Jan. 6, 1953 G. L. HENRY ET AL 2,624,475

METHOD AND APPARATUS FOR FEEDING GLASS FURNACES

Filed Aug. 4, 1949 2 SHEETS—SHEET 1

Fig. 1

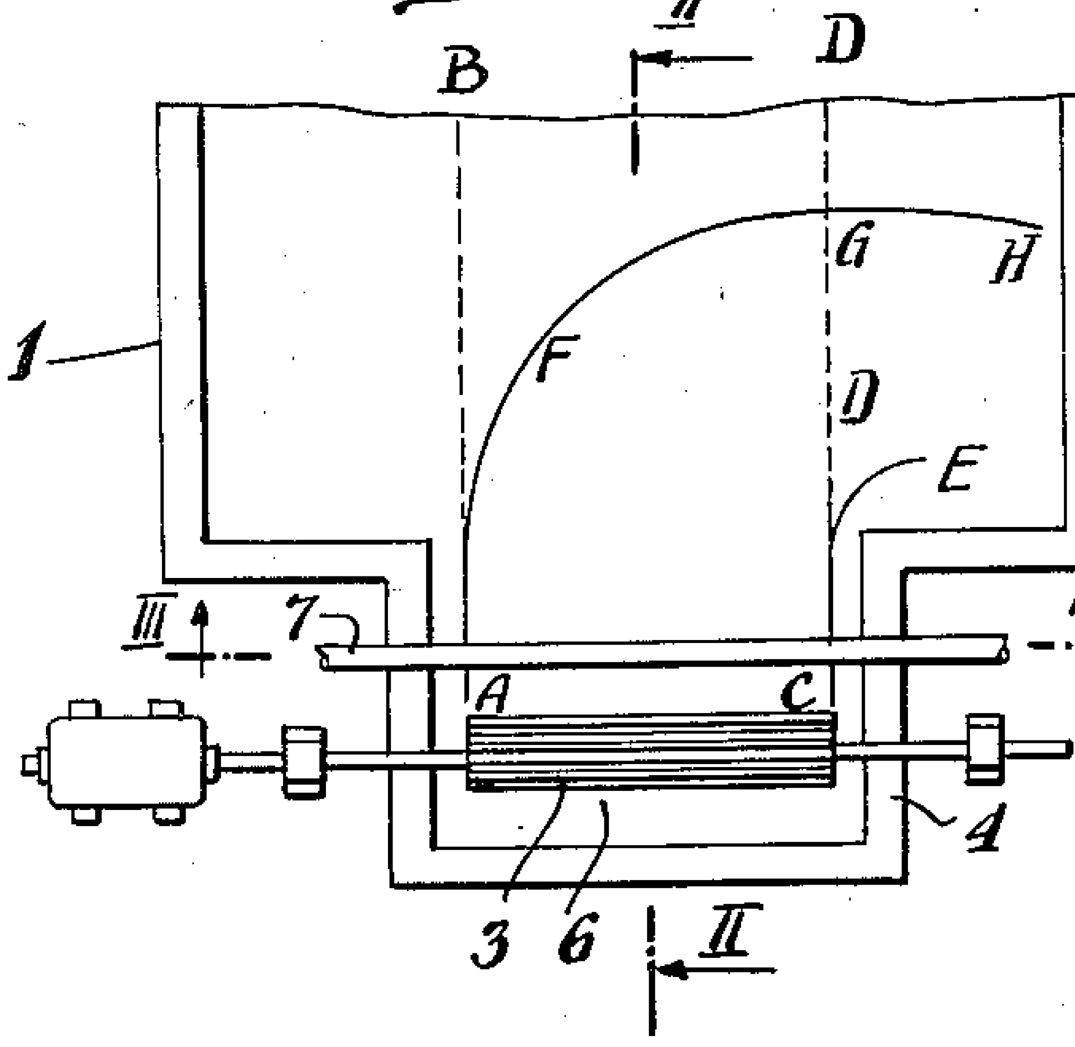


Fig. 2

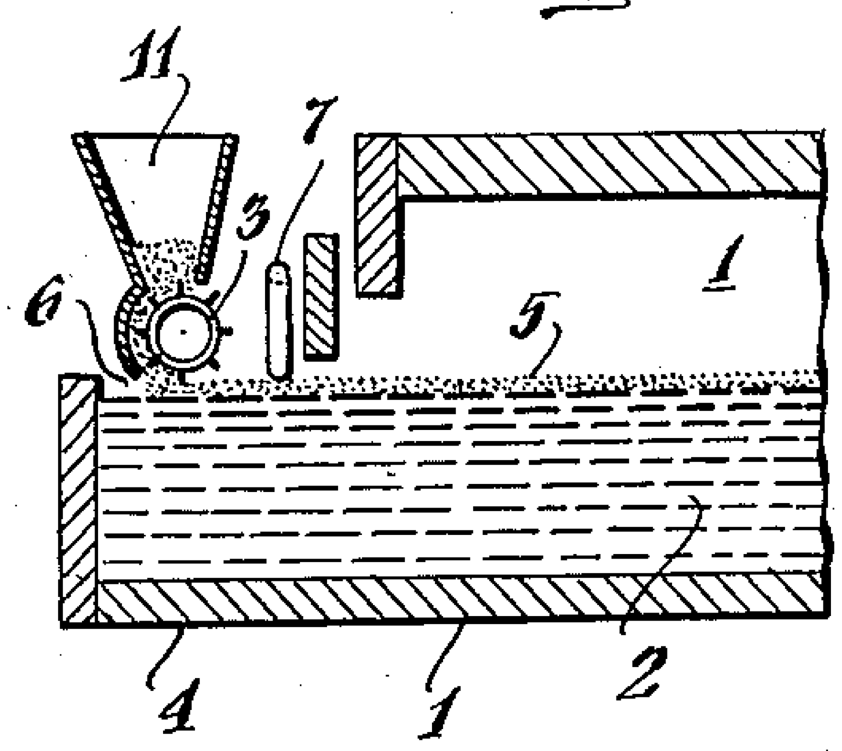


Fig. 3

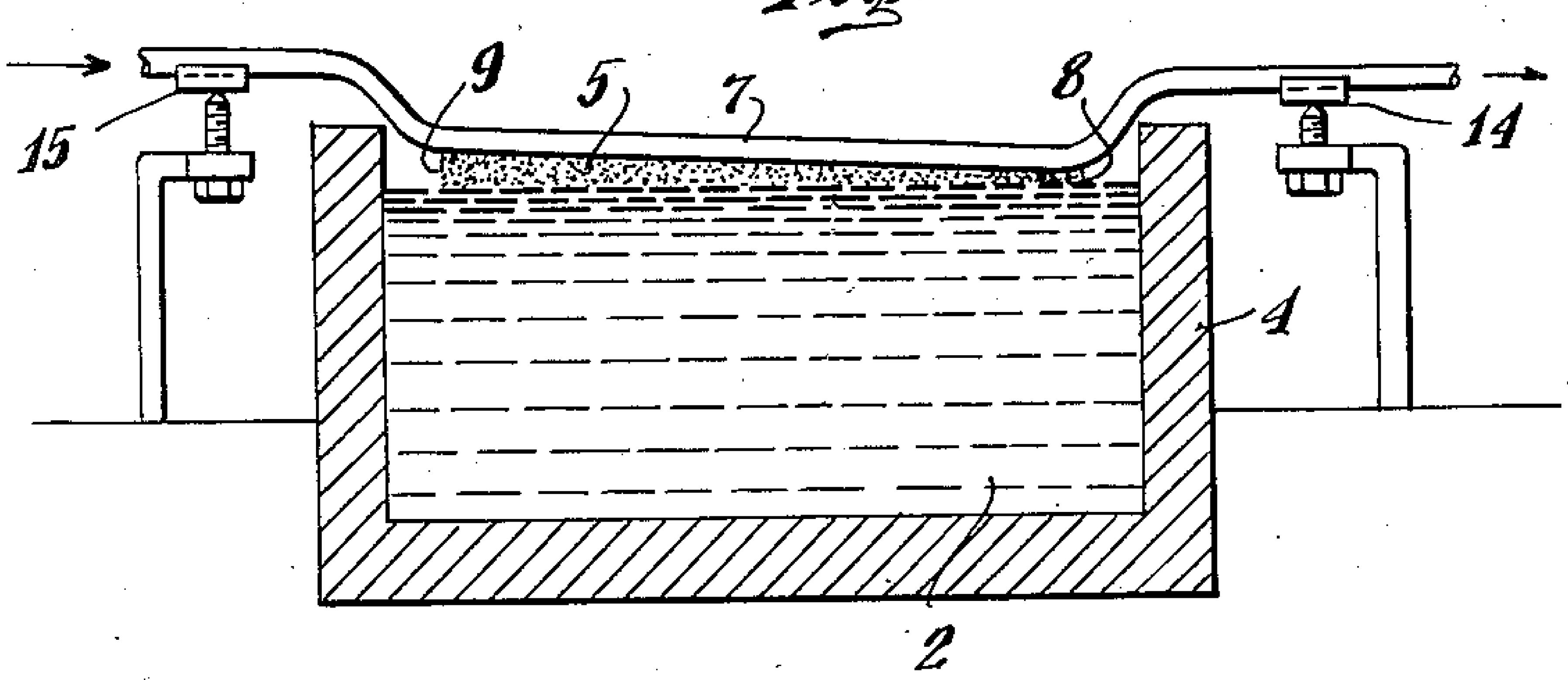


