C. L. SMITH & O. I. LEWELLYN.

VACUUM LIFTING MACHINE.

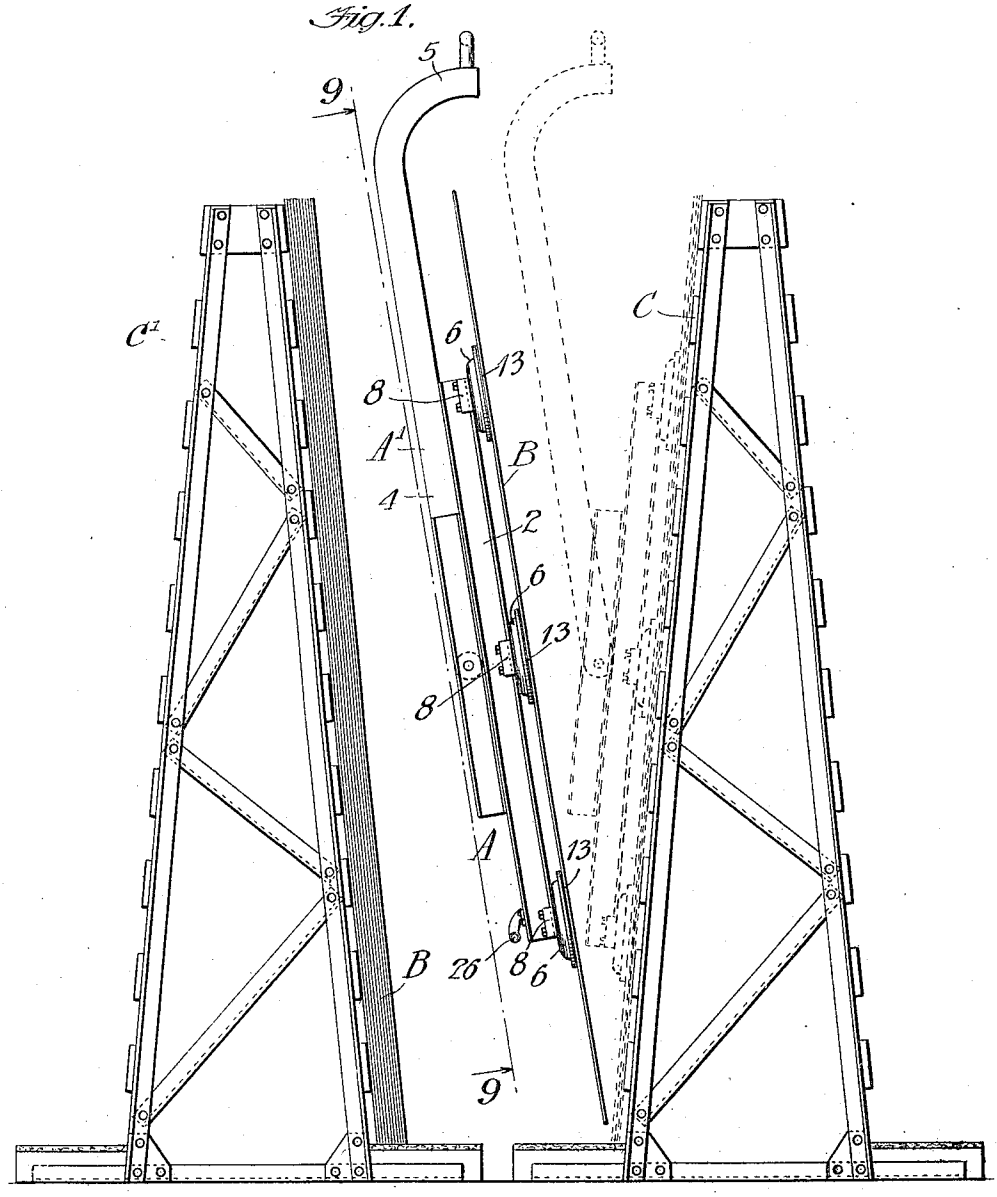
APPLICATION FILED APR. 3, 1916.

1,282,477.

Patented Oct. 22, 1918.

4 SHEETS—SHEET 1.

Fig. 1.



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4 SHEETS—SHEET 2.

Fig. 4.

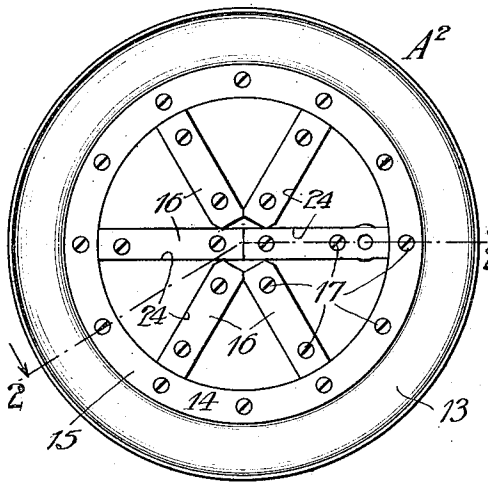


Fig. 5.

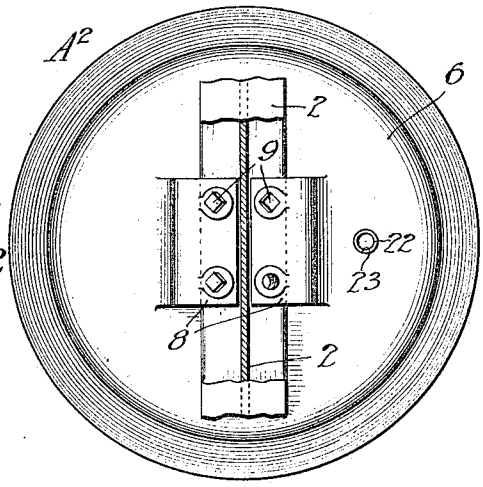


Fig. 2.

