Jan. 19, 1932. F. FRASER ET AL 1,841,580

METHOD AND APPARATUS FOR DRAWING SHEET GLASS

Filed April 18, 1930

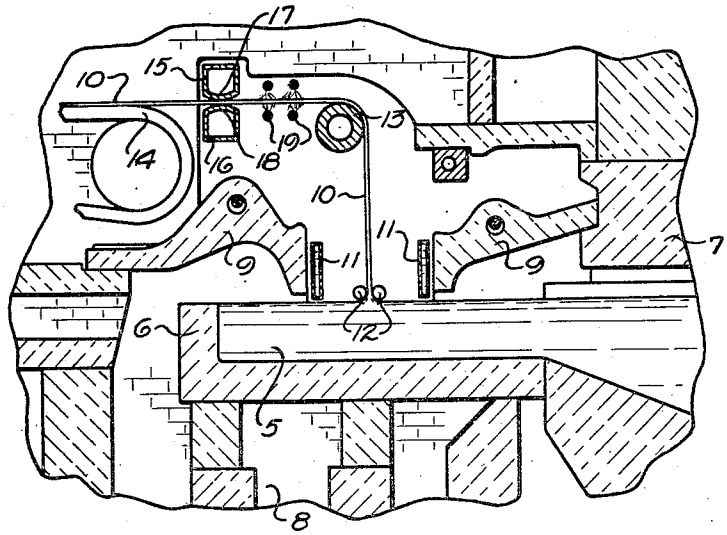


FIG. 1

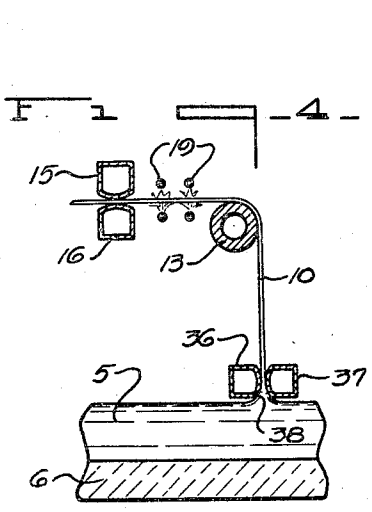


FIG. 4

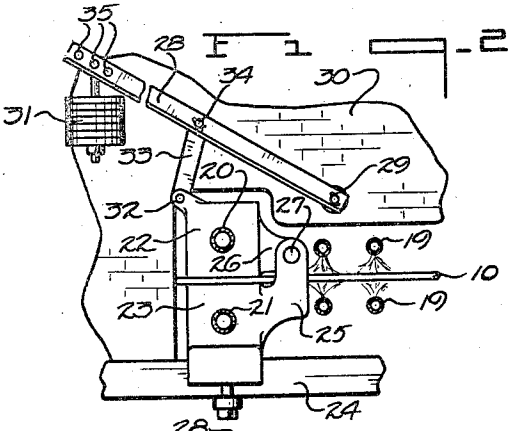


FIG. 2

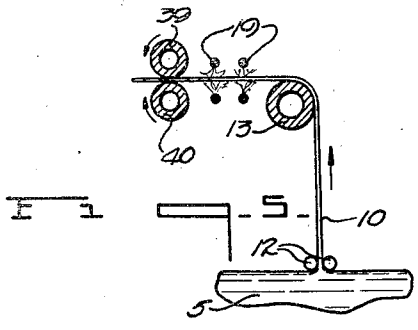


FIG. 5

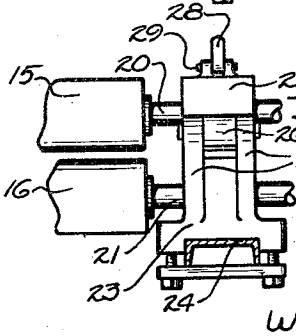


FIG. 3

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UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR DRAWING SHEET GLASS

Application filed April 18, 1930. Serial No. 445,490.

This invention relates to improvements in the art of drawing sheet glass and more particularly to an improved method and apparatus for removing surface defects or irregularities in the sheet whereby a flat, smooth and uniform thickness of sheet is produced.

