

J. PLAYER.
METHOD AND APPARATUS FOR DRAWING SHEET GLASS.
APPLICATION FILED JUNE 17, 1908.

991,642.

Patented May 9, 1911.

3 SHEETS—SHEET 1.

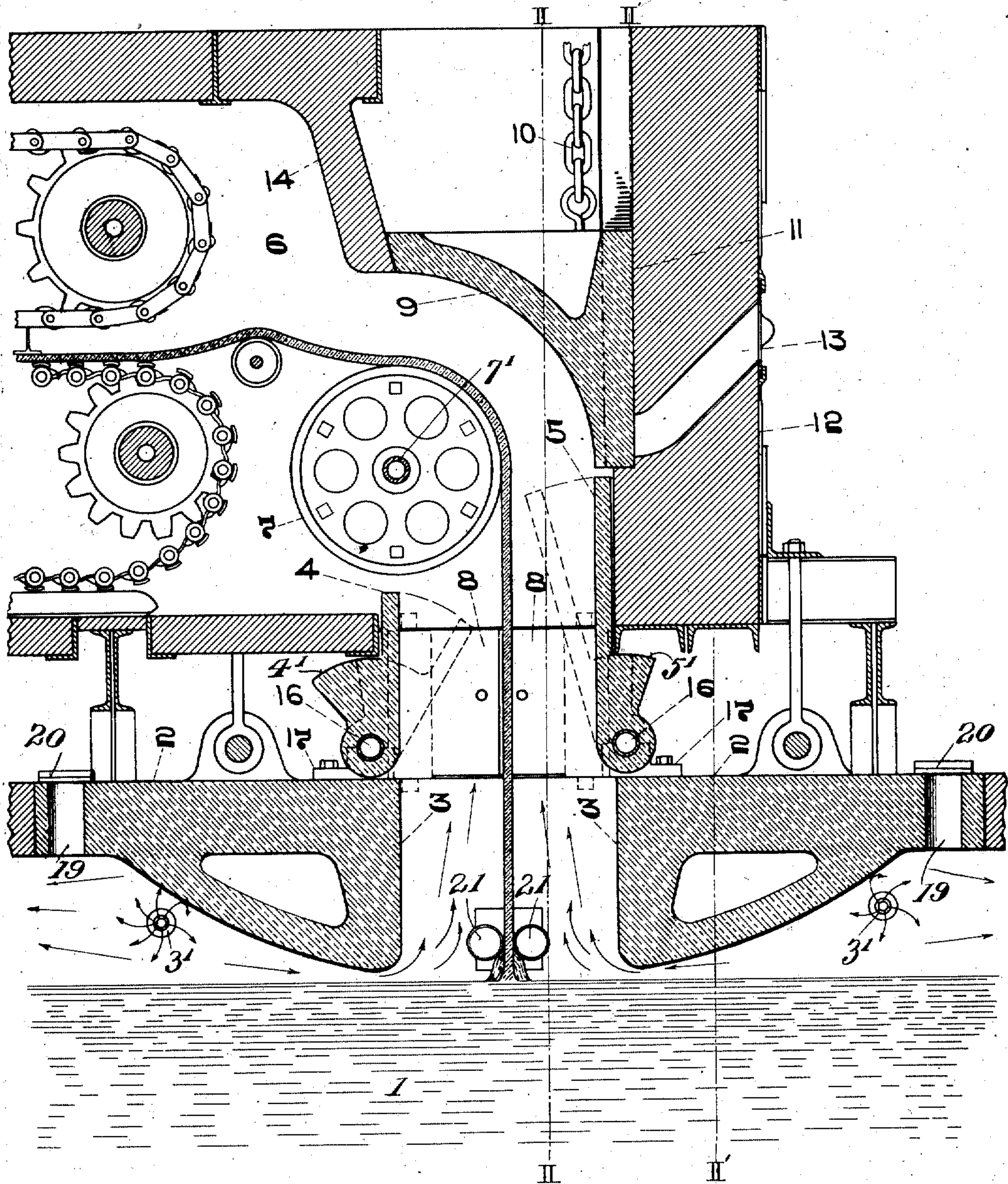


FIG. 1.

WITNESSES

N. B. Kernham

G. W. Thompson

INVENTOR

John Player

BY HIS ATTORNEYS *Mauro Cunniff & Masie*

J. PLAYER.
METHOD AND APPARATUS FOR DRAWING SHEET GLASS.
APPLICATION FILED JUNE 17, 1908.

991,642.

