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(54) **APPARATUS FOR ELIMINATING HETEROGENEOUS GLASS AND GLASS MANUFACTURING APPARATUS COMPRISING THE SAME**

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(57) **ABSTRACT**

The present disclosure provides an apparatus for eliminating a heterogeneous glass present in the top surface of a molten glass effectively, and a melting furnace and a glass manufacturing apparatus comprising the same. The apparatus for eliminating a heterogeneous glass according to one aspect of the present disclosure comprises a storage bath having an inlet and an outlet to receive a molten glass fed into the inlet and to discharge the received molten glass through the outlet, and an evacuating opening formed on the top of the storage bath, the evacuating opening allowing the received molten glass to overflow; a first gate being mounted close to the outlet of the storage bath to adjust an open area, thereby controlling the flow rate of the molten glass to be discharged through the outlet; and a second gate being mounted close to the inlet of the storage bath to control the height of the molten glass received in the storage bath at the section in which the evacuating opening is formed.

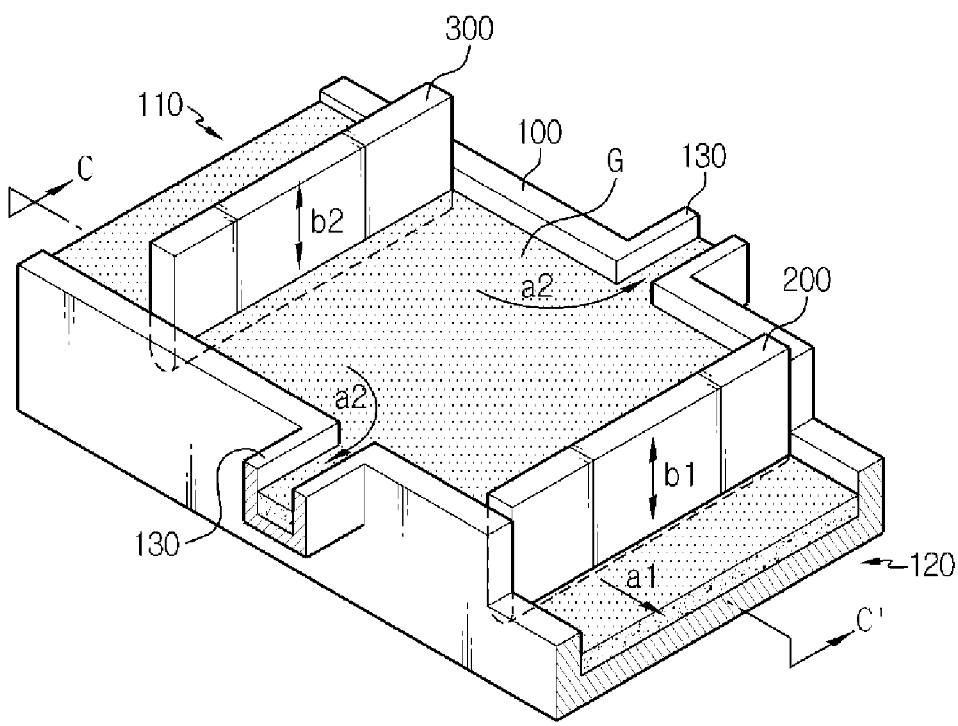


FIG. 1

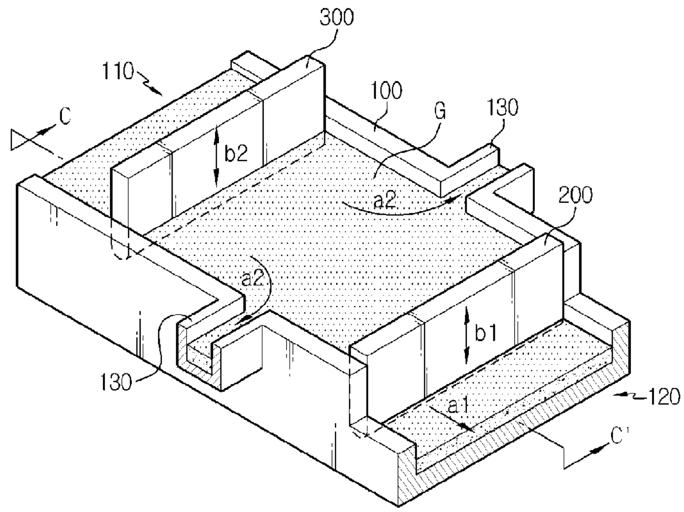


FIG. 2

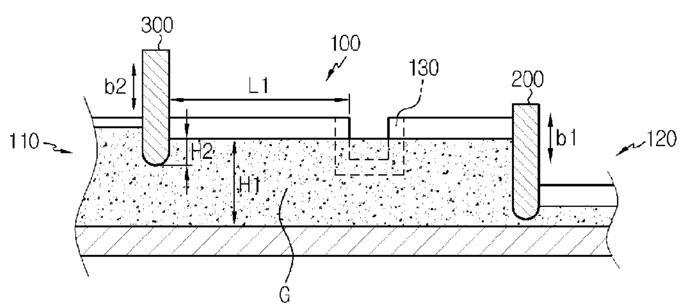
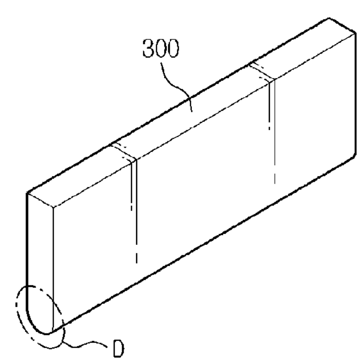


FIG. 3



APPARATUS FOR ELIMINATING HETEROGENEOUS GLASS AND GLASS MANUFACTURING APPARATUS COMPRISING THE SAME

TECHNICAL FIELD

[0001] The present disclosure relates to a glass manufacturing technique, and more particularly to a technique that can eliminate a heterogeneous glass present in the top surface of a molten glass effectively and stably when the molten glass is supplied from a melting furnace to a molding furnace.

BACKGROUND ART

[0002] There are various forms of glasses. Among these, flat glasses are representative and have been used in various fields such as a window glass, an automobile window screen, a mirror, and the like. A flat glass may be manufactured by various techniques.

[0003] Representatively, steps of melting, agitating, stabilizing, molding and slow cooling are applied in the manufacturing of glasses.

