

Oct. 6, 1953

S. A. HENDERSON
SUCTION APPARATUS

2,654,557

Filed June 24, 1950

2 Sheets-Sheet 1

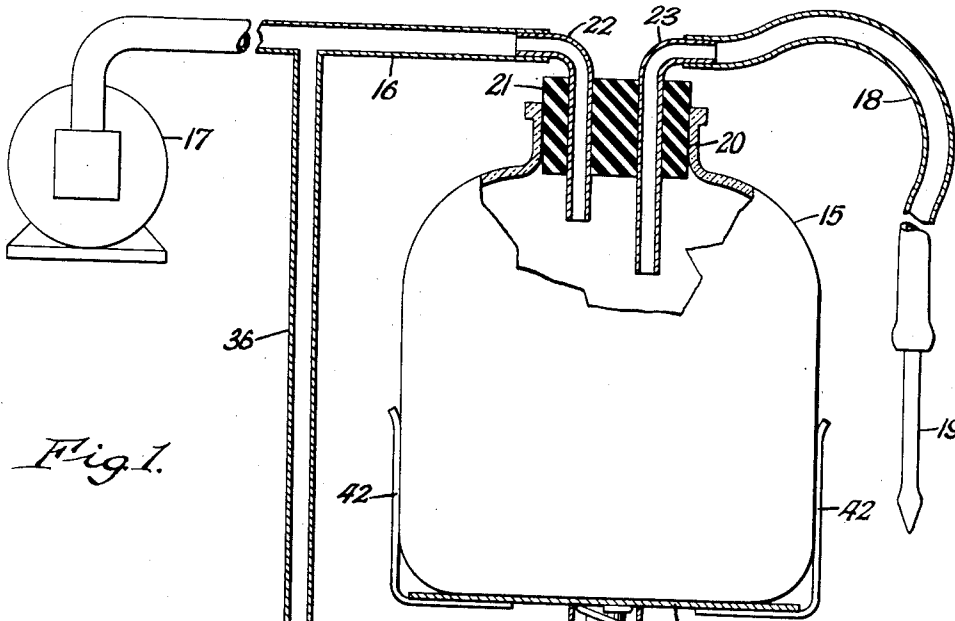


Fig. 1.

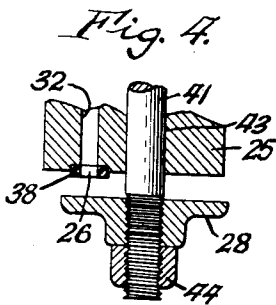


Fig. 4.

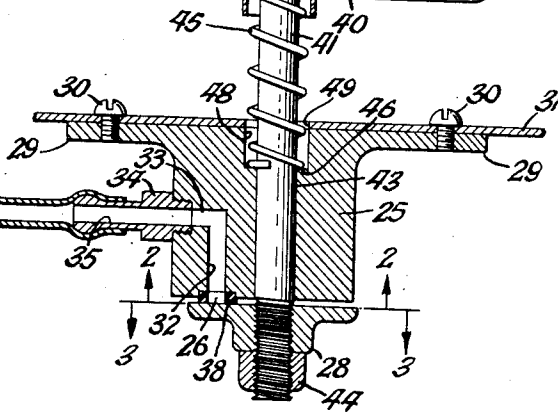


Fig. 3.

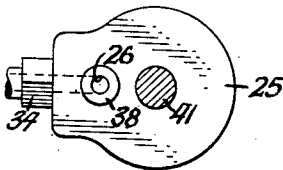


Fig. 2.

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2 Sheets-Sheet 2

Fig. 5.

