PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in and connected with Glass Melting Tanks or Furnaces

I, WILLIAM JOHN SMITH, a Subject of the King of Great Britain, of "Danmark", 16, Wolseley Road, Pt. Piper, Sydney, in the State of New South Wales, Commonwealth of Australia, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to improvements in and connected with glass melting tanks or furnaces.

The type of glass tank now in general use comprises a large melting chamber and a smaller working chamber, such chambers being separated by a bridge wall provided with a submerged passage or doghole through which the molten glass enters the working chamber. Both the melting chamber and the working chamber are of rectangular shape both in plan and in cross section and are covered by a common crown. The aforesaid bridge wall terminates below the crown so that the two chambers communicate above the glass level whereby the molten glass in the working chamber is subjected to the hot gases from the melting chamber.

The raw materials are delivered to the melting chamber at or near that end thereof which is remote from the aforesaid bridge wall and working chamber.

The working chamber is also usually provided with one or more forehearths from which the molten glass is delivered by mechanical feeders or other devices to forming machines.

From the foregoing description it will be evident that the level of the molten glass in the working chamber and its associated forehearths is the same as that in the melting chamber and, as the level in the forehearths cannot vary more than two or three inches without interfering with the operation of the usual feeding devices, it follows that the level in the melting chamber must be maintained substantially constant. This is a disadvantage when it is necessary either to repair the refractory walls of the tank or to melt glass of a different composition therein because, in either case, the molten glass which it is necessary to discharge represents almost the full capacity of the tank. It is the general practice to granulate the glass so discharged and to use it as cullet in subsequent melting operations but the discharge of such large quantities of molten glass (usually about 50 to 300 tons) involves a considerable loss of heat, the provision of granulating facilities of substantial size and much labor.

Another disadvantage which accrues from the existing necessity of maintaining a substantially constant working level in the melting chamber is that week-end periods during which the forming machines are generally not operated cannot be utilised for the purpose of melting further glass to supply some of the requirements of the following week. This again involves a considerable thermal loss because the temperature must be maintained in the tank at all times.

Still another important disadvantage of glass tanks as at present constructed and in which, as already stated, the melting and working chambers communicate freely with each other above the glass level is that the temperature conditions in these two chambers are interrelated and cannot be controlled independently. As a result it is not generally possible to maintain the glass in either of these chambers at the optimum temperatures. That is to say the temperature in the melting chamber is generally lower and the temperature in the working chamber is generally higher than the optimum temperatures for these respective chambers.

A further disadvantage of the usual construction of tank briefly described above is that "dead" areas of stagnant glass are formed at and near the square corners between the bottom and the walls both in the melting chamber and in the working chamber and, when the glass in these areas is disturbed as it frequently is due to various causes, heterogeneous glass passes to the feeding devices. Furthermore considerable heat is required to maintain the temperature of the glass in these dead areas.

[Price 1/-]

The rectangular plan form of the usual working chamber also imposes a limit on the number of machines which can be supplied therefrom because, in general, it is not practicable to extend the working chamber laterally not only because the space required would be considerably greater but also because it would be difficult to maintain the requisite temperature and composition at and adjacent the ends of a laterally elongated working chamber as well as for other reasons.

The vertical refractory walls of the tank in contact with the molten glass and particularly the walls of the melting chamber, progressively deteriorate under the severe conditions to which they are subjected. These walls are formed of large refractory blocks so that vertical and horizontal joints are formed therebetween.

It is found that these horizontal joints are penetrated by the molten glass and gases which " drill " upwardly—i.e., produce upwardly extending cavities in the downwardly facing surfaces of the blocks with the result that large portions of the front faces of the blocks occasionally break away. The vertical faces of the walls are also eroded by the downwardly moving convection currents which are set up in the molten glass in contact therewith.

Now the general object of the present invention is to provide improvements in the construction and arrangement of continuous melting glass tank furnaces and in methods of operation thereof whereby the abovementioned disadvantages will be overcome or minimised.

According to the invention, a continuous melting glass tank furnace comprises an elongated melting chamber, a working chamber which is adapted for the refining of the molten glass therein, and which is so arranged relatively to the melting chamber that the maximum level of molten glass in said working chamber would be below or not substantially above the level of the bottom of said melting chamber, means disposed at or adjacent one end of the melting chamber for discharging molten glass directly therefrom into the working chamber through a discharge outlet located adjacent the bottom of said melting chamber so that all or substantially all of the molten glass in the latter can flow into the working chamber, and means operable to regulate the flow of molten glass from said melting chamber to said working chamber.

