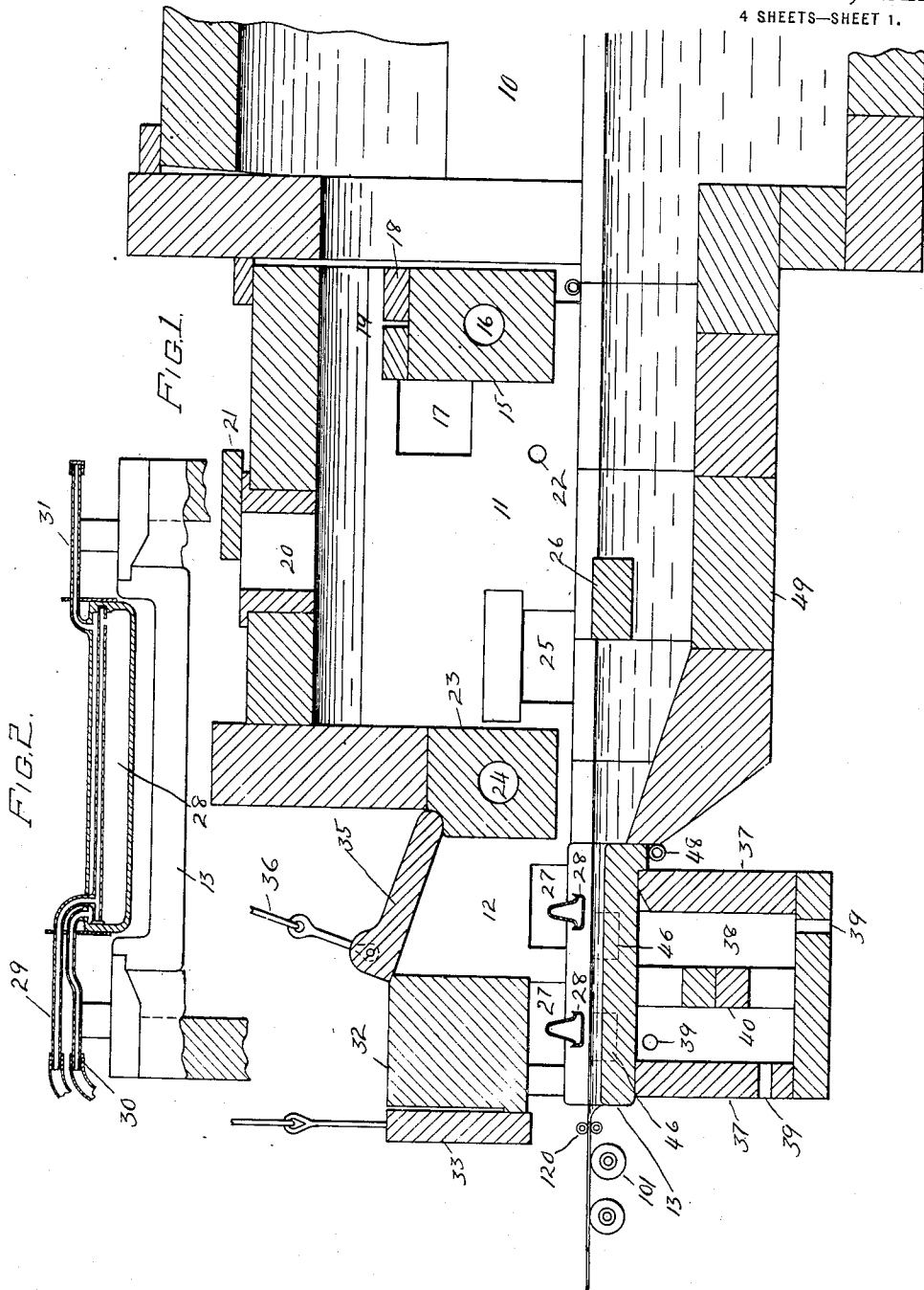


I. W. COLBURN.
 PROCESS AND APPARATUS FOR DRAWING SHEET GLASS.
 APPLICATION FILED OCT. 8, 1915.

1,394,809.

Patented Oct. 25, 1921.