Patented May 9, 1911.

3 SHEETS—SHEET 2.

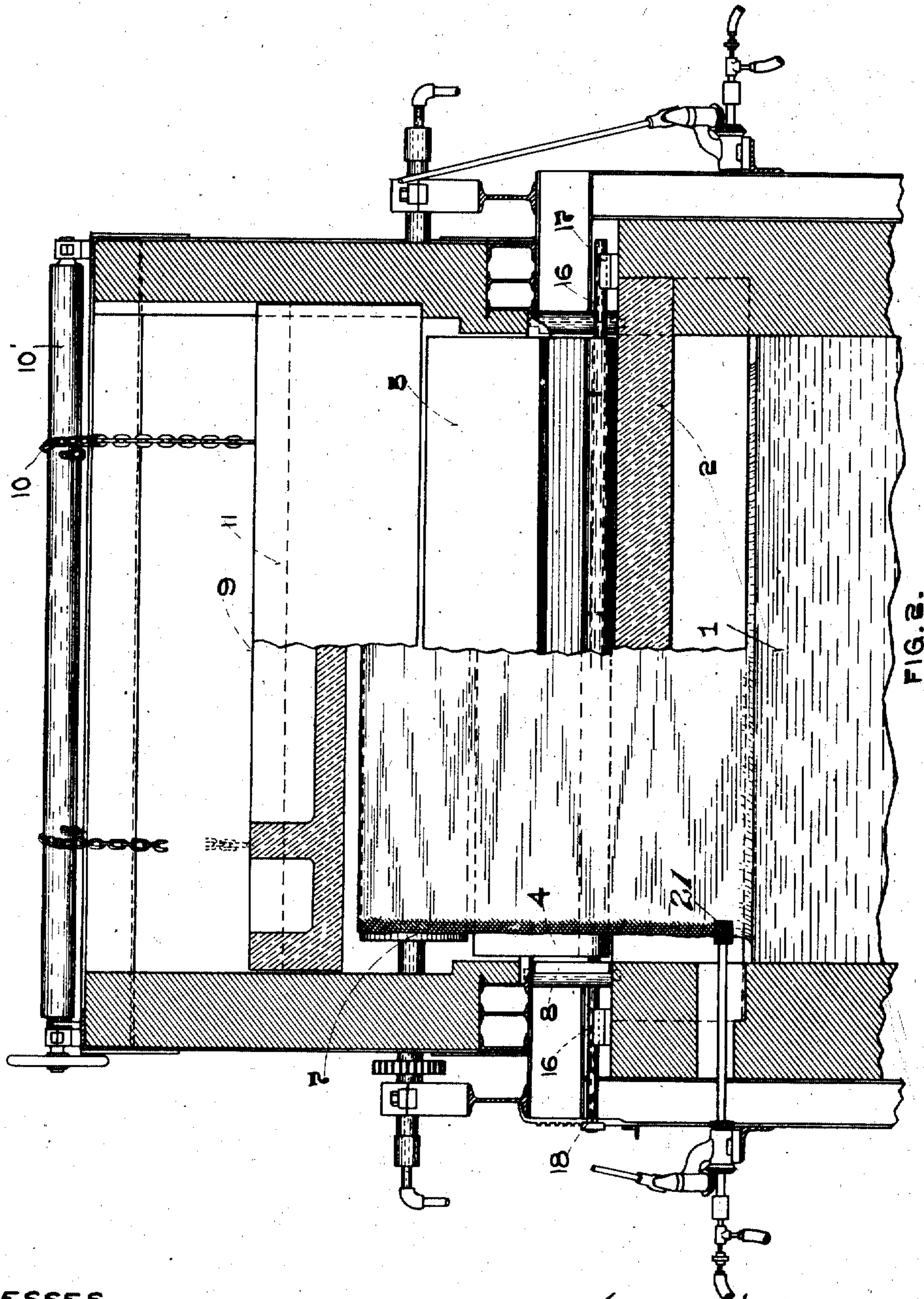


FIG. 2.

