C. L. SMITH.

VACUUM LIFTING MACHINE.

APPLICATION FILED SEPT. 24, 1913.

1,125,752.

Patented Jan. 19, 1915.

4 SHEETS—SHEET 1.

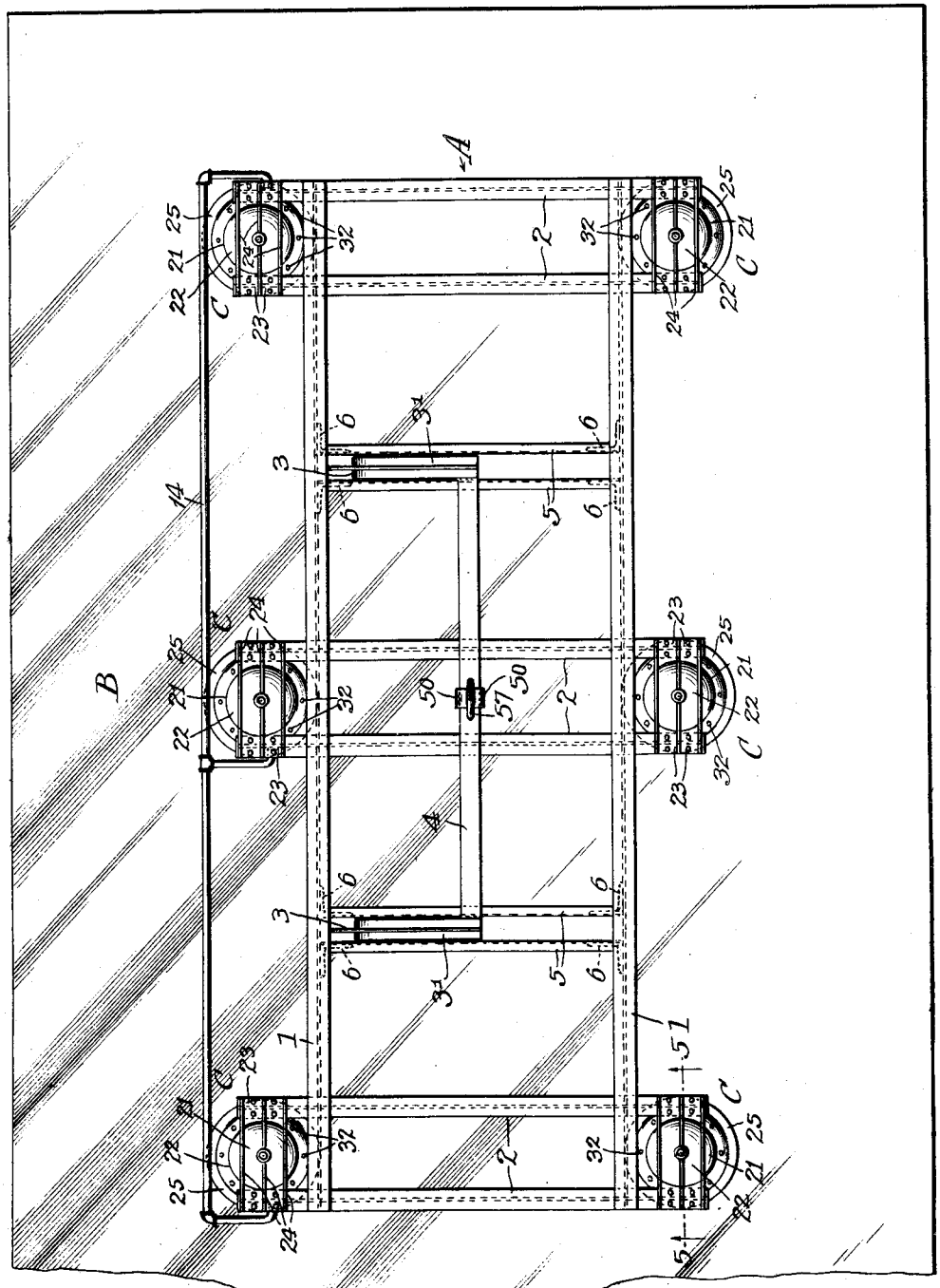


Fig. 1.

