structure.

Another object is to provide a basic type of electron gun structure which may be employed equally well in either high or low transconductance forms.

According to the present invention, an electron gun structure is provided which includes a flat cathode having on one side thereof a gun control grid and screen grid. On the opposite side of the cathode is a member which may be called a plate support. The plate support and the gun control grid are beaded to insulating members which also support the screen grid and possibly other gun electrodes. In addition, the plate support and the gun control grid have peripheral ears or the like on which insulating spacer members will be mounted utilizing suitable holes in said members. These insulating members in turn support and space the cathode and additional electrodes which may comprise a triode amplifier utilizing the same cathode as the electron gun from which electron emission occurs from both sides.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with the above-mentioned and further objects and advantages thereof, may best be understood by reference to the following description, taken in connection with the accompanying drawings, in which:

FIGURE 1 is a perspective view of part of an electron gun constructed in accordance with the present invention;

FIG. 2 is an elevation view of the electron gun structure of FIG. 1, and

FIGS. 3a and 3b are perspective views of portions of electron gun structures in accordance with the present invention.

Referring now to FIGS. 1 and 2, there is shown, in ascending order from the stem 10, a pair of rigid supports 12, a plate support 14, a triode control grid 16, a cathode 18, a gun control grid 20, a first accelerating grid or screen grid 22 and other gun electrodes 31. A pair of insulating spacers 23 and 24 are disposed on opposite sides of the gun and have apertures therein through which portions of the plate support 14, the triode control grid

16, the cathode 18 and the gun control grid 20 are disposed. In addition, ear portions 25 and 26 of the plate support 14 and the control grid 20, respectively, are beaded to two pairs of insulating rods 27 and 28 disposed on opposite sides of the gun structure. Also beaded to the insulating rods are the screen grid 22 together with some or all of the remaining electrodes of the gun 31.

Leads from the various gun electrodes would ordinarily be connected to the pins extending through the top of the stem 10. These leads are not shown so that the figures show the gun structures more clearly. The remaining electrodes 31 are generally employed remote from the stem 10 of the tube for focusing and acceleration. These electrodes may be conventional and will not be discussed herein. They will ordinarily be joined by beading to the structure shown.

The base support members 12 are shown as a pair of rigid metallic members in a U-shaped configuration. The ends of the members are welded to the stem leads while the bottom of the U portion is joined by welding to the plate support member 14.

The plate support member 14 may simply be a continuous flat plate having a pair of ears on each side. Two opposite pairs 25 are sealed in insulating members 27 and 28 extending along the gun. The remaining two opposite pairs 30 extend through and help support insulating spacer members 23 and 24.

When a triode amplifier is incorporated within the gun structure, the plate support 14 can be formed so as to provide the plate 29 as an integral part as shown in FIG. 3a. A separate support 14 and plate 29 can also be used as shown in FIG. 3b making it possible to select a plate of a particular height for a particular purpose.

The control grid 16 may be a planar grid such as a frame grid or other suitable type grid. The cathode 18 may be a conventional flat type as found in ordinary receiving tubes capable of emitting electrons from opposite sides for the high transconductance gun and from one side only in the case of a conventional low transconductance gun.

The control grid 20 is generally of the same configuration as the plate support 14. However, an aperture is provided therein for transmission of the electron beam from the cathode 18. This aperture is held in precise alignment with the aperture of the accelerating grid 22 because both members are joined to the insulating members 27 and 28 along the gun. An additional feature of the control grid 20 is that it may be formed so as to provide shielding of the cathode from external fields and thus prevent leakage of cathode current to other gun electrodes.

It should be noted that the structure in accordance with the present invention is not limited to one wherein a triode amplifier is incorporated in the gun. Because of some advantages of flat cathodes over the cylindrical type, it is often desirable to employ the general structure shown including the plate support 14 but without the anode 29 and control grid 16 comprising the amplifier.

It is seen that the present structure provides precise aperture alignment between the control grid 20 and the acceleration grid 22. It also permits the use of a flat cathode 18 which serves as the cathode of both the electron gun per se and the amplifier triode incorporated therein, providing a very high transconductance device in accordance with the teachings of the beforementioned copending applications.

It should be noted that the electrodes and components of a gun structure in accordance with the present invention are of simple design and may be formed by well known, inexpensive methods making ease of fabrication, whether in high or low transconductance gun types, an inherent feature of this design. The structure portion comprising the plate support 14 and the gun control grid 20 may be aligned with the accelerating grid 22 and sub-

sequent electrodes 31 of the gun and beaded together in a single operation. Furthermore, the screen grid 22 and subsequent focusing and accelerating electrodes 31 may be entirely conventional.

