

Dec. 31, 1968

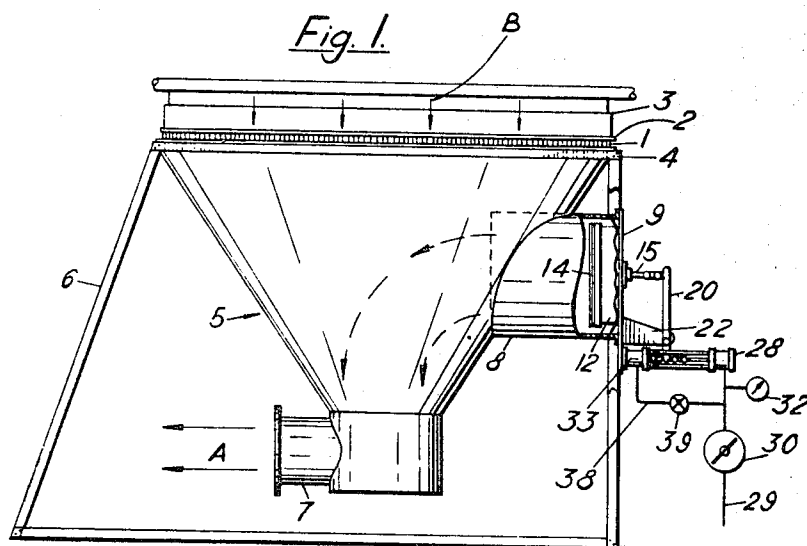
E. WILFORD

3,418,931

APPARATUS FOR STENCIL-PRINTING THICK FABRICS

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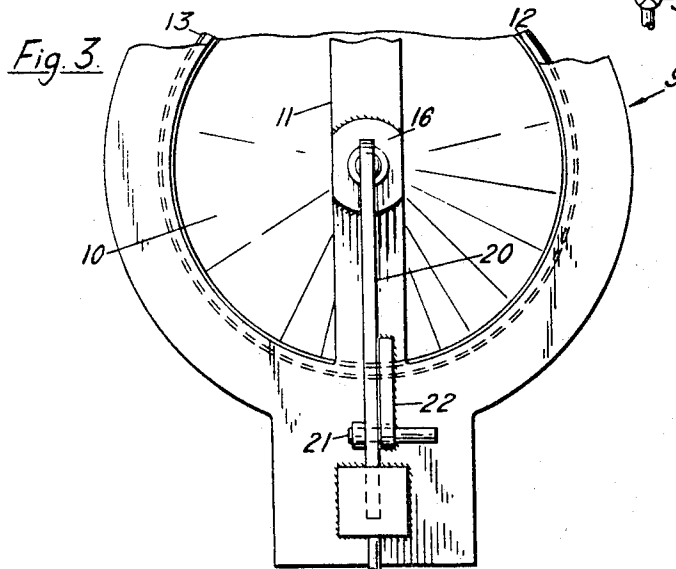
