United States Patent

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[33] **U.S.S.R.**
[31] **1,144,461 and 1,144,462**

[54] **CONTINUOUS LEHR FOR THE HEAT TREATMENT OF GLASS-BASED MATERIALS**
4 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **263/6;** 65/350
[51] **Int. Cl.** **F27b 9/14**
[50] **Field of Search** 263/6, 6c; 65/350

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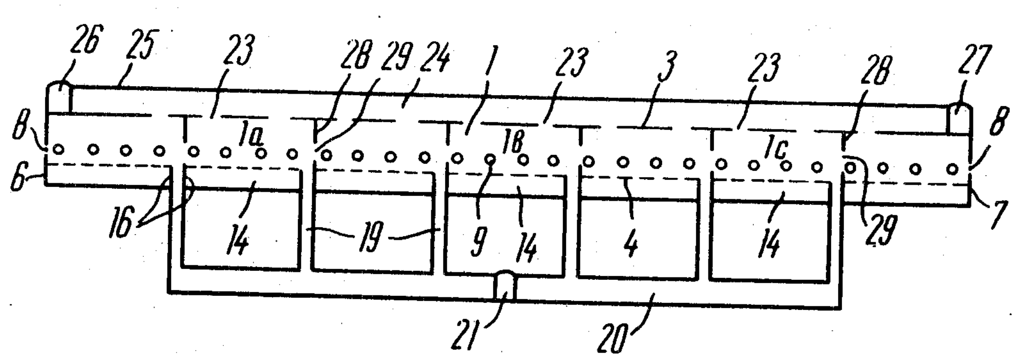
ABSTRACT: A lehr having a heating chamber below which are combination chambers on which is superposed a hearth grating. Direct heating devices are connected to the combustion chambers and to the upper part of the heating chamber through which extends a conveyor. The combustion chambers are subdivided by a longitudinal partition.



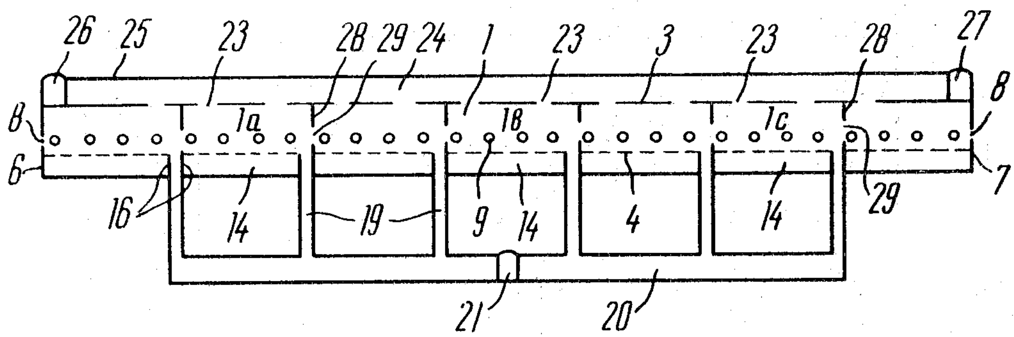

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FIG. 1

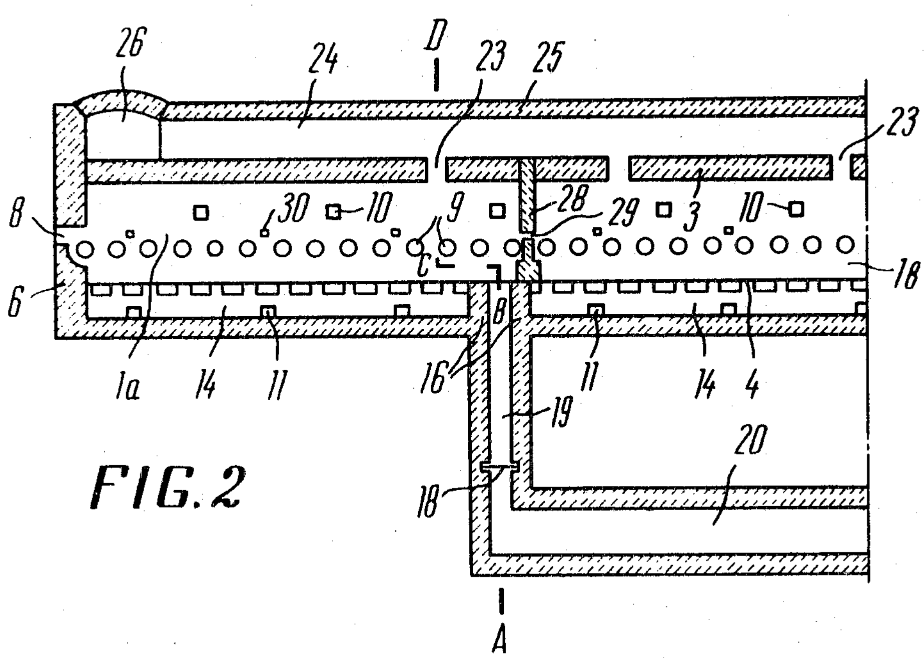
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FIG. 2

