No. 810,723. PATENTED JAN. 23, 1906.

J. CRAIG & R. E. ROWAN.

APPARATUS FOR FLATTENING GLASS.

APPLICATION FILED DEC. 28, 1904.

3 SHEETS—SHEET 1.

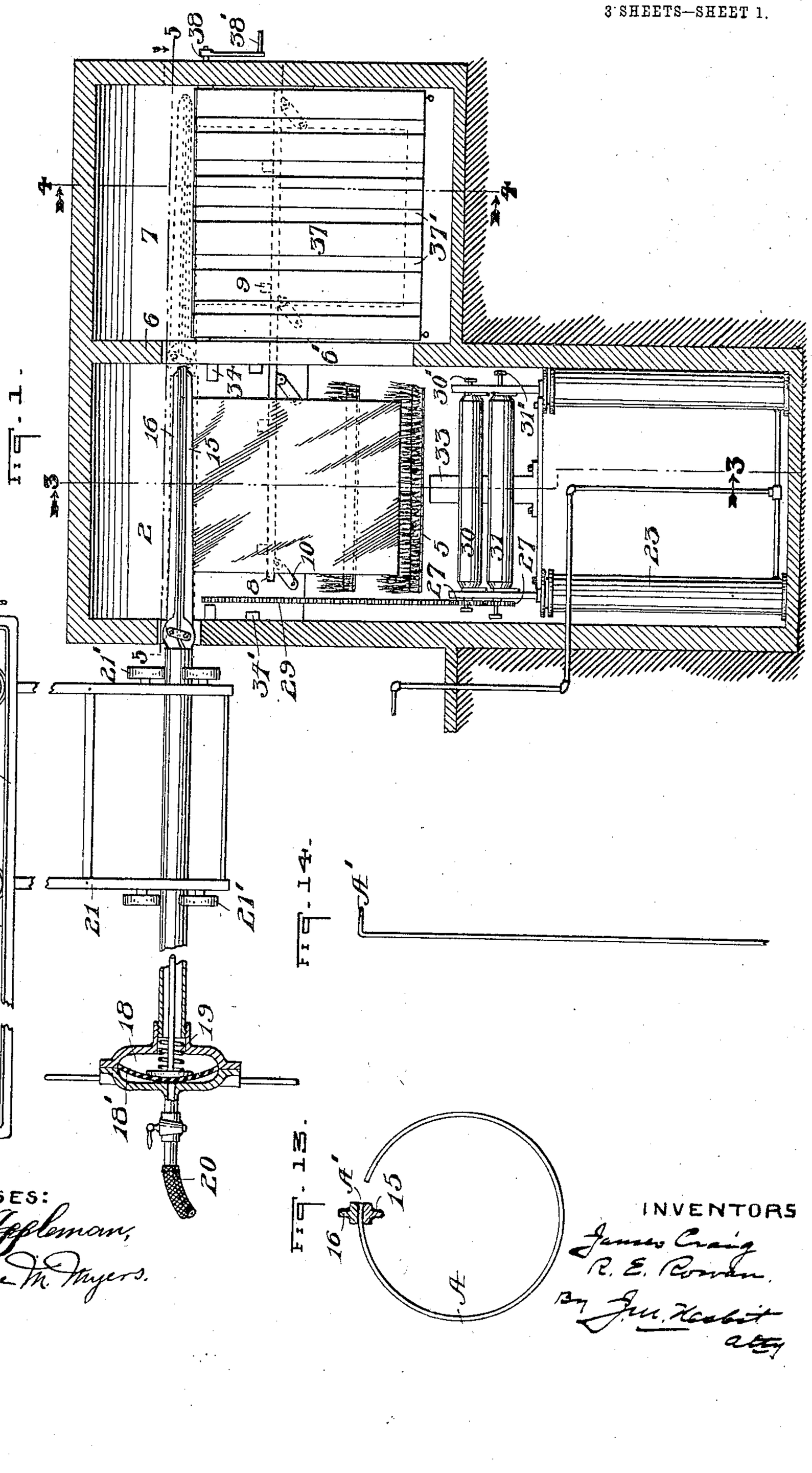

FIG. 1.

FIG. 14.

FIG. 13.