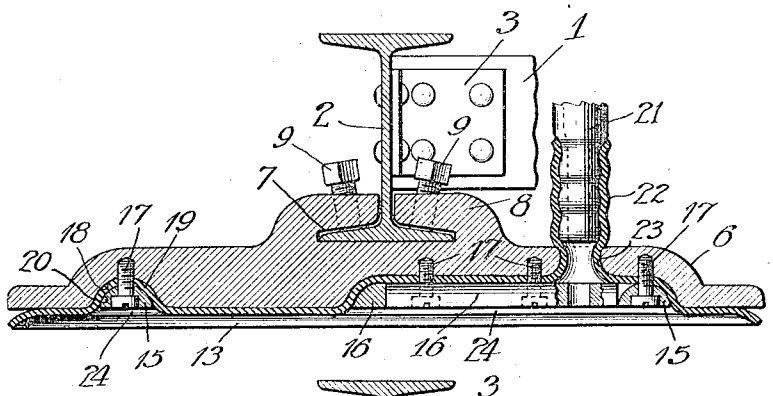
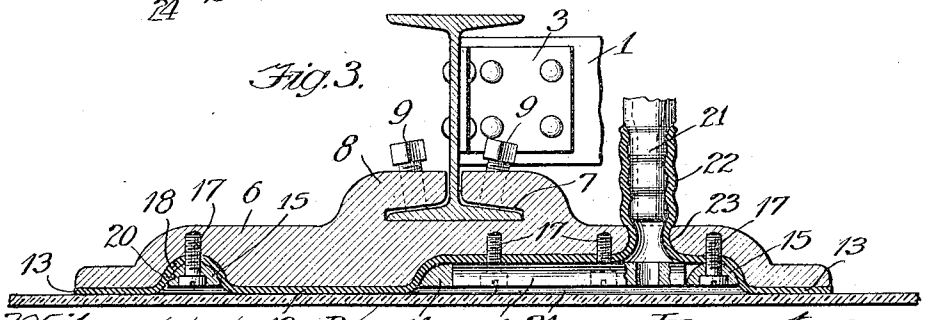


Fig. 3.



Witnesses

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VACUUM LIFTING MACHINE.

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4 SHEETS—SHEET 3.

Fig. 6.

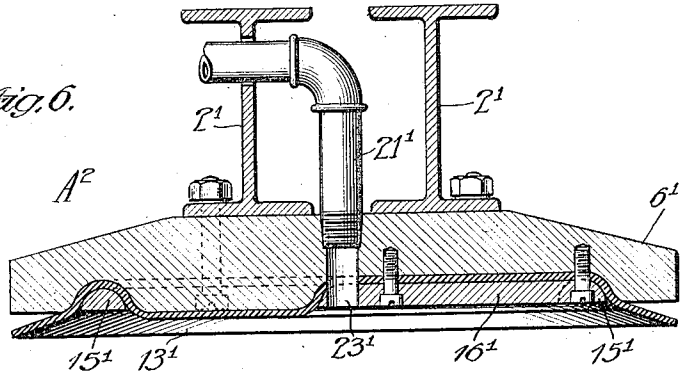


Fig. 7.

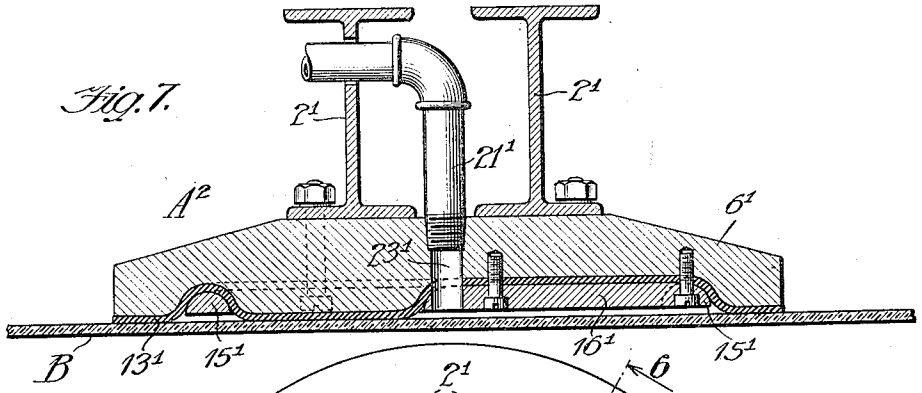
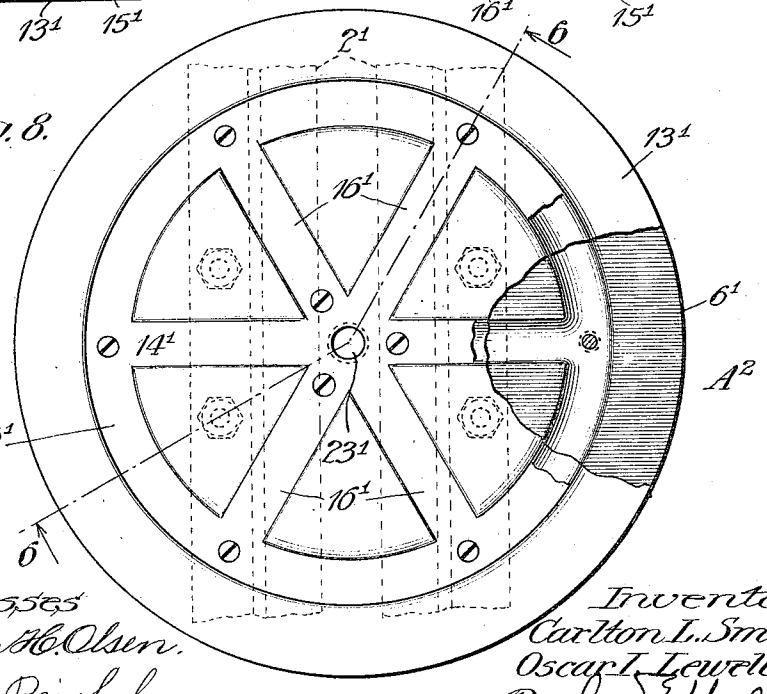


Fig. 8.



