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[54] **ARCUATE VACUUM LIFTER**
5 Claims, 7 Drawing Figs.

[52] U.S. Cl. 294/65
[51] Int. Cl. A47b 47/00,
B66c 1/02
[50] Field of Search. 294/64, 65

[56] **References Cited**

UNITED STATES PATENTS

2,578,220	12/1951	Billner	294/65
3,227,481	1/1966	Creskoff	294/64
3,229,345	1/1966	Ligon	294/64 X

ABSTRACT: A vacuum lifter which comprises an elongated frame having an arcuate concave surface and a deformable resilient gasket secured to the concave surface about the periphery thereof. A plurality of longitudinally extending deformable resilient gaskets are provided which extend along the lifter and are secured to the concave surface between the ends of the peripheral gasket and parallel to the sides of the peripheral gasket. The gaskets thereby form a plurality of longitudinally extending open chambers. Each of the chambers includes individual means which define a port for connecting the chambers to a source of reduced pressure. Means are also provided for selectively connecting either all of the ports to a source of reduced pressure or only a port of a central one of the chambers to a source of reduced pressure so that a large range of diameters of cylinders may be lifted to said vacuum lifter.

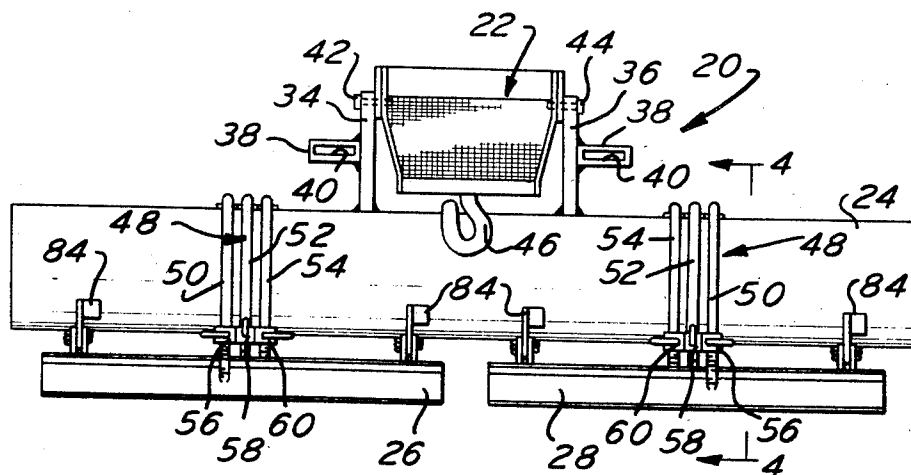


FIG. 1

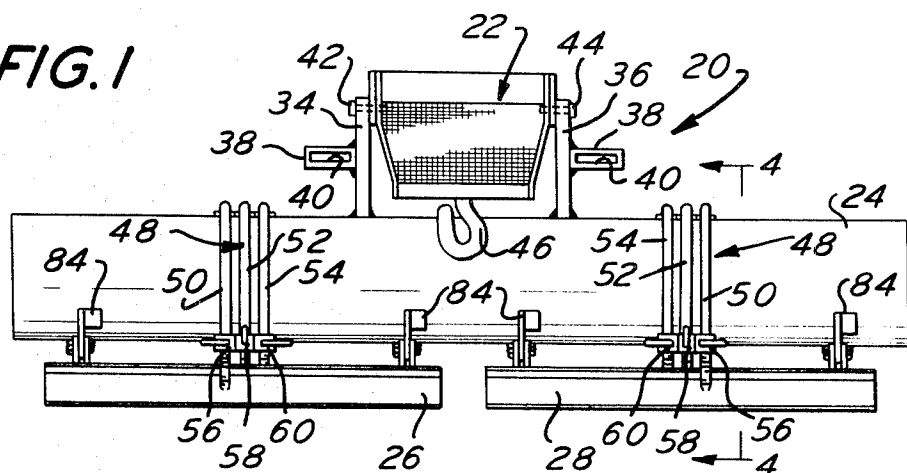


FIG. 2

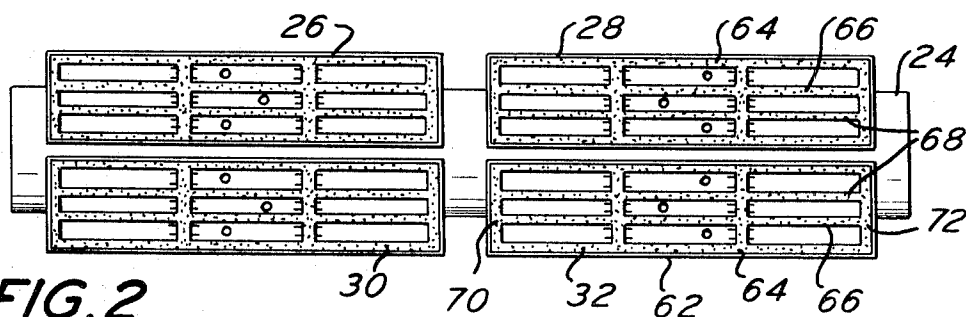
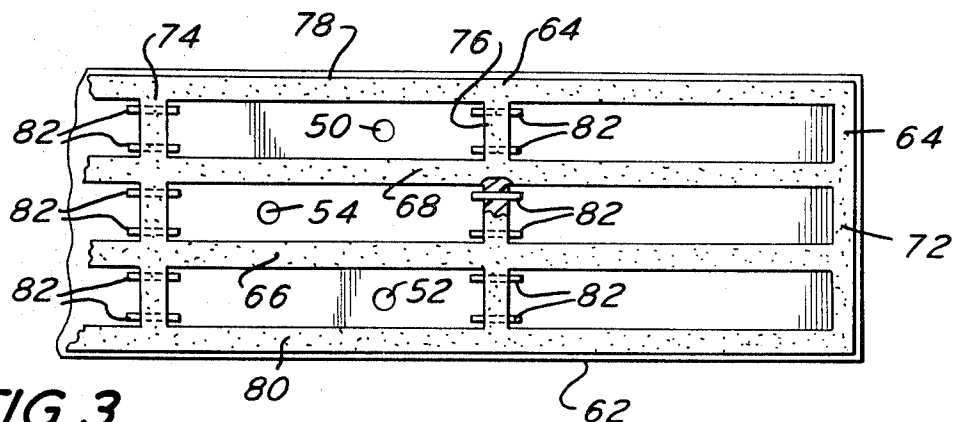