For this purpose adjustable valve means are provided for controlling the passage of glass from the melting chamber to the working chamber, such valve means being controllable either manually or automatically.

Preferably the floor of the melting chamber inclines downwardly to the outlet end and the discharge outlet is disposed substantially at or below the level of the lower end of the floor to permit of the discharge of the whole body of molten glass therein.

A salient feature of the invention resides in constructing the working chamber independently of the melting chamber and in providing means e.g. an inclined chute for directing the molten glass from the outlet of the melting chamber to the working chamber.

Another feature of the invention resides in a separate working chamber having its working level below that of the melting chamber, said working chamber being substantially circular in shape when viewed in plan to permit of forehearths being arranged radially thereon thus enabling an increased number of forming machines to be supplied therefrom.

The said working chamber or basin, as it may be termed, is preferably of substantially hemispherical shape—that is to say, it is substantially of semi-circular shape in cross section whereby the movement of convection currents is facilitated to promote homogeneity of temperature and composition while the area decreases in the downward direction so that there is less glass at the lower levels to be heated by conduction through the supernatant glass. Furthermore the hemispherical form of the basin eliminates the aforesaid " dead " areas which exist adjacent the corners of a working chamber of the usual construction.

The basin is covered by a suitable crown which may be provided centrally with a vertical outlet flue fitted with a damper to facilitate temperature control. Reheat burners may also be arranged above the glass level in substantially the usual way.

A salient feature of the invention resides in so constructing the basin as to permit of its being moved for the purpose hereinafter described.

Still another feature of the invention resides in a glass tank as above described and provided at or adjacent the discharge end of the melting chamber as well as at the opposite end with one or more batch filling means—e.g. stokers or dogboxes.

The invention also includes the method of operating a glass tank as above described comprising maintaining a substantially constant level of glass in the working chamber irrespective of variations in the level in the melting chamber.

Another feature of the invention resides in a melting chamber which is substantially of semi-circular shape in cross section—i.e. in the vertical plane at right

angles to the longitudinal axis of the chamber, thus promoting the flow of convection currents, progressively reducing the area below the glass level and eliminating the aforesaid " dead " areas.

The melting chamber may be of rectangular shape in plane while the end walls may be vertical. Alternatively either or both ends of the melting chamber may be of semi-circular shape when viewed in plan and of quadrant shape in sectional elevation—that is to say, either or both ends may constitute substantially a quarter of a sphere.

Other objects and features of the invention are hereinafter described with reference to the accompanying drawings in which:—

Figure 1 is a view in longitudinal section of a glass tank in accordance with the invention.

Figure 2 is a view in plan.

Figure 3 is a view in sectional elevation taken on the line 3—3 of Figure 1 and is drawn to a larger scale.

Figure 4 is a view in plane of the basin with the crown removed.

Figure 5 is a sectional view to a larger scale showing the discharge end of the tank and the adjacent portion of the basin and incorporates a modification.

Figure 6 is a perspective view showing details of construction of the melting chamber;

Figure 7 is a perspective view showing a portable basin, and

Figure 8 is a diagrammatic view showing a modification.

Referring now to the drawings, the reference numeral 10 designates an elongated melting chamber having a separate working chamber or basin arranged closely adjacent one end thereof, and a recuperator 12 arranged at the opposite end, though alternatively the tank may be of the regenerative type.

The melting chamber is of rectangular shape when viewed in plan, the end walls 13 and 14 being arranged vertically in the usual way while in transverse cross section (see Figure 3) the glass holding bath 15 of the tank is substantially semi-circular in shape and is formed, as far as possible, of refractory blocks of identical shape, thus facilitating the construction of the tank.

The glass holding portion 15 of the tank inclines downwardly from the recuperator end to the opposite end 14 thereof and an outlet opening 16 is provided in the wall at the outlet end, such opening being close to the bottom of the adjacent end of the floor whereby substantially all of the molten glass therein may be discharged therethrough.

