United States Patent

Creskoff

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[45] Feb. 8, 1972

[54] FLEXIBLE VACUUM LIFTER

[72] Inventor: **Jacob J. Creskoff**, Wynnewood, Pa.

[73] Assignee: **Vacuum Concrete Corporation of America**, Philadelphia, Pa.

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[21] Appl. No.: **20,280**

[52] **U.S. Cl.** **294/65**, 248/363

[51] **Int. Cl.** **F16b 47/00**

[58] **Field of Search** 294/64, 65; 248/363

[56] **References Cited**

UNITED STATES PATENTS

2,956,769	10/1960	Sigler et al.	248/363
3,506,747	4/1970	Creskoff	264/87
3,358,863	12/1967	Griffith et al.	214/501

Primary Examiner—Richard E. Aegerter
Assistant Examiner—Johnny D. Cherry
Attorney—Caesar, Rivise, Bernstein & Cohen

[57] **ABSTRACT**

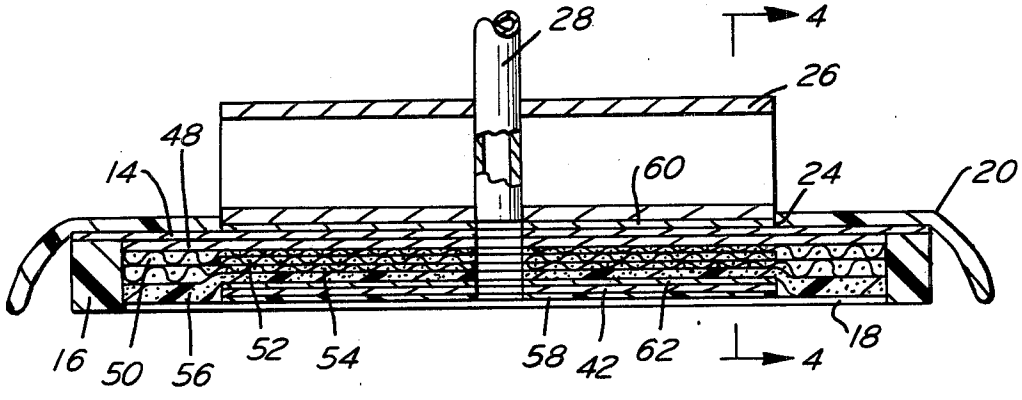
A flexible vacuum lifter which comprises a flexible elongated frame having a deformable resilient gasket secured to peripheral areas of one of the faces of the flexible lifter in order to define an enclosure. In the preferred embodiment of the invention the flexible lifter is backed with a cover sheet having a peripheral skirt that extends beyond the edges of the flexible lifter, with the cover sheet having an opening that permits a lifting frame to be directly secured to the flexible lifter.

Secured to the opposing face of the lifter and located within the enclosure defined by the sealing gasket is an assembly sheet. Also located within the enclosure are a pair of screens separated by a piece of expanded metal, with one of these screens being secured to the assembly sheet. Secured to the other screen and also located within the enclosure is a perforate sheet, and finally there is a stud assembly which is the structural component most remote from the cover sheet, but is also located within the enclosure.

A vacuum pipe passes through the lifting frame and is in good fluid or vacuum communication with the other components of the invention which have appropriate coinciding openings that terminate within the enclosure at approximately the level of the outer surface of the sealing gasket, with the outermost opening being located in a neoprene strip that is secured outwardly of the stud assembly.

It will be seen that the foregoing construction constitutes a flexible vacuum lifter that is capable of lifting objects of varying size and shape, as well as objects, like sheet metal for airplane wings that is otherwise easily deformed.

