Jan. 4, 1944. S. J. KOCH 2,338,336

CATHODE RAY TUBE AND PROCESS

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Fig. 1

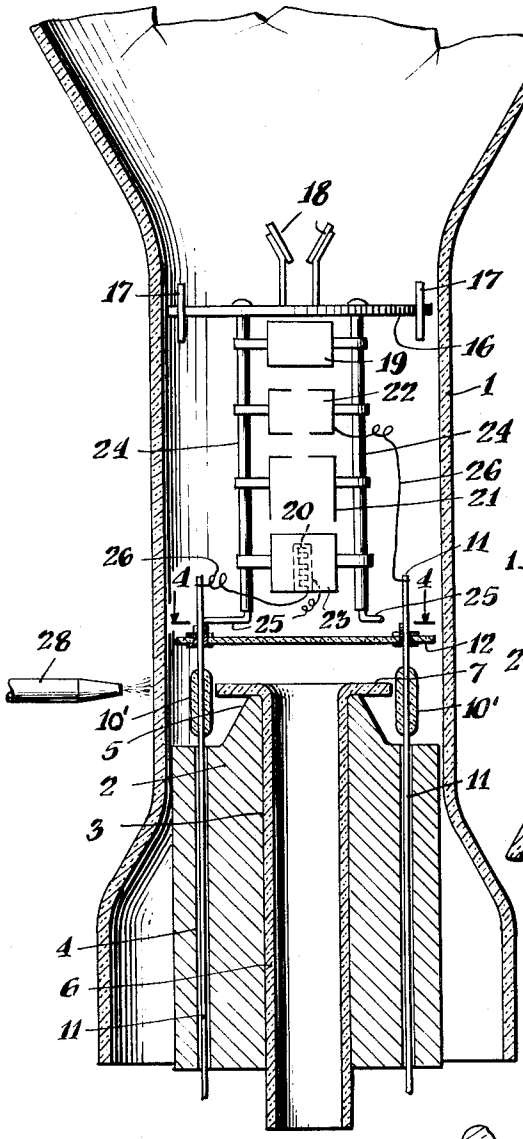


Fig. 2

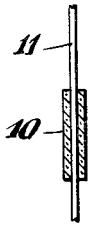


Fig. 3

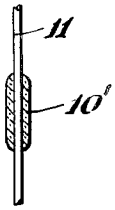


Fig. 4

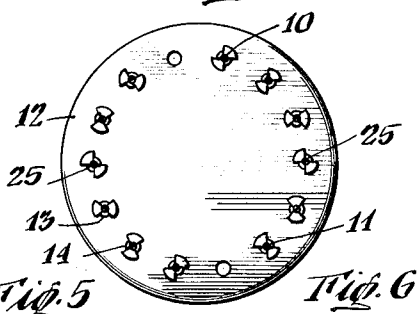


Fig. 5

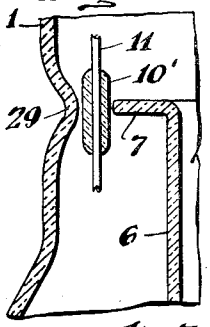


Fig. 6

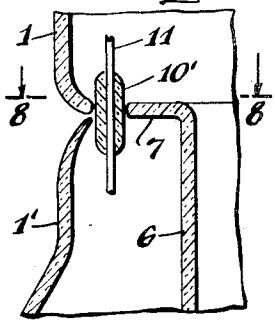


Fig. 7

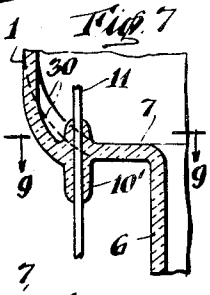


Fig. 8

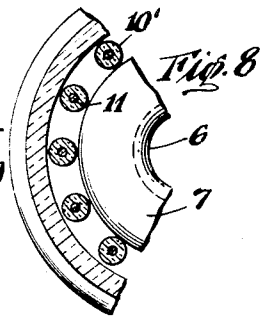
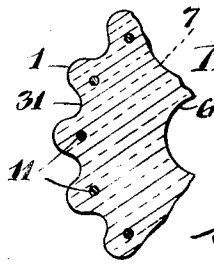