Additional versatility is built into gun structures in accordance with the present invention because of the fact that the insulating spacers 23 and 24 may be standardized so that one aperture pattern can be used for a variety of guns. That is, the spacing between the plate support and gun control grid may be maintained fixed, but the height of the anode used and therefore its spacing from the triode grid may be varied to obtain different triode amplification factors.

The gun structure is freed from mechanical stress because the rigid supports 12 make it possible to use lightweight and flexible connections to the gun components which need not provide support as well.

While the present invention has been shown in one form only, it will be obvious to those skilled in the art that it is not so limited but is susceptible of various changes and modifications without departing from the spirit and scope thereof.

We claim as our invention:

1. An electron gun structure comprising a cathode, a control grid and a screen grid located on one side of said cathode for forming an electron beam; a plate support member located on the opposite side of said cathode from said control grid and said screen grid, said plate support and said control grid supporting at their extremities insulating spacer plate-like members through which said cathode extends, said plate support, said control grid and said screen grid being mutually secured to rigid insulating elongated rod-like members.

2. An electron gun structure for forming an electron beam comprising a flat cathode, a first beam forming electrode spaced from said cathode, a second beam forming electrode spaced from said first beam forming electrode remote from said cathode, a support member spaced from said cathode on the side thereof remote from said first and second beam forming electrodes and transverse to said electron beam, a pair of insulating spacer plate members having apertures therein through which portions of said cathode, said first beam forming electrode and said support member extend, and one or more rigid insulating rod-like members mechanically secured to said first and second beam forming electrodes and to said support member.

3. An electron gun structure comprising a flat cathode having an electron emissive surface, a first beam forming electrode spaced from said cathode, a second beam forming electrode spaced from said first beam forming electrode remote from said cathode, said first and second beam forming electrodes having, respectively, first and second beam apertures aligned and positioned directly over said electron emissive surface of said cathode, a support member spaced from said cathode on the side thereof remote from said first and second beam forming electrodes, a pair of insulating spacer plate-like members having apertures therein through which portions of said cathode, said first beam forming electrodes and said support member extend, and one or more rigid insulating rod-like members mechanically secured to said first and second beam forming electrodes and to said support member.

4. An electron gun structure, disposed within an envelope including a stem member, comprising a flat cathode having an electron emissive surface, a first beam forming electrode spaced from said cathode, a second beam forming electrode spaced from said first beam forming electrode remote from said cathode, said first and second beam forming electrodes having, respectively, first and second beam apertures aligned and positioned directly over electron emissive surfaces of said cathode, a support member spaced from said cathode on the side thereof remote from said first and second beam forming electrodes, a pair of

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insulating spacer plate-like members having apertures therein through which portions of said cathode, said first beam forming electrode and said support member extend, two or more rigid insulating rod-like members mechanically secured to said first and second beam forming electrodes and to said support member, and one or more rigid mounting members mechanically secured to said support member and to said stem member.

5. An electron gun structure, disposed within an envelope including a stem member, comprising a flat cathode having two oppositely disposed electron emissive surfaces, a first beam forming electrode spaced from said cathode, a second beam forming electrode spaced from said first beam forming electrode remote from said cathode, a support member spaced from said cathode on the side thereof remote from said first and second beam forming electrodes, a grid spaced from and disposed between said cathode and said support member, an anode disposed on said support member, a pair of insulating spacer plate-like members having apertures therein through which portions of said cathode, said first beam forming electrode, said support member, and said grid extend, two or more rigid insulating rod-like members mechanically secured to said first and second beam forming electrodes and to said support member, and rigid mounting means secured to said support member and to said stem member.

6. An electron gun structure disposed within an envelope including a stem member as a portion thereof, comprising a flat cathode having two oppositely disposed electron emissive surfaces, an electron gun control grid spaced from said cathode, an electron gun screen grid and other gun electrodes spaced from said electron gun control grid

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remote from said cathode, said electron gun control grid and said electron gun screen grid having beam apertures therein mutually aligned with said one of said electron emissive surfaces of said cathode, a plate support member spaced from said cathode on the side thereof remote from said electron gun control grid and said electron gun screen grid, an amplifier control grid disposed between and spaced from said cathode and said plate support member, an anode supported directly by said plate support member, said electron gun control grid and said plate support member each having four side edges defining planes substantially perpendicular to the axis of the electron gun, each of said side edges having a pair of ear members jutting out therefrom, a pair of spacer members of insulating material having apertures therein, each of said spacer members having extending therethrough the two ears on one side of said electron gun control grid, the two ears on one side of said plate support member and portions of said cathode and said amplifier control grid, two or more rigid members of a glass-like insulating material mechanically securing by beading to the four remaining ear portions on each of said plate support members and said electron gun control grid and to said electron gun screen grid and to said other gun electrodes, and one or more rigid mounting members mechanically secured to said support member and to said stem member.

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