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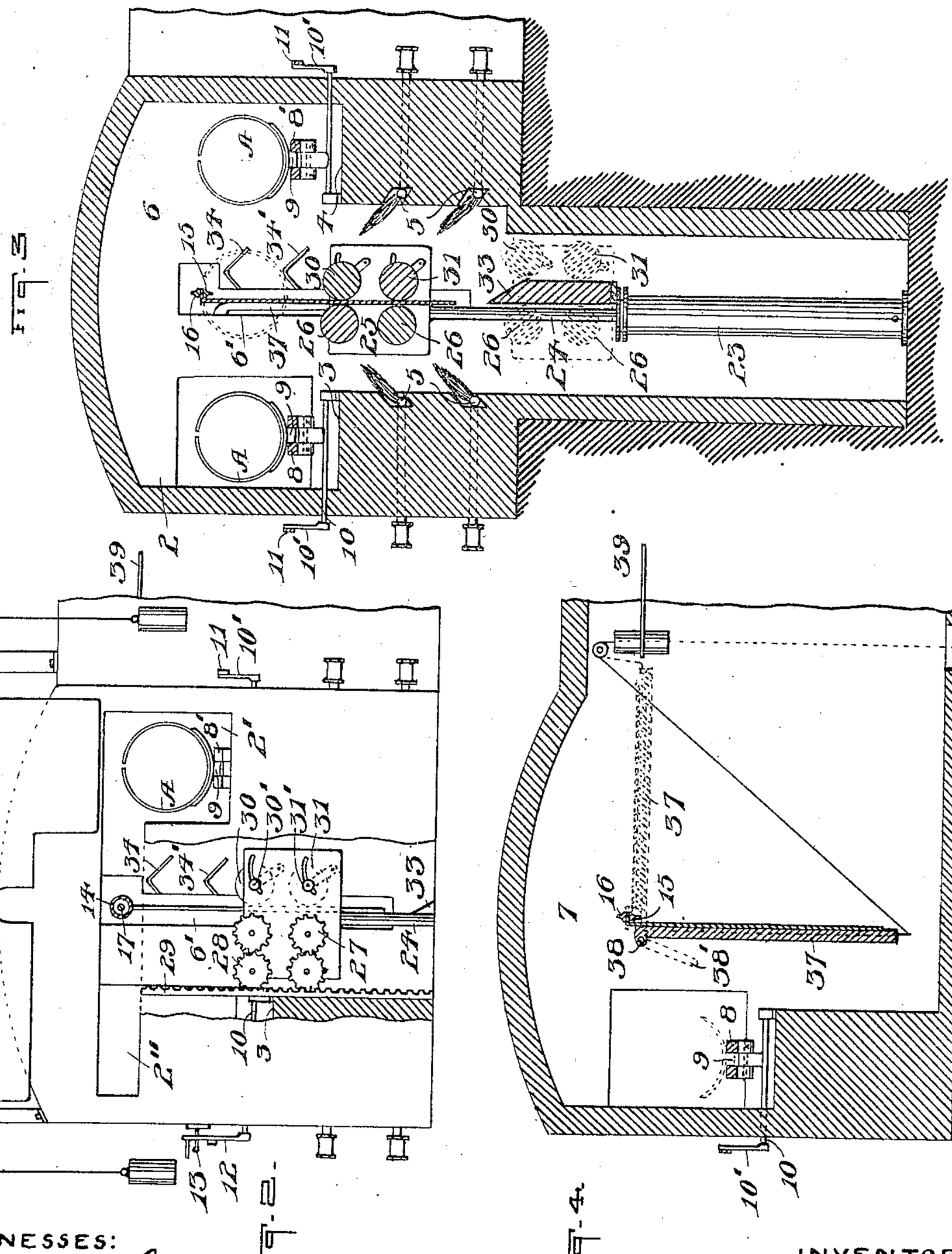

FIG. 2.

FIG. 3.

FIG. 4.

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3 SHEETS—SHEET 3.

Fig. 5.

