

May 23, 1939.

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2,159,164

SUCTION NOZZLE

Filed Dec. 19, 1935

2 Sheets-Sheet 1

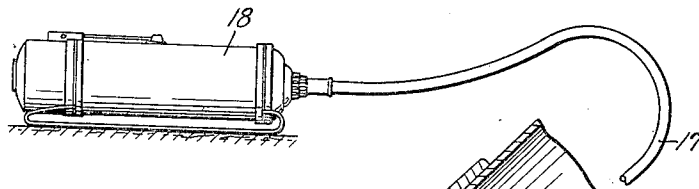


Fig. 1.

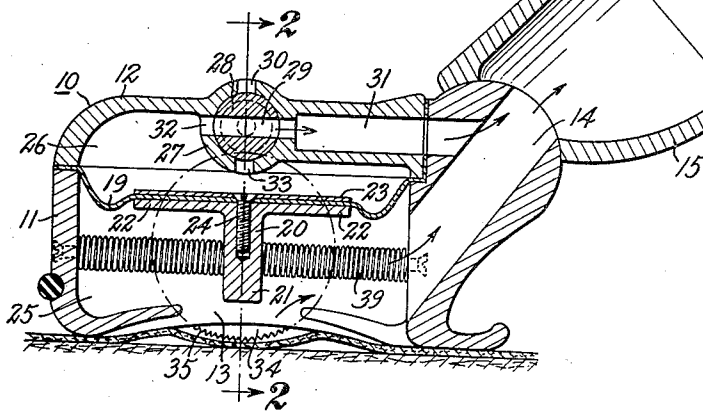


Fig. 3.

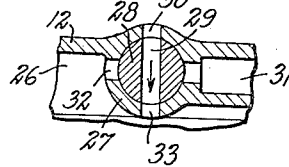
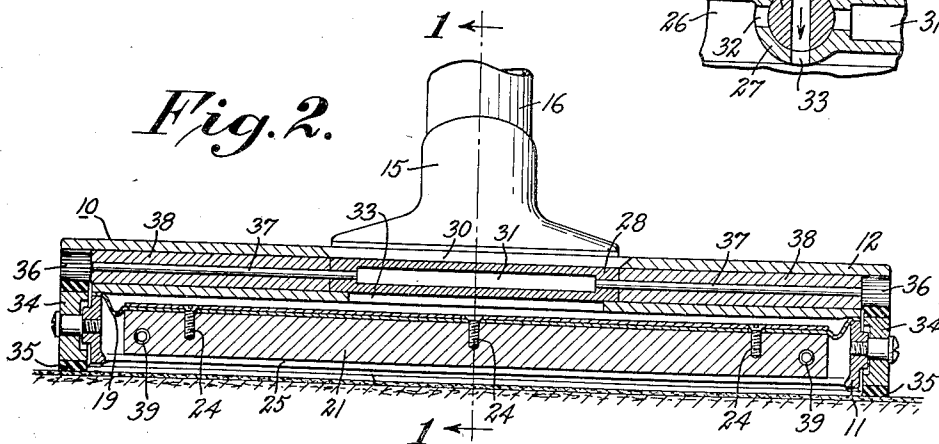


Fig. 2.



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2 Sheets-Sheet 2

Fig. 4.

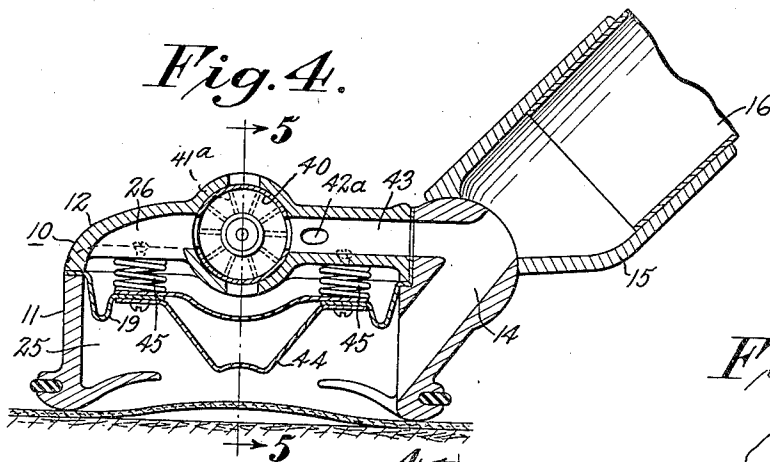


Fig. 6.

