

The invention relates to a method for annealing in an oven bases of vacuum tubes for relieving the residual stresses of glass and especially concerns means to avoid the oxidizing of the conducting wire(s) which the bases comprise. The invention also relates to an annealing oven to implement this method.

The bases of vacuum tubes, of cathode ray tubes for example, are generally made of glass and have the general form of a cake passed through by one or several metallic wires. The metallic wire(s) enable(s) to connect electrically electrodes contained in the vacuum tube to elements which are external to the vacuum tube.

The bases are usually produced by series from two cylindrical glass pieces which are heated, generally by burners, and which are then pressed against each other in a mould, the metallic wire(s) being embedded in the molten glass during the pressing operation of the two glass pieces.

The bases obtained in this manner must be annealed for relieving the residual stresses of glass. This annealing of the bases is generally performed by subjecting the bases to a predetermined temperature cycle. This can be obtained by passing the bases through an oven : when entering the oven, the bases are heated so as to be quickly brought to a temperature of approximately 500°C; during their advance in the oven, the bases are then cooled down slowly, especially from an upper temperature limit of approximately 450°C to a lower temperature limit of approximately 390°C, this temperature gradient being set on a predetermined oven length which, combined with the motion speed of the bases, is such that the temperature of the bases gradually passes from the upper

limit to the lower limit in a time period of approximately 15 min, the bases being brought back to the ambient temperature at the outlet of the oven by means external to the oven.

This method is particularly convenient to a series production. However, a defect can be observed which is not systematic and which consists in that the conducting wires of the bases show an oxidation process which is light but sufficient to be very detrimental to the quality of the weld seams between the wires of the bases and the electrodes of the vacuum tubes, this defect being all the more pronounced since the wires of the bases, generally made out of nickel, have been deoxidized, before passing through the annealing oven, by reduction in a hydrogen current, the wires being then made very chemically active. It results therefrom that it is necessary, after the annealing of the bases, to deoxidize again the conducting wires by shot-peening, for example, whereas their surface quality was entirely compatible to perform the welding seams, for example by electrical strength welding, before performing the annealing of the bases.

The object of the present invention is to improve the method for annealing the bases which is described above so as to obtain that the conducting wire(s) carried by each base have a surface quality compatible with the later welding seams, particularly that they are free from oxidation, even in case these wires have been first deoxidized by reduction in a hydrogen current. The invention also relates to an annealing oven for bases implementing the method according to the invention.

The present invention results from an unexpected effect obtained during a temperature checking operation on the length of the annealing oven. During this temperature checking operation, one or several temperature sensors have been placed in the oven at places, the temperature of which had to be known exactly ; the temperature sensors were connected to a temperature measuring device, external to the oven, by an electrically conducting wire contained in an insulating sleeve for high temperatures. After having noted down the temperatures in the oven, the authors of the invention observed that the conducting wires of a series of bases did not show any oxidation and they thought of investigating if there was a time correlation between the period of passage of this series of bases in the oven and these temperature measures in the oven. As they found that this correlation did exist, they thought that the improvement of the surface quality of the conducting wires of this series of bases is linked to the nature of the insulating sleeve of the wire which connects the temperature sensors to the measuring device. Later tests allowed to confirm the soundness of this reasoning.

According to the invention, a method for relieving the residual stresses of glass in bases, consisting in subjecting the bases to at least one predetermined temperature cycle by passing the bases through an oven, each base comprising at least one conducting wire, is characterized in that it consists in placing in the oven an element, at least a part of which is made out of silicone or of a silicone-base material during the passage through the oven.

The invention will better be understood by reading the following description which is a non-restrictive example

of the invention and the unique figure which represents, in a perspective view, the general configuration of an annealing oven implementing the method according to the invention.

Figure 1 shows schematically, as a non-restrictive example, a tunnel-type oven 1 with a rectangular section with an inner width l of approximately 0,60 m and an inner height h of approximately 0,40 m, the length L of the oven 1 being approximately 6 m. In the non-restrictive example which is described, the inner walls 2 of the oven are made of refractory bricks 3 and the outer wall is formed by one or several stainless steel sheets 5.

Bases $E_1, \dots, E_n$ of vacuum tubes, for example of cathode ray tubes (which are not represented) pass through the oven 1 along its length L in the direction represented by an arrow 8 for example, from a first end 7 which forms the inlet of the oven to a second end 9 which is the outlet of the oven. In the non-restrictive example which is described, both ends 7, 9 of the oven 1 are open to the ambient air.

Each base E_1 to E_n includes at least one conducting wire 15, made of nickel for example, which projects from the glass of the base and a part of which (which is not represented) is embedded in the glass. The bases E_1 to E_n are transported outside and inside the oven by a conveying device of a type known in itself consisting of, for example, a chain 11 which is movable in the direction shown by the arrow 8 by classic driving means (which are not represented). The bases $E_1, \dots, E_n$ are carried each in a cup 10 which is fixed to the chain 11.

In the non-restrictive example of the description, the oven 1 in the usual way comprises resistors (which are not represented) intended for heating the interior of the oven so that the bases E_1 to E_n , which enter the oven by the inlet 7, are on the one hand quickly brought to a high temperature of approximately 500°C for example on a first distance d_1 of the length L of the oven; on the other hand, the bases $E_1, \dots, E_n$ are then on a second distance d_2 , subjected to the above mentioned temperature gradient which enables to eliminate the glass stresses, temperature control devices (which are not represented) being used to this end in a classic way.

According to a characteristic of the invention, the oven 1 contains silicone or silicone-base material.