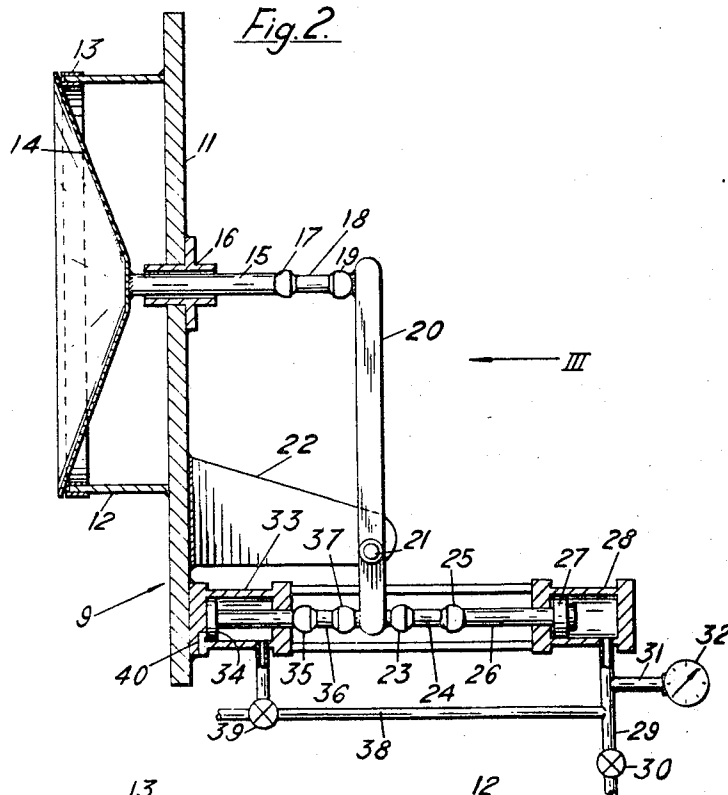
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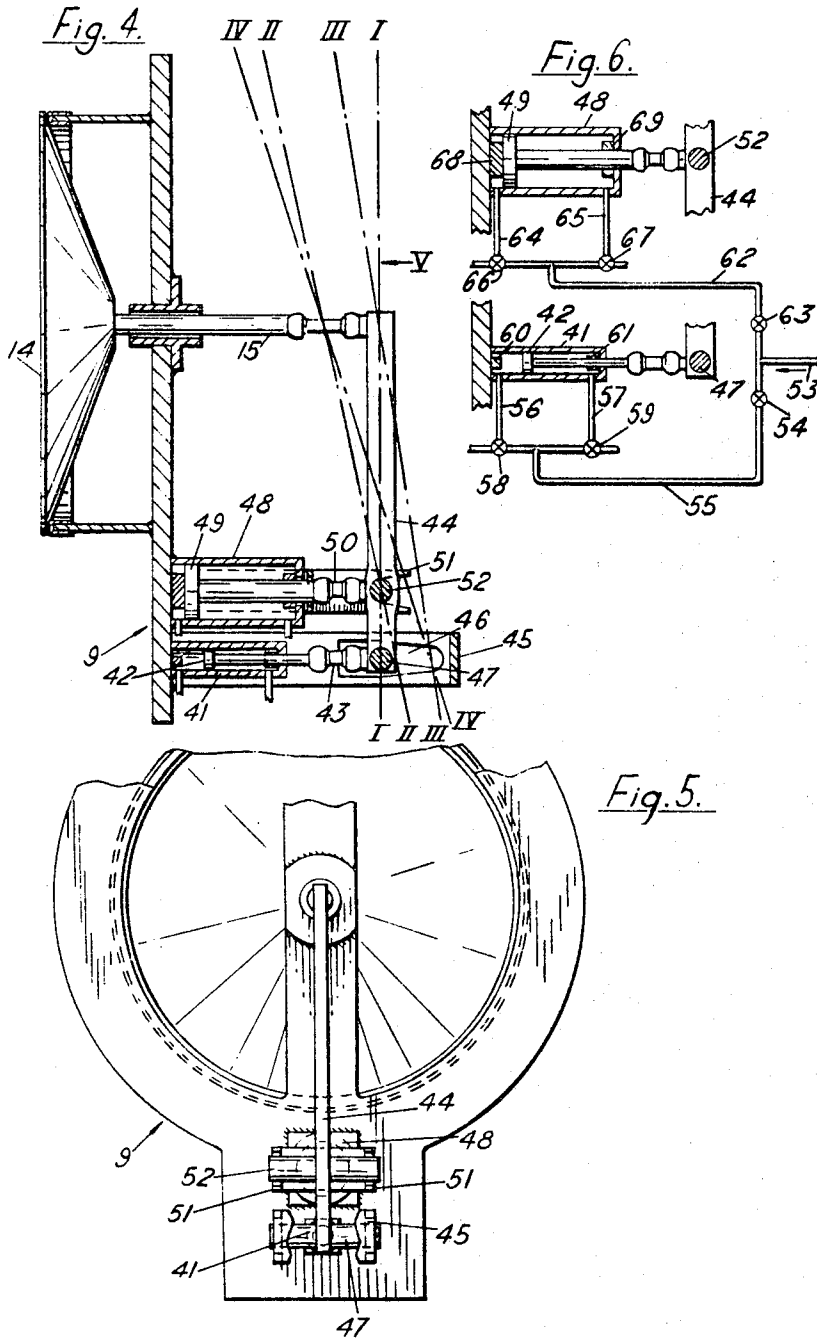
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Fig. 7.