4 SHEETS—SHEET 1.

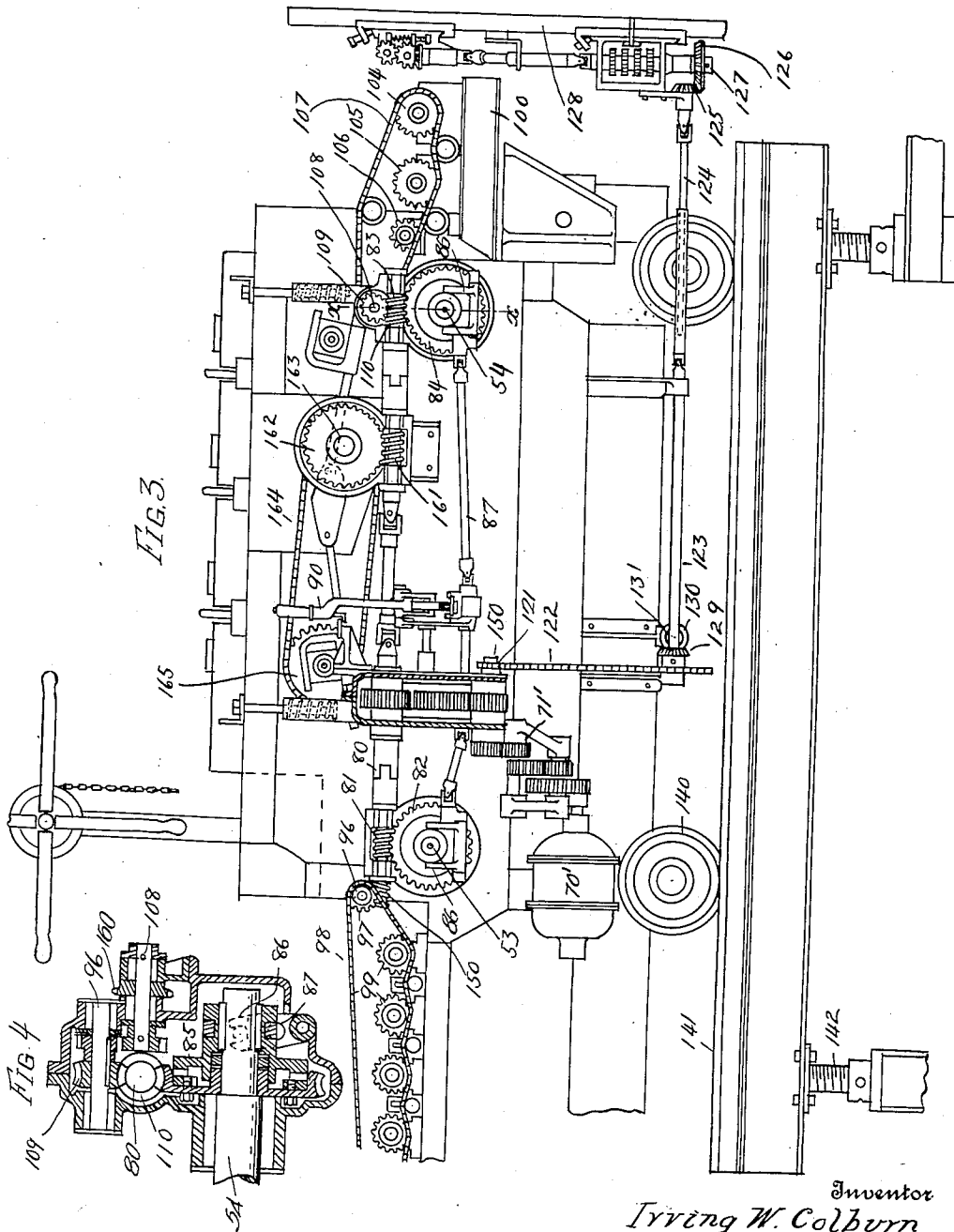


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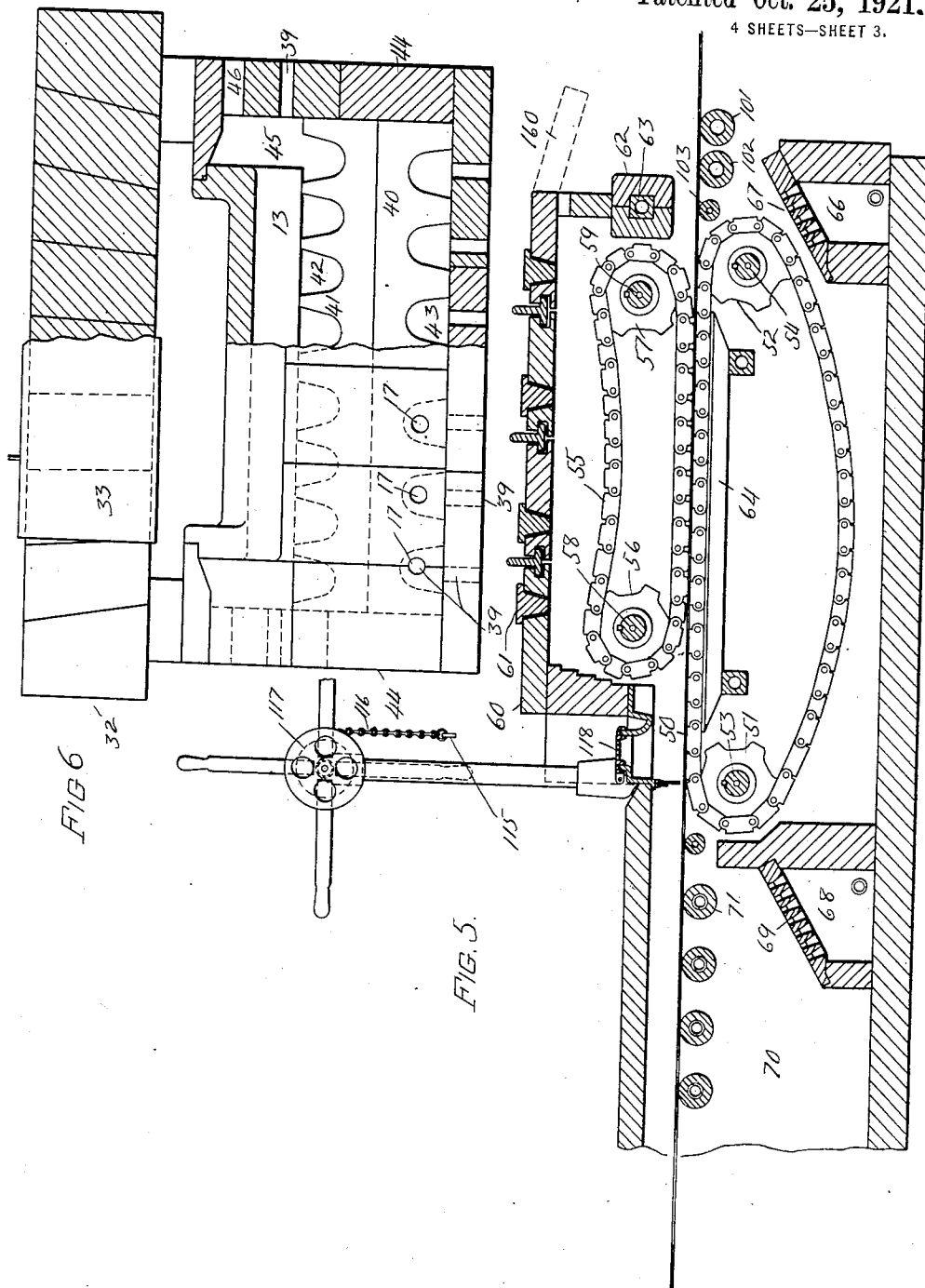
