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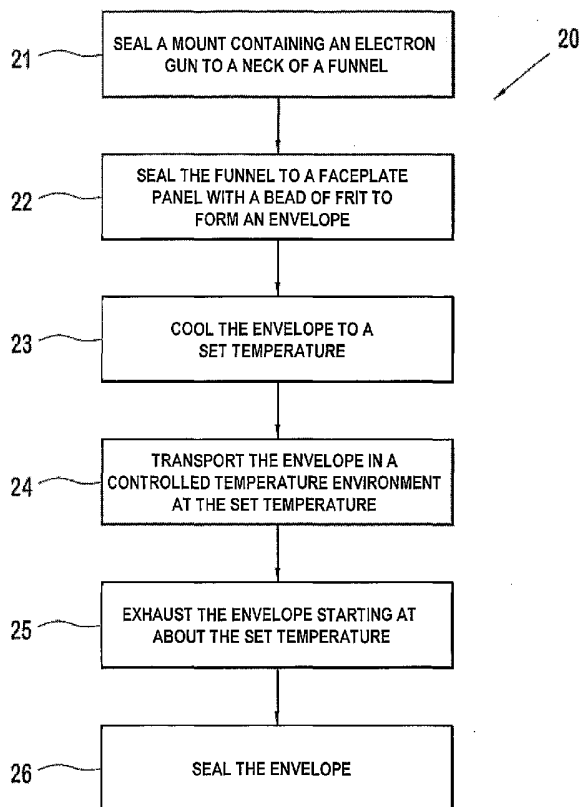
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(54) Title: A METHOD FOR THERMAL PROCESSING A CATHODE RAY TUBE



(57) Abstract: In a method for thermal processing a cathode ray tube, a glass mount containing an electron gun is sealed to a neck of a funnel. After sealing the mount containing the electron gun to the neck of the funnel, the funnel is sealed to a faceplate panel with a bead of frit to form an envelope by heating the funnel and the faceplate panel to a temperature of about 430-450 degrees Celsius. The envelope is then cooled to a set temperature of about 310-350 degrees Celsius. The envelope is then exhausted at a temperature of at least 310 degrees Celsius. The envelope is sealed to form the cathode ray tube.



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

A METHOD FOR THERMAL PROCESSING A CATHODE RAY TUBE

Field of the Invention

5 The invention relates to a method for making a cathode ray tube and, more particularly, to a method for making a cathode ray tube including thermal processing.

Background of the Invention

10 In a conventional thermal process for a cathode ray tube (CRT), a faceplate panel having a screen and a mask support frame assembly therein is sealed to a funnel to form an envelope. To seal the faceplate panel to the funnel, a bead of glass frit is applied to either a panel seal edge or a funnel seal edge, and the assembly is heated to a temperature of about 430 to 450 degrees Celsius. The bead of the glass frit melts as the assembly is heated to
15 permanently seal the funnel to the faceplate panel thereby forming the envelope. The envelope is cooled to a temperature of about 50 degrees Celsius and a glass mount having an electron gun is sealed to a neck of the envelope. The envelope is then heated a second time to a temperature of at least 310 degrees Celsius while being exhausted. The envelope must be exhausted at a high enough temperature and for a long enough time to ensure that water and
20 gases adsorbed by coatings and components inside the envelope are removed. The exhausted envelope is then cooled and hermetically sealed. As shown in the example in Figure 3, the two heating processes together can take approximately eight hours per envelope. The use of separate heating operations therefore is expensive, inefficient, and time consuming.

In an effort to reduce the number of heating operations and the amount of time it takes
25 to process the envelope, U.S. Patent No. 4,923,423 teaches using a dedicated oven to combine the frit seal, mount seal and exhaust processes. In this process, a faceplate panel having a screen and a mask support frame assembly therein is sealed to a funnel to form an envelope.

The faceplate panel and the funnel is heated in the dedicated oven to a temperature of about 430 to 450 degrees Celsius so that a bead of glass frit applied to either a panel seal edge or a funnel seal edge melts to permanently seal the funnel to the faceplate panel thereby forming the envelope. The envelope is then cooled to about 325 degrees Celsius, and an electron gun is sealed to the neck of the funnel. As the envelope continues to cool, the envelope is exhausted and hermetically sealed.