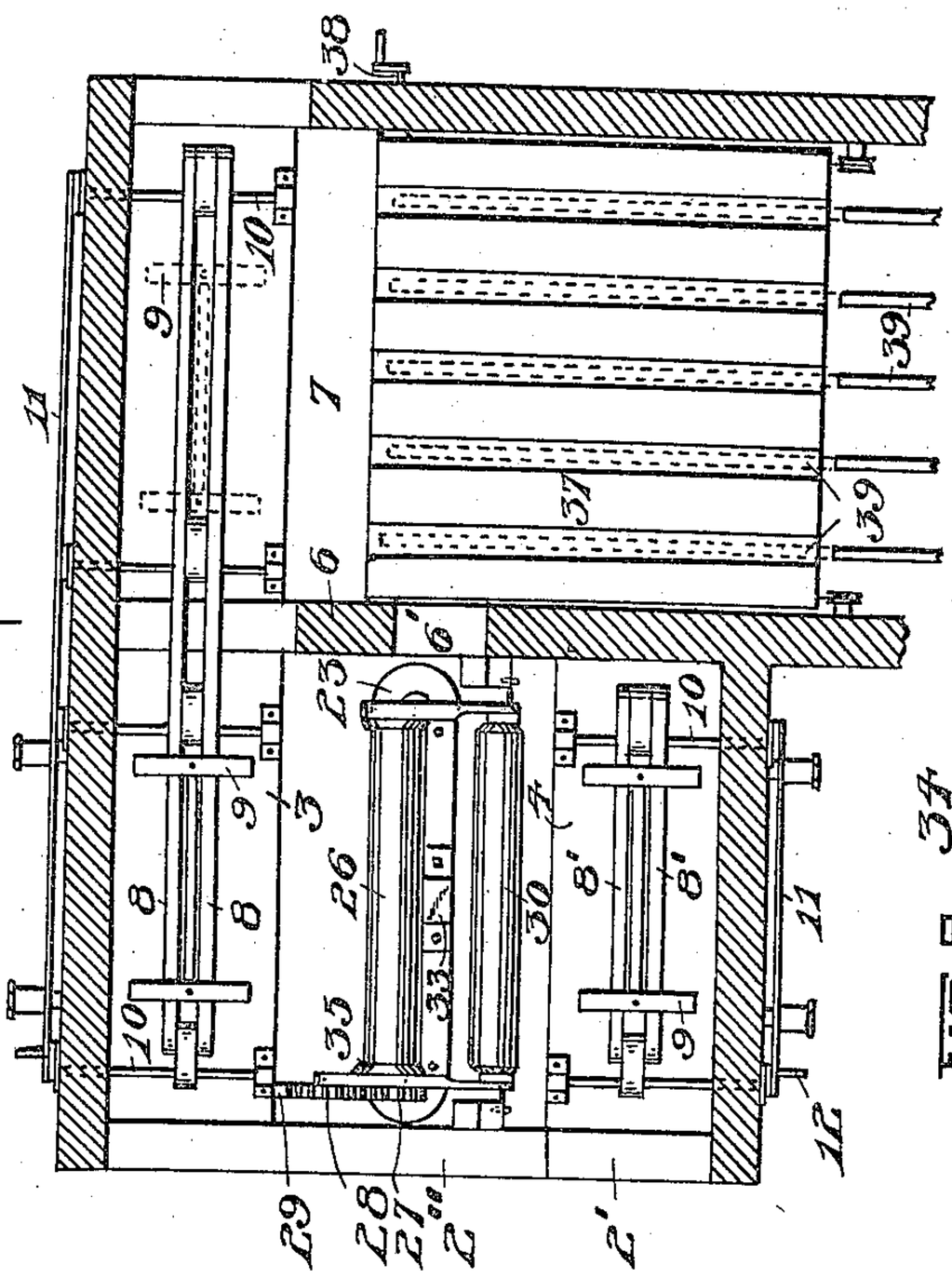


Fig. 10.