Witnesses
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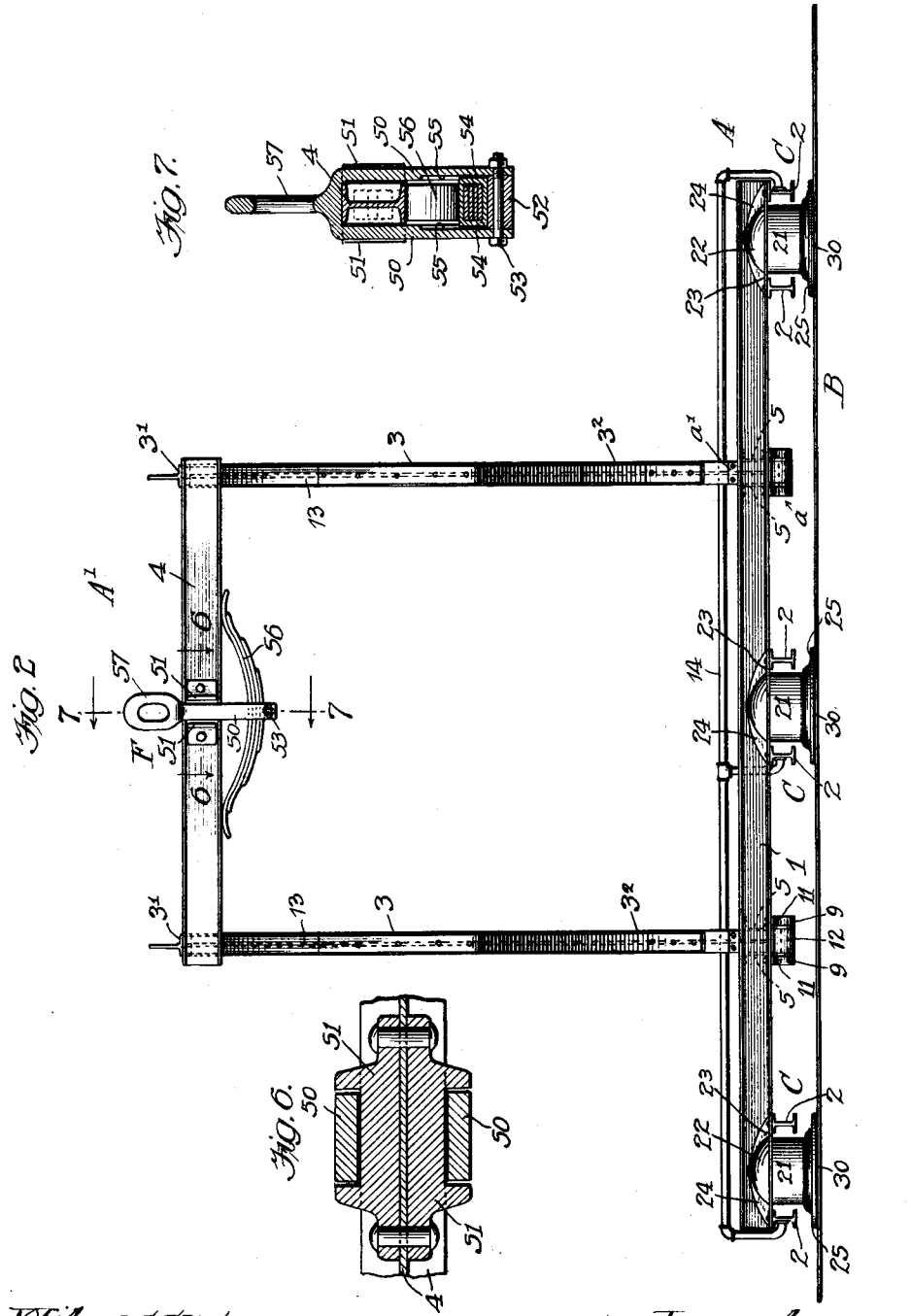
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4 SHEETS—SHEET 2.



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4 SHEETS—SHEET 3.

Fig. 8.