[0004] Among these, the melting step is to melt (fuse) raw materials of glass to produce molten glass, and may be conducted in a melting furnace made of fire bricks. Such a melting furnace conventionally needs a burner so as to control the temperature of the molten glass during the melting step, and the use of the burner may generate much gas in the upper portion of the molten glass (glass melt). The gas brings into contact with the top surface of the molten glass, and some components of the glass being in reaction with the gas or having strong volatility evaporate from the top surface of the molten glass, thereby altering the characteristic of the glass or forming a heterogeneous glass comprising foreign materials.

[0005] If such a heterogeneous glass present in the surface of the molten glass is introduced in a molding process, a glass product to be finally obtained may be deteriorated in its quality. Therefore, it is necessary to completely eliminate the heterogeneous glass present in the surface of the molten glass.

[0006] As a conventional method for eliminating such a heterogeneous glass, a technique of forming an overflow zone in a melting furnace has been representatively used. In the overflow zone, a molten glass is made to overflow, thereby eliminating a heterogeneous glass present in the surface of the molten glass.

[0007] However, this technique has the problem that an overflow rate may vary depending on the height of the molten glass. For example, when operation conditions or glass properties are changed in processes prior to the overflow zone step, the overflow rate in the overflow zone may exceed or be less than the optimum rate. If the overflow rate exceeds the optimum rate in the overflow zone, a normal glass being molten as well as a heterogeneous glass may be excessively eliminated to increase glass manufacturing cost and time. On the contrary, if the overflow rate is less than the optimum rate, the elimination of the heterogeneous glass is insufficient and the quality and yield of a glass product to be obtained may be seriously deteriorated.

DISCLOSURE

Technical Problem

[0008] The present disclosure is designed to solve the above problem, and therefore, the present disclosure is directed to providing an apparatus for eliminating a heterogeneous glass present in the top surface of a molten glass effectively, and a melting furnace and a glass manufacturing apparatus comprising the same.

[0009] These and other objects and aspects of the present disclosure can be understood by the following description, and will become apparent from the embodiments of the present disclosure. Also, it should be understood that these and other objects and aspects of the present disclosure may be achieved by any means in the scope of the disclosure and combinations thereof.