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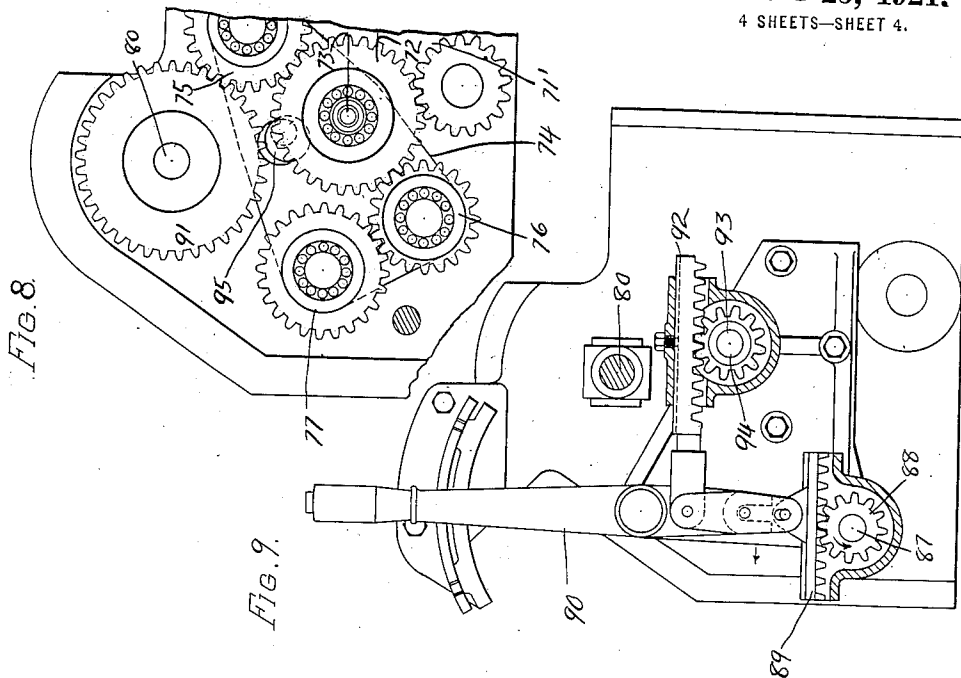
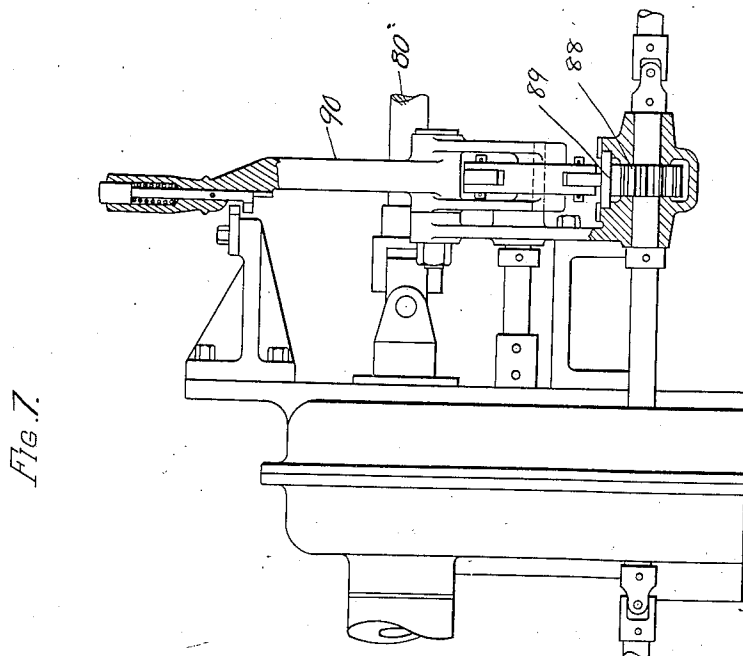
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4 SHEETS—SHEET 4.



