July 13, 1926. **1,592,444**

J. P. CROWLEY

DRAWING SHEET GLASS

Filed March 22, 1924

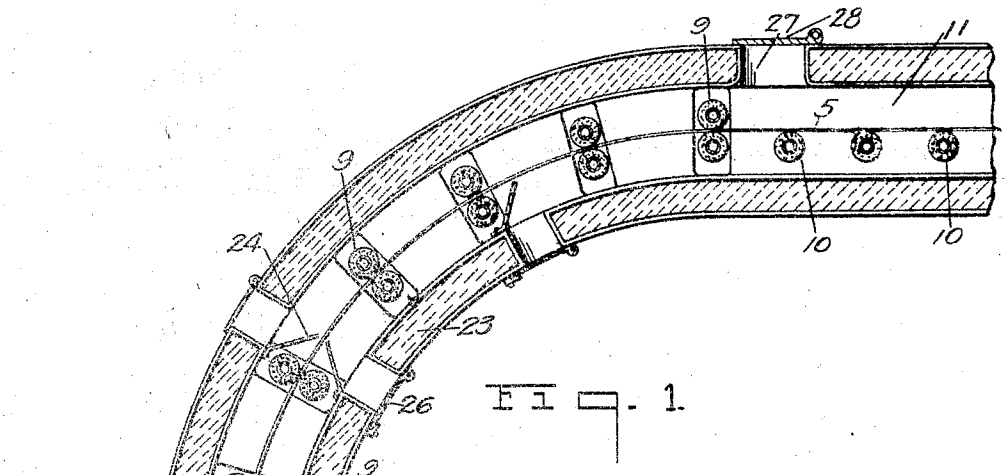
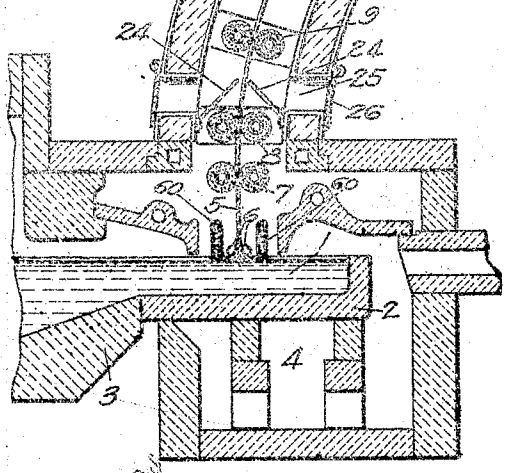


Fig. 1.



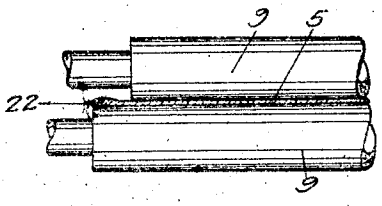
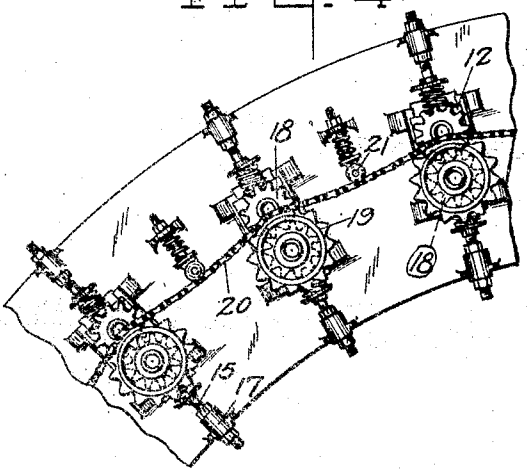


Fig. 2

Fig. 4



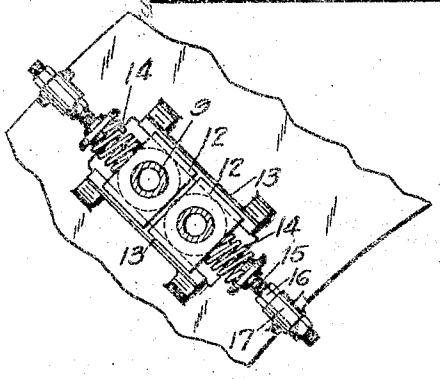


Fig. 3

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UNITED STATES PATENT OFFICE.