Technical Solution

[0010] To achieve the above objects, the present disclosure provides an apparatus for eliminating a heterogeneous glass, comprising a storage bath having an inlet and an outlet to receive a molten glass fed into the inlet and to discharge the received molten glass through the outlet, and an evacuating opening formed on the top of the storage bath, the evacuating opening allowing the received molten glass to overflow; a first gate being mounted close to the outlet of the storage bath to adjust an open area, thereby controlling the flow rate of the molten glass to be discharged through the outlet; and a second gate being mounted close to the inlet of the storage bath to control the height of the molten glass received in the storage bath at the section in which the evacuating opening is formed.

[0011] Preferably, the second gate constantly maintains the height of the molten glass received in the storage bath at the section in which the evacuating opening is formed.

[0012] Also, it is preferred that the heterogeneous glass-eliminating apparatus of the present disclosure further comprises a unit for measuring the height of the molten glass received in the storage bath at the section in which the evacuating opening is formed.

[0013] Preferably, the second gate is configured to move up and down, and increases the open area when it moves upwardly from the bottom.

[0014] Also, the second gate is preferably configured such that a horizontal distance between the second gate and the evacuating opening is not less than the double length of the depth of the second gate inserted in the molten glass at the side in which the evacuating opening is positioned.

[0015] In addition, the second gate is preferably configured such that the depth of the second gate inserted in the molten glass at the side in which the evacuating opening is positioned ranges from 10 to 50% of the depth of the molten glass received in the storage bath at the section in which the evacuating opening is formed.

[0016] Also, the second gate is preferably configured to have rounded bottom corners.

[0017] In addition, the second gate is preferably made of a refractory material.

[0018] In addition, the second gate is preferably coated with platinum on at least a part of the surface thereof.

[0019] Further, the present disclosure provides a melting furnace, comprising the above-mentioned apparatus for eliminating a heterogeneous glass.

[0020] Furthermore, the present disclosure provides a glass manufacturing apparatus, comprising the above-mentioned apparatus for eliminating a heterogeneous glass.

Advantageous Effects

[0021] According to the present disclosure, a heterogeneous glass being present in the top surface of a molten glass obtained in a melting furnace can be effectively eliminated.

[0022] Particularly, according to one aspect of the present disclosure, the height of an overflow zone in which the molten glass is made to overflow can be constantly maintained.

[0023] That is, even if there are factors that may change the height of an overflow zone, for example, may vary the operation conditions of a melting furnace or the properties of a glass, the height of the overflow zone can be constantly maintained. Therefore, according to the present disclosure, the overflow rate of the molten glass can be constantly maintained, and eventually a heterogeneous glass present in the top surface of the molten glass can be stably eliminated.

[0024] Thus, the present disclosure allows the effective and stable elimination of a heterogeneous glass in a molten glass to be introduced into a molding furnace and the like, thereby providing high quality of glasses and enhancing the production yield of the glasses.

DESCRIPTION OF DRAWINGS

[0025] The accompanying drawing illustrates a preferred embodiment of the present disclosure and together with the foregoing disclosure, serves to provide further understanding of the technical spirit of the present disclosure. However, the present disclosure is not construed as being limited to the drawing.

[0026] FIG. **1** is a perspective view schematically showing the configuration of a heterogeneous glass-eliminating apparatus according to one embodiment of the present disclosure.

[0027] FIG. **2** is a cross-sectional view being taken along to the C-C' line of FIG. **1**.

[0028] FIG. **3** is a perspective view schematically showing the configuration of a second gate according to one embodiment of the present disclosure.

MODE FOR DISCLOSURE

[0029] Hereinafter, preferred embodiments of the present disclosure will be described in detail with reference to the accompanying drawings. Prior to the description, it should be understood that the terms used in the specification and the appended claims should not be construed as limited to general and dictionary meanings, but interpreted based on the meanings and concepts corresponding to technical aspects of the present disclosure on the basis of the principle that the inventor is allowed to define terms appropriately for the best explanation.

[0030] Therefore, the description proposed herein is just a preferable example for the purpose of illustrations only, not intended to limit the scope of the disclosure, so it should be understood that other equivalents and modifications could be made thereto without departing from the spirit and scope of the disclosure.