WITNESSES

W. B. McKam

J. R. Thompson

BY HIS ATTORNEYS *Marion C. Lewis & Messrs.*

INVENTOR

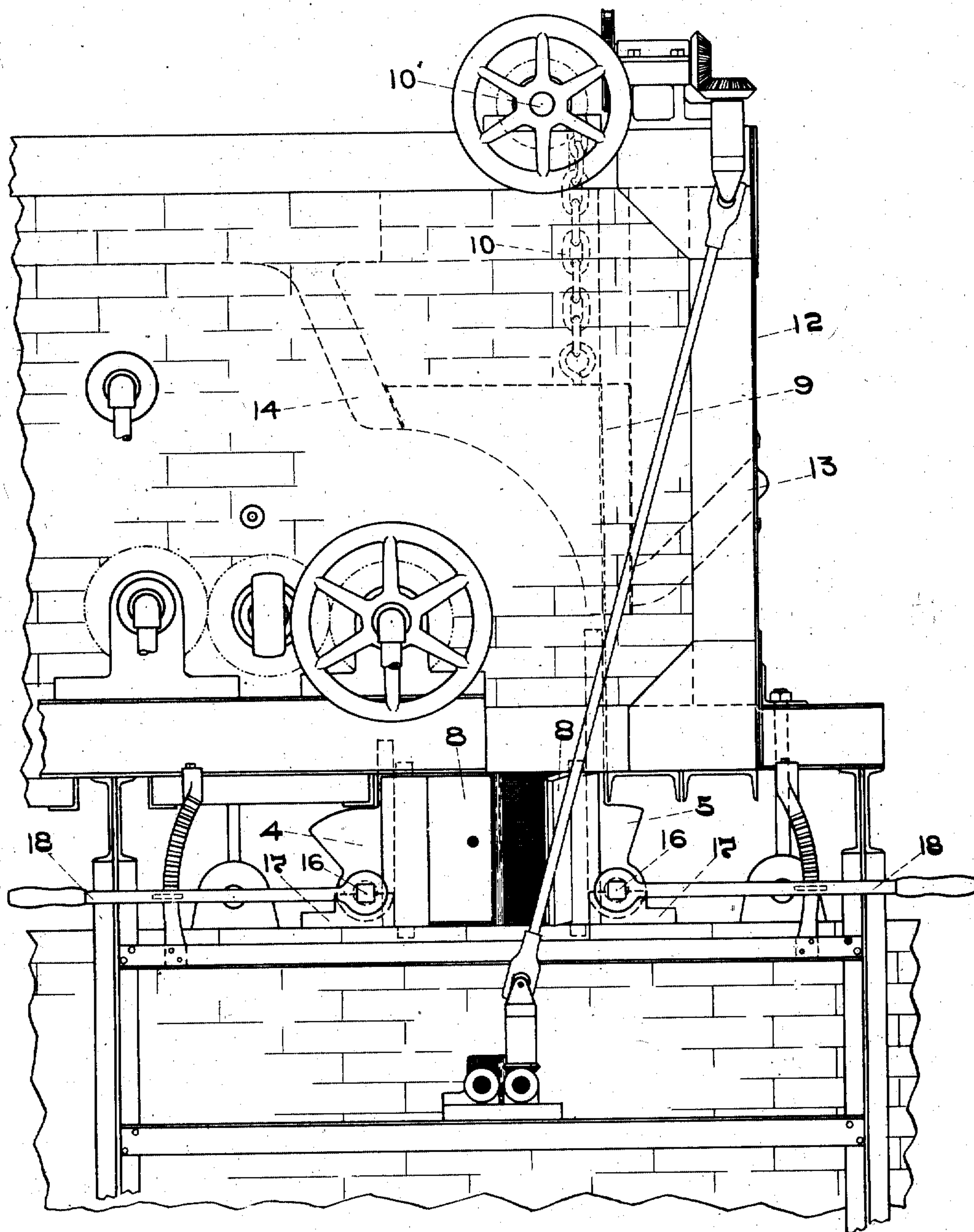
John Player

J. PLAYER.
METHOD AND APPARATUS FOR DRAWING SHEET GLASS.
APPLICATION FILED JUNE 17, 1908.

991,642.

Patented May 9, 1911.

3 SHEETS—SHEET 3.



WITNESSES

M. B. Merham
J. W. Thompson

FIG. 3.

INVENTOR

John Player

BY HIS ATTORNEYS *Marion Emerson Lewis & Massey*

UNITED STATES PATENT OFFICE.

JOHN PLAYER, OF RIVER FOREST, ILLINOIS.

METHOD AND APPARATUS FOR DRAWING SHEET-GLASS.