FIG. 3



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FIG. 4

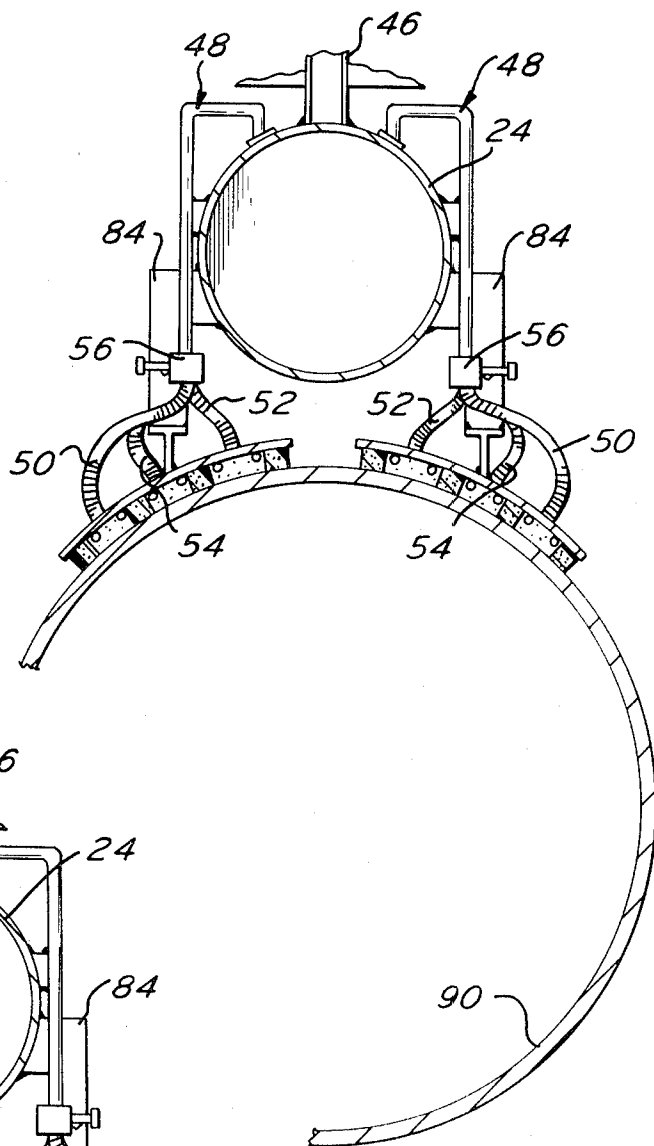
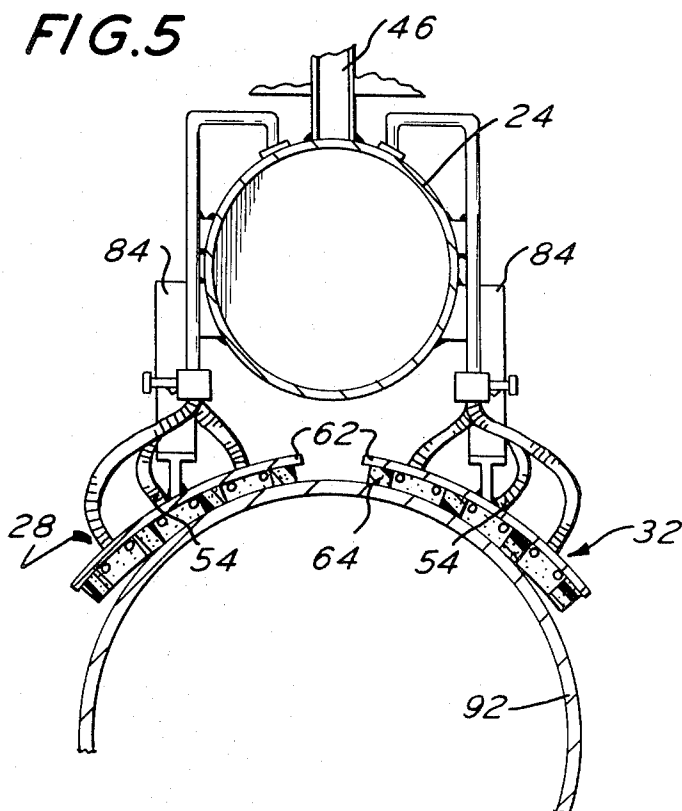