The refractory blocks forming the glass holding bath 15 of the tank are preferably bedded on wire mesh 20 (Figure 6) supported on longitudinally disposed inverted T-beams 21 the webs of which are disposed substantially radially with respect to the center of curvature of the bath. The flanges of these T-beams rest on the upper surfaces of a plurality of longitudinally spaced transverse cradles 22 of semi-circular form and these in turn are supported on suitable pillars, 23.

If desired, cooling air may be circulated through one or more of the longitudinally extending channels 24 between the T-beams 21 and in contact with the outer surface of the semi-circular bath of the melting chamber.

The semi-circular transverse shape of the glass holding portion 15 of the melting chamber provides several advantages in operation as well as in construction and some of these have been briefly referred to above. Thus the flow of convection currents is facilitated and erosion of the walls accordingly minimised. These currents flow outwardly at the surface of the glass to the side walls which exercise a cooling effect, and then downwardly in contact therewith and finally upwards at or about the longitudinal axis of the tank. In this way homogeneity of temperature and composition is promoted.

Furthermore the elimination of the sharp corners which exist in tanks of ordinary construction obviates the formation of dead areas of stagnant glass and the disadvantages attendant thereon.

In addition it will be clear that the area of the tank progressively decreases in the downward direction and this is thermally advantageous because there is less glass below the surface to be heated by convection or by conduction through the supernatant layers thereof.

Finally the improved construction herein described minimises the tendency for the molten glass to penetrate the longitudinal joints between the refractory blocks and to " drill " upwardly therefrom; firstly because of the substantial elimination of dead areas; secondly because the walls incline upwardly and outwardly from each longitudinal joint; and thirdly because the planes of these longitudinal joints are not horizontal but substantially radial to the center of curvature.

It will be noted that, although the cross-sectional shape of the tank has been described as being semi-circular, it is actually semi-polygonal, a close approach to the semi-circular form being obtained with flat faced refractory blocks which are more convenient to manufacture.

Furthermore it is to be noted from Figure 3 that the center of curvature is advantageously disposed somewhat above the maximum level of the glass so that the side walls incline upwards and outwards at that position.

If desired, either or both of the ends of the melting chamber may be of semi-circular shape in plan and of quadrant shape in longitudinal section (see broken lines in Figures 2 and 5), thus obviating the formation of sharp corners at the ends also.

The working chamber or basin 11 is of circular shape in plan and is constructed independently of the melting chamber 10 though it is located adjacent to the outlet end thereof.

The working level of the molten glass in the basin is disposed below the level of the bottom of the melting chamber and an inclined chute 25 is arranged in the central longitudinal plane of the melting chamber to deliver the molten glass discharged through the hole 16 in the end wall 14, into a radial receiving trough 27 formed in the adjacent peripheral portion of the basin. Alternatively the chute 25 may be arranged to direct the molten glass into the center of the basin with a view to maintaining more homogeneous conditions therein (see broken lines in Figure 5).

The discharge of molten glass from the melting chamber into the chute 25 is controllable by a refractory valve member 28 which is reciprocable to and from the discharge outlet 16, such valve-member, which is preferably water cooled, being operated manually or automatically in accordance with variations in the level of glass in the basin.

The basin 11 is of semi-circular shape in cross-section—that is to say, it is substantially hemispherical in form as shown, thus eliminating all corners and their attendant dead areas and providing the other advantages hereinbefore referred to. The refractory blocks forming the basin are preferably arrangd radially about a central circular block (see Figure 4) thus facilitating construction, and these blocks may be bedded on wire mesh 29 supported on a cradle 30 formed of inverted T-beams, the whole being carried on columns 32. In the particular embodiment shown, the basin constitutes rather less than a complete hemisphere, the center of curvature being disposed somewhat above the top thereof whereby the upper layer of blocks inclines upwards and outwards as shown in Figure 1, though various cross sectional shapes may be used.

An external lining 11^1 of heat insulating material is applied to the basin to reduce the loss of heat therefrom.

The basin is covered by a suitably supported crown 33 below which one or more reheat burners 34 may be arranged and a central vertical flue or chimney 35 extends upwards from the center of the crown; said flue being fitted with a suitable damper 36. Thus the temperature conditions in the basin may be regulated.

The basin is also provided with a plurality of radially arranged forehearths 31 which may be fitted with suitable feeding means of known type (not shown) by means of which the molten glass may be directed to associated forming machines through discharge openings 37. The circular form of the basin and its arrangement at a lower level than the bottom of the melting tank enables a larger number of machines to be arranged about and supplied from a working chamber than has heretofore been practicable.

