FLUID PRESSURE CONTROLLED HOLDING DEVICE FOR A LIFT UNIT
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ABSTRACT OF THE DISCLOSURE

A vacuum type holding apparatus for rapid attachment to an object and release therefrom upon command. The apparatus utilizes the flow of a liquid through a venturi for creating the vacuum for the attaching vacuum cup. A solenoid actuated valve blocks the normal flow of the liquid through the venturi and causes the liquid to flow into the vacuum portion of the venturi to destroy the vacuum and provide rapid release of the vacuum cup.

This invention relates to a lifting device and more particularly to a holding device for a lifting unit controlled by a fluid under pressure.

There are commercially available vacuum actuated lift cups for holding material in a firm grip for lifting or moving. However, in an automated production line, the available commercial lifters do not react fast enough during initial contact for seizure and for fast release when the material has been moved.

An object of this invention is to provide a vacuum lift device operable by a pressurized fluid for rapid activation and deactivation.

Another object of this invention is to provide a lift unit having a flexible cup operable by a pressurized fluid controlled by a solenoid and having snap-in connections for rapid and easy replacement of a faulty unit.

A further object of this invention is to provide a resilient bumper adjacent the flexible suction cup for cushioning the contact between the lift unit and the material to be moved for preventing localized deformation of the material to be moved.

Another object of this invention is to provide a lift system in which pressurized fluid is used to create a vacuum for holding an object and also is used to destroy the vacuum it created and exert pressure against the held object to repel it upon command.

These and other objects of this invention will be readily seen by reference to the following specification and drawings wherein:

FIG. 1 is a front view of this novel invention prior to contact with the material to be moved and prior to activation of the lift unit.

FIG. 2 is a view in the direction of the arrows, substantially along the line 2—2 of FIG. 1, showing the solenoid energized and the suction cup in contact with the material to be moved.

FIG. 3 is a view of the lift unit situated for movement into the mounting position on a lift arm of a transfer unit.

Referring now to the drawing, as best seen in FIG. 3, a lift unit 10 is located adjacent a lift arm 12 of a transfer unit (not shown). The lift arm 12 has coupling 14 connected to a source of fluid under pressure. In the preferred embodiment, pressurized air is used. A conventional bayonet type removable air connector having the female portion 16 secured in the lift arm 12 and connected to the pressurized air and the male portion 18 secured to the lift unit 10, is used for ease and rapidity of connecting the lift unit to the lift arm. A pair of female plugs 20 are secured in the lift arm 12 and connected to an electrical power source (not shown) and positioned for cooperating with a pair of male plugs 22, 23 mounted in the lift unit 10.

Referring now to FIGS. 1 and 2, the lift unit 10 includes a body portion 24 having a contact portion 26 secured thereto by a plurality of bolts 28. One or more spacer plates 30 may be positioned between the body portion 24 and the contact head 26, as desired to accommodate the various heights of the unit for different applications. A resilient contact ring 32 preferably of rubber or plastic is secured to the outer edge of the contact head 26. A commercially available vacuum cup assembly 34 is threadably secured in a threaded aperture 36 extending through the contact head 26. The vacuum cup assembly 34 includes a resilient cup portion 36 having an aperture 38 in the center thereof connecting the cup portion 36 with the hollow threaded portion 40.

A solenoid 42 is secured to the body portion 24 by screws 44 or other suitable means. The electrical leads 46, 48 from the solenoid are connected to the male plugs 22, 23 for actuation of the solenoid 42, upon command, when the lift unit 10 is mounted in operating position on the lift arm 12. A spring 50 biases the plunger 52 to the extended position shown in FIG. 1 and is compressed by the action of the plunger 52 when the solenoid is actuated, as shown in FIG. 2.

The air passage 54, within the body 24, connects the pressurized air from connector 18, to a venturi sleeve 56, threadably secured in a tubular cavity 58, of the body 24.

The venturi sleeve 56, includes an inlet passage 60, a funnel shaped outlet passage 62, having its smaller end connected to said inlet and a reduced section 64, the reduced section 64 cooperates with the walls of the cavity 58 to form an annular chamber 66, which is positioned about the juncture of the inlet passage 60 and the outlet passage 62. A plurality of air passages or outlets 68 extend from the juncture of the inlet and outlet passages to the chamber 66.

An air passage 70, extends from the chamber 66, to the hollow threaded portion 40, of the vacuum cup assembly 34, so that air may pass freely between the chamber 66, and the cup portion 36, of the vacuum cup assembly 34.