10 Claims, 4 Drawing Figures



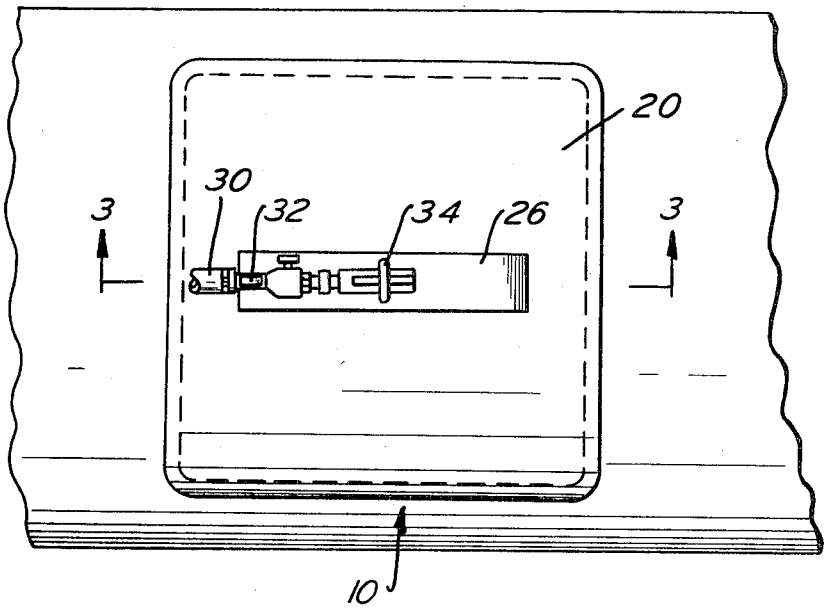
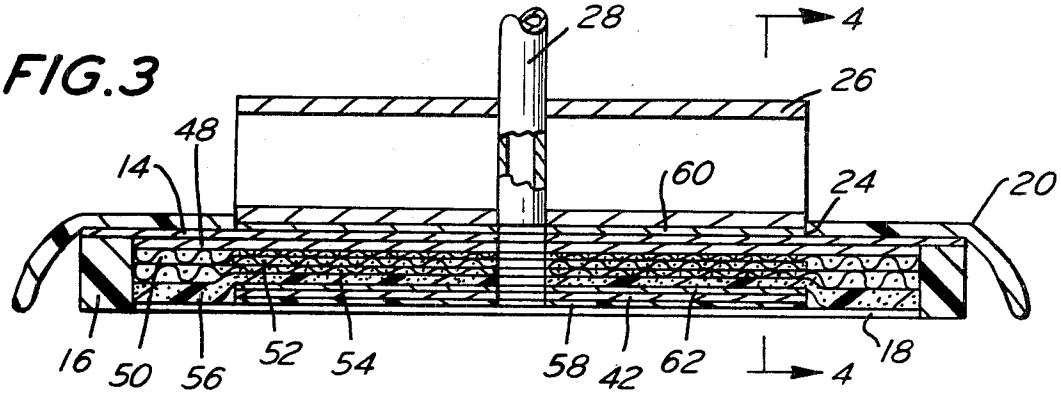


FIG. 1

FIG. 3



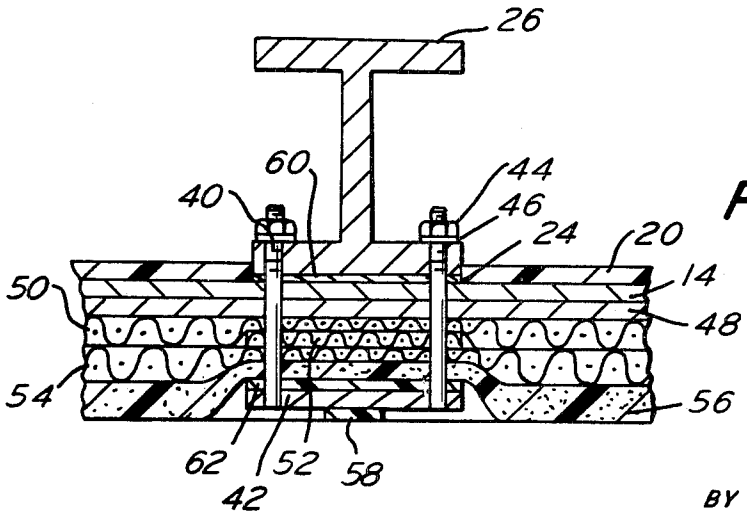


FIG. 4

INVENTOR
JACOB J. CRESKOFF
BY
Caesar, Rivise, Bernstein & Cohen
ATTORNEYS.