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DRAWING SHEET GLASS.

Application filed March 23, 1924. Serial No. 700,998.

This invention relates to the art of drawing sheet glass, and more particularly to an improved process and apparatus for drawing a continuous sheet of glass vertically from a mass of molten glass until it has become substantially set in flat sheet form, and subsequently transferring the sheet into the horizontal plane, where it is conveyed through a relatively long annealing oven or leer.

According to this invention the glass sheet is drawn upwardly from the pool of molten glass in flat sheet form, and is then gradually deflected by successive pairs of sheet-engaging rollers, through a large arc, until it reaches the horizontal plane, after which it is transported through the leer upon a series of driven conveying rollers as in installations now in use. The arc through which the sheet is bent will be so large and the curvature so slight that at no time the limit of elasticity of the formed sheet will be exceeded. The series of bending rollers are all enclosed by a curved shaft or housing, which maintains the sheet at the proper temperature and serves in fact as a portion of the annealing leer.

The objects and advantages of the invention will be more clearly understood from the following detailed description of one approved form of the apparatus.

In the accompanying drawings:

Fig. 1 is a longitudinal vertical section through that portion of the apparatus more directly concerned with this invention.

Fig. 2 is a fragmental view of one end of a pair of the sheet-engaging rollers.

Fig. 3 is a view showing the yieldable mounting for one end of a pair of these rollers.

Fig. 4 shows a portion of the driving mechanism for the sheet-carrying rollers.

The pool of molten glass 1 from which the sheet is drawn is held in a shallow receptacle 2 into which the glass flows from one end 3 of the continuous tank furnace or other source of supply. Receptacle 2 is mounted above a heating chamber 4 which maintains the molten pool 1 at the proper working temperature. The glass sheet 5 is continuously drawn upward from pool 1, any approved means being provided for forming the sheet and maintaining it at a constant width at its source. For example as here shown, the edges of the sheet are drawn up between pairs of small driven rollers 6, and coolers 60, as described more particularly in the patent to Colburn, 1,248,809, granted December 4, 1917. It is to be understood that this type of sheet-forming mechanism is merely shown by way of example and that, as far as this invention is concerned, the sheet may be formed at its source by any other approved system.

Mounted vertically above the sheet source is a pair of sheet-engaging rollers 7, and preferably a second pair of similar rollers 8 is also mounted vertically above and in line with the first pair a short distance therefrom. These pairs of rollers are driven in such a direction as to draw and guide the sheet vertically upward until it has become substantially set in flat sheet form. These rollers are preferably made of asbestos turned to have a comparatively true smooth peripheral surface, and these rollers will not injure the fire-polished surface of the sheet, particularly since the first engaging pair of rollers 7 is arranged at such a height above the source or sheet 5 that the surfaces will have become comparatively hard before these rollers are engaged.

At intervals beyond and above the pair of rollers 8 are a series of pairs of similar rollers 9 spaced along a gradually curving arc, terminating at its upper end tangent to the horizontal plane. The glass sheet 5 is engaged between these successive pairs of rollers and gradually bent until it lies in the horizontal plane upon the conveying rollers 10 in leer 11. The degree of curvature is so slight that the limit of elasticity of the sheet is never exceeded. In other words, it is not a plastic sheet that is being bent through this leer but advantage is taken of the spring or elasticity in the set sheet to bend it from the vertical into the horizontal plane. If properly proportioned there should be no great strain imposed upon the sheet by the directing rollers 9, but the natural sag of the sheet under the weight of the horizontally lying portion thereof should bend the sheet substantially along the arc through which it is directed by these rollers.