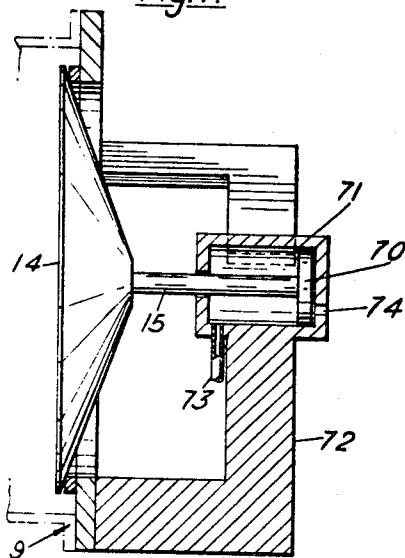
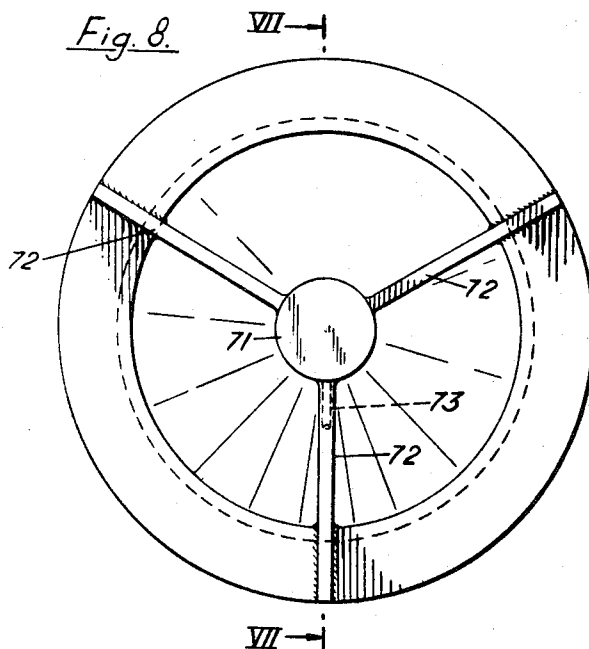


Fig. 8.



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3,418,931

APPARATUS FOR STENCIL-PRINTING THICK FABRICS

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5 Claims. (Cl. 101—126)

ABSTRACT OF THE DISCLOSURE

An apparatus for stencil-printing thick pile carpets using a free flowing coloring material with a constant pressure differential across the carpet created by suction pressure on one side of the carpet utilizes an adjustable pressure regulating valve to adapt the apparatus for printing on carpets having widely varying characteristics. The valve is a frusto-conical disc valve cooperating with a valve seat and having the concave sides subjected to suction. The disc valve is normally held on its seat by a pneumatic cylinder having the piston thereof connected to the valve through a universal joint. The linkage between the piston and the valve gives a mechanical advantage to the valve. There may be a second cylinder and piston to provide a second range of operation.

This invention relates in general to a stencil printing apparatus and more particularly to a novel stencil printer of the suction flow type provided with adjustable pressure regulating means to render the apparatus adaptable to print on fabrics having widely varying characteristics, such as thickness.

In Patent No. 3,129,442 to Thomas L. Leckie, assigned to the assignee of the present invention, there is described and claimed a method of printing a thick fabric in which a length of the fabric while stationary beneath a horizontal stencil and above a perforated support is traversed by a bottomless container of free-flowing coloring matter moving over the stencil and, during the traversing, suction is applied to the whole of the underside of the length of fabric and the pressure difference across the stencil and fabric beneath the container is maintained substantially constant. This method has proved of great utility in the printing of pile carpets. The suction, that is to say the negative pressure, varies with the pattern that is being printed through any given screen and with the material of the carpet itself. In printing normal carpets I have found suction equal to from 8 to 14 inches w.g. to be suitable.

In recent years carpets having a nylon pile have become popular, and many carpets have a pile consisting of looped nylon filament. In printing these carpets I have found considerable difficulty in maintaining uniformity of color. The difficulty arises from the complementary causes of the use of a largely non-absorbent fiber and a pile construction which tends to encourage uneven color distribution. This uneven distribution is further accentuated if the pile is of high and low construction. Again variation in the density of the usual hessian base of the carpet leads to uneven printing.