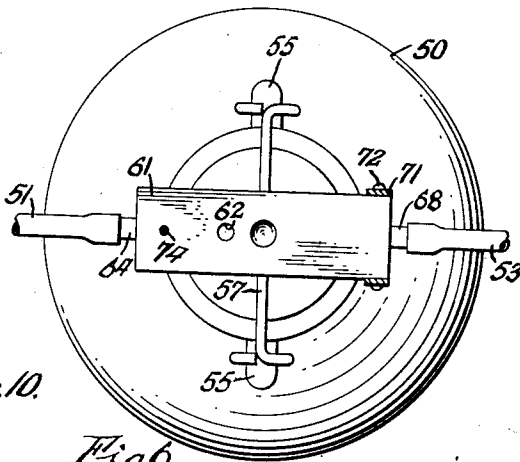
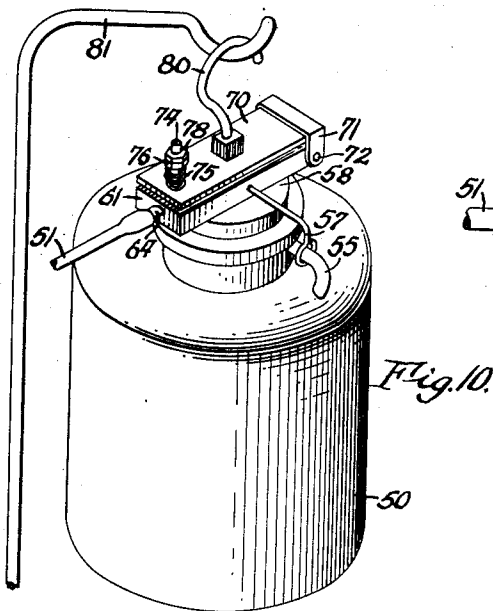
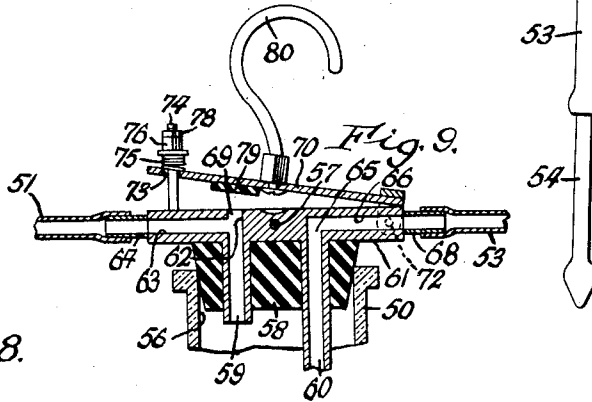
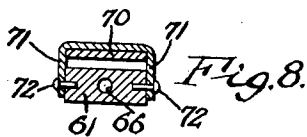
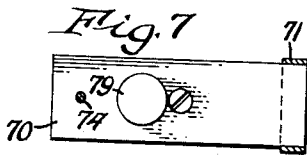
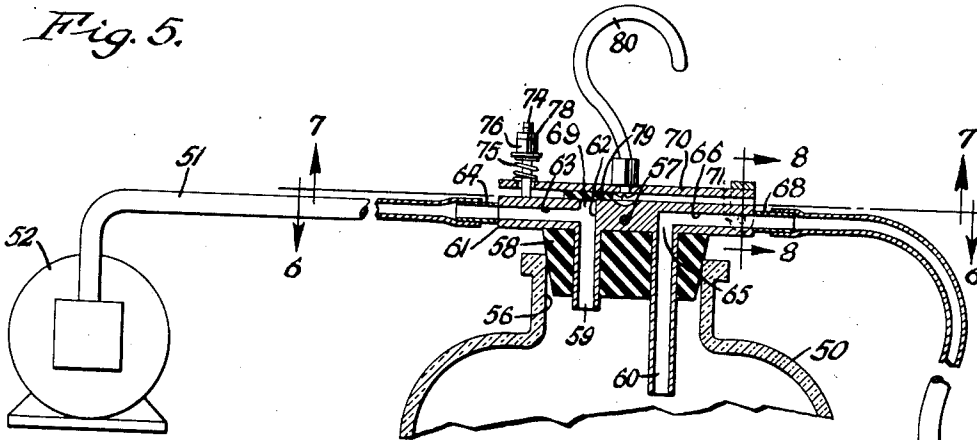


Fig. 6.
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UNITED STATES PATENT OFFICE

2,654,557

SUCTION APPARATUS

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1

This invention relates to suction apparatus in which liquid is collected in a receptacle, and more particularly to the improvement of providing in such apparatus means to prevent flooding of the suction line and pump connected with said receptacle.

An important application of suction apparatus of this type is in the medical and dental field for removing liquids with or without suspended matter therein, from body recesses, wounds and the like. The liquid material so withdrawn is usually collected in a suitable replaceable receptacle such as a glass jar which is supposed to be replaced with an empty jar when the level of the former's contents approaches the inlet of the suction line connected with this jar. However, during times of tension such as during operations, and otherwise, the condition of the collecting jar may be forgotten and the jar allowed to fill to a point where the liquid is sucked into the suction line. This floods the air pump connected with the suction line, necessitating disassembling and cleaning the pump and lines. The disadvantages of flooding the suction line and pump with the consequent breakdown of the suction apparatus during an operation, for example, are obvious.

