No. 625,801. Patented May 30, 1899.

W. PRESTON.

ANNEALING FURNACE FOR GLASS.

(Application filed Nov. 19, 1897.)

(No Model.) 2 Sheets—Sheet 1.

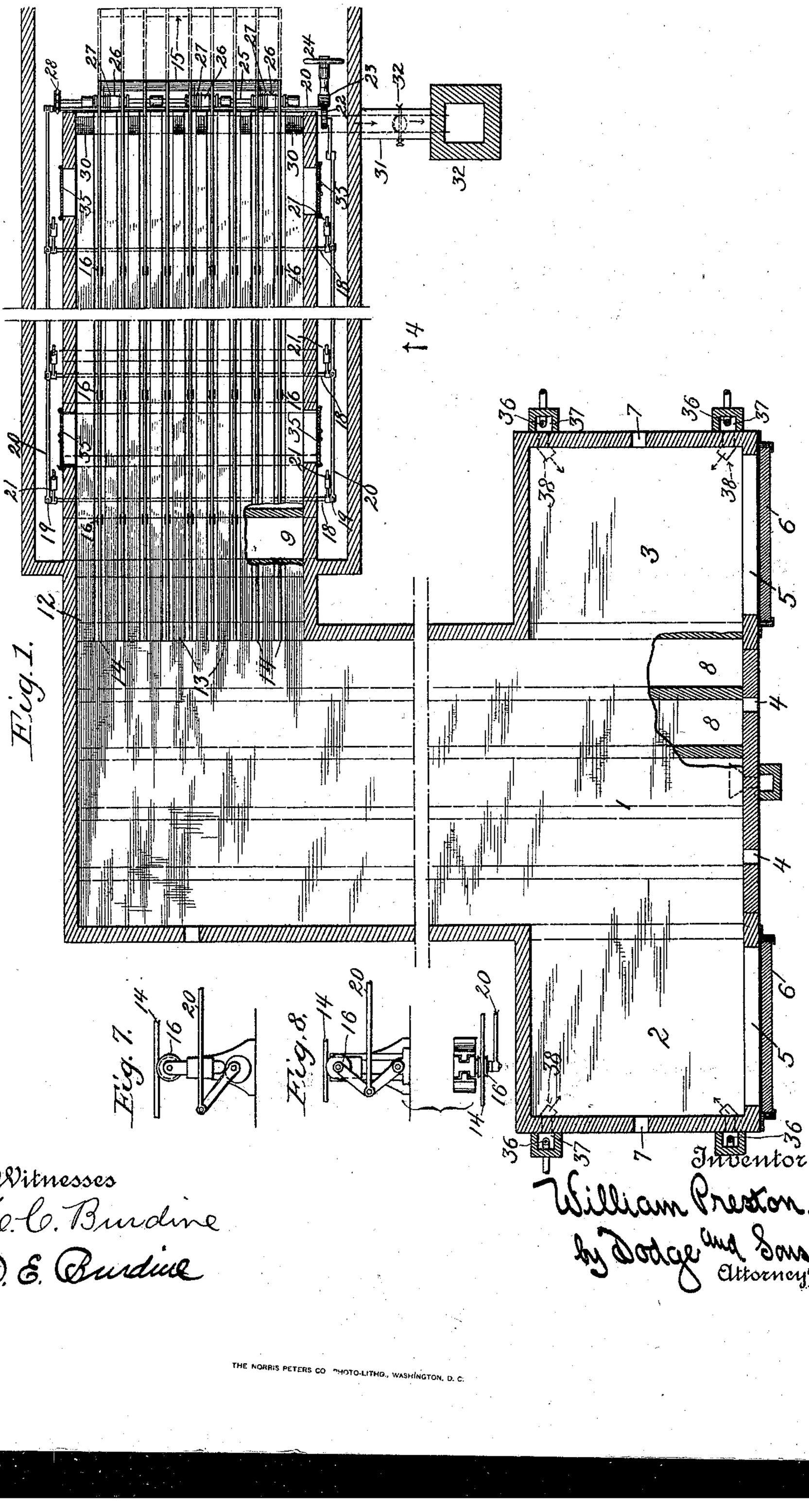

Fig. 1.

