

TITLE OF THE INVENTION

APPARATUS FOR ASSEMBLING ELECTRON GUN

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an apparatus for assembling an electron gun which is employed to serve as a cathode ray tube.

Related Background Art

Hitherto, as shown in Fig. 1, an electron gun has been assembled in an assembling line such that a beading process is performed. The beading process is performed such that heated and softened bead glass 55 is pressed against and joined to an electron gun body 51 to which a variety of elements including a plurality of grids G and a cathode 52 have been joined in a previous process.

As shown in Fig. 1, the electron gun body 51 has a plurality of support members 54 formed on the outer surfaces of the foregoing elements and structured to support the bead glass 55. The plural support members 54 are formed in the direction of an optical axis. The leading ends of the support members 54 of the electron gun body 51 are embedded in the bead glass 55. Moreover, the bead glass 55 is joined across the elements. Thus, the elements are joined and connected to one another through the bead glass 55.

An apparatus for assembling an electron gun (not shown) for use to join the

bead glass 55 to the electron gun body 51 incorporates a holding frame for holding the electron gun body 51, beds for holding the bead glass 55, burners for heating and softening the bead glass 55 held by the beds and bed moving mechanisms for moving the beds toward the electron gun body 51.

The apparatus for assembling an electron gun structured as described above is operated such that the bead glass 55 held by the beds is heated by the burners. Thus, the bead glass 55 is softened and melted. The bed moving mechanisms move the beds for holding the softened and melted bead glass 55 to the electron gun body 51 held by the holding frame. Thus, the support members 54 of the electron gun body 51 are embedded in the bead glass 55. After the bead glass 55 has been joined to the electron gun body 51, the apparatus for assembling an electron gun causes the beds to release the held bead glass 55. Moreover, the bed moving mechanisms are moved in a direction apart from the electron gun body 51 so as to be returned to the initial positions.

The conventional apparatus for assembling an electron gun must perform the beading process such that the mixture ratio of oxygen and LPG (Liquefied Petroleum Gas) which flow in the burners for heating and softening the bead glass 55 is controlled. Moreover, the beading conditions must be controlled which include the temperatures of the beds, time for which the bead glass 55 is heated, the positions at which the beds moved toward the electron gun body 51 are stopped and the moving speed of each bed.

The quality of the electron gun assembled under the controlled beading conditions is determined by the following factors: a state in which the support members 54 of the electron gun body 51 are embedded in the bead glass 55; an amount of inclination of the bead glass 55 from the direction of the optical axis of the electron gun body 51; intervals of the connected and secured elements in the direction of the optical axis; and deviation of the positions of the elements.

However, the beading conditions are determined in accordance with experience and proficiency of an operator of the apparatus for assembling an electron gun. Therefore, there arises a problem in that great skills are required to complete the operation. In particular, the state in which the bead glass 55 is heated exerts considerable influences on the quality of the assembled electron gun. Therefore, there arises a problem in that the operator must have great skills.

SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to provide an apparatus for assembling an electron gun with which conditions for a process for joining bead glass to an electron gun body can quantitatively be recognized so as to make the quality of the electron gun to be stable.

To achieve the foregoing object, an apparatus for assembling an electron gun according to the present invention comprises: pressing means for pressing bead glass against support members of an electron gun body; and load detecting means for

detecting loads which are imposed on the pressed bead glass.

The apparatus for assembling an electron gun having the above-mentioned structure is operated such that the load detecting means detect loads imposed by the pressing means for pressing the bead glass when the bead glass is joined to the support members of the electron gun body.

Other objects, features and advantages of the invention will be evident from the following detailed description of the preferred embodiments described in conjunction with the attached drawings.

BRIEF DESCRIPTION OF THE DRAWING

Fig. 1 is a side view showing an electron gun body and bead glass;

Fig. 2 is a side view showing an apparatus for assembling an electron gun according to the present invention;

Fig. 3 is a plan view showing the apparatus for assembling an electron gun;

Fig. 4 is a diagram showing an example of data detected by a load cell of a load detecting mechanism provided for the apparatus for assembling an electron gun; and

Fig. 5 is a flow chart of an operation of the apparatus for assembling an electron gun for joining bead glass to the electron gun body.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of an apparatus for assembling an electron gun according to the

present invention will now be described with reference to the drawings. As shown in Fig. 1, bead glass 55 is joined to the electron gun body 51 by the apparatus for assembling an electron gun according to the present invention. A variety of elements including a plurality of grids G having support members 54 for supporting the bead glass 55 and a cathode 52 are previously joined to the electron gun body 51.