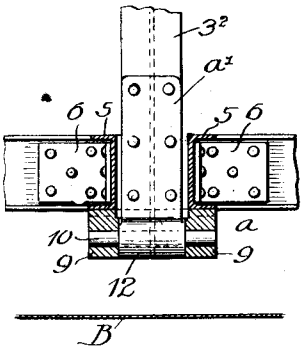
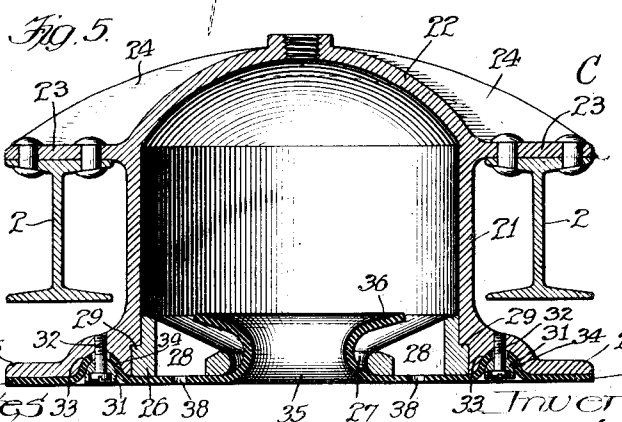


Fig. 3.

Fig. 5.



Witnesses

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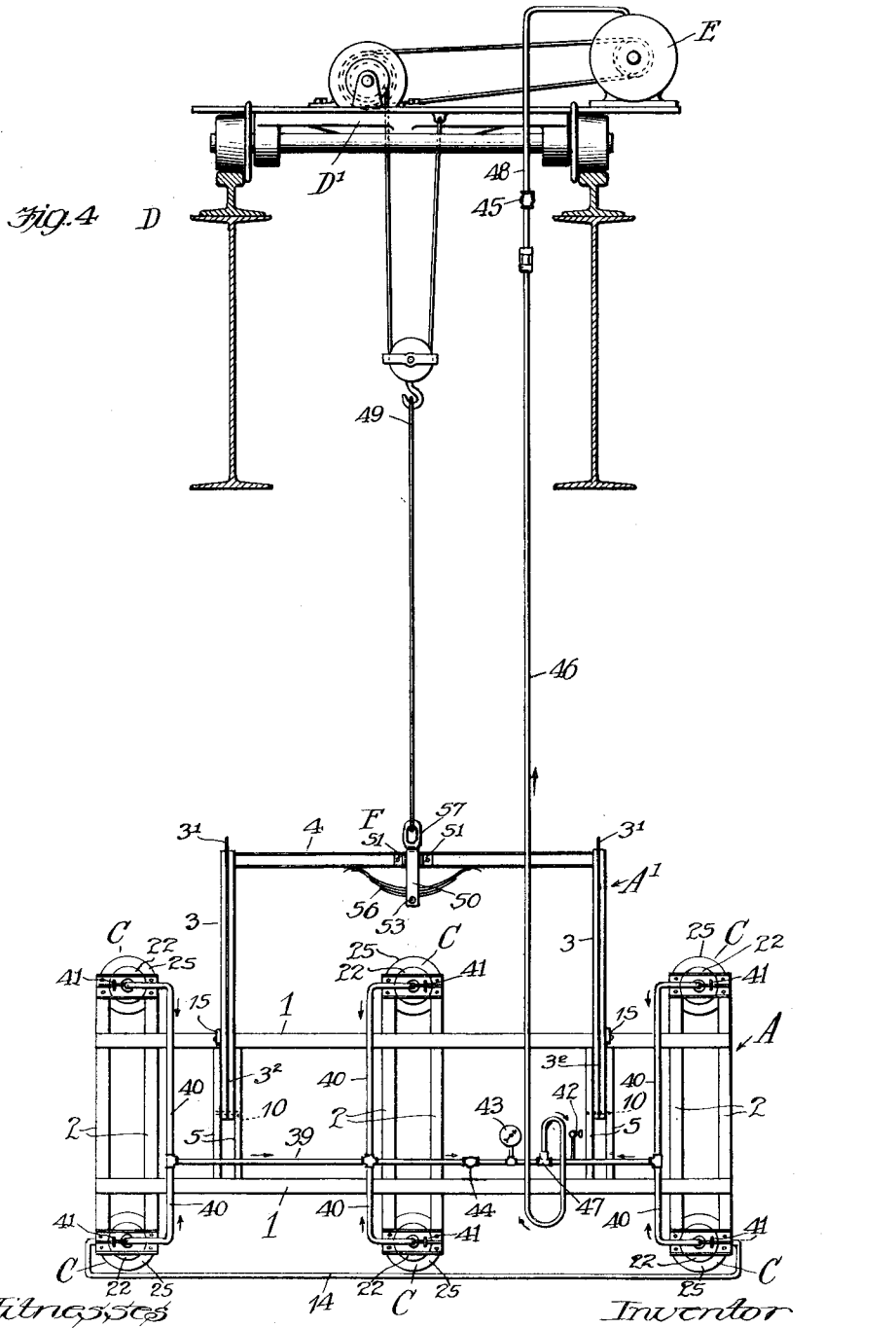
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4 SHEETS—SHEET 4.