Fig. 7.

Fig. 8.

Witnesses
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D. E. Burdine

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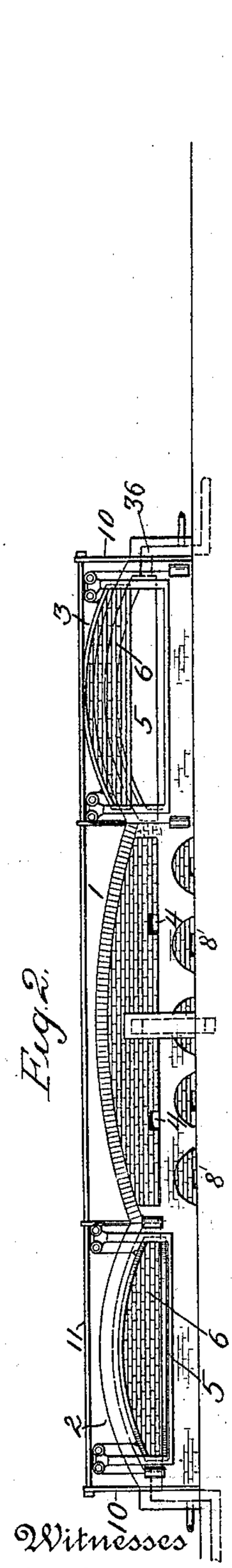

Fig. 2.

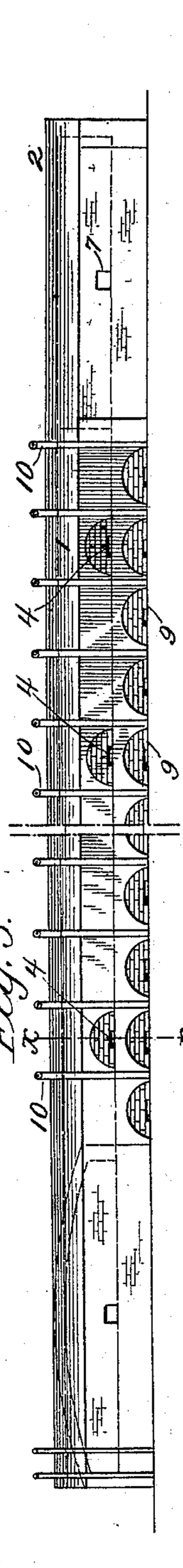

Fig. 3.

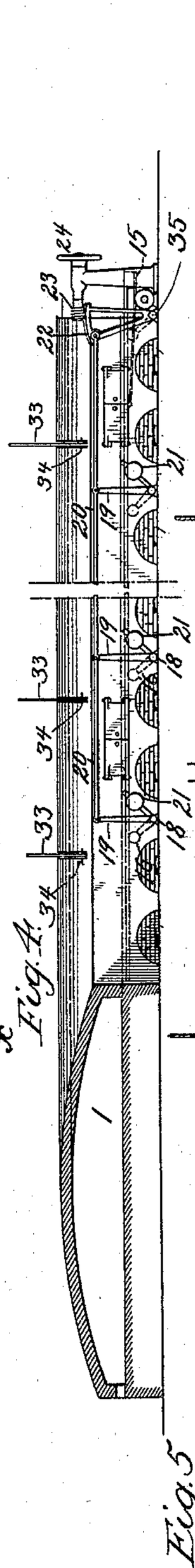

Fig. 4.

