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COMPACT CATHODE RAY TUBE

Filed April 3, 1958

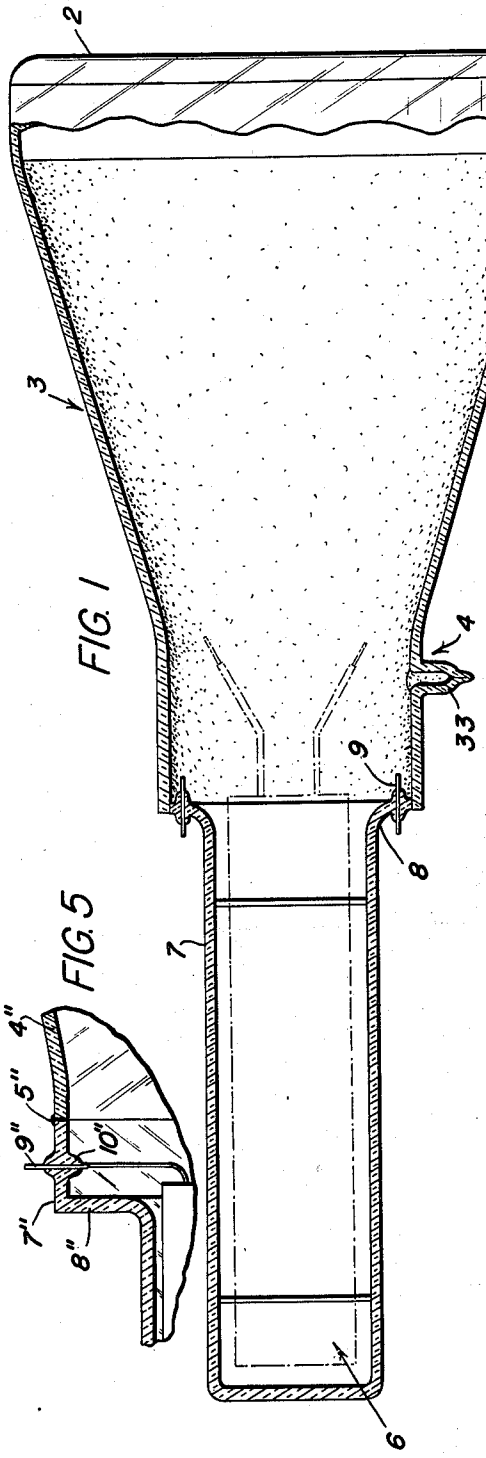

FIG. 1

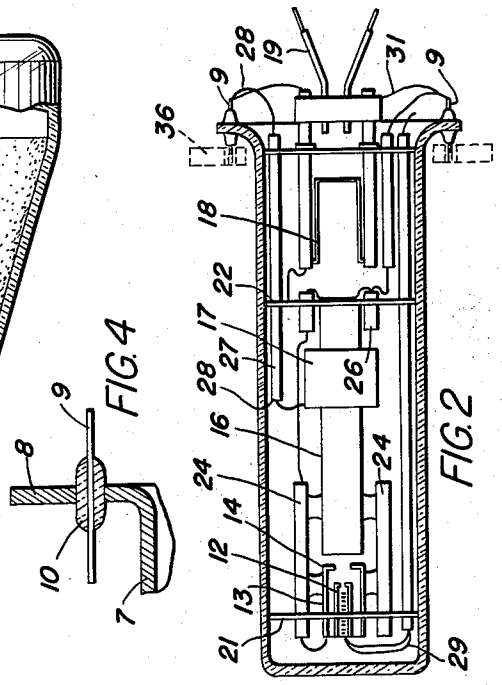

FIG. 2

FIG. 4

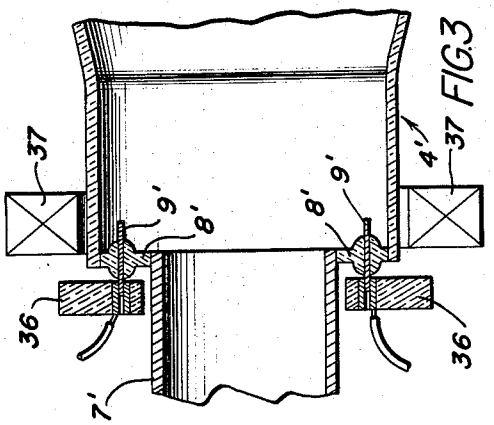

FIG. 3

FIG. 5

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COMPACT CATHODE RAY TUBE

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This invention relates to electron discharge devices and particularly to such devices of the cathode ray type.