Fig. 9



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Fig. 10

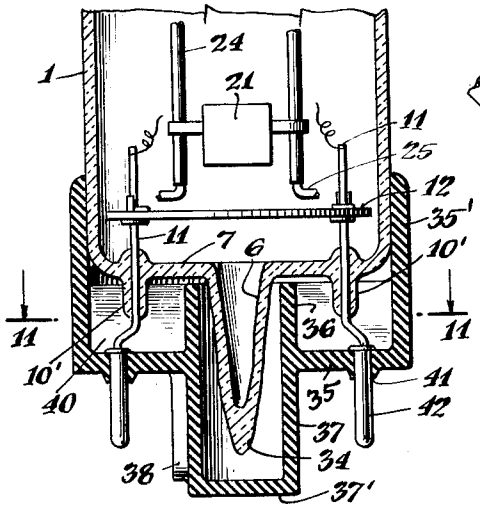


Fig. 13

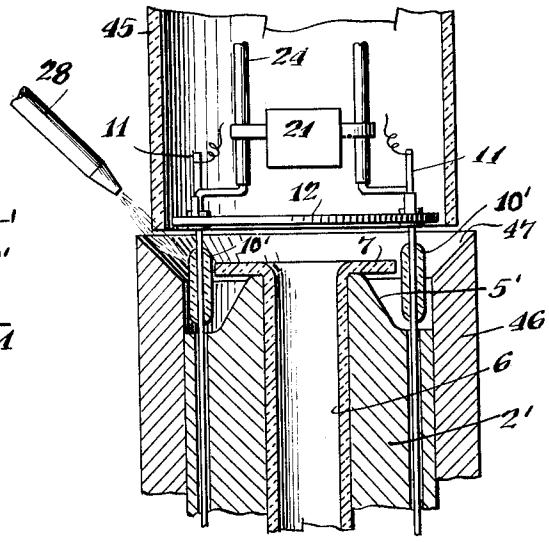


Fig. 11

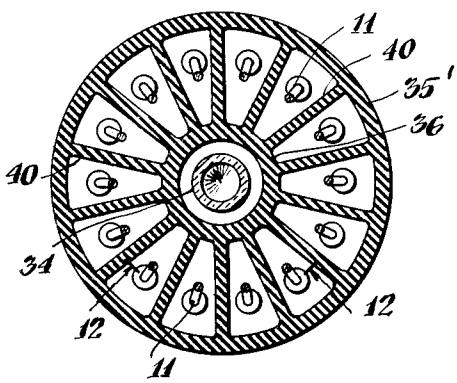


Fig. 12

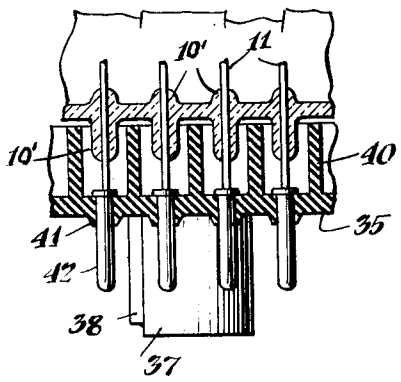
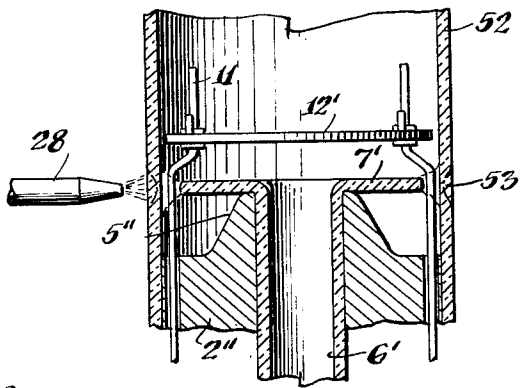


Fig. 14



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UNITED STATES PATENT OFFICE

2,338,336

CATHODE-RAY TUBE AND PROCESS

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Application November 28, 1941, Serial No. 420,744

12 Claims. (Cl. 250—141)

This invention relates to a cathode-ray tube and the process of producing the same, in which the electrical gun assembly is attached to the conductors that pass through the glass before the sealing of the glass assembly together. In one modification of the invention, glass beads are first sealed to the conductors before the conductors are sealed in place. By this invention the conductors may be brought out in such a manner as to provide the highest insulation between the conductors because the conductors pass through the glass on a circle of maximum diameter. In obtaining this maximum diameter, steps are taken that are very suitable for the processing of glass, thus simplifying the manufacturing process.

In carrying out this invention the cathode-ray tube leads are made to extend through the glass and are sealed in such a manner as to provide a maximum of insulation between the lead wires. With this invention the lead wires can be brought out on a circle whose diameter is almost as large as the inside diameter of the neck of the bulb.

