

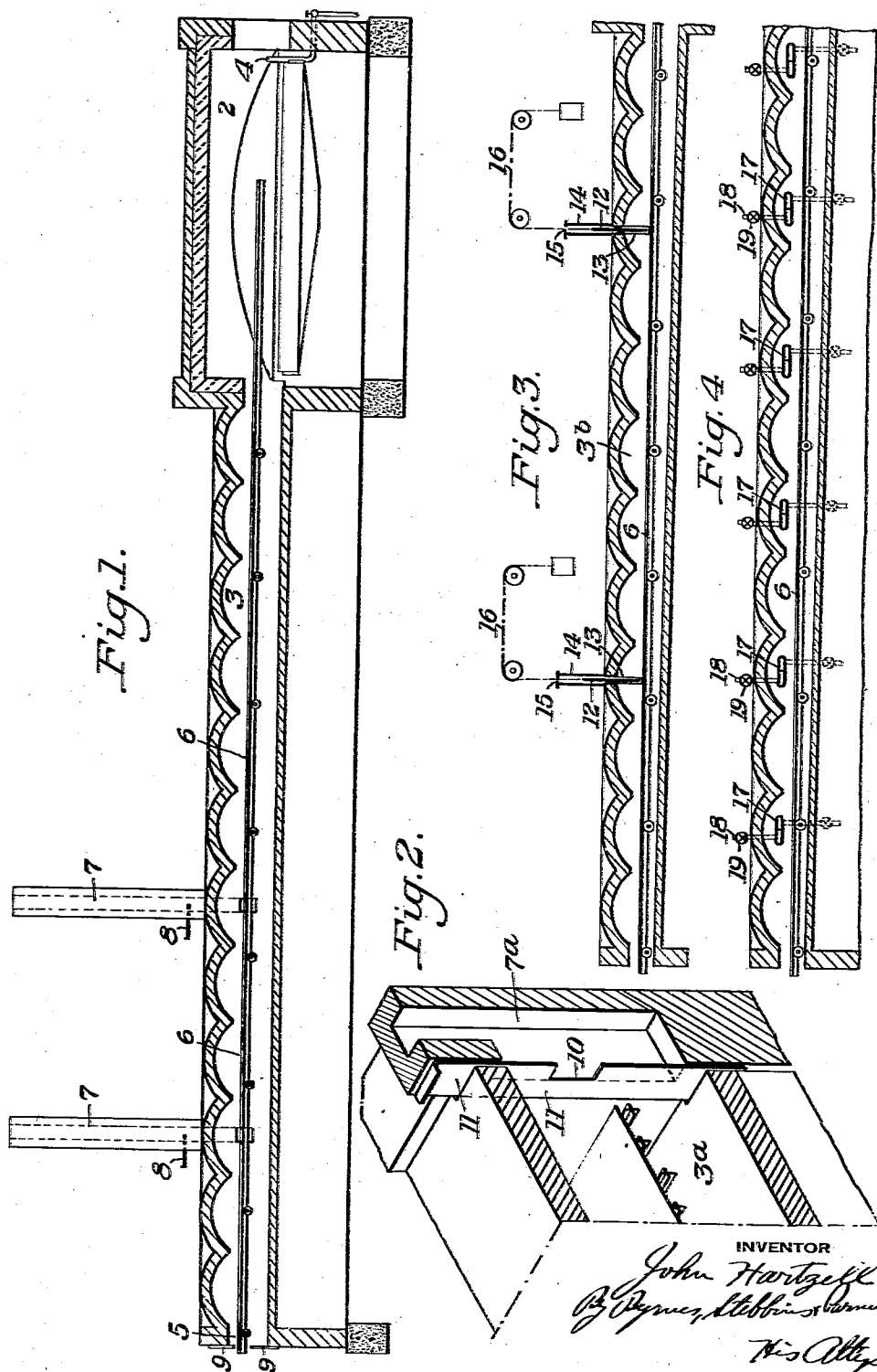
July 27, 1926.

1,593,632

J. HARTZELL

METHOD AND APPARATUS FOR ANNEALING AND COOLING SHEET GLASS

Original Filed Feb. 16. 1924 2 Sheets-Sheet 1



July 27, 1926.