Accordingly, the envelope undergoes a single heating operation in a process taking about four hours per envelope. The entire process, however, requires the use of a dedicated oven. Not only is the dedicated oven expensive to own and operate, but the equipment used to mount the electron gun and exhaust the envelope must be specially designed to work in cooperation with and withstand the heat of the dedicated oven, because both processes are performed while the envelope is in the dedicated oven.

Furthermore, those skilled in the art have been reluctant to combine processes that include thermal processing that may subject an electron gun to high temperatures in CRT manufacturing. To understand this reluctance, it is first necessary to describe the cathode, electron gun and process of sealing the panel to the funnel with frit. A typical cathode is composed of carbonates (usually barium, strontium and calcium) sprayed on a nickel substrate. A typical size is about 80 mils diameter and the carbonates are about 4 mils thick. The spraying mixture usually includes a material, such as nitrocellulose, used to give the carbonates some adherence after spraying. A typical electron gun is composed of stainless steel grids, which are spaced and fixed by inserting the grids in molten glass beads. The grids then remain rigid after the bead glass cools. These grids are equipped with metal tabs for electrical connections. In the frit seal process, frit is applied to the panel or funnel seal edge. The panel and funnel are placed in a fixture and heated to about 450 degrees Celsius in air. During this process, the glass and coatings on the glass liberate large amounts of water

resulting in a very wet atmosphere. Having the electron gun in the funnel can result in many adverse effects on the cathode and electron gun. The reason is that at 450 degrees Celsius, the nitrocellulose is decomposed and the adherence of the cathode is very poor. Vibrations and handling in a typicallehr oven could easily remove the cathode coating from the nickel base.

5 Further, the wet air in the frit sealed bulb could react with the carbonate coating causing the cathode to expand and lose the little adherence that it has to the nickel base. Additionally, the wet air in the frit sealed bulb could react with the cathode nickel substrate. The oxidation of the nickel substrate then could prevent proper activation of the cathode in subsequent processing. This could result in poor cathode adherence or poor emission. The wet air, at the
10 450 degrees Celsius, could react with the cathode coating. This could also prevent proper activation of the cathode in subsequent processing resulting in poor adherence or poor emission. Further, during the frit sealing process, all the electron gun grids will likely get oxidized. This could result in excessive outgassing of the grids during subsequent processing which would result in poor electron adherence and cause spurious emission, high leakage and
15 even electrical shorts when high voltage is applied to the grids.

The scope of the current invention is to develop a less expensive thermal processing method for a CRT wherein the envelope undergoes a single heating operation, without risk diminishing performance of the CRT.

20

Summary of the Invention

The invention relates to a method for thermal processing a cathode ray tube. In the method, a glass mount containing an electron gun is sealed to a neck of a funnel. After sealing the electron gun to the neck of the funnel, the funnel is sealed to a faceplate panel with a bead of frit to form an envelope by heating the funnel and the faceplate panel to a
25 temperature of about 430-450 degrees Celsius. The envelope is then cooled to a set

temperature of about 310-350 degrees Celsius. The cooled envelope is transported in a controlled temperature environment at the set temperature. The envelope is then exhausted at a temperature of at least 310 degrees Celsius. The envelope is sealed to form the cathode ray tube.

5

Brief Description of the Drawings

Figure 1 is a cross sectional view of a cathode ray tube.

Figure 2 is a flowchart of a method for manufacturing the cathode ray tube.

Figure 3 is a graph comparing the method for manufacturing the cathode ray tube

10 according to the present invention to a method for manufacturing a cathode ray tube according to the prior art.

Detailed Description of the Invention

Figure 1 shows a cathode ray tube (CRT) 1 having a glass envelope 2 comprising a
15 rectangular faceplate panel 3 and a tubular neck 4 connected by a funnel 5. The faceplate panel 3 consists of a viewing faceplate 8 and a peripheral flange or sidewall 9 with a panel seal edge 15. The panel seal edge 15 is sealed to a funnel seal edge 17 by a glass frit 7. The funnel 5 has an internal conductive coating (not shown) that extends from an anode button 6 toward the faceplate panel 3 and to the neck 4. A three-color phosphor screen 12 is carried by
20 an inner surface of the faceplate panel 3. The screen 12 may be, for example, a line screen of phosphor lines arranged in triads. A mask support frame assembly 10 is removably mounted in predetermined spaced relation to the screen 12. A glass mount 16 containing an electron gun 13, shown schematically by dashed lines in Figure 1, is centrally mounted within the neck 4 and generates and directs three inline electron beams, a center beam and two side or outer
25 beams, along convergent paths through the mask frame assembly 10 to the screen 12. The

CRT 1 is designed to be used with an external magnetic deflection yoke 14 shown in the neighborhood of the funnel-to-neck junction. When activated, the yoke 14 subjects the three beams to magnetic fields that cause the beams to scan horizontally and vertically in a rectangular raster over the screen 12.