991,642.

Specification of Letters Patent.

Patented May 9, 1911.

Application filed June 17, 1908. Serial No. 439,094.

To all whom it may concern:

Be it known that I, JOHN PLAYER, of River Forest, Illinois, have invented a new and useful Improvement in Methods and Apparatus for Drawing Sheet-Glass, which invention is fully set forth in the following specification.

This invention relates to the art of continuously drawing sheet glass from a mass of molten glass.

It has heretofore been proposed to continuously draw a sheet of glass in a vertical direction and after the sheet is formed to turn it from the vertical direction to a substantially horizontal direction over a bending roll, the glass being permitted to cool down between the drawing or formative point of the sheet and the roll, and then subsequently being reheated to insure the necessary plasticity and flexibility to enable the sheet to be turned from the vertical to the horizontal direction over the bending roll without breaking. It has also been proposed to draw a sheet of glass in a vertical direction from a molten mass of glass into the open atmosphere, and while the sheet is yet plastic enough to bend to turn it over a roller from the vertical to a horizontal direction and pass it into a continuous annealing furnace behind the roller. The difficulties involved in this procedure are such that it is very difficult, if not impossible, to produce a commercial sheet of glass, because of the great variations in the external atmosphere and the absence of any means for regulating the temperature of the sheet at the bending point. This regulation of the temperature of the sheet at the bending point is of great importance, since if the glass is too plastic the fire finish of the sheet will be marred where it contacts with the bending roller, and if it is not plastic enough it is liable to break when it is turned over the roller.

One of the objects of the present invention is to eliminate the reheating step and to provide a process and an apparatus whereby the sheet of glass may be drawn in an upward, and preferably vertical, direction into a regulated and gradually decreasing temperature from the drawing to the bending point, and then bent over a suitable bending device, as a bending roll, to the end that its direction of movement may be changed into a horizontal or other desired direction of movement without exposing the sheet to the varying influences of the external atmos-

phere, and without lowering the temperature of the glass below that point at which its direction of movement can be safely changed and the necessity of reheating the sheet thereby avoided.

With this and other objects in view, the invention consists, first, in continuously drawing a sheet of glass in an upward, and preferably in a vertical, direction from a mass of molten glass, into an atmosphere exposed to the heat-radiating surface of said molten glass, passing the drawn sheet through a regulated and gradually decreasing temperature, to the end that the sheet may be slowly cooled, and changing the direction of the movement of the sheet from an upward direction to a horizontal or other direction at a point where the glass still remains sufficiently plastic to permit such change in direction without breaking the sheet, but where it has at the same time become sufficiently hard to avoid marring the fire finish of the glass by contact with any object or apparatus, as for example, a bending roll, employed for effecting the change in direction.

Second, the invention consists in a method of continuously drawing a sheet of glass in an upward, and preferably vertical, direction, counteracting the narrowing tendency of the sheet, protecting the sheet from the cooling influence of the external atmosphere while at the same time permitting the sheet to gradually lower in temperature, and then changing the direction of movement of the sheet to a horizontal or other desired direction at a point where such change of direction may be effected without danger of breaking the glass, the whole being performed without reheating the sheet, and advantage being taken of the heat originally existing in the drawn sheet to maintain it sufficiently plastic to permit the bending operation or change of direction indicated.

Third, the invention consists in an apparatus for continuously drawing sheet glass, provided with a receptacle containing a mass of molten glass, means for continuously drawing a sheet of glass therefrom, means for providing a gradually decreasing temperature surrounding the sheet from the drawing point to the point where the sheet emerges from the apparatus, and means for changing the direction of movement of the sheet such, for example, as a bending roll, which last-mentioned means are situated at

a point where the sheet has become sufficiently cooled to avoid injury of the fire finish of the glass by contact with the bending means, while at the same time retaining
 5 sufficient plasticity to avoid breakage of the sheet when the direction of movement thereof is changed.

The invention further consists of certain novel methods of procedure and forms of
 10 apparatus which will be hereinafter more fully described and then pointed out in the claims.

The invention may be embodied in methods differing in detail, and the apparatus
 15 portion may receive a variety of mechanical expressions, without departing from the spirit of the invention, and the method and apparatus hereinafter to be described are set forth for the purpose of enabling the
 20 invention to be understood, and not for the purpose of defining the limits of the invention, reliance being placed on the claims for that purpose.