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VACUUM LIFTING MACHINE.

APPLICATION FILED APR. 3, 1916.

1,282,477.

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4 SHEETS—SHEET 4.

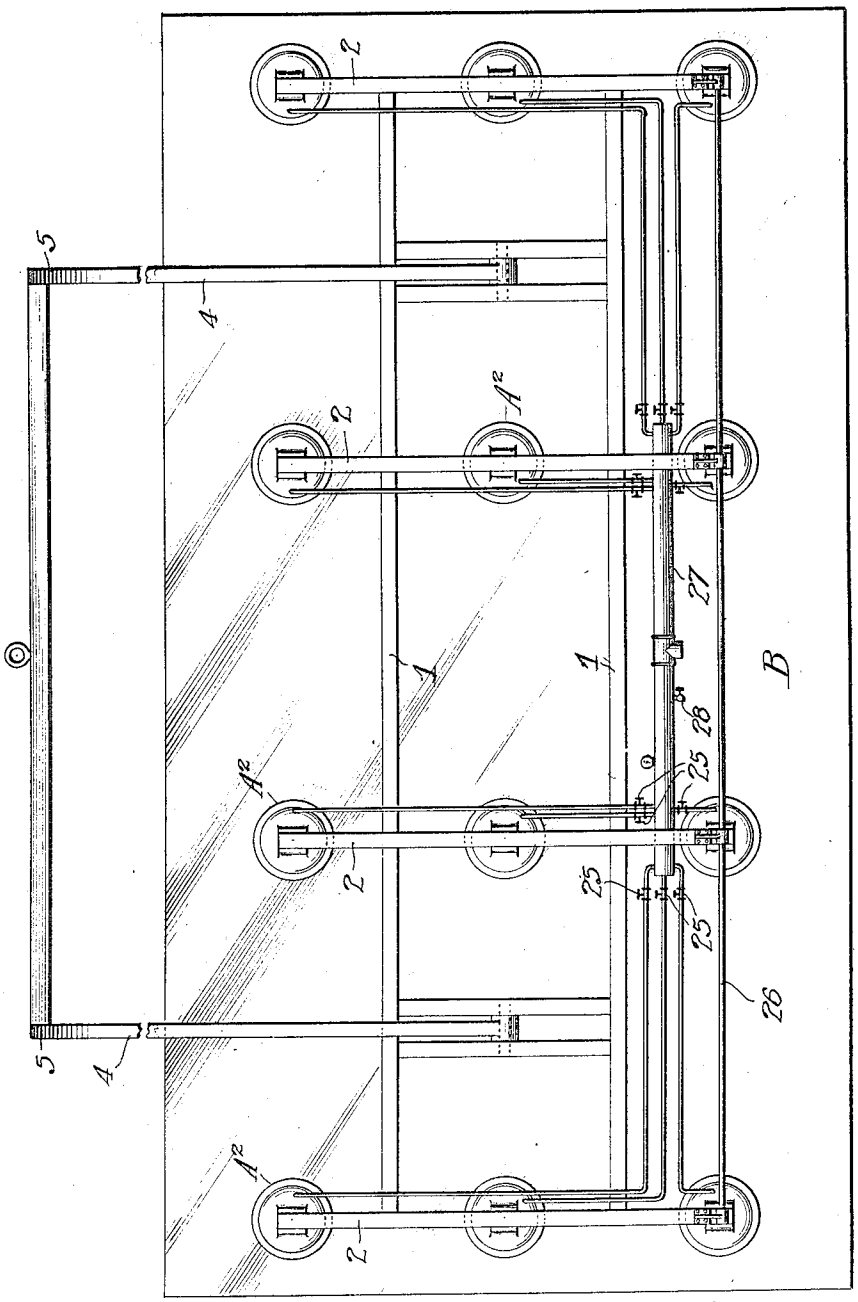


Fig. 9.

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UNITED STATES PATENT OFFICE.

CARLTON L. SMITH, OF SAGINAW, MICHIGAN, AND OSCAR I. LEWELLYN, OF KOKOMO, INDIANA, ASSIGNORS TO SAGINAW PLATE GLASS COMPANY, OF SAGINAW, MICHIGAN, A CORPORATION OF MICHIGAN.

VACUUM LIFTING-MACHINE.

1,282,477. Specification of Letters Patent. Patented Oct. 22, 1918.

Application filed April 3, 1916. Serial No. 88,560.

To all whom it may concern:

Be it known that we, CARLTON L. SMITH and OSCAR I. LEWELLYN, citizens of the United States, and residents, respectively, of Saginaw, in the county of Saginaw and State of Michigan, and of Kokomo, in the county of Howard and State of Indiana, have invented certain new and useful Improvements in Vacuum Lifting-Machines, of which the following is a specification.

This invention relates to vacuum lifting machines and relates particularly to vacuum lifting machines particularly designed and especially adapted for handling plates of glass which are too large and heavy to be handled by hand, of the general type shown and described in U. S. Letters Patent to Carlton L. Smith, No. 1,125,752, dated January 19, 1915.

A vacuum lifting machine of the general type to which the present invention relates comprises a frame adapted to be suspended from a traveling crane or the like by means of a cable attached to a bail pivotally connected to said frame, and suction pads mounted on said frame adapted for gripping the glass when the air is exhausted from between said pads and said plate of glass.