5 A method of manufacturing the CRT 1 will now be described in greater detail with reference to Figure 3 and flowchart 20 shown in Figure 2. In step 21, the funnel 5 is placed in a holder such that the neck 4 of the funnel 5 extends downward and a longitudinal axis of the funnel 5 is in a vertical position. The glass mount 16 containing the electron gun 13 is positioned within the neck 4. The mount 16 is sealed to the neck 4 using known methods to
10 permanently mount the electron gun 13 in the funnel 5. For example, a flame may be applied to an outer circumferential surface of the neck 4 to seal the mount 16 to the neck 4.

 A bead of the glass frit 7 or some other suitable sealant is applied to either the panel seal edge 15 or the funnel seal edge 17. In step 22, the panel seal edge 15 of the faceplate panel 3 is aligned with the funnel seal edge 17. The assembly is loaded into a heating unit,
15 such as a frit seal oven, where it is supported, in a conventional manner, to maintain proper alignment of the funnel 5 with the faceplate panel 3. The assembly is slowly heated to a temperature of about 430-450 degrees Celsius. As the assembly is heated, the bead of the glass frit 7 in contact with the panel seal edge 15 and the funnel seal edge 17 melts to permanently fix the funnel 5 to the faceplate panel 3 thereby forming the envelope 2. Any
20 existing organic substances (not shown) are removed from the screen 12 simultaneous with the formation of the envelope 2.

 In step 23, the envelope 2 is cooled to a set temperature of 310-350 degrees Celsius. In step 24, the envelope 2 is removed from the heating unit at the set temperature of 310-350 degrees Celsius and is conveyed to an exhausting machine in a controlled temperature
25 environment that maintains the envelope 2 at the set temperature. In step 25, the envelope 2 is

exhausted while it is maintained at or above 310 degrees Celsius. In step 26, the exhausted envelope 2 is hermetically sealed. The sealing is typically done by heating the tubulation (which is not shown and present at the end of the glass mount 16 through which the contents are exhausted). The tubulation melts from the applied heat causing the tubulation to close in on itself, thereby sealing the CRT 1.

In another embodiment of the invention, the set temperature could be about 250 degrees Celsius, and the envelope 2, which has been maintained at the set temperature, could be exhausted at a temperature of about 250 degrees Celsius. The exhaust temperature can be lower, because less moisture is adsorbed by conventional coatings and components on an inside surface of the envelope 2 between step 22 and step 25 as a result of the short amount of cooling time between step 22 and step 25.

Another embodiment includes the method of making a CRT which includes the steps of (1) sealing a mount containing an electron gun to a neck of a funnel, (2) sealing the funnel to a faceplate panel with a bead of frit or some other suitable sealant to form an envelope by heating the funnel and the faceplate panel to a suitable temperature, which could be about 430 to 450 degrees Celsius, (3) cooling the envelope to a set temperature, (4) exhausting the envelope at about the set temperature; and (5) sealing the envelope to form the cathode ray tube. Optionally, the steps of sealing the funnel to a faceplate panel, cooling the envelope to a set temperature, and exhausting are performed in a common machine without high temperature transfer of the envelope from one machine to another.

The method of manufacturing the CRT 1 according to the invention thereby uses a single heating operation to manufacture the envelope 2. The cost and amount of time required to manufacture the CRT 1 can therefore be kept at a minimum by using this method.

The foregoing illustrates some of the possibilities for practicing the invention. Many other embodiments are possible within the scope and spirit of the invention. It is, therefore,

intended that the foregoing description be regarded as illustrative rather than limiting, and that the scope of the invention is given by the appended claims together with their full range of equivalents.

What is Claimed is:

1. A method of making a cathode ray tube, comprising the steps of:

sealing a mount containing an electron gun to a neck of a funnel;

sealing the funnel to a faceplate panel with a bead of frit to form an envelope

5 after sealing the electron gun to the neck of the funnel by heating the funnel and the faceplate panel to a temperature of about 430 to 450 degrees Celsius;

cooling the envelope to a set temperature;

transporting the envelope in a controlled temperature environment at the set temperature;

10 exhausting the envelope at a peak temperature, then cooling the envelope at a controlled cooling rate; and

sealing the envelope to form the cathode ray tube.

