

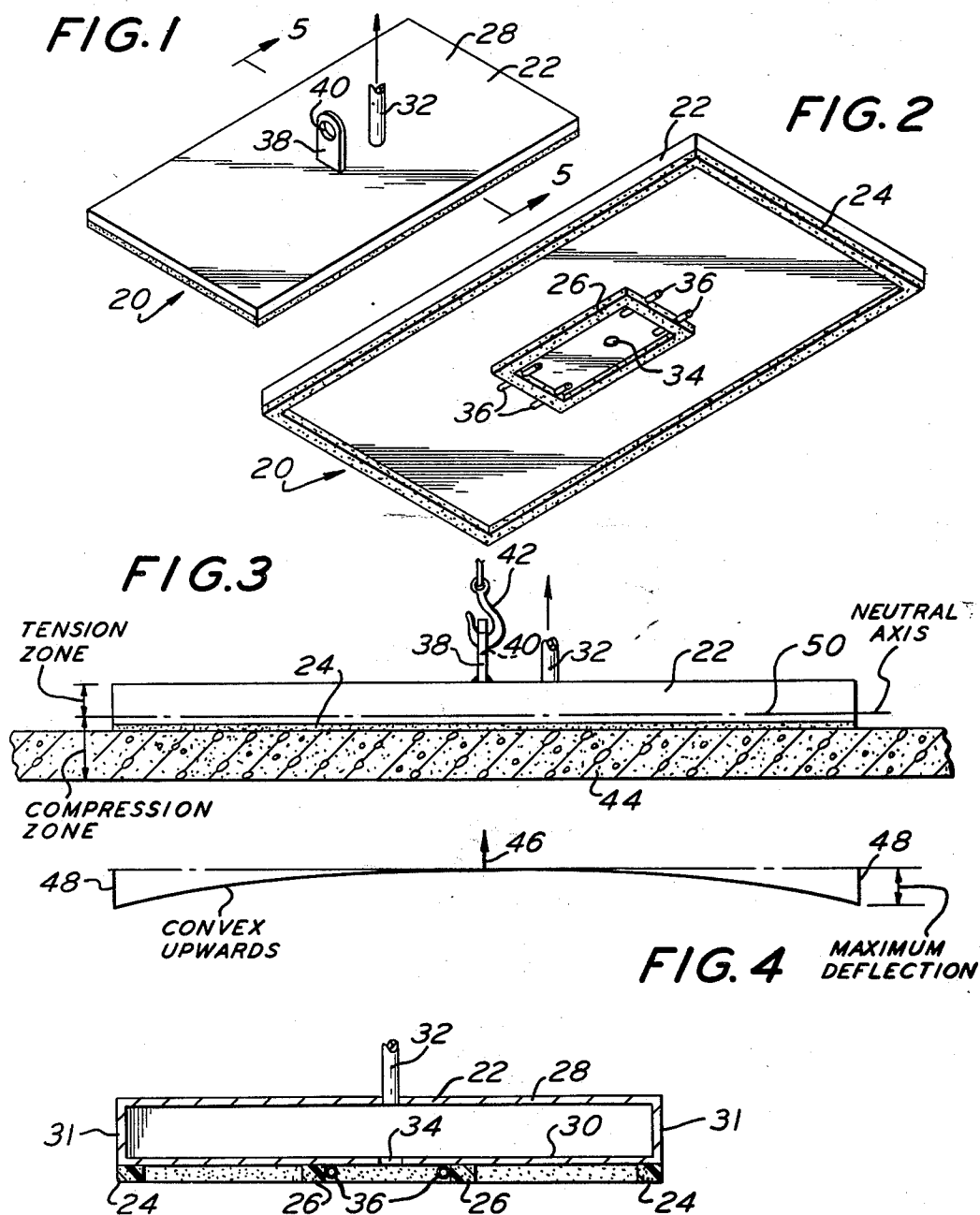
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VACUUM LIFTER WITH PRESTRESSING ACTION

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VACUUM LIFTER WITH PRESTRESSING ACTION
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5 Claims

ABSTRACT OF THE DISCLOSURE

A vacuum lifter which comprises a body member having a deformable work engaging and sealing gasket secured thereto. The sealing gasket defines an open chamber on the bottom surface of the body member. Means defining a port are provided for connecting the open chamber to a source of reduced pressure so that atmospheric pressure secures the vacuum lifter to a work. A lifting member is provided centrally of the body member so that a lifting force applied to the lifter at said lifting member pre-stresses the work as the work is lifted.