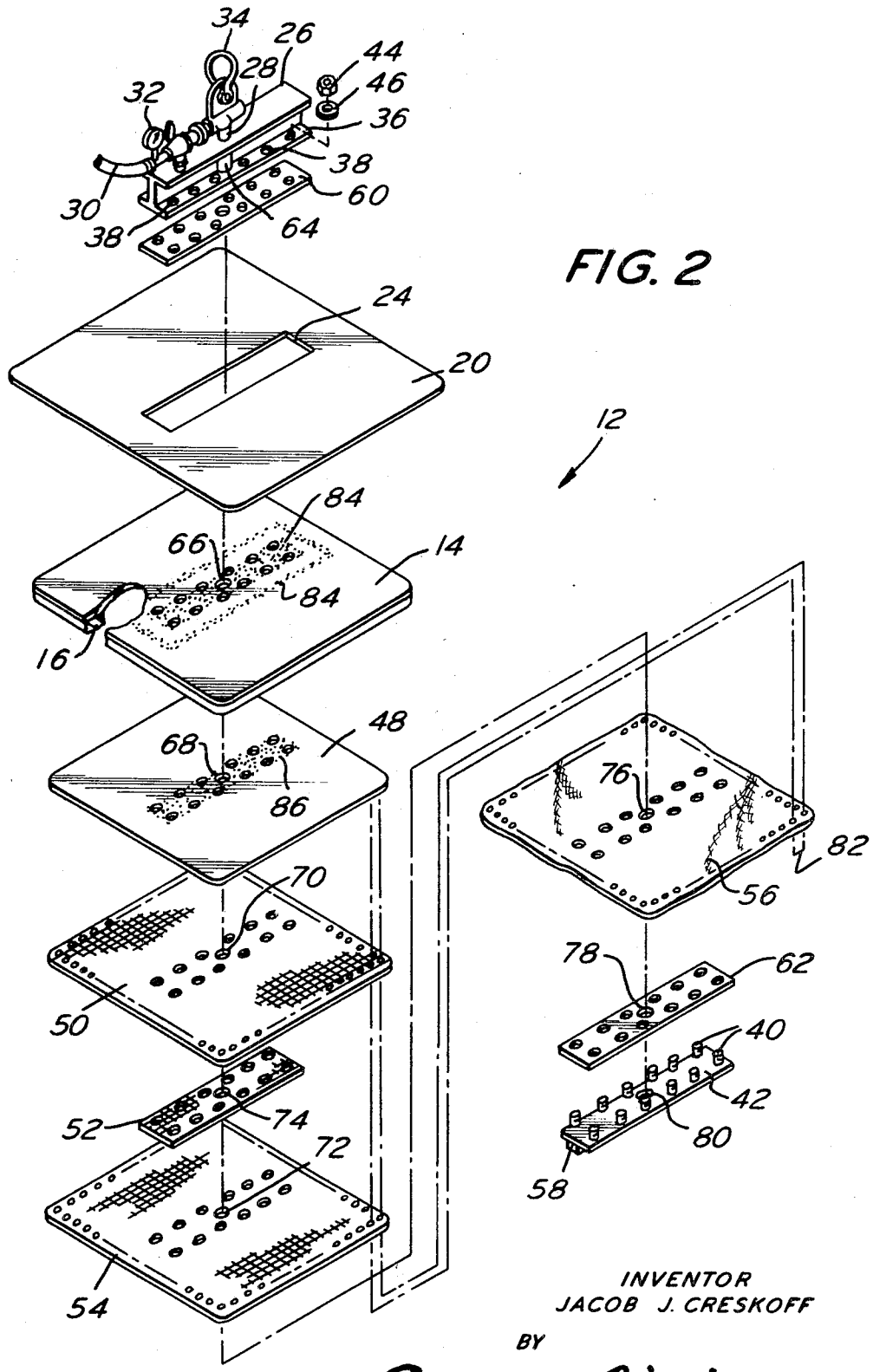


FIG. 2

INVENTOR
JACOB J. CRESKOFF

BY

Caesar, Rivise,
Bernstein & Cohen
ATTORNEYS.

FLEXIBLE VACUUM LIFTER

This invention relates to a flexible vacuum lifter and more particularly to a lifting device which is sufficiently resilient that it will conform to a large variety of sizes and shapes, as well as being usable in connection with objects that are otherwise easily deformed.

It is known to provide lifting apparatus which relay upon the principle of producing and maintaining a vacuum on a continuous basis at localized areas that are connected to a lifting frame as exemplified by U.S. Pat. No. 2,578,220. Throughout the years, various significant improvements have been made in the vacuum lifting art as exemplified by Creskoff U.S. Pat. Nos. 3,117,815 and No. 3,227,481. In order to complete this disclosure, reference is also made to Ligon U.S. Pat. No. 3,229,345.

