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OVERHEAD VACUUM-HELD SUPPORT

Filed June 29, 1966

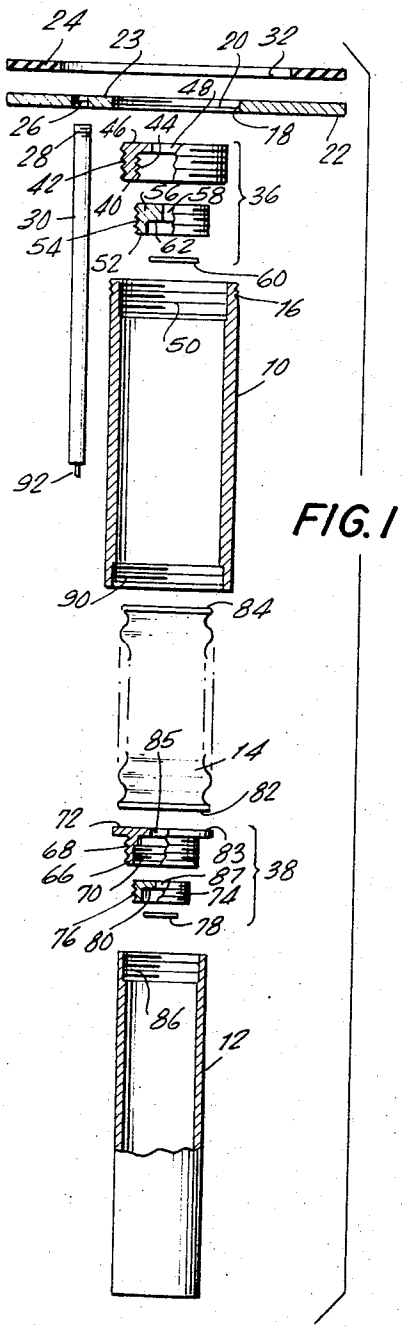


FIG. 1

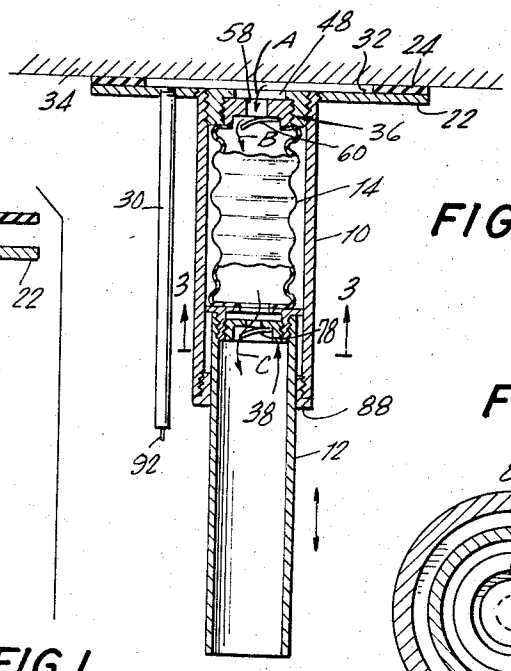
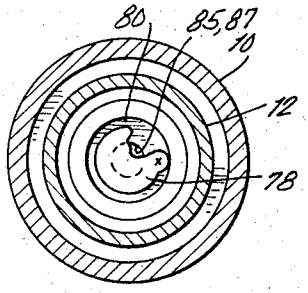