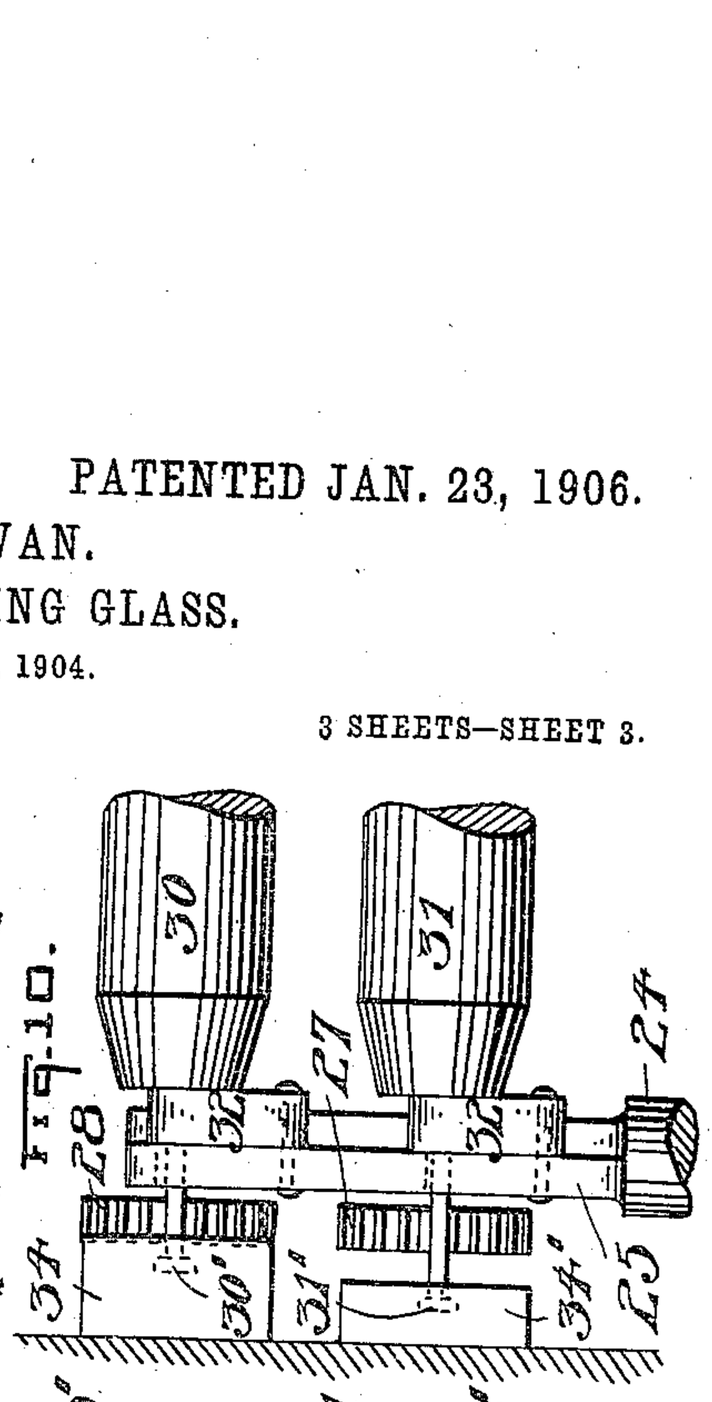


Fig. 9.

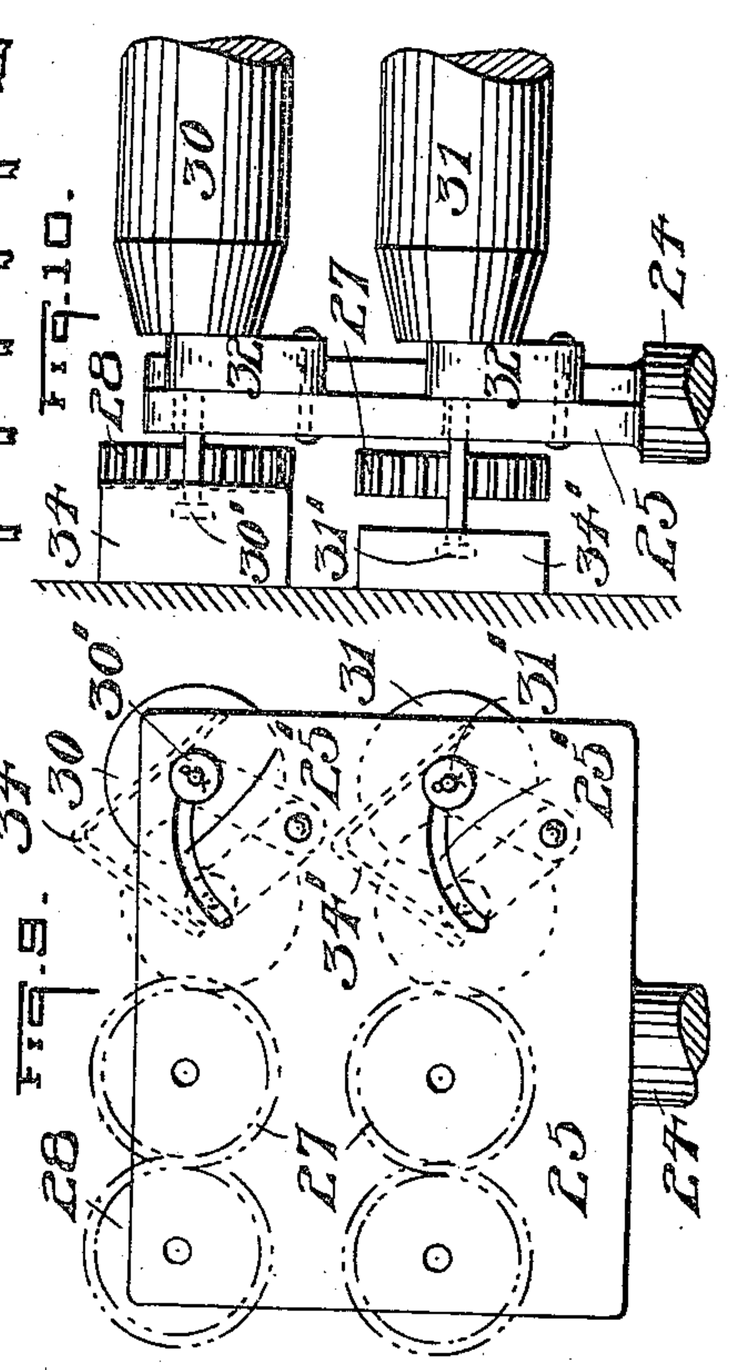


Fig. 12.