It has further been recognized as set forth in copending U.S. application Ser. No. 706,980, filed Feb. 20, 1968 and entitled "Arcuate Vacuum Lifter" that the vacuum frame is to have an arcuate concave surface for the purpose of conforming to the cylindrical surface of objects like a pipe, since the tangential contact achieved with a planar vacuum lifter does not enable seating of the lifter on the arcuate surface of the work.

However, where it is desired to lift objects having an irregular shape, it has been determined that even the arcuate vacuum lifter has its limitations. Furthermore, when using the arcuate vacuum lifter, it is generally necessary to have a workman check to determine that the arcuate frames have been properly seated upon the surface of the object to be lifted.

It is therefore an object of the present invention to provide a flexible vacuum lifter which is effective in lifting objects having a large variety of sizes and shapes.

Still another object of the present invention is to provide a flexible vacuum lifter which can be used to lift delicate articles, like the sheet metal for airplane wings, that is otherwise easily deformed with the equipment presently in use.

Still another object of the present invention is to provide a vacuum lifter that may be regarded as a universal lifter.

Still another object of the present invention is to provide a blanket-type vacuum lifter that can be produced at reasonable costs, and which is simple to operate and maintain.

The foregoing as well as other objects of the present invention are achieved by providing a vacuum lifter which is sufficiently resilient or pliable that it can conform to a large number of varying surfaces.

In the preferred embodiment of the present invention the vacuum lifter is comprised of a flexible frame or that has a sealing gasket secured to its outer face. The sealing gasket projects sufficiently outwardly of the blanket lifter so as to define an enclosure in which is located a number of layers of materials that are necessary to achieve a good balance of strength and rigidity.

A cover sheet is secured to the inner face of the lifter, with the cover sheet having a skirt that facilitates movement of the entire vacuum head across the surface of the object to be lifted, in such a way as to be protective of such surface. The cover sheet has an opening which permits a lifting frame to be directly secured to the lifter, with the lifting frame permitting the passage of a vacuum pipe.

Secured to the outer face of the lifter is an assembly sheet which acts as a stiffener and adds strength without adversely affecting the flexibility of the overall vacuum head. A first screen is secured to the assembly sheet, and a second screen is positioned immediately outwardly of the first screen, with a piece of expanded metal being interposed between the two screens. A perforate sheet is secured to the second screen in order to add further flexibility. Finally, there is a stud assembly which holds all the various layers together, with a neoprene strip being positioned outwardly of the stud assembly to act as a cushion.

All of the foregoing except the cover sheet are located in the enclosure that is defined by the lifter and the sealing gasket, with the outer surface of the neoprene strip being at approximately the same level as the outer face of the sealing gasket. Furthermore, each of the foregoing layers is perforate to allow direct vacuum communication back to the vacuum pipe.

It will be seen that by virtue of the foregoing construction, a highly resilient vacuum head is provided which can conform to a large number of surfaces, irrespective of size or shape.

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 top plan view of a flexible vacuum lifter embodying the present invention, with the vacuum lifter being in operative contact with a piece of work;

FIG. 2 is an exploded perspective view showing the various layers comprising the vacuum head of the present invention, including the lifting frame;

FIG. 3 is a somewhat enlarged sectional view taken along the lines 3—3 of FIG. 1; and

FIG. 4 is an enlarged sectional view taken along the lines 4—4 of FIG. 3.

Referring now in greater detail to the various figures of the drawing wherein like reference characters refer to like parts, a flexible vacuum lifter embodying the present invention is generally shown at **10** in FIG. 1. As shown in FIG. 3 the present invention basically comprises a resilient vacuum head **12** which as shown in FIG. 2 includes a flexible lifter or resilient base **14** having a sealing gasket **16** extending peripherally about the outer face of the flexible lifter **14** in order to define an enclosure **18** (FIG. 3). A series of layers of materials extend outwardly of the lifter **14**, but within the enclosure **18** for a variety of purposes as will be discussed hereinafter.

As shown in FIGS. 2 and 3 the resilient and flexible lifter **14** is backed with a cover sheet **20** having a peripheral skirt that aids in the sliding of the vacuum head **12** across the surface of an object to be lifted and seating of the gasket on the surface.