I find that the degree of suction required with a loop-pile nylon carpet is much less than that with a cut-pile carpet of other fibers, and commonly is in the range of from 1 to 4 inches w.g. In other words, the pressure difference which should be kept constant is less with nylon carpets, and variations in it have proportionately greater effect in producing uneven coloring. It appears that the color tends to run down the fiber more easily, and possibly to accumulate on the hessian base and in the subse-

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quent treatment of the carpet to flow to give an uneven appearance in the finished carpet. However this may be, I find that the desired constant pressure difference is more difficult to maintain with such low degrees of suction.

It is therefore a primary object of this invention to provide a novel stencil printing apparatus of the suction flow type having means for adjustably regulating the degree of suction in accordance with the characteristics of the material being printed upon.

It is a further object of this invention to provide such an apparatus having a suction box to pull coloring matter, such as a liquid dyeing agent, through a fabric overlaid with a pattern stencil and in which the pressure within the box is regulated to within close tolerances by valve means adjustable over a wide operating range.

In practice the suction is produced in a box, the top of which is formed by a perforated support on which the carpet or other thick fabric rests during the printing. According to the invention a valve subjected on one face to the suction in the box and on the other face to the atmosphere is provided to control the admission of air to the box through a valve seat and is held on the seat by a device which yields to allow the valve to move away from the seat when the suction reaches a predetermined value. Thus, air is admitted to the box to reduce the suction when this value is exceeded, even momentarily.

The device by which the valve is held on its seat may be a spring, but preferably is a piston in a cylinder to which fluid, preferably air, can be admitted under constant pressure. This pressure is adjusted so that when the suction is at the desired value it is just sufficient to hold the valve on its seat against the atmospheric pressure that tends to move it. When the suction increases, even momentarily, the piston moves against the pressure in the cylinder, and the valve moves to admit air to the suction box.

The valve itself is advantageously a frusto-conical disc seating on a rubber ring. I find that this valve tends to turn about its axis, and unless it is allowed to turn freely resistance to the desired movement to effect the control is set up. Likewise it is found that there is some tendency for the piston to turn in the cylinder. Accordingly, it is preferred to insert a universal joint in the connection between the valve and the piston. Although the piston and valve may be aligned, it is also desirable to interconnect them by a linkage which gives a mechanical advantage to the valve.

Some apparatus according to the invention will now be described by way of example with reference to the accompanying drawings, in which:

FIGURE 1 is an elevation, partly in section, of part of a stencil-printing machine;

FIGURE 2 shows part of the apparatus of FIGURE 1 in section on a larger scale;

FIGURE 3 is an elevation of part of FIGURE 2, looking in the direction of the arrow III;

FIGURES 4 and 5 are views similar to FIGURES 2 and 3 of a modified form of apparatus, FIGURE 5 being an elevation taken in the direction of the arrow V in FIGURE 4;

FIGURE 6 is a diagram of compressed-air connections to the apparatus shown in FIGURES 4 and 5;

FIGURES 7 and 8 are respectively a section through, and an elevation of, a third form of apparatus, FIGURE 7 being a section taken on the line VII—VII in FIGURE 8.

The apparatus shown essentially diagrammatically in FIGURES 1 to 3 is part of a stencil-printing machine in which a pile carpet 1 is printed through a stencil 2 with free-flowing coloring liquid supplied from a color box 3. During the printing operation the carpet 1 is stationary on the top 4 of a suction box 5 which is supported by a frame 6. The top 4 is formed with a large number of small open-

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ings through which air can pass, and in operation suction is set up in the box 5 by a fan not shown which draws air through an outlet 7 as shown by arrows A. Accordingly, air is drawn through the stencil 2, the carpet 1 and the top 4 of the box as shown by arrows B.

A cylinder 8 is let into the side of the box 5 and is also supported by part of the frame 6. The inner end of this cylinder is open, but the outer end is partly closed by a plate 9 which forms a support for the valve provided according to the invention. This plate 9 has an open center 10 spanned by a bar 11, and it carries a cylindrical collar 12, the free end of which is embraced by a rubber ring 13. This ring 13 forms a seat for a frusto-conical valve 14 which is carried by a stem 15 that passes through a bush 16 in the plate 9. It will be seen that the convex face of the valve 14 is subjected to atmospheric pressure, whereas the concave face is subjected to the pressure prevailing in the suction box 5.

