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APPARATUS FOR REMOVING THE SOLVENT FROM SOLUTIONS OF RESILIENT SUBSTANCES WHICH ARE APPLIED IN CONSIDERABLE THICKNESS TO THE SINGLE SHEETS OF LAMINATED GLASS FOR FORMING THE NONSPLINTERING INTERMEDIATE LAYERS

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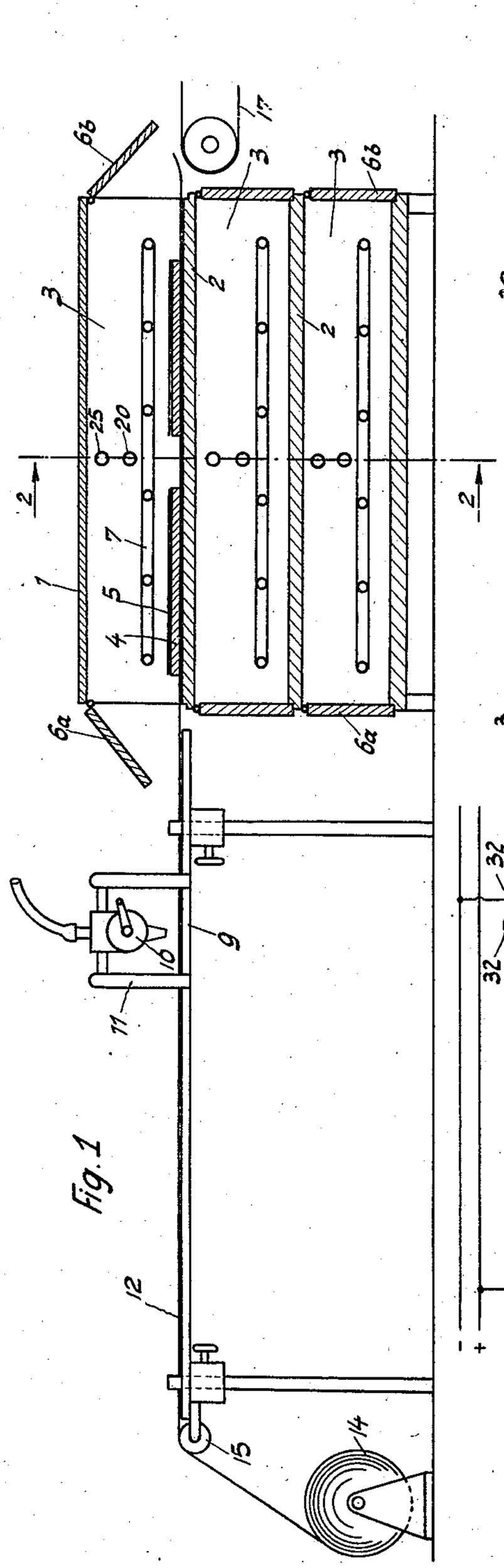

Fig. 1

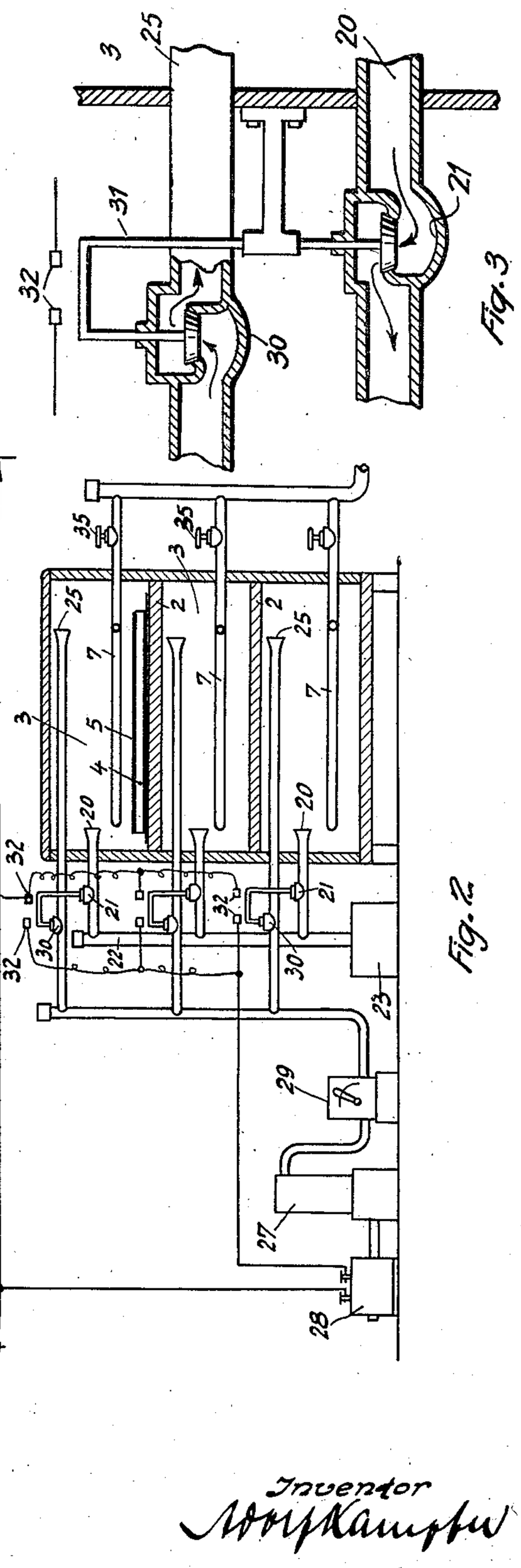

Fig. 2

Fig. 3

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7 Claims. (Cl. 34—12)

This invention relates to a method of removing the solvents from solutions of resilient substances which are applied in considerable thickness to the single sheets of laminated glass for the purpose of forming non-splintering intermediate layers, the layers being subjected in an enclosed space, for such time until the solvent has evaporated, to the action of an atmosphere charged with vapours of the solvent in order to keep the surfaces of the layers soft, and thus permit of the escape of rising bubbles of gas or vapour. It is the object of this invention to develop this process to an additional extent, so that there is ensured a more thorough removal of the solvent from the layers than has hitherto been possible, and so that at the same time danger of deliquescence or other variations in the position or form of the layers is eliminated.

Since the amount of air enclosed within the space is invariable, and at a constant temperature is capable of absorbing merely a given quantity of the solvent vapours up to complete saturation, a thorough removal of the solvent from the layers is only possible if the quantity of solvent contained in the layers is less than the power of absorption of the air. If it is greater, a proportion of the solvent must necessarily remain in the layers. An additional drawback associated with the old method consists in the fact that with increasing saturation of the air enclosed within the space the evaporation of the solvent is retarded, so that such a process requires a very long time, inasmuch as the point at which the solvent has been completely expelled or at which the air has been saturated with vapours of the solvent is extremely difficult to determine. In consequence the period of action of the solvent atmosphere is also very long, so that there is always the danger that the layers will be softened from the outside up to the point of deliquescence.

The invention consists in replacing the air above the layers, after its saturation with solvent vapours, or immediately prior thereto, by fresh air at the same temperature. This replacement of the saturated air by fresh air may be repeated as many times as needed until the solvent expelled from the layers has been completely removed. In lieu of this measure, or additional thereto, an increase in the powers of assimilation or absorption of the air above the layer for solvent vapours may be accomplished by a steady or a step-by-step increase in the temperature of the air.

If both measures—repeated substitution of the practically saturated air by unsaturated air and steady or step-by-step increase in the temperature of the air to be charged with the solvent vapours—are combined, the increase in pressure caused by the higher temperature may be utilized for automatically controlling the optimum degree of saturation in each stage, in such fashion that a pressure valve or the like, either directly or indirectly at a certain admissible pressure, allows a part of the mixture of vapour and air to escape from the enclosed space, and causes the replacement thereof by fresh air at the same temperature. In this way the evaporation of the solvent may be greatly accelerated, and the action of the solvent atmosphere on the layers so regulated as regards duration and intensity that in each case an excessive softening of the layers from the outside is avoided. By repeated substitution of the practically saturated air above the layer and repeated step-by-step increase in the temperature of the air to be saturated complete expulsion of the solvent contained in the layers may be quite readily accomplished in a comparatively short time. Once the solvent has been completely removed a deformation or even deliquescence of the layers is unable to take place, irrespective of the length of time for which the layers remain under the action of the last-mentioned temperature.

The solvent may be recovered in the known fashion by condensation from the mixture of air and solvent vapours discharged. The layers treated according to this process may be covered in immediate fashion with a cover sheet.

An apparatus suitable for carrying out the new process is illustrated diagrammatically by way of example in the drawing.

Fig. 1 shows the apparatus partly in vertical longitudinal section and partly in elevation.

Fig. 2 is a section along the line 2—2 in Fig. 1.

Fig. 3 is a detailed sectional view of the coupled valves controlling fluid flow through the inlet and outlet pipes of the chambers.

A container 1 is divided by horizontal partitions 2 into a plurality of superimposed channel-like chambers 3, which serve to receive the sheets of glass 4 with the layers 5 from which the solvent is to be removed. Each chamber 3 is capable of being closed tightly at the two ends by doors or flaps 6*a* and 6*b* or in other fashion, and contains a heating device, such as a serpentine tube 7 fed with steam. The partitions 2 forming the bottoms of the single chambers may be covered with sheets of glass for the purpose of obtaining an exactly flat form. Runners may also be provided in recesses or cavities in these bottoms for

the sheets of glass to be treated in the chambers.

In front of the container 1, i. e., opposite to the inlet openings in the ends of the chambers 3 closed by the flaps 6a, there is arranged a horizontal table 9, which is adjustable in such fashion as regards its elevated position by suitable means, as for instance, the collars 9a and set screws 9b that it may be moved successively into the planes of the floors of the several chambers. Above the table there is provided means 10, which serves for application of the plastic solution to the single sheets of glass, and which is carried by the table 9 through the medium of a support 11, and is accordingly adjustable in height together with the table. The sheets of glass to be furnished with the plastic layers are placed upon the table 9, then conducted below the application device 10, and finally passed into the particular chamber 3 which may have been selected. Various means may be employed for conveying the sheets of glass; for example, the table 9 may be furnished with a large number of operated runners situated in close proximity to each other. In the particular form of embodiment shown there is employed for conveying the sheets of glass a web 12 of paper or other cheap-quality material, which is drawn over the table through the particular chamber 3 to be charged. This web is withdrawn from a permanently mounted supply roll 14, and so deflected by means of a roller 15 mounted on the table that upon each adjustment of the table it moves along the surface of the table. After a chamber has been charged with the assistance of this web 12 with the desired number of coated sheets of glass the part of the web 12 located within the chamber is cut off, so that the chamber may be tightly closed. Immediately the treatment of the sheets of glass introduced into the chamber has been completed, i. e., immediately the plastic coatings on the sheets of glass have been freed of their solvents, the closure flap 6b or the like at the outlet end of the chamber is opened, in order to be able to withdraw the sheets of glass from the chamber with the assistance of the portion of the web of paper remaining in the chamber. If desired the finally treated sheets of glass may be discharged upon an endless conveying belt 17, which is adjustable as regards height.

Each chamber 3 is furnished with an outlet pipe 20 for the mixture composed of the solvent vapours and the air contained in the chamber. This outlet pipe 20 contains a choke valve 21, which is not illustrated in detail, and which opens automatically upon the pressure of the mixture of air and vapour contained in the chamber rising to a certain predetermined degree. This outlet valve may naturally also be arranged in such fashion that it is operable by hand or is controlled periodically by a suitable operating device. The outlets 20 of all chambers open out into a common pipe 22, by means of which the discharged mixture of solution saturated air is conducted to a condenser 23, in which the solvent may be recovered. Parallel to the outlets 20 there extends into each chamber 3 a pipe 25 serving for the supply of fresh air. This pipe 25 extends into a portion of the chamber 3 remote from the pipe 20 so that when fresh air enters through the pipe 25, it will force out air within the chamber 3 into the outlet pipe 20. All pipes 25 extend from header 26 of an air pump 27, which is driven by an electro-motor 28. The header 26 is connected to a regulatable heating device 29, by which the fresh air to be introduced into the chambers may be pre-heated to the desired temperature. Each fresh-air pipe 25 contains a choke valve 30, which is not illustrated more particularly, and which is positively connected in suitable fashion, as by a yoke 31 with the choke valve 21 of the mixture discharge pipe 20 pertaining to the same chamber, in such a manner that the two valves 21 and 30 may be opened and closed simultaneously. To the two valves 21 and 30 belonging to each chamber 3 there is associated a pair of contacts 32 controlling the circuit of the electro-motor 28, in such fashion that upon the common opening movement of the two valves the motor circuit is completed as for instance by the yoke 31, and together therewith the air pump 27 set into operation. If, therefore, the outlet valve 21 for the mixture of air and vapour pertaining to any particular chamber is opened, there occurs simultaneously the opening of the air inlet valve 30 and the supply of pre-heated air to the chamber.

The heating element 7 of each chamber is furnished outside of the container 1 with a manually operable or automatically acting device 35, shown as a valve for regulating the heating effect. With the assistance of this regulating device the temperature in the interior of each chamber may be increased gradually or step-by-step, in such a manner that complete saturation of the air in the chamber with the solvent vapours escaping from the plastic layers of the sheets of glass is never quite reached. This effect is amplified by the fact that when a certain pressure in the interior of the chamber has been attained, or at different pressure or temperature stages, a part of the mixture of air and vapour is discharged from the chamber and replaced by fresh, pre-heated air.

What I claim as new and desire to secure by Letters Patent is:—

1. Means for evaporating solvents from a layer of material to which the solvent has been applied, including a chamber having movable closures at its opposite ends, the chamber having a floor, a table disposed in alinement with the floor of the chamber closely adjacent thereto, a roll supporting a sheet of fibrous material, the fibrous material being drawn over said table and constituting a support for the article to be treated, the fibrous material constituting means whereby the article after the layer of material and solvent has been applied thereto may be drawn into said chamber and the closures closed, heating means disposed in said chamber, and means for withdrawing solvent saturated air from said chamber and for introducing fresh air.

2. An apparatus of the character described, including a plurality of superposed chambers, each chamber having movable closures at its ends, each chamber having heating means disposed above the floor of the chamber and each chamber having means whereby solvent saturated air may be withdrawn therefrom and fresh air introduced thereinto, a table adjustable into alinement with the floor of any one of said chambers and closely adjacent thereto, and a sheet of fibrous material adapted to be drawn over the face of the table and support the article to be treated and to be drawn into said chamber and thus convey the article from the table into the chamber.

3. In an apparatus of the character described, a chamber having means for opening or closing it, heating means within the chamber, a saturated

air outlet pipe leading from the chamber and having therein a pressure responsive valve, a fresh air pipe leading into the chamber, a valve controlling the passage of fresh air from said pipe into the chamber and a connection between the valves effecting simultaneous opening of the valves when the pressure within the chamber increases beyond a predetermined amount, an air pump and heater connected to the fresh air inlet pipe, an electric motor for the air pump, and means carried by the valves acting to close a circuit through the air pump motor when the valves are opened by a rise of pressure within the chamber.

4. In a mechanism of the character described, a chamber having means whereby it may be closed or opened, a heater extending into the chamber and having means for regulating heat therein, an outlet pipe leading from the chamber and adapted to conduct solvent saturated air from within the chamber, a pressure operated valve normally closing said outlet pipe but opening automatically upon the rise of pressure within the chamber beyond a predetermined amount, a fresh air inlet pipe opening into the chamber, a normally closed valve therein, and a connection between the first named valve and the last named valve causing the opening of the second named valve upon the opening of the first named valve.

5. An apparatus for preventing the deliquescence of a layer of resilient substance applied to a sheet of glass, including in combination a chamber adapted to be tightly closed and to contain a solution absorbent atmosphere, heating means in the chamber, means so constructed and arranged as to act automatically upon a predetermined increase of pressure within the chamber to cause the withdrawal of a portion of the gaseous contents of said chamber and the admission to the chamber of a fresh charge of medium, and automatically cutting off the admission of fresh medium to the interior of the chamber and the discharge of solvent-laden medium when the pressure within the chamber has become reduced to a predetermined degree.

6. An apparatus for preventing the deliquescence of a layer of resilient substance applied to a sheet of glass, including in combination a chamber adapted to be tightly closed and to contain a solution absorbent atmosphere, heating means in the chamber, a vapor outlet leading from the chamber, an inlet valve controlling an inlet leading into the chamber from a source of absorptive medium, a pressure actuated valve affected by the pressure within the chamber and opening the vapor outlet when the pressure within the chamber has reached a predetermined degree, and an operative connection between said pressure operated outlet valve and the inlet valve to cause the opening and closing of the inlet valve coincidently with the opening and closing of the outlet valve.

7. An apparatus for preventing the deliquescence of a layer of resilient substance applied to a sheet of glass, including in combination a chamber adapted to be tightly closed and to contain a solution absorbent atmosphere, heating means in the chamber, means operative to positively withdraw the gaseous medium from within said chamber and having a conductive connection with the chamber, a pressure operated valve normally shutting off passage of the gaseous medium between the chamber and the withdrawing means, an inlet valve controlling the inlet of fresh medium into said chamber, and an operative connection between said inlet valve and the outlet valve constructed and arranged to cause the opening or closing of the inlet valve coincidently with the opening or closing of the outlet valve.

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