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VACUUM LIFTER

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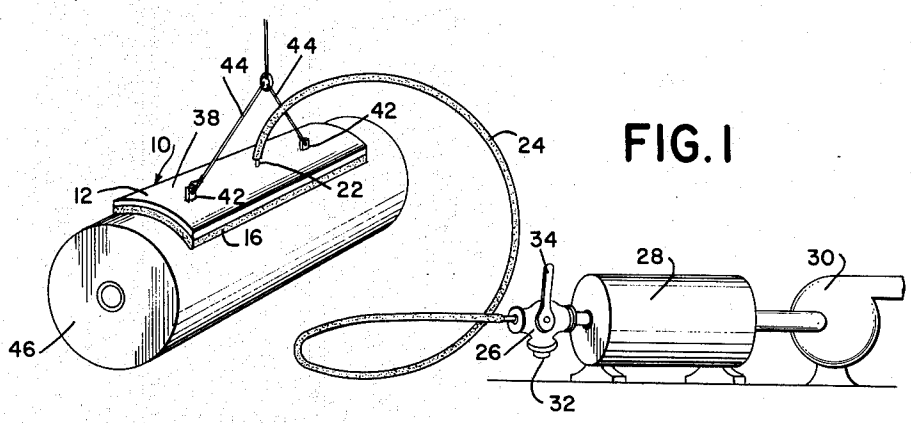


FIG. 1

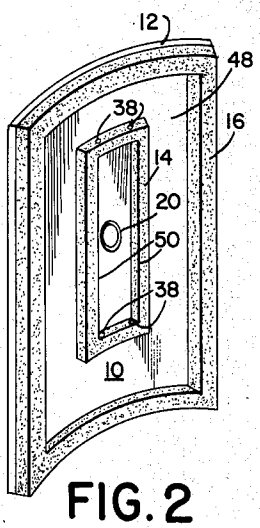


FIG. 2

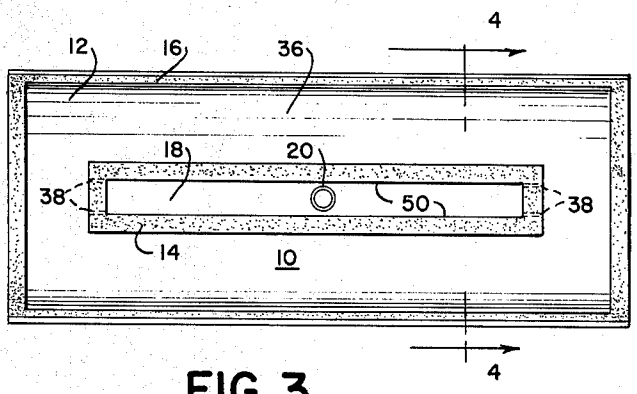


FIG. 3

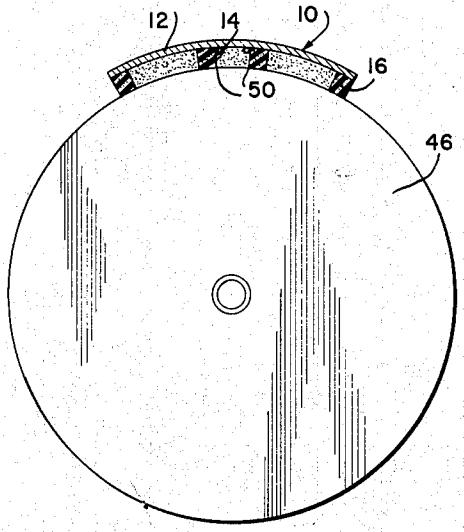


FIG. 4

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VACUUM LIFTER

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This invention relates to a vacuum lifter particularly intended for the handling of loads having convex surfaces.

One of the many uses for which the lifter of the present invention is eminently suited is the handling of large rolls of paper of the types employed in the publications industries. Whereas such paper rolls are produced in a large variety of sizes, a great proportion of them have diameters ranging from thirty inches to forty-two inches. Whereas the handling of such rolls by means of vacuum lifters has been proposed by the present applicant in the past, the diameter variation has always presented a serious problem, since known lifters will not accommodate such a range of sizes.

In accordance with the present invention, a lifter has been developed which will be universally applicable to loads having concave surfaces of widely varying forms and dimensions, including cylindrical and conical surfaces.

It is among the objects of the present invention to provide a vacuum lifter comprising a self-supporting frame having a first concave surface and a surface opposed thereto, a first deformable resilient gasket secured to the first surface having proximate edges defining a narrow open inner chamber with the frame, means defining a port for connecting the inner chamber with a source of reduced pressure, a second deformable resilient gasket secured to the first surface surrounding the first gasket defining an open chamber with the frame and first gasket, and means for connecting the outer chamber with a source of reduced pressure, the concave surface having a maximum radius between five and twenty times the distance between the proximate edges of the first gasket.

A preferred form of the invention provides a distance between the proximate edges of between one and five inches, a highly satisfactory lifter having been developed wherein the distance between the proximate edges of the first gasket is of the order of three inches. The gaskets are preferably compressible, and the inner gasket may be more highly compressible than the outer one, and they may be composed of a cellular elastomer.

The frame may be resilient and flexible and the inner and outer chambers are preferably interconnected by one or more passages having an aggregate cross-sectional area less than that of the port.

A more complete understanding of the invention will follow from a description of the accompanying drawings wherein:

FIG. 1 is a somewhat diagrammatic representation in elevation of a lifter applied to a load and connected with a vacuum pump through a reservoir;

FIG. 2 is a perspective view of a lifter conforming to the present invention;

FIG. 3 is a bottom plan view of a lifter embodying the invention; and

FIG. 4 is a sectional elevation taken along line 4—4 of FIG. 3 depicting the lifter in engagement with a load.