[0031] FIG. **1** is a perspective view schematically showing the configuration of a heterogeneous glass-eliminating apparatus according to one embodiment of the present disclosure.

[0032] Referring to FIG. **1**, the apparatus for eliminating a heterogeneous glass according to the present disclosure comprises a storage bath **100**, a first gate **200**, and a second gate **300**.

[0033] The storage bath **100** has a space capable of receiving a liquid, in which a high temperature molten glass is received. Also, the storage bath **100** has an inlet **110** and an outlet **120** formed therein, the inlet **110** allows the molten glass to be fed therethrough into a receiving space, and the outlet **120** allows the received molten glass in the receiving space to be discharged therethrough.

[0034] Meanwhile, since the storage bath **100** should receive a high temperature molten glass, it may be made of a refractory material such as a firebrick.

[0035] The storage bath **100**, which is a component of a melting furnace that melts the raw materials of a glass to produce a molten glass, is included within the melting furnace or is positioned in the rear end of the melting furnace to supply the molten glass into a molding furnace such as a float bath.

[0036] Particularly, the storage bath **100** may have an overflow zone that allows a part of the molten glass received to overflow. For this, the storage bath **100** may have one or more evacuating openings **130** on the top thereof. For example, as shown in FIG. **1**, two evacuating openings **130** are provided on the top of the storage bath **100**, and the molten glass in the top surface is made to overflow and is discharged, as indicated by the arrow a**2**. The molten glass may have a heterogeneous glass on the top surface thereof, and the heterogeneous glass may be made to overflow through the evacuating opening **130**, thereby being removed from the storage bath **100**.

[0037] The first gate **200** is configured to be mounted close to the outlet of the storage bath **100** so that it can open and close. Particularly, the first gate **200** can adjust an open area to control the flow rate of the molten glass to be discharged through the outlet **120** of the storage bath **100**.

[0038] Particularly, the first gate **200** may be configured to move up and down, as indicated by b**1** in FIG. **1**. The first gate **200** can adjust a distance between the lower end thereof and the bottom of the storage bath **100**, thereby controlling the flow rate of the molten glass to be discharged in the direction of al through the outlet **120**. For example, when the first gate **200** moves upwardly, the flow rate of the molten glass being discharged through the outlet **120** may be raised, and when the first gate **200** moves downwardly, the flow rate of the molten glass being discharged through the outlet **120** may be lowered.

[0039] Preferably, the first gate **200** can adjust an open area by measuring the flow rate of the molten glass being discharged through the outlet **120**. For example, when the flow rate of the molten glass being discharged through the outlet **120** is higher than the reference rate, the open area may increase, and when the flow rate of the molten glass being discharged through the outlet **120** is less than the reference rate, the open area may decrease.

[0040] The second gate **300** may be mounted close to the inlet **110** of the storage bath **100** with the evacuating opening **130** as the center. That is, as shown in FIG. **1**, the second gate **300** is provided in the left of the evacuating opening **130**. Therefore, the apparatus for eliminating a heterogeneous glass according to the present disclosure have the first gate **200** and the second gate **300** on both sides of the evacuating opening **130**. Shortly, in the apparatus for eliminating a heterogeneous glass according to the present disclosure, since the evacuating opening **130** is positioned between the first gate **200** and the second gate **300**, the overflow zone may be the section positioned between the first gate **200** and the second gate **300**.

[0041] The second gate **300** may be configured to open and close, similar to the first gate **200**. Particularly, the second gate **300** can adjust an open area, thereby controlling the height of the molten glass received in the storage bath **100** at the position in which the evacuating opening **130** is formed.

[0042] The configuration for controlling the height of the second gate **300** will be described below with reference to FIG. **2**.

[0043] FIG. **2** is a cross-sectional view being taken along to the C-C' line of FIG. **1**.

[0044] Referring to FIG. **2**, the second gate **300** may be configured to move up and down, as indicated by the arrow b**2**. The up-and-down movement of the second gate **300** can change an open area being provided by the second gate **300** and can change the flow rate of the molten glass fed through the second gate **300**. Thus, when the flow rate of the molten glass fed through the second gate **300** is changed, the height of the section in which the evacuating opening **130** is formed can be changed.