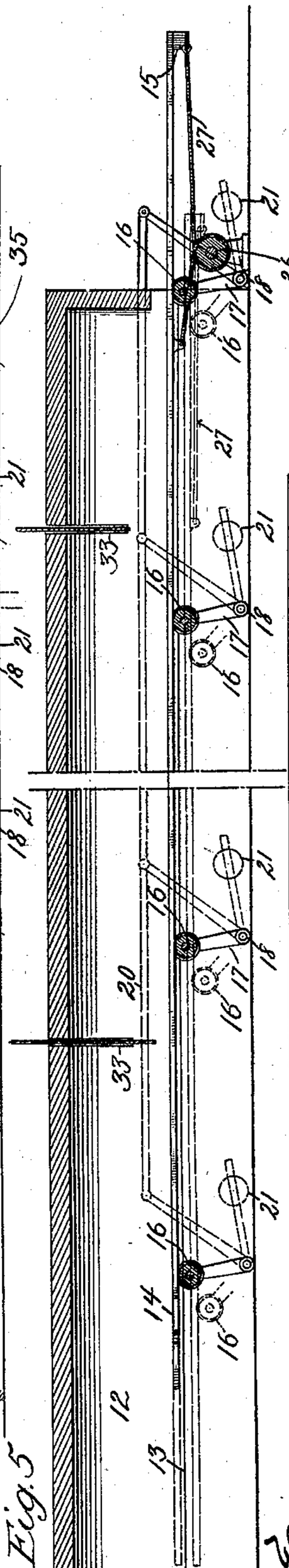

Fig. 5.

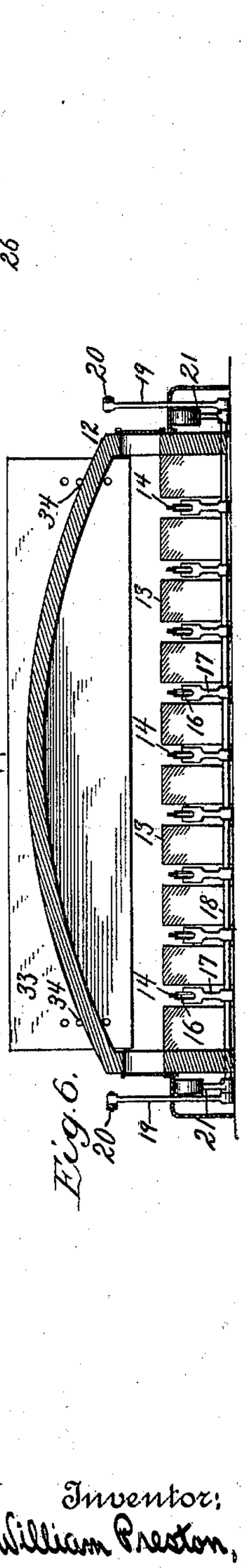

Fig. 6.

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UNITED STATES PATENT OFFICE.

WILLIAM PRESTON, OF ST. HELEN'S, ENGLAND.

ANNEALING-FURNACE FOR GLASS.

SPECIFICATION forming part of Letters Patent No. 625,801, dated May 30, 1899.

Application filed November 19, 1897. Serial No. 659,161. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM PRESTON, a subject of the Queen of Great Britain and Ireland, residing at St. Helen's, in the county of Lancaster, England, have invented certain new and useful Improvements in Annealing-Furnaces for Glass, of which the following is a specification.

My invention pertains to the annealing of glass; and it consists in an annealing furnace or leer of novel construction, through the use of which the process of annealing may be continuously carried on, with a resultant saving in time and fuel.

The prominent features of the invention are, first, the combination, with a kiln or "settling-arch," of two receiving-chambers at one end thereof in which to heat the glass to a proper temperature and a graduated or cooling-off leer at the other end thereof, and, second, novel means for moving the glass through the leer or through the arch, or both.

In the accompanying drawings, Figure 1 is a horizontal section or plan of the plant, the kiln or settling-arch being broken away to bring it within the limited dimensions of the sheet; Fig. 2, a front elevation; Fig. 3, a side elevation looking from the left-hand side of Fig. 1; Fig. 4, an elevation of one side of the leer; Fig. 5, a longitudinal sectional view of the leer, illustrating the manner of lifting the glass from its bed and moving the same through the leer; Fig. 6, a transverse vertical sectional view of the leer, showing the bed and the lifting devices; Figs. 7 and 8, views showing modified forms of the lifting devices.