FIG. 5



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FIG. 6

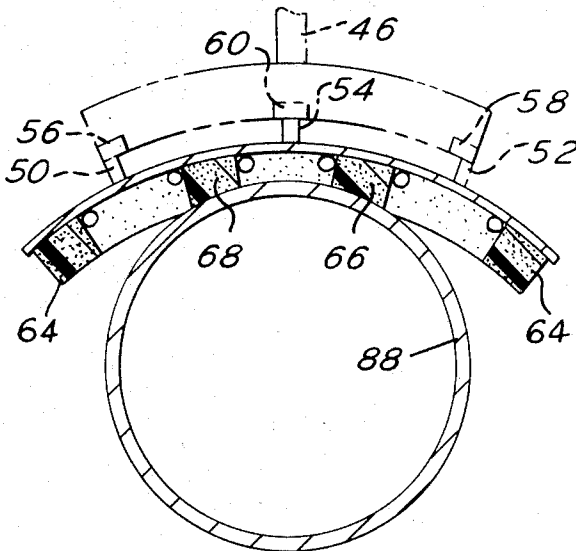
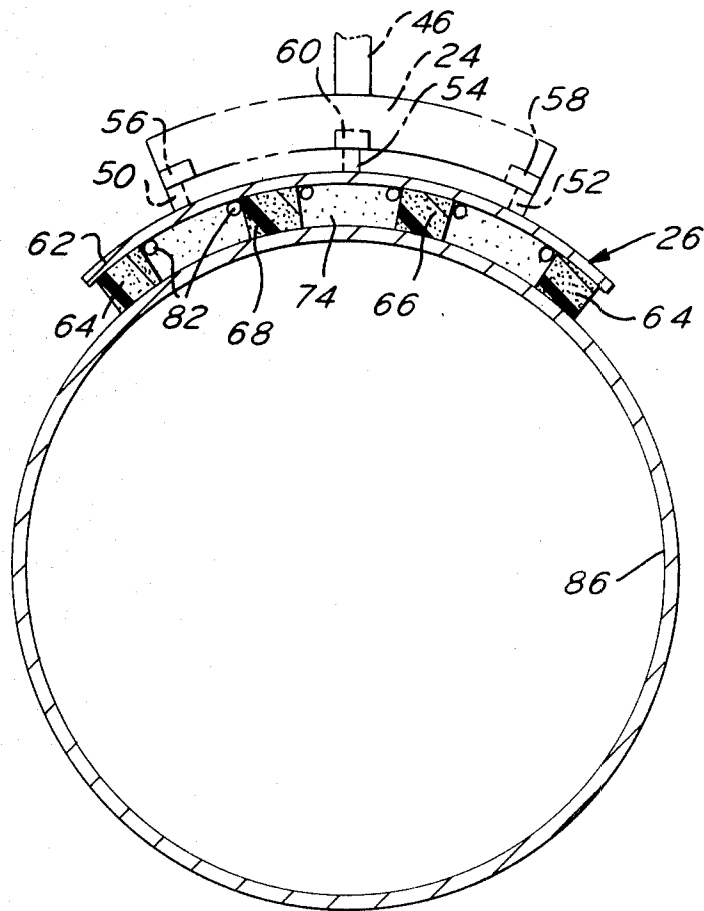