While this invention is not limited to use in connection with any particular type of sheet glass forming apparatus, it may be effectively used in the Colburn system such as is illustrated, for example, in the patent to Colburn, No. 1,248,809, granted December 4, 1917. In this system of forming sheet glass, the sheet is drawn continuously upward from a relatively shallow pool of molten glass and then, while still somewhat plastic, is deflected about a cooled bending roll into a horizontal plane. The sheet is then carried through a combined drawing and flattening mechanism wherein the sheet becomes set in final sheet form after which it is passed horizontally through an annealing leer. During the drawing and deflecting of the sheet and while it is still soft and plastic, there is sometimes a tendency, due to various conditions, for waves and other surface defects or irregularities to be formed therein. In the event such surface defects are permitted to remain in the sheet, they will naturally impair both the quality and the commercial value thereof.

An important object of the invention, therefore, is the provision of a method and means wherein any surface defects or irregularities present in the sheet can be removed therefrom preferably, though not necessarily, subsequent to the deflection thereof and while the same is still in a plastic condition whereby to produce a flat sheet, both smooth and uniform in thickness.

Another object of the invention is the provision of a method and means wherein opposite surfaces of the sheet are treated simultaneously to flatten or iron out any surface irregularities therein, the sheet being preferably submitted to a heat treatment prior to such flattening or ironing operation.

Another object of the invention is the provision of a method and apparatus wherein opposite surfaces of the sheet may also be subjected to a wiping or smoothing action at the base or meniscus thereof for minimizing the formation of waves or other surface irregularities in the sheet during the formation thereof.

A further object of the invention is to provide an apparatus wherein a sheet of glass is drawn upwardly from a mass of molten glass and deflected into a horizontal plane, and a pair of temperature controlled members arranged to engage opposite surfaces of the sheet while it is still in a soft and plastic condition and having a wiping or smoothing action thereupon to flatten the same, said members preferably having line contact with the sheet and means being provided for varying the pressure of said members thereupon.

Other objects and advantages of the invention will become more apparent during the course of the following description when taken in connection with the accompanying drawings.

In the drawings forming a part of this application and wherein like numerals are employed to designate like parts throughout the same,

Fig. 1 is a vertical longitudinal section through a portion of a sheet glass drawing apparatus showing the present invention in use,

Fig. 2 is a side elevation showing the means for mounting the sheet flattening or ironing members,

Fig. 3 is a view taken at right angles to Fig. 2,

Fig. 4 is a sectional view of a slightly modified arrangement, and

Fig. 5 is a sectional view of a still further modified arrangement.

Referring to the drawings and particularly with reference first to Fig. 1, the relatively shallow pool of molten glass 5 in receptacle 6 is in open communication with a continuous tank furnace 7 or other source of supply, and the molten pool 5 is maintained at the proper working temperature by the heating chamber 8 over which receptacle 6 is supported. All of the glass in receptacle 6, except for a comparatively narrow strip at each side of the sheet source, is enclosed by

a pair of cover tiles 9 and the glass sheet 10 is drawn upwardly from the exposed surface portion of the molten glass between a pair of water-cooled shields 11 which protect the sheet source from the heated gases which would otherwise flow out against the sheet from under the cover tiles 9 and also serve to chill the surface glass to the proper sheet drawing temperature. Pairs of driven edge-gripping rollers 12 engage each edge of the glass sheet 10 at its source to maintain the sheet at the desired constant width. The sheet 10 is drawn upwardly until substantially set but while still sufficiently plastic is deflected into the horizontal plane about a cooled bending roll 13 and then run through a combined drawing and flattening means, the draw table 14 only of which is shown, and then on through a suitable annealing leer.