In the manufacture of plate glass, the plates of glass, between different operations thereon and also when finished, are stored in racks, usually consisting of fixed frames or supports which define plane surfaces against which said plates of glass are adapted to lean in edgewise position, the planes of said supporting surface being inclined at such an angle to the vertical as will insure the stability of the plates of glass in said racks. These racks are usually arranged in series spaced sufficient distances apart to permit the lifting machine carrying a plate of glass to enter between adjacent racks when the frame of the machine is turned to bring the plate of glass into a substantially vertical plane.

A principal object of the present invention is to economize the space occupied by said racks. Broadly stated, we effect this object by reducing the thickness of the vacuum lifting machine so that, when the frame is turned into vertical, edgewise position, it will enter spaces of minimum width between said racks. Specifically we attain this end by a novel form of suction pad which is relatively much thinner than any suction pads for a similar purpose of which we have any knowledge; and also by so shaping the bail of the machine that the lower ends of the side bail members will conform substantially to the inclination of the glass supporting surface of the racks for storing the glass.

A further object of the invention is to provide an improved suction pad which will be effective as regards gripping and holding the glass, but which will subject the glass to no strain due to the action of said suction pads. To effect this object, a suction pad embodying our invention comprises a body portion preferably made from an integral piece of metal, as cast iron, the under face or surface of which is of desired shape, usually flat, and which is provided with a hole or opening which extends through the same from top to bottom and the rear end of which is adapted to be connected with a vacuum pump or the like. Said suction pad also comprises a diaphragm of soft, flexible material, preferably rubber, secured to the under face or surface of said disk and provided with a hole or opening which registers with the hole or opening in the body portion of said pad adapted for connection with the vacuum pump. The diaphragm is adapted to be connected to the face of the body portion of said suction pad by mechanical means only and entirely independent of the suction applied to said suction pad in operation. This end we preferably attain by clamping the diaphragm to the body portion of said suction pad by means of a suitable grid which is so constructed and arranged that when secured to the face of the body portion of said suction pad it will compress said pad tightly against the face of the body portion of said suction pad around the hole or opening therein to which the vacuum pump is applied, thus preventing the exhaustion of air from between said diaphragm and the face of the body portion of said suction pad by the action of the vacuum pump. With this construction it is obvious that the said diaphragm will not be held tightly against the face of the body portion of said suction pad at points remote from the grid, but will be free to sag slightly so that a plate of glass will not be held tightly against the rigid face of the body portion of said suction pad. A further advantage arising from our im-

proved construction is due to the fact that, adjacent to the suction opening of said pad, the diaphragm, being held to the face of the body portion of said pad by a sealed joint, dust and dirt are prevented from working behind said diaphragm and accumulating in lumps which experience with vacuum cups heretofore used has shown is liable to cause the glass to break, due to the irregularity of the surface of said vacuum cups which engage said glass. Our improved construction also eliminates the necessity of removing the diaphragm periodically to clean the contacting faces of the body portion of said pad and of said diaphragm.

In the accompanying drawings in which our invention is fully illustrated,

Figure 1 is a diagrammatic view of a vacuum lifting machine of our invention shown as applied in use for depositing a plate of glass in one of two adjacent racks.

Fig. 2 is a sectional view on the line 2—2 of Fig. 4 of a suction pad of our invention, as it will appear when not in use.

Fig. 3 is a similar view showing the same as applied in use.

Fig. 4 is a bottom plan view thereof.

Fig. 5 is a top plan view thereof, the upper flange of the supporting I-beam being broken away to expose underlying parts.

Figs. 6 and 7 are sectional views substantionally similar to Figs. 2 and 3, of a suction pad embodying our invention in modified form.

Fig. 8 is a bottom plan view thereof; and

Fig. 9 is a diagrammatic view from the position 9—9 of Fig. 1.

Referring now particularly to Fig. 1 of the drawings A designates, as a whole, the frame of the machine, A′ the bail thereof, pivotally connected thereto, B a plate of glass being carried by said machine and about to be deposited in a rack C of adjacent racks, indicated at C, C′, adapted for receiving and storing said glass.

Excepting as hereinafter particularly described, the vacuum lifting machine, including the body portion A and the bail A′, are substantially identical in construction with the machine shown and described in said U. S. Letters Patent No. 1,125,752, to which reference is made for a description thereof and which need not, therefore, be repeated herein.

As regards the frame A of the machine of the present application, the transverse frame members 2 may be secured to the undersides of the longitudinal frame members 1, in the manner shown in said Patent No. 1,125,752. This is the construction contemplated in Figs. 6 to 8, inclusive, of the drawings. But, to reduce the thickness of said frame, said frame members 1 and 2 will preferably be arranged at substantially the same level, the transverse frame members 2 being continuous and the longitudinal frame members 1 being made in sections, the number of sections corresponding to the number of transverse frame members and the lengths thereof being equal to the distance between adjacent transverse frame members, and the webs of said frame members being rigidly connected by means of angle plates 3 riveted or otherwise rigidly secured thereto, respectively. This latter construction is shown in Figs. 1 to 5, inclusive, of the drawings.

Secured to the frame A are any desired number of suction pads, designated as a whole A^2. Said suction pads correspond generally to the vacuum cups of said Patent No. 1,125,752 and when placed in contact with a plate of glass and the air exhausted therefrom, are adapted to grip and hold a plate of glass to the frame A so that said plate of glass may be carried from place to place, either in horizontal or vertical position.

In order to permit the frame A to be turned into edgewise position beyond the vertical, the side members 4 of the bail A′ are curved or bowed adjacent to their upper ends, as shown at 5, to permit desired pivotal movement of the frame A and plate of glass B, and in order that said bail shall increase the thickness of the machine when turned into edgewise position to as small an extent as possible, the side members 4 of said bail from the bowed portions 5 thereof to the hinges which connect said bail to the frame A extend at an angle to the vertical substantially equal to or slightly less than the angle of inclination of the glass supporting surfaces of the glass racks C, C′.