FIG. 7

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ARCULATE VACUUM LIFTER

This invention relates generally to vacuum lifters and more particularly to a vacuum lifter which is capable of handling a relatively large range of diameters of cylinders.

Vacuum lifters for cylindrical objects require arcuate concave frames which are substantially similar in diameter to the cylinder to be lifted so that a seal can be formed completely about the deformable gasket between the lifter and the surface of the cylinder. Therefore, only a small variation in the size of the diameter of the cylinder can be accommodated by a single arcuate vacuum lifter. Thus, where there is a large range of sizes of cylinders which are required to be lifted, a large number of sizes of vacuum lifters must be provided. However, it is expensive to provide a plurality of vacuum lifters where a large range of cylinders are to be lifted.

It is therefore an object of the invention to overcome the aforementioned disadvantages.

Another object of the invention is to provide a new and improved vacuum lifter which handles a large range of diameters of cylinders.

Another object of the invention is to provide a new and improved vacuum lifter which has a plurality of chambers which are selectively connected to a source of reduced pressure for lifting various sizes of cylinders.

Yet another object of the invention is to provide a new and improved vacuum lifter having an arcuate concave frame, the lifting surface of which has a peripheral sealing gasket and a plurality of intermediate sealing gaskets for forming a central chamber and two side chambers which are individually connectable to a source of reduced pressure.

These and other objects of the invention are achieved by providing a vacuum lifter having an elongated frame with an arcuate concave surface and a deformable resilient gasket secured to the concave surface about the periphery thereof. A plurality of longitudinally extending resilient gaskets are provided which extend between the ends of the peripheral gasket and are secured to the concave surface parallel to the sides of the peripheral gasket. The gaskets thereby form a plurality of longitudinally extending open chambers, each of which includes individual means defining a port for connecting the chambers to a source of reduced pressure. Means are also provided for selectively connecting all of the ports to a source of reduced pressure simultaneously and for connecting only the port of the central one of the chambers to a source of reduced pressure.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein

FIG. 1 is a side elevational view of a pipe lifter embodying the invention;

FIG. 2 is a bottom plan view of the pipe lifter embodying the invention;

FIG. 3 is a fragmentary enlarged bottom plan view of a vacuum lifter embodying the invention;

FIG. 4 is a cross-sectional view taken along the line 4-4 in FIG. 1 of the pipe lifter lifting a large diameter pipe;

FIG. 5 is a cross-sectional view taken along the line 4-4 in FIG. 1 of the pipe lifter shown lifting a pipe of an intermediate size diameter;

FIG. 6 is a diagrammatic illustration of a vacuum lifter lifting the largest diameter pipe which it can accommodate to illustrate the principle of operation of the invention; and

FIG. 7 is a diagrammatic illustration of a vacuum lifter lifting the smallest diameter of pipe which it can accommodate to illustrate the operation of the invention.