It is accordingly the principal object of the present invention to prevent flooding of the suction line in apparatus of the character described.

Another object is to provide such apparatus in which the level of liquid collected in the receptacle is permitted to rise no higher than a predetermined level.

A further object is to provide such apparatus in which the suction or subatmospheric pressure at the suction nozzle of the liquid collecting line leading to the receptacle is completely cut off when the weight of the receptacle and its contents reach a predetermined value.

A further object is to provide such apparatus in which an audible signal is produced when the need occurs for replacing a full receptacle with an empty one.

Further objects and advantages of the invention will be apparent from the following description and accompanying drawings wherein:

Fig. 1 is a fragmentary vertical central sectional view through apparatus embodying one form of the present invention, certain parts of the apparatus being illustrated in full or partial elevation.

Figs. 2 and 3 are horizontal transverse sectional views thereof taken on the correspondingly numbered lines of Fig. 1.

2

Fig. 4 is a fragmentary sectional view similar to Fig. 1 of the bypass valve mechanism shown therein and illustrating this valve open.

Fig. 5 is a fragmentary vertical central sectional view through apparatus embodying another form of the present invention, certain parts of the apparatus being illustrated in full or partial elevation.

Figs. 6 and 7 are horizontal transverse sectional views thereof taken on the correspondingly numbered lines of Fig. 5.

Fig. 8 is a vertical transverse sectional view thereof taken on line 8-8, Fig. 5.

Fig. 9 is a fragmentary sectional view similar to Fig. 5 of the bypass valve mechanism shown therein and illustrating this valve open.

Fig. 10 is a fragmentary perspective elevational view, on a reduced scale, of the collecting receptacle and associated valve mechanism shown in Figs. 5-9.

Referring to Figs. 1-4 the suction apparatus embodying one form of the invention is shown as comprising a collecting receptacle 15, a suction line 16 having one open end communicating with the interior of the receptacle 15 and its other open end connected with the inlet of any suitable conventional air pump 17, and a liquid collecting line 18 having one open end communicating with the interior of the receptacle 15 and its other open end connected with a suction nozzle 19. The lines 16 and 18 are tubes made of a flexible material such as rubber or a suitable plastic. The receptacle 15 is shown as being in the form of a conventional gallon glass jar having a mouth 20 closed by a removable stopper 21. This stopper 21 is shown as provided with spaced holes extending axially through the stopper in which holes are arranged the vertical legs of elbows 22 and 23. As shown, the end of the tubing 16 is connected with the laterally extending leg of the elbow 22 and the end of the tubing 18 is connected with the laterally extending leg of the elbow 23.

It will be seen that with the air pump 17 operating a subatmospheric pressure will be established in the lines 16 and 18 and the receptacle 15. If the nozzle 19 is presented to liquid the liquid will be drawn into and through the line 18, elbow 23 and be discharged into the receptacle 15.

Associated with the foregoing apparatus are means for preventing the flooding of the suction line 16 and hence the pump 17 with liquid collected in the receptacle 15 through the line 18, this being accomplished by venting the suction

line 16 to the atmosphere when the weight of the receptacle 15 and its contents reaches a predetermined value. Such means are shown as comprising a stationary valve body member 25 having a port 26 in its lower face which vents to the atmosphere and is connected with the suction line 16, and a vertically movable valve closure member 28 associated with the receptacle 15 and normally closing the port 26.

The valve body member 25 is shown as having at its upper end radially outwardly extending arms 29 connected as by screws 30 with a rigid supporting shelf 31 or the like of a portable cabinet (not shown) for housing the receptacle 15 and the pump 17. The port 26 in the valve body member 25 connects with a vertical passage 32 in turn communicating with a horizontal passage 33. At the outer end of this horizontal passage 33, the member 25 is provided with an enlarged internally threaded counterbore to receive the externally threaded end of a nipple fitting 34 which has a through bore 35. The outer end of this fitting 34 is shown as having one end of a bypass line or tube 36 connected thereto, the opposite end of which connects with the suction line 16 at any suitable place between the pump 17 and the receptacle 15.

