Nov. 7, 1967 J. E. OLSON 3,351,370

VACUUM BARREL HANDLERS

Filed July 19, 1965 4 Sheets-Sheet 1

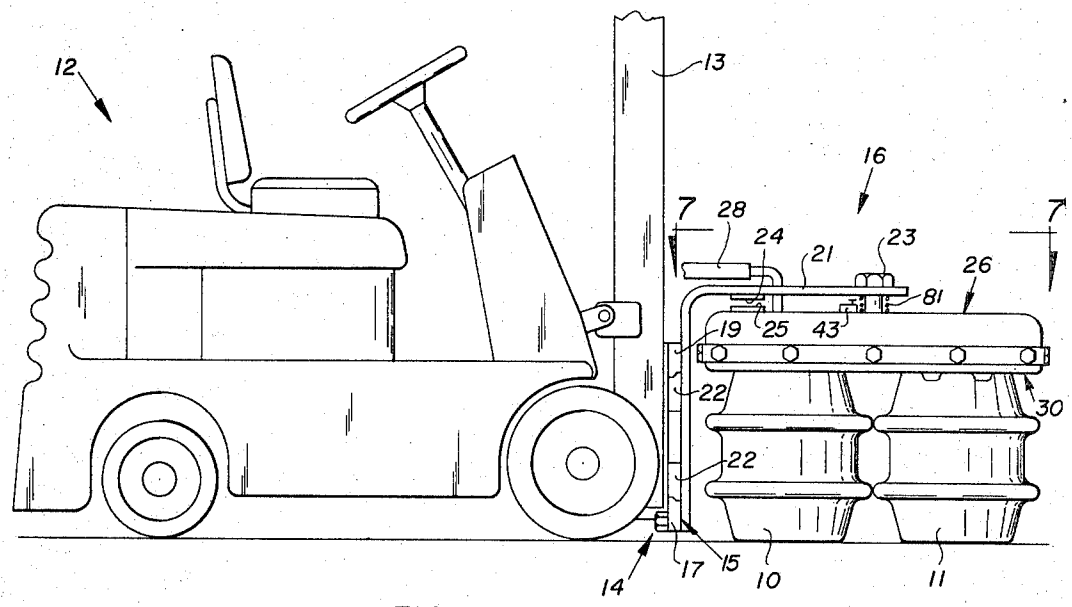


FIG. 1

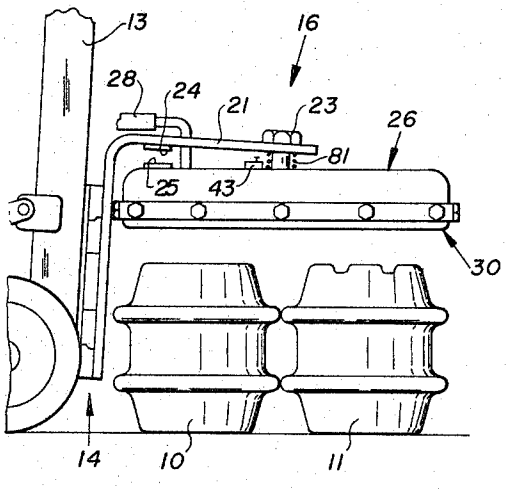


FIG. 2

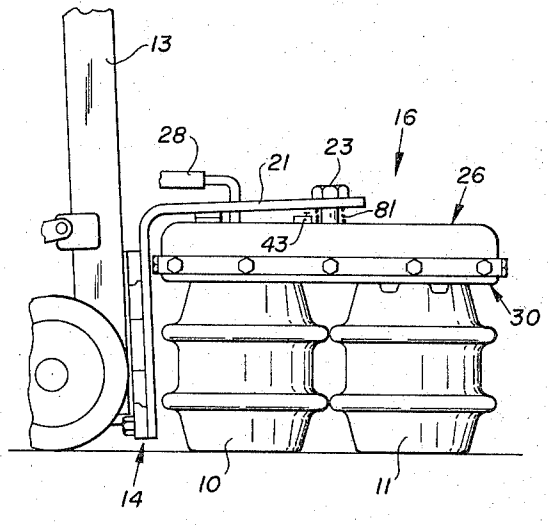


FIG. 3