2. The method of claim 1, wherein the set temperature is between 310 to 350 degrees
15 Celsius.

3. The method of claim 1, wherein the envelope is exhausted at a temperature of at least 310 degrees Celsius.

- 20 4. The method of claim 1, wherein the set temperature is about 250 degrees Celsius.

5. A method of making a cathode ray tube, comprising the steps of:

sealing a mount containing an electron gun to a neck of a funnel;

sealing the funnel to a faceplate panel with a sealant to form an envelope by

25 heating the funnel and the faceplate panel to a temperature sufficient for sealing;

cooling the envelope to a set temperature;

transporting the envelope in a controlled temperature environment at the set temperature;

exhausting the envelope at a peak temperature, then cooling the envelop at a controlled rate; and

sealing the envelope to form the cathode ray tube.

6. The method of claim 5, wherein the set temperature is between about 310 to 350 degrees Celsius.

7. The method of claim 5, wherein the envelope is exhausted at a temperature of at least 310 degrees Celsius.

8. The method of claim 5, wherein the set temperature is about 250 degrees Celsius.

9. A method of making a cathode ray tube, comprising the steps of:

sealing a mount containing an electron gun to a neck of a funnel;

sealing the funnel to a faceplate panel with a bead of frit to form an envelope after sealing the mount containing the electron gun to the neck of the funnel by heating the funnel and the faceplate panel to a temperature of about 430 to 450 degrees Celsius;

cooling the envelope to a set temperature;

exhausting the envelope at a peak temperature , then cooling the envelope at a controlled cooling rate; and

sealing the envelope to form the cathode ray tube.

10. The method of claim 9, wherein the set temperature is between about 310 to 350 degrees Celsius.
- 5 11. The method of claim 9, wherein the envelope is exhausted at a temperature of at least 310 degrees Celsius.
12. The method of claim 9, wherein the set temperature is about 250 degrees Celsius.
- 10 13. The method of claim 9, wherein steps of sealing the funnel to a faceplate panel, cooling the envelope to a set temperature, and exhausting are performed in a common machine without high temperature transfer of the envelope from one machine to another.

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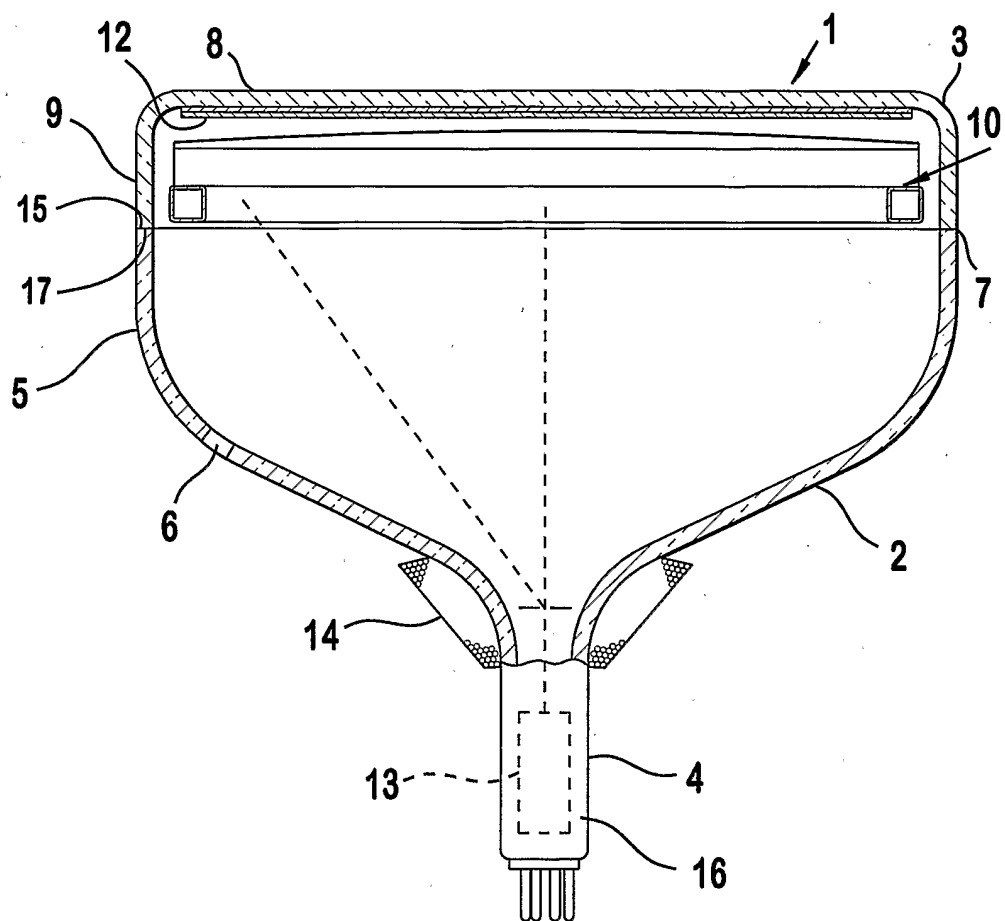