[0045] For example, referring to FIG. **2**, H**1** represents the height (depth) of the molten glass at the section in which the evacuating opening **130** is formed, i.e., the overflow zone, and H**1** may relatively be raised when the open area increases by the upward movement of the second gate **300**. On the other hand, H**1** may relatively be lowered when the open area decreases by the downward movement of the second gate **300**. Thus, in the apparatus for eliminating a heterogeneous glass according to the present disclosure, the height of the molten glass received in the storage bath **100** can be controlled through the second gate **300**.

[0046] Preferably, the second gate **300** is preferably configured to constantly maintain the height of the molten glass received in the storage bath **100** at the section in which the evacuating opening **130** is formed. That is, the second gate **300** can adjust an open area so that H**1** shown in FIG. **2** can be constantly maintained. In the present disclosure, the constant maintenance of the molten glass height means that the height of the molten glass is maintained into a constant value or within a constant range.

[0047] According to such an embodiment, even though the operation conditions of the melting furnace or the properties of the glass are changed, the height of the molten glass at the section in which the evacuating opening **130** is formed can be constantly maintained, and therefore, the overflow rate through the evacuating opening **130** can be constantly maintained. Thereby, a heterogeneous glass present in the top surface of the molten glass can be effectively eliminated, making it prevent the problem that the heterogeneous glass is insufficiently eliminated or the normal glass is excessively eliminated.

[0048] Preferably, the apparatus for eliminating a heterogeneous glass according to the present disclosure further comprises a height-measuring unit.

[0049] The height-measuring unit measures the height of the molten glass received in the storage bath **100** at the section in which the evacuating opening **130** is formed. For example, the height-measuring unit can measure the distance of H**1** in FIG. **2**. Thus, the height is measured by the height-measuring unit, the information of the height measurement is transferred into the second gate **300** to be used for controlling the operation of the second gate **300**. For example, when the height (H**1**) measured by the height-measuring unit is less than the reference height, the second gate **300** moves upwardly to increase an open area, thereby raising the height of the molten glass received in the storage bath **100** at the section in which the evacuating opening **130** is formed.

[0050] Preferably, the second gate is configured such that a horizontal distance between the second gate **300** and the evacuating opening **130** is more than the double length of the depth of the second gate **300** inserted in the molten glass at the side in which the evacuating opening is positioned.

[0051] For example, in FIG. **2**, when L**1** represents the distance between the second gate **300** and the evacuating opening **130**, and H**2** represents the depth of the second gate **300** inserted in the molten glass, the L**1** and H**2** preferably satisfy the following relation.

[0052] $L1>2H2$

[0053] By such relation, the sufficient length can be obtained so that a heterogeneous glass present in the surface of the front side (the left of FIG. **2**) of the second gate **300** is enough to be raised into the surface again after passing through the second gate **300**. Therefore, it is possible to prevent the problem that the heterogeneous glass is not raised to the surface and not made to overflow into the evacuating opening **130** while the heterogeneous glass present in the front side of the second gate **300** passes through the second gate **300**, and then moves into the direction (the right of FIG. **2**) of the section in which the evacuating opening **130** is formed.

[0054] Also, the second gate **300** is preferably configured such that the depth of the second gate **300** inserted in the molten glass at the side in which the evacuating opening **130** is positioned ranges from 10 to 50% of the depth of the molten glass received in the storage bath **100** at the section in which the evacuating opening **130** is formed.

[0055] For example, in FIG. **2**, when H**2** represents the depth of the second gate **300** inserted in the molten glass at the side in which the evacuating opening **130** is positioned, and H**1** represents the depth of the molten glass received in the storage bath **100** at the section in which the evacuating opening **130** is formed, the H**1** and H**2** preferably satisfy the following relation.

[0056] $0.1 \leq H2/H1 \leq 0.5$

[0057] By such relation, the flow rate of the molten glass that passes through the second gate **300** can be lowered below a certain level to minimize the formation of vortex and to make a heterogeneous glass be raised into the surface of the molten glass again after passing through the second gate **300**, from which the heterogeneous glass is surely made to overflow and be eliminated.

[0058] Also, the second gate **300** is preferably configured to have rounded bottom corners.