The stem 15 is connected through a ball joint 17 to a link 18 which in turn is connected through another ball joint 19 to a vertical lever 20, which close to its lower end is pivotally mounted as shown at 21 in a bracket 22 that is fixed to the plate 9. The lower end of the lever 20 is connected through a ball joint 23 to a link 24, which in turn is connected through another ball joint 25 to the stem 26 of a piston 27 that works in a cylinder 28. This cylinder 28 is supplied with air under constant pressure through a pipe 29 in which a constant-pressure valve 30 is inserted, and from which a branch 31 runs to a pressure gauge 32. It will be seen that the air pressure inside the cylinder 28 urges the piston 27 to the left as seen in FIGURE 2, and therefore urges the lever 20 to rock in a clockwise direction about its pivot 21 and thus to urge the valve 14 on to its seat 13. The valve 30 is adjusted so that, taking into account the mechanical advantage given by the lever 20, which may advantageously be 4:1 in favor of the valve 14, this valve will move off its seat under the action of the atmospheric pressure on its convex face when the pressure in the suction box drops below the predetermined value known to be desirable for the particular carpet that is being printed.

The pressure available from most compressed-air lines is about 80 pounds per square inch, which can be reduced reliably by a constant-pressure valve to 10 pounds per square inch, but not to any much lower figure. Working with air at 10 pounds per square inch, it is very difficult to obtain an accurate response to suction variations over the whole range of suction of from 1" w.g. to 14" w.g. or more with a single cylinder 28 and piston 27. On the other hand it is important in practice that a single machine should be able to print different carpets or other fabrics as may be desired, and accordingly the suction should be controllable through such a wide range. Accordingly, as shown in FIGURES 2 and 3, it is preferable to provide a second cylinder 33 with a piston 34 the stem of which is connected through a ball joint 35 to a link 36, which in turn is connected through another ball joint 37 to the lower end of the lever 20. A pipe 38 branches from the pipe 29 to enter the cylinder 33 and is controlled by a three-way valve 39, which can connect the pipe 38 to the cylinder 33 or connect the cylinder to the atmosphere while closing the pipe 38. When this valve connects the pipe 38 to the cylinder 33, compressed air admitted to the cylinder urges the piston 34 to the left as shown in FIGURE 3, that is to say in the same direction as the piston 27 is urged by the air in the cylinder 28. Air trapped in the cylinder can escape through a bleed port 40. When the suction is being controlled in the range of 1" w.g. up to 8" w.g. the valve 39 is set to put the cylinder 33 in communication with the atmosphere, and the resistance to the inward movement of the valve 14 is applied through the piston 27 alone. The valve 39 is set to supply compressed air to the second cylinder 33, which is thus brought into use, when the predetermined suction is to be over 8" w.g.

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In the construction shown in FIGURES 4, 5 and 6, two cylinders of different size are used, but only one is in operation at any given time. Both cylinders are mounted on the plate 9, the smaller cylinder 41 housing a piston 42 the stem of which is connected by a link 43 as in the previous construction to the lower end of a lever 44 which corresponds to the lever 20. An open bracket 45 with slots 46 in its sides embraces and extends past the cylinder 41, and the ends of a pin 47 that passes through the lower end of the lever 44 enter the slots 46.

The larger cylinder is shown at 48 and houses a piston 49 the stem of which is connected by a link 50 to the lever 44. Two brackets 51 with forked ends project from the cylinder 48, and a pin 52 that passes through lever 44 enters these forked ends.

With this apparatus compressed air from a pipe 53 can be supplied to the cylinder 41 through a constant pressure valve 54 in a pipe 55 which branches into two pipes 56 and 57 running to the two ends of the cylinder 42 and controlled by three-way valves 58 and 59 respectively. The movement of the piston 42 in the cylinder 41 is limited by seats 60 and 61 in order to ensure that air can either enter the cylinder through the pipe 56 or 57 as the case may be to move the piston or leave the cylinder through one or other of the pipes to escape to atmosphere through the valve 58 or 59.

Compressed air can similarly be supplied to the cylinder 48 through a pipe 62 controlled by a constant-pressure valve 63, and branch pipes 64 and 65 respectively controlled by three-way valves 66 and 67. The piston 49 likewise has seats 68 and 69 to limit its movement in either direction.