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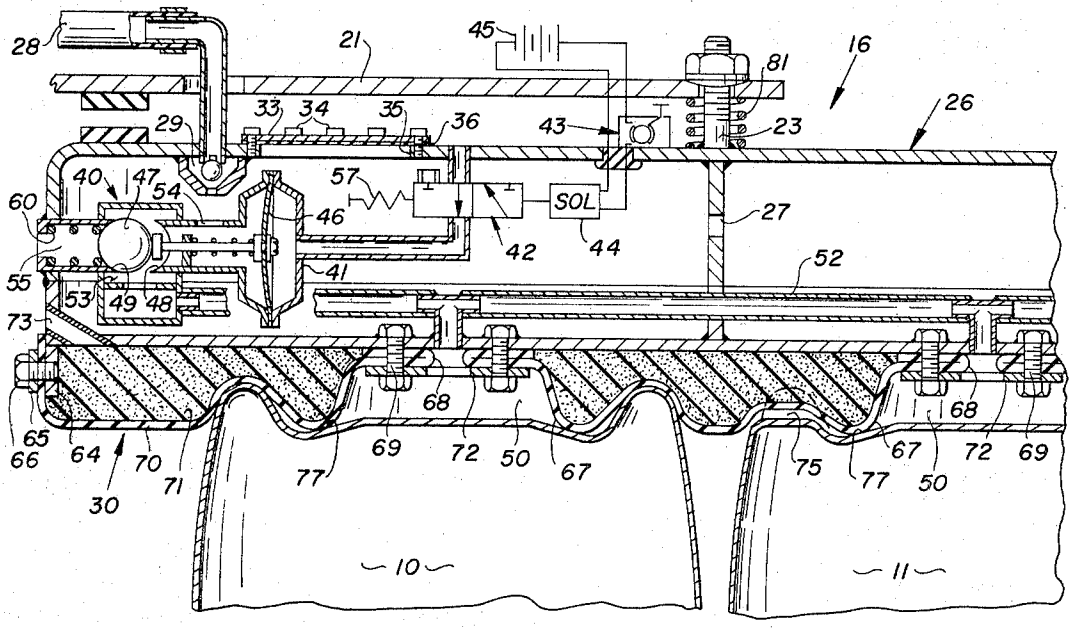


FIG. 4

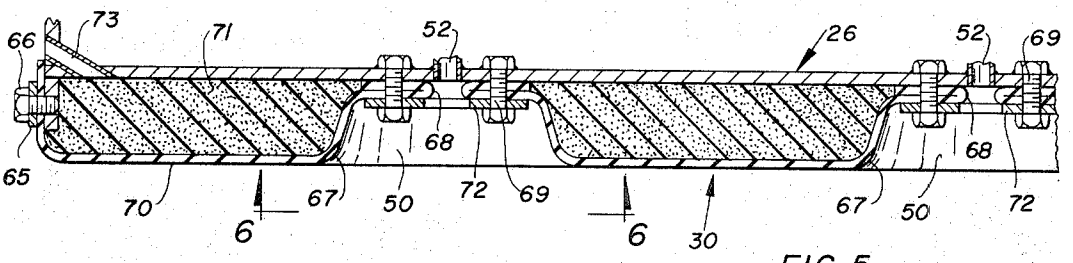


FIG. 5

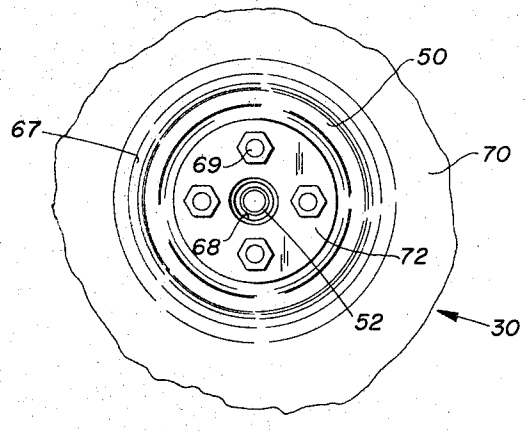


FIG. 6

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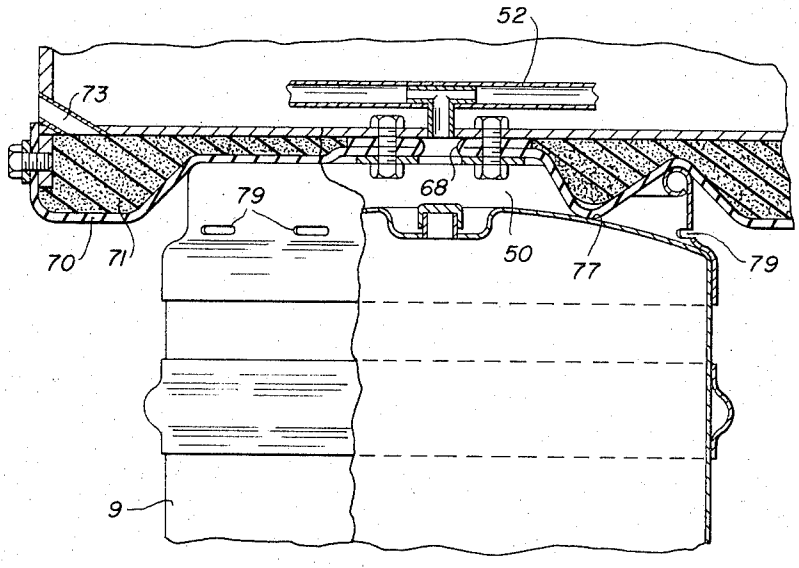