In the Colburn process, there is usually employed a so-called idler roll positioned between the bending roll 13 and the adjacent end of the draw table 14 for supporting the sheet to prevent sagging thereof. In the preferred form of the present invention, however, this idler roll is removed and substituted therefor are the superposed stationary members 15 and 16 positioned above and beneath the sheet respectively to engage opposite surfaces thereof. These members extend transversely the entire width of the sheet and may be formed from any suitable non-corrosive material such as nickel, nichrome, monel or the like. Each member is in the form of a substantially rectangular hollow casing through which is adapted to be circulated a suitable cooling medium such as water, air, etc. These members 15 and 16 are provided to have a wiping or smoothing action upon opposite surfaces of the glass sheet as it is passed therebetween and in sliding contact therewith so that they will tend to flatten or iron out any surface defects or irregularities which may be present in the sheet and thereby facilitate the production of a flatter and smoother sheet of a more uniform thickness. The bottom 17 of the upper member 15 and likewise the top 18 of the lower member 16 are preferably arcuately curved transversely as shown so that they have substantially line contact with the sheet and thus reduce the area of contact between said members and sheet to a minimum.

After the sheet has been deflected about bending roll 13 and before it passes between members 15 and 16, it is preferably submitted to a temperature treatment whereby it may be softened to facilitate the wiping action of said members thereupon. This temperature treatment of the sheet is herein effected by the provision of a plurality of burners 19 adapted to direct heat upon the sheet both from above and beneath although other types of heating means may be employed if preferred. The members 15 and 16 not only act to iron out the surface irregularities from the sheet but, in addition, the member 16 serves to support the sheet at a point between the bending roll and the draw table to prevent sagging thereof. While the idler roll has not been shown, it could, of course, be used if desired, although with the arrangement illustrated it is not believed to be necessary.

In Figs. 2 and 3 is shown one way in which the members 15 and 16 may be mounted so that the pressure thereof upon the sheet can be varied as desired. To this end, there are associated with the opposite ends of members 15 and 16 the hollow shafts or tubular extensions 20 and 21 respectively which are supported by bearings 22 and 23. The cooling medium circulated through the members may be introduced thereinto and exhausted therefrom through the extensions 20 and 21 at the opposite ends thereof. The bearing 23 at each end of member 16 is supported upon and rigidly secured to an inverted channel beam 24, said bearing being provided with the spaced vertical ears 25 offset therefrom. The bearing 22 at each end of member 15 is provided with a lug 26 inserted between the spaced ears 25 and pivotally secured thereto by means of a pivot pin 27. The numeral 28 designates a relatively long lever pivotally secured at one end as indicated at 29 to the side wall 30 of the machine and carrying at its outer end a weight 31. Pivoted to the bearing 22 as at 32 is a link 33, the other end of which is pivoted as at 34 to the lever 28 intermediate its ends. With the construction above described, it will be apparent that the upper member 15 is pivotally mounted with respect to the lower member 16 and is normally urged toward the same by the weight 31. The pressure of the members upon the sheet can of course be varied by moving the weight 31 along the lever 28 to any one of the various positions indicated at 35 or by varying the value of said weight while maintaining it in the same position.

Referring to Fig. 4, the arrangement disclosed therein is substantially the same as that illustrated in Fig. 1, with the exception that the sheet width maintaining rollers 12 are omitted and there is substituted therefor the members 36 and 37. These members are of substantially the same construction as members 15 and 16 above described and are positioned to engage opposite surfaces of the sheet at the base or meniscus 38 thereof and throughout the entire width of said sheet. The inner adjacent side walls of these members are also arcuately curved transversely so that the lower portions thereof fit substantially into the curvature of the sheet meniscus. These members not only serve to maintain the sheet to width but are also adapted to have a wiping or smoothing action upon opposite surfaces of the glass so as to minimize

the formation of waves and surface irregularities in the sheet as it is drawn upwardly.

In Fig. 5 is illustrated an arrangement which is also somewhat like that disclosed in Fig. 1, with the exception that instead of employing the stationary members 15 and 16, rotatable members or rolls 39 and 40 are here used. These members are adapted to be rotated quite slowly in a direction opposite to the direction of travel of the sheet and, when so driven, will have a wiping or smoothing effect upon the sheet to iron or flatten out any surface irregularities or defects therein. The same advantages will be achieved by the use of these rotatable members as by the use of the members 15 and 16 and, in addition, new surfaces will be constantly brought into contact with the sheet. The rotatable members can be employed in conjunction with the knurled rolls 12 as shown, with the stationary members 36 and 37, or similar rotatable members can be positioned to engage the base or meniscus of the sheet and to rotate slowly in a direction opposite to the direction in which it is drawn. The rotatable members 39 and 40 can be mounted in exactly the same manner as illustrated in Figs. 2 and 3, with some suitable type of driving means therefor.