The presence of silicone or of silicone-base products inside the oven 1 avoids the oxidizing of the conducting wires 15 of the bases E_1 to E_n . This has been proved by repeated tests which have been performed further to the unexpected effect observed by the authors of the invention and caused by the presence of one or several high temperature conducting wires contained in an insulating sleeve which is provided for being placed at high temperatures, the examination of such a high temperature wire having proved that it consisted of stranded wires of nickel, coated with glass wool and silicone elastomer.

The authors of the invention think that probably silicone disintegrates and subsequently modifies greatly and locally the atmosphere of the oven, particularly by consuming oxygen.

Later tests have shown that the oxidation of the conducting wires 15 of the bases was also avoided with silicone in the form of a mastic laid along the way of the bases E1 to En in the oven 1, way which is symbolized in fig. 1 by the length L of the oven. For example, the silicone mastic can be arranged as a strip 22 on a corner angle 21 which is placed in the oven parallel to its length L; the strip 22 can have a length which is less than that of the oven 1. The silicone mastic can also be laid on one or several links 23 of the chain 11 so that silicone is always present on the length L of the oven; the silicone mastic is so introduced into the oven by the motion of the chain 11 so that it can be easily renewed.

The silicone or silicone-base product used has a limited action in time so that it must be replaced as soon as a loss of efficiency is observed or at the end of periods, the duration of which depends on the working conditions of the oven and which must be determined empirically.

A preferred embodiment of the invention consists in using a silicone elastomer in form of a silicone cable 26 which has approximately the length L of the oven; its replacement is made easy because it can be fixed with one end 29 to one of the links 23 so as to pass through the oven 1 thanks to the motion of the chain 11, the opposite end 31 of the cable 26 remaining on the side of the inlet 7 of the oven 1. The silicone cable 26 can be made of a conducting wire 27 coated with a high temperature silicone-base coating 28. The advantage of such a silicone cable is that it exists ready-made in industry where it is commonly used in other applications and that it is easy to supply.

In the non-restrictive example of the invention, the silicone cable 26 is tightened in the length L of the oven 1. To this end, it is fixed at each of its ends 29, 31 (visible thanks to aperture shown in the drawing of the arch 45 of the oven) by the conducting wire 27 to posts 30, sealed in the inner wall 2 of the oven, in the vicinity of the ends 7, 9 of the oven. The silicone cable 26 can, however, just as well be longer than the oven and then be fixed to posts external to the oven.

It should be pointed out that with a silicone cable 26 of the type of a high temperature conducting wire with a length of approximately 6 m and a diameter of approximately 2,5 millimeters, it is possible to anneal 250 000 bases by avoiding the oxidation of the conducting wires of these bases.

CLAIMS

1. Method for relieving the residual stresses of the glass of bases consisting in subjecting the bases (E1,..., En) to at least one predetermined temperature cycle by passing the bases (E1,..., En) through an oven (1), each base (E1 to En) comprising at least one conducting wire (15), characterized in that it consists in placing in the oven an element (26, 22), at least a part of which is made out of silicone or of a silicone-base material (28) during the passage of the bases (E1 to En) to avoid the oxidation of the conducting wires (15).
2. Method according to claim 1, characterized in that said element (26) comprises a silicone elastomer.
3. Method according to claim 1, characterized in that said element (22) is made of a silicone mastic (22).
4. Method according to one of the claims 1 or 2, characterized in that it consists in tightening, inside the oven (1), a cable (26), at least a part of which is a silicone elastomer.
5. Method according to claim 4, characterized in that the cable (26) is tightened approximately along a way (L) along which the bases (E1 to En) pass through the oven (1).
6. Method according to one of the claims 4 or 5, characterized in that the cable is made of an electrically conducting wire (27) which has an insulating sleeve (28), at least a part of which is made out of silicone.



7. Method according to claim 6, characterized in that the electrically conducting wire (27) is made out of nickel.
8. Method according to claim 1, characterized in that the conducting wires (15) of the bases (E1 to En) are made out of nickel.
9. Method according to claim 3, the bases (E1,..., En) being carried by a movable chain (11), characterized in that the silicone mastic is laid on the chain (11).
10. Method according to claim 3, characterized in that the silicone mastic is laid in the oven (1) in a strip (22) arranged along a way (L) of the bases (E1,..., En).
11. Method according to any of the preceding claims, characterized in that the oven (1) is open to the ambient air.
12. Method according to any of the preceding claims, characterized in that the oven (1) has the form of a tunnel, at least one end (9) of which is open to the ambient air and a length (L) of which represents the way of the bases through the oven (1).
13. An annealing oven for bases of vacuum tubes, the oven (1) having the form of a tunnel in which bases (E1,..., En) are transported on a way corresponding to a length (L) of the tunnel, the bases (E1 to En) being subjected during said way (L) to at least one predetermined temperature cycle, each base (E1 to En) comprising at least one conducting wire (15), characterized in that the oven (1) contains an element (26, 22), at least a part of which is made of silicone or a silicone-base material.



14. An oven according to claim 13, characterized in that said element (26) consists of a wire (27) which is electrically conducting and which has an insulating sleeve (28), at least a part of which is made out of silicone.
15. An oven according to claim 14, characterized in that the electrically conducting wire (27) is made out of nickel.
16. An oven according to claim 13, characterized in that said element (22) consists of a silicone mastic.
17. An oven according to claim 13, characterized in that at least one of the ends (7, 9) of the oven (1) is open to the ambient air.



* C L H S *