Referring now in greater detail to the various figures of the drawing wherein similar reference characters refer to similar parts, a pipe lifter embodying the invention is generally shown at 20 in FIG. 1.

The pipe lifter 20 basically comprises a vacuum pump 22, a vacuum supply tank 24 and a plurality of vacuum lifters 26, 28, 30 and 32. A pair of mounting brackets 34 and 36 includes an outwardly projecting lug 38 having an opening 40 for receiving a hook or cable to connect the pipe lifter 20 to a crane or other lifting device.

The vacuum pump 22 is pivotably supported by the mounting brackets 34 and 36 and is connected thereto by a pair of shafts 42 and 44 which extend laterally from vacuum pump 22.

The shafts 42 extend through the mounting brackets 34 and 36 and are rotatably mounted therein. Thus, the vacuum pump 22 is pivotable about the longitudinal axis of the shafts 42 and 44.

The vacuum pump 22 is pivotable secured so that it constantly maintains a horizontal disposition. Therefore, if the pipe lifter is rotated about its longitudinal axis, the vacuum pump 22 maintains the same disposition relative to the ground so that the engine therein is not inadvertently expunged.

The vacuum pump 22 is connected via a pipe 46 to the tank 24. As best seen in FIG. 4, tank 24 acts as a reservoir for the partial vacuum produced by the vacuum pump 22.

The vacuum supply tank 24 is connected via four sets of pipes 48, each of which is connected to one of the vacuum lifters 26 through 32. Each set of pipes includes three individual pipes 50, 52 and 54 which are selectively connected by valves 56, 58 and 60, respectively, to the vacuum lifters 26 through 30.

As best seen in FIGS. 2 and 5, each of the vacuum lifters basically comprises an arcuate frame having opposed parallel arcuate surfaces. Attached to the concave arcuate inner surface of the frame 62 is a first deformable resilient sealing gasket 64 which extends about the bottom concave surface of the plate 62. A pair of longitudinally extending deformable resilient sealing gaskets 66 and 68 extend from one end 70 of the sealing gasket 64 to the other end 72 of sealing gasket 64 and are secured to the concave surface of the vacuum lifter parallel to the sides 78 and 80 of sealing gasket 64. The gaskets define three distinct open chambers underneath the frames 62 of the vacuum lifters 26 through 32.

As best seen in FIG. 3, a pair of transversely extending deformable resilient sealing gaskets 74 and 76 are also provided which extend from one side 78 of sealing gasket 64 to the other side 80. Gaskets 74 and 76 extend parallel to ends 70 and 72 of sealing gasket 64 and are secured to the concave surface of the frame.

Gaskets 74 and 76 separate each of the three open chambers formed by gaskets 64, 66 and 68 into three subsections or compartments. The gaskets 74 and 76 further include tubes 82 which define fluid passage means from the central compartments of the individual chambers to the end compartments thereof.

The tubes 82 enable all of the compartments of an open chamber to be in constant fluid communication with each other.

There are thus three individual chambers provided beneath the plate 62 on the concave surface thereof. A first side chamber is formed between side 78 of sealing gasket 64 and sealing gasket 68. A second central chamber is formed between gaskets 66 and 68 and a third side chamber is formed between gaskets 66 and side 80 of gasket 64. Each of the chambers is completely separated from the others.

A port is defined in each of the chambers by one of pipes 50, 52 and 54. Pipes 50 and 52 are each connected to one of the side chambers and pipe 54 is connected to the central chamber.

Each of the chambers is divided into three subsections or compartments by the gaskets 74 and 76 which include fluid passage means 82 which are smaller in aggregate area than the port defined in each of the chambers by the pipes 50, 52 and 54, respectively.

The central compartment of each of the chambers acts to be reduced in pressure more quickly than the end sections of the

chambers in that the area of the port defined by the pipes entering the chambers is larger than the aggregate area of the tubes connecting the central section to the end sections.

As seen in my U.S. Patent No. 3,227,481 issued on Jan. 4, 1966, these gaskets 74 and 76 facilitate sealing and securing of the vacuum lifters 26 through 32 to the cylinder which is lifted thereby.