FIG. 1

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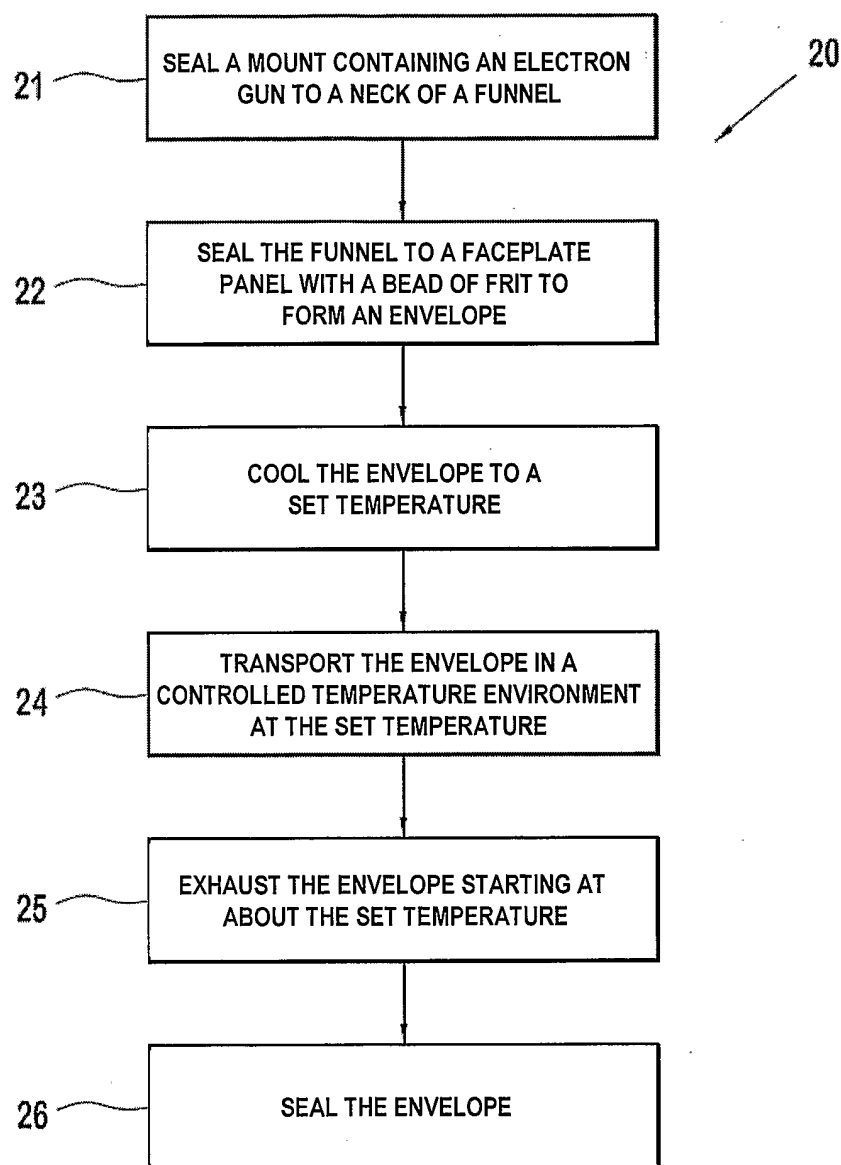