FIG. 4A

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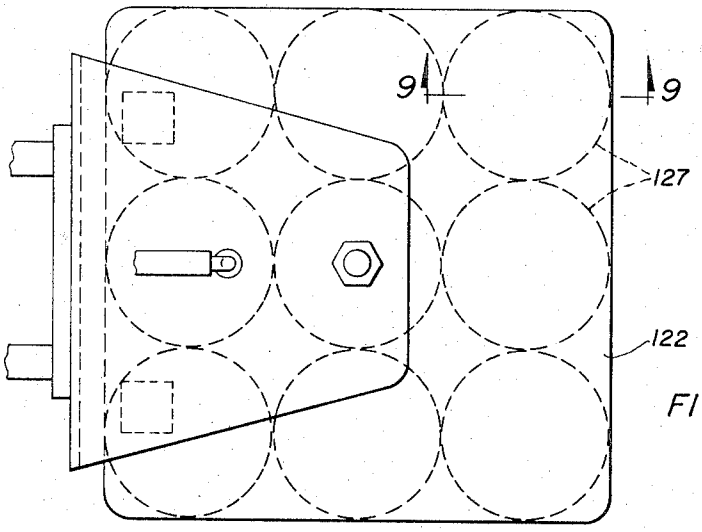


FIG. 8

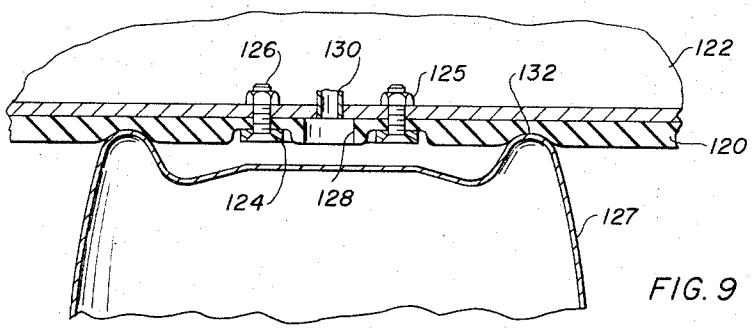


FIG. 9

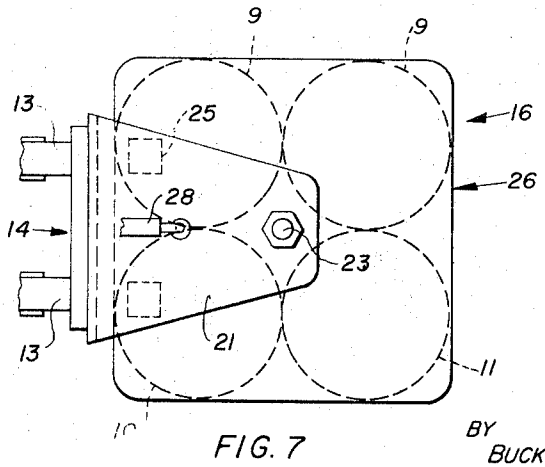


FIG. 7

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VACUUM BARREL HANDLERS

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Filed July 19, 1965, Ser. No. 472,768
20 Claims. (Cl. 294—64)

This invention relates to vacuum article handlers, and more particularly to vacuum barrel handlers.

An object of the invention is to provide new and improved vacuum article handlers.

Another object of the invention is to provide new and improved vacuum barrel handlers.

A further object of the invention is to provide a vacuum particle handler adapted to engage simultaneously the upper ends of a plurality of like particles, lift the articles and transport the articles to a desired location, and particularly to provide in such a handler a vacuum head construction which is floatingly supported during the initial contact thereof with an article and which is rigidly supported while carrying the article.

Another object of the invention is to provide a vacuum head adapted to sealingly engage a barrel with a serrated or otherwise unsealable projecting rim.

Another object of the invention is to provide a vacuum head comprising a thin and flexible membrane for contacting with the article to be picked up, which is subject to full atmospheric pressure on its upper side in order that the membrane might most effectively seal over irregularities in contour of the article.

Another object of the invention is to provide a vacuum head adapted to take full advantage of the Venturi effect of air rushing through initial leakage spots in the contact area.

Yet another object of the invention is to provide a padded vacuum head adapted to engage and conform to a serrated or indented rim of a barrel.