A discharge opening normally fitted with a plug 38 is provided in the bottom of the basin to enable the molten glass to be discharged therefrom when desired.

From the foregoing description it will be evident that the maintenance of the required working level in the basin is not dependent upon the level of molten glass in the melting chamber with the result that several important operating advantages are obtained.

Thus melting may proceed at the full capacity of the tank throughout the week (including the week-end) in order that, during the periods when the machines are in operation, the molten glass may be used at a greater rate than the rate of melting. When operated in this way the glass level would fall progressively throughout the working week but would be restored by the glass melted during the week-end.

Another important advantage is that, as the melting and working chambers are quite separate, each such chamber may be operated at the optimum temperature therefor.

Furthermore, if it becomes necessary to empty the melting chamber either for the purpose of reconstructing it or to enable glass of a different composition to be melted therein, it is possible to discontinue the supply of the batch materials and eventually to discharge substantially all of the molten glass into the basin before the tank is shut down. Thus the only glass which cannot be utilised by the forming machines is the relatively small quantity which is present in the basin when the melting chamber is empty. This again provides a considerable saving of fuel and reduces the labor and equipment which would otherwise be required to granulate and handle the discharged glass. The complete discharge

of molten glass from the melting chamber 10 is facilitated if the discharge outlet 16 communicates with a well or sump 39 in the floor of the melting chamber as shown in Figure 5.

It will be clear that these operating advantages accrue from arranging the basin or working chamber at a lower level than the melting chamber in conjunction with suitable means for controlling the flow of molten glass thereinto, and that they do not depend upon the novel constructional features of the chambers previously described. Thus this form of the invention is not limited to melting and working chambers constructed as hereinbefore described.

With the usual glass tank, which has a working chamber at one end and separated from the melting chamber by a bridge wall provided with a submerged opening generally termed a dog-hole, it is essential to deliver the batch materials to the tank at or adjacent that end thereof which is remote from the refining chamber.

However, when the working chamber is entirely separate from the melting chamber as herein described, it is possible to provide one or more additional " dog-boxes ", stokers or other batch feeding means adjacent the outlet end of the tank, thus reducing the time required for refilling particularly at the week-ends. Thus it will be noted that in Figure 2 a stoker 40 is arranged in the usual position while an additional stoker 41 is arranged diagonally opposite thereto and near the discharge end.

The stoker 41 would not ordinarily be used while molten glass was passing to the basin 11 as unmelted batch materials would be liable to pass thereinto, but, as already indicated, such additional stoker or one or more equivalent " dog-boxes " would facilitate the operation of refilling the tank at week-ends and other periods when molten glass is not being discharged.

According to another form of the invention, the basin 11 is portable as shown somewhat diagrammatically in Figure 7 whereby, after it has been filled from the tank 10, it may be transported on rails 42 to another location where the glass therein is used either by hand workers or by suitably feeding it to fabricating machines. the basin shown in the Figure being provided with openings 43 suitable for manual workers, though it may, if desired, be adapted for the discharge of glass therefrom by mechanical feeders if the latter and/or the temperature of the glass are suitably regulated to compensate for variations in the glass level. In *lieu* of transporting the basin on rails it may be arranged to be moved by an overhead crane or in any other convenient way.

It is proposed that a number of portable basins as above described be employed in association with the melting tank so that same may be filled in succession and then transported to the desired working locations so that one tank may supply the glass required for a large number of fabricating machines and/or manual workers, such basins being returned to the tank for refilling when necessary.

With the usual glass tank there is a definite limit to the number of machines or manual workers which or who can be conveniently accommodated about the working end of the tank but by means of portable basins as herein described this disadvantage is overcome and the full melting capacity of the tank may be utilised, while additionally a more efficient layout of plant is possible and the working conditions for the operatives are improved. This is particularly true in the case of hand workers who usually work from melting pots arranged in a circular pot furnace. Thus operatives may be working from one pot while a fresh batch is being melted in a neighboring pot which therefore requires to be heated to a higher temperature.

While it is preferred to employ basins of hemispherical form, it will be evident that the invention is not limited thereto.