1,593,632

J. HARTZELL

METHOD AND APPARATUS FOR ANNEALING AND COOLING SHEET GLASS

Original Filed Feb. 16, 1924 2 Sheets-Sheet 2

Fig. 5.

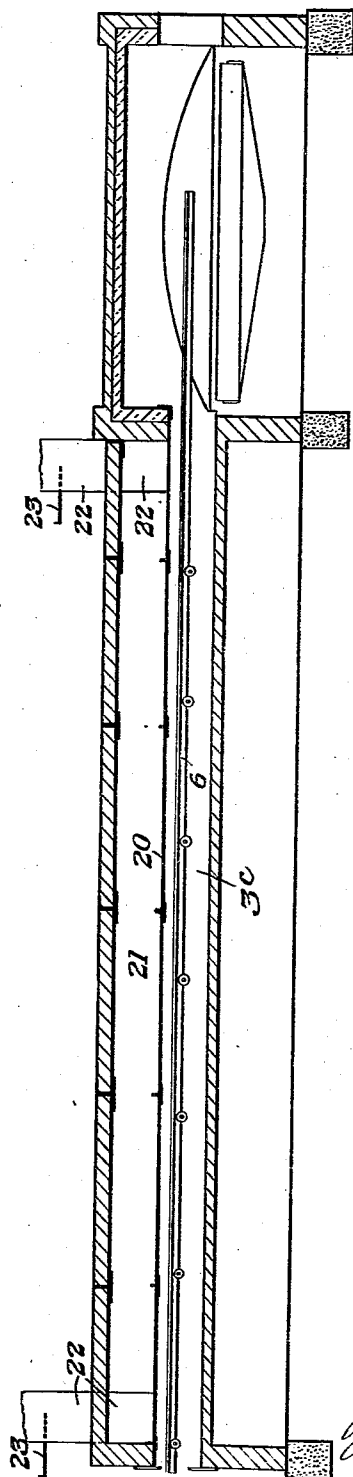
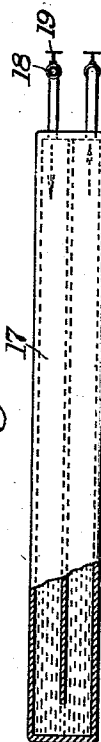


Fig. 6.



INVENTOR

John Hartzell
By James H. Hartzell
His Atty

Patented July 27, 1926.

1,593,632

UNITED STATES PATENT OFFICE.

JOHN HARTZELL, OF ARNOLD, PENNSYLVANIA, ASSIGNOR TO WINDOW GLASS MACHINE COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF NEW JERSEY.

METHOD AND APPARATUS FOR ANNEALING AND COOLING SHEET GLASS.

Application filed February 16, 1924, Serial No. 693,249. Renewed January 2, 1926.

This invention relates to a method and apparatus for annealing and cooling sheet glass, and is particularly useful in connection with apparatus having as a source of heat a chamber wherein a previous operation is performed upon the sheet glass, such as a flattening oven or a drawing apparatus, although the invention is not in any way limited thereto.

In the annealing and cooling of sheet glass, it has been found that if a leer tunnel of uniform cross section is used and all of the gases supplied to one end thereof are permitted to travel the entire length of the tunnel, the gas stream above the glass will soon be much hotter than the stream below, and as a result the lower face cools more rapidly, so that the glass is warped when it is delivered from the leer tunnel.

I provide for supplying flat hot glass to a horizontally extending leer tunnel, supplying streams of gases to the tunnel above and below the glass level adjacent one end of the tunnel, passing both the streams toward the other end of the tunnel, and diverting a portion of the gases from one of the streams in amounts sufficient to substantially balance the heat losses from the two faces of the glass. This may be accomplished either by removing a portion of the gases from one of the streams from the leer tunnel, or by diverting it to the other stream. In either case, the heat losses from the two faces of the glass are equalized so that flat glass is produced.

In the accompanying drawings illustrating the preferred embodiment of my invention, as applied to a flattening oven and connected leer tunnel for working on glass formed by the cylinder process,—

Figure 1 is a vertical section through a flattening oven and connected leer tunnel embodying my invention;

Figure 2 is a perspective view through a section of a leer showing a slightly modified form of the apparatus shown in Figure 1,

Figures 3, 4 and 5 are sectional views through leer tunnels showing modified forms of the invention, and

Figure 6 is a top plan view of a cooler used in the embodiment of Figure 4.