A still further object of the invention is to provide a vacuum head having an accumulator therein adapted to be connected to an article-engaging portion thereof.

Another object of the invention is to provide an article handler having control means operable by a vacuum head when the latter engages an article to automatically create a vacuum in the head to cause the article to be securely engaged thereby.

A further object of the invention is to provide a vacuum head having an article-engaging portion supported by an accumulator tank having piping and valving enclosed therein.

The invention provides vacuum article handlers having article engaging heads. Each head preferably includes padded article engaging portions carried by an accumulator tank in which are mounted manifold means and valving adapted to connect the article engaging portions to the tank. The article engaging portions may comprise an impervious resilient membrane on one face of a resilient pad and adapted to conform to and seal to uneven surfaces of articles to be gripped thereby. Preferably the entire other face of the pad is subjected to atmospheric pressure. Preferably the head actuates a control mechanism to automatically connect the accumulator tank to the article engaging portions when the latter are moved into firm engagement with articles and to automatically relieve the vacuum in the article engaging portions when articles carried thereby are set down.

A complete understanding of the invention may be obtained from the following detailed description of vacuum article handlers forming specific embodiments thereof, when read in conjunction with the appended drawings, in which:

FIGS. 1, 2 and 3 are side elevation views of a vacuum article handler forming one embodiment of the invention with parts thereof in different positions;

FIG. 4 is an enlarged, fragmentary vertical section, partially schematic, of the vacuum article handler of FIG. 1;

FIG. 4A is an enlarged, fragmentary vertical section of the vacuum holder article handler of FIG. 1;

FIG. 5 is a view similar to FIG. 4 but without barrels engaged by a vacuum head of the vacuum article handler;

FIG. 6 is an enlarged, bottom plan view taken substantially along line 6—6 of FIG. 5;

FIG. 7 is an enlarged, top plan view taken substantially along line 7—7 of FIG. 1;

FIG. 8 is a top plan view of a vacuum article handler forming an alternate embodiment of the invention; and

FIG. 9 is an enlarged, fragmentary vertical section taken along line 9—9 of FIG. 8.

Referring now in detail to the drawings, the vacuum article handler shown in FIGS. 1 to 6 is adapted to engage, lift, carry, lower and release a large number of articles, such as, for example, kegs or barrels 9, 10 (FIG. 4A), and 11 (FIG. 1) and includes a lift truck 12 having a known tiltable mast 13 carrying a carriage 14 which may be raised or lowered as desired by power of the truck as controlled by the operator of the truck. A vacuum lift attachment 16 is detachably secured to the carriage and includes an L-shaped triangular arm 21 (FIGS. 1–3) mounted detachably on the bars 22 of the lift truck carriage 14 by bracket portion 15, a detachable bar 17 and a fixed bar 19. At the apex of the triangular arm, a hanger bolt 23 is mounted loosely in a bore in the arm. Two pads 24 at the other corners of the triangular arm are provided for engagement with pads 25 mounted on the top side of an accumulator tank 26, which acts as a rigid frame to support a padded or cushioned contact member or vacuum head 30. The hanger bolt 23 is rigidly secured to the top of the tank substantially directly over the center of gravity of the tank and the load carried by the head. When approaching the load, which, for the vacuum head 30, comprises four of the barrels 9, 10 and 11 arranged in two closely spaced rows with two barrels in each row, the mast of the lift truck is tilted forward, which causes a separation between the pads 24 and 25 and thus leaves the vacuum head free to adjust itself in any direction to accommodate the heads of the barrels to be picked up. After the load is picked up, the upper end of the mast is tilted back until the pads 24 and 25 contact each other, which stabilizes the load.

The accumulator tank 26 is large and its bottom is planar and substantially of the same length and width as the vacuum head 30 which is mounted on the lower side of it, the planar bottom of the tank forming a rigid frame or rigid backing plate for the vacuum head. The length and width of the bottom of the tank are somewhat greater than necessary to fully cover four barrels, as best illustrated in FIG. 3. The tank is reinforced inside with struts 27 (FIG. 4) which prevent it from collapsing, and is connected by a hose 28 to a source of vacuum (not shown), which may be the manifold of the engine of the lift truck. A check valve 29 is provided at the entrance of the tank to prevent loss of vacuum when the source of vacuum temporarily stops functioning. A cover plate 33 detachably secured by capscrews 34 to the top of the tank in a position covering access opening 35 compresses sealing gasket 36 to seal the opening. The cover plate may be opened for mounting valving, piping and controls in the tank and maintenance of these elements. If desired, instead of the cover plate, the tank may be in two sealed, separable sections to provide access to the interior thereof.