A lifter **10** illustrated in the drawings comprises a frame or plate **12** to one surface of which are secured by means of adhesive, or in other suitable fashion, an inner gasket **14** and an outer gasket **16**. Referring to FIG. 3 it will be observed that the inner gasket **14** defines with the frame or plate **12** an open chamber **18** containing a port **20** for communication with a source of reduced pressure through

a nipple **22**. The nipple **22** receives a hose **24** which is connected through a valve **26** with a reservoir **28** connected to the suction side of a vacuum pump **30**. The valve is depicted as being of the three-way type providing a port **32** for the purpose of admitting atmosphere to the port **20** by proper manipulation of the valve handle **34**.

The outer gasket **16** defines a chamber **36** with the frame or plate **12** and the inner gasket **14**. The inner chamber **18** is connected with the outer chamber **36** by passage means, which may assume the form of small diameter tubes **38**, extending through the inner gasket **14** and having an aggregate cross-sectional area less than the cross-sectional area of the port **20** through which the inner chamber **18** communicates with the vacuum pump **30**.

As will be observed from the drawings, the frame or plate **12** has a concave surface receiving the gaskets and this surface is of substantially cylindrical form having a diameter approximating that of the largest cylindrical surface encountered in connection with loads to be handled. By having the inner gasket **14** more deformable or compressible than the outer gasket **16**, it will follow that the lifter will readily adapt itself to loads having cylindrical surfaces of smaller diameters. Similarly, by using a frame or plate **12** which is resilient and somewhat flexible, the lifter can also adapt itself readily to loads having smaller diameters.

The outer surface **40** of the frame or plate opposed to that bearing the gaskets is provided with a pair of lugs **42** containing openings for the reception of hooks or cables **44** for cooperation with a crane or other lifting devices for elevating the lifter together with its load **46**.

In order to render lifters according to the present invention effective, it has been found that the cylindrical, conical or other concave surfaces **48** should have radii of between five and twenty times the distance between the proximate linear edges **50** of the gasket **14**. The distance between these proximate edges will preferably lie between one and five inches and a distance of three inches has produced highly satisfactory results. The gaskets are preferably compressible and composed of a cellular elastomer. The ratio of the area of the port **20** to the aggregate area of the fluid passage means between the inner and outer chambers may be between 1.1:1 and 96.0:1, a preferred range of ratios lying between 25.0:1 and 50.0:1, a ratio of 36.0:1 having been found to be highly satisfactory in conjunction with a particular lifter which has been tested over a substantial period of time. In this particular lifter, the volume of the chamber defined by the inner gasket and plate is of the order of 0.28 cubic feet and the volume contained within the outer gasket is of the order of 1.18 cubic feet. For this lifter, a vacuum pump having a capacity of one-third horsepower is employed and the diameter of port **20** is one and one-half inches. Each of the four tubes **34** shown as providing communication between the inner and outer chambers has an inside diameter of one-eighth inch. With this equipment, a vacuum corresponding to twenty inches of mercury is established within a few seconds in both the inner and outer chambers when the valve is adjusted to provide communication between the vacuum pump and the port **20**, with the lifter in engagement with a load. To release the lifter from the load, the valve is adjusted to admit atmospheric pressure through the port **32** and the hose **24** to the port **20**.

By providing an inner gasket **14** of higher compressibility than the outer gasket **16**, the flexibility of the frame can be reduced or eliminated without sacrificing the universal application of the lifter to loads having curvilinear surfaces ranging over widely varying radii.

The ratio of the area within the second gasket to the

area within the first gasket may be between 2.5:1 and 16.0:1, a preferred range being between 4.0:1 and 13.0:1, the particular lifter described above providing a ratio of 5.0:1 in this regard.

When the lifter is applied to a load having substantially the maximum diameter for which the lifter is intended, when the proximate linear edges **50** of the inner gasket **14** engage the surface of the load, the valve **26** will be operated to connect the inner chamber **18** with the reservoir **28** and vacuum pump **30** so that the air within this inner chamber will be quickly evacuated through the relatively large port **20**. As result of this evacuation of the inner chamber, the inner gasket **14** will become deformed or compressed bringing the concave surface of the frame closer to the load so that a seal will be effected between the outer gasket **16** and the load **46**. Continued application of the reduced pressure will remove the air from the outer chamber **36** through the passages **38** so that the outer chamber will also be evacuated relatively quickly placing the lifter and load in their operating relationship whereby the lifter and load can be moved to a desired position. When the valve **26** is manipulated to admit atmospheric pressure through the port **32** and the port **20**, the lifter will quickly release the load.

It will be observed that if the inner gasket **14** is more highly compressible than the outer gasket **16**, the lifter will adapt itself to loads having surfaces of substantially smaller diameters than the largest diameter for which the lifter is designed. Similarly, where the frame or plate **12** is somewhat resilient and flexible, the device will also readily adapt itself to rolls or other substantially cylindrical loads having diameters less than the maximum diameter for which the device was designed.

Whereas only one example of the invention has been described with reference to the drawings, such variations as will occur to those skilled in the art are contemplated as coming within the scope of the appended claim.

I claim:

A vacuum lifter comprising a self-supporting frame having a concave surface and a surface opposed thereto, a first deformable resilient gasket secured to said concave surface having proximate edges defining a narrow open inner chamber with said frame, means defining a port for connecting said inner chamber with a source of reduced pressure, a second deformable resilient gasket secured to said concave surface surrounding said first gasket defining an open outer chamber with said frame and first gasket, and means for connecting said outer chamber with a source of reduced pressure, said concave surface having a maixmum radius between five and twenty times the distance between said proximate edges, said inner gasket being more highly compressible than said outer gasket.

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