In the embodiment of the invention illustrated in Figure 1, there is shown a flattening oven 2 having a horizontally extending leer tunnel 3 connected therewith. The oven 2 is heated in any desired manner, as by gas burners 4, and the heat from the oven passes through the leer tunnel 3 toward the delivery opening 5. Leer rods 6 of any suitable construction are placed in the leer tunnel 3 for supporting the glass as it travels therethrough, and when the leer is in operation, these rods are effective for supporting the glass sheets in such manner as to form a substantially continuous partition through the leer tunnel, so that hot gases from the flattening oven 2 are divided into two streams, one above and one below the glass sheets.

It will be understood that the term "flattening oven" as used herein refers to the oven as a whole, and is intended to include not only that portion of the apparatus where the glass is actually flattened, but also the so-called dummy oven, cooling oven and piling oven, as will be well understood by those skilled in the art.

It has been found that where a leer tunnel of substantially uniform cross section from end to end is employed, it is practically impossible to so regulate the gas streams on both sides of the glass sheet in the ordinary leer tunnel as to substantially equalize the heat losses from the two faces of the glass. I provide for diverting a portion of the gases from one of the streams, and this is accomplished in the embodiment of Figure 1 by stacks 7 having dampers 8 therein. I have found that with a leer such as shown in Figure 1, four stacks, two on either side of the leer, as illustrated, will be sufficient to satisfactorily control the gas streams. By adjusting the dampers 8 any desired quantity of hot gas may be taken off by the stacks 7, and it will be found that by suitable regulation of these dampers and of auxiliary dampers 9 at the delivery end of the leer tunnel, flat glass may be produced.

Figure 2 shows a slightly modified form of stack connection, wherein the leer tunnel 3 is provided with a suitable number of stacks 7, each connected to the leer tunnel by an opening 10 in a sheet metal shield 11. The metal shield 11 is adjustable up or down, as will be readily seen from Figure 2,

for suitably controlling the heat losses from the gas streams. If desired, dampers similar to the dampers 8 may be provided in the stacks 7^a.

5 Figure 3 illustrates a form of the invention in which the leer tunnel 3^b is provided with vertically adjustable dampers 12 above the glass level. The dampers 12 slide in grooves 13 recessed in the side walls of the leer tunnel, and where they project above the roof of the tunnel, are surrounded by enclosing boxes 14 having a small opening 15 in the top thereof for a counterweight cable 16. By suitably adjusting the dampers 12 it will be found that the hot gases may be diverted from the upper stream to the relatively cooler lower stream in amounts sufficient to equalize the rate of cooling from the two faces of the glass and produce an unwarped product.

It will be noted that the embodiment of Figure 3 shows a leer tunnel having a bottom which slopes upwardly toward the delivery end, but it will be understood that while this is desirable in order to compensate for the reduced volume of the gases as they drop in temperature, a flat bottom, such as shown in Figure 1, may be employed in connection with any of the various forms of the invention, and that conversely, a sloping bottom may be used with the embodiment of Figure 1, if desired. The advantages of the sloping bottom are particularly set forth in the application of Lawrence A. Gessner, Serial No. 672,530, filed November 3, 1923, in which it is shown that by providing a leer tunnel decreasing in cross sectional area toward the delivery end thereof, it is possible to maintain the velocity of the gases traveling through the leer tunnel, thereby preventing the ingress of cold air from the delivery end of the tunnel, and thus prevent the displacement of warm gases below the glass to the space above the glass by such cold air. The sloping bottom is advantageous in connection with my invention, however, since it minimizes the amount of control required to operate the apparatus commercially.

10 It is desirable to place the dampers 12 beyond the annealing range of the glass, and the locations shown in Figure 3 will be found satisfactory. In the illustrated forms of the invention, they are shown as they have been applied to a flattening oven having a wheel substantially seventeen feet in diameter and connected to a leer tunnel fifty feet long and seven feet wide. It will be found that if the first damper 12 is located as shown at the right hand portion of Figure 3, the glass will generally be annealed before it reaches this point, and that the full effectiveness of the heat currents is present over this range, thereby insuring proper annealing. The dampers, however, effectually

baffle the flow of the upper stream, or, in other words, provide a special retardation of the gases in excess of the usual friction losses, so that the usual relation of the upper and lower streams is sufficiently modified to achieve the desired results.