The aforesaid fixed or portable basins may also be used in connection with the manufacture of window glass and other flat glass including plain, colored and opal glass.

While, as above described, the molten glass passes direct from the melting chamber to a working chamber arranged at a lower level, another chamber could be interposed. For example, a working chamber as herein described could be arranged adjacent to the working end of a glass tank of ordinary construction, the molten glass then gravitating from the usual working chamber into the working chamber through a valve controlled opening. This is shown diagrammatically in Figure 8 in which 10 designates the melting chamber of an ordinary glass tank, 10^1 the usual working chamber, 10^2 the doghole, and 11 the basin or actual working chamber to which molten glass is delivered under the control of a valve (not shown) by means of a chute 25 from the chamber 10^1.

I am aware of U.S. Patent Specification No. 1,957,252 which discloses two glass melting tanks each provided in an extension of the floor thereof with a discharge outlet by means of which molten glass may be delivered under the control of a valve to a relatively small and shal-

low working chamber associated with a fabricating machine of the suction type. The melting tanks are of the intermittent or single-batch melting type. Thus, a batch of glass is melted in one tank and refined therein before the molten glass is delivered therefrom to the working chamber. When the whole of the contents thereof has been delivered to the working chamber the subsequent supply to the latter will be from the other melting tank, while a fresh batch of glass is being melted in the first tank. And so on. The working chamber of this prior Specification does not, therefore, serve as a refining chamber, as is possible with the working chamber of the present invention when the level in the melting chamber is relatively low—for example, towards the end of the working week.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A continuous melting glass tank furnace comprising an elongated melting chamber, a working chamber which is adapted for the refining of the molten glass therein, and which is so arranged relatively to the melting chamber that the maximum level of molten glass in the working chamber would be below or not substantially above the level of the bottom of the melting chamber, means disposed at or adjacent one end of the melting chamber for discharging molten glass directly therefrom into the working chamber through a discharge outlet located adjacent the bottom of the melting chamber so that all or substantially all of the molten glass in the latter can flow into the working chamber, and means operable to regulate the flow of molten glass from the melting chamber to the working chamber.

2. A continuous melting glass tank furnace according to Claim 1 wherein said working chamber is covered and reheating means are arranged therein above the level of the molten glass.

3. A continuous melting glass tank furnace according to Claim 1 or 2 wherein said working chamber is formed separately from said melting chamber and is spaced laterally from the discharge end thereof.

4. A continuous melting glass tank furnace according to any preceding Claim wherein said regulating means comprises a horizontally movable valve member associated with said discharge orifice.

5. A continuous melting glass tank furnace according to any preceding Claim wherein said working chamber is substantially of circular shape in plan.

6. A continuous melting glass tank furnace according to any of Claims 1 to 4 wherein the glass holding portion of said working chamber is substantially hemispherical in form.

7. A continuous melting glass tank furnace according to any preceding claim wherein the working chamber is provided with a laterally extending receiving trough for the molten glass from the melting chamber.

8. A continuous melting glass tank furnace according to Claim 3 wherein the glass holding portion of said working chamber is substantially hemispherical in form and is provided with a plurality of radially arranged forehearths each having a gob discharge orifice therein.

9. A continuous melting glass tank furnace according to any of Claims 3 to 7 inclusive wherein said working chamber is of portable construction.

10. A continuous melting glass tank furnace according to Claim 1, 3 or 5 wherein the floor or bottom of said melting tank inclines downwardly to the discharge end thereof.

11. A continuous melting glass tank furnace according to Claim 1, 3 or 5, wherein said melting chamber is formed with a sump or well at or near the discharge end thereof, said sump or well being provided with said discharge outlet.

12. A continuous melting glass tank furnace or combination according to Claim 6 or 9, wherein said working chamber is provided at its lower end with a normally plugged discharge orifice.

13. A continuous melting glass tank furnace according to Claim 1, 2 or 3 including means for supplying batch materials to the melting chamber at a position remote from the working chamber and additional means arranged adjacent said working chamber for supplying batch materials to the melting chamber.

14. The method of operating a glass tank or furnace according to any preceding Claim wherein the level of glass in the working chamber is maintained substantially constant irrespective of variations in the level of glass in the melting chamber.