In the accompanying drawings illustrating
 25 one form of apparatus which may be employed in practicing my invention, Figure 1 is a central, vertical, longitudinal section of the fore part or end of a continuous sheet glass drawing machine. Fig. 2 is a transverse section on lines II II', Fig. 1; and
 30 Fig. 3 is a side elevation of Fig. 1.

The drawing apparatus employed may be such as shown and described in U. S. Patent No. 867,948, to I. W. Colburn and E. Washburn, dated October 15, 1907, for apparatus
 35 for drawing sheet glass, and in its general form the apparatus here illustrated is that shown in said drawings.

Referring to the drawings, 1 is a heated
 40 chamber containing a mass of molten glass, which molten glass is received in said chamber from any suitable source, as for example, a suitable melting furnace, and 2, 2, are covering tiles preferably of suitable refractory material, leaving a transverse opening
 45 between them, which opening has walls 3, 3, here shown as having vertical opposing faces, the lower edges of said walls extending into close proximity to the surface of the molten mass in the working chamber 1, but without contacting therewith. Any suitable means may be employed for maintaining the molten glass in the working chamber 1 in a suitable working condition, as
 50 for example, the burners 3', 3', supplemented, if desired, by heat from any suitable source, as, for example, that from the melting furnace. The drawing of the sheet of glass may be initiated in any suitable
 60 manner, as by a suitable bait inserted in the mass of molten glass and drawn upward, and then its direction changed, as here shown, from the upward to a substantially horizontal direction, though manifestly, if
 65 desired, instead of a horizontal movement

the sheet might have imparted to it an upwardly inclined or a downwardly inclined movement. After the drawing of the sheet has once been initiated, the same may be continued in any suitable manner and by any
 70 suitable means for exerting a continuous pull upon the sheet, and as here shown said means consist of a continuous drawing table cooperating with grip bars to seize and advance the sheet.

As the sheet of glass is drawn in an upward direction from the formative point, and after its direction has been changed, it is passed continuously from the drawing point onward through a closed chamber
 80 within which the temperature is gradually decreased from the formative point of the sheet to the point where the sheet finally issues from said closed chamber fully annealed and ready to be divided into sections.
 85 The construction of the last or left hand portion of this annealing chamber may be that of any suitable annealing chamber, and since the specific construction thereof does not form any part of the present invention,
 90 it has been deemed sufficient to show merely the forward end of the same, but it will be understood that it is a long annealing chamber of any suitable construction through which the glass is advanced, the temperature
 95 in the chamber gradually decreasing from the front or drawing end shown in the drawings to the exit end thereof. The forward end of this closed chamber consists in the present instance of a vertically extending portion leading upward from the
 100 drawing or formative point of the sheet to the substantially horizontal portion 6. The walls 3, 3, of the covering tiles, rear and front walls 4 and 5, and side walls above the tiles serve to provide a closed conduit from
 105 the drawing point of the sheet to the point where the vertical portion of said closed chamber communicates with the horizontal portion 6 thereof. As here shown, the rear and front walls 4 and 5 are hinged in any
 110 suitable manner on a horizontal axis, to the end that they may be inclined toward the sheet, each of said walls being provided with segmental portions 4', 5', serving to substantially close the opening when the said walls are inclined from the vertical, as shown in dotted lines in Fig. 1. The side walls are provided with doors 8, 8, mounted on
 115 vertical axes, for the purpose of permitting access to be had to the sheet and the working chamber from the sides of the machine during the drawing operation.

Located at the point where the substantially vertical portion of the drawing chamber communicates with the horizontal portion is any suitable means over which the sheet may be bent to change its direction of movement, here shown as a bending roll 7, and in the present instance this roll is shown
 120
 125
 130

as provided with a hollow shaft 7' through which, if found desirable, any suitable cooling medium may be circulated.

Forming a portion of the ceiling or structural wall above said vertical portion is a vertically adjustable head block 9, the front vertical face 11 of which fits snugly against the inner face of the wall 12 of the structure, through which are provided openings or ventilating ports 13, normally closed by the downwardly projecting vertical portion of the block 9. This block is provided with suitable means for raising and lowering the same, as, for example, chains 10 passing over shaft 10'. The opening in the ceiling of the drawing chamber which is normally closed by the block 9 is one which gradually flares or expands in an upward direction. In the present instance this is accomplished by providing an inclined or receding abutting wall 14 depending from the top of the chamber 6, the proportion of the parts being such that when the block 9 is lowered in the position shown in Fig. 1, it entirely closes said opening and the ports 13, but when the block is raised it not only opens the ports 13, but also provides an opening between the block 9 and the wall 14, which latter opening increases in area in proportion as the block is raised.