Each of the chambers is individually connected to the source of vacuum supply by one of the pipes 50, 52 and 54 via valves 56, 58 and 60, respectively. Each of the valves 56, 58 and 60 is selectively actuatable. When the valves are opened, the chambers are connected to the source of vacuum supply. When the valves are closed, the chambers are disconnected from the source of vacuum supply. Each of the valves is individually operable and manually actuatable. Solenoid valves or other automatic valves may also be used.

Thus, either all of the chambers can be connected to the vacuum supply or one of the chambers can be connected to the vacuum supply at a time. As will hereinafter be seen, this feature enables a larger variation in the range of sizes of cylinders which can be lifted by the vacuum lifter embodying the invention.

Each of the vacuum lifters 26 through 32 depends from the bottom of vacuum tank 24 and is secured thereto by a pair of pivotable mounting brackets 84 which are secured to the lower surface of the tank 24. The pivotable mounting brackets 84 support the vacuum lifters and enable the vacuum lifters to be pivotable against the surface of the cylinder to be lifted so that maximum alignment of the frames 62 of the vacuum lifters with the surface of the cylinder is facilitated.

The principle of operation of the invention is best seen in FIGS. 6 and 7. FIG. 6 is a diagrammatic illustration of a vacuum lifter being used for the maximum size cylinder which it is adapted to lift. In FIG. 7, the vacuum lifter is diagrammatically illustrated in operation with the smallest diameter of cylinder which the vacuum lifter is adapted to lift. For ease of reference, the vacuum supply tank 24, the pipe 46, valves 54, 56 and 58, and pipes 50, 52 and 54 are diagrammatically illustrated in phantom in FIGS. 6 and 7.

It should be noted that the radius of curvature of the frame 62 of the lifter is substantially equal to the radius of curvature of the surface of the largest cylinder which the vacuum lifter is designed to lift. The frame is therefore substantially similar in curvature to assure that the sealing gasket 64 is substantially parallel to the surface of the cylinder when lifting the largest diameter of cylinder which the lifter can accommodate.

Thus, when lifting a large diameter cylinder 86, each of the valves 56 through 60 is open so that the three chambers of the vacuum lifter are connected to the source of reduced pressure. In view of the closeness in fit of the sealing gasket 64 entirely about the periphery thereof, each of the three chambers is easily sealed when the vacuum supply is connected thereto.

In this respect, with all three pipes 50, 52 and 54 connecting the three chambers to the source of vacuum supply, the vacuum lifter 26 can accommodate a range of pipes which vary several inches in diameter. For example, it has been found in experiments that if the radius of curvature of the frame 62 is the same as that of a cylinder of 42 inches in diameter, the vacuum lifter can accommodate, with all three chambers connected to the vacuum supply, cylinders having diameters in a range of approximately 31 inches to 42 inches.

When the cylinder is of a smaller diameter than 31 inches, the vacuum lifter 26 can accommodate the cylinder by having the valves 56 and 58 closed and thereby enabling only pipe 54 which leads to the central chamber to be opened to the vacuum supply. Thus, a small diameter pipe 88 is lifted with only the central chamber of the vacuum lifter connected to a source of reduced pressure. It can be seen that the gaskets 64, 68, 74 and 76 are deformable enough to accommodate the deviation between the arc of the lifter and the arc of cylinder 88. Thus, where the largest diameter that can be accommodated by the lifter with three chambers connected to a source of reduced pressure is 42 inches, a cylinder as small as

24 inches can be lifted by connecting the central compartment alone to the source of vacuum supply. The sealing gaskets 66, 68 and the ends 70 and 72 of sealing gasket 64 are deformed to accommodate the curvature of the cylinder and seal the central chamber of the lifter.

Referring to FIG. 4, the pipes 50, 52 and 54 of each set 48 are connected to the vacuum supply tank 24 via valves 56, 58 and 60, respectively, in order to lift the pipe 90 which is of relatively large diameter. The pipe 90 is secured by each of the vacuum lifters 26 through 32, each of which is placed against the top surface thereof.

The vacuum supply is then provided via pipes 50, 52 and 54 to each of the chambers. The pressure in the central compartment of each chamber is reduced and thereby enables atmospheric pressure to urge the vacuum lifters to the pipe and seal the gaskets about the end compartments of the chamber. The tubes 82 then enable the pressure in the end compartments to be reduced. The reduced pressure in the open chambers beneath the frames 62 of the vacuum lifters enables the pipe lifter 20 to lift the pipe 90.