Fig. 4



Witnesses

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UNITED STATES PATENT OFFICE.

CARLTON L. SMITH, OF SAGINAW, MICHIGAN.

VACUUM LIFTING-MACHINE.

1,125,752. Specification of Letters Patent. Patented Jan. 19, 1915.

Application filed September 24, 1913. Serial No. 791,523.

To all whom it may concern:

Be it known that I, CARLTON L. SMITH, a citizen of the United States, and a resident of Saginaw, in the county of Saginaw and State of Michigan, have invented a certain new and useful Improvement in Vacuum Lifting-Machines, of which the following is a specification.

This invention relates to machines for handling plate glass and like products.

The primary object of the invention is to provide a machine by means of which plates of glass which are too large and heavy to be handled by hand may be handled by power, quickly, conveniently and safely, that is, practically without danger to those operating the machine, and also with a minimum breakage of glass as compared with any means or method of handling glass of which I have any knowledge.

To effect these objects, a machine of my invention comprises the various features, combinations of features and details of construction hereinafter described and claimed.

In the accompanying drawings, in which a machine of my invention is fully illustrated—Figure 1 is a top plan view of a vacuum lifting machine of my invention; Fig. 2 is a side view thereof; Fig. 3 is an end view thereof showing, in dotted lines, the frame of the machine in tilted position; Fig. 4 is a side view of my improved lifting machine with the frame in tilted position, showing, in diagram, the means for handling and operating the same; Fig. 5 is an enlarged, central, sectional view of one of the vacuum cups taken substantially on the line 5—5 of Fig. 1; Fig. 6 is an enlarged, fragmentary, sectional view on the line 6—6 of Fig. 2; Fig. 7 is an enlarged sectional view on the line 7—7 of Fig. 2; and Fig. 8 is an enlarged sectional view taken on the line 8—8 of Fig. 3, showing particularly the hinge which connects the bail to the frame of the machine.

My improved machine comprises a suitable frame designated, as a whole, A, which, in the preferable construction shown, consists of longitudinal frame members 1, preferably I-beams, which are rigidly connected by pairs of transverse frame members 2, which also are preferably I-beams, and which, as shown, are connected to the under sides of said longitudinal members 1 and project beyond the same at both sides of the machine frame.

Hinged to the frame A is what, for convenience, may be referred to as a bail, designated, as a whole, A′. As preferably constructed, said bail A′ consists of T-bars 3, the upper ends of which are rigidly connected to an I-beam 4 which extends parallel with the frame members 1. As shown, the bail members 3 are hinged directly to channel bars 5 which are arranged in pairs with their flat sides toward each other and the ends of which are rigidly connected to the longitudinal frame members 1, as by angle irons or brackets 6, which fit tightly between the flanges of the I-beams 1 and of said channel bars 5. My invention contemplates the use of any desired or approved form of hinge for thus hinging the bail A′ to the frame A. A desirable form of hinge shown comprises members *a*, *a′* secured to the frame A and to the lower ends of the bail members 3, respectively. The members *a* secured to the frame A consist of plates 7 secured to the under sides of the pairs of channel bars 5, and depending from the under sides of which are lugs 9 provided with bearings adapted to receive the hinge pins or pintles 10.

The hinged members *a′* consist of butts riveted or otherwise rigidly secured to the flat sides of the bail members 3, the bearing bosses 12 of which fit endwise between the adjacent ends of the bearing lugs 9 on the hinged members *a* and which are provided with bearings adapted to receive the pins or pintles 10.

In the operation of the machine, a plate of glass, designated B, is carried at the under side of the frame A, by means presently described, and the hinges for said frame A are attached thereto in such positions that their axes will be substantially in line with the center of gravity of the frame A and the load carried thereby, consisting of the plate of glass B, thus providing for turning the frame A into position to bring the plate of glass B into a substantially vertical plane, which is the preferable position in which to carry said plate of glass, and to provide for conveniently depositing the plates of glass edgewise in the racks or frames in which they are stored.