To effect the objects of our present invention as it relates to reducing the thickness of the suction pads A^2, said suction pads may be constructed in several different ways.

What we now consider the preferable construction is that shown in detail in Figs. 2, 3, 4 and 5 of the drawings, and which will now be described. As said suction pads are all similar in construction, a description of one thereof will suffice for all, and said description will therefore be in the singular. Said suction pad comprises a body portion 6 preferably made of an integral piece of cast iron or other suitable metal. Formed in the back or upper side of the body portion 6 of said suction pad is a T-slot 7 of suitable size and shape to receive the lower flange of the transverse frame member 2, consisting preferably of an I-beam. In the preferable construction shown, the T-slot 7 is formed in a projection 8 on the back or upper side of said suction pad and said suction pad is adapted to be secured in adjusted position on the flange of said I-beam forming the transverse frame member 2 by means of set screws 9 threaded through said

projections 8 and the lower ends of which are adapted to bear against the upper side of the lower flange of said I-beam. With the described construction it is obvious that said pad may be quickly and conveniently adjusted to and removed from the transverse member 2 and its position thereon varied as may be desired.

The under face or side of the body portion 6 of said pad may be of any desired shape, being usually flat, and said body portion is made as thin as practicable consistent with requisite strength.

Secured to the under face of the body portion 6 of said suction pad is a diaphragm 13 of suitable material impermeable to air, preferably soft rubber or the like. As shown said diaphragm 13 is clamped to the face of the body portion 6 of said suction pad by what may be properly described as a grid, designated as a whole 14, and which comprises a circular portion or ring 15 and radial arms or spokes 16, said ring 15 and arms or spokes 16 being secured to said casing by means of bolts 17 which extend through holes formed therein and in the diaphragm 13 and are threaded into holes formed in the body portion 6 of said suction pad. In order to bring the lower face of the grid 14 entirely above the exposed lower face of the diaphragm 13, grooves 18 are formed in the under side or face of the body portion 6 of said suction pad, which are the same size and shape in plan view as the grid 14. The diaphragm 13 is formed with ribs 19 on its upper side which are adapted to enter the grooves 18 in the lower face of the body portion 6 of said suction pad and with corresponding grooves 20 in its exposed or lower face adapted to receive the grid 14. The depth of the grooves 18 in the body portion of the suction pad is greater than the aggregate thickness of the diaphragm 13 and grid 14 so that, when said diaphragm and grid are secured in position to the face of the body portion 6 of said suction pad, the lower face of the grid will be entirely above the exposed surface of the diaphragm 13.

Air is adapted to be exhausted from between the under side of the diaphragm 13 and any object with which it rests in contact by means of suitable connection with a vacuum pump, not shown. In the preferable construction shown, said connection comprises a pipe 21 mounted on said frame A, which is connected to a neck or nipple 22 formed on the diaphragm 13 and which extends upward through a hole 23 formed through the body portion 6 of the suction pad in line with one of the radial grooves 18 therein, and in the grid 14, whereby said neck or nipple 22 will communicate directly with the channels 24 formed in the exposed face of the diaphragm 13 by the grid 14, the lower face of which is located back of the exposed face of said diaphragm in the manner heretofore explained. To prevent the neck or nipple 22 of the diaphragm 13 from collapsing under suction, the end of the pipe 21 connected thereto preferably extends inside of said neck or nipple.

The pipe 21 is controlled by a stop cock 25 by means of which said suction pad A^2 may be "cut in" and "cut out." As shown, the connection of the pipe 21 to the diaphragm is eccentric to the center of the body portion 6 of the suction pad, being preferably located in such position that it will be inside of the transverse frame member 2 which will protect said pipe connection and prevent same from contact with other objects which might operate to loosen or break the same.

Adjacent to its outer edges, the diaphragm 13 curves downwardly away from the under face or surface of the body portion 6 of the suction pad, thus imparting to said diaphragm a shallow cup-shape, so that when said diaphragm is brought into contact with an article, as the plate of glass B, its extreme outer edges will come into contact therewith first. Thus, when the air is exhausted from said suction pad A^2, the suction produced thereby, operating on the relatively thin and flexible outer edges of said diaphragm, will draw the same firmly into contact with the surface of the plate of glass and will cause the same to conform exactly to the surface of the glass, including the usual shallow depressions therein, entirely around the circumference of said diaphragm.

This contact will operate to prevent any air from entering between said diaphragm and the surface of the glass B, so that, as the exhaustion of the air from the suction pad A^2 continues the adhesion of said diaphragm to the plate of glass will proceed progressively from the outer edges of said diaphragm inwardly until the entire surface of the diaphragm outside of the air passageway or channel 24 defined by the ring portion 15 of the grid 14, adheres closely to the surface of the glass. Inside of the channel 24 defined by said ring, the exhaustion of the air will proceed in all directions from the channels defined by said ring 15 and the arms or spokes 16.

A tight joint is maintained between the diaphragm 13 and the surface of the body portion 6 of the suction pad surrounding the neck or nipple 22 of the diaphragm 13 by an arm of the grid which passes beneath said neck or nipple. Access of dust and dirt between said diaphragm and the surface of the body portion 6 of the suction pad will thus be impossible, and the formation of lumps beneath said diaphragm by the accumulation of dust and dirt, effectually prevented.

With the described construction, it is obvious that there will be no adhesion between the diaphragm 13 and the body portion 6 of the suction pad due to suction and that said diaphragm will be held to said body portion 6 merely by the grid 14. In this manner, all strain on the glass due to drawing the same into close contact with the face of the body portion 6 of the suction pad, with consequent danger of breaking said glass, will be avoided.

The machine is adapted to be handled and guided by means of a handle 26, Fig. 1, which is connected to members 2 of the machine frame A on the side of the machine which is lowermost when the machine frame A is tilted into a vertical plane.