This invention relates generally to vacuum lifters and more particularly to a vacuum lifter for large brittle objects such as concrete forms and slabs.

In conventional vacuum lifters, a difficulty frequently encountered when lifting large concrete bodies is cracking which occurs when the concrete body is lifted vertically and when it is rotated from a horizontal disposition to a vertical disposition. This cracking is caused by tensile stresses imparted by the lifter to the concrete which are greater than that which the concrete body can withstand. Moreover, the ability of the concrete bodies to withstand large tensile stresses is reduced because they are not normally prestressed.

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

Another object of the invention is to provide a new and improved vacuum lifter which effectively prevents cracking of a work such as a concrete body when lifted.

Another object of the invention is to provide a new and improved vacuum lifter which prestresses the work as it is lifted.

Another object of the invention is to provide a new and improved vacuum lifter which is so constructed that the vacuum lifter and the work act as a composite unit when lifted together so that the deflection thereof is convex upwards.

Another object of the invention is to provide a new and improved vacuum lifter which is lifted at or near the center of the vacuum lifter so that the entire work is in compression when the work is lifted from a horizontal position.

These and other objects of the invention are achieved by providing a vacuum lifter which comprises a body member having a deformable work engaging and sealing gasket secured thereto which defines an open chamber. Means are provided which define a port for connecting the open chamber to a source of reduced pressure so that atmospheric pressure secures the vacuum lifter to the work. A lifting member is provided centrally of the body member so that a lifting force applied to the lifting member causes the lifter to prestress the work as it is lifted.

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 perspective view of the vacuum lifter embodying the invention taken above the body of the lifter;

FIG. 2 is a perspective view of the vacuum lifter embodying the invention taken from below the body member;

FIG. 3 is a side elevation view of the vacuum lifter in operation supporting a work which is shown in section for purposes of clarity;

FIG. 4 is a graphical representation of the transverse deflection longitudinally along the lifter in the position shown in FIG. 3; and

FIG. 5 is a sectional view taken along the line 5—5 in FIG. 1.

Referring now to the various figures of the drawing wherein similar reference characters refer to similar parts, a vacuum lifter embodying the invention is shown generally at 20 in FIGS. 1 and 2.

Vacuum lifter 20 basically comprises an elongated rectangular body member 22, a first deformable work engaging and sealing gasket 24 which is secured to the lowermost surface of the body member 22 about the periphery thereof and a second deformable work engaging and sealing gasket 26 which is secured to the lowermost surface of lifter 20 and is concentric with and provided with gasket 24.

As best seen in FIG. 5, the body member 22 preferably comprises a hollow rectangular steel frame which includes a pair of parallel rectangular planar spaced upper and lower walls 28 and 30, respectively. Walls 28 and 30 are spaced by an integral peripheral vertically extending wall 31. A pipe 32 is secured to the top wall 28 of the body member 22 and defines a port for connecting the inner cavity of body member 22 to a source of vacuum supply.

The lowermost wall 30 includes a circular opening 34 which defines a port for connecting the chambers formed by the gaskets 24 and 26 to a source of reduced pressure. Walls 28, 30 and 31 are otherwise impervious and the cavity in the frame of body member 22 acts as a vacuum supply reservoir. That is, when the vacuum lifter is elevating a body, the vacuum pump which provides the source of reduced pressure may be turned off in that the large cavity within the body member 22 continues to provide reduced pressure to the chambers within gaskets 24 and 26 even though there is some loss of reduced pressure through gasket 26 and through a porous work.

A plurality of small diameter tubes are provided which extend through the inner gasket 26. These tubes connect the inner chamber which is defined by the gasket 26 and the outer chamber which is defined between the outer gasket 24 and the inner gasket 26. The aggregate cross-sectional area of the tubes is smaller than the area of the opening 34 so that during the setting of the vacuum lifter on a work, a partial vacuum is first formed in the inner chamber and the atmospheric pressure then causes the vacuum lifter to be urged against the work thereby causing sealing gasket 24 to seal the outer chamber.

The operation and advantages of the inner gasket are described in detail in my Patent No. 3,117,815 which issued Jan. 14, 1964.

A lifting lug 38 is secured to the uppermost surface of the top wall 28 of the body member 22 preferably by welding. Lug 38 is secured centrally of the top wall 28 and includes an opening 40 which is provided for the reception of a cable or a hook 42 for cooperation with a crane or other lifting device for elevating the lifter together with its load or work 44.