As shown in Figs. 2 and 3, the apparatus 1 for assembling an electron gun incorporates a magazine 5 for holding the electron gun body 51, to which the bead glass 55 will be joined; pair of beds 6 and 7 for holding the bead glass 55; a pair of burners 8 and 9 for heating and softening the bead glass 55 held by the beds 6 and 7; bed moving mechanisms 11 for moving the beds 6 and 7 toward the electron gun body 51; and load detecting mechanisms 12 and 13.

The magazine 5 is disposed in a central portion of the apparatus 1 for assembling an electron gun. Thus, an end of the electron gun body 51 in the direction of the optical axis of the electron gun body 51 is held by the magazine 5 in such a manner that the support members 54 of the electron gun body 51 oppose the beds 6 and 7.

As shown in Figs. 2 and 3, the pair of the beds 6 and 7 are disposed to oppose each other across the burners 8 and 9. Each of the beds 6 and 7 has a main surface in which a plurality of adsorbing openings (not shown) are formed. The adsorbing openings are communicated with a vacuum apparatus through suction pipes. Since air is sucked through the adsorbing openings, the beds 6 and 7 adsorb and hold the

supplied bead glass 55.

Each of the beds 6 and 7 includes a heater 15 for heating the beds 6 and 7. Moreover, a temperature detecting device 16, for example, a thermocouple, for detecting the temperatures of the beds 6 and 7 is embedded in each of the beds 6 and 7. The temperature detecting devices 16 are connected to the heaters 15 so that the heating operations which are performed by the heaters 15 are controlled in accordance with the detected temperatures.

As shown in Figs. 2 and 3, the pair of the burners 8 and 9 are disposed to oppose the beds 6 and 7, respectively. A plurality of jetting openings for jetting out flame are formed in the burners 8 and 9 at positions opposing the beds 6 and 7. The jetting openings are communicated with a gas supply apparatus through supply pipes.

The bed moving mechanisms 11 incorporates support plates 18 for supporting the beds 6 and 7; support bases 19 for movably holding the support plates 18 in directions indicated by arrows a_1 and a_2 and directions indicated by arrows b_1 and b_2 shown in Figs. 2 and 3; and a cam plate 20 for moving the support bases 19.

The beds 6 and 7 are secured and joined to ends of the support plates 18. Guide rails 22 running parallel to each other are disposed above the support bases 19, the guide rails 22 being structured to movably support the support plates 18 in the directions indicated by the arrows a_1 and a_2 and the directions indicated by the arrows b_1 and b_2 shown in Figs. 2 and 3. A guide groove (not shown) is formed in each of the support plates 18 so that the support plates 18 are movably supported in such a manner

that the guide grooves move along the guide rails 22.

The cam plate 20 is formed into a disc-like shape, the central portion of which is supported by a rotational shaft 23. The support bases 19 are, through joining members 24, joined to the cam plate 20. When cam plate 20 is rotated in a direction indicated by an arrow r shown in Figs. 2 and 3, the cam plate 20 moves the support bases 19 in the form of circular arcs.

Therefore, when the cam plate 20 is rotated, the bed moving mechanisms 11 move the support plates 18 and the beds 6 and 7 supported on the support bases 19 in the directions indicated by the arrows a_1 and a_2 and the directions indicated by the arrows b_1 and b_2 shown in Figs. 2 and 3. The foregoing directions are directions in which the support plates 18 and the beds 6 and 7 approach/move away from the electron gun body 51.

As shown in Figs. 2 and 3, each of the load detecting mechanisms 12 and 13 incorporates a load cell 26 which is a strain gauge or the like. The load detecting mechanisms 12 and 13 are disposed adjacent to the support plates 18 of the bed moving mechanisms 11. Each of the load detecting mechanisms 12 and 13 incorporates a contact member 27 jointed to the upper surface of the support plate 18 of the bed moving mechanism 11 and a contact plate 28 disposed at a position with which the leading end of the contact member 27 is brought into contact.

The load cell 26 is joined to the upper surface of the contact plate 28 in a state in which the load cell 26 is in contact with the leading end of the contact member 27.