As further shown in FIG. 2 the cover sheet **20** has a rectangular opening **24** which permits the lifting frame **26** to be directly secured to the inner face of the lifter **14**.

With reference to FIG. 2 it will be seen that the lifting frame **26** is essentially an I-beam having a central opening that permits the passage of vacuum pipe **28** as better seen in FIG. 3. There is a vacuum inlet line **30** (FIG. 2) that leads backwardly to a vacuum pump. The vacuum inlet line **30** extends downstream to the vacuum pipe **28** in a conventional way with a vacuum gauge **32** being provided. It is to be noted that the vacuum inlet line **30** meets the vacuum pipe **28** in a standard L-connection, with a lifting hook **34** being provided for securement to a hoist or other lifting device (not shown).

With further reference to FIG. 2, it will be seen that the base **36** of the lifting frame **26** has a series of spaced openings **38** formed therein for reception of appropriately arranged lugs **40** which extend from the stud assembly **42**. It will be seen from an inspection of FIG. 2 that all other layers of material that are incorporated into this invention carry openings similar to the openings **38** in order to allow the lugs **40** to pass through ever layer and to be received in the openings **38** where the lugs **40** are fastened in place using nuts **44** and washers **46**.

With reference to FIG. 2 it will be seen that starting with cover sheet **20** and moving outwardly from the lifting frame **26** there is in successive order the flexible lifter **14**, an assembly sheet **48**, a first screen **50**, an expanded metal strip **52**, second screen **54**, perforate sheet **56**, the outer surface of which is in contact with the stud assembly **42** that includes outer neoprene strip **58**.

It will be further observed that two protective pads **60** and **62** are also employed in connection with the flexible vacuum lifter of the present invention. There is an inner protective pad **60** that is interposed between the base **36** of the lifting frame **26** and the inner surface of the flexible lifter **14**. There is an outer protective pad **62** that is interposed between the perforate sheet **56** and the stud assembly **42**.

It is to be further noted from FIG. 3 that the outer end 64 of the vacuum pipe 28 is in vacuum communication with all layers comprising the present invention in order that vacuum will be effective upon the surface of the object that is to be lifted. This is accomplished by providing a central opening 66 in the lifter 14, a central opening 68 in the assembly sheet 48, central openings 70 and 72 in the screens 50 and 54, central opening 74 in the expanded metal strip 52, central opening 76 in the perforate sheet 56, central opening 78 in the outer protective pad 62 and central opening 80 in the stud assembly 42 that also passes through the outer neoprene strip 58.

In view of the foregoing the vacuum is effective through the imperforate but flexible lifter 14 and assembly sheet 48. It is to be noted, however, that the screens 50 and 54 contain many openings, and indeed the expanded metal strip 52 functions as a three dimensional spacer and vacuum distributor to enhance the openings in the screens. The expanded metal strip may be substituted for by a plurality of washers which are provided between screens 50 and 54 and telescoped over the lugs 40. Thus, the vacuum being drawn through inlet line 30 is effectively distributed across substantially the entire area of the screens 50 and 54 as well as substantially across the entire area of the perforate sheet 56 which likewise contains a large number of openings.

It is to be understood that the materials comprising the various layers of the present invention, except for expanded metal strip 52 and stud assembly 42 should generally be flexible, although it is to be understood that it is conceivable that the present invention could tolerate one or more relatively rigid layers, although the resulting vacuum lifter would lack certain amount of flexibility.

In the preferred form of the invention the cover sheet 20 is comprised of neoprene rubber of approximately ¼-inch thickness that is reinforced with a glass fiber mat or layer.

The flexible lifter is also of neoprene rubber while the assembly sheet 48 is of about ⅛-inch thickness and may be of a somewhat stiffer neoprene rubber.

The screens 50 and 54 are composed of 16-mesh steel fly screen.

The perforate sheet 56 is preferably of a mesh made from either nylon or rubber, and serves to protect the center surfaces of the object being lifted.

Each of the protective pads 60 and 62 may be comprised of neoprene rubber that is reinforced with glass fiber layers or mats, with a pad being about one-fourth inch thick. The neoprene strip 58 is similarly comprised and is positioned on the outer surface of stud assembly 42 in order to prevent any damage to the object being lifted.

It is to be noted that the screens 50 and 54 function not only to distribute the vacuum, but also add tensile strength to the entire assembly.