In order that the suction pads A^2 may be separately "cut out" and "cut in," that is the suction thereof broken and restored, by the operator when standing at the side of the machine on which the handle 26 is located, and particularly for cutting the suction pads at the upper side of the machine frame "out" and "in" when said frame is turned to bring the plate of glass B carried thereby into a vertical plane, the suction pipes 21 are all run to the side of the machine frame to which the handle 26 is secured and connected into a relatively large pipe or header 27 which is connected directly with the vacuum pump and the stop cocks 25 are inserted into the pipes 21 adjacent to the ends thereof which are connected to the pipe or header 27, where they may be conveniently reached by the operator when holding the handle 26, all as clearly shown in Figs. 1 and 9 of the drawings.

The suction of the suction pads A^2, which are in communication with the pipe or header 27 is adapted to be broken by means of a vent valve 28 in the pipe or header 27. When open, said vent valve 28 will admit air directly from the atmosphere to said pipe or header 27 and will, of course, release the glass from the suction pads, thus permitting them to be deposited at a desired point.

In the preferable construction shown, Figs. 2, 3 and 4, the ring portion 15 and the spokes or arms 16 of the grid 14 are formed separate from each other, said ring and each of said arms forming a separate piece. Our invention, however, contemplates equally forming said ring and said arms or spokes integral with each other.

As a further modification of our invention, we also contemplate bolting or otherwise securing the suction pads A^2 to the transverse frame members 2 of the frame A.

As still a further modification of our invention, we also contemplate making the suction connections to the suction pads A^2 at their centers instead of eccentrical thereto. To provide for conveniently making central suction connections to said suction pads, the transverse members 2 of the frame A, to which said suction pads are secured, are arranged in pairs, each consisting of a suitable structural shape, and the suction pads A^2 being secured thereto in such relation that the suction connections thereof will be exposed between different pairs of said frame members.

The foregoing modifications are illustrated in Figs. 6 to 8, inclusive, of the drawings. Referring now to said figures, 2′ designates the transverse frame members of the frame A. As shown, said frame members 2′ are formed from I-beams, but our invention contemplates equally, the use of any other structural shapes suitable for the purpose.

The body portion 6′ of the suction pad A^2 is secured to the under sides of said frame members 2′, being bolted to the lower flanges thereof, and the upper side of said suction pad being made flat to form a bearing for said frame members.

The diaphragm 13′ is secured to the under side of the body portion of said pad by means of a grid 14′, in substantially the same manner that the diaphragm 13 is secured to the body portion 6 of the suction pad by the grid 14 in Figs. 2 to 5 of the drawings and heretofore described, excepting that the ring 15′ and the spokes or arms 16′ of said grid are formed integral with each other instead of in separate pieces, and the diaphragm has no neck or nipple, as in the preferred embodiment of our invention.

The suction connection to said suction pad A^2, consists of a hole 23′ formed centrally through the body portion 6′ thereof, the diaphragm 13′ and the center of the grid 14′, and communicates with the grooves 24′ formed in the exposed lower side or face of said diaphragm 13′. A pipe 21′ connected into said hole 23′ at the rear or upper side of the body portion 6′ of said suction pad is adapted for connecting the same with a vacuum pump or the like, not shown.

The grid 14′ forms a tight joint between the diaphragm 13′ and the face of the body portion 6′ of the suction pad around the hole 23′, thus preventing the exhaustion of the air from between said diaphragm and said body portion of the suction pad in the operation of the machine, thus effectually obviating all danger of breaking of the glass by the action of the suction pads in the operation of the machine.

The suction pipe 21′ preferably extends through a hole formed in the web of one of the frame members 2′, which will thus form both a support and a guard therefor.

We claim.

1. In a machine of the type described, the combination of a frame, a bail hinged to said frame, and suction pads secured to the under side of said frame, and suction connections

therefor, the sides of said bail being off-set adjacent to their ends remote from their hinged ends and being inclined from said off-set portions to their hinged ends, and said suction pads comprising body portions made as thin as consistent with requisite strength, for the purpose specified, substantially as described.

2. In a machine of the type described, the combination of a frame comprising rigidly connected longitudinal and transverse frame members arranged at substantially the same level, a bail hinged to said frame, the side members of said bail being off-set adjacent to their ends remote from their hinged ends and being inclined from said off-set portions to their hinged ends, and suction pads secured to said frame, comprising body portions made as thin as consistent with requisite strength and suction connections to said pads, all for the purpose specified, substantially as described.

3. In a machine of the type described, the combination of a frame, a bail hinged to said frame, and suction pads secured to the under side of said frame, and suction connections therefor, the sides of said bail being off-set adjacent to their ends remote from their hinged ends and being inclined from said off-set portions to their hinges, for the purpose specified, substantially as described.

4. In a machine of the type described, the combination of a frame, a bail hinged to said frame, a handle on said frame for handling the same, suction pads on said frame and suction connections therefor, said suction connections comprising a pipe or header mounted on the machine frame adjacent to the handle of said machine, branch pipes connecting said suction pads with said main pipe or header, and stop cocks in said branch pipes all located within reach of the machine operator from the side of the machine frame to which the handle is secured, substantially as described.

5. In a machine of the type described, the combination of a frame, suction pads secured thereto, and suction connections for said suction pads, said suction pads comprising body portions having relatively large exposed faces and diaphragms secured to and which overlie the faces of said body portions, the means for securing said diaphragms to said body portions comprising mechanical means only applied at separated points over considerable areas of said pads to provide connections of requisite strength constructed and arranged to permit said diaphragms to sag away from the faces of the body portions of said pads under the loads to which they are subjected in use, thereby relieving the load from all stresses due to the suction of said pads, substantially as described.