A shuttle valve 40 (FIG. 4) is operated by a vacuum actuator 41 which in turn is controlled by a solenoid valve 42, the valves 40 and 42 and the actuator 41 being

mounted in the tank. The solenoid valve is operated by a push-push sequencing switch 43. When the vacuum head 30 is first lowered onto the heads of the barrels 9, 10 and 11, with the head 30 fully covering the group of four barrels and four indentations 50 in the head being roughly centered relative to the barrels, the arm 21 moves down with respect to the sequencing switch 43 and actuates it to complete the circuit between a solenoid 44 and battery 45. This causes the valve 42 to expose a diaphragm 46 in the vacuum actuator 41 to atmospheric pressure on one side with the result that the diaphragm moves toward the ball 47 unseating it from a seat 48 and seating it on a seat 49. Thus, ambient pressure which had been admitted to the body of the valve 40 and, hence, to the indentations 50, is cut off and air from the indentations 50 is free to pass through a manifold 52, the seat 48 and an aperture 54 into the accumulator. Because the valve 40 itself is in the accumulator so that the manifold, which has a low volume relative to that of the tank, is short, the air rushes out of the indentations 50 at high velocity. This, as will be described later, contributes to the sealing of a membrane 70 where it passes over irregularities in contour of the barrel. The volume of the accumulator tank is so great, as compared to the combined volume of the indentations 50 and the manifold, that vacuums are drawn almost immediately at the indentations 50. Because of the great difference in these volumes, there is very little increase in pressure in the accumulator and it makes no difference whether the vacuum source is operating at the moment or not.

As soon as the pressure within the indentations 50 has been equalized to that of the accumulator tank 26, the barrels may be raised and transported. When the barrels are set down, the carriage 14 (FIG. 1) can be lowered a short distance after the barrels are on the floor to actuate the sequencing switch 43 (FIG. 4) in its second phase to break the circuit and allow a spring 57 to pull the spool of the valve 42 into discharge position to open the diaphragm chamber to the low pressure of the accumulator tank. This will pull the diaphragm 46 to the right, as viewed in FIG. 4, and will allow spring 60 to move the ball 47 to the seat 48. This allows ambient atmospheric pressure to enter the valve body 53 through the port 55 and immediately break the vacuum in the indentations 50 to release the barrels.

On the under side of the accumulator tank 26 is the padded or cushioned contact member or head 30, which includes an air impervious, resilient, stretchable, elastomer membrane 70 not adhered to but stretched over an air pervious, resilient, foam rubber pad or cushion 71. At intervals in the contact member there are the indentations 50 surrounding holes 68 in the membrane and pad. Each of the indentations is generally of the shape of a shallow circular pan and has an outwardly flared rim portion 67. The indentations are produced by annular plates 72 secured by bolts 69 in positions surrounding and compressing the membrane and the adjacent portion of the foam rubber pad. The peripheral edge portion of the membrane is sealingly clamped against a continuous flange or rim 64 of the tank 26 by a band 65 secured to the flange by capscrews 66. The space occupied by the foam rubber pad is vented by spaced openings 73 to the atmosphere so that a pressure, atmospheric pressure, much higher than that of the air in the indentations 50, will be exerted at all times on the upper side of the membrane 70 to cause it to conform more closely to the tops of the barrels to be handled, the pressure in the indentations 50 when htey are connected to the interior of the accumulator tank being about one-half of that of the atmosphere or lower. The pad has enough stiffness to force the membrane into a preliminary light sealing contact with the barrel inside the upper rim of the barrel. The main surface of the outside of the membrane is substantially planar prior to contact with the articles to the end that sealing will be effective almost anywhere. However, the gaps caused by indentations smaller than the notches 75 in the rim of the barrel are closed by the pad of this construction because of the initial pressure of the pad, followed up abruptly by the pressure surge. If we assume that the initial contact, caused by the physical pressure of the pad alone, does not quite seal at notches 75, then a high velocity rush of air occurs through the small unsealed openings between. The natural result of this, which is demonstrated in all Venturis, is a low pressure. Thus, we have a very low pressure acting on the bottom of the membrane and a full atmospheric pressure acting on the top of the membrane. The result of this is that the membrane, which under this unique construction is quite thin and flexible, is immediately depressed into a tight sealing contact. This ties in with the accumulator because it takes a quick surge of air to get the velocity necessary to produce the Venturi effect. The membrane also may be stretched slightly away from the pad by the differential pressure to improve the seal between the membrane and the barrel. This is best shown in FIG. 4A. The membrane, when in contact with the barrels and with the vacuum in the indentations 50, is, in effect, a deformable, inflated container, the bottom of the tank forming the top of the container and the container being filled or inflated with the pad and air at the higher pressure of the atmosphere. If desired, the openings 73 may be omitted and the container filled with air at a pressure as high as or even somewhat higher than that of the atmosphere.