With earlier methods of preparing cathode-ray tubes, a glass press was first made to serve for hermetical sealing of the glass to the metal and for rigid assembly of the metal wires with respect to each other. This press was manufactured in the form of a flat press or a circular press or a button stem. In all cases, however, the press was made in one operation and was then cooled. For satisfactory further processing the press should not be materially heated another time in the region where the wires go through the glass. However, a second heating of the glass had to be made for sealing the neck to the stem, and consequently the press of whatever style had to be made with a rather long flange of some shape so as to allow sealing at the extremity of the flange and yet provide heat insulation by length of path to prevent softening of the already-formed press around the wires. With this invention the sealing can be completed in a single heating operation.

By the present invention a very short press structure can be utilized which is as efficient as the button stem in this regard. Furthermore, with this method it is possible to provide much longer pant-leg beads for insulation purposes on the lead wires than is practical on a mold for making button stems.

Another advantage of this invention is that it makes it possible to utilize a very large exhaust tubulation on the tube, allowing more rapid pumping than is possible where a small exhaust tubulation is necessary because of the need for making the wire lead circle small as is the case with the button stem.

The invention will be understood from the following description in connection with the accompanying drawings, in which:

Fig. 1 is a vertical section, partly broken away, showing an illustrative embodiment of the invention;

Figs. 2 and 3 are sections through beads on wires for use in the invention;

Fig. 4 is a plan view along the line 4—4 of Fig. 1;

Figs. 5, 6 and 7 are sectional views partly broken away showing steps in the process;

Fig. 8 is a section along the line 8—8 of Fig. 6;

Fig. 9 is a section along the line 9—9 of Fig. 7;

Fig. 10 is a vertical section through the lower part of the tube, showing the base attached;

Fig. 11 is a section along the line 11—11 of Fig. 10;

Fig. 12 is a section along the line 12—12 of Fig. 11;

Fig. 13 is a vertical section showing a modification of the invention; and

Fig. 14 is a vertical section showing another modification.

In the drawings, reference character 1 indicates the neck portion of a cathode-ray tube with the remainder of the tube broken away. A cylindrically shaped mandrel or support 2 which is a portion of a sealing machine extends into the lower end of the neck 1 during the processing of the tube. The mandrel 2 has a large opening 3 along its center, and several smaller openings 4 near its periphery through which wires can be inserted. These openings 4 are outside of the conically shaped extension 5 at the upper end.

A glass tube 6 having a flange 7 resting upon the conical extension 5 is supported by this mandrel. This tube 6 is the exhaust tubulation for the final cathode-ray tube.

In order to increase the strength of the structure it is sometimes desirable to bring out the flange 7 on the exhaust tube 6 at some other angle than the right angle shown in Fig. 1.

In preparing a beaded wire, a short glass cylinder 10 is placed on a wire 11 (Fig. 2) and this glass cylinder is drawn into a bead by heat and sealed to the wire 11, as shown at 10' (Fig. 3).

A supporting member 12 (Figs. 1 and 4) of mica or other insulating material is provided with holes 13 near its periphery. These holes are provided with eyelets 14 through which the wires 11 pass and to which these wires may be welded.

As shown in Fig. 4, it has been found desirable to manufacture these cathode-ray tubes with

positions for fourteen wires coming through the glass but using only twelve leads with a vacant gap between the groups of six. The negative voltage group of electrodes is brought out on one group of six leads, and the positive group of electrodes is brought out on the other group of six leads, so as to provide a maximum of voltage insulation.

A second supporting member 16 of mica or other insulating material makes the top part of the gun structure of the cathode-ray tube rigid. It carries cross-pieces or centering spacers 17 which are resilient so as to hold the assembly rigid in the neck by having the ends thereof pressing against the inside wall of the neck.

It is sometimes desirable to put additional centering spacers like those shown at 17 on the insulating support member 12 for purposes of holding the gun structure in the center of the tube.

The gun structure, consisting of deflection plates 18 and 19, cathode 20, first and second anodes 21 and 22, and control grid 23, is supported on ceramic rods 24, which are in turn supported upon wires 25 which may be welded to some of the wires 11 which are attached to the supporting member 12 and pass through the beads 10'. Lead wires 26 are connected from wires 11 to different parts of the gun structure in the known manner.