The lower end of the vertical passage 32 in the valve body member 25 is enlarged as shown to receive a valve seat washer 38 composed of any suitable material such as rubber. The outer or lower face of this seat washer 38 is arranged below the lower face of the valve body member 25 so that a space 39 exists between the opposing faces of the valve members 25 and 28 when the port 26 is closed or covered.

The valve closure member 28 is actuated by the weight of the receptacle 15 and its contents. For this purpose the receptacle 15 is shown as resting on a platform 40 arranged on the upper end of a vertical rod or post 41 which is connected at its lower end to the valve closure member 28. The platform 40 preferably carries circumferentially spaced upstanding receptacle centering fingers 42. The rod 41 is shown as slidably arranged in a bore 43 extending vertically through the valve body member 25. The lower end of this rod 41 is externally threaded and the valve closure member 28 which is in the form of a disk is centrally internally threaded so as to screw onto the lower end of the rod 41, as shown. A lock nut 44 is arranged as the threaded end of the rod 41 below the member 28 and can be jammed thereagainst so as to prevent the member 28 from turning relative to the rod.

Means are provided for urging the relatively movable valve seat and closure members 25 and 28 respectively toward each other to close the port 26 and yet such means are operable to permit these members to separate and open the port 26 when the weight of the receptacle 15 and its contents reaches a predetermined value. Such means are shown as comprising a helical compression spring 45 surrounding the upper portion of the rod 41 and having its upper end bearing against the bottom surface of the platform 40 and its lower end bearing against an upwardly facing shoulder 46 on the valve body member 25. This shoulder 46 is formed by a counterbore 48 at the upper end of the bore 43 and which counterbore also continues as a registering hole 49 through the shelf 31.

It will be noted that when the bypass valve mechanism is closed as shown in Fig. 1, a sub-atmospheric pressure bears against the upper

face of the valve closure member 28 over the area covered by the port 26 while on the opposite or lower side of this member atmospheric pressure bears against a projection of the same port area. This condition of atmospheric pressure assisting the spring 45 to keep the valve closed continues as long as the port 26 is closed but as soon as even a slight separation takes place between the seat washer 38 and the valve closure member 28, this atmospheric bias is destroyed and in effect the load on the spring 45 is increased thereby causing the members 25 and 28 to separate further resulting in a sudden unrestricted opening of the port 26 whereby the suction line 16 is vented to the atmosphere, as illustrated in Fig. 4. This venting or bypassing of the suction line 16 to the atmosphere between the pump 17 and the receptacle 15 destroys the suction in the liquid collecting line 18 and renders the same useless for its intended purpose.

It will also be noted that the initial compression of the spring 45 can be adjusted by varying the relative axial position of the valve closure member 28 on the rod 41. Thus if it is desired to allow the weight of the contents of the receptacle 15 to increase to a higher value before separating the valve members 25 and 28 and thereby stop the flow of liquid material into the receptacle, the valve closure member 28 is adjusted along the rod 41 closer to the platform 40. On the other hand, if it is desired to have the valve open at a lower increase in weight of the spring supported parts, the valve closure member 28 is adjusted along the rod 41 to reduce the initial compression of the spring 45. Adjustment of the valve opening should be such that the level of the liquid never reaches the lower end of the elbow 22 and preferably the valve should open when sufficient clearance exists between this elbow and the level of the liquid in the receptacle 15 so that splashings are not drawn into the suction line 16.

When the valve opens, the filled receptacle 15 should be removed and replaced with an empty one which will permit the spring 45 to close the valve again, until its effect is overcome by the weight of the additional liquid collected. It will also be noted that the valve closure member 28 can turn relative to the seat washer 38 so that the seating face of this washer can engage a different part of the upper surface of the member 28.

It is desired to have a sudden and positive connection of the bypass line 36 with the atmosphere and consequent destruction of the suction in the liquid collecting line 18 so that the operator is definitely aware of the inoperativeness of the apparatus, as with the present invention. This can be audibly noticed by the hissing sound of air rushing into the port 26.