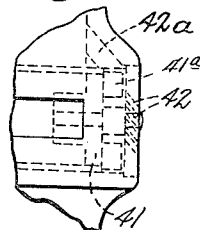


Fig. 5.

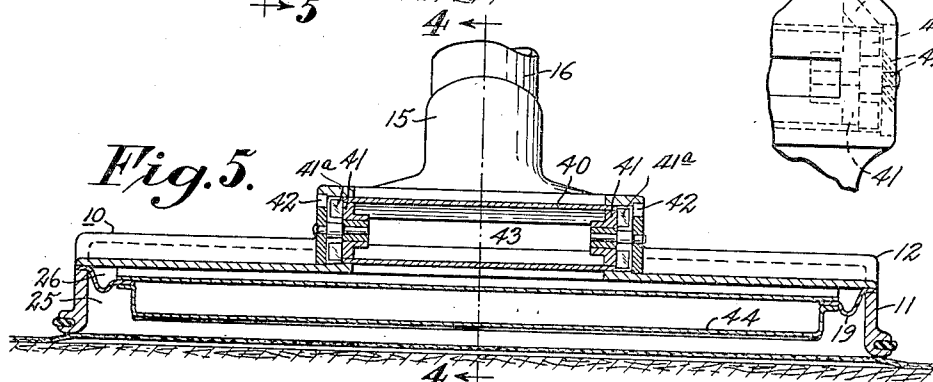


Fig. 7.

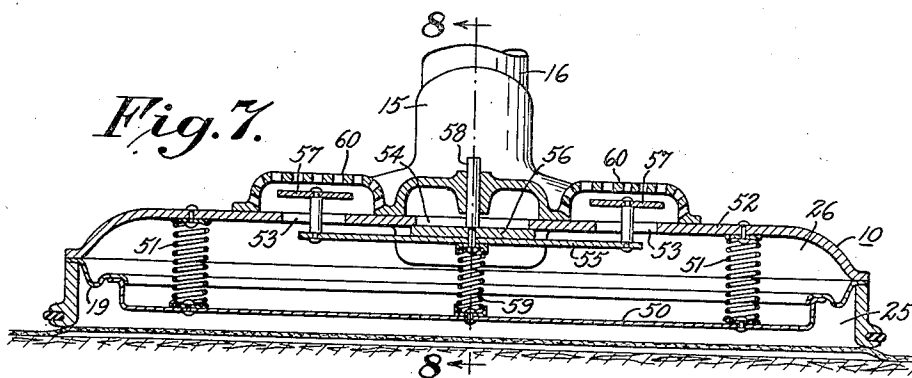
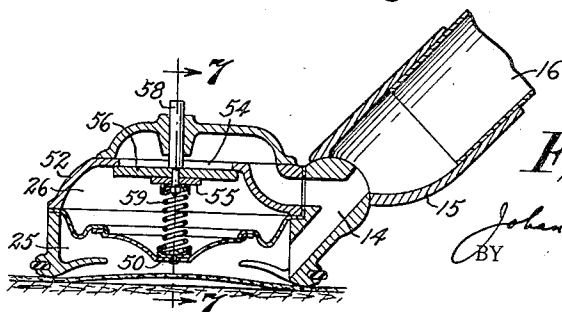


Fig. 8.



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SUCTION NOZZLE

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13 Claims. (Cl. 15-13)

My invention relates to suction nozzles and more particularly, to suction nozzles of the type provided with an agitator or beater member. Still more particularly, my invention relates to nozzles of the kind in which operation of the agitator is caused by the air flow through the nozzle.

One of the objects of my invention is to provide a nozzle of this type in which the agitator in no manner interferes with the flow of the cleaning air through the nozzle, which flow may, consequently, be continuous and non-interrupted.

Another object of my invention is to provide a nozzle in which a substantially large force is available for operating the agitator.

In accordance with my invention, I provide a nozzle having a suction inlet and an outlet adapted to be connected to a source of suction. This inlet and outlet are permanently in uninterrupted communication with each other. An agitator is movably mounted within the nozzle and connected to an operating member therefor which is continuously subjected on one side to a substantially constant pressure while the other side of the operating member is alternately subjected to the low pressure of the suction source and to atmospheric pressure. This operating member may conveniently be a flexible diaphragm, although a piston working in a cylinder could be employed. In order to subject the operating member to the different pressures, I provide a valve arrangement which, in one position, connects one side of the operating member to the atmosphere and in another position, connects this side of the operating member to the source of suction. In the present application, I have disclosed three more or less specific arrangements for actuating this valve. In the first, a rotary valve is actuated by means of a wheel which is caused to rotate by movement of the nozzle over a surface. In the second, a rotary valve is actuated by means of a small air driven turbine which is caused to rotate by an auxiliary stream of air drawn into the nozzle. In the third embodiment, reciprocating valves are operated by movement of the agitator member itself.