FIG. 2

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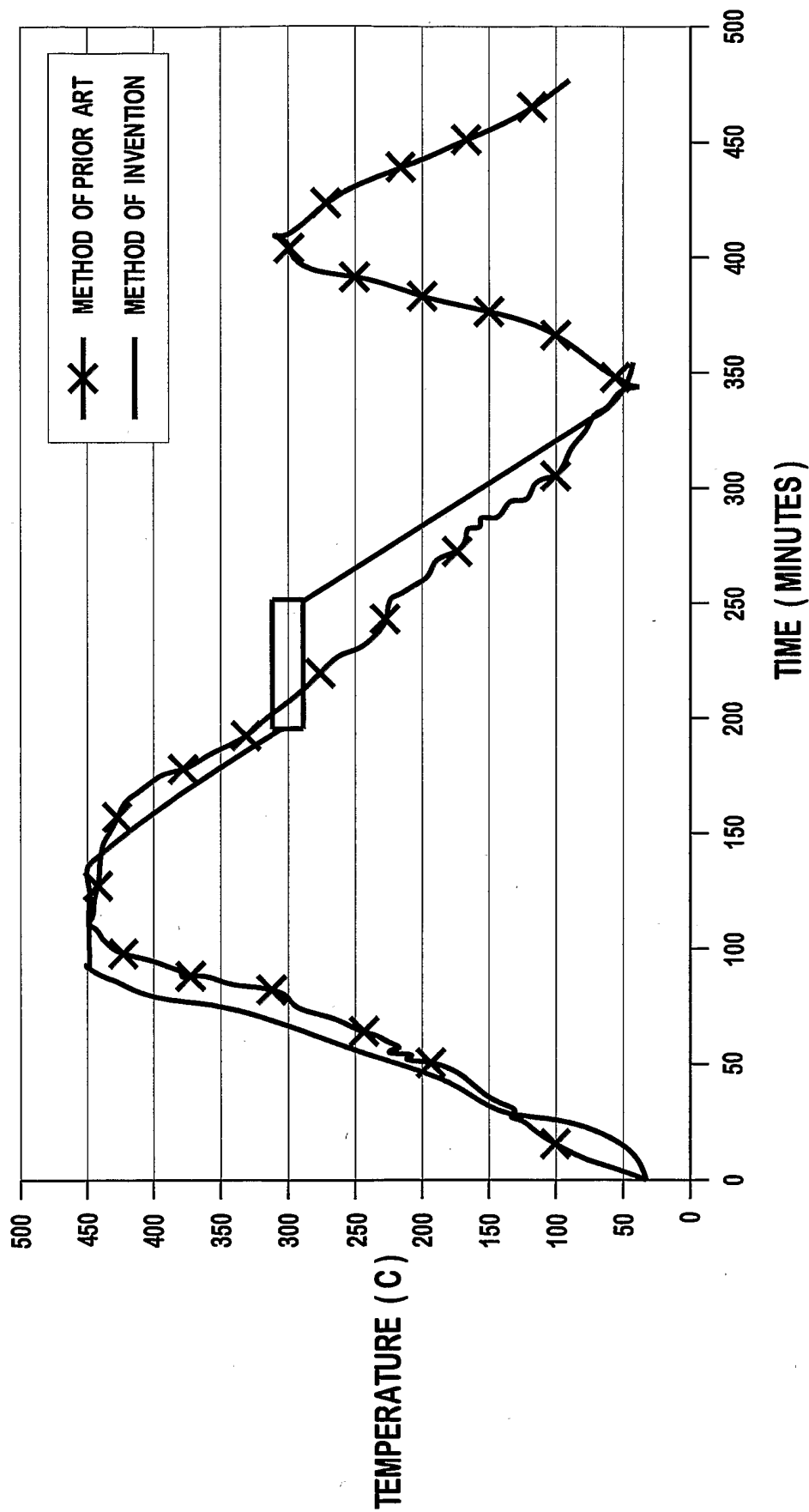


FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US2004/035535

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01J9/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 923 423 A (STOCKDALE ET AL) 8 May 1990 (1990-05-08) cited in the application abstract; claim 1; figure 1 -----	1,5,9
A	US 4 622 084 A (CHANG ET AL) 11 November 1986 (1986-11-11) abstract; claims 1,4 column 1, line 26 - line 38 column 2, line 25 - line 65 -----	1,5,9
A	US 6 021 648 A (ZONNEVELD ET AL) 8 February 2000 (2000-02-08) abstract; figure 2 column 1, line 25 - line 46 column 2, line 54 - column 3, line 19 -----	1,5,9

☐ Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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