Referring to Figs. 5-10, the suction apparatus there shown embodying another form of the invention also comprises a collecting receptacle 50, a suction line or tubing 51 having one open end communicating with the interior of the receptacle 50 and its other open end connected with the inlet of any suitable conventional air pump 52, and a liquid collecting line or tubing 53 having one open end communicating with the interior of the receptacle 50 and its other open end connected with a suction nozzle 54. The receptacle 50 is shown as a glass jar having a pair of diametrically opposite apertured ears 55 and a mouth 56 closed by a removable stopper 58. This stopper 58 is shown as provided with holes extending axially

5

through the stopper and in which are arranged tubes 59 and 60. These tubes 59 and 60 have their upper ends connected with a valve body member 61 which is shown as a rectangular block supported on the stopper 58 and connected by a bail wire 57 to the ears 55 of the receptacle 50.

The bore of the tube 59 is shown as communicating with a vertical passage 62 extending completely through the valve body member 61. A horizontal passage 63 is provided in the member 61 and at one end connects with the vertical passage 62 and at its other end extends through a nipple 64 to which the suction line 51 is connected.

The bore of the tube 60 is shown as communicating with a vertical branch passage 65 in the valve body member 61 and which passage extends from the lower face thereof to a point short of the upper face thereof. A horizontal passage 66 is provided in the member 61 and at its inner end connects with the upper end of the vertical passage 65 and its other end extends through a nipple 68 to which the liquid collecting line 53 is connected.

It will be seen that with the upper end or port 69 of the vertical through passage 62 closed, in a manner hereinafter explained, and with the air pump 52 operating, a subatmospheric pressure will be established in the lines 51 and 53 and the receptacle 50. If the nozzle 54 is presented to liquid the liquid will be drawn into and through the line 53, passages 66 and 65, tube 60 and be discharged into the receptacle 50.

In the form of the invention shown in Figs. 5-10, the port 69 is uncovered when the weight of the receptacle 50 and its contents reaches a predetermined value and hence flooding of the suction line 51 and the air pump 52 is prevented. This is accomplished by pivoting or hinging a valve closure member 70 on the valve body member 61 and constantly urging this closure member 70 to cover and seal the port 69. As shown the valve closure member 70 is in the form of a rectangular plate overlying the upper surface of the valve body member 61 in slightly spaced relation thereto. The end of this valve closure member 70 adjacent the nipple 68 carries a pair of depending ears 71 which straddle the valve body member 61 and are journaled on the ends of aligned pivot pins 72 which extend outwardly from the member 61, as best shown in Fig. 8.

The opposite end of the valve closure member is provided with an enlarged hole 73 through which a rod 74 upstanding or rising from the valve body member 61 extends. A helical compression spring 75 is shown as surrounding the intermediate portion of this rod 74 and arranged with its lower end bearing against the upper surface of the valve closure member 70. The upper end of the spring 75 bears against the lower face of an adjusting nut 76 arranged on the threaded upper end of the rod 74, a lock nut 78 being also arranged on the rod 74 above the lock nut 78.

Opposite the port 69 the lower face of the valve closure member 70 is shown as carrying a valve disk 79 composed of any suitable material such as rubber, the lower face of which is engageable with the upper face of the valve body member 61 around the port 69 therein, as shown in Fig. 5.

The valve closure member 70 is shown as mounted on the lower end of a hook 80 by which all pendant parts associated therewith can be hung from any suitable support such as the arm 81 shown in Fig. 10. In this manner the apparatus is rendered readily portable.

6

The spring 75 is adjusted to have an initial compression sufficient to hold the valve members 61 and 70 together so that the disk 79 is pressed against the valve body member 61 and closes the port 69. It will be noted that the spring 75 counterbalances the weight of the suspended parts including the receptacle 50. When this weight increases to a point sufficient to compress the spring 75 further, as by the receptacle 50 filling to a predetermined level with liquid sucked in through the line 53, the spring 75 yields which acts to pivot the members away from each other about the axis of the coaxial pins 72, as shown in Fig. 9. This separation of the members uncovers the port 69 and vents the line 51 to the atmosphere through the upper portion of the vertical passage 62 in the valve body member 61.

As with the first form of the invention, it will be noted that the spring 75 is assisted by atmospheric pressure acting against the valve body member 61 over an area equivalent to the cross-sectional area of the port 69, when this port is closed as shown in Fig. 5 and a subatmospheric pressure obtains in the suction line 51, however, this atmospheric bias is destroyed as soon as the seal between the port closure disk 79 and the seat therefor on the valve body member 61 is broken. Losing this atmospheric bias acts to suddenly place an increased load on the spring 75 which thereupon compresses further as shown in Fig. 9 thereby to insure a sudden and complete opening of the vent port 69 and consequent discontinuance of suction in the liquid collecting line 53.