Plate glass is usually stored edgewise in suitable frames or racks, and for reasons presently apparent, in handling the glass and in depositing the same in the racks or frames, it is necessary that provision be

made for turning the frame A into a position in which the upper edge of the plate of glass B will pass the vertical, and for locking said frame in such position. To provide for thus turning said frame A past the vertical, substantially into the position shown in dotted lines, Fig. 3, the bail members 3 are preferably made sufficiently long to permit the upper edge of the plate of glass B to swing under the I-beam 4 which connects said bail members 3, and said bails are bowed in proper manner to permit desired pivotal movement of the frame A and plate B. As shown, the desired bow or offset is imparted to the bail members 3 by forming the same with substantially horizontal sections 3′ at the upper ends thereof. Also, to bring the hinges which connect the bail A′ to the frame A centrally below the bail member 4, the bail members 3 comprise sections 3^2 at their lower ends which are downwardly inclined to bring the ends thereof vertically beneath the I-beam 4, as desired. Also, if desired, the bowed bail members 3 may be reinforced by braces 13 which connect the upper horizontal sections 3′ and the lower inclined section 3^2 of said bail bars adjacent to their ends with the intermediate vertical sections of said bail members.

The machine is adapted to be handled and guided by means of a handle 14, the ends of which are connected to the extreme I-beams 2 of the machine frame A on the side of the machine which is lowermost when the machine frame A is tilted to bring the plate of glass B into a vertical plane. Said handle 14 may be made of any suitable material, a desirable material consisting of ordinary gas pipe.

The frame A is adapted to be secured in edgewise or vertical position by means of a suitable lock consisting, as shown, of a gravity latch 15 pivoted to one of the bail members 3, a hook 16 at the end of which is adapted to engage the flange of the I-beam 1 which is uppermost when said frame A is tilted into vertical position. As shown, said latch 15 is pivoted to a bracket 17 riveted or otherwise secured to the bail member 3 in suitable position, suitable stops on said bracket limiting the pivotal movement of said latch 15. As shown, said stops consist of lugs 18 and 19 on the bracket 17, the lug 18 operating to support said latch 15 in position for automatic engagement with the I-beam 1 which it is designed to engage, and the stop projection 19 defining the extreme raised position of said latch 15, the position of said stop 19 being such that, when released, it will always return to its operative position in contact with the stop lug 18.

To provide for automatic engagement of the latch 15 with the I-beam 1, the outer end of said latch is beveled as shown at 20, whereby, as the frame A is turned pivotally, the edge of the flange of the I-beam 1, striking said inclined surface 20, will ride over said flange and the catch will fall by gravity to locking position as soon as the flange of said I-beam has passed the hook 16 thereon.

The plate of glass B is adapted to be secured to the under side of the frame A by means of vacuum cups designated as a whole C, secured to said frame. As shown, said vacuum cups comprise cups secured between each pair of I-beams 2 of the machine frame. The machine shown comprises six vacuum cups C, secured to the ends of each pair of I-beams 2. My invention, however, contemplates the use of a greater or less number of vacuum cups, as desired, depending upon the size of plates which the machine is designed to handle. My invention also contemplates the use of any desired or approved form of vacuum cup. The preferable form of vacuum cup shown, comprises a substantially cylindrical casing 21 made of cast iron or the like, the lower end of which is open and the upper end of which is closed by means of a head 22 which, as shown, is formed integral with the side walls of said casing. Formed on said casing 21 adjacent to its upper end are lateral projections or brackets 23, which rest upon and are bolted or otherwise rigidly secured to the upper sides of the pairs of I-beams 2, to which said vacuum cups are secured, respectively. The projections or brackets 23 are reinforced and strengthened by means of ribs or flanges 24.

Formed at the lower end of the casing 21 is a flange 25 and secured in the open end of said casing is a spider 26, said spider being provided with a central opening 27, and with a plurality of openings 28 surrounding said central opening 27. The spider 26 is secured in the end of the casing 21 with a driving fit, the position of said spider being defined by abutting shoulders 29, formed on said casing and on said spider. The lower sides of the flanges 25 and of the spider 26 are dressed to form substantially true surfaces, the relation being such that the face of the spider will be a very slight fraction of an inch inside of the lower face of the flange 25, say .0005.