[0059] FIG. **3** is a perspective view schematically showing the configuration of a second gate **300** according to one embodiment of the present disclosure. Referring to FIG. **3**, the second gate **300** is configured in the form of a plate whose bottom corner may be rounded in the form of a curved surface form. That is, as shown by D in FIG. **3**, when seeing the second gate **300** at the front, its bottom form may be a rounded semicircle. According to such a configuration, the molten glass can pass through the second gate **300** smoothly, and the formation of vortex can be minimized.

[0060] However, the present invention is not limited to such a configuration, and the second gate **300** may be variously configured.

[0061] Also, the second gate **300** is preferably made of a refractory material. Since the second gate **300** comes into contact with a high temperature molten glass, it is favorable to be made of a refractory material being endurable to high temperature conditions.

[0062] In addition, the second gate **300** is preferably coated with a material being not brought into reaction with a high temperature molten glass on at least a part of the surface thereof. For example, the surface of the second gate **300** may be coated with platinum being chemically stable to a high temperature molten glass.

[0063] The apparatus for eliminating a heterogeneous glass according to the present disclosure can be applied in a glass melting furnace that melts glass raw materials and supplies the molten glass into a molding furnace such as a float bath. That is, the glass melting furnace of the present disclosure may comprise the above-mentioned apparatus for eliminating a heterogeneous glass. In this melting furnace, a bath receiving a molten glass may act as the storage bath **100** of the above-mentioned apparatus for eliminating a heterogeneous glass.

[0064] Further, the present disclosure provides a glass manufacturing apparatus, comprising the above-mentioned apparatus for eliminating a heterogeneous glass. Particularly, the glass manufacturing apparatus of the present disclosure may comprise the above-mentioned apparatus for eliminating a heterogeneous glass in a melting furnace. Besides, the glass manufacturing apparatus of the present disclosure may comprise a molding furnace and a slow cooling chamber.

[0065] Hereinabove, the present disclosure has been described by the limited embodiments and drawings, but is not limited thereto, and it should be understood that various changes and modifications may be made by those skilled in the art within the spirit of the disclosure and the equivalent scope of the appended claims.

1. An apparatus for eliminating a heterogeneous glass, comprising:

a storage bath having an inlet and an outlet to receive a molten glass fed into the inlet and to discharge the received molten glass through the outlet, and an evacuating opening formed on the top of the storage bath, the evacuating opening allowing the received molten glass to overflow;

a first gate being mounted close to the outlet of the storage bath to adjust an open area, thereby controlling the flow rate of the molten glass to be discharged through the outlet; and

a second gate being mounted close to the inlet of the storage bath to control the height of the molten glass received in the storage bath at the section in which the evacuating opening is formed.

2. The apparatus for eliminating a heterogeneous glass according to claim **1**, wherein the second gate constantly maintains the height of the molten glass received in the storage bath at the section in which the evacuating opening is formed.

3. The apparatus for eliminating a heterogeneous glass according to claim **1**, which further comprises a unit for measuring the height of the molten glass received in the storage bath at the section in which the evacuating opening is formed.

4. The apparatus for eliminating a heterogeneous glass according to claim **1**, wherein the second gate is configured to move up and down, and increases the open area when it moves upwardly from the bottom.

5. The apparatus for eliminating a heterogeneous glass according to claim **1**, wherein the second gate is configured such that a horizontal distance between the second gate and the evacuating opening is not less than the double length of the depth of the second gate inserted in the molten glass at the side in which the evacuating opening is positioned.

6. The apparatus for eliminating a heterogeneous glass according to claim **1**, wherein the second gate is configured such that the depth of the second gate inserted in the molten glass at the side in which the evacuating opening is positioned ranges from **10** to **50**% of the depth of the molten glass received in the storage bath at the section in which the evacuating opening is formed.

7. The apparatus for eliminating a heterogeneous glass according to claim **1**, wherein the second gate is configured to have rounded bottom corners.

8. The apparatus for eliminating a heterogeneous glass according to claim **1**, wherein the second gate is made of a refractory material.

9. The apparatus for eliminating a heterogeneous glass according to claim **1**, wherein the second gate is surface-coated with platinum.

10. A glass melting furnace, comprising the apparatus for eliminating a heterogeneous glass according to claim **1**.

11. A glass manufacturing apparatus, comprising the apparatus for eliminating a heterogeneous glass according to claim **1**.

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