FIG. 2

FIG. 3



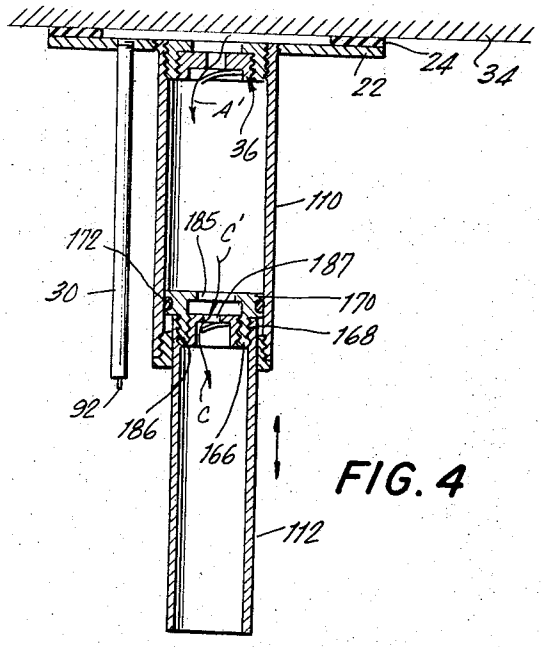


FIG. 4

INVENTOR.
SIDNEY R. DEITCH
BY
Brisbin & Goldfarb
ATTORNEYS

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OVERHEAD VACUUM-HELD SUPPORT

Sidney R. Deitch, New York, N.Y.
(61—35 98th St., Rego Park, N.Y. 11374)

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This invention pertains to an overhead vacuum-held support, and more particularly to a fixture which can be attached to an overhead or vertical-wall surface by air pressure alone, this being accomplished by means for creating and retaining a vacuum between the overhead or vertical-wall surface and a contained body of the fixture, the force created thereby being sufficient to support the weight not only of the fixture but also the weight of other objects attached to or suspended from the fixture.

It is therefore an object of the present invention to provide a fixture for suspending objects from an overhead or vertical surface, such as from a ceiling or wall, which will be convenient to attach and which will leave no remaining marks or damage to the wall surface when removed.

A further object of the invention is to provide a temporary overhead support which is readily attachable and detachable so as to be easily moved from one location to another and easily stored when not in use, easily demountable for cleaning and for sterilization, when necessary.

A further object of the invention is to provide an overhead support which will be easily removable as a fixture and not become a legal part of the building structure to which it temporarily is attached.

Still another object of the invention is to provide a temporary support for tools and equipment during installation and/or repair work.

Still a further object of the invention is to provide a support which can be readily and easily attached to and detached from an overhead horizontal or vertical surface without the use of additional tools, skilled labor or conventional methods of mounting an overhead support, which might otherwise damage the mounting surface.

To these ends, and in accordance with one feature of the invention, an inner and an outer hollow shaft are provided which telescopically engage each other. The upper hollow shaft as well as the lower shaft are each provided in their upper portions with a one-way check valve for flow of air downwardly and outwardly through both hollow shafts. A deformable gasket engages the ceiling or wall surface to which the fixture is to be attached; and the upper hollow shaft is secured to a mounting plate which rests against the gasket and which has a central opening through which air can be drawn into and through the two check valves as the smaller of the two shafts is pressed into the larger.

According to another feature of the invention, bellows means are provided within the larger of the two hollow shafts and between the two check valves. In this embodiment, since the bellows are substantially air tight at the place where the bellows contacts the two valves, the tolerance between the outer and inner hollow shafts need not be so close as to provide an air-tight seal.

According to a further feature of the invention an extended tube of relatively small diameter is provided, extending from the mounting plate to a point approximately level with the remote end of the hollow shaft of large diameter, and provided with an exhaust needle valve to release the vacuum.

The device is affixed to a surface by pressing the gasket against the surface and by merely pressing in and out the inner shaft relative to the outer shaft, which causes

air to flow outwardly through the two valves, thus creating a vacuum. The vacuum may easily be released by pressing in the needle valve in the lower end of the small diameter tube.

These and other ancillary objects, features and advantages of the invention, these features being set forth with particularity in the claims annexed hereto, will become more apparent from the following description of typical embodiments of my invention, illustrated by way of example only on the accompanying drawings, in which:

FIG. 1 is an exploded view, partially in section, of a first embodiment of my invention;

FIG. 2 is a longitudinal cross section of the device of FIG. 1, in assembled condition and mounted on a surface from which it is supported by vacuum;

FIG. 3 is a transverse section taken along line 3—3 of FIG. 2, with the valve flap partially cut away to better illustrate the structure; and

FIG. 4 is a longitudinal cross section through another embodiment of my invention in which no bellows means are required.