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UNITED STATES PATENT OFFICE.

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PROCESS AND APPARATUS FOR DRAWING SHEET-GLASS.

1,394,809.

Specification of Letters Patent.

Patented Oct. 25, 1921.

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To all whom it may concern:

Be it known that I, IRVING W. COLBURN, a citizen of the United States of America, residing at Toledo, in the county of Lucas and State of Ohio, have invented certain new and useful Improvements in Processes and Apparatus for Drawing Sheet-Glass, of which the following is a specification, reference being had therein to the accompanying drawings.

The invention relates to the art of making sheet glass. The object of the invention is to provide a process and apparatus whereby sheet glass of uniform width and thickness may be drawn from the molten mass and subsequently annealed, after which it can be cut up into the desired sizes for the market. The invention consists in the process and apparatus for drawing the glass in a flat sheet horizontally, from the molten mass; in the mechanism for operating the drawing table either forward or backward; the means for regulating the temperature of the glass; in the construction of the glass holding apparatus or tank from which the glass is drawn; and in the arrangement and combination of the various parts as more fully hereinafter described and particularly pointed out in the claims.

In the drawings:

Figure 1 is a vertical central longitudinal section through the melting, cooling and drawing chambers, showing in full and dotted lines different forms of drawing chambers;

Fig. 2 is a section through the drawing chamber, illustrating the construction of the cooling device therein;

Fig. 3 is a side elevation of the drawing device, showing the operating mechanism therefor;

Fig. 4 is a longitudinal section of the drive and clutch mechanism at the right-hand end of Fig. 3;

Fig. 5 is a longitudinal section through the drawing mechanism and through the drawing table and grip-bars;

Fig. 6 is a sectional elevation looking at

the front of the glass holder or tank shown in Fig. 1.

Fig. 7 is a front elevation, partly in section, of the operating handle for the reverse mechanism;

Fig. 8 is a side elevation of the reverse gear mechanism; and

Fig. 9 is a side elevation of the lever-controlled mechanism shown in Fig. 7, partly in section.

10 represents the continuous tank in which the batch is melted and from which it flows into a cooling tank, 11. At the forward end of the cooling tank is a drawing chamber, 12, the bottom of which is preferably formed of a tile, 13, which, as shown in full lines in Figs. 1 and 2, is of a trough-shape. It may be of the shape shown, or of other configuration, so as to leave a free lateral outlet at the forward end and form a comparatively shallow pool of glass, from the edge of which the sheet is to be drawn.

Between the chambers 10 and 11 I have shown a jack-arch, 15, provided with an air-cooling passage 16. 17 is an aperture in the wall of the chamber 11, through which bricks, 18, may be placed, on top of the jack-arch 15, to more or less restrict the passage, 19, for the gases passing from the chamber 10. 20 is an aperture in the roof of the chamber 11, closed by a valve 21 which may be more or less opened to likewise aid in the temperature control of the chamber 11. 22 shows a burner opening through which a gas flame may be introduced when it is desired to increase the heat in the chamber 11. 23 is a jack-arch at the forward end of the chamber 11; provided with an air-passage, 24. 25 is an aperture for inserting the floater-block, 26, which aperture is ordinarily bricked up when the device is in use as is also the aperture 17.

In the side walls of the chamber 12 are apertures, 27, through which may be inserted metallic chambers, 28, having water inlet pipes, 29, and outlet pipes, 30. They are also provided at one end with extensions, 31, for supporting the same on the side wall

of the tank opposite the inlet opening. The openings 27 may also be bricked up in the use of the device.

32 is a jack-arch at the front of the chamber 12; 33 is a raising and lowering closure for the opening at the front end of the chamber 12.

35 represents the tile forming the top or portion thereof of the chamber 12. It is hinged at its inner end and provided with a suitable lifting device, such as a rope or cable, 36, so that it may be opened more or less to allow the escape of heat for controlling the temperature in the chamber 12. In its closed position this tile may rest against the jack-arch 32.

The drawing tank or tile which forms the bottom of the drawing chamber 12 is shown as supported upon the foundation walls, 37, forming a heating chamber, 38, therein. Gas flames may be directed to this chamber from gas inlet openings, 39.

To form a middle support for the tile 13 I build the middle partition or supporting wall, 40, which, as shown in Fig. 6, has reduced supporting points, 41, between which are gas passages, 42. Similar gas passages, 43, are formed at the bottom.

The side walls, 44, of the heating chamber 38 are spaced away from the sides of the tile or tank 13, so as to leave vertical flues, 45, extending at the side of the same; gas outlets, 46 being provided in the side walls.

48 is a cooling water pipe arranged between the tank or tile 13 and the bottom, 49, of the tank, below the cooling chamber 11.

The drawing mechanism, in its general construction and arrangement, is similar to that shown in my previous Patent 966,653, comprising:

An endless drawing table, 50, which passes over sprocket-wheels, 51, 52, at opposite ends, which sprocket-wheels are secured to shafts, 53, 54. Above the drawing table is an endless chain or carrier comprising grip-bars, 55, which are hinged together to form an endless carrier and which pass over sprocket-wheels, 56, 57, supported on shafts, 58, 59.

This drawing mechanism is inclosed within suitable brick-work casing, 60, and I have shown the top as provided with vent openings, 61, for controlling the temperature. At the inlet end is a tile division wall, 62, supported on a hollow iron mantle or cross-bar, 63, through which water may be passed to cool it.

64 are guides for the horizontal portion of the drawing table.

66 is a heating chamber having gas outlet, 67, for heating the drawing chamber, and 68 is a gas chamber having an outlet, 69, for heating the leer chamber 70 and in which I have shown suitable supporting rolls, 71, upon which the drawn glass passes into the leer or annealing oven.

The drive mechanism for the drawing table I have shown as capable of propelling the table in either direction, so that the bait can be drawn therethrough toward the tank or the glass can be drawn in the opposite direction through the drawing chamber and into the leer. The actuating mechanism is as follows:

70' represents the motor; 71' a train of gears for gearing back, the final gear, 72, of which is journaled on a stationary shaft, 73, in a suitable framework on the side of the drawing chamber. Pivoted on this shaft is a rocking frame, 74, (shown in full and dotted lines in Fig. 8,) carrying at one end a driving pinion, 75, and at the other end two driving pinions, 76, 77, in mesh with each other; the pinions 75 and 76 being in mesh with the driving gear 72. 80 is a longitudinal shaft journaled in suitable bearings on the side of the drawing chamber, having thereon, at its outer end, a worm, 81, meshing with a worm-wheel, 82 on the shaft 53. At the other end is a worm, 83, meshing with a worm-wheel 84 on the shaft 54; these worm-wheels being loose on the shaft and adapted to be controlled by clutch members, 85, adapted to be actuated by clutch yokes, 86, on the rock shaft 87; the construction being such that the rocking of the shaft will throw one clutch in and throw the other out, upon being rocked in one direction, and reverse the operation by movement in the other direction.

The shaft 87 has upon it a spur-gear, 88, with which is engaged a rack-bar 89, on the end of an actuating lever, 90, (Fig. 9).

It will be obvious from this description that the rocking of the lever 90 will either clutch the shaft 53 to the worm-wheel 82 and unclutch the worm-wheel 84 from the shaft 54, or vice versa. When the lever 90 is rocked to throw in the clutch between the shaft 53 and the worm-wheel 82, the frame 74 is rocked to engage the pinion 75 with a gear-wheel 91, on the shaft 80, which will cause the drawing table to move toward the leer. When the lever 90 is moved in the reverse direction, so as to disengage the worm-wheel 82 from the shaft 53 and engage the worm-wheel 84 with the shaft 54, the frame 74 will be rocked to disengage the pinion 75 from the gear-wheel 91 and engage the pinion 77 with the gear-wheel 91, thereby causing the shaft 54 to act as the drive-shaft and move the drawing table in the reverse direction.

This rocking of the frame 74 is effected by means of a rack, 92, connected to the lever 90, engaging a pinion, 93, on a stub-shaft, 94, which stub-shaft is provided at its end with an eccentric 95, (Fig. 8) engaging a bearing in the frame 74 to effect this movement. I have shown the leer rolls as driven from the shaft 80 by means of a worm, 150, on the

end thereof engaging a worm on a shaft, 96, which is geared to the shaft carrying sprocket-wheel 97, a sprocket-chain, 98, passing thereover and engaging with sprocket-wheels 99 on the leer roll shafts.

The endless grip-bar device is driven through a worm, 161, on the shaft 80, meshing with a worm-wheel, 162, on a stub-shaft 163, upon which shaft is a sprocket-wheel (not shown) and over which passes a sprocket-chain 164, which passes over a sprocket-wheel, 165, on the shaft 58.

At the forward end of the device is an inwardly extending frame, 100, upon which are journaled hollow rolls, 101, 102 and 103; these rolls being provided at their ends with sprocket-wheels 104, 105 and 106, and which engage the sprocket-chain 107 which passes over a sprocket-wheel 160, on a shaft 108, which shaft is driven by means of intermediate gearing from a worm-wheel 109 engaging a worm 110 on the shaft 80, as shown in Fig. 4.

The upper faces of these rolls are in line with the upper face of the drawing table, and they are geared so that they move at the same speed as the drawing table.

115 is a bait, shown suspended upon a chain, 116, passing over a windlass 117 and adapted to be lowered so that it will rest upon the drawing table through an aperture controlled by a door, 118. When thus laid upon the table and the table moved toward the tank by means of mechanism described, the bait, with its attached chain will be drawn forwardly on the drawing table and can be brought to the front of the machine and engaged with the glass at the outlet end of the glass tank or at what may be called the drawing lip. When thus engaged the drawing table may be reversed and the bait, with its attached glass, will be drawn through the machine and over the drawing table, and when it has reached a point below the windlass 117 it may be broken off and the bait withdrawn; whereupon a continued motion of the drawing table will continue to draw the glass from the tank over the rolls 101, 102 and 103, and over the drawing table and carry it into the leer.

I provide for the edges of the drawn sheet edge rolls, 120, which may be of the construction shown in my previous Patent 966,653. The function of these rolls, it is well understood, is to maintain the width of the sheet, and they may be driven in any suitable manner. In this case I have shown them driven by means of a sprocket-wheel, 121, on the end of the shaft 150', by means of a sprocket-chain 122 driving a shaft 123 which is provided with a telescopic extension, 124, having on its end a beveled pinion, 125, meshing with a beveled pinion 126, on a vertical shaft 127 which, by suitable gears, will drive the shaft carrying the knurled

rolls 120. The vertical shaft 127 and the drive mechanism therefor is carried on a face-plate, 128, preferably fastened to the front of the drawing chamber. The rolls upon the opposite side are driven by the bevel gear-wheel 129 on the shaft 123, which meshes with a beveled gear-wheel, 130, and shaft, 131, extending to the opposite side of the machine, where corresponding mechanism is provided for the opposite pair of rolls (not shown).

This drawing mechanism I have shown supported on wheels, 140, running on rails, 141, with vertical adjustment mechanism, 142, therefor, so that it can be raised and lowered to the desired height in relation to the drawing-lip of the machine and moved the desired distance from the drawing lip.

In using the machine to draw the glass sheet horizontally from the drawing-lip as shown in Fig. 1, the roll 101 is placed a material distance from the drawing lip, which distance must be sufficient to enable the sheet to draw to the desired thickness from the molten mass and to have formed upon it the natural finish or glaze so that when it contacts the roll 101 the roll will not affect or change, or mar, the natural finish of the glass.

It is obvious that the sheet, is being drawn in this form from the edge of the glass, unsupported and free to radiate its heat, will rapidly cool and the sheet will be drawn to its substantially finished thickness before it contacts the roll. The distance which the roll is separated from the drawing-lip depends largely upon the thickness of the glass which it is desired to draw and the temper of the glass at the drawing point. This temperature can be controlled by means of the hinged cover 35 and the water coolers 28; also by means of the valve or slide 21 and the heat in the chamber 38. It is customary also to provide suitable gas burners inside of the chamber 12 which can be used if desired to raise the temperature therein.

The glass being drawn by the drawing table and grip-bars at the same speed that the rolls 101, 102 and 103 are driven, at no time will there be any rubbing action between the sheet and its supporting or drawing mechanism. While I have shown three of these rolls between the drawing table and the drawing lip, less or more may be used; indeed the glass might be drawn directly from the drawing lip upon the drawing table.

I have shown in dotted lines in Fig. 5 a hood 160, which may be placed above the rolls so as to retain the heat more or less at that point and prevent the too rapid cooling of the glass before it reaches the drawing-table.

What I claim as my invention is:

1. The method of making sheet glass, con-

- sisting in melting the batch and flowing it laterally in a fluid state to a lateral outlet, cooling the mass near the outlet, drawing a flat sheet laterally from the surface edge of the outlet, unsupported a sufficient distance to substantially gage the sheet and form a glaze thereon, then in flattening the sheet by drawing it forward over supporting means, and cooling the sheet.
2. The combination with a glass tank having an unimpeded lateral outlet for surface glass, means for gripping and drawing laterally therefrom a sheet of glass, comprising a drawing table, grippers for gripping the sheet to the table, and a support intermediate the outlet and drawing table, the support being spaced from the outlet a sufficient distance to enable a sheet to be drawn free from support, and to form and substantially gage the sheet and form the glaze thereon before contacting said support.
3. The combination with a glass tank having an unimpeded lateral outlet for the surface glass, of a glass drawing machine for drawing a sheet horizontally therefrom, said machine comprising a supporting and drawing mechanism spaced from the tank outlet a sufficient distance to cause the formation of an unsupported sheet of the desired thickness, and means for moving said drawing and supporting means at the same speed as the sheet.
4. The combination with a glass tank having an unimpeded lateral outlet for the surface glass, of a drawing means comprising a horizontal drawing table on which the drawn sheet rests, and continuously moving gripper bars contacting the glass upon the table, supporting devices between the drawing table and tank, said supporting devices being driven at the same speed as the sheet, and being separated from the tank a sufficient distance to cause the formation of an unsupported sheet of the desired thickness before it contacts the supporting means.
5. The combination with a glass tank having an unimpeded lateral outlet for the surface glass, of a machine for drawing sheet glass laterally therefrom, comprising an endless horizontal drawing table, horizontally moving grippers above the table, a driven supporting roll between the tank and the table, spaced from the drawing lip a sufficient distance to draw an unsupported sheet to gage the sheet and form a glaze thereon.
6. In a sheet drawing mechanism, the combination of an endless drawing table, wheels at opposite ends over which it passes, shaft supporting the wheels, driving mechanism, and mechanism for connecting the driving mechanism to the shafts to drive one shaft in one direction and the other in the opposite direction.
7. In a sheet glass drawing mechanism, the combination of an endless drawing table and grip-bars traveling above the same, sprocket-wheels over which the endless drawing table passes, shafts supporting the wheels, a driving mechanism, connections therefrom to both shafts, a reversing mechanism and means for connecting one shaft to the forward drive mechanism and disconnecting the other shaft, or for connecting the latter shaft to the reverse mechanism and disconnecting the former.
8. The method of forming sheet glass, consisting in permitting molten glass to flow by gravity over a member disposed in a heated atmosphere and having a flat surface and drawing the glass from the outer end of said member.
9. The method of forming sheet glass consisting in supplying glass in evenly distributed form to the surface of a slab at the rear of its discharge end and in the presence of a heated atmosphere, the glass flowing over the slab by gravity and being drawn from its discharge end to stretch the glass to predetermined size.
10. The method of forming sheet glass, consisting in permitting molten glass to flow over a heat surrounded slab, and drawing the glass from the slab, the heat being less at the portion of the slab from which the glass is drawn than at the point of flow of the glass thereon.
11. The method of forming sheet glass, consisting in providing a slab within a heated chamber and projecting the discharge end thereof into a temperature which is less than that of the chamber, and causing molten glass to flow onto the slab within the chamber and to be drawn from the discharge end thereof.
12. The method of forming sheet glass, consisting in permitting molten glass to flow in a regulated stream onto and over a heated slab in the presence of a surrounding heat and drawing the glass from the slab, the heat diminishing from the portion of the slab on which the glass first flows to the portion thereof from which the glass is drawn, the drawing stress being applied beyond the point of set of the sheet.
13. The method of forming sheet glass consisting in permitting molten glass to flow over a slab in the presence of a heated atmosphere, and drawing the glass from the slab.
14. The method of forming sheet glass consisting in permitting molten glass to flow over a slab disposed in a heated atmosphere, cooling the glass toward the discharge end of the slab, and drawing the glass from the outer end of the slab.
15. The method of forming sheet glass consisting in permitting molten glass to flow over a heated slab in the presence of a heated atmosphere, and applying continuous

predetermined pull on the glass after leaving the slab to size the same.

16. The method of forming sheet glass consisting in flowing glass in a molten state over a heated slab in a heated atmosphere to flatten and temper the same, and applying a stretching pull to the glass after leaving the slab to size it.

17. The method of forming sheet glass consisting in permitting molten glass to flow over a slab in the presence of a surrounding heat, and drawing the glass from the slab, the heat being less at the portion of the slab from which the glass is drawn than at the point of flow of the glass thereon.

18. In an apparatus of the class described, a heated chamber having an opening therein, a slab within the chamber and onto which the molten material may flow and be drawn therefrom in a continuous sheet form through said opening, and means for varying the size of the opening to regulate the temperature in the chamber.

19. In an apparatus of the class described, a heated chamber having an opening therein, a slab disposed in a heat surrounded position in said chamber to register with said opening, means for containing molten glass and permitting it to flow on said slab preparatory to passing over and being drawn from the slab in continuous sheet form.

20. The method of making sheet glass consisting in melting the batch and flowing

it in shallow sheet form to the drawing point, tempering the mass while in such shallow sheet form, and then drawing laterally a sheet from the edge of said tempered mass and maintaining the drawn sheet free from contact with any surface until a glaze has formed thereon.

21. The combination with a glass tank, a flat tile or slab upon which the glass is adapted to flow in a shallow sheet form from the tank, means for tempering the glass on the tile or slab, and means separated from the outer edge of the tile for laterally drawing a sheet from the tempered glass unsupported a sufficient distance to gage the sheet and form a glaze thereon.

22. The combination with a glass-melting tank, of a chamber, a flat tile or slab dividing said chamber into upper and lower compartments and upon which the glass flows in shallow sheet form from said tank, means for controlling the temperature in each of said compartments to temper the glass on said tile or slab, and sheet-glass drawing means adjacent the outer edge of said tile or slab.

In testimony whereof I affix my signature in presence of two witnesses.

IRVING W. COLBURN.

Witnesses:

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JAMES N. ANGUS.