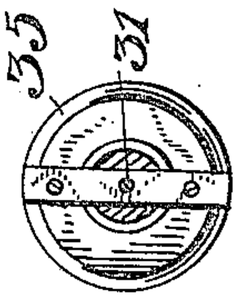


Fig. 8.

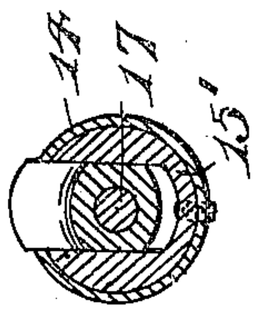


Fig. 6.

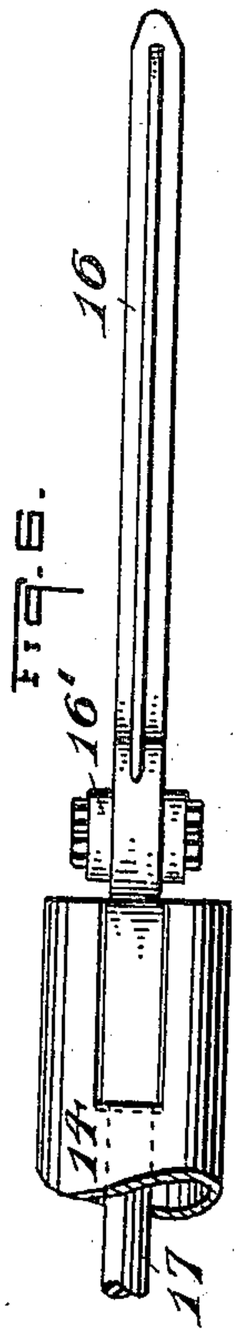


Fig. 7.

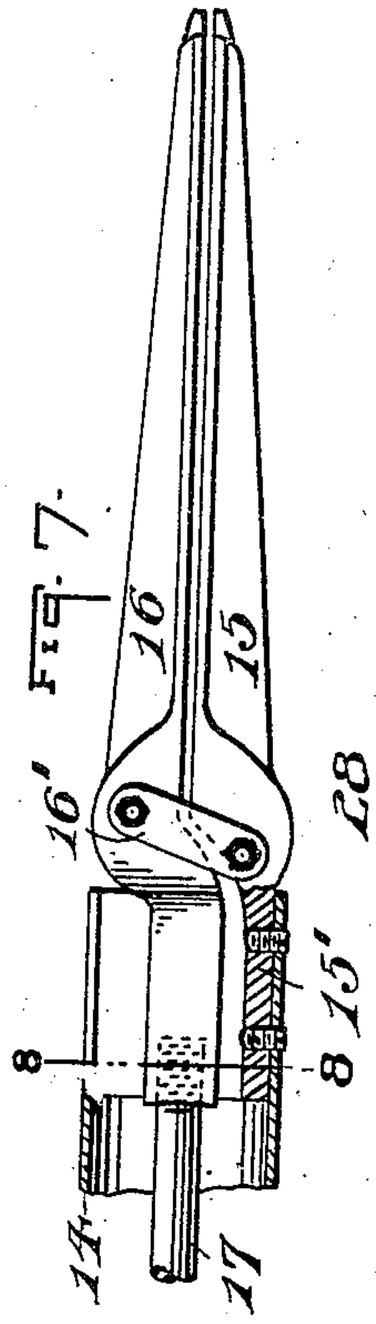
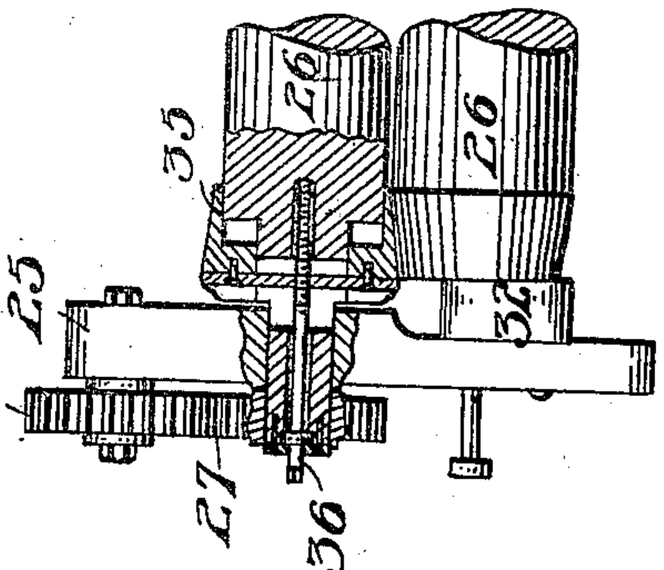


Fig. 11.



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UNITED STATES PATENT OFFICE.

JAMES CRAIG AND ROBERT E. ROWAN, OF PARNASSUS, PENNSYLVANIA.