It is to be understood that the form of the invention herewith shown and described is to be taken as the preferred embodiment of the same, and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

We claim:

1. In sheet glass apparatus, the combination with means for drawing a sheet of glass upwardly from a bath of molten glass, and means for deflecting the sheet in advance of said drawing means from the vertical into a substantially horizontal plane, of means engaging opposite surfaces of the sheet at a point between the drawing and deflecting means and having substantially line contact therewith for removing surface irregularities therefrom.

2. In sheet glass apparatus, the combination with means for drawing a sheet of glass upwardly from a bath of molten glass, and means for deflecting the sheet in advance of said drawing means from the vertical into a substantially horizontal plane, of means simultaneously engaging opposite surfaces of the sheet at a point between the drawing and deflecting means and having substantially line contact therewith for producing a wiping action thereupon to flatten or iron out any surface irregularities therein.

3. In sheet glass apparatus, the combination with means for drawing a sheet of glass upwardly from a bath of molten glass, and means for deflecting the sheet in advance of said drawing means from the vertical into a substantially horizontal plane, of a pair of members engaging opposite surfaces of the sheet at a point between the drawing and deflecting means for removing surface irregularities therefrom, said members having substantially line contact with said sheet.

4. In sheet glass apparatus, the combination with means for drawing a sheet of glass upwardly from a bath of molten glass, and means for deflecting the sheet in advance of said drawing means from the vertical into a substantially horizontal plane, of members disposed above and beneath said sheet and engaging opposite surfaces thereof at a point between the drawing and deflecting means for producing a wiping action thereupon to flatten or iron out any surface irregularities therein, and means for varying the pressure of said members upon the sheet.

5. In sheet glass apparatus, the combination with means for drawing a sheet of glass upwardly from a bath of molten glass, and means for deflecting the sheet in advance of said drawing means from the vertical into a substantially horizontal plane, of members positioned above and beneath the sheet and adapted to engage opposite surfaces thereof simultaneously at a point between the drawing and deflecting means to flatten or iron out any surface irregularities therein, the member beneath the sheet being fixed and the member above said sheet being movable, and means for normally urging the upper member toward the lower member.

6. In sheet glass apparatus, the combination with means for drawing a sheet of glass upwardly from a bath of molten glass, and means for deflecting the sheet in advance of said drawing means from the vertical into a substantially horizontal plane, of superposed members positioned above and beneath the sheet and adapted to engage opposite surfaces thereof simultaneously at a point between the drawing and deflecting means to flatten or iron out any surface irregularities therein, means for pivotally mounting the upper member with respect to the lower member, and means for normally urging the upper member toward the lower member.

7. In sheet glass apparatus, the combination with means for drawing a sheet of glass upwardly from a bath of molten glass, and means for deflecting the sheet in advance of said drawing means from the vertical into a substantially horizontal plane, of superposed members positioned above and beneath the sheet and adapted to engage opposite surfaces thereof simultaneously at a point between the drawing and deflecting means to flatten or iron out any surface irregularities therein, fixed bearings for supporting the member beneath the sheet and having spaced ears, movable bearings for supporting the member above the sheet and having lugs inserted be-

tween said ears and pivotally secured thereto, and weighted link means for normally urging the upper member towards the lower member.

8. In sheet glass apparatus, the combination with means for drawing a sheet of glass upwardly from a bath of molten glass, means for deflecting the sheet in advance of said drawing means from the vertical into a substantially horizontal plane, of means engaging opposite surfaces of the sheet at a point between the drawing and deflecting means and having substantially line contact therewith for removing surface irregularities therefrom, and means for heating the sheet in advance of said last mentioned means.

9. In sheet glass apparatus, the combination with means for drawing a sheet of glass upwardly from a bath of molten glass, means for deflecting the sheet in advance of said drawing means from the vertical into a substantially horizontal plane, of members disposed above and beneath said sheet and engaging opposite surfaces thereof at a point between the drawing and deflecting means and having substantially line contact therewith for producing a wiping action thereupon to flatten or iron out any surface irregularities therein, and means for heating opposite surfaces of the sheet in advance of said members.