Finally, the sealing gasket 16 is a closed cell neoprene R411N (medium firm) which is about one-half inch thick and about 1 inch wide.

Reference is hereby made to copending applications Ser. No. 706,980, that was previously referred to and U.S. Pat. No. 3,506,297, issued Apr. 14, 1970 to Jacob J. Creskoff, for further details with reference to the vacuum distribution system, as well as the lifting frame 56.

Also, as can be seen in FIG. 2, staples 82 are provided about the periphery of perforate sheet 56 which pass inwardly through perforate sheet 56, then through the screens 50 and 54 to be received in the assembly sheet 48.

It can also be seen from FIG. 2 that the lugs 40 pass through aligned openings in the various layers, and then through rectangular opening 24 of cover sheet 20 and then through openings in protective pad 60, with the lugs 40 then being received in openings 38 in base 36 of the lifting frame 26.

As best seen in FIG. 2, adhesive is applied to the shaded areas 84 of lifter 14 and area 86 of assembly sheet 48 to strengthen the securement between the various layers of the vacuum head 12.

It should also be noted that cover sheet 20 is not connected in any way to the lifter 14 but merely rests on the top surface thereof. The cover sheet is maintained in place by the alignment of rectangular opening 24 which fits loosely about the rectangular base 36 of lifting frame 26. The cover sheet is thus enabled to provide a seating force to the peripheral sealing gasket 16 that facilitates the seating of the blanket lifter 14.

In use it will be seen that the work will be contacted by the neoprene strip 58, the perforate sheet 56, the resilient sealing gasket 16, and by the skirt 22 of the cover sheet 20. All of these surfaces are resilient and nondamaging. Thus, the vacuum head 12 will conform to a large number of varying surfaces to provide an effective seal, and thereby enable vacuum lifting in a universal way. Clearly, a series of vacuum heads 12 may be provided in varying arrangements as will occur to those skilled in the art.

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 is claimed as the invention is:

1. A vacuum lifter comprising a source of vacuum, a flexible lifter having a pair of opposed parallel faces, said source of vacuum being effective at said flexible lifter, a resilient sealing gasket secured to one of said faces of said lifter and extending from said flexible lifter, a lifting member secured to the other of said faces and adapted to impart a lifting force to said flexible lifter, said gasket and said flexible lifter being conformable and securable to a wide variety of surfaces of objects to enable lifting of said objects when said lifting force is imparted to said flexible lifter.

2. The invention of claim 1 including a resilient cover sheet provided over the top surface of said flexible lifter, with said cover sheet having a peripheral skirt located outwardly of said sealing gasket.

3. The invention of claim 2 including an assembly sheet positioned against the outer face of said flexible lifter, with said vacuum being effective through a portion of said cover sheet, said lifter and said assembly sheet being nonrigid.

4. The invention of claim 3 including a first screen positioned against the outer face of said assembly sheet, a second screen, a spacer being interposed between said screens, with said second screen otherwise being positioned against the outer face of said first screen, both of said screens being flexible.

5. The invention of claim 4 including a flexible perforate sheet positioned against the outer face of said second screen.

6. The invention of claim 5 including a stud assembly having lugs which extend through said perforate sheet, said screens, said spacer, said assembly sheet, said flexible lifter, and said cover sheet to be received in the base of a lifting frame.

7. The invention of claim 6 wherein said cover sheet includes an opening that allows the base of said lifting frame to be directly secured to said flexible lifter, with said lifting frame also including a lifting hook, and means to convey vacuum to said flexible lifter.

8. The invention of claim 7 including an enclosure defined by said flexible lifter and sealing gasket, said enclosure receiving said assembly sheet, said screens, said spacer, said perforate sheet and said stud assembly, with said stud assembly including an outer neoprene strip that is essentially in line with the outer surface of said sealing gasket when said lifter is secured to said work.

9. The invention of claim 8 wherein the skirt of said cover sheet includes outer edges that are essentially in line with said sealing gasket.

10. The invention of claim 8 wherein said spacer comprises an expanded metal strip.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,640,562 Dated February 8, 1972

Jacob J. Creskoff

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

(1) Column 1, line 41 delete "blanket-type".

(2) Column 1, line 44 after the word "a" insert the word --flexible--.

(3) Column 2, line 59 "ever" should be --every--.

Signed and sealed this 20th day of June 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents