

No. 667,007.

Patented Jan. 29, 1901.

L. H. DOLAN.

APPARATUS FOR FORMING PLATE OR SHEET GLASS

(Application filed Jan. 12, 1900.)

(No Model.)

6 Sheets—Sheet 1.

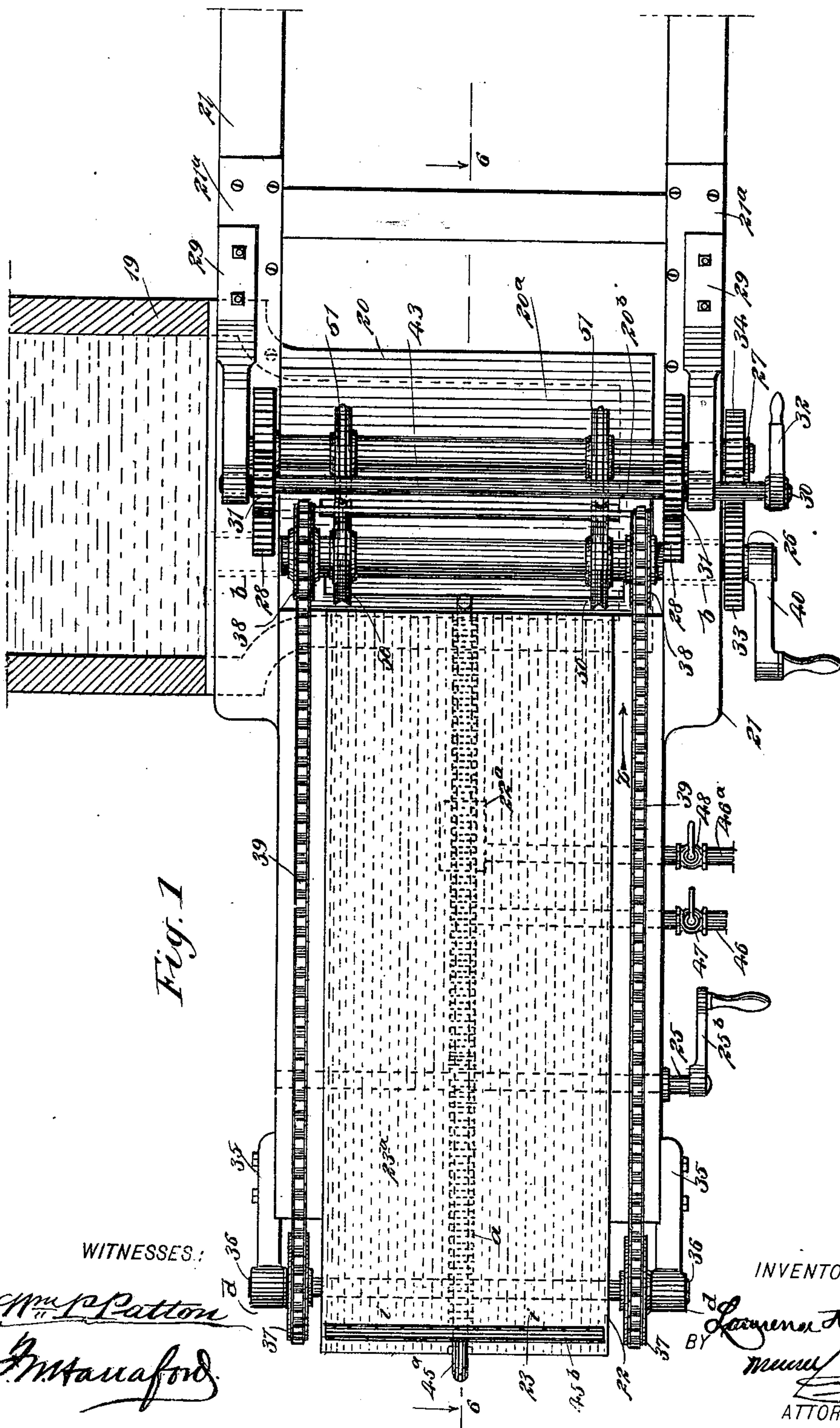


Fig. 1

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6 Sheets—Sheet 2.

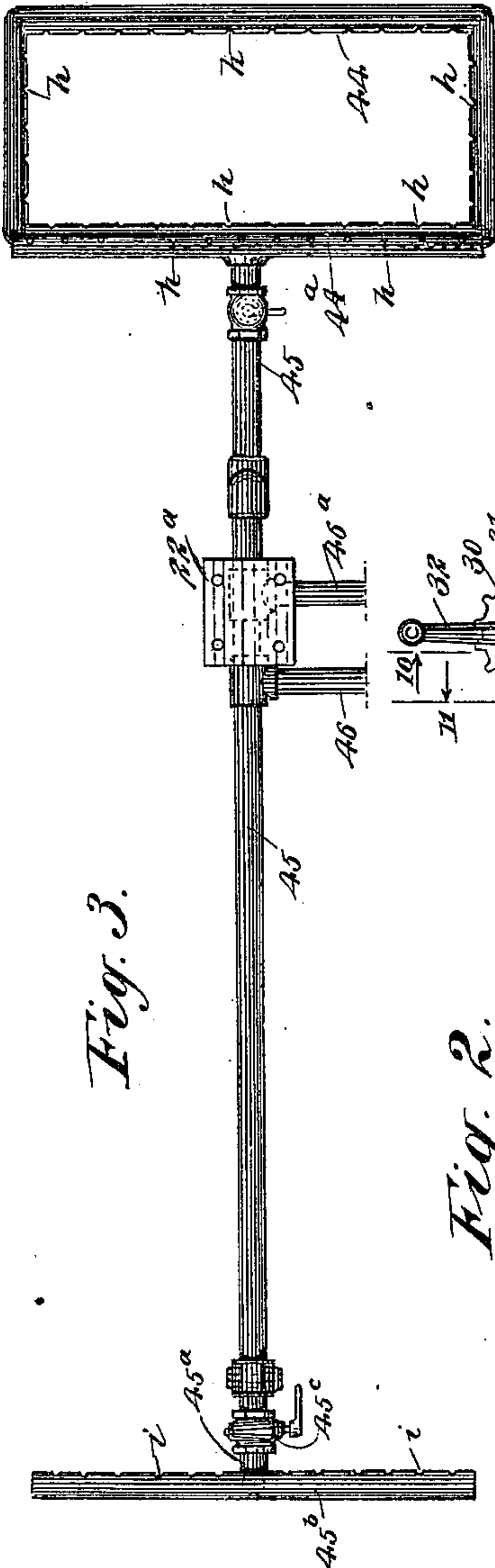


Fig. 3.

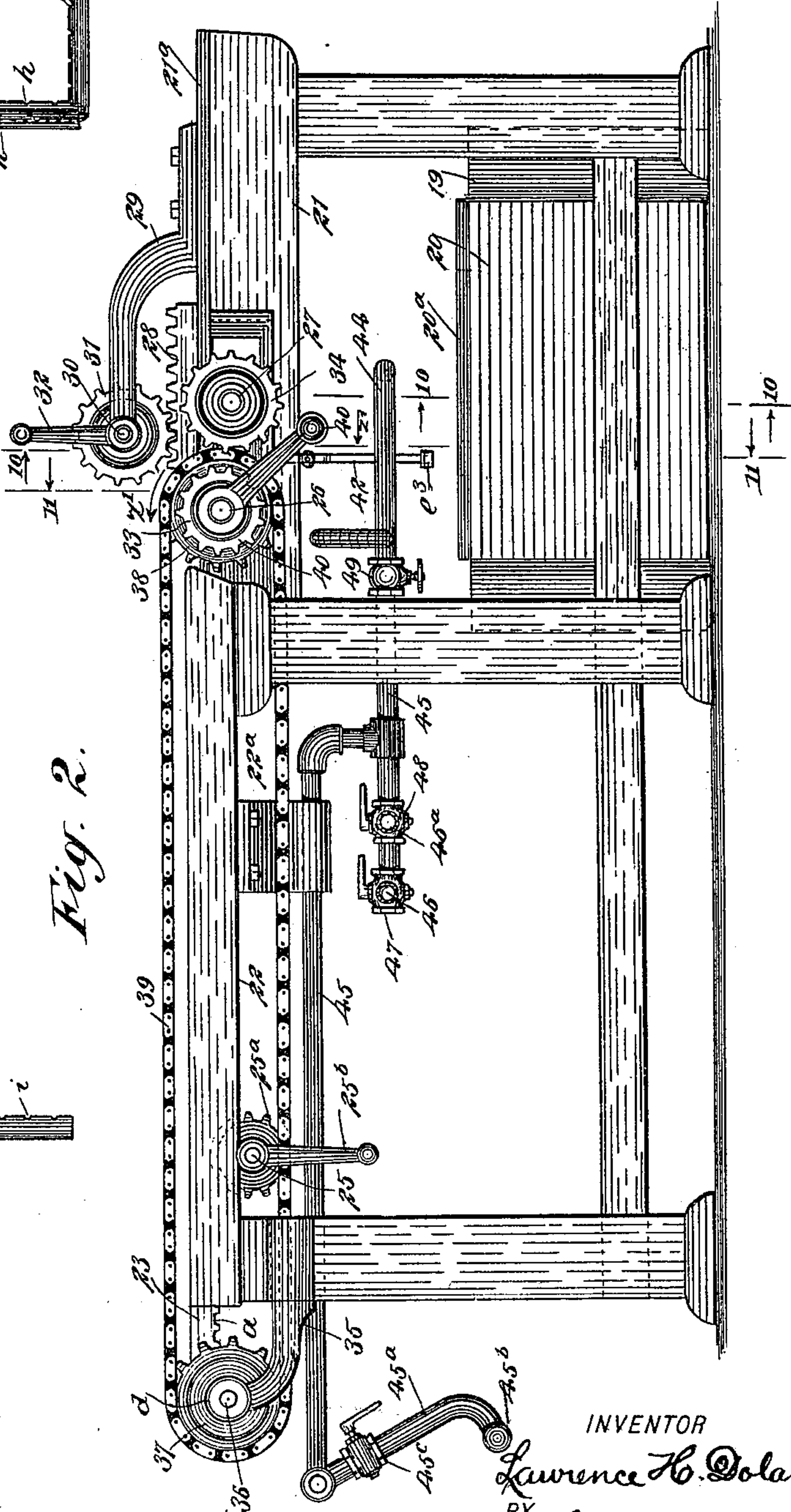


Fig. 2.

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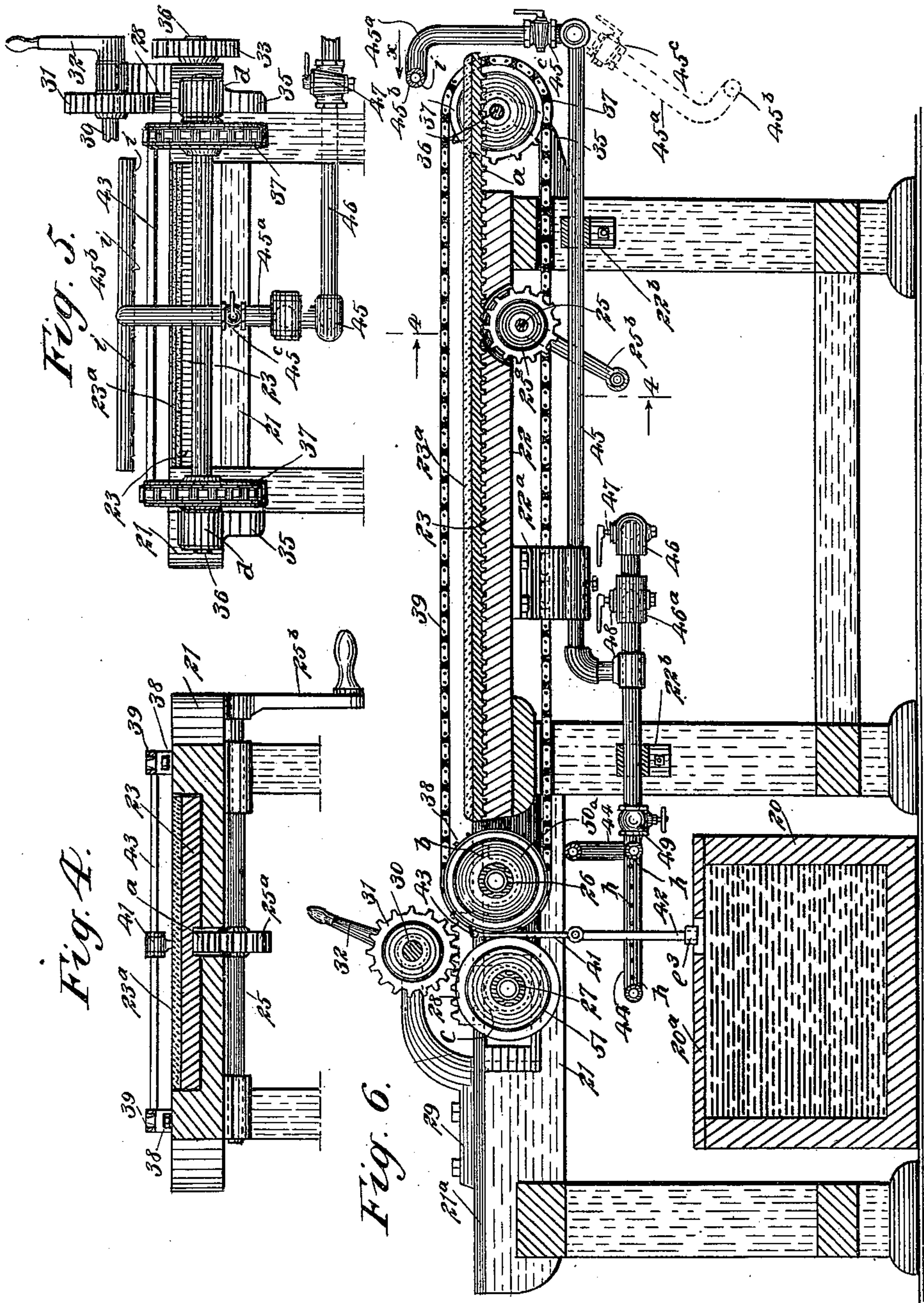
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6 Sheets—Sheet 3.



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6 Sheets—Sheet 4.

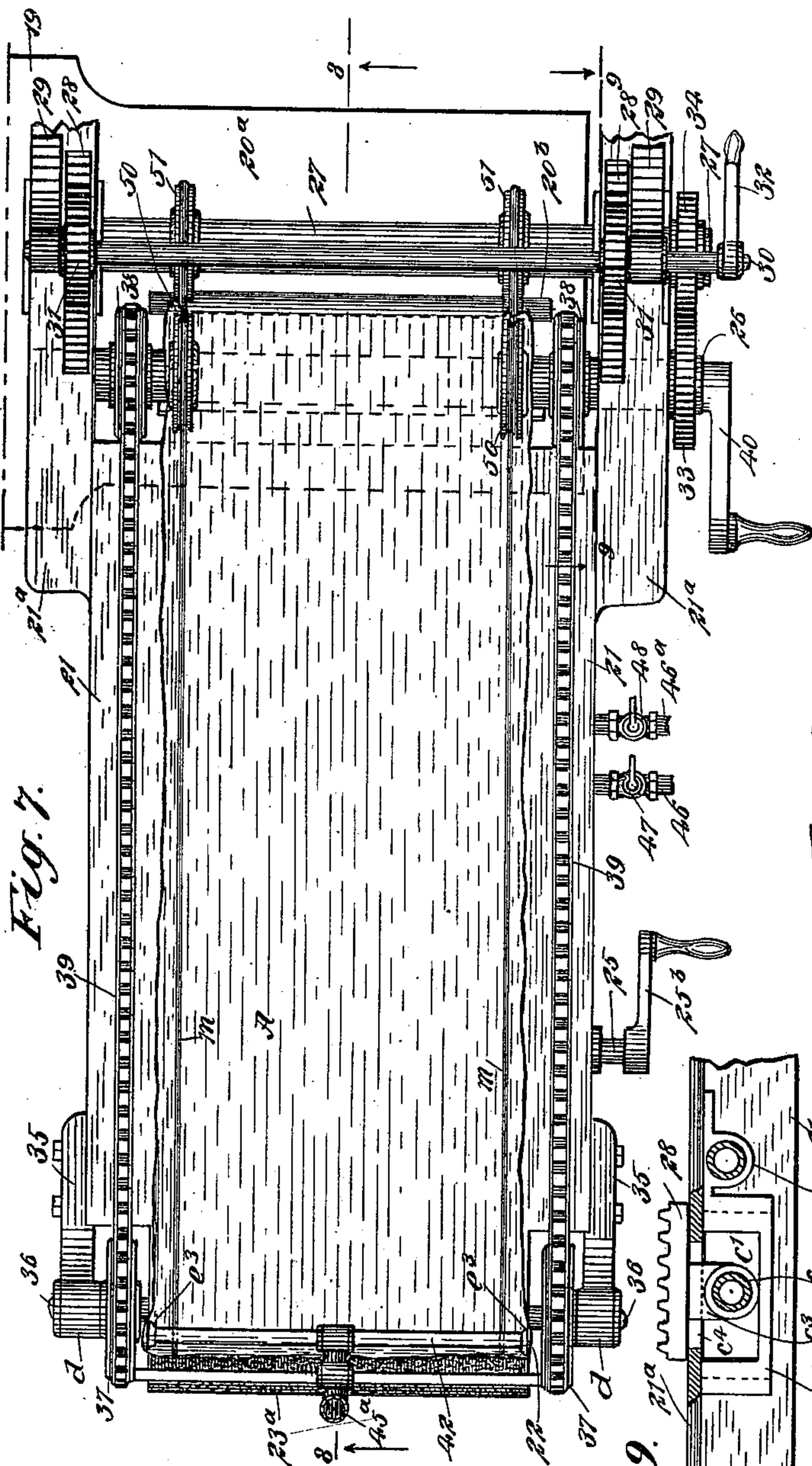


Fig. 7.

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Fig. 9.

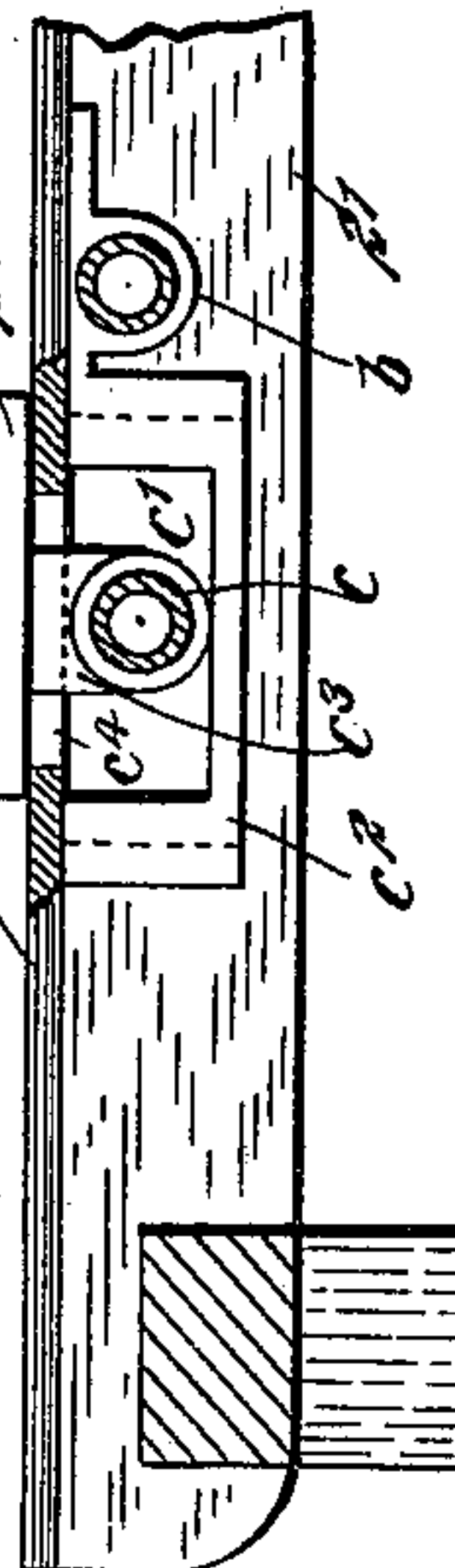
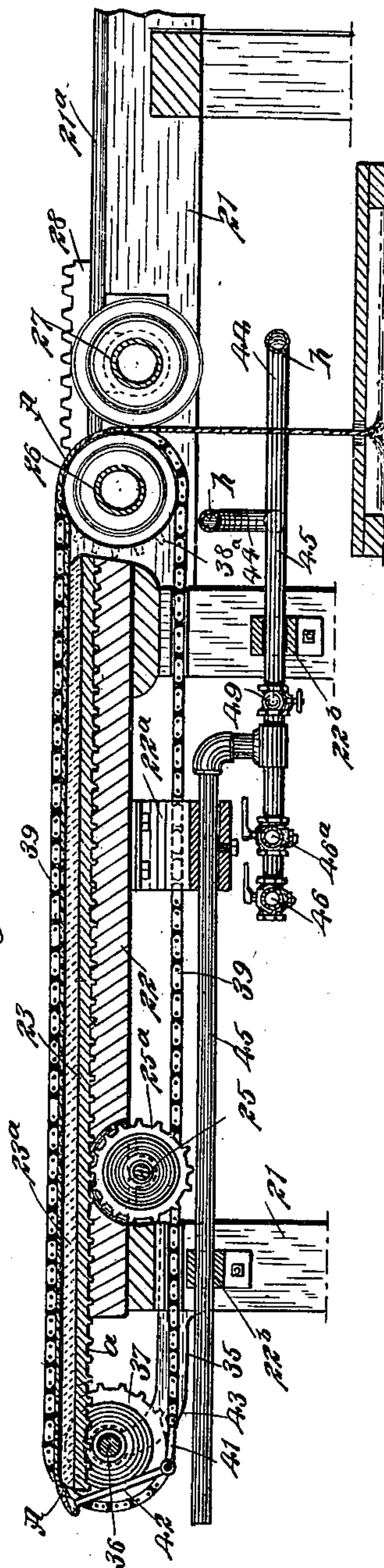


Fig. 8.



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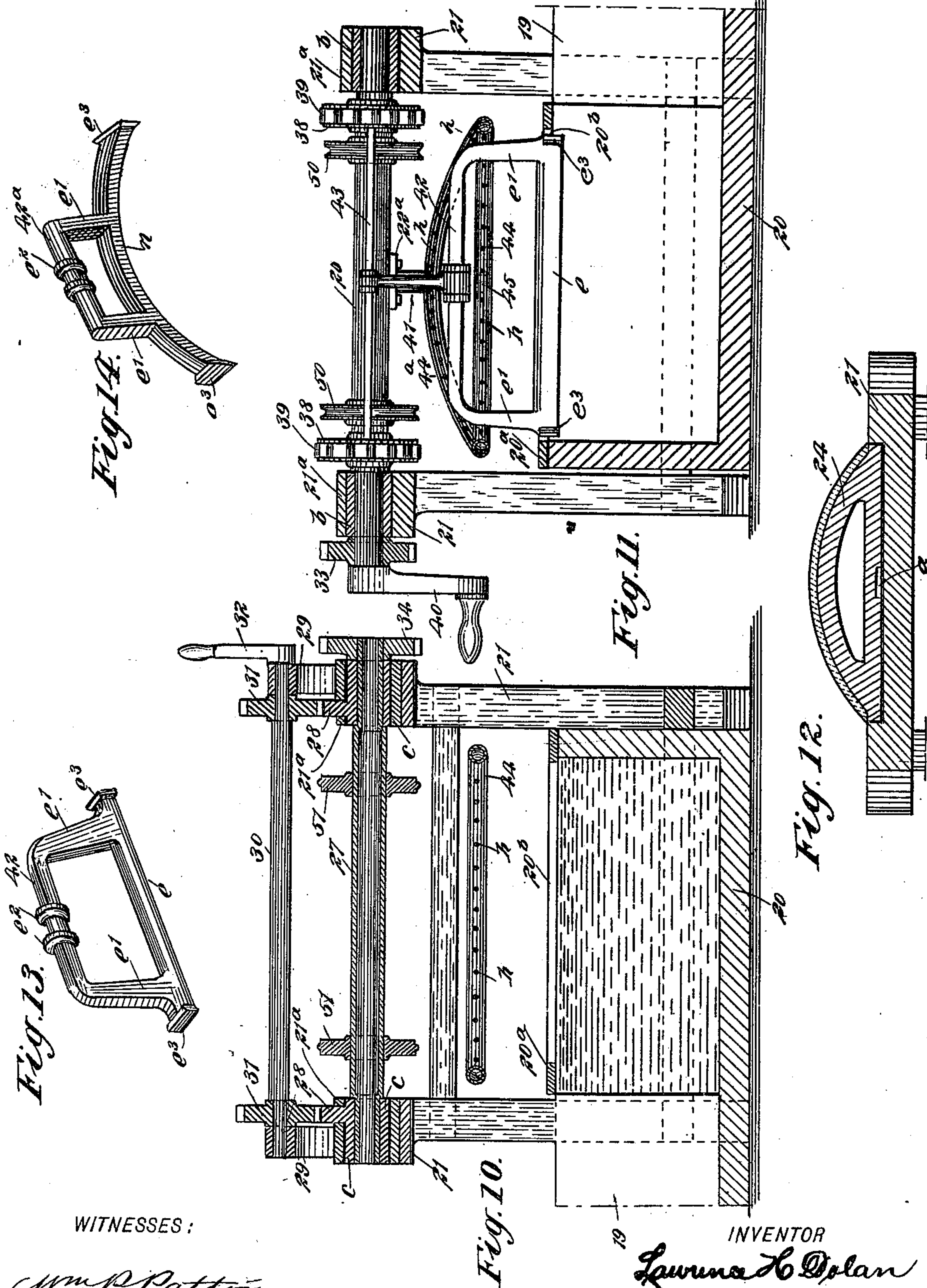
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APPARATUS FOR FORMING PLATE OR SHEET GLASS.

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(No Model.)

6 Sheets—Sheet 5.



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No. 667,007.

Patented Jan. 29, 1901.

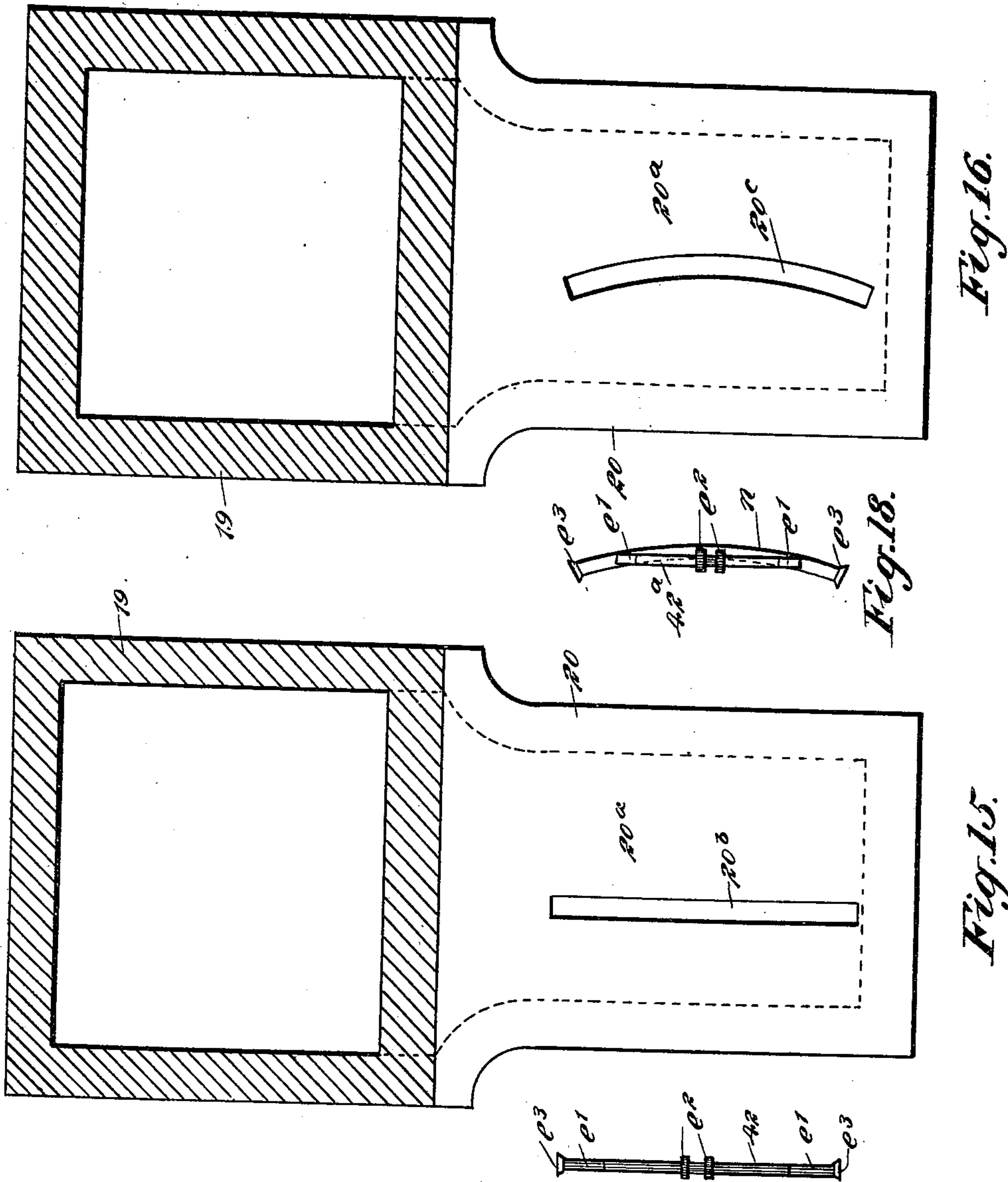
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APPARATUS FOR FORMING PLATE OR SHEET GLASS.

(Application filed Jan. 12, 1900.)

(No Model.)

6 Sheets—Sheet 6.



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Fig. 17.

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UNITED STATES PATENT OFFICE.

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TO ALBERT B. TAYLOR, OF SAME PLACE.

APPARATUS FOR FORMING PLATE OR SHEET GLASS.

SPECIFICATION forming part of Letters Patent No. 667,007, dated January 29, 1901.

Application filed January 12, 1900. Serial No. 1,213. (No model.)

To all whom it may concern:

Be it known that I, LAWRENCE H. DOLAN, a citizen of the United States, and a resident of Pendleton, in the county of Madison and State of Indiana, have invented a new and Improved Apparatus for Forming Plate or Sheet Glass, of which the following is a full, clear, and exact description.

This invention relates to the manufacture of sheet and plate glass, either flat or bent into curved form.

The object of my invention is to provide a novel apparatus for the formation of sheet and plate glass, either flat, curved, or corrugated, which will enable the rapid and perfect manufacture of such products from molten glass without the use of a blowing-tube or casting a plate of glass by the pouring of melted glass upon a bed-plate or into a mold, the new device greatly facilitating the production of large sheets or plates of glass of uniform thickness and fine finish rapidly and devoid of imperfections and at a low cost.

The invention consists in the novel means for the manufacture of sheet or plate glass, as hereinafter described, and defined in the appended claims.

The accompanying drawings illustrate the preferred mechanical device provided for carrying my invention into effect, similar characters of reference indicating corresponding parts in all the figures.

Figure 1 is a plan view of the sheet or plate glass forming machine. Fig. 2 is a side elevation of the same. Fig. 3 is a detached plan view of a fluid-distributing device that is a detail of the machine. Fig. 4 is a transverse sectional view substantially on the line 4 4 in Fig. 6. Fig. 5 is an end elevation of operative details seen in the direction of the arrow *x* in Fig. 6. Fig. 6 is a sectional side view substantially on the line 6 6 in Fig. 1. Fig. 7 is a plan view of the device, exemplifying the formation of an elongated sheet or plate of glass. Fig. 8 is a sectional side elevation taken substantially on the line 8 8 in Fig. 7. Fig. 9 is a partly-sectional inner side elevation of a portion of the machine-frame and details thereon, taken substantially on the line 9 9 in Fig. 7. Fig. 10 is a transverse partly sectional elevation substantially on the line 10 10 in Fig. 2. Fig.

11 is a transverse partly-sectional elevation essentially on the line 11 11 in Fig. 2. Fig. 12 is a cross-section of the machine-frame and bed thereon and of one form of plate-former supported by the bed. Fig. 13 is a perspective view of a glass gathering and drawing frame employed in forming flat sheets or plates of glass. Fig. 14 is a perspective view of a gathering and drawing frame used in forming transversely-bent sheets or plates of glass. Fig. 15 is a sectional plan view of a glass-furnace and a plan view of a laterally-extended glass-holder communicating with the furnace and adapted to receive the drawing-frame shown in Fig. 13. Fig. 16 is a view similar to Fig. 15, the glass-holder being adapted to receive the drawing-frame shown in Fig. 14. Fig. 17 is a top edge view of the drawing-frame shown in Fig. 13, and Fig. 18 is a top edge view of the drawing-frame shown in Fig. 14.

The principle upon which is based the operation of my apparatus for manufacturing sheet and plate glass, briefly described, consists in drawing a wide or narrow sheet or plate of glass from a suitable reservoir containing molten glass, controlling the temperature of the glass as it is in process of formation into a plate or sheet, imposing the drawn sheet or plate upon an appropriate forming-plate supported upon a frame or the like, and providing means to render the side edges of the glass sheet or plate true, and also providing means to detach the cooling plate or sheet from the mass of glass held in the reservoir.

The glass-furnace 19 may be of any preferred form which will be well adapted for melting a mass of glass and keeping it in a molten condition. At one side of the furnace 19 a reservoir or holder 20 is laterally extended therefrom, in open communication with the interior of said furnace near its base, so that the molten glass will pass into the holder, and any suitable means may be employed to maintain the glass in the holder at a proper temperature. A detachable cover-plate 20^a is imposed upon the otherwise open top of the holder 20, and in said cover-plate a slot is formed, which may be straight in the side walls thereof, as represented at 20^b in Fig. 15, or be formed as the arc of a circle, as shown in Fig. 16 at 20^c, said slots being of such relative di-

mensions, respectively, as will permit the free movement therethrough of the gathering-frame shown in Figs. 13 and 17 or the gathering-frame represented in Figs. 14 and 18, for a purpose which will be hereinafter described.

The machine for drawing glass plates or sheets from the glass-holder 20 through a slot 20^b or 20^c in its top preferably is constructed as follows: An elongated rectangular frame 21, proportioned in its dimensions to suit the size of the sheets or plates of glass to be manufactured, is positioned near one end of and above the glass-holder 20, so that the slot in the cover 20^a will be disposed transversely of the machine-frame, as indicated in Figs. 1 and 7. The height of the frame 21 is proportioned to afford proper space between the cover 20^a and the horizontal top members of the machine-frame, and, as shown said, frame is open above the glass-holder 20. Extending from a point near the glass-holder 20 to the left-hand end of the frame 21, a bed-piece 22 is secured upon said frame and serves as a table for support and guidance of a longitudinally-removable forming-plate 23 or 24. The forming-plates may be either flat on the top surface, as shown at 23 in Figs. 4 and 5, or may have a convex top surface, considered transversely thereof, as indicated in Fig. 12, and it is to be understood that said forming-plate may be given a corrugated top surface, if this is desired. The forming-plate, having any preferred form at its top surface, is to be seated upon the top of the bed-piece or table 22, and the side edges of the elongated forming-plate should be parallel with each other and may with advantage have a loose engagement with guides formed on or secured upon the bed-piece, so as to prevent a lateral displacement of the forming-plate.

To facilitate the longitudinal movement of a forming-plate 23 or 24 in placing or removing the same upon or from the bed 22, a toothed rack α may be formed or secured upon the lower side of each forming-plate, at or near the transverse center thereof, and a pinion 25^a, mounted and secured upon the rotatable transverse shaft 25, is meshed with the toothed rack when a forming-plate is slid endwise upon the outer end of the bed 22, which will enable a convenient placement of the forming-plate by a manipulation of the crank-handle 25^b, that is fixed upon the outer extremity of the shaft 25. It will be seen that by the rotation of the crank-handle 25^b in proper direction the forming-plate that is located upon the bed 22 may be displaced therefrom and another forming-plate substituted therefor having a like top surface or of different shape, as may be desired.

Transversely of the main frame 21 and directly above the glass-holder 20 two preferably hollow shafts 26 27 are journaled in boxes carried by side members of said frame. The hollow shaft 26, which is nearest to the transverse edge of the bed-piece 22, is held to rotate in the boxes b , which may be station-

ary and located in openings in the frame, as indicated in Figs. 9 and 11. The other hollow shaft 27 is journaled in boxes c , which are held to slide longitudinally of the side members of the main frame 21, wherein openings c' may be formed, and for durability, as well as convenience in manufacture, an elongated casing c^2 may be provided for lining each opening c' , as shown as to one box in Fig. 9. To hold the boxes c slidably within the rectangular casings c^2 and the boxes b also in place, there may be like cap-plates 21^a provided, one for each upper side piece of the main frame 21 and removably secured thereon by screws or other means. Upon the upper sides of the boxes c webs c^3 project upward through longitudinal slots c^4 , formed in the cap-plates 21^a, said webs respectively connecting the boxes c with the lower sides of the two similarly-toothed rack-bars 28, the teeth of which project upwardly, as indicated in Fig. 9. Two similar bracket-arms 29 are held upon said members of the main frame 21 and have their free ends formed with bearings to receive the journal ends of a transverse shaft 30. Two similar gears 31 are respectively affixed upon the end portions of the shaft 30, which gears are held over the rack-bars 28 and have toothed engagement therewith. A handle-bar 32 or its equivalent is mounted and secured upon an extremity of the shaft 30, that projects beyond one of the gears 31, and by a rocking manipulation of the handle-bar the racks 28 and boxes c may be moved toward or from the hollow shaft 26, which of course will correspondingly move the hollow shaft 27.

Upon the hollow shafts 26 27 two spur-gears 33 34 are respectively secured, preferably upon the side of the machine where the handle-bar 32 is located, and it will be obvious that by the manipulation of said handle-bar these gears may be meshed together or be separated, as occasion may require.

Two bracket-arms 35 are respectively secured upon the side members of the main frame, so as to project beyond the outer end of the bed-piece 22, the free ends of said arms having box-bearings d , adapted to receive the journal ends of the transverse sprocket-shaft 36, which are loosely held therein. Upon the sprocket-shaft 36 two sprocket-gears 37 are secured, respectively, adjacent to one of the bracket-arms 35, as indicated in Figs. 1 and 7.

Two sprocket-gears 38 are mounted and affixed upon the hollow shaft 26 in alinement with the similar gears 37, and upon each pair of alined gears an endless sprocket-chain 39 is mounted in taut condition. A crank-handle 40 is secured upon the extremity of the shaft 26, which projects outside of the spur-gear 33, or, if preferred, any equivalent device may be substituted for the crank-handle. It will be evident that by a rotatable movement of the crank-handle 40 in the direction of the arrow z' in Fig. 2 the sprocket-chains 39 will be moved so that their upper runs will travel toward the sprocket-gears 37.

A gathering and drawing frame 42 is provided as an essential adjunct for the formation of a flat sheet or plate of glass according to my invention and is constructed essentially as follows: A gathering-bar *e* extends across the lower portion of the frame and near its ends is joined with the depending side members *e'*, which are formed or secured upon a transverse top member of the frame. A pair of spaced collars *e''* may be formed or affixed upon the top cross-bar of the gathering-frame near its center for the retention of a link-bar 41 in connection with said top cross-bar, as shown in Fig. 11, the frame 42 being likewise shown in Fig. 17. On the ends of the gathering-bar *e* transverse projections in the form of short flanges or ears *e'''* project laterally therefrom, these projections serving to hold melted glass and bind a gathered charge of glass upon the ends of the bar, as will be hereinafter more fully explained. A cross-bar 43 extends between the two sprocket-chains 39 and is secured by its ends thereto at opposite points, so as to dispose said cross-bar at right angles to the runs of the chains, and upon the cross-bar 43 at or near its center of length the remaining end of the link-bar 41 is loosely secured. The relative proportions of the gathering-frame and link-bar are such as will permit these parts to be lowered by the downward movement of the chains 39 and cross-bar 43 over the sprocket-gears 38 and enter a proper distance within the glass-holder 20 through the straight slot 20^b in the cover-plate 20^a, such an operation evidently resulting from a rotatable movement of the crank-handle 40, the gathering-frame being shown in position for its descent into the holder in Fig. 11.

Above the glass-holder 20 a fluid-jet device is positioned, the purpose of which is to throw hot or cold jets upon a sheet or plate of glass which is in process of formation. As shown, the jet device essentially comprises a tubular oblong body 44, to one side member of which the conduit-tube 45 is joined for conducting air or gaseous vapor to said body, and the latter is perforated to provide a series of spaced perforations *h* on its inner side. An arched tubular member 44^a may be joined to the side portion of the oblong body 44, which latter is tapped by the conduit-tube 45, and this attached member 44^a also has a series of spaced perforations *h* formed in it for the escape of air or gaseous vapor therefrom. The conduit-tube 45 is hung from the lower side of the bed-piece 22 by the bracket 22^a and also by its engagement with supports 22^b, that are held transversely upon upright members of the main frame 21, as represented in Figs. 2, 6, and 8. Two supply-pipes 46 46^a extend laterally from the conduit-tube 45 and are when complete of a length which permits their attachment, respectively, to a source of air-supply under pressure and an inflammable gas supply, also under pressure. A suitable valve 47 is introduced in the air-supply

pipe 46, and a valve 48 is connected with the air-supply pipe 46^a, these valves serving to control the flow of gas or air into the tubular conduit 45. A valve 49 may also be introduced in the conduit-tube 45, near the oblong body 44, to graduate the flow of fluid from its perforations or cut off the fluid from said body. The conduit-tube 45 may with advantage be extended from the hanger-bracket 22^a to the outer end of the bed-piece 22 and have a jointed section 45^a held to rock thereon, this tube-section carrying a transverse jet-pipe 45^b and a valve 45^c, the latter affording means to cut off the escape of gaseous vapor from the jet-pipe 45^b or graduate its discharge from the series of spaced perforations *h* formed in the side thereof which is nearest to the end of the bed-piece 22.

Upon the hollow shaft 26 two similar scoring-wheels 50 are affixed, respectively, near the opposite side members of the main frame 21, and upon the hollow shaft 27 two scoring-wheels 51 are secured, which are respectively positioned in alinement with the wheels 50. The peripheries of the scoring-wheels on one hollow shaft may have each a rib projected therefrom, which ribs are directly opposite grooves formed one in each scoring-wheel that is fixed upon the other hollow shaft, so that by a rocking movement of the handle-bar 32 the scoring-wheels 51 on the shaft 27 may be moved to engage with the wheels 50 on the other shaft 26.

In the operation of the complete apparatus if flat sheets or plates of glass are to be formed the glass-holder 20 is supplied with molten-glass composition from the furnace 19 and the cover-plate having the straight transverse slot 20^b in it is placed upon the holder. The gathering-frame 42 is now lowered into the holder 20, passing down through the slot 20^b, this being effected by manipulation of the crank-handle 40 and consequent longitudinal movement of the sprocket-chains 39 in the direction of the arrow *z* in Fig. 1. When there is a coating of glass formed upon the cross-bar *e* and ears *e'''*, due to the chilling of the melted glass by the cool bar, said gathering-bar and ears will be firmly connected with the molten composition held in the reservoir 20. A slow reversed movement of the crank-handle 40, or in the direction of the arrow *z'* in Fig. 2, will draw the gathering-frame 42 upwardly and then horizontally toward the outer end of the forming-plate 23. A current of cool air from the conduit-tube 45 is permitted to escape from the jet-orifices in the tubular body 44 and the arched piece 44^a, and as said body surrounds the slot 20^b it will be apparent that the air thus expelled will project toward the frame 42 as it rises from the holder 20. A quantity of the hot glass composition will adhere to the chilled portion thereof that is fast to the gathering-frame, and the cool-air current striking this adhering material as it emerges from the slot in the holder cover-plate will render the glass vis-

cous by lowering its temperature a proper degree. The tenacity of the sheet or plate of glass thus started in formation will enable a continuation of the operation to be effected

5 by the slow rotation of the crank-handle 40, as before mentioned, and will result in the drawing of a sheet or plate of glass from the holder 20 up and then horizontally over the forming-plate 23, whereon it will eventually

10 rest and be rendered level. The forming-plate 23 may have an asbestos-board covering secured upon its upper surface, as indicated at 23^a, to prevent a sudden chilling of the plate, it being essential that the glass

15 sheet or plate shall cool gradually to prevent it from cracking. It is also feasible to dispense with the asbestos covering 23^a if the forming-plate is heated somewhat before it is placed in position on the bed-piece of the

20 machine. While the sheet or plate of glass is in process of formation the scoring-wheels on the hollow shaft 26 will be in loose contact therewith near the side edges of the glass and support the same. This mechanism en-

25 ables the sheet to be drawn of uniform width and thickness and relieves the strain from the gathering-bar *e*. Simultaneously with the drawing of molten glass from the holder 20 the movable hollow shaft 27 and scoring-wheels

30 on it are moved toward the scoring-wheels on the shaft 26, so that the scoring-wheels on the shaft 27 will forcibly bear upon the soft sheet or plate of glass as it is being upwardly drawn. The beads and grooves on the scoring-wheels

35 50 51 will cause the hot sheet or plate of glass as it is moving to be indented or scored near each side edge thereof, so that parallel and straight edges may be produced if the material outside of the scores *m* on the sheet or

40 plate A is removed by breaking this surplus material away from the plate or sheet of glass where it is scored. (See Fig. 7.) As the drawing-frame 42 has been moved to the outer end of the forming-plate 23 when a glass sheet

45 or plate A is completed and rests upon the forming-plate, it is essential that safe means be provided to detach the frame near its gathering-bar *e* from the glass plate. To effect this, the jointed section 45^a of the con-

50 duit-tube 45 is rocked upwardly into the position indicated in Figs. 1, 5, and 6, so that the jet-pipe 45^b will be disposed above and near to the drawing-frame 42. A flow of mixed air and gas is now introduced into the

55 conduit-tube 45 from the supply-pipes 46 46^a, and this inflammable gaseous vapor is ignited as it escapes from the jet-orifices in the body 44 and jet-pipe 45^b. The heat evolved by combustion of the inflammable vapor that

60 escapes in jets from the ring 44 and pipe 45^b will speedily melt the glass from the drawing-frame and also sever the sheet from the stub portion that projects up from the holder 20 through the slot 20^b, and in this manner

65 the completed sheet or plate of glass is detached from the drawing-frame and glass in the holder 20. It will be evident that the

stub portion which has been cut from the plate or sheet of glass will drop by its gravity back into the molten material and become 70 melted again.

It is to be understood that a proper number of forming-plates 23 is to be supplied, and when a plate or sheet of glass has been formed on one of said plates the plate of glass 75 and its support may be removed from the bed-piece 22 and placed in an annealing-oven, if this is desired. A duplicate forming-plate is then placed in position on the bed-piece for a renewal of the operation, so that the manu- 80 facture of the sheets or plates of glass may be continued indefinitely. Of course the finished sheet or plate of glass may be rendered square and true on the ends and cut into pieces, if desired. 85

If it is desired to give plates or sheets of glass a transversely-curved body, the forming plate or plates are convexed in cross-section upon their upper surface a proper de- 90 gree to give the required curvature to the sheets or plates of glass.

The gathering and drawing frame 42^a is employed when bent glass plates are to be manufactured, and, as shown in Figs. 14 and 15, this drawing-frame is substantially similar to 95 the drawing-frame 42, with the exception that the gathering-bar *n* thereon is laterally curved to adapt it to pass freely through the curved slot 20^c in the cover-plate 20^a. In operation the drawing-frame 42^a is connected to the 100 cross-bar 43, as already described with regard to the drawing-frame 42, and the concave side of the gathering-bar *n* is arranged to contact with the convex top surface of the forming-plate 24 as this drawing-frame is 105 moved lengthwise of the forming-plate. The plate or sheet of glass initially formed by the curved drawing-bar *n* on the frame 42^a will assume the curvature of said bar, and as the sheet or plate is drawn over the convex sur- 110 face of the forming-plate 24 the hot glass plate will conform to the convexity of the forming-plate and take its shape in cross-section therefrom. It is to be understood that a plurality of the forming-plates 24 may be 115 supplied to be used successively, as specified with regard to the forming-plates 23, and also that the means for detachment of a completed plate or sheet of glass from glass in the holder 20 and from the drawing-frame 42, already 120 described, may with advantage be employed.

In further explanation of the scoring device comprising the paired wheels 50 51 and shafts 26 27, rotatably supporting said wheels, it is preferred to render these shafts hollow 125 and open at their ends, thus permitting the free passage of air therethrough to prevent the shafts from becoming excessively hot. Furthermore, if found necessary for the better support of the plastic sheet or plate of 130 glass as it passes up from the holder 20 duplicates of the sets of scoring-wheels 50 51 may be held to rotate with a pair of transverse shafts mounted loosely upon a suitable

support, these supplementary wheels and shafts carrying them, if employed, being located between those shown and the top of the holder, as indicated in dotted lines at 50^a in Fig. 8.

5 With the improved apparatus sheets or plates of glass may be formed of a desired width and length defined by the dimensions of the apparatus, and the completed sheets or plates, which are produced rapidly, will be measurably perfect and require little labor to finish them.

By my improved apparatus the plates of glass are bent while hot to a desired curvature and at one operation, thereby saving time and labor.

In the drawings I have shown one machine for drawing sheets or plates of glass; but, as indicated in Fig. 1, the main frame 21 may be extended at one end for the accommodation of a complete duplicate machine to be employed in connection with another furnace and glass-holder, so that the plant for the manufacture of glass sheets or plates may be increased to double its capacity if this is necessary.

It is to be understood that some minor details of construction may be changed in form and arrangement without exceeding the scope of the invention. Hence I do not desire to limit myself to the precise shapes and arrangement of parts shown.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

35 1. In a sheet or plate glass forming apparatus, a holder for molten glass, a form for shaping the sheet or plate of glass, a gathering device movable into and out of the holder and also movable lengthwise of the form, and mechanism for inserting the gathering device into the holder and then moving it, with the glass adhering thereto, lengthwise of the form.

40 2. In a sheet or plate glass forming apparatus, a holder for molten glass, a form for shaping the sheet or plate of glass, a gathering device movable into and out of the holder and also lengthwise over the form, and mechanism for dipping the gathering device into the holder, then raising it with the glass adhering thereto, and finally drawing it, with the glass, lengthwise over the form.

50 3. In a sheet or plate glass forming apparatus, a holder adapted to receive molten-glass composition from a furnace, a glass-gathering device insertible within the holder to become attached to the molten-glass composition, means to draw the gathering device from the holder over a form, producing a drawn sheet or plate of glass, and a device adapted to blow a cool current upon the sheet or plate while in process of formation.

60 4. In a sheet or plate glass forming apparatus, a holder adapted to receive molten-glass composition from a furnace, a glass-gathering device insertible within the holder to become attached to the molten-glass composition, means to draw the gathering device from the

holder over a form, producing a drawn sheet or plate of glass, and a device adapted to blow jets of ignited inflammable vapor upon the completed sheet or plate of glass near its extremities, to release it from the mass of glass composition in the holder and also from the gathering and drawing device.

5. In a sheet or plate glass forming apparatus, the combination with a holder containing molten-glass composition, and a supported form, of a gathering and drawing device insertible within the holder, mechanism for moving the gathering device over the form, and a device adapted to indent parallel scores near the side edges of the sheet or plate.

6. In a sheet or plate glass forming apparatus, the combination with mechanism adapted to draw a sheet or plate of glass from a mass of molten-glass composition, of a plurality of supported rotatable scoring-wheels, adapted to indent parallel grooves in the moving sheet or plate of glass near its side edges.

7. In a sheet or plate glass forming apparatus, the combination with mechanism adapted to draw a sheet or plate of glass from a mass of molten-glass composition contained in a holder, of a forming-plate supported above the holder, a pair of shafts held to rotate across and above the holder, one movable toward the other, and pairs of scoring-wheels mounted upon said shafts and adapted to indent parallel grooves in the moving sheet or plate of glass near its side edges.

8. In a sheet or plate glass forming apparatus, the combination with mechanism adapted to draw a sheet or plate of glass from a mass of molten-glass composition contained in a holder, of a form supported above and in sequence with the holder, to receive the drawn sheet or plate of glass, and a fluid-jet device adapted to project cool air upon the sheet or plate of glass issuing from the holder, to reduce its temperature.

9. In a sheet or plate glass forming apparatus, the combination with a holder containing molten-glass composition, a form adapted to receive the glass, of a glass gathering and drawing frame movable lengthwise of the form, and mechanism adapted to progressively move the gathering and drawing frame so as to insert it into the molten glass and subsequently move it lengthwise over the form to cause glass drawn by the frame to take shape from the form.

10. In a sheet or plate glass forming apparatus, the combination with a holder containing molten glass, a supported form at one side of the holder, a glass gathering and drawing frame insertible in the holder, and mechanism adapted to dip the gathering-frame in the holder and subsequently move it over the form, of a scoring device for removing rough side edges of the glass sheet or plate while forming, and a fluid-jet device adapted to blow cool air on the glass sheet or plate as it issues from the holder, and also to project jets of ignited gaseous vapor across the com-

pleted sheet or plate near its ends, to release said plate or sheet.

11. In a sheet or plate glass forming apparatus, a holder for molten glass, a form for shaping the sheet or plate of glass, said form having a convex top surface, a gathering device movable lengthwise over the form and provided with a curved gathering-bar, and means for dipping the gathering-bar into the holder, then raising it with the glass adhering thereto, and finally drawing it, with the glass, lengthwise over the form.

12. In a sheet or plate glass forming apparatus, a glass gathering and drawing device, comprising a gathering-bar having ears or projections at its ends, and means for operating said bar.

13. In a sheet or plate glass forming apparatus, the fluid-jet device comprising a conduit-tube, a tubular body at one end of said conduit-tube, and foraminated on its inner side, a transverse jet-pipe foraminated along one side and pivotally attached to the opposite end of the conduit-tube, an air-supply, a gas-supply to induct mixed air and gas through the conduit-tube into said body and jet-pipe, and valves for the control of air and gas into and from said body and jet-pipe.

14. In a sheet or plate glass forming apparatus, the glass gathering and drawing device, comprising a skeleton frame having a gathering-bar at the lower part thereof, joined to side bars and a top bar, ears on the ends of the gathering-bar, and means to connect the top bar with drawing mechanism.

15. In a sheet or plate glass forming apparatus, the combination with the glass gathering and drawing frame, of means to progressively move said frame, comprising pairs of rotatably-supported sprocket-gears, a sprocket-chain engaging each aligned pair of sprocket-gears, a cross-bar connecting the chains, and a loose suspending connection between the cross-bar and gathering-frame.

16. In a sheet or plate glass forming apparatus, the combination with a glass gathering and drawing frame, comprising a curved gathering-bar, side members and a top cross-bar, of a supported form having a convex top surface, and means to progressively move the gathering-frame over the form, comprising two rotatable shafts held one at each end of the form, sprocket-gears on said shafts, aligned in pairs, and a sprocket-chain mounted on each pair of gears.

17. In a sheet or plate glass forming apparatus, the combination with a frame, and a support thereon, of a longitudinally-elongated

forming-plate, the top surface of which is in conformity with the shape of the glass plate or sheet to be formed, a longitudinally-extended rack on the lower side of the forming-plate, a rotatable cross-shaft on the frame, a pinion on the shaft adapted to mesh with the rack, and a crank-handle or the like at the outer end of said shaft.

18. In a sheet or plate glass forming apparatus, the combination with a frame, boxing on the side members of the frame, adapted to slide longitudinally, a rack above each box and connected thereto, a rotatable transverse shaft held above the racks, spur-gears on the shaft respectively meshing with one of the racks, and means to rock the shaft.

19. In a sheet or plate glass forming apparatus, the combination with a frame, boxes on the side members of said frame, one pair of boxes being adapted to slide toward the other, a cross-shaft in each pair of boxes, said shafts being held in parallel planes, a rack attached upon each slidable box, a rotatably-supported transverse shaft over the racks, spur-gears held on the shaft and respectively meshing with the racks, and means to rock said shaft.

20. In a sheet or plate glass forming apparatus, the sheet or plate scoring device, comprising wheels secured oppositely in pairs upon rotatable transverse parallel shafts, one shaft being adapted to receive adjustment toward and from the other shaft, and each pair of scoring-wheels having a projecting rib formed on the periphery of one wheel, and a mating groove formed in the periphery of the other wheel.

21. In a sheet or plate glass forming apparatus, a holder for molten glass, a frame having a slideway, a form movable in said slideway, means for sliding the form, and a gathering and drawing device for taking molten glass from the holder and drawing it over the form.

22. In a sheet or plate glass forming apparatus, a holder for molten glass, a gathering and drawing device for dipping into said holder and withdrawing glass therefrom in the condition of a sheet, a form over which the gathering and drawing device is arranged to move lengthwise, and devices, located at the receiving end of the form and arranged to engage the glass sheet at the edges.

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

LAWRENCE H. DOLAN.

Witnesses:

CHAS. E. GOODRICH,
F. L. STONE.