Secured to the under face of the casing 21 is a diaphragm 30 of suitable flexible material impermeable to air, preferably rubber or the like. As shown, the diaphragm 30 is clamped to the casing 21 by a ring 31 clamped to said shell or casing by means of bolts 32 which extend through holes or openings formed in said ring 31 and in the diaphragm 30, and are threaded into holes formed in the flange 25 on said casing 21. In order to bring the ring 31 and the clamping screws 32 entirely above the lower face

of the diaphragm 30, a circular groove 33 is formed in the under side of the flange 25 substantially concentric with the shell or casing 1, said diaphragm 30 being formed with a corresponding groove 34 on its under side to receive said clamping ring 31 and with a rib on its upper side adapted to enter the groove 33 in the flange 25 of said casing, the depth of said groove 33 being greater than the aggregate thickness of the grooved portion of said diaphragm and of the ring 31. Formed at the center of said diaphragm 30 is a hole or opening 35 surrounding which, at the rear side of said diaphragm, is a flange 36, which extends through the opening 27 in the spider 26 and outwardly beyond the edges of said hole or opening. Preferably, also, the diaphragm 30 is provided with holes or openings 38 which register with the openings 28 in the spider 26 for the purpose of better exhausting any air which may work or seep through between the diaphragm 30 and the surface of the glass during the operation of the machine, thus maintaining a more perfect vacuum and suction beneath said diaphragm.

Connected to the casings 21 of the vacuum cups C are suction pipes which communicate with a suitable vacuum pump, as presently described, whereby a continuous suction will be produced and a sustained vacuum maintained in each of the vacuum cups C. As shown, said suction pipe connections comprise a wrought iron pipe 39 which extends lengthwise above the machine frame A, preferably adjacent to the handle 14, so that the controlling valves therein may be conveniently manipulated by those operating the machine. Said longitudinal pipe 39 is connected with each of the vacuum cup casings 21 by branch pipes 40 which connect said pipe 39 with holes formed in the head 22 of the vacuum cup casing.

Each of the vacuum cups C is adapted to be "cut out" separately by means of valves 41 in the branch pipes 40, and the vacuum in the vacuum cups C, which are in communication with the pipe 39, is adapted to be broken by means of a valve 42 in the pipe 39, which, when open, will admit air directly from the atmosphere to said pipe 39. Preferably, also, the pipe 39 is provided with a vacuum gage 43, and with an automatic vacuum regulating valve 44 and a check valve 45, which is adapted to be closed by the suction in the pipe 39, should the vacuum pump be rendered temporarily inoperative from any cause.

The spiders 26 form a skeleton bridge in the open ends of the casings 21 of the vacuum cups, which will support the glass to which said vacuum cups are applied against the suction in said vacuum cups, which, owing to the large size of the casings 21, will subject the glass to a severe strain, which, if the glass were unsupported, might be sufficiently strong to break said glass.

The frame A, together with the glass carried thereby, is adapted to be handled by means of a traveling crane. My invention contemplates the use of any desired or approved form of crane, of which many different types are readily available. I have therefore shown said crane in diagram only, D indicating the traveler thereof and D′ the trolley car or truck thereof, on which the hoisting drum, not shown, is mounted. In the preferable construction shown, the vacuum pump for producing and maintaining a vacuum in the vacuum cups C is mounted on the trolley car or truck D′ of the crane, said vacuum pump being indicated at E. Said vacuum pump E is connected with the pipes 39 on the machine frame A by means of a flexible vacuum hose 46, the lower end of which is connected to a nipple 47 on said pipe 39, and the upper end to a wrought iron pipe section 48 which communicates directly with said vacuum pump. Said flexible hose 46 will permit perfect freedom of movement of the pivoted frame A, thus providing for turning the plate of glass carried by said machine and for depositing the same in any position desired.