The contact plates 28 have a plurality of heat radiating fins 29 joined to the upper surfaces of the support plates 18 and arranged to radiate heat conducted from the beds 6 and 7.

The load cell 26 is electrically connected to a load-cell amplifier 31 which amplifies and produces an output of detected voltage. Moreover, the load cell 26 is connected to a load recorder 32 for recording the detected voltage levels. The load-cell amplifier 31 incorporates a display panel 33 for displaying the voltage level detected by the load cell 26. Thus, an operator is enabled to detect the load. The load recorder 32 incorporates a recording needle which is oscillated in accordance with the load detected by the load cell 26 so as to record the loads on a moving sheet.

That is, the value detected by the load cell 26 is recorded by the load recorder 32 such that a waveform, for example, as shown in Fig. 4 is recorded. The axis of ordinates of a graph shown in Fig. 4 stands for loads (kgf) which are reaction forces added from the electron gun body 51 and to the bead glass 55 pressed against the support members 54 of the electron gun body 51. On the other hand, the axis of abscissa stands for time (seconds).

As shown in Fig. 4, impact force f_1 caused when the bead glass 55 is brought into contact with the support members 54 of the electron gun body 51 and load f_2 caused when the support members 54 are embedded in the bead glass 55 are recorded as waveforms. Therefore, the load detecting mechanisms 12 and 13 enable the beading conditions to be formed into numerals which can quantitatively be recognized.

The load-cell amplifier 31 of each of the load detecting mechanisms 12 and 13 is electrically connected to an alarm device (not shown) which issues an alarm if a value detected by the load cell 26 does not satisfy a predetermined range, for example, if the detected value exceeds a predetermined load. Therefore, the load detecting mechanisms 12 and 13 incorporating the alarm device enable an operator to reliably recognize an abnormal state.

The apparatus 1 for assembling an electron gun incorporates burner moving mechanisms (not shown) for moving the burners 8 and 9 in directions indicated by the arrows c and d shown in Fig. 3. The burner moving mechanisms move the burners 8 and 9 through the burner support members 34 for supporting the burners 8 and 9.

When the bead glass 55 is heated and melted, the burner moving mechanisms move the burners 8 and 9 to positions at which the burners 8 and 9 oppose the bead glass 55 held by the beds 6 and 7. After the bead glass 55 has been heated and melted by the burners 8 and 9, the burner moving mechanisms move the burners 8 and 9 to retraction positions apart from the positions between the electron gun body 51 and the bead glass 55.

The apparatus 1 for assembling an electron gun incorporates glass supply mechanisms (not shown) for supplying bead glass to the beds 6 and 7, respectively. The glass supply mechanisms are disposed adjacent to the beds 6 and 7.

The operation of the apparatus 1 for assembling an electron gun having the above-mentioned structure to join the bead glass 55 to the electron gun body 51 will

now be described.

In step ST1 shown in Fig. 5, the glass supply mechanisms (not shown) of the apparatus 1 for assembling an electron gun supply bead glass 55 to the beds 6 and 7. The supplied bead glass 55 is adsorbed and held by the beds 6 and 7. In step ST2 the apparatus 1 for assembling an electron gun causes the burners 8 and 9 to start heating the bead glass 55 adsorbed and held by the beds 6 and 7.

In step ST3 the apparatus 1 for assembling an electron gun causes the burners 8 and 9 to heat the bead glass 55 for a predetermined time. Thus, the bead glass 55 held by the beds 6 and 7 is melted as required. Then, the operation for heating the bead glass 55 is completed. After the burners 8 and 9 have completed the operations for heating the bead glass 55, the burner moving mechanisms move the burners 8 and 9 to the retraction positions apart from the beds 6 and 7.

In step ST4 the apparatus 1 for assembling an electron gun starts performing a beading operation for embedding the support members 54 of the electron gun body 51 into the heated and molten bead glass 55 to join the support members 54. In step ST5 the bed moving mechanisms 11 move the beds 6 and 7 at predetermined speeds in the directions indicated by the arrows a_1 and a_2 shown in Fig. 3 in which the beds 6 and 7 approach the support members 54 of the electron gun body 51 held by the magazine 5.