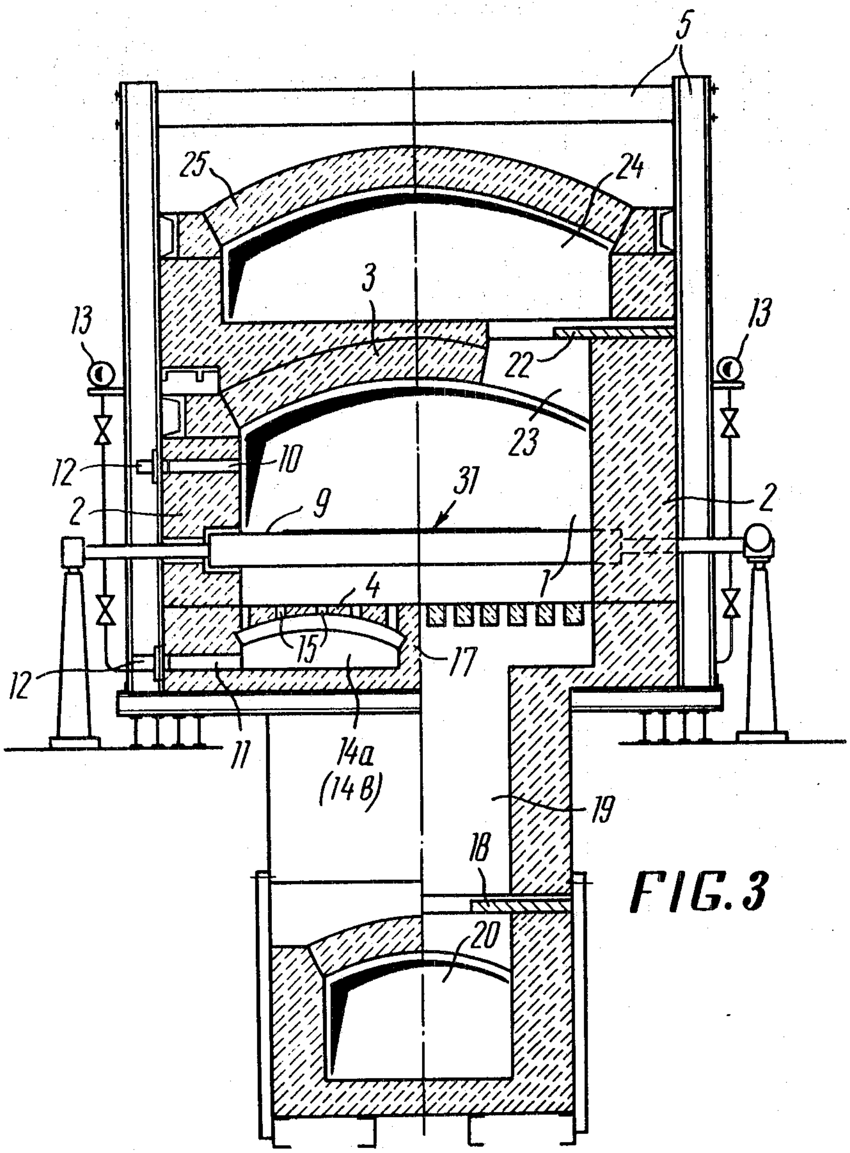

FIG. 3

CONTINUOUS LEHR FOR THE HEAT TREATMENT OF GLASS-BASED MATERIALS

The present invention relates to lehrs for heat-treating and more particularly for effecting crystallization of glass-based materials.