My improved machine is adapted to be suspended from the hoisting cable of the crane, indicated at 49, and to relieve the glass from shocks due to sudden starting and stopping of the hoisting drum in the operation of the crane, which might be sufficiently severe to break the suction of the vacuum cups and thus detach the plate of glass B from the frame A against the suction of the vacuum cups C, thus permitting the same to fall and probably to break, I preferably connect the machine to the hoisting cable 49 by means of a spring clevis, designated, as a whole, F. As shown, said clevis is fork-shaped, the sides of the opening between the prongs 50 thereof being substantially parallel. Said prongs 50 are fitted to guide grooves formed in blocks 51 secured to opposite sides of the I-beam 4, said blocks being preferably fitted into the channels of said I-beam and being secured thereto by means of bolts which extend through rigid parts of said clevis guides and the intermediate web of said I-beam. Secured between the lower ends of the clevis prongs 50 is a saddle block 52, said saddle block being preferably removably secured in position by means of a bolt 53 which extends through alined openings formed in the lower ends of said clevis prongs 50 and said block 52. To prevent turning of said saddle block, it is preferably provided on its opposite sides with tongues 54 which are

slidably fitted to grooves 55 formed in the lower ends of the adjacent sides of said clevis prongs 50. Inserted between the clevis block 52 and the under sides of the I-beam 4 is a suitable spring, preferably and as shown, a leaf spring 56.

Formed on the upper end of the clevis F is an eye 57 adapted for engagement by a hook on the lower end of the hoisting cable 49. Said clevis F being freely movable in the clevis guides 51, it is obvious that any shock due to sudden starting or stopping of the crane hoist will be sustained and absorbed by the spring 56, so that the plate of glass B held by the machine will be practically unaffected thereby.

In the operation of the machine, the machine frame A is applied to the plate of glass B with the faces of the diaphragms 30 resting on the glass. The valves 41 being opened, the vacuum pump is started, and is caused to operate substantially continuously, the regulating valve 44 maintaining a uniform vacuum which will be indicated by the gage 43. When the vacuum cups are fully seated on the glass, and the desired vacuum produced in the vacuum cups C, the crane is operated to exert a pull on the hoisting cable 49 which will bring the spring 56 under tension and exert a yielding pull on the glass tending to lift the same. Where the glass is free to rise, the operation of said hoisting drum will continue until the frame and glass are raised to the desired height. Where the glass is cemented in position, as to the deck or table of a grinding or polishing machine, it will be subjected to a slight initial pull only, the adhesion of said glass to the deck or table being broken by forcing thin wedges or levers under the edges of said glass until the glass is detached and is free to be raised, after which it is lifted to a desired height as when the glass is originally free.

In carrying the glass from one place and depositing it in another, the frame A, together with the plate of glass B, is preferably turned or tilted into position shown in Fig. 3, in which said plate of glass is in a slightly inclined position with its upper edge slightly beyond the vertical. When it is desired to deposit the plate of glass B in a rack, it is first brought in proper position to the rack by means of the crane, usually with its lower edge slightly above the blocks on which the lower edge of said plate is designed to rest when in said rack. The valve 42 is opened slightly to permit a quantity of atmospheric air to enter the vacuum cups C to reduce the vacuum therein, the admission of air being continued until the weight of the glass causes the same to slide downwardly in contact with the diaphragms 30 until its lower edge rests upon the blocks of the rack on which it is designed to rest. The valve 42 is then fully opened to entirely break the vacuum and release the machine from the plate of glass B, and movement imparted to the frame A by means of the crane, to exert a pressure on the plate of glass B which will operate to turn the same about its lower edge as a fulcrum until its outer or under side comes in contact with the supports of the rack, which are inclined at a slight angle to the vertical, usually about equal to the inclination of the plate of glass B when in the machine, but at the opposite side of the vertical, so that the position of said plate in the rack will be stable. The machine is then withdrawn and is ready for use for handling other plates of glass.

When the plate of glass B is to be laid flat, as on a deck or table, it will, of course, be tilted into horizontal position, lowered to position and the vacuum released.

In case the plate of glass B being handled is of such size or shape that one or more of the vacuum cups C does not bear thereon, said vacuum cup or cups may be "cut out" by closing the valves or stop cocks 41 in the branch pipes 40 leading thereto, without affecting the operation of the other vacuum cups or of the machine.

I claim:—

1. In combination, an overhead support, a bail depending therefrom, a glass-lifting frame hinged to the lower end of said bail, the axes of the hinges being substantially in line with the center of gravity of the frame when loaded, for the purpose set forth.

2. In combination, a glass-engaging frame, a bail hinged to said frame, said bail being bowed and being of sufficient length to permit the frame hinged thereto together with its load to tilt beyond a vertical plane, and means engaging the upper ends of the bail for suspending the same.