Fig. 4

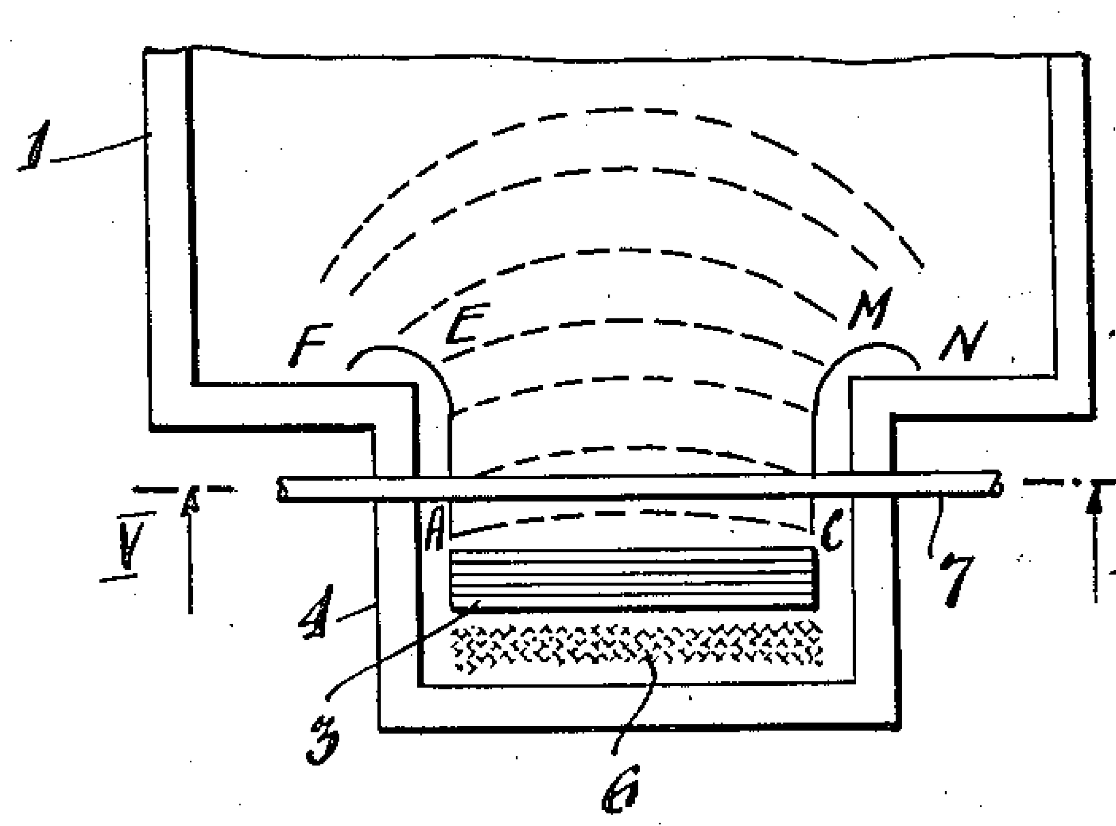


Fig. 5

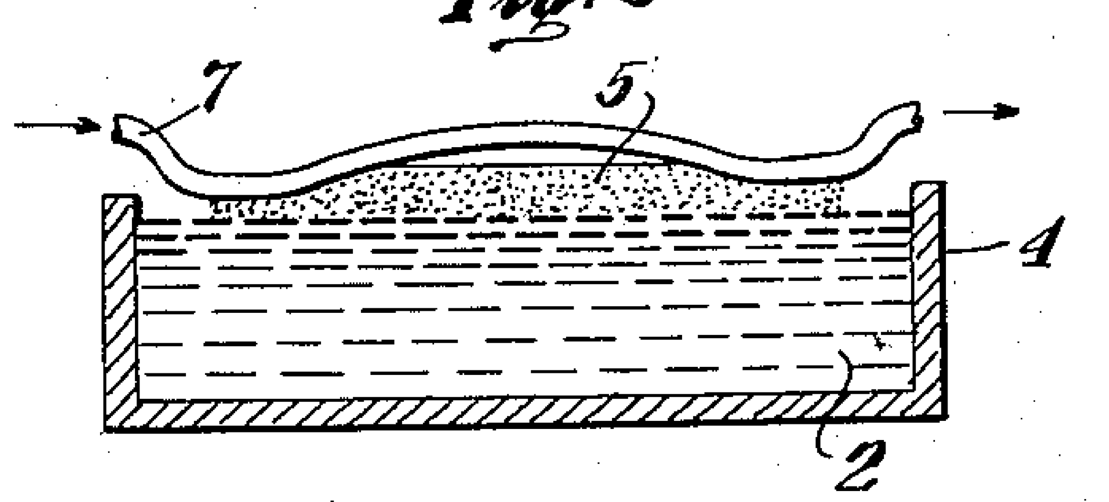
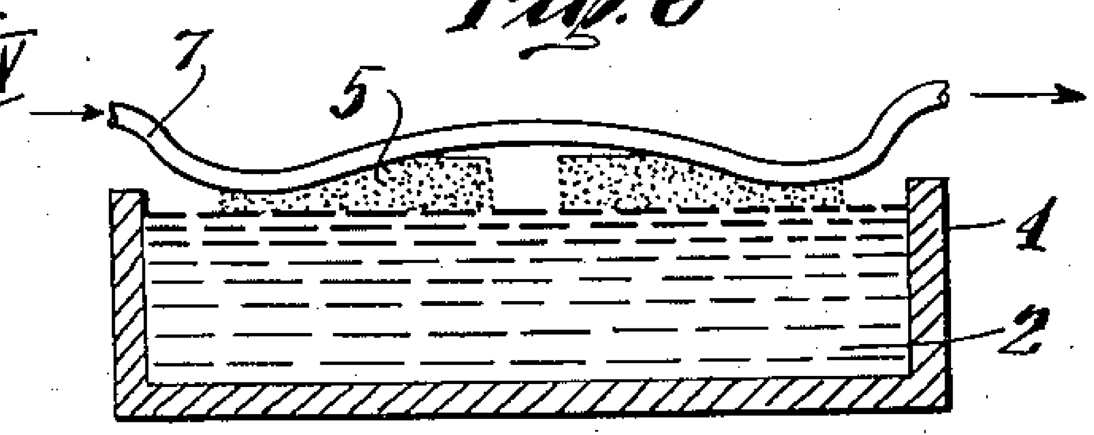