As commonly constructed at the present time annealing-furnaces consist simply of an arched chamber having an opening at one end for the admission of glass plates or sheets or of trays containing smaller articles of varied form and an opening at the opposite end for the delivery thereof. At the receiving end or at some point between the two ends heat is admitted or applied to the chamber, so that the temperature is graduated and made less from such point to the end or ends. The plates of glass to be annealed are placed in the oven or chamber from end to end to the extent of its holding capacity, and the chamber being properly closed the glass is subjected for a number of days to a proper temperature, which is gradually reduced, this being commonly effected by removing from time to time a few bricks from the walls of the chamber, and thereby admitting a gradually-increasing amount of cool air from without. The proper annealing is under such common method of procedure effected only after four or five days, rarely less than five, and sometimes requiring a longer period. When the annealing is completed, the plates are withdrawn from the same end of the chamber through which they are introduced by means of hooks, which are carried into the chamber by attendants and to which are attached ropes, extending out to the space in front of the oven or chamber. These ropes are pulled by workmen, and thus one plate after another is drawn out.

It will be seen that under the method or plan just described, which is that universally employed in practical work in glass-factories, it is impossible to carry on a continuous or progressive annealing of plates of glass, withdrawing plates that are sufficiently annealed, leaving others a further time, and introducing fresh plates to be treated.

Plate-glass is very heavy, and owing to this fact and to the large size of the plates it is impracticable to move them for any great distance over a floor or bed by pushing. So, too, it is impracticable to handle plates of any size with forks, as is done with sheet-glass. It is therefore necessary so to construct the plant that the glass may be introduced into the kiln, preliminarily heated, pushed back a sufficient distance to insure the proper setting of the glass to protect it against subsequent sagging or sinking, and then to deliver it to suitable mechanism, whereby it may be carried progressively through the leer in which the graduated cooling is performed. To accomplish this end, the kiln in which the first or preliminary cooling and setting of the glass is effected, and which receives the glass from the annealing-chamber proper, is made only long enough to afford space for handling, usually two lengths or plates of glass, this length permitting the plates to be pushed rearward over the floor from the receiving end or chamber, but being as great a length as will permit such pushing of the glass.

The leer, which receives the glass from the kiln, is arranged at an angle, advisably a right angle, to the kiln, so that the plates moved back to the rear end of the kiln may then be delivered to the leer by push-rods introduced through the side of the kiln, the plates being then delivered sidewise into the leer. In this way I am enabled to move the plates conveniently and quickly, each independently of others, through the kiln and from said kiln into the leer, in which latter chamber they are handled simultaneously by suitable mechanical appliances, which cause all the plates therein to be advanced simultaneously and quickly.

It should be noted that glass is differently classified in different countries. Thus in the United States the term "plate-glass" is applied only to that which is cast upon a bed or table and is rolled, and such only is contemplated in the present description. In England, France, and Germany a different classification is adopted, and some of what is known under the general terms "sheet-glass" or "window-glass" in the United States is in said countries designated as "patent plate-glass" or occasionally "plate-glass," and this notwithstanding the fact that it is merely blown or cylinder glass flattened, but of greater thickness than the ordinary sheet or window glass of the United States. Glass of the latter description—that is to say, the so-called "plate-glass"—can be and is handled in the same manner as ordinary window-glass, being flattened, as is other window-glass, and lifted and moved with forks, as rolled plate-glass cannot be owing to its size and weight. This will be readily appreciated when it is borne in mind that some of the plates of glass weigh over twelve hundred pounds. In the following description these facts are to be kept in mind, and it is to be understood that only plate-glass is contemplated in this description, or, in other words, those large plates which by reason of their size and weight cannot be handled by forks.

Numerous attempts have been made to produce an annealing-oven in which the annealing operation might be carried on continuously under perfect control and with ease and convenience of operation; but, so far as I am aware, there has been but little deviation in practice from the comparatively crude construction above outlined.

I have adopted and will now describe a plan of construction which affords better and easier control of the furnace and greatly simplifies the handling of the glass therein.

Referring to the drawings and first to Fig. 1, the receiving end of the annealing plant will be seen to consist of a middle chamber 1, which, as shown in Fig. 2, extends backward a considerable distance, and two side chambers 2 and 3, one at either side of the chamber 1. The middle chamber is the kiln or settling-arch and is closed at its front end, except for small openings 4, through which to insert rods or implements for pushing the plates, sheets, or trays rearwardly in and through the kiln. The side chambers have wide openings 5, preferably provided with drop-doors or sliding fronts 6, by which they may be closed to prevent waste of heat, said chambers being provided with suitable means for heating them to a temperature suited to the work to be performed. This temperature may vary, and commonly will do so, according to the character of the glass and the form and class of bodies treated; but in all cases it should be sufficient to raise or to restore the glass to so high a temperature that by gradually lowering it therefrom the structural character of the glass shall be changed, that its intense hardness shall be reduced, and that the strain or compression produced by the first cooling or partial cooling shall be eliminated and the glass be thereby freed from liability to disruption when struck a moderate blow or when scratched or cut.

Any usual form of heating apparatus may be employed, and as this constitutes no part of the present invention it need not be further described.

Both chambers 2 and 3 open laterally into the middle chamber or kiln 1, so that the glass introduced into either of the side chambers may after being duly heated therein be shoved into the kiln or central chamber by means of rods or implements inserted through holes 7, formed in the side walls of the chambers 2 and 3. By the aid of said side chambers I am enabled to bring the glass speedily to the temperature necessary or suitable to the proper carrying out of the annealing operation, which can be but imperfectly performed, if at all, when the glass enters the kiln below the requisite temperature. In the transfer of the plate from the casting-bed the glass not infrequently becomes cooled below the point at which annealing should begin, and in every such case it is essential to good results that the glass be again brought to the proper temperature preparatory to the gradual and prolonged cooling by which the structural change is effected.

By providing two heating-chambers 2 and 3 they may be used alternately, and thus the kiln may be fed more rapidly than would otherwise be practicable. So, too, either chamber or the heating apparatus thereof may at any time be repaired without necessitating any interruption in the use of the kiln.

The kiln or central chamber receives heat from the side chambers 2 and 3 and is also additionally heated through such portion of its length as may be deemed expedient. Arches or flues 8 are formed beneath the floor or bed of the kiln 1 to permit air to enter to cool or temper the kiln. This kiln is of such length as to accommodate two plates of glass in the direction of its length, such length being found necessary to insure the proper and thorough setting of the glass preparatory to its entering the leer and to insure it against

sagging or sinking therein between its points of support, but a greater length being carefully avoided, since it would be impracticable to move the plates over the floor of the kiln by pushing from the front if a longer travel were provided. The side walls of the structure may be stayed by uprights 10, connected by tie-rods 11, or otherwise constructed.

At the rear end of the kiln and at an angle thereto is a leer 12, designed to receive the glass plates or bodies after their passage through the kiln and to continue the gradual cooling thereof. This leer is of special construction, having a bed or floor 13, grooved or channeled to receive a series of rails 14, which are placed parallel to one another and are connected at their outer ends to a bar or cross-head 15, by which they may be moved in unison. The rails lie normally flush with or slightly below the surface of the bed 13, being supported by grooved rollers 16, carried by arms 17, projecting from rock-shafts 18, extending transversely across the leer beneath its bed or floor, as seen in Figs. 1, 4, 5, and 6. The rock-shafts are provided with radial arms or levers 19, which are connected by rods or links 20, so that all the shafts may be rocked simultaneously and equally, thus lifting their rollers 16 in the same time and to the same extent, and consequently elevating the entire bed of rails in every portion alike. By sufficiently rocking the shafts 18 the rails will be carried above the bed or floor of the leer, and thus the plates, sheets, or trays lying upon the bed or floor will be lifted off the floor and held upon the rails alone. To facilitate the lifting of the rails and the bodies lying on the bed or floor, the rock-shafts may be provided with counterbalanced arms 21, projecting therefrom on the opposite side of their axes from that occupied by the roll-carrying arms 17. The load to be lifted in such a leer frequently amounts to a number of tons, and it is therefore necessary to provide mechanism affording the leverage or power necessary to lift such a load, less the offset afforded by the counterbalances. A convenient means for the purpose is illustrated in Fig. 4, where a toothed sector 22 is shown pin-jointed to one of the rods or links 20 and arranged to mesh or engage with a worm or screw 23, by which the sector may be swung about its pivot or axis 35. This construction affords adequate power, the screw being furnished with a hand-wheel 24 of adequate size for the purpose. Obviously any other convenient rig may be substituted or the rock-shafts may be turned by power. So, too, the rollers 16 may be carried by vertically-movable yokes, lifted by eccentrics, toggles, or equivalent devices of common and well-known construction, as illustrated in Figs. 7 and 8. In other words, the essential feature in this regard is the raising and lowering of the rail-supports, and this may be accomplished in a variety of ways that will readily suggest themselves to the practical mechanic. While the rails are in their elevated position and the glass is thus lifted off the bed or floor, the rails are moved longitudinally rearward, thereby carrying all the contents of the leer in that direction a distance equal to the movement of the rails. When the necessary travel is effected, the rollers 16 are lowered to their normal position by turning the worm or screw 23 backward and the rails are permitted to fall below the surface of the bed or floor, after which they are moved longitudinally inward to their first position preparatory to a second elevation and outward movement. In this way the glass within the leer is lifted from the bed, advanced a given distance, and set down upon the bed or floor in its new position, and this operation is repeated as often and to as great an extent as required by the circumstances of the case.

Various mechanisms may be employed to effect the longitudinal traverse of the rails or rail-bed, but that represented in Figs. 1, 4, and 5 will be found simple and effective. This comprises a horizontal shaft 25, extending across the end of the leer below the level of its bed or floor and carrying either a continuous drum or a series of short drums 26, about which are wrapped or wound chains or flexible bands 27, the opposite ends of which are attached to the cross-head 15 and to the rails 14 at points sufficiently separated to permit the requisite travel of the rails. When the shaft and drums are turned in one direction, they move the rails to the rear and when turned in the reverse direction they return the rails inward to their first position, as will be readily understood upon referring to Fig. 5. The shaft 25 is furnished with a hand-wheel 28, by which to turn it, or it may be driven by power, if desired.

The heated air which enters the forward end of the kiln flows backward through the same and thence through the leer, being gradually absorbed on its passage and counteracted to any extent required by the admission of air to the arches or flues 8 beneath the floor of the kiln and similar flues 9 beneath the floor of the leer. These arches are useful not only in admitting cool air beneath the floors or beds of the kiln and leer, but also in preventing moisture from finding its way from the ground to the beds or floors of these chambers. In practice it is found convenient to brick up the ends of these flues or arches, leaving out one brick or more, according to the amount of air deemed best to be admitted. By inserting a brick or bricks or a piece of a single brick the opening may be readily reduced in size.

To insure the proper flow of the heated air through the kiln and leer, there is provided at the rear end of the latter a series of outlets 30, which communicate with a flue 31, in turn connected with a stack or chimney 32. This may be a stack used in connection with other portions of the glass plant or a special one, as found convenient in any given

case. A valve or damper 32 serves to regulate the strength of the draft or current.

At suitable points in the length of the leer vertically-adjustable plates 33 are provided by which the heated air may be caused to impinge more or less directly upon the glass or permitted to flow freely along the upper part of the arch with comparatively little effect upon the glass. Rods or pins 34 may be used to hold the plates at the desired elevation, or they may be hung and adjusted in any convenient manner.

As a matter of convenience in making repairs it is found desirable to construct arches in the walls in which the push-holes 4 and 7 are to be formed and to fill in these arches with brickwork, leaving out a brick where the hole is to be located. This construction permits the ready removal of the brickwork from any arch, thus affording access to any part of the kiln, leer, or heating-chambers for repairs, cleaning, or the like. This construction is illustrated in Fig. 2 in connection with the kiln or central chamber 1.

The lever system by which the rock-shafts are turned is advisably inclosed, as indicated in Fig. 6, to prevent undue ingress of air into the kiln and to prevent drafts.

A swivel-table or other suitable receiving-support may be arranged at the exit end of the leer to receive the glass therefrom, as is commonly done in connection with existing annealing-furnaces.

If desired, the same system of rails with their elevating and traversing devices may be employed in the kiln.

Suitable openings may be formed at intervals in the side walls of the leer 12 and provided with doors 35 to permit ready access to the interior thereof, the casing which covers the lever system being usually made of sheet metal and readily removable in whole or in part, though the attendant may pass in between the main wall and the casing if preferred.

While no special form of heating apparatus is essential to the operation of my furnace, I contemplate using, in practice, a suitable combustible gas, introducing the same at convenient points, mingled with a proper percentage of air. The gas may be introduced by pipes 36 into flues 37, opening into the heating-chambers at points above the floors thereof, suitable air-inlets being formed in the flues.

It is preferred to apply nozzles 38 to the flue-outlets, directed toward the middle of the chambers 2 and 3. This general arrangement, common in glass plants, gives long sheets of flame across the chamber-floors and is found well suited to the purpose in view.

The heat from chambers 2 and 3 traverses the kiln 1 and the leer, and may be supplemented, if desired, by flames from other heaters suitably located, if this be found necessary in any given case.

I am aware that it is not broadly new to construct annealing-furnaces for cylinder or sheet glass, such as is used for ordinary windows, with two preliminary flattening or striking ovens in which the cylinders are opened and flattened out and with a cooling or annealing chamber communicating with both of the flattening-ovens and designed to receive glass from each. I am further aware that ovens for annealing plate-glass have been constructed with two preliminary heating-chambers, both communicating with a cooling or annealing chamber; but in this the glass was carried upon cars into and through the several chambers, a plan at once expensive and otherwise unsatisfactory and undesirable. I am not aware, however, that an annealing-oven of this character has ever been proposed for handling plate-glass in the manner proposed by me, which requires features of construction not found in the annealing plants for sheet-glass referred to. Thus it is essential that the warming-chambers, the kiln, and the leer be each formed or provided with a floor of brick, masonry, or stone and that the several floors be on a common level, so that the plates of glass may not be injured by resting for any considerable time upon metal and that they may be shoved readily from chamber to chamber while lying upon such floor.

It is a well-known fact that if glass be supported upon metal bars or gratings while undergoing the annealing process all those portions which rest directly upon the metal remain exceedingly hard and brittle, and it is impossible to properly cut or divide the glass across the lines or spaces so affected. For this reason floors of stone, earthenware, or masonry are essential. It is likewise requisite that the plates be allowed to rest upon their flat faces, as they are incapable of supporting themselves upon or by their edges when raised to the annealing temperature. From this it follows that the openings from one chamber to another must be such as to permit the large plates to pass through in horizontal position while lying directly upon the bed.

Having thus described my invention, what I claim is—

1. In a glass-annealing plant, the combination of a kiln; a preliminary heating-chamber at the side thereof; and a leer at the rear end of the kiln and at an angle thereto; said chamber, kiln and leer communicating with one another and being each provided with a floor of stone or earthenware, said floors being in common plane, and the walls of the preliminary heating-chamber and the kiln being provided with push-holes, whereby plates of glass may be pushed directly over or upon the floors from the preliminary chamber into the kiln, through the kiln, and from the latter into the leer, substantially as set forth.

2. In a glass-annealing plant, the combination of two preliminary heating-chambers; an intermediate kiln directly communicating

with both of said chambers; and a leer directly communicating with the kiln and arranged at an angle thereto, the several chambers having floors of stone or earthenware, in common plane, and the walls of the kiln and the preliminary heating-chambers being provided with push-holes, whereby push-rods may be introduced to push plates of glass over said floors from the preliminary chambers into the kiln, through the kiln and thence into the leer, the two chambers permitting the kiln to be supplied alternately.

In witness whereof I hereunto set my hand in the presence of two witnesses.

WILLIAM PRESTON.

Witnesses:

HORACE A. DODGE,

WILLIAM W. DODGE.