APPARATUS FOR FLATTENING GLASS.

No. 810,723. Specification of Letters Patent. Patented Jan. 23, 1906.

Application filed December 28, 1904. Serial No. 238,605.

To all whom it may concern:

Be it known that we, JAMES CRAIG and ROBERT E. ROWAN, citizens of the United States, residing at Parnassus, in the county of Westmoreland and State of Pennsylvania, have invented certain new and useful Improvements in Apparatus for Flattening Glass, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to apparatus for flattening sheet-glass, and has particular reference to the flattening of blown-glass cylinders into window and other sheet glass.

The primary object of the invention is to provide simple and efficient apparatus for practicing the method of flattening described and claimed in our application for Letters Patent, Serial No. 177,371, filed October 17, 1903.

Under the present practice after the cylinders are blown they are capped off—that is, their closed ends are cracked off and they are cracked from end to end, so that when heated in the flattening-oven they will open and flatten out, and as the movable flattening-stone carries the sheets progressively past the several stations of the oven they are operated upon by smoothing-tools in the hands of skilled flatteners in such manner that when they reach the oven-discharge for passage into the annealing-leer they are flat and quite as free from irregularities as by such flattening process it is possible to make them. By this old method only the upper face of the glass is operated upon, the under face remaining flat upon the stone, with the result that in some instances the opposite faces of the sheets are subjected to unequal temperatures. Furthermore, any irregularities in the stone or particles of foreign matter thereon make their impress in the glass, and the resulting flaws are the cause of considerable waste.

With our improved method, wherein we obviate the difficulties above noted, the glass is flattened while supported with both surfaces freely exposed in the successive temperatures incident to the flattening operation. We accomplish this by inserting the cracked cylinders in an oven, wherein they are suspended by one longitudinal edge and subjected to sufficient heat to cause them to uncurl and drop by gravity into the form of substantially flat sheets. The conditions may be such that the glass will thus flatten into commercial form; but as such conditions would probably be exceptional we provide for evening the sheets while suspended by subjecting their surfaces to opposing pressures applied, preferably, by rolls which may be passed thereover a sufficient number of times to impart an absolutely perfect and even finish, also a gloss that is unobtainable by the old method of flattening. After the sheets have been flattened and while still in upright position they are passed, preferably, into an intermediate or cooling chamber and are there turned to horizontal position and received by the traveling rods of the leer in which they receive the final annealing.

In the accompanying drawings, Figure 1 is a longitudinal sectional view of apparatus constructed in accordance with our invention. Fig. 2 is a front elevation of the flattening-oven, a portion of the front wall being broken away. Fig. 3 is a vertical cross-sectional view taken on line 3 3 of Fig. 1, and Fig. 4 is a similar view taken on line 4 4 of the same figure. Fig. 5 is a sectional plan view. Figs. 6, 7, and 8 are detail views of the glass-gripping device, Fig. 8 being a cross-sectional view taken on line 8 8 of Fig. 7. Figs. 9, 10, 11, and 12 are detail views of the roll mechanism. Figs. 13 and 14 are views illustrating the shape of the glass before and after the flattening operation.

Referring to the drawings, 2 designates the flattening-oven, having its lower portion contracted, thus forming the opposite ledges 3 and 4, which are sufficiently separated to receive the roll mechanism presently to be described. Situated in the opposite walls of this narrowed portion are gas-burners 5. A partition 6 separates oven 2 from the cooling and transfer chamber 7, into which the flattened sheets are passed through the narrow partition-opening 6′.

The partition 6 is formed with an opening in line with ledge 3, and extending over the latter and through chamber 7 are parallel track-forming bars 8, and slidable thereon is a carriage or cradle 9, which sustains a glass cylinder or roller, the latter being first introduced into chamber 7, where it is heated in a preliminary way before passing into flattening-oven 2. Similar track-bars 8′ may be positioned over ledge 4; but as the arrangement of the apparatus is such that these bars cannot extend through chamber 7 it is necessary to introduce the glass through an opening 2′ in the front of the oven. It is neces-

sary to sustain the cylinders at a uniform elevation when attaching the suspending means presently to be described, and as the cylinders vary in size we have provided for raising and lowering tracks 8 and 8′ by securing them to the short rock-shafts 10, with an exterior bar or link 11 connecting the crank-arms 10′ on the projecting ends of the rock-shafts, an actuating-crank 12 being provided, which is held in desired adjustment by pin 13.