Fig. 6



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METHOD AND APPARATUS FOR FEEDING GLASS FURNACES

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Fig. 7

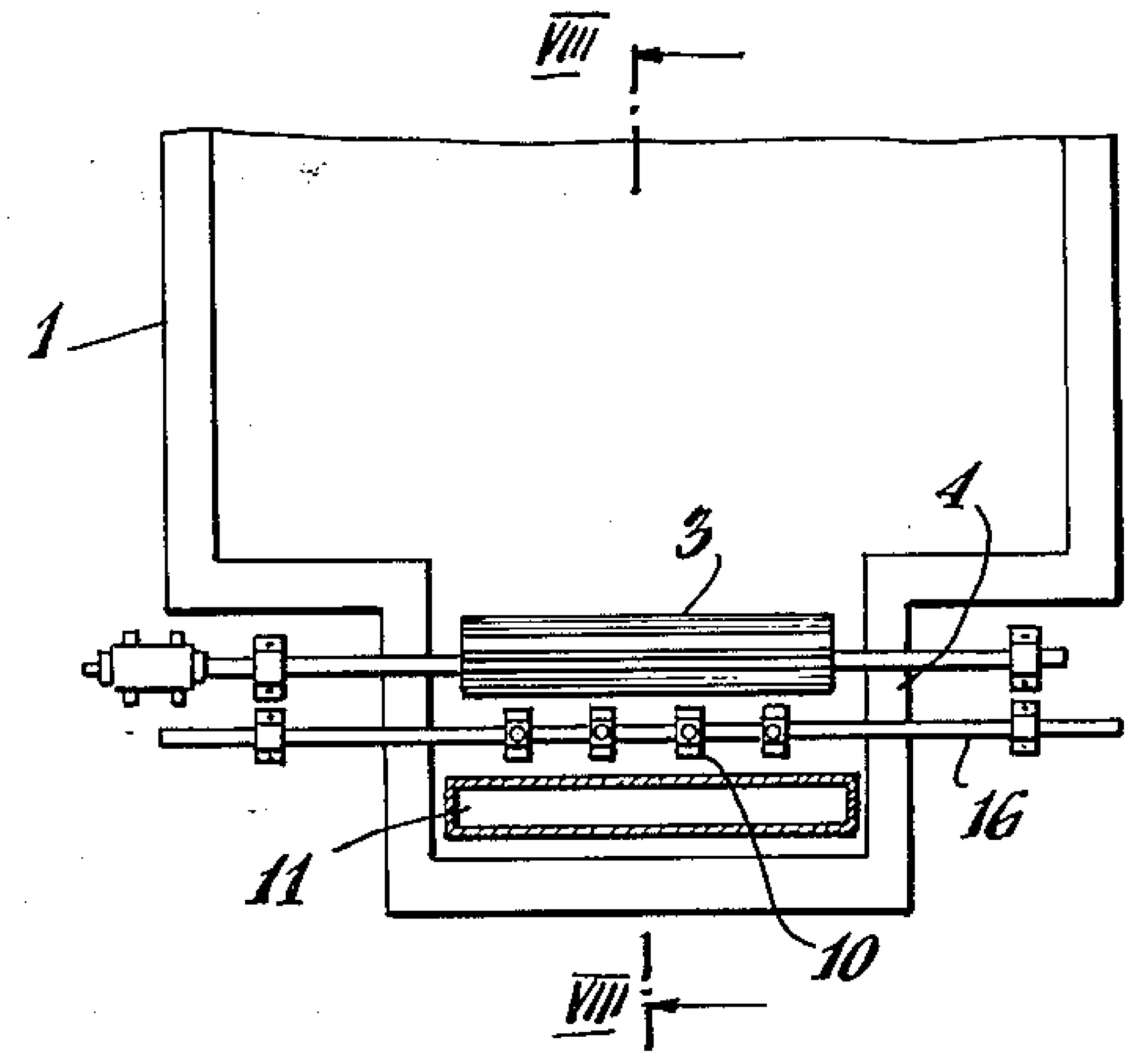


Fig. 8

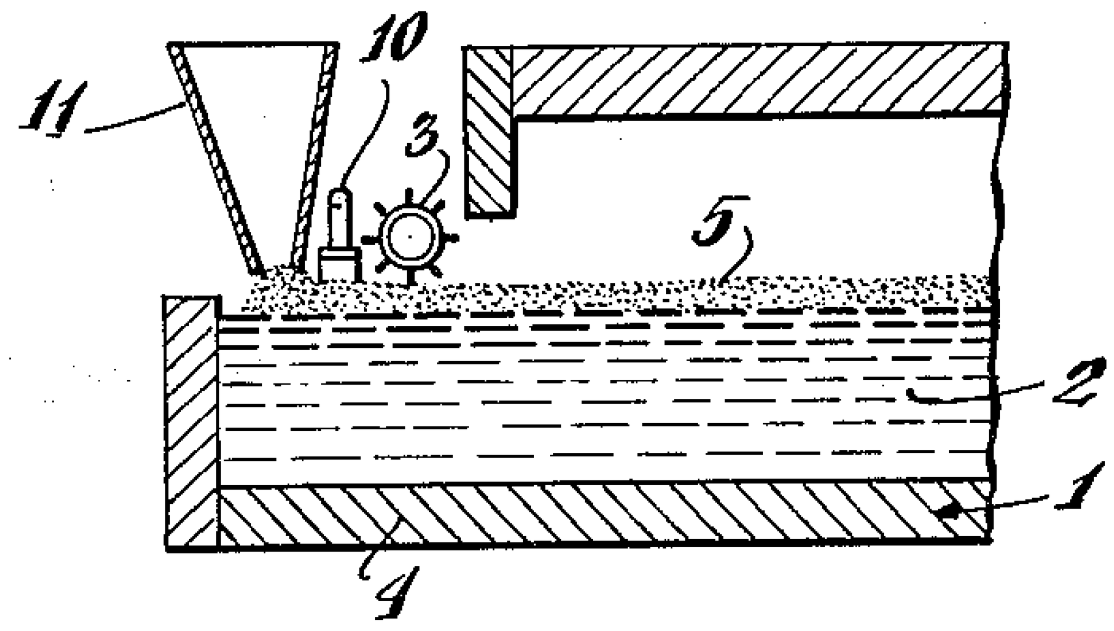
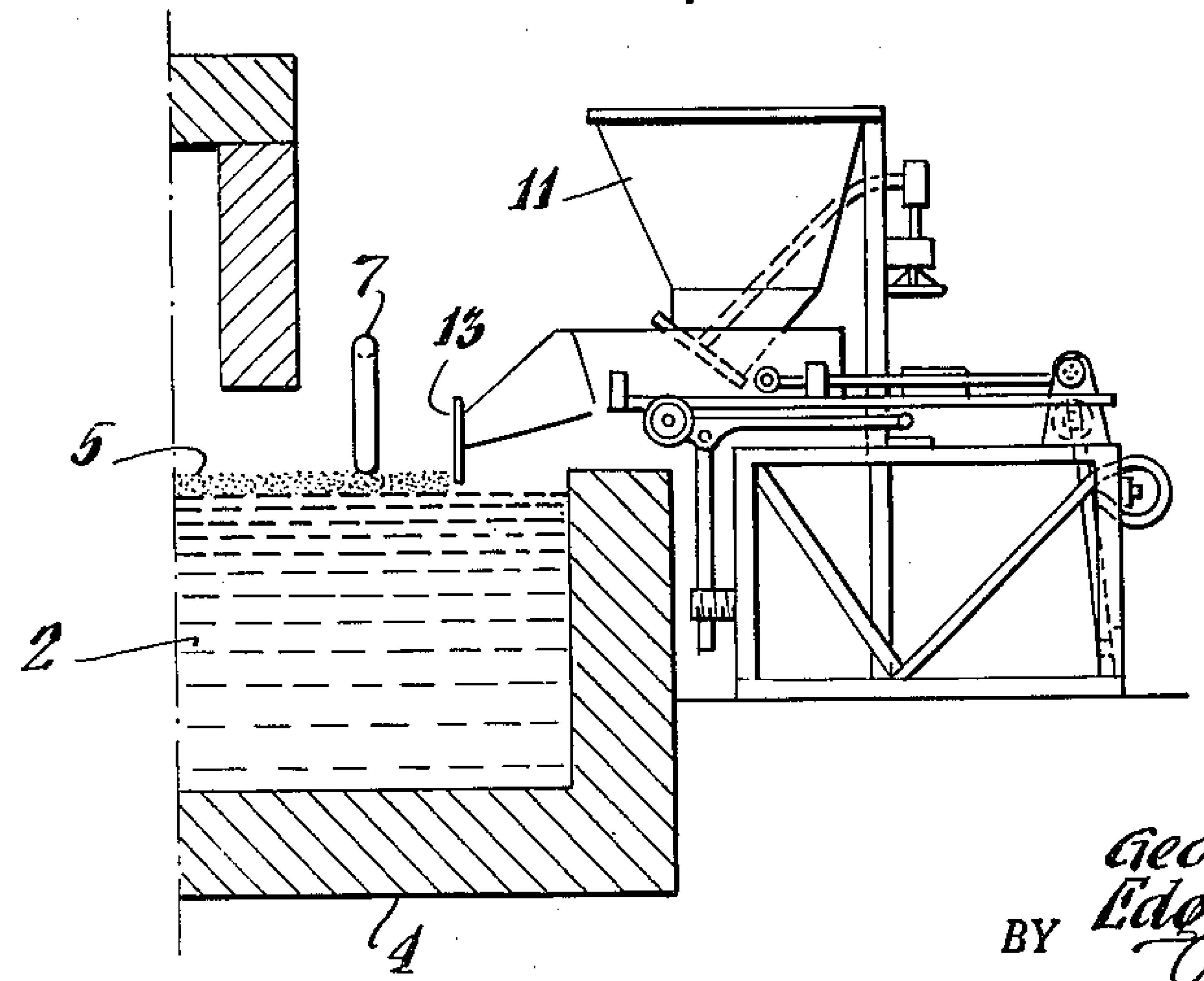