10. In sheet glass apparatus, the combination with means for drawing a sheet of glass upwardly from a bath of molten glass, means for deflecting the sheet in advance of said drawing means from the vertical into a substantially horizontal plane, of stationary superposed members disposed above and beneath said sheet and engaging opposite surfaces thereof at a point between the drawing and deflecting means and having substantially line contact therewith for producing a wiping action thereupon to flatten or iron out any surface irregularities therein.

11. In sheet glass apparatus, the combination with means for drawing a sheet of glass upwardly from a bath of molten glass, means for deflecting the sheet in advance of said drawing means from the vertical into a substantially horizontal plane, of rotatable superposed members disposed above and beneath said sheet and engaging opposite surfaces thereof at a point between the drawing and deflecting means for producing a wiping action thereupon to flatten or iron out any surface irregularities therein, said members rotating in a direction opposite to the direction of travel of the sheet.

12. In sheet glass apparatus, the combination with means for drawing a sheet of glass upwardly from a bath of molten glass, means for deflecting the sheet in advance of said drawing means from the vertical into a substantially horizontal plane, of means engaging opposite surfaces of the sheet at a point between the drawing and deflecting means and having substantially line contact therewith for removing surface irregularities therefrom, and means positioned to have a wiping action on opposite surfaces of the sheet at the base or meniscus thereof.

13. In a sheet glass apparatus, the combination with means for drawing a sheet of glass upwardly from a bath of molten glass, means for deflecting the sheet in advance of said drawing means from the vertical into a substantially horizontal plane, of members disposed above and beneath said sheet and engaging opposite surfaces thereof at a point between the drawing and deflecting means for producing a wiping action thereupon to flatten or iron out any surface irregularities therein, and stationary members extending transversely of the sheet and engaging opposite surfaces thereof throughout its entire width at the base or meniscus thereof for producing a wiping action upon said sheet as it is drawn.

14. The method of producing sheet glass, which consists in drawing the sheet upwardly from a bath of molten glass, deflecting the sheet from the vertical to the horizontal, subjecting opposite surfaces of said sheet simultaneously to a wiping action to smooth or iron out any surface irregularities therein, and in then annealing said sheet.

15. The method of producing sheet glass, which consists in drawing the sheet upwardly from a bath of molten glass, deflecting the sheet from the vertical to the horizontal, submitting the sheet to a heat treatment, subjecting opposite surfaces of said sheet simultaneously to a wiping action to smooth or iron out any surface irregularities therein, and in then annealing said sheet.

16. The method of producing sheet glass, which consists in drawing the sheet upwardly from a bath of molten glass, deflecting the sheet from the vertical to the horizontal, submitting the sheet to a heat treatment, subjecting opposite surfaces of said sheet simultaneously to a wiping action to smooth or iron out any surface irregularities therein, in absorbing heat from the sheet during the time it is being subjected to such wiping action, and in then annealing said sheet.

17. The method of producing sheet glass, which consists in drawing the sheet upwardly from a bath of molten glass, passing the glass before it assumes sheet form between a pair of members having a wiping action thereon, subjecting opposite surfaces of the sheet after it is formed simultaneously to a wiping action to smooth or iron out any surface irregularities therein, and in then annealing said sheet.

18. The method of producing sheet glass, which consists in drawing the sheet upwardly from a bath of molten glass, passing the glass before it assumes sheet form between

a pair of members having a wiping action thereon, submitting the sheet to a heat treatment, subjecting opposite surfaces of the sheet simultaneously to a wiping action to smooth or iron out any surface irregularities therein, and in then annealing said sheet.

19. The method of producing sheet glass, which consists in drawing the sheet upwardly from a bath of molten glass, passing the glass before it assumes sheet form between a pair of members having a wiping action thereon, submitting the sheet to a heat treatment, subjecting opposite surfaces of said sheet simultaneously to a wiping action to iron out any surface irregularities therein, in absorbing heat from the sheet during such wiping action, and in then annealing said sheet.

Signed at Toledo, in the county of Lucas, and State of Ohio, this 15th day of April, 1930.

FRANK FRASER.
WILLIAM E. NOBBE.