Each of the rollers 9 is mounted at its ends in bearing boxes 12 slidable toward or from one another in guides 13 on the sides of the enclosing housing. A compression spring 14 bears at one end against bearing 12 and at its other end against an adjusting screw 15 adjustable by nut 16 through an ear 17 on the housing. These springs 14

hold the rollers 9 yieldably toward one another against the sheet, but allow the rollers to separate somewhat to conform to the various thicknesses of sheets which may be drawn in this machine. The compression of springs 14 may be adjusted by suitably manipulating the nuts 16 on screws 15. Also the pair of rollers 9 may yield as a unit in either direction against one or other of the springs 14 in response to unusual strains in the glass sheet 5 which is passing between the pair of rollers.

On one end of the supporting shaft of each roller 9 is mounted a long toothed gear 18 meshing with a similar gear on the end of its companion roller. These two gears compel the rollers to turn at the same speed but in opposite directions, and at the same time the long teeth allow the rollers to adjust themselves toward or from one another. On the outer end of the lower roller of each pair is mounted a sprocket wheel 19, and a continuous sprocket chain 20 passes over the entire series of sprockets 19 as shown in Fig. 4. Spring-pressed tightener rollers 21 bear on the chain between each pair of sprockets 19 to hold the chain in engagement with the sprockets. The return loop of this chain is not here shown, but it is to be understood that this loop engages at some convenient place with a driving mechanism whereby all of the sets of rollers will be simultaneously driven at the same speed.

In most forms of sheet drawing mechanism the edge portions 22 of the sheet will be formed somewhat thicker than the main central portion of the sheet. To accommodate these thicker edges the upper row of rollers 9 are made somewhat shorter than the lower rollers as shown in Fig. 2. This will give a support for the entire width of the sheet, but the upper sheet engaging rollers do not contact with the thickened edge portion. Obviously, this arrangement could be reversed, that is the lower row of rollers could be made shorter than the upper row, or both series of rollers could be of the shorter length.

The entire series of rollers 9 is carried in a long curved arcuate housing 23, which is substantially a downwardly curving continuation of the leer 11. At intervals in this curved housing 23 are arranged pairs of sloping shields or deflectors 24 which serve to catch broken glass or other débris and deflect this toward the side walls of the housing. Openings 25, provided with hinged closures 26, are located opposite the lower ends of deflectors 24 to permit the removal of the broken glass. These deflectors 24 also serve as dampers or heat regulators which hold back the heated gases to some extent in the lower part of the leer and provide a gradually cooler temperature as the sheet passes through the curved leer 23 into the main leer 11. Heating means may be located at any desired point in either portion of this leer, although the heat from the sheet itself will largely suffice to maintain the leer at the proper temperature.

An opening 27 provided with closure 28, in the top of leer 11 adjacent the upper end of curved housing 23, permits the bait to be inserted and lowered between the pairs of rollers 9 whose direction of rotation is then reversed, into the pool of molten glass 1, to start the sheet drawing operation.

After the glass sheet 5 has reached the horizontal plane, it will pass onto the supporting rollers 10 which are driven in any approved manner as in similar installations now in use.

This installation combines the advantages of drawing and flattening the sheet in the same vertical plane, with the advantages of annealing and cutting the sheet in the horizontal plane, where there is no limit to the length of leer that may be used.

Claims:

1. In the art of producing sheet glass, the process of drawing the sheet from its molten source in a vertical direction until substantially set, and then bending the sheet into another plane along an arc of such curvature that the bending strains will not exceed the elastic limit of the sheet.

2. In the art of producing sheet glass, the process of drawing the sheet from its molten source in a vertical direction until substantially set, and then bending the sheet gradually into another plane, the curvature at no time being sufficient to overcome the elastic limit of the sheet.

3. In the art of producing sheet glass, the process of drawing the sheet from its molten source in a vertical direction until set in flat sheet form, and then gradually bending the sheet into another plane within its limit of elasticity without destroying the established flatness of the sheet.