Fig. 9



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2,624,475

METHOD AND APPARATUS FOR FEEDING GLASS FURNACES

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14 Claims. (Cl. 214—35)

It is known to feed vitrifiable materials into glass tank furnaces by introducing the mixture of the said materials—known as the batch—into the furnace in the form of a substantially continuous sheet or layer of uniform thickness, which floats on the molten bath and melts in proportion as it progresses into the furnace.

An object of this invention is to make it possible to vary the direction of the said sheet of batch, either in order to correct deviations due to accidental causes, or in order to bring the sheet at each instant to that point of the furnace at which the melting conditions are the best.

The present invention relates to a method and apparatus by means of which it is possible to guide the sheet of batch in its progress at will. To this end, the progress of the sheet is retarded over all or part of its length when, after having been distributed over the bath, the sheet advances under the action of the feeding arrangement. This retarding action is exerted by one or more elements penetrating more or less deeply into the sheet, at the necessary points for imparting the required direction thereto. It is thus possible to act on the sheet of batch in proximity to the feeding arrangement before it has been subjected to the action of the flames, and thus to control from a distance its displacement over its entire length.

In order that the invention may be readily understood, reference will be made to the following figures, which show by way of example a number of forms of embodiment thereof:

Fig. 1 is a plan view of the rear of a tank furnace and of the head thereof, on which there is fitted a feeding arrangement of the type described in applicants' Belgian Patent No. 466,139 of the 22nd June 1946,

Fig. 2 is a vertical section along the line II—II of Fig. 1,

Fig. 3 is a cross-section along the line III—III of Fig. 1,

Fig. 4 is a plan view similar to that of Fig. 1, showing another form of embodiment of the method,

Fig. 5 is a cross-section along the line V—V of Fig. 4,

Fig. 6 is a section similar to Fig. 5, but showing a variant of the arrangement of Figs. 4 and 5,

Fig. 7 is a plan view similar to Fig. 1, showing another form of the invention,

Fig. 8 is a longitudinal section along the line VIII—VIII of Fig. 7, and

Fig. 9 illustrates the application of the method according to the invention to a furnace equipped with a feeding arrangement different from that of the preceding figures.

In the example illustrated in Figs. 1 to 3, the tank 1 of the tank furnaces is extended rearwardly by a head 4 of a width generally smaller than that of the tank. The molten glass 2 fills the tank 1 and the head 4 to a certain height. The furnace-feeding arrangement 3 here shown is the bladed roller of the arrangement forming the subject of applicants' Belgian Patent No. 466,139, but it will be understood that it may be replaced by any other arrangement for feeding the batch in sheet form into the furnace. The sheet of batch 5 is deposited at 6 by a distributing hopper 11 and distributed over the head 4 by the feeding arrangement 3, which also imparts thereto an impulse causing it to progress continuously towards the interior of the furnace.

The glass ingredients which are handled by the apparatus and method of the present invention have been referred to as "batch" and may hereinafter be described as "granular." These terms are employed in a generic sense and not by way of limitation. The method and apparatus of the invention are adaptable for use with substantially all ingredients used in glass making and with a wide range of particle sizes. The use of these phrases is not intended to limit the invention to the use of any specific material nor to any specific particle size or range of sizes.

When the sheet of batch is deposited on the surface of the molten glass, it floats there, with the lower portion of the sheet sunk slightly into the liquid mass. As the sheet is pushed toward the interior of the furnace, it carries with it a portion of the liquid near the surface thereof, creating a current which transmits the driving force to other parts of the sheet. Some driving force is also transmitted through the sheet itself. The sheet and the adjacent portion of the liquid act as a more or less cohesive mass.

Under this impulse, the sheet assumes a certain speed which is constant at all points, and advances regularly without deformation, the edges thus following the straight paths AB and CD. In this way, a practically continuous sheet is obtained, which covers the surface ABCD which melts in proportion as it progresses into the zone of action of the flames from the hearth of the furnace.

To vary the direction of the sheet, according to the present invention, a partial or differential retarding action is exerted on its movement.

To this end, a resistant element is employed which can be constructed of refractory material, or which may be constituted by a metal pipe in which water circulates, as shown at 7. The said pipe may be curved as shown in Fig. 3 and it is so inclined as to touch the sheet of batch 5, and even to penetrate into the said sheet over a part of its length. The position of the said pipe may be controlled so as to vary the position and the length of its zone of contact with the sheet of batch and the strength of its action thereon.