Further objects and advantages of my invention will be apparent from the following description considered in connection with the accompanying drawings which form a part of the specification and of which:

Fig. 1 is a cross-sectional view showing one embodiment of my invention and is taken on the line 1-1 of Fig. 2;

Fig. 2 is a cross-sectional view taken on the line 2-2 of Fig. 1;

Fig. 3 is a cross-sectional view of a valve shown in Fig. 1, but in a different position;

Fig. 4 is a cross-sectional view of another embodiment of my invention and is taken on the line 4-4 of Fig. 5;

Fig. 5 is a cross-sectional view taken on the line 5-5 of Fig. 4;

Fig. 6 is a top view of a portion of the device shown in Figs. 4 and 5;

Fig. 7 is a cross-sectional view of a third embodiment of my invention and is taken on the line 7-7 of Fig. 8; and

Fig. 8 is a cross-sectional view taken on the line 8-8 of Fig. 7.

Referring more particularly to Figs. 1 through 3, reference character 10 designates a hollow body including a lower hollow member 11 and an upper hollow member 12. Lower member 11 is formed with a suction inlet opening 13 and an outlet opening 14. A handle member 15 is pivotally secured to member 11 so that the interior of the handle member is always in communication with outlet 14. Handle member 15 is adapted to receive a tubular member 16 which may be connected by means of a flexible hose 17 with a vacuum cleaner unit 18 which constitutes a source of suction.

Clamped between lower member 11 and upper member 12 is a flexible diaphragm 19, the more central portion of which is movable and is secured to an agitator member 20. Agitator 20 may be T shaped in cross-section, the stem 21 of the T being arranged adjacent to opening 13. The arms 22 of the T are secured to the diaphragm 19 with the aid of a plate 23 secured to the agitator by means of a bolt 24, the diaphragm being clamped between the arms 22 and the plate 23.

Diaphragm 19 thus divides the interior of hollow member 10 into a lower chamber 25 and an upper chamber 26. Lower chamber 25 is continuously in communication with outlet 14 and hence, always subjected to the low pressure produced by the source of suction. Within upper chamber 26, there is formed a valve housing 27 within which is rotatably mounted a valve member 28, formed with a passage 29 therethrough. An opening 30 in the upper part of member 12 establishes communication between the atmosphere and the interior of valve housing 27, while a passage 31 establishes communication between the valve housing and outlet 14. Openings 32

and 33 connect the interior of the valve housing with space 26.

Rotatably mounted at either end of the hollow member 10 are wheels 34 which are adapted to roll on the surface being cleaned, such as a carpet. These wheels are preferably provided with rubber treads 35 which frictionally engage smaller wheels 36 mounted on shafts 37 extending from each wheel 36 to the adjacent end of rotary valve member 28. Spacer sleeves 38 may be provided around the portions of shafts 37 between the wheels 36 and the valve 28 and these sleeves may be fixed against axial movement, thereby preventing axial movement of the wheels 36, shafts 37, and valve 28.

Coil springs 39 extend in a substantially horizontal direction between the vertical walls of member 11 and the stem portion 21 of the agitator and may be conveniently located adjacent to either end of the agitator.

The operation of the above described device is as follows:

With the parts in the positions shown in Fig. 1, the reduced pressure produced by the vacuum cleaner unit 18 is communicated through hose 17, tubular member 16, handle member 15, and outlet passage 14 to the space 25 in the hollow member 10. This causes flow of air through inlet opening 13, and the air entrains dust particles and other dirt present on or in the surface being cleaned. This low pressure also acts on the underside of the flexible diaphragm 19. However, with the valve member 28 in the position shown in Fig. 1, this low pressure also acts upon the upper side of the diaphragm through the passage 31, the passage 29 in the valve member, and the opening 32 in the valve housing. Consequently, the pressures on both sides of the diaphragm are balanced and there is no tendency for the diaphragm to move. However, if the nozzle is moved over the floor, wheels 35 are caused to rotate and their rotation is transmitted through wheels 36 and shafts 37 to valve member 28 which is turned to the position shown in Fig. 3. In this position, the upper side of the diaphragm is subjected to atmospheric pressure by virtue of the communication established through opening 30, passage 29, and opening 33. Inasmuch as the pressure acting on the lower side of the diaphragm has not been altered, there results an unbalance in the pressures acting on the diaphragm and the higher atmospheric pressure acting in upper chamber 26 causes the diaphragm to move downwardly against the resistance offered by the springs 39. The agitator 20 is moved downward by this movement of the diaphragm and the lower edge of the stem 21 strikes the surface being cleaned and dislodges dirt adhering thereto, which dirt is picked up by the air stream entering through inlet opening 13. As soon as further rotation of the valve member causes it to return to the position shown in Fig. 1, or rather to a position at a 180 degrees therefrom, communication between the atmosphere and chamber 26 is interrupted while communication is again established between this chamber and the outlet passage 14. This causes the pressures on both sides of the diaphragm to again become balanced and the springs 39, which were stressed by the preceding downward movement of the agitator, now serve to return the agitator and the diaphragm to the position shown in Fig. 1.

Any desired speed of rotation of the valve member for a given linear speed of the nozzle

may be had by properly choosing the diameter of the wheels 36. That is to say, the smaller the diameter of wheels 36, the faster will be the rotation of valve member 28 for a given linear speed of the nozzle over the floor. In the embodiment shown, wheels 36 are of a small diameter and hence the valve member is rotated rapidly and, inasmuch as the diaphragm moves through two complete cycles for each rotation of the valve, the result is that the diaphragm and the agitator attached thereto are reciprocated rapidly whenever the nozzle is moved either backwards or forwards at a normal speed.

In the embodiment shown in Figs. 4 through 6, the valve member 40, which corresponds to valve member 28 in the first embodiment, is rotated by means of a pair of turbine rotors 41 secured at either end of the valve member. A plurality of inclined passages 42 admit atmospheric air to the rotors and guide the flow of air so that it strikes turbine blades 41a to cause rotation of the rotors. The air discharged from the rotors 41 flows through passages 42a, one of which is clearly shown in Fig. 6, to the passage 43 which leads to the outlet 14.

Flexible diaphragm 19 separates the interior of hollow member 10 into the upper chamber 26 and the lower chamber 25. An agitator member 44 is secured to the movable portion of diaphragm 19 and is suspended by a plurality of coil springs 45. Springs 45 perform the same function as springs 39 in the first embodiment.

When the pressure within outlet 14 is reduced, air is caused to flow through inclined passages 42 to the turbine rotor 41, thereby causing rotation of these rotors which in turn cause rotation of the valve member 40. The air discharged from the rotors flows through passage 42a to the outlet 14. Rotation of valve member 40 alternately connects the space 26 with the atmosphere and with outlet 14, in the same manner as described in connection with the first embodiment. The result is that the pressure existing within upper chamber 26 rapidly fluctuates between atmospheric pressure and the lower pressure produced by the vacuum cleaner unit. Inasmuch as the pressure existing in the lower chamber 25 is substantially constant, the rapid variation in pressure acting on the upper side of the diaphragm causes it to be reciprocated rapidly in a vertical direction. As before explained, atmospheric pressure acting on the upper side of the diaphragm moves it downwardly, thus stressing springs 45, and when the pressures on both sides of the diaphragm are equalized, these springs contract to move the diaphragm and the agitator member 44 attached thereto in an upwardly direction.

It will be seen that the speed of vibration of the agitator member in this embodiment of my invention is independent of the speed of motion of the nozzle over the surface undergoing cleaning.

In the embodiment shown in Figs. 7 and 8, the hollow member 10 is divided into a lower compartment 25 and an upper compartment 26 by flexible diaphragm 19 to which is attached an agitator member 50. Agitator 50 is supported in the position shown in Fig. 7 by means of a plurality of coil springs 51, the upper ends of which are connected to the top portion 52 of the hollow member. Top portion 52 is provided with one or more openings 53 communicating with the atmosphere and with an opening 54 which communicates with outlet opening 14. A bridge member

55 carries a valve member 56 for regulating flow through opening 54 and valve members 57 for regulating flow through openings 53. Bridge 54 is secured to a reciprocally supported pin 58 and is connected to agitator member 50 by means of a coil spring 59. Guards 60 formed with apertures therethrough may be provided for covering openings 53 and enclosing valve members 57.