4. In the art of producing sheet glass, the process of drawing and flattening the sheet in the same vertical plane, then deflecting the continuous sheet after it has become substantially set without exceeding its limit of elasticity into a horizontal plane, and there annealing the sheet.

5. In the art of producing sheet glass, the process of drawing and flattening the sheet in the same vertical plane, then deflecting the continuous sheet after it has become substantially set without exceeding its limit of elasticity into a horizontal plane, and continuously annealing the sheet during the bending process and after it reaches the horizontal plane.

6. Apparatus for making sheet glass, comprising a receptacle containing a pool of molten glass, and means for drawing a continuous sheet of glass vertically therefrom

and carrying the sheet into another plane, comprising means for drawing the sheet vertically from the pool until set in flat sheet form, and means for gradually bending the flat sheet against its own elasticity into another plane.

7. Apparatus for making sheet glass, comprising a receptacle containing a pool of molten glass, and means for drawing a continuous sheet of glass vertically therefrom and carrying the sheet into another plane, comprising means for drawing the sheet vertically from the pool until set in flat sheet form, means for gradually bending the flat sheet against its own elasticity into another plane, and means for continuously enclosing the sheet and bending means.

8. Apparatus for making sheet glass, comprising a receptacle containing a pool of molten glass, and means for drawing a continuous sheet of glass vertically therefrom and carrying the sheet into another plane, comprising a series of pairs of rollers between which the sheet is held, some of the pairs of rollers being positioned at intervals along a curved path.

9. Apparatus for making sheet glass, comprising a receptacle containing a pool of molten glass, and means for drawing a continuous sheet of glass vertically therefrom and carrying the sheet into another plane, comprising a series of pairs of rollers between which the sheet is yieldably held, some of the pairs of rollers being positioned at intervals along a curved path.

10. Apparatus for making sheet glass, comprising a receptacle containing a pool of molten glass, and means for drawing a continuous sheet of glass vertically therefrom and carrying the sheet into another plane, comprising a series of pairs of rollers between which the sheet is held, the first sheet engaging rollers directing the sheet in the vertical plane until substantially set in flat sheet form, and subsequent sets of rollers being positioned at intervals along a curved path.

11. Apparatus for making sheet glass, comprising a receptacle containing a pool of molten glass, and means for drawing a continuous sheet of glass vertically therefrom and carrying the sheet into another plane, comprising a series of pairs of rollers between which the sheet is held, some of the pairs of rollers being positioned at intervals along a curved path, and means for rotating the rollers.

12. Apparatus for making sheet glass, comprising a receptacle containing a pool of molten glass, and means for drawing a continuous sheet of glass vertically therefrom and carrying the sheet into another plane, comprising a series of pairs of rollers between which the sheet is held, the first sheet engaging rollers directing the sheet in the vertical plane until substantially set in flat sheet form, and subsequent sets of rollers being positioned at intervals along a curved path, and means for rotating the rollers.

13. Apparatus for making sheet glass, comprising a receptacle containing a pool of molten glass, and means for drawing a continuous sheet of glass vertically therefrom and carrying the sheet into another plane, comprising a series of pairs of rollers between which the sheet is held, some of the pairs of rollers being positioned at intervals along a curved path, and a continuous enclosing housing for the sheet and rollers.

14. Apparatus for making sheet glass, comprising a receptacle containing a pool of molten glass, and means for drawing a continuous sheet of glass vertically therefrom and carrying the sheet into another plane, comprising a series of pairs of rollers between which the sheet is held, the first sheet engaging rollers directing the sheet in the vertical plane until substantially set in flat sheet form, and subsequent sets of rollers being positioned at intervals along a curved path, means for rotating the rollers, and a continuous enclosing housing for the sheet and rollers.

Signed at Toledo, in the county of Lucas and State of Ohio, this 18th day of March, 1924.

JOSEPH P. CROWLEY.