When the apparatus shown in FIGURES 4 and 5 is to work with low suction in the suction box 5, the valves 66 and 67 are set so that air is supplied through the pipe 65 to the cylinder 48, and air on the left-hand side of the piston 49 can escape to atmosphere through the valve 66. The valve 63 is adjusted so that the pressure on piston 49 forces it hard against the seat 68. The pin 52 thereupon becomes the pivot point of the lever 44, the movement of which is now controlled through the smaller cylinder 41, to which air under constant pressure is admitted through the pipe 57, the valve 58 being set to connect the cylinder 41 to the atmosphere. The limits of the rocking movement of the lever 44 with this setting of the valves are shown by broken lines I and II in FIGURE 4.

When the apparatus is to work with higher suction in the suction box 5, the constant-pressure valve 54 is adjusted to supply air at high pressure to the cylinder 41 through the valve 58 and pipe 56, and the valve 59 is set to allow air in the right-hand side of the cylinder to escape to atmosphere. As a result the piston 42 is forced against the seat 61, and now the pin 47 becomes the pivot point of the lever. The movement of the lever is controlled through the larger cylinder, the constant-pressure valve 63 being set to supply air under low pressure through the pipe 62 and the valves 66 and 67 being set so that this compressed air enters the cylinder through the pipe 64, while air on the right-hand side of the piston 49 can escape to atmosphere through the pipe 65. The limits of movement of the lever 44 with this setting of the various valves, are shown by the broken lines III and IV in FIGURE 4.

As examples of appropriate dimensions for the pistons and pressures of the air supplied to these cylinders in the apparatus shown in FIGURES 4 and 5, the area of the valve seat is 100 square inches, the area of the piston 49 is 2.5 square inches and the area of the piston 42 is 0.5 square inch. The linkage gives the valve a mechanical advantage of 5:1 over the piston 49 and 4:1 over the piston 42. To control the movement of the valve at a suction in the range of 1 inch to 4 inches w.g. the small cylinder is used and, for example, is supplied with air at a pressure of 28 p.s.i. when the valve is to move if the

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suction exceeds 1 inch w.g. The large cylinder is used in the range of 4 inches to 14 inches w.g., and, for example, at 14 inches w.g. is supplied with air at a pressure of 100 p.s.i.

The apparatus shown in FIGURES 7 and 8, which is of a simpler nature, may be used when air under high pressure is available or the control of the suction in the box 5 is to be effected over only a limited pressure range.

In this apparatus the stem 15 of the valve 14 carries a piston 70 which works in a cylinder 71 carried by a frame 72 on the plate 9. A pipe 73 is provided for the supply of air under constant pressure to the cylinder 71, which has a bleed port 74 through which air trapped in front of the piston can escape.

I claim:

1. An apparatus for stencil printing on fabric by the application of free-flowing coloring matter to the fabric comprising:

- (a) a suction box having a perforated top for the passage of air into the box and adapted to support the fabric and a stencil,
- (b) means for evacuating air from the box to thereby create a suction,
- (c) a valve seat for the admission of air into the box,
- (d) a frusto-conical disc regulating valve cooperating with the valve seat and subjected on its concave face to the suction in the box and on its convex face to the atmosphere for controlling the admission of air into the box, and
- (e) a piston in a cylinder to which fluid can be admitted under pressure, the piston connected to the valve through a universal joint and being operative to normally hold the valve on the seat but allowing the valve to move away from the seat when the suction in the box reaches a predetermined level.

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2. An apparatus as defined in claim 1 in which the connection between the valve and the piston includes a mechanical linkage with a lever which gives a mechanical advantage to the valve.

3. An apparatus as defined in claim 1 in which the means for holding the valve on its seat comprises a second cylinder and piston adapted to be brought into use on an increase in the predetermined level of the suction.

4. An apparatus as defined in claim 1 in which the means for holding the valve on its seat comprises two cylinders and pistons adapted to be brought into alternate use in accordance with the predetermined level of the suction.

5. An apparatus as defined in claim 4 in which both pistons are mounted side by side are separately pivotally connected to spaced points on one end of a single lever connected to the valve, so that the pivoted connection of each piston becomes a pivot for the lever when the valve is being controlled through the other piston.

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U.S. Cl. X.R.

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