3. In combination, a glass-engaging frame, a bail hinged thereto, the relation being such that the axes of the bail hinges are substantially coincident with the center of gravity of the vacuum frame when loaded, said bail being bowed and being of sufficient length to permit the frame hinged thereto together with its load to tilt beyond a vertical plane, and suspending means engaging centrally the top bar of the bail.

4. In combination, a glass-engaging frame, a bail hinged to said frame, said bail being bowed and being of sufficient length to permit the frame hinged thereto together with its load to tilt beyond a vertical plane, and means engaging the upper ends of the bail for suspending the same, means being provided for temporarily securing said frame in tilted position.

5. A frame for a machine of the type described, comprising longitudinal frame members and transverse frame members arranged in pairs, vacuum cup casings ar-

ranged between the pairs of transverse frame members, and brackets on said casings which project over and are secured to the transverse frame members between which said vacuum cup casings are located, respectively, substantially as described.

6. A frame for a machine of the type described, comprising longitudinal frame members, transverse frame members which connect said longitudinal frame members, vacuum cup casings secured to said frame, a bail hinged to said frame and a spring clevis arranged to suspend said frame from a hoisting cable, substantially as described.

7. A frame for a machine of the type described, comprising longitudinal frame members, transverse frame members which connect said longitudinal frame members, vacuum cup casings secured to said frame, a bail hinged to said frame, a spring clevis arranged to suspend said frame by its bail from a hoisting cable, said clevis being fork-shaped and the prongs thereof being slidably fitted to guide grooves formed in said bail, a block secured between the lower ends of the prongs of said clevis and a spring inserted between said block and the under side of said bail, substantially as described.

8. A frame for a machine of the type described, comprising longitudinal frame members, transverse frame members which connect said longitudinal frame members, vacuum cup casings on said frame, and a bail hinged to said frame, the relation being such that the axis of the bail hinge will be substantially in line with the center of gravity of said frame when loaded, substantially as described.

9. A frame for a machine of the type described, comprising longitudinal frame members, transverse frame members which connect said longitudinal frame members, vacuum cups secured to said frame, and a bail hinged to said frame, said bail being bowed and being made sufficiently long to permit the frame with its load to be tilted into a position past a vertical plane, substantially as described.

10. A vacuum cup comprising a casing one end of which is closed and the other end open, a flange around the open end of said casing, a spider secured in the open end of said casing, a diaphragm secured to the open end of said casing and which covers the outer faces of said flange and of said spider, said casing being provided with an opening adapted for connection with a vacuum pump or the like, substantially as described.

11. A vacuum cup comprising a casing one end of which is closed and the other end open, a flange around the open end of said casing, a spider secured in the open end of said casing provided with a central opening, a diaphragm secured to the open side of said casing and which covers the outer faces of said flange and of said spider, said diaphragm being provided with a central opening, a flange on said diaphragm around the central opening therein which extends through the opening in said spider, said vacuum cup casing being provided with an opening adapted for connection with an exhaust pump or the like, substantially as described.

12. A vacuum cup comprising a casing one end of which is closed and the other end open, a flange around the open end of said casing, a spider secured in the open end of said casing provided with a central opening and with other openings outside of said central opening, a diaphragm secured to the open side of said casing and which covers the outer faces of said flange and of said spider, said diaphragm being provided with a central opening and with holes outside of said central opening which register with the outer openings in said spider, a flange on said diaphragm around the central opening therein which extends through the central opening in said spider, the casing of said vacuum cup being provided with an opening adapted for connection with a vacuum pump or the like, substantially as described.

13. A vacuum cup comprising a casing one end of which is closed and the other end open, a flange around the open end of said casing, a spider secured in the open end of said casing, a diaphragm secured to the open end of said casing and which covers the outer faces of said flange and of said spider, the means for securing said diaphragm to said casing comprising a ring clamped to the vacuum cup casing outside of said diaphragm, said diaphragm being shaped to form a groove on its under side to receive said clamping ring, and a corresponding rib on its upper side, and the face of said vacuum cup being grooved to receive the rib formed on said diaphragm, the relation being such that said clamping ring will be entirely back of the outer face of said diaphragm, substantially as described.

In testimony that I claim the foregoing as my invention, I affix my signature in presence of two subscribing witnesses this 3rd day of September, A. D. 1913.

CARLTON L. SMITH.

Witnesses:

ARTHUR B. CRANE,

A. C. BORDEN.