15. The method of operating a continuous melting glass tank furnace according to any of Claims 1 to 9 inclusive, comprising melting batch materials in the melting chamber at a substantially uniform daily rate, removing molten glass from the working chamber during "working" periods at a rate substantially greater than the melting rate, whereby the level in the melting tank falls, and

low working chamber associated with a fabricating machine of the suction type. The melting tanks are of the intermittent or single-batch melting type. Thus, a batch of glass is melted in one tank and refined therein before the molten glass is delivered therefrom to the working chamber. When the whole of the contents thereof has been delivered to the working chamber the subsequent supply to the latter will be from the other melting tank, while a fresh batch of glass is being melted in the first tank. And so on. The working chamber of this prior Specification does not, therefore, serve as a refining chamber, as is possible with the working chamber of the present invention when the level in the melting chamber is relatively low—for example, towards the end of the working week.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A continuous melting glass tank furnace comprising an elongated melting chamber, a working chamber which is adapted for the refining of the molten glass therein, and which is so arranged relatively to the melting chamber that the maximum level of molten glass in the working chamber would be below or not substantially above the level of the bottom of the melting chamber, means disposed at or adjacent one end of the melting chamber for discharging molten glass directly therefrom into the working chamber through a discharge outlet located adjacent the bottom of the melting chamber so that all or substantially all of the molten glass in the latter can flow into the working chamber, and means operable to regulate the flow of molten glass from the melting chamber to the working chamber.

2. A continuous melting glass tank furnace according to Claim 1 wherein said working chamber is covered and reheating means are arranged therein above the level of the molten glass.

3. A continuous melting glass tank furnace according to Claim 1 or 2 wherein said working chamber is formed separately from said melting chamber and is spaced laterally from the discharge end thereof.

4. A continuous melting glass tank furnace according to any preceding Claim wherein said regulating means comprises a horizontally movable valve member associated with said discharge orifice.

5. A continuous melting glass tank furnace according to any preceding Claim wherein said working chamber is substantially of circular shape in plan.

6. A continuous melting glass tank furnace according to any of Claims 1 to 4 wherein the glass holding portion of said working chamber is substantially hemispherical in form.

7. A continuous melting glass tank furnace according to any preceding claim wherein the working chamber is provided with a laterally extending receiving trough for the molten glass from the melting chamber.

8. A continuous melting glass tank furnace according to Claim 3 wherein the glass holding portion of said working chamber is substantially hemispherical in form and is provided with a plurality of radially arranged forehearths each having a gob discharge orifice therein.

9. A continuous melting glass tank furnace according to any of Claims 3 to 7 inclusive wherein said working chamber is of portable construction.

10. A continuous melting glass tank furnace according to Claim 1, 3 or 5 wherein the floor or bottom of said melting tank inclines downwardly to the discharge end thereof.

11. A continuous melting glass tank furnace according to Claim 1, 3 or 5, wherein said melting chamber is formed with a sump or well at or near the discharge end thereof, said sump or well being provided with said discharge outlet.

12. A continuous melting glass tank furnace or combination according to Claim 6 or 9, wherein said working chamber is provided at its lower end with a normally plugged discharge orifice.

13. A continuous melting glass tank furnace according to Claim 1, 2 or 3 including means for supplying batch materials to the melting chamber at a position remote from the working chamber and additional means arranged adjacent said working chamber for supplying batch materials to the melting chamber.

14. The method of operating a glass tank or furnace according to any preceding Claim wherein the level of glass in the working chamber is maintained substantially constant irrespective of variations in the level of glass in the melting chamber.

15. The method of operating a continuous melting glass tank furnace according to any of Claims 1 to 9 inclusive, comprising melting batch materials in the melting chamber at a substantially uniform daily rate, removing molten glass from the working chamber during "working" periods at a rate substantially greater than the melting rate, whereby the level in the melting tank falls, and

maintaining substantially constant the level in the working chamber.

16. A glass melting chamber and a separate working chamber constructed and arranged substantially as described with reference to Figures 1 to 4 of the drawings.

17. A glass melting chamber and a separate portable working chamber constructed and arranged substantially as described with reference to Figure 7 of the drawings.

18. A continuous melting glass tank furnace, as claimed in any preceding claim, having a glass melting chamber of which the glass holding portion is substantially of semi-circular shape in transverse section and is constructed substantially as described with reference to Figures 1, 3 and 6 of the drawings.

Dated this 26th day of October, 1943.

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