The vacuum lifter 20 is so constructed that when the vacuum lifter is lifting a work, there is a composite structural action between the lifter and the work such that the entire work is in compression.

The work 44 is compressed by the shear forces between the vacuum lifter and the work because the deflec-

tion along the length of the vacuum lifter is convex upwards. Referring to FIG. 4, a graphical representation of the vertical deflection along the vacuum lifter of the body 22 thereof when the vacuum lifter is elevating a work in a horizontal disposition is illustrated. As seen therein, at the center of the curve where the lug 38 provides the lifting force to body member 22 which is denoted by arrow 46 there is minimum deflection. There is maximum deflection, however, at the ends 48. Thus, by providing lifting action at only one point along the length of the body member, the greatest deflection is at the ends of the lifting member which thereby produces a deflection curve which is convex upwards.

When the deflection curve is convex upwards, the entire mass of the structure above the neutral axis is in tension and the entire mass of the structure below the neutral axis is in compression.

The vacuum lifter 20 is therefore so designed insofar as the dimensions, the rigidity and the strength thereof are concerned, that the neutral axis which is best seen in FIG. 3 in dotted lines at 50 extends through the body of the vacuum lifter when a work is being lifted thereby. Thus a work such as a concrete slab is entirely in compression as it is lifted. The entire lifter above the neutral axis 50 is thus in a tension zone and the entire mass including the bottom of the lifter and the work is in the compression zone.

It can therefore be seen that as the work 44 is lifted in a horizontal disposition the composite structural action which causes maximum deflection at the ends of the vacuum lifter causes the work to be compressed and thereby prestressed. There is a resultant greater strength attributed to the work which thereby enables greater manipulation of the work without resultant cracks therein.

To lift a work, the vacuum lifter 20 is placed on a work 44. The pipe 32 is then connected to a vacuum supply. The reduced pressure in the chambers defined by gaskets 24 and 26 enables atmospheric pressure outside the chambers to secure the lifter to the work. To remove the lifter from the work, pipe 32 is connected to atmospheric pressure.

It should be understood that the lug 38 need not be provided at the exact center longitudinal of the body member 22 of the vacuum lifter 20. So long as the lug 38 is provided adjacent or near the center of the elongated body member, the deflection curve is convex upwards and thereby causes the neutral axis to extend through the body member 22 of the vacuum lifter. Moreover, more than one lug may be provided along a single line extending transverse to the longitudinal axis of the vacuum lifter body 22. However, a lifting force may be applied to the body 22 along only a single transverse line to the longitudinal axis to maintain the desired composite lifting action.

It should also be understood that the shape of body member 22 need not be rectangular, but may also be

circular or square. The lifting force, however, must remain adjacent the center of the lifter to maintain convex upward deflection when the lifter is in operation.

Without further elaboration, the foregoing will so fully illustrate my invention that others may, by applying current or further 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 body member having a deformable work engaging and sealing gasket secure thereto defining an open chamber, means defining a port for connecting said open chamber to a source of reduced pressure so that atmospheric pressure secures the vacuum lifter to a work, and a lifting member provided centrally of the body member, the position of said lifting member with respect to said body member causing a neutral stress axis to extend through said body member as said work is lifted by said vacuum lifter, said work thereby being prestressed as said work is lifted.

2. The invention of claim 1 wherein substantially all of said lifting force is applied to said lifting members so that the deflection curve of said lifter and said concrete body along said bodies is convex upwards which causes said neutral axis to extend through said body member.

3. The invention of claim 1 wherein said vacuum lifter includes a second deformable work engaging and sealing gasket secured to the lower surface of said body member within said first mentioned sealing gasket, said second gasket having fluid transfer means for connecting said chamber between said first and second gaskets to said port.

4. The invention of claim 1 wherein said body member is hollow, the cavity of said body member acting as a reservoir of reduced pressure for supporting said work.

5. A vacuum lifter comprising a body member having a planar lower surface, a deformable work engaging and sealing gasket secured to said lower surface defining an open chamber, means defining a port for connecting said open chamber to a source of reduced pressure so that atmospheric pressure secures said vacuum lifter to a work, a lifting member secured at the center of said body member, said body member being so dimensioned that lifting of said body member at said lifting member causes a neutral stress axis to extend through said body member above said work so that said work lifted by said vacuum lifter is entirely in compression and is prestressed thereby as it is lifted.

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