Cathode ray tubes as presently made comprise a generally conical envelope having a coated screen on its large forward end and a rearwardly extending tubular neck portion at its rearward end; this tubular portion contains the electron gun assembly including a heated cathode at the rearward end thereof, a number of focusing, modulating, accelerating, etc., electrodes in the intermediate portion of the gun, and deflection plates at the forward end of the gun (or magnetic deflection yokes). Leads are brought from these elements through a header seal to a terminal base or plug attached to the rear end of the tubular portion. Where the cathode ray tube is to be used for high frequency work, the capacity of relatively long leads from the forwardly-located deflection plates to the rear base may be undesirable, and in some cases separate leads are brought out from the deflection plates and other forwardly located elements of the gun, through the wall of the envelope near the forward end of the tubular neck portion. However, this requires hand manufacture and assembly and is expensive and time-consuming. Furthermore, the presence of a terminal plug on the rear end of the tube adds to the material and manufacturing cost and to the length of the cathode ray tube, which dimension is often a limiting factor in space design of equipment using the tube.

It is a primary object of the present invention to overcome the present disadvantages and eliminate the rearwardly extending base plug. According to the invention, the electron gun leads are brought out to a separate annular header near the forward end of the gun, and through which the gun passes. The inner rim of this header is sealed to the tubular neck portion to form a unitary assembly, the gun being supported in and by the tubular neck portion to form a sub-assembly of gun, header and neck portion. This sub-assembly is then joined to the envelope by sealing the outer rim of the header to the small end of the envelope. The header carries all of the necessary terminals sealed into it. Since the header is near the forward end of the gun, the high frequency deflection plate leads are very short, while the longer leads extend to the cathode and focusing or beam collimating electrodes, etc., which are not high frequency components.

The header is essentially an annular disc bearing a circular configuration of terminals, which may be of pin-plug type to directly mate with an annular female socket fitting over the neck portion. The header is preferably fabricated as a unitary flared portion of the neck, which thus reduces the cost of manufacture and assembly.

Another advantage of the invention is that it provides a standard sub-assembly consisting of electron gun, header and neck tube which may be used with a variety of different sized envelopes, to which the sub-assembly may be attached by a simple sealing operation which can be performed by known types of automatic machinery. A further advantage is that the sub-assembly is

more rugged than the present electron gun assembly by itself, since the electron gun is firmly supported in the tubular neck portion and accurately aligned therewith, so that it is only necessary to correctly position the tubular neck portion with respect to the small end of the envelope to accurately align all of the elements.

A further advantage is that the envelope can be more readily prepared by internally coating its front face with fluorescent screen material, and its side walls with the conventional coating of graphite or similar material, since these materials can be inserted through the larger rear portion of the envelope, rather than through the narrow and more remote bottom of the neck portion.

Another advantage is that the novel construction requires fewer parts and is more readily adapted to manufacturing techniques than the present standard construction; it is also more readily adapted to standardization.

The specific nature of the invention as well as other objects and advantages thereof will clearly appear from a description of a preferred embodiment as shown in the accompanying drawing, in which:

Fig. 1 is a sectional view of a cathode ray tube embodying the invention;

Fig. 2 is a view partly in section of the unitary sub-assembly comprising the neck, header and electron gun;

Fig. 3 is an enlarged sectional view of a modified form of the invention using a metal neck portion;

Fig. 4 is a sectional detail showing one way of holding a pin in the header; and

Fig. 5 is a sectional partial view showing a modification.

Referring to Fig. 1, the cathode ray tube according to the invention has the usual face plate or screen 2 formed as the face end of an envelope or flask 3, which tapers down to a relatively reduced portion 4, as is conventional in cathode ray tubes. This portion of the tube is of standard construction, and it will be understood that it may be made entirely of glass, or may be made of metal with a glass face plate 2 sealed thereto, in accordance with standard construction. Similarly, the face-plate 2 of the tube, which is coated on the interior with a fluorescent material, may be either circular, rectangular, or any other desired shape, in accordance with known practice.