As shown in FIGS. 1–3, the device according to the invention comprises an outer hollow shaft **10** and an inner hollow shaft **12**, the inner shaft fitting telescopically into the outer shaft. Bellows means **14**, collapsible in the longitudinal direction, are arranged to fit into the upper end of the hollow shaft **10**. The outer hollow shaft **10** is provided at its upper end with outer threads **16** which are engageable with internal threads **18** of a bore **20** of a mounting plate **22**. A deformable gasket **24** rests against the outer surface of mounting plate **22**, on the side thereof opposite or away from the hollow shafts **10** and **12**. The mounting plate **22**, in addition to the threaded opening **20**, has a second threaded opening **26** which is adapted to receive the threaded end **28** of a tube **30**. The gasket **24** has an opening **32** therein which is at least coextensive with the opening **20** in mounting plate **22** and also extends over the opening **26**. The gasket **24** is preferably sufficiently soft and pliable so that it covers any irregularities in the contacted wall or ceiling surface sufficiently so that there is no air leakage between the surface **34** and the mounting plate **22** when the device is in vacuum condition. Two flutter or check valves **36**, **38** are provided and these fit respectively into the ends of the outer hollow shaft **10** and the inner hollow shaft **12** which ends are closest to the mounting plate **22**.

The check valve **36** comprises an outer ring member **40** provided with outer annular threads **42**, inner annular threads **34**, and a cap **46** having a central opening **48** through which air can pass from the openings **32** and **20** in the space between the cap **46** and the wall or ceiling mounting surface **34**. The threads **42** are adapted to engage internal threads **50** in the upper end of the outer hollow shaft **10**.

In addition to the outer ring **40**, the valve **36** comprises an inner ring **52** having annular outer threads **54** adapted to engage the outer threads **44** of the ring **40**. The inner ring **52** is provided with a cap **56** having an opening **58** which communicates with the opening **48** of the outer ring. A flexible diaphragm **60** is adapted to fit into a recess **62** of the inner ring **52** and to be fastened at only one side thereof to the cap **56** by fastening means **64** (FIG. 3), so that when air passes through the valve **36** in the direction of arrow A of FIG. 2, the non-fastened side of the diaphragm **60** can move down away from its normal position of closing the opening **58**.

The check valve **38** comprises an outer annular ring **66** having outer threads **68**, inner threads **70** and a collar **72** of a diameter such as to provide a sliding fit within the hollow shaft **10**. An inner ring **74** is provided with outer threads **76** adapted to engage the inner threads

70 of the valve ring 66. A flexible diaphragm 78 is adapted to fit within a recess 80 of the inner ring 74, one side of the diaphragm 78 being fastened into the recess 80 in a manner similar to that at 64 of diaphragm 60.

The collar 72 of the annular ring 66 is provided with a central opening 85, and the inner ring 74 is provided with a central opening 87 in its cap in order to permit the flow of air in the direction of arrow C of FIG. 2

The bellows 14 rests with one end 82 thereof engaging the upper surface 83 of the collar 72. A gasket or other sealing means may be provided between the surfaces 82 and 83. Similarly, the other end 84 of the bellows 14 sealingly engages the ring 40 of valve 36.

The threads 68 of the valve 38 engage the internal thread 86 in the upper end of the inner hollow shaft 12, and a bushing 88 (FIG. 2) threaded into an internal thread 90 in the lower end of shaft 10 provide a sliding fit for the inner hollow shaft 12 to slide into and out of the hollow shaft 10.

A needle valve 92 is provided in the end of tube 30 furthest from the threaded end 28 and functions to allow a flow of ambient air into the tube 30 to release a vacuum when the needle 92 is pressed inwardly.

The device of FIGS. 1–3 operates as follows.