In carrying out the process one or more blow torches 28 are provided for heating the outside of the neck 1 in proximity to the beads 10' with the parts assembled as shown in Fig. 1, which also shows a general arrangement of the gun assembly, the lead wires, the exhaust tubulation on its supporting mandrel, and the neck of the tube, ready for its sealing operation. A portion of the side of Fig. 1 is shown in Fig. 5 after the heating for sealing purposes has continued sufficiently to cause a shrinking-in of the glass of the neck 1 into a circular groove, as indicated at 29. In practicing the invention a number of stationary heaters 28 arranged in a circle apply heat all around the neck 1, and the entire structure may be rotating to assure uniformity of heating of the glass. This heating process is shown carried farther in Fig. 6 where the glass has become still more molten under the flames, and the weight of the enlarged lower portion or cullet 1' of the neck has caused the glass to pull away. This bottom undesired portion of the glass neck is discarded. Up to this point the flames have heated the beads 10' by transfer of heat through the glass, but upon removal of the neck portion 1' the flames impinge directly upon the beads 10' as will be obvious from Fig. 6 and upon the edge of the flange 7 of the tubulation 6 so as to seal the remaining lower end of the neck 1 to the beads 10' and to the outer edge of the flange 7 of the tubulation 6, as shown more clearly in Figs. 7 and 9. The dotted lines 30 in Fig. 7 and the indentations 31 in Fig. 9 show that the glass will tend to shrink-in still more between the positions of the beads 10' than at the points where the neck is sealed directly to these beads.

As shown in Fig. 8, the lead wires 11 with their beads 10' are located on a circle and the wires 11 contact only with the beads 10', while the neck 1 of the tube touches these beads only after this neck has been drawn inward by the action of the flames from the torches 28.

After the tube has been sealed as described above, the exhaust tubulation 6 may be attached to a vacuum system and the tube pumped out to create the desired vacuum in the usual way. When the tube has been processed on the pumps or a sufficient vacuum has been reached, the tube is removed by sealing off the tubulation 6 by heating to yield a result shown at the seal-off tip 34 of Fig. 10. Fig. 10 also shows the tube base 35 attached to this finished cathode-ray tube, and the lead wires 11 terminating in the base pins or terminals 42.

The portion 36 of the base 35 is an annular ring extending up around the seal-off tubulation 6, and the portion 37 with the closed end 37' is a projection to fit an opening at the center of a tube socket. It is provided with a key 38 to enable the base to be inserted and oriented in the socket. The portion 37 also serves as a protecting housing for the sealed-off tubulation 34. Baffle fins or plates 40 (Figs. 10–12) extend from the annular ring 36 to the wall 35' of the base and provide additional insulation between the leads 10, as will be obvious from Figs. 10, 11 and 12. The lower portions of the beads 10' are made into a long pant-leg, so that the free path through air from the metal of one wire to the metal of the adjacent wire is considerably lengthened since the upper edges of the baffle fins 40 extend considerably beyond the lower ends of the extended beads 10' (Fig. 12). The insulation with this type of glass work and base is further improved over old styles of button stems because this sealing method allows a very large radius for the circle of the lead wires as they come through the glass, so that these wires are located correspondingly farther apart. The holes 41 (Figs. 10 and 12) provide for insertion of the contact pins 42, which may be either stamped into place or molded in place in the manufacture of the base.

In the modification shown in Fig. 13 the sealing method for attaching the neck 45 to the lead wires and the flange 7 is somewhat different from that already described. In this figure the neck 45 is cut off and does not have the enlarged cullet portion shown in Fig. 1. An additional movable sleeve 46 of iron, carbon, or other fire-resistant material is provided with an inwardly sloping portion 47 at its top. The fires 28 play at an angle to the neck 45 so as to heat the bottom of this neck, and also to impinge directly upon the beads 10' and the rim of the flange 7. When the lower portion of the neck 45 has become molten, the bulb of the tube is lowered so that the end of the molten neck 45 strikes the sloping surface 47 of this shaping mold 46, causing the molten glass to be forced inwardly against the partly molten beads 10' and partly molten rim of the flange 7. This forced action assists in causing good fusing together of the glass elements. Subsequent lowering of the mold 46 permits further application of the flames to complete the sealing process. After sealing the neck and the flange together with the lead wires to form a hermetical joint, the tube is cooled by a slow annealing process and exhausted and sealed as already described.

Instead of lowering the bulb, as described above, it is sometimes desirable to employ the conventional method of having a plurality of movable jaws, either two or four, which can be brought up against the molten glass to press it into shape and position instead of depending upon the shrinking of the glass during the heating, or depending upon the use of the sloping portion 47. With the jaw action, it will, of course, be desir-

able to have the neck cut so as to extend farther down than shown in Fig. 13.