In accordance with standard construction, the reduced portion of the envelope usually is extended rearwardly for a considerable distance in order to house the electron gun, the leads for which are brought out at the base end of the tube, usually to an insulating plug provided with contact pins. In the present invention, the electron gun structure is housed in a separate tubular housing 7, completely closed at its rearward end, and flaring outwardly at its forward end to comprise an annular flange 8 bearing a number of conductive terminal pins 9 which extend therethrough as shown, in hermetically sealed fashion. This, together with the necessary insulation characteristic, can be obtained by using known metal-glass seals, or in any other known fashion. The gun tube 7 may be made of glass, in which case the terminals 9 will be insulated from each other by the material of which the tube is made; however, the gun tube 7 may also be made of metal, as shown in Fig. 3, at 7', and the annular header, instead of being formed as a flange on the tube, may be a separate glass annular disc 8', which supports, seals, and insulates the circular array of terminals 9'. It will be apparent that the entire tube 7 could be metal, with an outwardly turned metal flange exactly similar in shape to that shown in Fig. 1 at 8, the terminals 9 being supported on the metal flange or header by glass beads, as shown at 10 in Fig. 4. This construction has the maximum strength and ruggedness, although the all-glass header construction has the advantage of a greater sur-

face of insulating material between pins, which is of importance in some applications. As used herein, the header is a pre-formed or prefabricated component of the vacuum tube envelope having conductive elements hermetically sealed therein, the inner portion of said conductive elements being connected electrically to the electrode elements within said vacuum tube, and the external portion of said conductive elements serving to make electrical connection to the external electrical circuitry associated with said vacuum tube.

The electron gun 6, which may be of any standard construction, is mounted within and supported by tube 7. Fig. 2 shows a typical electron gun construction comprising a cathode filament 12, positioned in a cathode thimble 13, and surrounded by a cup-shaped control electrode 14. The electron beam produced by these elements is focused and controlled by a further series of electrodes 16, 17, and finally by the deflection plates 18 and 19, the exact construction and arrangement of these elements being no part of the present invention, except for the fact that they are all mounted on a unitary supporting framework to constitute the electron gun structure. One element of this supporting framework is a series of thin metal discs 21, 22, 23, here shown as three in number, although it will be apparent that even two such discs would be sufficient to support the electron gun in the tube 7. The discs are made of an outside diameter commensurate with the inside diameter of the tube 7, so that the assembly may be retained in the tube as a light friction fit, or in any other desired manner. The discs are centrally apertured to hold the main electron gun components, and in addition support a series of annularly arranged insulating posts or tubes 24, 26, 27, etc., which may be used as further support for the electron gun elements, and also as tubular insulating guides for the leads to the respective elements of the electron gun, as shown, for example, at 28 and 29. It will be understood that the exact details of construction of the gun may be widely varied within the scope of the present invention, the essential feature being that the gun is designed to be rigidly supported in the tube, and the header supporting the external terminals or pins 9 being annularly arranged around the gun near the forward end thereof to minimize the length of deflection plate leads. For example, instead of discs 21, spring fingers could be employed which would serve to center the gun in the tube, and at the same time to resiliently support the gun against shocks.

The various leads from the gun elements are, of course, connected to the pins 9 as indicated by leads 28 and 31, and in most instances the rigidity of the leads is sufficient to hold the gun structure and tube satisfactorily together. Where further support is necessary, stiff wires may also be used running from the structural parts of the gun, such as 22, to dead pins in the header.

It will be seen that the elements of Fig. 2 form a sub-assembly. This sub-assembly is now sealed to the envelope 3 as shown in Fig. 1, and the entire cathode ray tube assembly is exhausted in any suitable manner, as for example, by a suitable nipple 33 provided in the envelope 3.

The annular header 8 may contain a standard number of pins 9 for mating with a suitable annular female plug 36 (see Fig. 3) and the number of pins on each standard sized header may be varied in suitable steps to provide for a range of types of cathode ray tubes.