If the top of the barrel to be handled is a continuous ring as illustrated by barrel 10, as viewed in FIG. 4, the soft backing of the membrane 70 by the sponge rubber pad 71 would hardly be necessary. However, many barrels and kegs, illustrated by barrel 11, have a series of notches, castellations or depressions 75 around the rim. The depressions 75 are often so formed that it is difficult or impossible to cause even the cushioned contact member to make sealing contact all around in spite of the pressure difference acting on the membrane, as illustrated in FIG. 4 where, it will be observed, that membrane 70 does not touch the bottoms of the notches. However, the contact member does sealingly engage the head of the barrel inside the rim to form a closed circular line or band contact 77. If the barrel is of the type of the barrel 9 shown in FIG. 4A it is apparent that the membrane would have to seal at some place such as the contact band 77 inside the raised rim, because perforations 79 would allow air to enter under the seal even if contact were perfect at the top of the rim. The maximum diameter of each indentation 50 is substantially smaller than the diameter of the head of each barrel so that all portions of the band contact 77 will be well inside the rim of the barrel even if the indentation 50 is far off center relative to the barrel. The diameter of each indentation 50 can be substantially less than that shown in the drawings, if desired, to give an even wider margin in aligning the indentation with the barrel and still provide a much stronger than necessary lifting or gripping force on the barrel.

When it is desired to pick up a barrel, or several barrels, the vacuum head is pressed down hard on the barrels with the result that the membrane 70 will form the line contacts 77 with the respective barrels. In certain cases, I find it desirable to have a spring 81 surrounding the bolt 23 between the top of the accumulator 26 and the arm 21. The spring is made strong enough to allow considerable pressure to be developed by the arm 21 before the switch 43 is actuated. This assures optimum deformation of the spongy pad 71 before the valve ball 47 is moved off the seat 48 to allow air to be drawn from the indentations 50 into the accumulator. This creates a vacuum in each indentation and causes the membrane to sealingly contact the head of the barrel at the closed circular line contacts 77 even though ambient air might pass between the barrel and the membrane at the notches 75 or through the perforations 79. It should be noted that when the vacuum

head is not in contact with the barrel, the membrane **70** will lie in a plane broken only by the indentations **50** and, therefore, it is not necessary to place the indentations precisely over the center of each barrel. It will be noted from FIG. 4 that a great margin of error can be tolerated. The spring **81** also tends to hold the tank away from the arm **21** so as to prevent actuation of the switch **43** from jars or bumps.

Embodiment of FIGS. 8 and 9

The vacuum article handler shown in FIGS. 8 and 9 is generally similar to the vacuum article handler of FIGS. 1 to 7, but has a thinner, less cushioned contact member or membrane **120**, which preferably is of an air impervious, somewhat resilient, elastomer material and is of sheet-like form. The member **120** is mounted directly on the bottom of accumulator tank **122** by annular plates **124**, nuts **125** and bolts **126**. Also, the vacuum handler of FIGS. 8 and 9 is shown as adapted to carry nine barrels or kegs **127** while the handler of FIGS. 1 to 7 is of a size adapted to carry four kegs **9**, **10** and **11** though, of course, the vacuum handler of FIGS. 1–7 may be of the larger size if desired. Holes **128** lead to manifold pipes **130**, which may be selectively connected to the tank **122** and the atmosphere by valving (not shown) like the valves, **29**, **40** and **42**. The member **120** is impervious to air and is cushioned suffiicently to sealingly engage unnotched rims **132** of the kegs **127**, the member **120** being sufficiently resilient to conform to the upper portion of the rim **132** completely therearound to form an excellent sealing contact therewith.

The above described vacuum article handlers quickly and strongly grasp the barrels. These handlers automatically grip the barrels and automatically release the barrels merely by lowering them. By using the accumulator tanks as the frames of the vacuum heads, no accumulator tanks on the chassis of the lift trucks are needed.

While the article handlers described above are designed to engage and lift only loads in which all of the openings in the heads are closed by a full number of barrels for each load, the article handlers may be provided with volume responsive check valves in each of the branches of the manifolds each adapted to close off the branch of the manifold leading to one of the vacuum head holes which is not over an article to be lifted. A valve well suited for such use is that disclosed in my U.S. Patent 3,147,872.

It is to be understood that the above-described arrangements are simply illustrative of the application of the principles of the invention. Numerous other arrangements may be readily devised by those skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. A vacuum head for picking up through sealing contact an article having a projecting, non-sealable outer rim, comprising:

a rigid back-up member with a periphery beyond the limits of the article to be picked up, and a hole within said limits,

an impervious, flexible membrane sealingly fastened to said member adjacent said periphery and adjacent said hole,

a pervious pad substance between said back-up member and said membrane,

means creating a predetermined pressure on the face of said membrane adjacent said pad substance, and

means to create a pressure between said membrane and said article substantially lower than said predetermined pressure to cause said predetermined pressure to force said membrane into tight sealing contact with said article inside the said outer rim.