Figure 4 illustrates another form of the invention, wherein coolers 17 having fluid inlets 18 provided with adjustable valves 19 are provided in the upper portion of the leer tunnel. It will be seen that by suitably regulating the valves 19, the upper stream may be cooled so as to compensate for the generally lower temperature of the lower stream, and thus prevent warping of the glass sheets as they travel through the leer tunnel. The coolers are preferably constructed as shown in Figure 6, since their form insures uniform cooling the entire width of the leer.

Figure 5 illustrates a form of the invention wherein the leer tunnel 3^c is provided with a relatively thin roof 20 having a flue or duct 21 thereabove. Cooling fluid is admitted to and taken from the duct through openings 22 provided with dampers 23 and connected to suitable means such as a stack or a blower (not shown) for maintaining a current through the flue 21. By suitably regulating the dampers 22 the cooling effect of the thin roof 21 on the gases in the leer tunnel may be varied as desired, and the proper amount of heat thus abstracted from the upper stream.

I provide for annealing and cooling sheet glass by supplying streams of heated gas to the tunnel above and below the glass level, permitting the streams to travel through the tunnel and abstracting heat from the upper stream in amounts sufficient to obtain a substantially uniform rate of heat loss on both sides of the glass. It will be seen that this abstraction of heat from the upper stream takes place in any of the various illustrated embodiments of the invention, and that I am thus enabled to produce a product superior to that ordinarily obtained in apparatus of this character.

I have illustrated a few closely related forms of my invention as applied to an annealing and cooling oven used in connection with a flattening oven, and it will be seen that in all the illustrated forms the gases in the leer tunnel are drawn in a heated condition from a chamber wherein a previous operation has been performed on the glass, and also that such gases travel through the leer tunnel in the same direction as the glass. The invention, however, is not limited to such forms, nor to a leer wherein the gases and the glass move concurrently, as the broader phases of the invention may be equally well applied to a leer employing a counter-flow of gases and to many other constructions within the scope of the following claims.

I claim:

1. In the method of annealing and cooling sheet glass the steps consisting in supplying flat hot glass to a horizontally extending leer tunnel, supplying streams of heated gases to the tunnel above and below the glass level adjacent the end of the tunnel where the glass enters and permitting the streams to travel through the tunnel in contact with the glass, and abstracting heat from the upper stream in amounts sufficient to substantially equalize the rate of heat loss from the two faces of the glass, substantially as described.
2. In the method of annealing and cooling sheet glass the steps consisting in supplying flat hot glass to a horizontally extending leer tunnel, supplying streams of gases to the tunnel above and below the glass level and permitting the streams to travel through the tunnel in contact with the glass, and abstracting heat from the upper stream in amounts sufficient to substantially equalize the rate of heat loss from the two faces of the glass, substantially as described.
3. In the method of annealing and cooling sheet glass the steps consisting in supplying flat hot glass to a horizontally extending leer tunnel, supplying streams of gases to the tunnel above and below the glass level adjacent one end of the tunnel, passing both the streams toward the other end of the tunnel and in contact with the glass, and diverting a portion of the gases from one of the streams in amounts sufficient to substantially equalize the heat losses from the two faces of the glass, substantially as described.
4. In the method of annealing and cooling sheet glass the steps consisting in supplying flat hot glass to a horizontally extending leer tunnel, supplying streams of heated gases to the tunnel above and below the glass level adjacent one end of the tunnel, passing both the streams toward the other end of the tunnel and in contact with the glass, and diverting a portion of the gases from the upper stream in amounts sufficient to substantially equalize the heat losses from the two faces of the glass, substantially as described.
5. In the method of annealing and cooling sheet glass the steps consisting in supplying flat hot glass to a horizontally extending leer tunnel, supplying streams of gases to the tunnel above and below the glass level adjacent one end of the tunnel, passing both the streams toward the other end of the tunnel, and diverting a portion of the gases from the upper stream to the lower stream in amounts sufficient to substantially equalize the heat losses from the two faces of the glass, substantially as described.
6. In the method of annealing and cooling sheet glass the steps consisting in supplying flat hot glass to a horizontally extending leer tunnel, supplying streams of heated gases to the tunnel above and below the glass level adjacent the end of the tunnel where the glass enters and permitting the streams to travel through the tunnel in contact with the glass, and diverting a portion of the gases from at least one of the streams, substantially as described.
7. In the method of annealing and cooling sheet glass the steps consisting in supplying flat hot glass to a horizontally extending leer tunnel, supplying streams of heated gases to the tunnel above and below the glass level adjacent the end of the tunnel where the glass enters and permitting the streams to travel through the tunnel, and baffling the flow of the gases in at least one of the streams intermediate the ends of the leer tunnel, substantially as described.
8. In the method of annealing and cooling sheet glass the steps consisting in supplying flat hot glass to a horizontally extending leer tunnel, supplying streams of heated gases to the tunnel above and below the glass level adjacent the end of the tunnel where the glass enters and permitting the streams to travel through the tunnel, and baffling the flow of the gases in at least one of the streams intermediate the ends of the leer tunnel and beyond the annealing range, substantially as described.
9. Apparatus for annealing and cooling sheet glass including a horizontal extending leer tunnel, means for passing sheet glass therethrough, means for introducing gaseous streams into said tunnel above and below the glass, whereby the glass is bathed by such gaseous streams, and means for diverting a portion of at least one of said streams intermediate the ends of the leer tunnel, substantially as described.
10. Apparatus for annealing and cooling sheet glass including a horizontally extending leer tunnel, means for passing glass therethrough, means for introducing gaseous streams into said tunnel above and below the glass whereby the glass is bathed by such gaseous streams, and adjustable means for diverting a portion of at least one of said streams intermediate the ends of the tunnel, substantially as described.
11. Apparatus for annealing and cooling sheet glass including a horizontally extending leer tunnel, means for passing glass therethrough, means for introducing gaseous streams above and below the glass and in the same tunnel with the glass whereby the streams make contact with the glass, and means for abstracting a portion of the heat from the upper stream in amounts sufficient to substantially equalize the rate of heat loss from the two faces of the glass, substantially as described.
12. Apparatus for annealing and cooling sheet glass including a horizontally extending leer tunnel, means for passing glass

therethrough, means for introducing gaseous streams above and below the glass, and means for diverting a portion of the gases in the upper stream to the lower stream in amounts sufficient to substantially equalize the rate of heat loss from the two faces of the glass, substantially as described.

13. Apparatus for annealing and cooling sheet glass including a horizontally extending leer tunnel, means for passing glass therethrough, means for introducing gaseous streams into said tunnel above and below the glass, and means intermediate the ends of the tunnel for baffling the gas flow in at least one of said streams, substantially as described.

14. Apparatus for annealing and cooling sheet glass including a horizontally extending leer tunnel decreasing in cross sectional area toward the delivery end thereof, means for passing glass therethrough, means for introducing streams of heated gas into said tunnel above and below the glass remote from the delivery end of the leer tunnel; and means intermediate the ends of the tunnel for diverting a portion of at least one of said streams, substantially as described.

15. Apparatus for annealing and cooling sheet glass including a horizontally extending leer tunnel decreasing in cross sectional

area toward the delivery end thereof, means for passing glass therethrough, means for introducing streams of heated gas into said tunnel above and below the glass remote from the delivery end of the tunnel, and means for abstracting a portion of the heat from the upper stream, substantially as described.

16. In the method of annealing and cooling sheet glass, the steps consisting in supplying flat hot glass to a horizontally extending leer tunnel, permitting streams of gases to travel through the tunnel above and below the glass level, and artificially varying the cooling effect of one stream relative to the other, substantially as described.

17. In the method of annealing and cooling sheet glass, the steps consisting in supplying flat hot glass to a horizontally extending leer tunnel, permitting streams of gases to travel through the tunnel above and below the glass level, and artificially varying the cooling effect of one stream relative to the other sufficiently to substantially equalize the rate of heat loss from the upper and lower faces of the glass, substantially as described.

In testimony whereof I have hereunto set my hand.

JOHN HARTZELL.