The walls 4 and 5 may be constructed of any suitable material, preferably refractory material, and are hinged to the cover tiles 2, 2, by means of rods 16 turning in suitable pillow blocks 17, operating rods 18 being provided for the purpose of rocking said walls upon their pivots.

In some instances, it is manifest that instead of the entire forward and rear walls 4 and 5 being rocked upon their pivots, the walls proper might be permanently located, and be provided with suitable rocking members which could be inclined toward the glass to a greater or less degree, for a purpose which will be hereinafter described.

For the purpose of affording means for assisting in regulating the temperature in the working chamber, suitable ventilating ports 19, 19, may, if desired, be provided through the tiles 2, 2, which ports are controlled by any suitable valve devices 20, 20.

Any suitable means may be provided for counteracting the well-known tendency of the drawn sheet to narrow during the drawing operation. As here shown, such means consist of side-holding rolls 21, 21, of the character shown in the application of I. W. Colburn aforementioned, which serve to grip the edge portions of the sheet during the drawing operation, but as the specific construction of said side-holding rolls does not form any part of the present invention, it is not deemed necessary to illustrate the same in detail.

Operation: The drawing of the sheet be-

ing initiated in any suitable manner, and the sheet bent over the bending roll, and the sheet being advanced through the drawing and annealing chamber by the grip bars or any other suitable means or method, the temperature in the vertical portion of the drawing chamber as the sheet passes upwardly through said vertical portion is carefully regulated, to the end that the temperature of the sheet shall gradually decrease from the formative point upward, with a view of gradually reducing the temperature and consequent plasticity of the sheet to the point where the glass will be hard enough to avoid any marring effect of the bending roll upon the fine fire finish of the glass, while at the same time leaving the glass sufficiently plastic to have its direction of movement changed without danger of breaking the same. If the heat arising on each side of the sheet of glass from the working chamber is found to be too great, the head block 9 is elevated, thus opening the ventilating ports 13 and also permitting the escape of the heat between the wall 14 and the block 9. On the other hand, if it is found that the heat arising from the working chamber when the walls 4 and 5 stand in the vertical position shown in full lines in Fig. 1 is not sufficient to maintain the sheet in the desired plastic condition, said walls are inclined to a greater or less degree toward the sheet, as shown in dotted lines in Fig. 1, by manipulating said walls through the medium of the operating levers 18, 18. By this means the heat from the working chamber is directed intimately against the faces of the drawn sheet and its cooling retarded to a sufficient extent to maintain it in the desired plastic condition. It will therefore be observed that by means of the head block 9, the ventilating ports 13 and the inclined heat-deflecting walls 4 and 5, the temperature of the sheet at the point where its direction of movement is changed may be regulated to a nicety, and that this desired degree of plasticity is obtained without cooling the sheet below the temperature at which it may be safely bent over the bending roll, with the consequent necessity of reheating the same.

While as herein shown, the means for advancing the sheet through the annealing chamber and applying the drawing power thereto is that of an endless table and grip bars for seizing the sheet, it will be understood that the invention is not limited to such drawing and advancing means, since any other suitable means may be employed for this purpose.

As herein shown, reliance is placed upon the heat radiated from the surface of the molten mass in the working chamber 1 to supply the required gradually decreasing temperature in the chamber surrounding the upwardly extending portion of the sheet be-

tween its formative point and the bending point thereof, but it is manifest that any other source of heat might be employed for this purpose, the essential feature being that the sheet of glass should be surrounded by an atmosphere whose temperature gradually decreases from the formative point of the sheet to the point where it is bent to change its direction of movement. It will be also understood from what is mentioned above that instead of the hinged walls 4 and 5, the walls proper may be permanent walls, and that suitable deflectors may be hinged to the permanent walls, which deflectors can be operated so as to stand in a vertical direction or to be inclined toward the sheet for the purpose of directing the heat to a greater or less extent into close proximity with the sheet. Many other details of construction herein shown might be varied without departing from the spirit of the invention, and such details are designed to be included in the following claims.