A stopper or plug 72 is secured to the plunger 52 of the solenoid 42, for movement into contact with the larger end of the outlet passage 62, when the solenoid is not energized, whereby the stopper 72 effectively blocks escape of pressurized air from the outlet. Upon energizing of the solenoid 42, the plunger 52 overcomes the biasing action of spring 50 and moves the stopper 72 from contact with outlet 62, thus allowing the pressurized air to escape therefrom.

In the operation of this device, with the lift unit secured to a lift arm, the solenoid 42 is energized by manual controls or automatic controls, such as a microswitch positioned for contact with the lift arm during its movement. Upon energizing of the solenoid, the plunger 52 and stopper 72 move to the position shown in FIG. 2. In this position, the pressurized air flows from its source through the couplings 16, 18, and the air passage 54 to the inlet passage 60 of the venturi sleeve 56. As the pressurized air passes through the venturi sleeve 56 from the inlet passage 60 through the outlet passage 62 to the atmosphere. The venturi effect of such passage creates a reduced pressure at the juncture at the inlet 60 and outlet 62 passages causing air to be drawn from the chamber 66, through air passages 68, and a vacuum is created by such venturi action in said chamber. The vacuum thus created extends through air passage 70 to the vacuum cup assembly 34, and when the cup 36 contacts an object, such as the flat plate 74, the reduced
pressure within the cup 36 and the atmospheric pressure on the plate 74, opposite the cup provides a force differential acting on the plate for moving the plate 74 into contact with the contact ring 22, in the position shown in FIG. 2. A person skilled in the art can easily calculate the relative size of air passages 68, inlet passage 60, outlet passage 62, and cup 34 for given conditions of air pressure and the weight of the object to be moved by the unit.

For rapid disconnect of cup 34, from plate 74, the solenoid is deenergized thus the plunger 52 and the stopper 72 are returned to the position shown in FIG. 1, at which time the escape of the pressurized air from outlet 62 is blocked. The travel of the pressurized air then will flow from the inlet 60, through the air passages 68 to the chamber 66, and through passage 70 to the vacuum cup assembly 34. As the pressurized air enters the cup 36, the vacuum therein is changed to a pressurized area greater than atmospheric pressure and the plate 74 is forced by such pressure away from ring 32, and cup 36, thus releasing and forcing the plate from the lift unit.

While but one embodiment of the present invention has been illustrated and explained, it is obvious various changes and modifications may be incorporated without departing from the spirit and scope of the following claim.

What is claimed is:

1. A holding device for a lift unit including means for attaching said lift unit to a movable arm for movement therewith, a source of fluid under pressure; a venturi sleeve having an inlet, a plurality of outlets, said inlet being connected to said pressurized fluid source for passage of said pressurized fluid therethrough; stopper means for controlling the flow of said pressurized fluid from said outlets upon command, flow of said pressurized fluid through one of said outlets creating reduced pressure in said other outlet; a chamber connected to said other outlet, a fluid passage extending from said chamber, a vacuum cup assembly operably connected to said fluid passage, said vacuum cup assembly including a flexible cup portioned for contacting a surface, said cup portion having a reduced pressure of less than atmospheric pressure therein when said pressurized fluid passes through said one outlet for using atmospheric pressure to urge and hold said vacuum cup assembly and said surface into closer contact; resilient means for limiting movement in one direction between said surface and said holding unit; actuating means for controlling movement of said stopper means out of and into engagement with said one outlet, said pressurized fluid passing through said other outlets in said flexible cup portion when said stopper means is in contact with said one outlet for creating a pressure therein greater than atmospheric pressure whereby said surface is repelled from said flexible cup and released from said holding device, said actuating means includes a solenoid having a plunger positioned therein for reciprocal movement relative thereto when said solenoid is energized, said stopper means secured to one end of said plunger for movement into and from engagement with said one outlet as said plunger is reciprocated, spring means biasing said plunger and said stopper means into engagement with said one outlet, energizing of said solenoid causing movement of said plunger to overcome the biasing action of said spring means and move said plunger means from engagement with said one outlet whereby said pressurized fluid flow therethrough, and means for energizing said solenoid upon command.

2. The holding device claimed in claim 1 wherein said resilient means for limiting movement between said holding device and said held surface includes a resilient material attached to said holding device and spaced from said vacuum cup a distance great enough to permit actuation of said cup during application at a vacuum thereto.

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