The lehrs, known in the prior art, are used for annealing glass, the process being employed to remove stresses, set up in glass, by slowly cooling it within the range of temperatures from 610—590°C. to 420—370°C. and by subsequent intensive cooling down to 100—70°C. In such a process no structural transformations take place in the material.

These lehrs have a heating chamber, heated in its upper and lower parts and defined by a hearth, two sidewalls, and a flat roof, and furnished with a conveying device, generally a roller conveyor, to transport the glass strip to be annealed. The lower part of the heating chamber is fire heated by combustible gases coming in through underhearth ducts, while its upper part is direct-fired or heated by electric heaters situated under the roof, the products of combustion being removed from the chamber and underhearth ducts through flue ducts.

Owing to their temperature conditions, conventional lehrs are unsuitable for production of crystallized glass materials since it has been found that the process of crystallization requires the material, heated in the course of formation, to be slowly cooled down to 680—720°C. to insure the beginning of nucleation; soaked at this temperature for a period of time sufficient for complete nucleation; then heated to a temperature of 900—980°C. at which time a gradual precipitation and growth of crystals take place around the nuclei; subsequently annealed at 480°C. and, finally, a cooled down to 100—70°C. Only in such a manner can structural transformations in the glass-based material be accomplished.

An the object of this invention is to provide a continuous lehr with an improved method of heating its heating chamber to insure the temperature conditions required for crystallization of glass-based materials.

Described in the present invention is a continuous lehr for the heat treatment of glass-based materials with a conveying device which transports the material through the heating chamber of the lehr, this heating chamber being direct-fired in its upper and lower parts, and connected to flue ducts. According to a feature of the invention for heating the lower part of the heating chamber, a hearth grating is provided below the conveying device to form combustion chambers under it, the combustion products entering from these combustion chambers into the heating chamber via the hearth grating.

In the preferred embodiment of the present invention, cross partitions with apertures for the conveying device are provided in the heating chamber of the lehr, the latter being thus subdivided by the partitions into several working chambers interconnected through the apertures.

For a more uniform heating of the lower part of the heating chamber, the combustion chambers, under the hearth grating are longitudinally subdivided into several ducts, the preferred number of such ducts being two.

An advantage of the present invention is that it makes it possible to develop, by simple means, the desired temperature conditions for the upper and lower parts of the heating chamber as well as to achieve a uniform heating throughout the material to be crystallized.

Another advantage of the invention is the possibility of maintaining and controlling the temperature conditions along the whole length of each working compartment as required for the crystallization process of the glass material.

The invention will become more fully apparent from the following description of one embodiment which is given with reference to the accompanying drawings, in which:

FIG. 1 is a schematic representation of a continuous lehr according to the invention, shown in a longitudinal section;

FIG. 2 is the head portion of the lehr on enlarged scale; and

FIG. 3 is an enlarged stepped section through line ABCD of the lehr, shown in FIG. 2.

The description of the invention and of the mode of operation will be made for the case of processing a crystalline glass sheet material.

The proposed continuous lehr for the heat treatment of glass-based materials has a direct-fired heating chamber **1** (FIGS. **1** and **3**) defined by longitudinal sidewalls **2**, roof **3** and hearth grating **4**, enclosed in a metal framework **5** which carries and binds together the brickwork of the lehr.

The heating chamber **1** is direct-fired and ports **10** and **11** are provided in the sidewalls **2** for this purpose. The parts are arranged in a staggered pattern in their corresponding rows. Inspirator-type gas burners **12** connected to manifold **13** of a combustible gas supply are mounted at the entry of the ports **10** and **11**. The ports **11** discharge into combustion chambers **14** formed under the hearth grating **4** through which the products of combustion are delivered into the heating chamber **1** via holes **15** of the grating.