2. The vacuum head of claim **1** wherein said pad is sufficiently stiff to force said membrane into a preliminary light sealing contact with said article inside said outer rim.

3. The vacuum head of claim **1** wherein the main surface of the outside of said membrane is substantially planar prior to contact with said article to the end that sealing is effective almost anywhere.

4. In combination,

a pad of pervious, spongy, resilient material,

a membrane of impervious material positioned on one face of the pad,

a rigid, plate-like member engaging the other face of the pad,

annular means for clamping annular portions of the pad and the membrane to the member and forming an indentation in the pad and the membrane,

the portions of the pad, the membrane and the member inside the annular means having holes therethrough,

means for effecting relative pressing movement between the member and the end of a keg with the holes generally centered relative to the keg to press the membrane against a rim and a head of the keg, and

means for withdrawing air from the holes.

5. The combination of claim **4** wherein the member has a hole therethrough connecting the inner face of the membrane to the atmosphere.

6. In combination,

a rigid plate-like member having a plurality of spaced holes therethrough,

a pad of resilient material having one face lying on one face of the plate and having a plurality of holes therethrough aligned with the holes in the plate,

an impervious membrane having a plurality of holes therethrough,

means securing the edge portions of the membrane to the member in a position of the membrane in which the membrane covers the other face of the pad and the edge portions of the membrane cover the edges of the pad and the holes in the membrane are aligned with the holes in the pad and member,

annular clamping means engaging the portions of the membrane surrounding the holes and compressing the portions of the pads surrounding the holes to form indentations, and

means for withdrawing air from the holes.

7. In combination,

a shallow manifold tank having a bottom wall provided with a plurality of spaced openings therethrough,

resilient sheet means covering the exterior face of the bottom wall and having openings coincident with the openings in the bottom wall,

a valve body mounted in the tank and having a first opening, a second opening to the atmosphere and a third opening to the interior of the tank,

manifold means connecting the first opening in the valve body to the openings in the bottom wall,

valve means movable between a first position closing the second opening from the first and third openings and connecting the first and third openings and a second position connecting the first and second openings and closing the third opening therefrom, and

control means for moving the valve means between the first and second positions thereof.

8. In combination,

a rigid plate-like member having a plurality of spaced holes therethrough,

a pad of resilient material having one face lying on one face of the plate and having a plurality of holes therethrough aligned with the holes in the plate,

an impervious membrane having a plurality of holes therethrough,

means securing the edge portions of the membrane to the member in a position of the membrane in which the membrane covers the other face of the pad and

the edge portions of the membrane cover the edges of the pad and the holes in the membrane are aligned with the holes in the pad and member,

annular clamping means engaging the portions of the membrane surrounding the holes and compressing the portions of the pads surrounding the holes to form indentations, and

means for withdrawing air from the holes.

9. In combination,

an arm,

a vacuum head,

means suspending the vacuum head from the arm for limited relative movement therebetween,

vacuum creating means,

valve means operable when in a first condition to connect the vacuum creating means to the vacuum head and when in a second condition to connect the vacuum head to the atmosphere, and

means operable alternately by alternate movements of the arm toward the head for actuating the valve means alternately to the first condition and the second condition thereof.

10. In combination,

a pad of pervious, spongy, resilient material,

a flexible, resilient membrane of impervious material mounted on one face of the pad,

a rigid, plate-like member engaging the other face of the pad,

annular means for clamping annular portions of the pad and the membrane to the member and forming an indentation in the pad and membrane,

the portions of the pad, the membrane and the member inwardly of the annular means having holes therethrough,

means for pressing the member toward the end of a keg with the holes generally centered relative to the keg to press the membrane against a rim and a head of the keg,

an accumulator under vacuum in close proximity to said indentation,

means for applying ambient pressure on the side of said membrane adjacent said plate, and

means for suddenly opening communication between said accumulator and said indentation so that ambient air outside said indentation will rush between said membrane and said keg to cause maximum differential air pressure between opposite sides of said membrane in order that the membrane will seal to the keg.

11. The combination of claim **10** wherein the said means for opening communication is automatically triggered by a predetermined contact force between said membrane and said keg.