This embodiment of my invention operates as follows:

The parts in the position shown in Figs. 7 and 8, the upper chamber 26 is in communication with the atmosphere through openings 53 and the openings in guards 60. Consequently, atmospheric pressure acts on the upper side of the diaphragm. When the pressure is reduced in outlet 14 and consequently in lower chamber 25, the atmospheric pressure forces the diaphragm and agitator downwardly against the action of springs 51. This movement also stresses spring 59 and tends to cause the bridge member 54 and the valves carried thereby to move downwardly. However, at first, the bridge does not move due to the fact that atmospheric pressure is acting against the lower face of valve member 56 while a reduced pressure is acting against the upper face. However, continued downward movement of the diaphragm and agitator stresses spring 59 sufficiently so that the force tending to hold valve member 56 closed is overcome and the bridge member moves downwardly, thus establishing communication between upper chamber 26 and outlet 14 through opening 54, while valve members 57 close openings 53, thus cutting off communication with the atmosphere. The upper and lower sides of diaphragm 19 are hence subjected to the same low pressure and the springs 51 move the diaphragm upwardly. Bridge 54 does not follow immediately, due to the unbalanced pressures acting on valve members 57, but the bridge is moved upwardly when spring 59 has been stressed sufficiently to overcome the difference between atmospheric and the lower pressure acting on the opposite sides of valve members 57. The result is that the diaphragm and the agitator attached thereto are reciprocated rapidly and, again in this case, the period of reciprocation is independent of the speed of movement of the nozzle over the floor.

It will be seen that in all embodiments, the passage from the suction inlet opening 13 through the nozzle to the outlet 14 is continuously open and unimpeded by the agitator or the mechanism for operating it.

It will be noted that in all embodiments, and more especially in those shown in Figs. 4 through 8, the pivotal connection of member 15 to member 11 is so located that if the center line of tubular member 16 is prolonged downwardly it intersects the floor behind the center line of the inlet opening if the tubular member is inclined approximately 40 degrees or more from the floor. Thus, when the nozzle is moved back and forth, that is pushed and pulled by the tubular member, the line of force applied to the tubular member intersects the floor behind the center line of the inlet opening. This results in the rear lip of the nozzle being pressed against the floor harder than the forward lip during forward movement of the nozzle when it is being pushed by the tubular member. On the other hand, when the nozzle is being pulled backward by the tubular member, there is a tendency for the rear lip to be raised more than the front one. In other words, whichever lip is leading bears against the floor with less force than the trailing lip.

Whenever a nozzle is operated on a rug or other flexible floor covering the latter tends to be pushed up in the form of a wave by the leading lip. However, due to the fact that the leading lip in the present nozzle bears but lightly against the rug, it will pass thereover without pushing up a wave in the rug. This results in an easier gliding of the nozzle over the rug. Furthermore, the trailing lip, which bears against the rug with more force than the leading lip, does tend to give the rug a wave form, but this wave occurs within the nozzle opening where it aids in promoting flow of air through the material of the rug by lifting the rug slightly away from the solid floor.

While I have shown and described three more or less specific embodiments of my invention, it is to be understood that this has been done for purposes of illustration only and my invention is not to be limited thereby, but its scope is to be determined by the appended claims viewed in the light of the prior art.

What I claim is:

1. In a suction nozzle, a hollow member having an inlet opening and an opening adapted to be connected to a source of suction, an agitator movably mounted within said hollow member, means for reciprocating said agitator including a reciprocable member, means for mounting said reciprocable member in said hollow member so that opposite sides of said reciprocable member may be subjected to substantially different pressures, one side being continuously subjected to a substantially constant pressure, and means for subjecting the other side of said reciprocable member alternately to atmospheric pressure and to the low pressure created by said source of suction.

2. In a suction nozzle, a hollow member having an inlet opening and an opening adapted to be connected to a source of suction, an agitator movably mounted within said hollow member, means for reciprocating said agitator including a reciprocable member, means for mounting said reciprocable member in said hollow member so that opposite sides of said reciprocable member may be subjected to substantially different pressures, one side being continuously subjected to the substantially constant low pressure created by said source of suction, and means for subjecting the other side of said reciprocable member alternately to atmospheric pressure and to said low pressure.