Along the length of the heating chamber **1**, the combustion chambers **14** are separated by cross or transverse partitions **16** (FIGS. **1** and **2**) while in the longitudinal direction these chambers are subdivided by partitions **17** into two parallel ducts **14*a*** and **14*b*** as shown in FIG. **3**. Between the partitions **16** of two adjacent combustion chambers **14** vertical ducts **19** are provided, closed by slide dampers **18** and connecting the working space of the heating chamber **1** to a horizontal underhearth duct **20** whose middle portion enters flue duct **21** (FIG. **1**). From the upper part of the heating chamber **1**, the products of combustion are removed through vertical ducts **23** provided in the roof **3** of the heating chamber and closed by slide dampers **22** (FIG. **3**). These ducts are in communication with a horizontal overroof duct **24** covered by a vault **25** which bears against the framework **5** of the lehr apart from the sidewalls **2**. The overroof duct **24** is connected through two flue ducts **26** and **27** to smoke exhausters (not shown) arranged at the head and tail portions of the lehr.

In order to control and maintain the prescribed temperature conditions along the entire length of the heating chamber **1**, the latter may be subdivided into several working compartments **1*a***, **1*b***, **1*c*** (FIG. **1**) by means of cross partitions **28** with apertures **29** to let the material pass along the conveying device **9** and to connect the working compartments with each other.

Visual observations of the heat treatment of material can be accomplished through peepholes **30** (FIG. **2**) disposed in the side walls **2** of the lehr along the entire length of the heating chamber **1**.

The general principle of operation of the lehr is given below.

Glass material, formed into a strip **31** (FIG. **3**), enters the heating chamber **1** on the conveying device **9** through the aperture **8** in the end wall **6**, and is heat treated in accordance with the temperature conditions specified above.

In the heating chamber **1**, the strip **21** of material becomes unevenly heated between its top and bottom surfaces. The top surface of the strip **31** is heated by flames emerging from ports **10** provided in the sidewalls **2**, and by radiation from the roof **3**, whereas the bottom surface of strip **31** is heated by a great number of flames entering the heating chamber **1** from the combustion chambers **14** via openings **15** in the hearth grating **4**. The central portion of the strip, the width of which is equal to that of the partition **17**, is heated less intensively than its side portions, which results in an equalization of temperature in the lateral direction of the strip **31**, warpage in the latter being thus avoided.

The temperature conditions in the lehr are controlled by means of thermocouples (not shown) mounted in the heating chamber **1** and the combustion chambers **14**. The gas atmosphere within the lehr is controlled by means of pressure indicators (not shown) and is adjusted by means of the slide dampers **18** and **22**.

The rate of travel of the strip in the heating chamber **1** is adjusted by changing the speed of the drive of the conveying device **9**. When emerging from the lehr at its end wall **7**, the strip of crystalline glass material is cut into sheets of desired size.

We claim:

1. A continuous lehr for the heat treatment of a glass-based material comprising: means providing a heating chamber having upper and lower parts, means for heating the heating chamber in its upper and lower parts respectively by direct-firing; a conveying device for transporting said material, disposed in said heating chamber; flue ducts connected to said heating chamber; a hearth grating disposed in said heating chamber below said conveying device; means providing combustion chambers to which said means for heating the lower part of the heating chamber is connected, said combustion chambers being covered from above by said hearth grating, the products of combustion being directed from said combustion chambers through said hearth grating, cross partitions, the heating chamber being subdivided into a plurality of working chambers by said cross partitions spaced longitudinally therein, said chambers being interconnected through apertures provided in said cross partitions through which extends the conveying device, and longitudinal partitions, the combustion chambers being subdivided below the hearth grating by said longitudinal partitions into at least two ducts.

2. A lehr as claimed in claim 1, wherein the second said means provides rows of ports opening into the upper part of the heating chamber and into the combustion chambers respectively, the ports in one row being staggered relative to the ports in the other row.

3. A lehr as claimed in claim 1, comprising a vault covering the heating chamber, means above the vault providing a horizontal duct extending along said heating chamber and connected by selected of said flue ducts to the latter, and slide dampers between the horizontal duct and heating chamber.

4. A lehr as claimed in claim 3 comprising cross partitions separating the combustion chambers. means providing vertical ducts between the latter said cross partitions coupling adjacent combustion chambers, and slide dampers in said vertical ducts.