The modification shown in Fig. 14 is particularly applicable to soft glass working. Here it is not necessary to go through the preliminary step of placing glass beads on the wires 11. The entire process of sealing the wires through the glass and attaching the exhaust tube to the neck is done in one operation, thus providing the further advantage of getting a still greater increase in possible diameter of the circle for the lead wires 11. The neck 52 may be straight, as shown, although it may be provided with a cullet similar to the one shown on the neck 1 of Fig. 1. In this modification the flange 7' on the exhaust tubulation 6' has a wider flange, since it is possible to bring out the lead wires 11 on a larger diameter circle. The flames from the blow torches impinge upon the outside of the neck 52, causing the glass to shrink-in and fuse with the rim of the flange 7', at the same time hermetically sealing the lead wires 11 in place. The excess portion of the neck 52 drops away at the bottom in a manner indicated by the dotted lines 53. In this modification, using no beads on the wires, the neck can also be cut off, as shown in Fig. 13, and the sealing operation can be completed without requiring certain of the bottom portions of the neck to fall away.

In carrying out the process the conventional method of rotating the entire assembly on a machine using several consecutive sets of fires or torches may be employed, thus rendering it easy to get different angles of firing, as suggested in connection with Fig. 13.

For operations using soft glass it is sometimes desirable to seal the terminals to the exhaust tubulations and the neck without using the preliminary step of placing beads on the glass, but for hard glass the beading has been found desirable as a preliminary step in obtaining the best hermetical sealing. This present method of obtaining a very short mount structure is applicable to both hard and soft glass; whereas, heretofore it has been practically impossible to manufacture a button stem with its necessarily short mount structure when using hard glass.

While this invention has been described in detail in connection with cathode-ray tubes, it is also applicable to vacuum tubes in general. The increased voltage insulation and the simplified glass working process are very valuable in the manufacture of many other types of vacuum tubes.

What is claimed is:

1. In the process of producing a cathode-ray tube, the step which comprises assembling an exhaust tubulation and neck of a tube with respect to each other in spaced relation with electric conductors in the open space between them while supporting the gun structure of said tube in said neck on said conductors.

2. In the process of producing a cathode-ray tube, the step which comprises assembling an exhaust tubulation and neck of a tube with respect to each other in spaced relation with electric conductors in the open space between them while supporting the gun structure of said tube in said neck on said conductors, said conductors having glass beads thereon.

3. In the process of producing a cathode-ray tube, the step which comprises assembling an exhaust tubulation and neck of a tube with respect to each other in spaced relation with electric conductors in the open space between them while supporting the gun structure of said tube in said neck on said conductors, said conductors having glass beads thereon and hermetically sealed thereto.

4. In the process of producing a cathode-ray tube, the steps which comprise assembling an exhaust tubulation and neck of a tube with respect to each other in spaced relation with electric conductors in the open space between them while supporting the gun structure of said tube in said neck on said conductors, and sealing said tubulation to said neck.

5. In the process of producing a cathode-ray tube, the step which comprises assembling an haust tubulation and neck of a tube with respect to each other in spaced relation with electric conductors in the open space between them while supporting the gun structure of said tube in said neck on said conductors, said tubulation comprising a tube with its end flared outwardly to form a rim.

6. In the process of producing a cathode-ray tube, the steps which comprise assembling an exhaust tubulation and neck of a tube with respect to each other in spaced relation with electric conductors in the open space between them while supporting the gun structure of said tube in said neck on said conductors, and applying heat to seal said tubulation to said neck.

7. In the process of producing a cathode-ray tube, the steps which comprise assembling an exhaust tubulation and neck of a tube with respect to each other in spaced relation with electric conductors in the open space between them while supporting the gun structure of said tube in said neck on said conductors, applying heat to seal said tubulation to said neck, and simultaneously sealing said conductors in place.

8. The process which comprises assembling the internal metal elements of a cathode-ray tube to the electrical conductors thereof which are to lead through the glass for supporting said metal elements, and subsequently hermetically sealing said conductors and securing them with respect to one another simultaneous with the sealing of the bulb to the exhaust tubulation ready for exhaust.

9. A cathode-ray tube having electric conductors for said tube sealed in said tube in close proximity to the inside wall of the neck of said tube supporting the gun structure of said tube in said neck and having glass integral with the tube extending along said conductors outside of said tube, the distance between centers of conductors opposite each other being at least approximately three-quarters of the inside diameter of said neck.

10. A cathode-ray tube having electrical conductors sealed through the end of its neck portion and means to provide a meandering air path between exposed portions of adjacent conductors outside of said end.

11. A cathode-ray tube having electrical conductors sealed through the end of its neck portion and insulating baffles between exposed portions of said conductors outside of said tube.

12. A cathode-ray tube having electrical conductors sealed through the end of its neck portion and means comprising baffles and insulators on said conductors to provide a meandering air path between exposed portions of adjacent conductors outside of said end.

STANLEY J. KOCH.