In the case of Fig. 3, it will be seen that the pipe 7, which hardly touches the layer of batch 5 on its edge 9, is so inclined that its contact with the sheet is progressively more pronounced in the direction towards the edge 8, without however reaching the level of the molten glass. As it passes below the pipe 7, the batch is compressed between the said pipe and the molten glass 2 on which the sheets floats. The sheet of batch is forced downwardly against the buoyant force which tends to keep the sheet floating on the molten glass. As the sheet is pushed farther down by the pipe 7, the buoyant force acting upwardly increases and consequently the friction between the pipe 7 and the surface of the batch also increases. The force which moves the batch downwardly is a resultant force derived from the driving force acting on the sheet and the reactive force acting through the pipe 7. The reactive force of the pipe 7 has a component acting in opposition to the forward movement of the sheet. The friction of the batch against the pipe also tends to retard the movement of the sheet and the underlying layer of molten glass. The reactive force opposing the forward movement of the sheet and the friction of the sheet against the pipe 7, both increase as the pipe 7 is lowered. Consequently the retarding effect increases as the pipe is lowered. In the construction shown in Fig. 3, the retarding effect also varies from one edge of the sheet to the other. As hereinbefore explained, it may be varied by adjusting the height and the inclination of the pipe with respect to the sheet, as also the length of pipe brought into contact with the batch. This adjustment is effected by means known per se, for example by raising or lowering one or both of the supports 14, 15.

The retarding effect of the pipe 7 produces either a compression of the batch in the direction of the forward movement of the sheet, or a relative sliding of the furnace feeding member with respect to the sheet, this sliding taking place on the part of the sheet which is aligned with the portion in contact with the pipe and being proportional to the strength of the action of the said pipe.

Owing to this retarding effect, the initial speed imparted by the feeding arrangement to the sheet —which speed was constant at all points—is modified proportionally to the strength of the retardation. The resultant speed is therefore variable from one edge of the sheet to the other, being lowest at the point 8 and highest at the point 9. It follows that the sheet of batch undergoes a rotational movement and spreads out fanwise, its edges following paths such as CDE and AFGH (Fig. 1).

The pipe 7 may also be given other forms, for example that shown in Fig. 5. In this case, the retarding action is highest on the edges of the sheet and lowest or even zero at the centre, according to whether the pipe emerges in the neighbourhood of the axis of the sheet or not. The speed therefore varies from one edge to the other, being lowest on the edges and highest at the centre. The sheet is then spread out fanwise in the form shown in Fig. 4, the edges following paths such as AEF and CMN, so that it eventually covers all the surface of the bath in the tank of the furnace, thus enabling a continuous sheet of batch to be set up, which extends over the entire width of the tank 1, while the head 4 through which it is introduced is of substantially smaller width than the actual tank.

The dotted lines represent the evolution of the form of a generatrix AC in proportion as it progresses.

This effect is further accentuated if the feeding arrangement is adapted to interrupt the sheet at its centre as shown in Fig. 6. Two separate sheets are then formed; one on the left turning to the left, and one on the right turning to the right, and these two sheets, can by reason of the rotational movements, reach the side walls of the furnace, and thus cover the entire surface of the bath, in the rear part of the tank.

The result of these various arrangements will be to spread out the batch fanwise over the entire width of the tank of the furnace. The molten glass bath will therefore be practically covered over its entire surface in the melting zone, which will impart maximum efficiency to the said zone. In this way, also, the batch will be prevented from travelling too rapidly forward under the action of the feeding arrangement alone, which would be likely to promote too rapid a passage, through the melting zone, of portions of batch which might thus escape the effect of the high temperatures before having melted completely.

The same result can also be obtained by exerting the retarding action on the sheet of batch, not by means of a continuous element, but by means of a series of retarding elements 10 disposed as diagrammatically indicated in Figs. 7 and 8. These retarding elements—which consist of retractory materials or are constituted by metal members cooled by water circulation—are mounted on a support 16 by known means, and are adapted to be individually adjusted so as to be able to exert a progressive retarding action from one edge of the sheet to the other, and to produce discontinuously a variation of the retarding action similar to that which is continuously obtained in the arrangements hereinbefore described.

It is further to be noted from Figs. 7 and 8 that the retarding device is located, not on the output side of the feeding arrangement 3, but well in front of it, between the point at which the sheet of batch is deposited on the molten glass and that at which it receives its impulse from the feeding machine 3 for the purpose of feeding it towards the interior of the furnace. Tests carried out by the applicants have in fact proved that if the differential retarding action is exerted on the sheet of batch slightly before it receives the said impulse, it behaves—by reason of its cohesion—in the same manner as if the retarding action were applied on the output side of the feeding arrangement.

It will readily be understood that the method according to the invention is applicable to a sheet of batch regardless of the type of feeding apparatus from which it receives the impulse necessary to cause it to progress towards the furnace. In Fig. 9, there is shown the application of the invention to a glass furnace equipped with an apparatus comprising a push member: the push member 13 is actuated with a reciprocating translational movement parallel to the surface of the glass. At each rearward movement of the push member, a part of the batch coming from the hopper 11 is deposited on the bath. In its forward movement, the push member 13 forces the batch before it, thus forming a practically continuous sheet which progresses in jerks. The pipe 7 exerts its action on the sheet thus formed, in the same way as in Figs. 1 to 6.