3. In a suction nozzle, a hollow member having an inlet opening and an opening adapted to be connected to a source of suction, a flexible diaphragm mounted within said member so that opposite sides of said diaphragm may be subjected to substantially different pressures, an agitator connected to a movable portion of said diaphragm, one side of said diaphragm being uninterruptedly subjected to a substantially constant pressure, and means for subjecting the other side of said diaphragm alternately to atmospheric pressure and to the low pressure created by said source of suction.

4. In a suction nozzle, a hollow member having an inlet opening and an opening adapted to be connected to a source of suction, a flexible diaphragm mounted within said member so that opposite sides of said diaphragm may be subjected to substantially different pressures, an agitator connected to a movable portion of said diaphragm, one side of said diaphragm being uninterruptedly subjected to the substantially constant low pressure created by said source of suction and means for subjecting the other side of

said member alternately to atmospheric pressure and to said low pressure.

5. In a suction nozzle, a hollow member, a movable diaphragm dividing the space within said member into a first chamber and a second chamber, said member being formed with a suction inlet opening and an outlet opening both communicating with said first chamber, means for connecting said outlet opening to a source of suction, an agitator operable by said diaphragm, and means for alternately connecting said second chamber to the atmosphere while isolating it from said source of suction and connecting it to said source of suction while isolating it from the atmosphere.

6. In a suction nozzle, a hollow member, a diaphragm having a movable central portion and dividing the space within said member into a first chamber and a second chamber, an agitator connected to said movable portion, said hollow member being formed with a suction inlet opening and an outlet opening both communicating with said first chamber, means for connecting said outlet opening to a source of suction, means for alternately connecting said second chamber to the atmosphere while isolating it from said source of suction and connecting it to said source of suction while isolating it from the atmosphere whereby said diaphragm and agitator are moved in one direction due to pressure variations, and resilient means for resisting movement in said direction and causing movement in the opposite direction.

7. In a suction nozzle, a hollow member, a movable diaphragm dividing the space within said member into a first chamber and a second chamber, said member being formed with a suction inlet opening and an outlet opening both communicating with said first chamber, means for connecting said outlet opening to a source of suction, an agitator operable by said diaphragm, a rotary valve for alternately connecting said second chamber to the atmosphere and to said source of suction, and means for rotating said rotary valve.

8. A device as claimed in claim 7 including a wheel rotatable by movement of the nozzle over a surface to be cleaned for rotating said rotary valve.

9. A device as claimed in claim 7 including a turbine rotor rotatable by flow of air produced by the source of suction for rotating said rotary valve.

10. In a suction nozzle, a hollow member, a movable diaphragm dividing the space within said member into a first chamber and a second chamber, said member being formed with a suction inlet opening and an outlet opening both communicating with said first chamber, means

for connecting said outlet opening to a source of suction, an agitator operable by said diaphragm, and valve means for alternately connecting said second chamber to the atmosphere and to said source of suction, said valve means being operable in response to movement of said diaphragm.

11. In a suction nozzle, a hollow member, a movable diaphragm dividing the space within said member into a first chamber and a second chamber, said member being formed with a suction inlet opening and an outlet opening both communicating with said first chamber, means for connecting said outlet opening to a source of suction, an agitator operable by said diaphragm, a valve for controlling communication between said second chamber and said source of suction, a valve for controlling communication between said second chamber and the atmosphere, and means for operating both of said valves simultaneously so that when one valve is open, the other is closed.

12. In a suction nozzle, a hollow member, a movable diaphragm dividing the space within said member into a first chamber and a second chamber, said member being formed with a suction inlet opening and an outlet opening both communicating with said first chamber, means for connecting said outlet opening to a source of suction, an agitator operable by said diaphragm, a valve for controlling communication between said second chamber and said source of suction, a valve for controlling communication between said second chamber and the atmosphere, said valves being connected for simultaneous operation so that when one valve is open, the other is closed, and means for operating said valves by movement of said diaphragm.

13. In a suction nozzle, a hollow member, a movable diaphragm dividing the space within said member into a first chamber and a second chamber, said member being formed with a suction inlet opening and an outlet opening both communicating with said first chamber, means for connecting said outlet opening to a source of suction, an agitator operable by said diaphragm, a valve for controlling communication between said second chamber and said source of suction, a valve for controlling communication between said second chamber and the atmosphere, a rigid member connecting said valves for simultaneous operation so that when one valve is open, the other is closed, and resilient means connecting said rigid member with said diaphragm for transmitting movement of said diaphragm to said rigid member to operate said valves, said resilient means causing the movement of said rigid member to lag behind that of said diaphragm.

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