Since the beds 6 and 7 of the apparatus 1 for assembling an electron gun are moved toward the support members 54 of the electron gun body 51, the support

members 54 of the electron gun body 51 are, in step ST6, gradually embedded in the bead glass 55. The load cell 26 of each of the load detecting mechanisms 12 and 13 detects and records impact forces and loads imposed on the bead glass 55 which is pressed against the electron gun body 51 after the bead glass 55 has been brought into contact with the electron gun body 51. When the beds 6 and 7 have been moved to predetermined stop positions with respect to the electron gun body 51, bed position detecting devices (not shown) of the apparatus 1 for assembling an electron gun detect ends of the beds 6 and 7. Thus, the movements of the beds 6 and 7 are stopped.

In step ST7 the positions of the moved beds 6 and 7 of the apparatus 1 for assembling an electron gun are maintained for a predetermined time in a state in which the support members 54 of the electron gun body 51 have been embedded in the bead glass 55. Thus, the bead glass 55 is cooled and solidified.

Then, the beds 6 and 7 of the apparatus 1 for assembling an electron gun release the adsorbed and held bead glass 55. In step ST8 the beds 6 and 7 are moved in directions indicated by the arrows b_1 and b_2 shown in Fig. 2 in which the beds 6 and 7 are moved apart from the bead glass 55 joined to the electron gun body 51. Thus, the beds 6 and 7 are returned to the initial positions. The magazine 5 releases the electron gun body 51 to which the bead glass 55 has been joined, and then holds a next electron gun body 51 to which bead glass 55 will be joined.

As described above, the apparatus 1 for assembling an electron gun incorporates the load detecting mechanisms 12 and 13 each having the load cell 26 for detecting

loads imposed on the bead glass 55. Therefore, the beading conditions under which the bead glass 55 is joined to the support members 54 of the electron gun body 51 can quantitatively be detected. Therefore, the apparatus 1 for assembling an electron gun enables an unskilled operator to easily and satisfactorily perform the beading operation without a necessity of having skills and specific proficiency. Therefore, the apparatus 1 for assembling an electron gun is able to stably improve the qualities of the electron guns.

The load detecting mechanisms 12 and 13 of the apparatus 1 for assembling an electron gun incorporate the recording and reproducing means, such as the load recorders 32. Therefore, data, such as waveform samples of the beading conditions, can be collected. Therefore, the qualities of the electron guns can furthermore stably be improved.

The apparatus 1 for assembling an electron gun incorporates the alarm device for issuing an alarm when an abnormal state, in which values detected by the load detecting mechanisms 12 and 13 do not satisfy predetermined ranges, has been realized. Therefore, an operator is able to reliably recognize the abnormal state. As a result, the qualities can be made stable and manufacturing yield can be improved.

The apparatus 1 for assembling an electron gun according to the present invention may be provided with a control means for feedback-control the bed moving mechanisms 11 in accordance with, for example, values detected by the load detecting mechanisms 12 and 13. If the control means for controlling the moving speeds of the

beds 6 and 7 in accordance with the loads imposed on the bead glass 55 is provided for the apparatus 1 for assembling an electron gun, the quality of the electron gun can furthermore be improved.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form can be changed in the details of construction and in the combination and arrangement of parts without departing from the spirit and the scope of the invention as hereinafter claimed.



WHAT IS CLAIMED IS:

1. An apparatus for assembling an electron gun comprising:
support structures having a plurality of support members and capable of supporting an electron gun body;
holding members movably disposed in directions in which said holding members approach/move away from said electron gun body and structured to hold bead glass which must be joined to said electron gun body;
heating means for heating and softening said bead glass held by said holding members;
pressing means which moves said holding members so as to press said bead glass against said support members of said electron gun body; and
load detecting means for detecting loads imposed on said bead glass pressed by said pressing means.
2. An apparatus for assembling an electron gun according to claim 1, further comprising support frames for movably supporting said holding members and structured to be moved by said pressing means, wherein
said support frames have said load detecting means at positions with which ends of said holding members are brought into contact.





3. An apparatus for assembling an electron gun according to claim 1, further comprising recording means for recording values detected by said load detecting means.
4. An apparatus for assembling an electron gun according to claim 1, further comprising display means for displaying values detected by said load detecting means.
5. An apparatus for assembling an electron gun according to claim 1, further comprising alarm means for issuing an alarm when an abnormal state has been realized in which a value detected by said load detecting means does not satisfy a predetermined range.
6. An apparatus for assembling an electron gun according to claim 1, further comprising control means for controlling said pressing means in accordance with values detected by said load detecting means.