It is also possible to bring out the terminals radially instead of parallel to the tube axis, as shown in Fig. 5. For this purpose, the neck tube is preferably enlarged at its forward end to match the rear wall portion of the tube envelope, to which it may be sealed as shown at 5''. The remaining elements correspond to those shown in the other figures and are similarly identified except that a double-prime ('') is added to each reference character. This construction is of particular advantage when external leads are to be fastened to the terminals, as more space is available for this operation. Although the terminals 9'' are shown extending through the cylindrical wall section 7'' of the enlarged end of the neck, it will be apparent that it could also be embedded in annular flange section 8'' in a radial position and still retain the advantage of this arrangement.

The invention is also adapted to cathode ray tubes using magnetic deflection, in which case the magnetic deflection yoke may be positioned as shown in Fig. 3 at 37, in accordance with conventional practice. It will be apparent that the sub-assembly as shown in Fig. 2 may also be provided in a range of sizes for use with a larger range of sizes of cathode ray tube envelopes.

The construction shown is particularly well adapted for miniaturization for a number of reasons. In the first place, elimination of the base reduces the overall tube length. Further, since the neck is not required to have great mechanical strength as in the case where it supports the tube mechanically and also supports the gun elements from one end, the neck diameter and wall thickness can be reduced, minimizing neck size and weight, and the gun diameter can then be correspondingly reduced with advantage.

The above construction is particularly well adapted for mass production methods, because the expensive, time-consuming hand work required to bring leads out through the walls is eliminated. The annular header can be preformed by standard manufacturing techniques used in making multi-terminal headers for other electrical equipment which must be hermetically sealed such as small vacuum tubes, relays and transformers, electronic sub-assemblies, etc. Since the terminal pins are accurately positioned in the header, they are not affected by the sealing operation, as is the case where the leads are brought out through the glass walls of the cathode tube. Thus it is not necessary to use a separate plug with a number of pins or pin sockets positioned therein, as is the present practice. Furthermore, the fact that there are no rearwardly projecting plugs and pins on the very rear end of the tube makes the maximum linear dimension of the tube shorter, and since this dimension is often the greatest limitation in the size of the equipment housing the tube, it means that such equipment can be reduced in ovreall dimensions. Elimination of the plastic plug base also increases the resistance of the tube to the effects of humidity and moisture by providing only glass insulation between pins, the glass being much more impervious to such deleterious effects.

It will be apparent that the embodiments shown are only exemplary and that various modifications can be made in construction and arrangement within the scope of my invention, as defined in the appended claims.

I claim:

1. A cathode ray tube comprising a forward chamber having a transparent front face plate portion with a fluorescent screen on the inside surface thereof and side wall terminating in a rearward opening; a tubular electron gun chamber, of smaller diameter than said opening closed at the rear and opening at the front into the forward chamber; a pre-formed annular glass header portion extending substantially radially outward from the forward opening of the gun chamber to the rearward opening of the forward chamber, said header containing a plurality of accurately spaced pre-positioned and pre-formed rigid conductive male terminal pins extending therethrough and hermetically sealed therein; an electron gun supported in and by said tubular gun chamber and containing a plurality of electrically separate electrode elements, said elements comprising electron-producing means, electron-beam defining electrode means, and beam-deflecting electrode means, and respective leads from said elements to said terminal pins whereby said elements may be connected to external circuits.

2. The invention according to claim 1, said respective

leads constituting all of the leads from the electron gun to the exterior of the tube, said tube being free of terminal members at its closed end.

3. An electron gun sub-assembly constituting an electron discharge device comprising electron-producing elements, controlling-electrode elements, supporting and mounting means retaining said elements in a desired axial alignment, a tubular housing closed at the rear end thereof and open at the forward end thereof, said tubular housing supporting said electron-producing elements, an annular header sealed at its inner rim to the open end of said tubular housing and flaring outwardly from said rim, said annular header having a plurality of preformed and prepositioned rigid conductive male terminal pins hermetically sealed in said header, said pins extending through said header generally parallel to the axis of said tubular housing, and a plurality of electrical leads from said electron-producing elements and electrode elements to respective ones of said terminal members, and connected to the front ends of said terminal members.

4. The invention according to claim 1, said male terminal pins extending through said header in a direction

generally parallel to the axis of the tubular gun chamber, and an annular female plug mating with said terminal pins, said plug loosely surrounding said tubular chamber.

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