The longitudinally-cracked cylinders A are placed on carriages 9 with the cracks uppermost, and while in position in either side of the flattening-oven the suspending means is clamped or attached to one of the longitudinal cracked edges A′. The suspending means is preferably in the form of tongs, which are carried by the inner end of a tubular bar 14, which is operative through horizontal slot 2″ in the front of the oven. The bottom jaw 15 of the tongs is secured to bar 14, the extremity of the jaw being in the form of a slotted head 15′, which is secured within the bar extremity. The movable jaw 16 is secured to rod 17, extending through tubular bar 14, and said jaw is connected to jaw 15 by links 16′, which operate to either close or open the tongs as rod 17 is moved longitudinally. For thus moving the rod its outer end extends into diaphragm-chamber 18, carried by the extremity of bar 14, and bears against diaphragm 18′. A spring 19 operates to hold rod 17 normally retracted and the jaws open. Air under pressure supplied from any suitable source is admitted to chamber 18 through flexible pipe 20, and under this air-pressure diaphragm 18′ operates to move inward rod 17 and close and hold closed the tongs, with edge A′ of the glass clamped and securely held therebetween.

The glass clamping or sustaining mechanism is necessarily movable across oven 2, so that the cylinder or roller on either of tracks 8 or 8′ may be engaged. This may be conveniently accomplished by supporting bar 14 in a frame 21, suspended from overhead crane 22, whereby the sustaining mechanism may be moved toward or away from the oven, also across the same, as may be required. Bar 14 is preferably sustained within frame 21 by rollers 21′, so that it may be easily turned for manipulating the tongs.

After the cylinder has been engaged by the tongs in the manner described cradle 9 may be lowered by depressing the track-bars, and bar 14 is moved laterally, so as to position the cylinder centrally within oven 2, and as the glass softens it drops or straightens by gravity. In some instances the glass may thus flatten to commercial form without further operation; but as a general rule it will be necessary to subject the straightened-out glass to opposing pressures in order to perfectly flatten it, and we will now describe the flattening means, which we have here embodied in opposing rolls for acting on the opposite faces of the sheet.

Positioned within the lower portion of the furnace are two cylinders 23 with pistons 24 thereof, each carrying a head 25, and journaled in these heads are the two driven rolls 26, one above the other. Secured to the journal of each of these rolls is a pinion 27, and meshing therewith are intermediate pinions 28, which in turn mesh with the fixed vertical rack 29. Opposite rolls 26 are two laterally-swinging non-driven rolls 30 and 31, which are journaled between arms 32, pivoted to heads 25. The journals of these rollers project through slots 25′ of said heads and carry antifriction-rollers 30′ and 31′, respectively.

As the roll mechanism moves to lowered position the rolls pass over the fixed wedge 33, which operates to throw outward the swinging rolls 30 and 31, in which position they remain until raised over the suspended sheet of straightened-out glass. As the mechanism approaches the upward limit of its travel the projected journals of the outturned rolls 30 and 31 enter the inverted-**V**-shaped guides 34 and 34′, secured one above the other to the end walls of oven 2. The upper guides 34 are so projected as to be within the path of antifriction-rollers 30′ of the upper swinging roll 30, and the same is true of the lower guide 34′ with respect to the roller 31′ of the lower swinging roll 31. As the outwardly-turned roll-journals enter these guides and continue to move upward they are turned inward by contact with the inclined guide-faces; but after the said rolls have been turned past their centers of gravity the said guides operate to move the rolls slowly and easily into contact with the sheet of glass and prevent injury thereto. The swinging rolls are thus brought into opposing relation with the driven rolls 26 and are held in such position by their own weight, and as the roll mechanism is lowered the opposing rolls, acting on the opposite faces of the glass, operate to smooth or straighten the same, removing all abrupt irregularities or protuberances that may have been formed in either surface of the blown cylinder.

While the arrangement is preferably such that the glass is operated on only while the rolls are moving downward, the invention is not limited in this regard.

It is desirable to maintain a space between the opposing rolls corresponding to the desired thickness of the finished sheet in order to avoid excessive thinning or stretching, and as this space may vary with different grades of glass we provide adjustable means for maintaining the same in the form of cone-shaped sleeves 35 at the ends of rolls 26. Rolls 30 and 31 bear against these sleeves and maintain the required space between the rolls. For varying this space the sleeves are

adjusted either inward or outward by screws 36, fixed in the extremities of the roll-journals.

After the glass has been perfectly flattened and finished by one or more passages of the rolls thereover the latter are allowed to remain in lowered position and bar 14 is moved inward and carries the flattened sheet through partition-opening 6′ into chamber 7 and in front of the downwardly-turned backstone or plate 37, mounted on shaft 38, carrying operating-crank 38′ at its outer end. The backstone is then turned, and with it the glass sheet, to horizontal position, this movement being assisted by counterweighted lines, as shown. Tong-carrying bar 14 readily turns between rollers 21′ and accommodates itself to the turning movement of the sheet. The air-pressure acting on diaphragm 18′ is then released, when spring 19 throws outward rod 17, thus opening and releasing the tongs, which are withdrawn into or entirely through oven 2, as may be necessary for attaching them to a fresh cylinder A. Backstone 37 is grooved on its top face at 37′ to receive the longitudinally-movable leer-rods 39, which are projected beneath the sheet of glass and operate to lift the same from the backstone and carry it forward into the leer. As the construction and operation of rod-leers are well understood by those skilled in the art, we deem it sufficient to show only portions of the rods.