6. In a machine of the type described, the combination of a frame, suction pads secured thereto, and suction connections for said suction pads, said suction pads comprising body portions and diaphragms secured to the faces of said body portions with considerable areas thereof in contact and said diaphragms being exposed and adapted to contact with the load throughout substantially their entire areas, said body portions and diaphragms being provided with holes to which said suction connections are made, and means to prevent suction applied to said suction connections from exhausting the air from between said suction pads and diaphragms, substantially as described.

7. In a machine of the type described, the combination of a frame, suction pads secured thereto, and suction connections for said suction pads, said suction pads comprising body portions and diaphragms secured to the faces of said body portions with considerable areas thereof in contact and said diaphragms being exposed and adapted to contact with the load throughout substantially their entire areas, said body portions and diaphragms being provided with holes to which said suction connections are made, and means for forming tight joints between said body portions and diaphragms around said holes in said body portions and diaphragms, substantially as described.

8. In a machine of the type described, the combination of a frame comprising members provided with flanges at their lower edges, suction pads secured to said flanged frame members, said securing means comprising T-slots formed in said suction pads adapted to receive the flanges on said flanged frame members and means for securing said pads in adjusted positions on said flanged frame members, substantially as described.

9. In a machine of the type described, the combination of a frame, suctions pads secured thereto, said suction pads comprising body portions and diaphragms secured to the faces of said body portions with considerable areas thereof in contact, the means for securing said diaphragms to said body portions comprising grids clamped to the body portions of said suction pads, said diaphragms being shaped to form grooves in their exposed sides to receive said grids and corresponding ribs on their upper sides, and the body portions of said suction pads being grooved to receive the ribs formed on said diaphragms, the relation being such that the under sides of said grids will be entirely above or back of the exposed faces of said diaphragms, suction connections to said suction pads, said body portions and diaphragms being provided with holes to which said suction connections are made, and means for forming tight joints between said

body portions and diaphragms around the suction holes therein, substantially as described.

10. In a machine of the type described, the combination of a frame, suction pads secured thereto, said suction pads comprising body portions and diaphragms secured to the faces thereof, the means for securing said diaphragms to said body portions comprising grids clamped to the body portions of said suction pads, said diaphragms being shaped to form grooves in their exposed sides to receive said grids and corresponding ribs on their upper sides, and the body portions of said suction pads being grooved to receive the ribs formed on said diaphragms, the relation being such that the under sides of said grids will be entirely above or back of the exposed faces of said diaphragms, said suction pads being provided with holes formed through the body portions thereof and the diaphragms secured thereto and which communicate with the channels formed in the exposed faces of said diaphragms by the grids which secure said diaphragms to the body portions of said suction pads, and suction connections to said suction pads which communicate with said holes, substantially as described.

11. In a machine of the type described, the combination of a frame, suction pads secured thereto, said suction pads comprising body portions and diaphragms secured to the faces thereof, the means for securing said diaphragms to said body portions comprising grids clamped to the body portions of said suction pads, said diaphragms being shaped to form grooves in their exposed sides to receive said grids and corresponding ribs on their upper sides, and the body portions of said suction pads being grooved to receive the ribs formed on said diaphragms, the relation being such that the under sides of said grids will be entirely above or back of the exposed faces of diaphragms, said suction pads being provided with holes formed through the body portions thereof, and suction connections to said suction pads, comprising nipples formed on said diaphragms which extend through the holes in the body portions of said suction pads, substantially as described.

12. In a machine of the type described, the combination of a frame, suction pads secured thereto, said suction pads comprising body portions and diaphragms secured to the faces thereof, the means for securing said diaphragms to said body portions comprising grids clamped to the body portions of said suction pads, said diaphragms being shaped to form grooves in their exposed sides to receive said grids and corresponding ribs on their upper sides, and the body portions of said suction pads being grooved to receive the ribs formed on said diaphragms, the relation being such that the under sides of said grids will be entirely above or back of the exposed faces of said diaphragms, said suction pads being provided with holes formed through the body portions thereof, and suction connections to said suction pads, comprising nipples formed on said diaphragms which extend through the holes in said body portions, said nipples being formed on ribs of said diaphragms and said diaphragm supporting grids being provided with holes in line with the holes through said nipples and through which said nipples communicate with the channels formed in the exposed faces of said diaphragms by the diaphragm supporting grids, substantially as described.

13. In a machine of the type described, the combination of a frame, suction pads secured thereto, said suction pads comprising body portions and diaphragms secured to the faces thereof, the means for securing said diaphragms to said body portions comprising grids clamped to the body portions of said suction pads, said diaphragms being shaped to form grooves in their exposed sides to receive said grids and corresponding ribs on their upper sides, and the faces of said suction pads being grooved to receive the ribs formed on said diaphragms, the relation being such that the under sides of said grids will be entirely above or back of the exposed faces of said diaphragms, said suction pads being provided with holes formed through the body portions thereof, and suction connections to said suction pads, comprising nipples formed on said diaphragms which extend through the holes in said body portions, said nipples being formed on ribs of said diaphragms and said diaphragm supporting grids being provided with holes in line with the holes through said nipples, through which said nipples communicate with the channels formed in the exposed faces of said diaphragms by the diaphragm supporting grids, and said diaphragm supporting grids operating to form tight joints between said diaphragms and the body portions of said suction pads around said nipples, substantially as described.

14. A suction pad comprising a body portion having a relatively large exposed face and a diaphragm secured to and which overlies the face of said body portion, the means for securing said diaphragm to said body portion comprising mechanical means only applied at separated points over a considerable area of said pad to provide connections of requisite strength constructed and arranged to permit said diaphragm to sag away from the face of the body portion of said pad under the load to which it is subjected in use, thereby relieving the load from all stresses due to the suction of said pad, substantially as described.