What is claimed is:—

1. The method of drawing sheet glass, which consists in drawing a sheet of glass in an upward direction from a mass of molten glass into an atmosphere exposed to the heat-radiating surface of said molten mass, bending the drawn sheet to change its direction of movement, and continuously passing the drawn sheet through an atmosphere of constantly decreasing temperature from the drawing point onward.

2. The method of drawing sheet glass which consists in preparing a mass of molten glass, continuously drawing a sheet of glass therefrom in an upward direction into an atmosphere exposed to the heat-radiating surface of said mass, bending the sheet to change its direction of travel, excluding the external atmosphere from said sheet between the drawing point and the bending point, and passing the sheet through an atmosphere which constantly decreases in temperature from the drawing point onward.

3. The method of drawing sheet glass which consists in preparing a mass of molten glass, drawing a sheet of glass upward therefrom into a closed chamber exposed at its bottom to the surface of the molten mass, and bending the sheet into approximately a horizontal direction without reheating.

4. In an apparatus for drawing sheet glass, the combination of means containing a mass of molten glass, means for drawing a sheet of glass therefrom in an upward direction, a closed chamber surrounding the upwardly extending portion of the sheet of glass and in open communication with the said mass of molten glass, means bending the sheet of glass to change its direction of travel, and ventilating means in the upper portion of said chamber, whereby a temper-

ature may be maintained in said chamber gradually decreasing from the formative point of the sheet of glass to the bending point thereof.

5. In an apparatus for drawing sheet glass, the combination of means containing a mass of molten glass, means for drawing a sheet of glass therefrom in an upward direction, means bending said sheet to change its direction of travel, a closed chamber surrounding the upwardly extending portion of the sheet, and means directing the heat of said chamber against the opposite faces of the sheet during the drawing operation.

6. In an apparatus for drawing sheet glass, the combination of a receptacle containing a mass of molten glass, means for continuously drawing a sheet of glass therefrom in an upward direction, a bending roll over which the sheet of glass is bent to change its direction of travel, and oppositely disposed inclined plates on opposite sides of the sheet between the formative and bending points thereof, whereby the heat arising from said molten mass is directed against the opposite faces of the sheet during the drawing operation.

7. In an apparatus for drawing sheet glass, the combination of means containing a mass of molten glass, means for drawing a sheet of glass therefrom in an upward direction, means bending said sheet to change its direction of travel, an inclosing chamber surrounding the upwardly extending portion of said sheet of glass between its formative point and its bending point, and ventilating means located approximate to the bending point of the sheet.

8. In an apparatus for drawing sheet glass, the combination of a receptacle containing a mass of molten glass, means for drawing a sheet of glass therefrom in an upward direction, a bending roll over which the said sheet is bent to change its direction of travel, an inclosed chamber surrounding the upwardly extending portion of the drawn sheet, an opening in the top of said chamber, and adjustable means normally closing said opening and operable to open the same whereby the temperature of said chamber may be regulated.

9. In an apparatus for drawing sheet glass, the combination of a chamber containing a mass of molten glass, means for drawing a sheet of glass therefrom in an upward direction, a closed chamber surrounding the upwardly extending portion of said sheet and open at the bottom to said mass of molten glass, ventilating openings in the upper portion of said chamber, means for regulating said openings, hinged plates on opposite sides of said sheet, and means for inclining said plates with reference to the faces of said sheet.

10. In an apparatus for drawing sheet

glass, means containing a mass of molten glass, a chamber extending vertically upward from said mass, means for drawing a sheet of glass upwardly in said chamber, 5 means for providing a gradually decreasing temperature in said chamber from the bottom thereof upward, and a normally closed side door in said chamber.

11. In an apparatus for continuously 10 drawing sheet glass, means containing a mass of molten glass, a chamber extending upward from said mass, an annealing oven at an angle to said chamber, means for drawing a sheet of glass into said upwardly 15 extending chamber, and means providing a temperature in said upwardly extending chamber gradually decreasing from the bottom thereof upward.

12. In an apparatus for continuously

drawing sheet glass, the combination of a 20 receptacle containing a mass of molten glass, means drawing a sheet of glass therefrom in an upward direction, an annealing oven extending at an angle to said upwardly extending sheet and into which the 25 sheet is continuously passed as drawn, and temperature regulating means gradually decreasing the temperature of the sheet between its formative point and said annealing oven. 30

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

JOHN PLAYER.

Witnesses:

S. T. CAMERON,
W. B. KERKAM.