Other modifications in the form of the arrangements described are obviously possible without departing from the scope of the invention.

We claim:

1. A method of feeding batch in granular form into a glass furnace, comprising feeding the batch onto the surface of the molten glass as a floating sheet of substantially uniform thickness, imparting an impulse to the sheet to move it into the furnace, and applying a retarding action to a portion only of said sheet adjacent the upper surface thereof and having a substantial depth, while leaving a laterally adjacent portion unretarded, so that the unretarded portion moves faster than and is turned toward the retarded portion.

2. A method of feeding batch in granular form into a glass furnace, comprising feeding a floating sheet of batch onto the surface of the molten glass near one end of the furnace, impelling said sheet towards the opposite end of the furnace, and blocking the movement in the direction of said opposite end of a portion of said sheet adjacent the upper surface thereof and having a substantial depth which varies across the width of the sheet, so that the speed of the sheet is varied in proportion to the depth of the blocking and the less blocked portions move faster than and are turned toward the more blocked portions.

3. A method of feeding batch in granular form into a glass furnace, comprising feeding the batch onto the surface of the molten glass near one end of the furnace, spreading the batch over the glass to form a floating sheet of substantially uniform thickness, impelling said sheet towards the opposite end of said furnace, applying a retarding action to said sheet over only part of its width, and varying the direction of progress of said sheet by regulating said retarding action.

4. A method of feeding batch in granular form into a glass furnace, comprising feeding the batch onto the surface of the molten glass near one end of the furnace, spreading the batch over the glass to form a floating sheet of substantially uniform thickness, impelling said sheet towards the opposite end of said furnace, and applying a controllable retarding action to the upper surface of the marginal portions only of said sheet.

5. A method of feeding batch in granular form into a glass furnace, comprising feeding the batch onto the surface of the molten glass as a floating sheet interrupted in the center, impelling the two parts of said sheet side by side towards said furnace, and applying a retarding action to the outer marginal portions only of said sheet.

6. An apparatus for feeding batch into a glass furnace, comprising in combination with a furnace, means for feeding a floating sheet of batch in granular form onto the surface of the molten glass, and means for retarding the progress of the batch over the molten glass over only a part of its width, said retarding means comprising at least one member reaching below the surface of said sheet but above the surface of the glass.

7. An apparatus for feeding batch into a glass furnace comprising in combination with a furnace, means for feeding the batch in the form of a floating sheet of granular material onto the surface of the molten glass at the head of said furnace, means for impelling the sheet of batch towards the opposite end of the furnace, and means engaging the upper surface of said sheet for producing on the progress of said sheet a non-uniform retarding action which varies from one side edge of the sheet to the other.

8. An apparatus as claimed in claim 7, wherein the retarding means for producing a retarding action on the sheet of batch comprises an element extending over the entire width of the sheet of batch and penetrating into the sheet by unequal depths at different points of said width.

9. An apparatus as claimed in claim 7, wherein the means for producing a retarding action on the sheet of batch comprises a plurality of adjustable elements arranged side by side.

10. An apparatus as claimed in claim 7, wherein the means for producing a retarding action on the sheet of batch comprises a tube extending across said sheet and inclined downwardly on at least one side thereof.

11. An apparatus for feeding granular batch into a glass furnace, comprising in combination with a furnace, means for feeding side by side two floating half-sheets of batch onto the surface of the molten glass at the inlet end of said furnace, means for impelling said half-sheets towards the opposite end of said furnace, and means for producing a retarding action on the progress of said half sheets, said means engaging said half-sheets only near the outer edges thereof.

12. An apparatus for feeding pulverulent batch into a glass furnace, comprising in combination with a furnace having a head narrower than the main furnace, means for distributing a floating sheet of pulverulent batch over the surface of the molten glass and extending substantially the whole width of said head, means for impelling said sheet towards and into said furnace, and means in contact with the marginal portions only of the upper surface of said sheet to retard the progress of said marginal portions and cause said sheet to spread laterally into the furnace.

13. A method of feeding batch in granular form into a glass furnace, comprising the steps of feeding the batch onto the surface of the molten glass as a floating sheet of substantially uniform thickness, applying to said sheet a driving force which is substantially uniform over the width of the sheet, and blocking the movement in the direction of said force of a portion of said sheet adjacent the upper surface thereof and having a thickness which varies along the width of the sheet, so that the speed of the sheet is varied along its width and the faster moving portions are turned toward the slower moving portions, thereby diverting at least part of the sheet from the direction of movement imparted by said driving force.

14. Apparatus for feeding batch into a glass furnace, comprising means for feeding onto the surface of the molten glass a floating sheet of batch in granular form, said sheet being of substantially uniform thickness, means for diverting at least part of the sheet from the direction of movement imparted by the feeding means comprising means projecting downwardly into the path of travel of the sheet a distance which varies along the width of the sheet, said downwardly projecting means being effective to retard the speed of the portions of the sheet engaged thereby.

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EDGARD BRICHARD.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,623,057	Kingsley	Apr. 5, 1927
2,281,050	Redshaw	Apr. 28, 1942