12. In combination,

a generally horizontal lifting arm,

a downwardly facing vacuum head,

means connecting the central portion of the vacuum head to the arm for limited pivotal movement therebetween about a pair of normal horizontal pivot axes to permit the vacuum head to move into substantial alignment with an article therebelow as the vacuum head is moved downwardly by the arm into engagement with the top of the article,

means for applying a vacuum to the vacuum head,

means for raising the arm to lift the head and the article and for tilting the arm in a generally vertical plane, and

mutually engageable stop means on the arm and the head operable when the arm is tilted to prevent further pivotal movement of the head relative to the arm about both pivot axes.

13. Apparatus according to claim **1** including means for moving said back-up member toward and away from an article to be picked up for engaging said membrane with the article,

valve means for connecting said hole to a source of vacuum, and

control means operable by movement of the membrane into engagement with an article to actuate the valve means to connect the source of vacuum to said hole.

14. In combination:

vacuum head means,

moving means for moving the vacuum head means into engagement with an article to be lifted,

lost motion means connecting the vacuum head means to said moving means,

evacuating means,

valve means for connecting the evacuating means to the vacuum head means,

control means operable by movement of the vacuum head means into engagement with an article to actuate the valve means to connect the evacuating means to the vacuum head means,

said control means being positioned on either the vacuum head means or the moving means in a position for actuation, when lost motion occurs between said vacuum head means and said moving means.

15. Apparatus according to claim **1** including an accumulator tank,

said vacuum head being mounted on the accumulator tank,

said means to create a pressure between said membrane and said article including means for connecting the vacuum head to the interior of the tank,

and means for evacuating the tank, and

check valve means adapted to prevent flow of air to the tank from the means for evacuating the tank.

16. Apparatus according to claim **1** wherein said back-up member comprises a portion of an accumulator tank for creating quickly a vacuum on the article-confronting side of said impervious membrane upon engagement of said membrane with an article to be lifted, said hole being in communication with the interior of said tank, and said means to create a pressure between said membrane and said article including means connected to the interior of said tank.

17. In a vacuum article handler for picking up an article having a projecting outer rim which may be discontinuous,

a vacuum head comprising:

a pad of resilient material having an imperforate flexible article engaging surface and a perforate thickness behind said surface,

a vacuum opening extending through both said imperforate surface and said perforate thickness, said opening being isolated from said imperforate thickness,

a rigid backing member engaging the pad in face-to-face relationship behind said perforate thickness for pressing a portion of said perforate thickness surrounding said opening against the article to be lifted,

a source of vacuum for connection to said opening, and

vent means connecting said perforate thickness to ambient air so as to maintain an ambient pressure within said perforate thickness and behind said imperforate surface and thereby substantial differential pressure on the opposite sides of said imperforate surface to enhance sealing engagement with said surface with an article to be lifted,

said pad facing downwardly and said head being supported from an overhead support member by a swivel connection, said connection providing limited verticle movement of said head relative to said support member upon contact of said pad with a load,

a valve actuating switch between said head and said

support member operable upon upward movement of said head for connecting said source of vacuum with said opening,

said support member being tiltable in a generally vertical plane, and

stop means on said head and support member operable when mutually engaged to prevent swiveling movement of the head and to resist upward movement of the head,

said stop means being operable through tilting of said support member.

18. Apparatus according to claim **17** wherein said backing member comprises part of an accumulator tank and wherein there are means for connecting said vacuum source to said tank and said tank to the opening through said pad, said means including said switch.

19. Apparatus according to claim **16** including valve means within said accumulator tank for connecting the interior of said tank with said hole.

20. In a vacuum-type load handling apparatus for picking up through sealing contact a group of articles each having an upwardly projecting outer rim on an upper surface thereof, said apparatus comprising:

a generally horizontally disposed accumulator tank having horizontal dimensions at least several times greater than the vertical dimension thereof,

a vertically movable overhead support member for said tank,

swivel means connecting said tank to said overhead support member for permitting relative movement between the support member and the tank,

the accumulator tank having a substantially flat rigid bottom surface,

a sheet of resilient material extending continuously over a substantial portion of the bottom surface of the tank,

said sheet having at least an outer impervious article-confronting surface,

a plurality of openings extending through the sheet and the bottom wall of the tank,

a source of vacuum connected to the interior of the tank, and

valve means for controlling communication with the interior of the tank and said openings so that upon contact of the sheet with the rims of the articles to be lifted with said openings lying within said rims, the spaces within said rims can be evacuated to permit lifting said articles by raising said support member.

References Cited

UNITED STATES PATENTS

1,302,028	4/1919	Fuchs	294—64
2,308,209	1/1943	Schmutzer	294—65
2,819,806	1/1958	Vieth	294—65 X
2,890,077	6/1959	Littell	294—65
3,219,379	11/1965	Ames	294—64
3,229,345	1/1966	Ligon	294—64 X
3,240,525	3/1966	Wood	294—64

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