Referring to FIG. 5, the pipe lifter 20 is seen in operation lifting a pipe 92 which is relatively small in diameter. The valves 56 and 58 of pipes 50 and 52 are closed and only the valve 60 of pipe 54 of each of the vacuum lifters 26 through 32 is open. The vacuum lifters are set upon the pipe 92 and the pipes 54 are connected to the source of reduced pressure. The pressure in the central compartment of the central chamber of each of the vacuum lifters is reduced causing atmospheric pressure to urge the vacuum lifters against the surface of pipe 92. The gaskets about the end compartments of the central chamber are sealed and the pressure in the end compartment is reduced via tubes 82.

Thus, only the central chambers of lifters 26 through 32 are utilized in order to lift the pipe 92.

It should be understood that the size of the vacuum lifter may be varied in accordance with the range of sizes of cylinders that the lifter is designed to lift. The largest diameter of cylinder that the lifter is designed for determines the radius of curvature of the frame of the vacuum lifters.

The gasket material should have been deformable characteristics to accommodate at least a 1/8-inch deviation between the arc of the lifter and the arc of the cylinder.

Without further elaboration, the foregoing will so fully illustrate my invention that others may, by applying current or future knowledge, readily adapt the same for use under various conditions of service.

What I claim as my invention is:

1. A vacuum lifter comprising an elongated frame having an arcuate concave surface and a deformable resilient gasket secured to said concave surface about the periphery thereof and a plurality of longitudinally extending deformable resilient gaskets, said longitudinal gaskets being parallel to each other and extending from one end of said peripheral gasket to the other end, said gaskets thereby forming a plurality of longitudinally extending open chambers, each of said chambers being connected by a separate fluid passage to a source of reduced pressure, said fluid passages being connected to said source of reduced pressure via selectively actuatable valves so that a cylinder of a diameter substantially equal to the diameter of said arcuate concave surface is lifted when all of said valves are open and a cylinder of substantially smaller diameter than the diameter of said concave surface is lifted when only the one valve connected to the central one of said chambers is open.

2. A pipe lifter comprising a plurality of vacuum lifters as set forth in claim 1, said lifters being pivotably secured to an elongated tank which acts as a reservoir for said vacuum supply, said vacuum lifters each being pivoted against the surface of a cylinder for lifting thereof.

3. The invention of claim 2, wherein a vacuum pump for creating said vacuum supply is secured to the tank, said vacuum pump, tank and vacuum lifter being lifted together with a load.

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4. A vacuum lifter comprising an elongated frame having an arcuate concave surface and a deformable resilient gasket secured to said concave surface about the periphery thereof and a plurality of longitudinally extending deformable resilient gaskets, said gaskets extend between the ends of said peripheral gasket, said gaskets forming a plurality of longitudinally extending parallel open chambers, each of said chambers including means defining a port for separately connecting said chambers to a source of reduced pressure and means for selectively connecting all of said chambers to a source of reduced pressure simultaneously or connecting only one of

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said chambers to a source of reduced pressure, each of said open chambers includes transversely extending gaskets for dividing said chambers into a central and two end compartments, said transversely extending gaskets having fluid passage means for connecting said central compartment to said end compartments.

5. The invention of claim 4, wherein the aggregate area of said fluid passage means is smaller in area than the means defining a port, said means defining a port being located in said central compartment of said chamber.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,591,227

Dated July 6, 1971

Jacob J. Creskoff

It is certified that errors appear in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

- (1) Abstract - second line from the bottom "to" should be --by--.
- (2) Column 1, line 54 after the word "wherein" insert a colon (:).
- (3) Column 2 paragraph 1, should be changed to read as follows:

--The pipe lifter 20 basically comprises a vacuum pump 22, a vacuum supply tank 24 and a plurality of vacuum lifters 26, 28, 30 and 32. A pair of mounting brackets 34 and 36 are secured to the top of tank 24. Each of the brackets 34 and 36 include an outwardly projecting lug 38 having an opening 40 for receiving a hook or cable to connect the pipe lifter 20 to a crane or other lifting device--

Signed and sealed this 28th day of December 1971.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Acting Commissioner of Patents