The edge A′ of the glass which is gripped by the tongs being at right angles to the body of the suspended sheet, the hold is very secure and there is no danger of the glass slipping therefrom. As there is more or less waste in cutting all sheet-glass due to irregular edges, &c., the waste occasioned by this turned edge is of no moment.

With our improved apparatus the flattening is accomplished entirely by mechanical operations, thus doing away with expensive skilled labor and increasing the output as compared with the old method of manual flattening.

As we believe ourselves to be the first to provide apparatus for subjecting heated glass to opposing pressures for the purpose of flattening it while held suspended, we do not confine ourselves to the means or mechanism herein shown and described for accomplishing the same. Thus it will be understood that the invention may be variously embodied without departing from the spirit and scope thereof as defined by the appended claims.

We claim—

1. Glass-flattening apparatus comprising an oven, glass-holding means therein from which sheet-glass is adapted to be freely suspended, and means movable vertically within the oven for subjecting the freely-suspended glass to opposing pressures.

2. Glass-flattening apparatus comprising an oven, glass-holding means therein from which sheet-glass is adapted to be freely suspended, and glass-rolling mechanism movable vertically over the freely-suspended glass.

3. Glass-flattening apparatus comprising an oven, glass-holding means therein from which sheet-glass is adapted to be freely suspended, and opposing rolls movable vertically within the oven for operating on opposite surfaces of the freely-suspended glass.

4. Glass-flattening apparatus comprising an oven having a laterally-contracted lower portion, glass-holding means operative above the said contracted portion for sustaining the glass freely suspended therein, and heating means at opposite sides of said contracted portion.

5. Glass-flattening apparatus comprising an oven having a laterally-contracted lower portion, glass-holding means operative above said contracted portion for sustaining the glass freely suspended therein, heating means at opposite sides of the contracted portion, and vertically-movable glass-flattening means operative within said contracted portion.

6. Glass-flattening apparatus comprising an oven having a narrowed or contracted lower portion, a ledge within the oven above and at one side of the contracted portion, a glass-cylinder support above said ledge, and laterally-movable glass-suspending means adapted to engage the cylinder and move it laterally and sustain it above the contracted lower portion of the oven as it uncurls or straightens thereinto.

7. Glass-flattening apparatus comprising an oven, a glass-cylinder support at each side of the oven, the oven being unobstructed downwardly between the supports, and glass-suspending means adapted to sustain the glass when straightened within said downwardly-unobstructed portion of the oven.

8. Glass-flattening apparatus comprising an oven, glass-suspending means, opposing fixed and movable rolls within the oven for engaging opposite surfaces of the glass, and means for moving the rolls vertically over the suspended glass.

9. Glass-flattening apparatus comprising an oven, glass-suspending means, driven rolls within the oven for engaging one surface of the glass, rolls within the oven and movable toward and from the glass for engaging the opposite surface thereof, and means for causing all of the rolls to traverse the glass.

10. Glass-flattening apparatus comprising an oven, glass-suspending means, opposing rolls movable vertically over the surfaces of the glass, means for moving the rolls apart when in lowered position, and means operative when the rolls are raised for moving them into opposing relation.

11. Glass-flattening apparatus comprising an oven, glass-suspending means, opposing fixed and movable rolls within the oven for rolling the opposite surfaces of the glass, the movable rolls being held in engagement with the glass by force of gravity and means for moving the rolls vertically over the suspended glass.

12. Glass-flattening apparatus comprising an oven, glass-suspending means, a movable roll-support within the oven, rolls fixed in said support for engaging one surface of the glass, and rolls movably mounted in the support and constructed and arranged to engage the opposite surface of the glass by force of gravity.

13. Glass-flattening apparatus comprising an oven, glass-suspending means, opposing rolls within the oven adapted to traverse the opposite surfaces of the glass, and means for varying the space between the opposing rolls.

14. Glass-flattening apparatus comprising an oven, a chamber at one side of the oven and separated therefrom by a vertical wall having a vertically-elongated opening, and glass-suspending means movable horizontally within the oven and chamber and through said communicating opening for sustaining the glass in either of said compartments.

In testimony whereof we affix our signatures in presence of two witnesses.

JAMES CRAIG.
ROBERT E. ROWAN.

Witnesses:
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J. M. NESBIT.