Adjustment of the nut 76 and hence the initial compression of the spring 75 will vary the setting at which the bypass valve will open.

It will be seen that the present invention provides simple and positive operating apparatus for venting a suction line to prevent the overfilling of a liquid collecting receptacle with which such suction line is connected.

I claim:

1. In suction apparatus including a closed collecting receptacle and separate suction and liquid inlet lines communicating with the upper part of said receptacle, the combination therewith of means to prevent flooding of said suction line with liquid collected within said receptacle, said means comprising valve body and closure members one of which is movable relative to the other, said valve body member being provided with a port vented to the atmosphere and which is arranged to be normally closed by said valve closure member, means establishing communication between said port and suction line at all times, said receptacle being connected with the movable one of said members whereby the weight of said receptacle and its contents tend to separate said members to open said port, and means urging said members to close said port and operable to permit said members to separate and open said port when said weight reaches a predetermined value.

2. In suction apparatus including a closed collecting receptacle and separate suction and liquid inlet lines communicating with the upper part of said receptacle, the combination therewith of means to prevent flooding of said suction line with liquid collected within said receptacle, said means comprising valve body and closure members one of which is movable relative to the other, said valve body member being provided with a port vented to the atmosphere and which is arranged to be normally closed by said valve closure member, means establishing communica-

tion between said port and suction line at all times, said receptacle being connected with the movable one of said members whereby the weight of said receptacle and its contents tends to separate said members to open said port, and means urging said members to close said port and operable to permit said members to separate and open said port when said weight reaches a predetermined value, said urging means being assisted in maintaining said port closed by atmospheric pressure acting upon an area equivalent to that of said port, such atmospheric bias being destroyed upon separation of said members sufficient to permit leakage between said members at said port thereby creating a sudden increase in load on said urging means which operates to further separate said members whereby a sudden unrestricted opening of said port is effected and said suction line is vented to the atmosphere.

3. In suction apparatus including a closed collecting receptacle and separate suction and liquid inlet lines communicating with the upper part of said receptacle, the combination therewith of means to prevent flooding of said suction line with liquid collected within said receptacle, said means comprising valve body and closure members one of which is movable relative to the other, said valve body member being provided with a port vented to the atmosphere and which is arranged to be normally closed by said valve closure member, means establishing communication between said port and suction line, a rod connected with the movable one of said members and movably arranged in an opening in the other of said members and supporting the weight of said receptacle and its contents, and spring means operatively arranged between said rod and said other of said members to resist relative movement therebetween in a direction to separate said members but operable to permit said members to separate and open said port when said weight reaches a predetermined value.

4. In suction apparatus including a closed receptacle and separate suction and liquid inlet lines communicating with the upper part of said receptacle, the combination therewith of means to prevent flooding of said suction line with liquid collected within said receptacle, said means comprising valve body and closure members one of which is movable relative to the other, said valve body member being provided with a port vented to the atmosphere and which is arranged to be normally closed by said valve closure member, means establishing communication between said port and suction line at all times, a movable platform supporting said receptacle, means connecting said platform and the movable one of said members, and yielding means urging said members to close said port and operable to permit said members to separate and open said port when the weight of said receptacle and its contents reaches a predetermined value.

5. In suction apparatus including a closed receptacle and separate suction and liquid inlet lines communicating with the upper part of said receptacle, the combination therewith of means to prevent flooding of said suction line with liquid collected within said receptacle, said means comprising valve body and closure members the latter of which is movable relative to the former, said valve body member being provided with a port vented to the atmosphere and which is arranged to be normally closed by said valve closure member, means establishing communication between said port and suction line, a movable

platform supporting said receptacle, means rigidly connecting said valve closure member and platform, and yielding means operatively interposed between said platform and valve body member to urge said valve closure member to close said port and operable to permit said members to separate and open said port when the weight of said receptacle and its contents reaches a predetermined value.

6. In suction apparatus including a closed receptacle and separate suction and liquid inlet lines communicating with the upper part of said receptacle, the combination therewith of means to prevent flooding of said suction line with liquid collected within said receptacle, said means comprising a valve body member having a port vented to the atmosphere, means establishing communication between said port and suction line, a movable valve closure member arranged on one side of said valve body member and normally closing said port therein, a movable platform supporting said receptacle and arranged on the side of said valve body member, opposite from said valve closure member a rod connecting said platform and valve closure member and movably arranged on said valve body member, and yielding means operatively interposed between said platform and valve body member to urge said valve closure member to close said port and operable to permit said members to separate and open said port when the weight of said receptacle and its contents reaches a predetermined value.