The fixture is attached to an overhead or a wall surface by pressing the shaft 10 in the direction of mounting plate 22 so that firm contact is made between the surface 34 and the gasket 24. While such contact is maintained, the inner shaft 12 is moved in a longitudinal direction with alternate inward and outward motions, thus expanding and compressing bellows 14. The action of the bellows causes air to be drawn from the contained area between the upper surface 23 of mounting plate 22 and the overhead surface 34 through valve 36 and into the bellows 14, this air being subsequently expelled from the bellows 14 through the lower valve 38. FIG. 2 illustrates how air tends to flow in the direction of arrows A, B and C through the two valves 36 and 38, while the bellows 14 collapses in a longitudinal direction. Normal ambient air pressure against the mounting plate 22 thus provides a holding force of up to approximately 14.7 pounds per square inch to press the plate 22 against the mounting surface 34, depending upon the completeness of the vacuum. Tools or other objects may be suspended from the shaft 12 by means of hooks, shelves or other holding devices. Repeated and forceful withdrawals of air from the contained area creates an increase space of vacuum in that area which causes the ambient air pressure on the under side of plate 22 to force the plate towards the overhead surface 34 and so to affix the plate 22 and gasket 24 against the surface 34.

In order to release and dismount the device from the surface 34, pressure is applied to the stem valve 92, which causes air to flow in through tube 30 and in sequence through the openings 26, 32, 20, 48 and 58, to reach the other side of flexible valve diaphragm 60 and eventually the flexible valve diaphragm 78, thus releasing the vacuum within the bellows 14 and within tube 10. When the air pressure on the inside as well as the outside of mounting plate 22 is equal, the ambient air pressure will no longer be only on only one side of the mounting plate 22 and will thus permit the device to be released from the surface 34.

The embodiment of my invention shown in FIG. 4 is similar to that in FIGS. 1–3, except that the bellows means 14 are eliminated by providing sealing means 173 to seal the joint between the outer hollow shaft 110 and the inner hollow shaft 112. The valve 36 is similar to the valve 36 in the embodiment of FIGS. 1–3. However, the valve 138 is somewhat modified from the valve 38 by

having a cap 170 with a collar which has a peripheral groove 172 for holding the sealing means or O-ring 173 which seals the cap 170 against the inner surface of hollow shaft 110. The cap 170 has a cylindrical portion 166 provided with outer threads 168 which engage the internal threads 186 in the upper end of the hollow shaft 112.

The cap 170 and the inner ring portion of valve 138 are provided with respective openings 185 and 187 in order to permit the flow of air in the direction of arrow C'.

The device of FIG. 4 operates in a manner analogous to that above described with respect to FIGS. 1–3, except that the sealing means 170, 173 make it unnecessary to use a bellows such as 14.

It will be obvious to those skilled in the art, upon studying this disclosure that devices according to my invention can be modified in various respects and hence may be embodied in apparatus other than as particularly illustrated and described herein, without departing from the essential features of my invention within the scope of the claims annexed hereto.

I claim:

1. A support fixture comprising a plurality of mutually telescoping hollow shafts including an outer end shaft, a mounting plate fixed to said outer end shaft, deformable gasket means engaging said mounting plate, said gasket means and said mounting plate having aligned openings communicating with said hollow shafts, valve means within said hollow shafts, alowing one-way directional flow of air therethrough for creating a vacuum at said openings, and vacuum release means communicating with said openings for releasing said vacuum.

2. A support fixture according to claim 1, including bellows means within said outer end shaft, said bellows means being longitudinally collapsible in the direction of the axis of said outer end shaft, said valve means comprising a pair of check valves, and sealing means forming air-tight joints with respective end of said bellows means and with said pair of check valves.

3. A support fixture according to claim 1, including sealing means forming a slidable joint between said outer end shaft and another of said shafts, said other shaft telescopically engaging said outer end shaft.

4. A support fixture according to claim 1, said vacuum release means comprising a tube attached at one end thereof to said mounting plate and communicating with said openings, said tube having controllable air inlet means at the other end thereof.

5. A support fixture according to claim 1, said valve means comprising an outer ring, an inner ring having a recess and being sealingly engageable with and within said outer ring, and a diaphragm within said recess, said diaphragm having a portion thereof attached to and another portion thereof unattached relative to said inner ring to permit air flow in one direction only through said recess.

6. A support fixture according to claim 3, said sealing means comprising a cap having an axial through-opening and a circumferential recess, and O-ring means within said recess and engageable with the said outer end shaft, and means securing said cap to said other shaft.

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JOHN PETO, *Primary Examiner.*