15. A suction pad comprising a body portion and a diaphragm secured to the face of said body portion with considerable areas of said diaphragm and body portion in contact and said diaphragm being exposed and adapted to contact with the load throughout substantially the entire area thereof, said body portion and diaphragm being provided with holes to which suction connections are adapted to be made, and means to prevent suction applied thereto from exhausting the air from between said suction pad and diaphragm, substantially as described.

16. A suction pad comprising a body portion and a diaphragm secured to the face of said body portion with considerable areas of said diaphragm and body portion in contact and said diaphragm being exposed and adapted to contact with the load throughout substantially the entire area thereof, said body portion and diaphragm being provided with holes to which suction connections are adapted to be made, and means for forming a tight joint between the body portion of said pad and said diaphragm around said holes therein, substantially as described.

17. A suction pad comprising a body portion, a diaphragm secured to the face thereof, the means for securing said diaphragm to said body portion of said suction pad comprising a grid clamped to said body portion outside of said diaphragm, said diaphragm being shaped to form grooves in its exposed side to receive said grid and corresponding ribs on its upper side, and the face of the body portion of said suction pad being grooved to receive the ribs formed on said diaphragm, the relation being such that the outer side of said grid will be entirely above or back of the exposed face of said diaphragm, whereby said grid will form communicating channels in the exposed face of said diaphragm and suction connections extending through said body portion of said suction pad and said diaphragm and which communicate with the grooves formed in the exposed face of said diaphragm, substantially as described.

18. A suction pad comprising a body portion, a diaphragm secured to the face thereof, the means for securing said diaphragm to said body portion of said suction pad comprising a grid clamped to said body portion outside of said diaphragm, said diaphragm being shaped to form grooves in its exposed side to receive said grid and corresponding ribs on its upper side, and the face of the body portion of said suction pad being grooved to receive the ribs formed on said diaphragm, the relation being such that the outer side of said grid will be entirely above or back of the exposed face of said diaphragm, whereby said grid will form communicating channels in the exposed face of said diaphragm, and said body portion and diaphragm being provided with holes to which suction connections are adapted to be made and which communicate with the channels formed in the exposed face of said diaphragm by said grid, substantially as described.

19. A suction pad comprising a body portion, a diaphragm secured to the face thereof, the means for securing said diaphragm to said body portion of said suction pad comprising a grid clamped to said body portion outside of said diaphragm, said diaphragm being shaped to form grooves in its exposed side to receive said grid and corresponding ribs on its upper side, and the face of the body portion of said suction pad being grooved to receive the ribs formed on said diaphragm, the relation being such that the outer side of said grid will be entirely above or back of the exposed face of said diaphragm, whereby said grid will form communicating channels in the exposed face of said diaphragm and said suction pad being provided with holes formed through the body portion thereof and the diaphragm secured thereto to which suction connections are adapted to be made and which communicate with the channels formed in the exposed face of said diaphragm by the diaphragm support grid, and said grid operating to seal the space between said diaphragm and the body portion of such suction pad around said suction connection, substantially as described.

20. A suction pad comprising a body portion provided with a hole which extends therethrough, a diaphragm secured to the face of said body portion, and a nipple formed on said diaphragm which extends through the hole in said body portion to which suction connections are adapted to be made, substantially as described.

21. A suction pad comprising a body portion provided with a hole which extends therethrough, a diphragm secured to the face of said body portion, and a nipple formed on said diaphragm which extends through the hole in said body portion to which suction connections are adapted to be made, and means for forming a tight joint between the body portion of said suction pad and said diaphragm around said nipple, substantially as described.

22. A suction pad comprising a body portion provided with a hole which extends therethrough, a diaphragm secured to the face thereof, the means for securing said diaphragm to said body portion of said suction pad comprising a grid clamped to said body portion outside of said diaphragm, said diaphragm being shaped to form grooves in its exposed face to receive said grid and corresponding ribs on its upper

side, and the face of the body portion of said suction pad being grooved to receive the ribs formed on said diaphragm, the relation being such that the outer side of said grid will be entirely above or back of the exposed face of said diaphragm, whereby said grid will form communicating channels in the exposed face of said diaphragm, a nipple formed on said diaphragm which extends through the hole in the body portion of said suction pad, said nipple being formed on a rib of said diaphragm and said diaphragm supporting grid being provided with a hole in line with the hole through said nipple through which said nipple will communicate with the channels formed in the exposed face of said diaphragm by the diaphragm supporting grid, substantially as described.

23. A suction pad comprising a body portion provided with a hole which extends therethrough, a diaphragm secured to the face thereof, the means for securing said diaphragm to said body portion of said suction pad comprising a grid clamped to said body portion outside of said diaphragm, said diaphragm being shaped to form grooves in its exposed face to receive said grid and corresponding ribs on its upper side, and the face of the body portion of said suction pad being grooved to receive the ribs formed on said diaphragm, the relation being such that the outer side of said grid will be entirely above or back of the exposed face of said diaphragm, whereby said grid will form communicating channels in the exposed face of said diaphragm, a nipple formed on said diaphragm which extends through the hole in the body portion of said suction pad, said nipple being formed on a rib of said diaphragm and said diaphragm supporting grid being provided with a hole in line with the hole through said nipple through which said nipple will communicate with the channels formed in the exposed face of said diaphragm by the diaphragm supporting grid, said grid forming a tight joint between said diaphragm and the body portion of said pad around said nipple, substantially as described.

In testimony that we claim the foregoing as our invention, we affix our signatures in the presence of two subscribing witnesses this 24 day of February, 1916.

CARLTON L. SMITH.
OSCAR I. LEWELLYN.

Witnesses for Carlton L. Smith:
ALBERT C. BORDEN,
GLEN L. SMITH.
Witnesses for Oscar I. Lewellyn:
LOUIS MEHLIG,
RAYMOND MEHLIG.

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