7. In suction apparatus including a closed receptacle and separate suction and liquid inlet lines communicating with the upper part of said receptacle, the combination therewith of means to prevent flooding of said suction line with liquid collected within said receptacle, said means comprising a valve body member having a port vented to the atmosphere and a bore arranged to one side of said port, means establishing communication between said port and suction line, a movable platform supporting said receptacle and arranged on the side of said valve body opposite from said valve closure member, a rod slidably arranged in said bore and connecting said platform and valve closure member, and a compression spring arranged on said rod and operatively between said platform and valve body member to urge said valve closure member to close said port and operable to permit said members to separate and open said port when the weight of said receptacle and its contents reaches a predetermined value.

8. In suction apparatus including a closed receptacle and separate suction and liquid inlet lines communicating with the upper part of said receptacle, the combination therewith of means to prevent flooding of said suction line with liquid collected within said receptacle, said means comprising a valve body member having a port vented to the atmosphere and a bore arranged to one side of said port, means establishing communication between said port and suction line, a movable platform supporting said receptacle and arranged on the side of said valve body opposite from said valve closure member, a rod slidably and rotatably arranged in said bore and connected at one end to said platform, the other end of said rod having an adjustable threaded connection with said valve closure member, and a compression spring arranged on said rod and operatively between said platform and valve body member to urge said valve closure member to close said port and operable to permit said mem-

bers to separate and open said port when the weight of said receptacle and its contents reaches a predetermined value.

9. In suction apparatus including a closed receptacle and separate suction and liquid inlet lines communicating with the upper part of said receptacle, the combination therewith of means to prevent flooding of said suction line with liquid collected within said receptacle, said means comprising valve body and closure members one of which is movable relative to the other, said valve body member being provided with a port vented to the atmosphere and which is arranged to be normally closed by said valve closure member, means establishing communication between said port and suction line, means connecting the movable one of said members to said receptacle so that it supports the weight of said receptacle and its contents, means arranged to permit of movement of said movable one of said members toward and from the other, and yielding means urging said members to close said port and operable to permit said members to separate and open said port when said weight reaches a predetermined value.

10. In suction apparatus including a closed receptacle and separate suction and liquid inlet lines communicating with the upper part of said receptacle, the combination therewith of means to prevent flooding of said suction line with liquid collected within said receptacle, said means comprising valve body and closure members one of which is movable relative to the other, said valve body member being provided with a port vented to the atmosphere and which is arranged to be normally closed by said valve closure member, means establishing communication between said port and suction line, means connecting the movable one of said members to said receptacle so that it supports the weight of said receptacle and its contents, hinge means connecting said members, and yielding means urging said members to close said port and operable to permit said members to separate and open said port when said weight reaches a predetermined value.

11. In suction apparatus including a closed receptacle and separate suction and liquid inlet lines communicating with the upper part of said receptacle, the combination therewith of means to prevent flooding of said suction line with liquid

collected within said receptacle, said means comprising a valve body member having a port vented to the atmosphere, a valve closure member hinged to said valve body member and normally closing said port therein, means establishing communication between said port and suction line, means connecting the movable one of said members to said receptacle so that it supports the weight of said receptacle and its contents, and yielding means urging said members to close said port and operable to permit said members to separate and open said port when said weight reaches a predetermined value, said yielding means comprising a rod on one of said members and projecting through an opening in the other of said members, an adjusting nut on the outer end of said rod and a compression spring arranged on said rod between said nut and said other of said members.

12. In suction apparatus, the combination comprising a jar having apertured ears on opposite sides of its mouth, a removable stopper arranged in said mouth, separate suction and inlet lines communicating with the interior of said jar through said stopper, and means arranged to prevent flooding of said suction line with liquid collected within said jar, said means comprising a valve body member arranged above said stopper, means connecting said valve body member with said ears, said valve body member being provided with a port, communicating with said suction line and vented to the atmosphere, a valve closure member arranged above said valve body member and arranged to normally close said port, hinge means connecting said members, and yielding means urging said members toward each other to close said port and operable to permit said members to separate and open said port when the weight of said jar and its contents reaches a predetermined value.

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