April 27, 1965 C. F. FISCHER 3,180,608

VACUUM HOLDING OF THIN PLIABLE MATERIAL

Filed Nov. 5, 1963 2 Sheets-Sheet 1

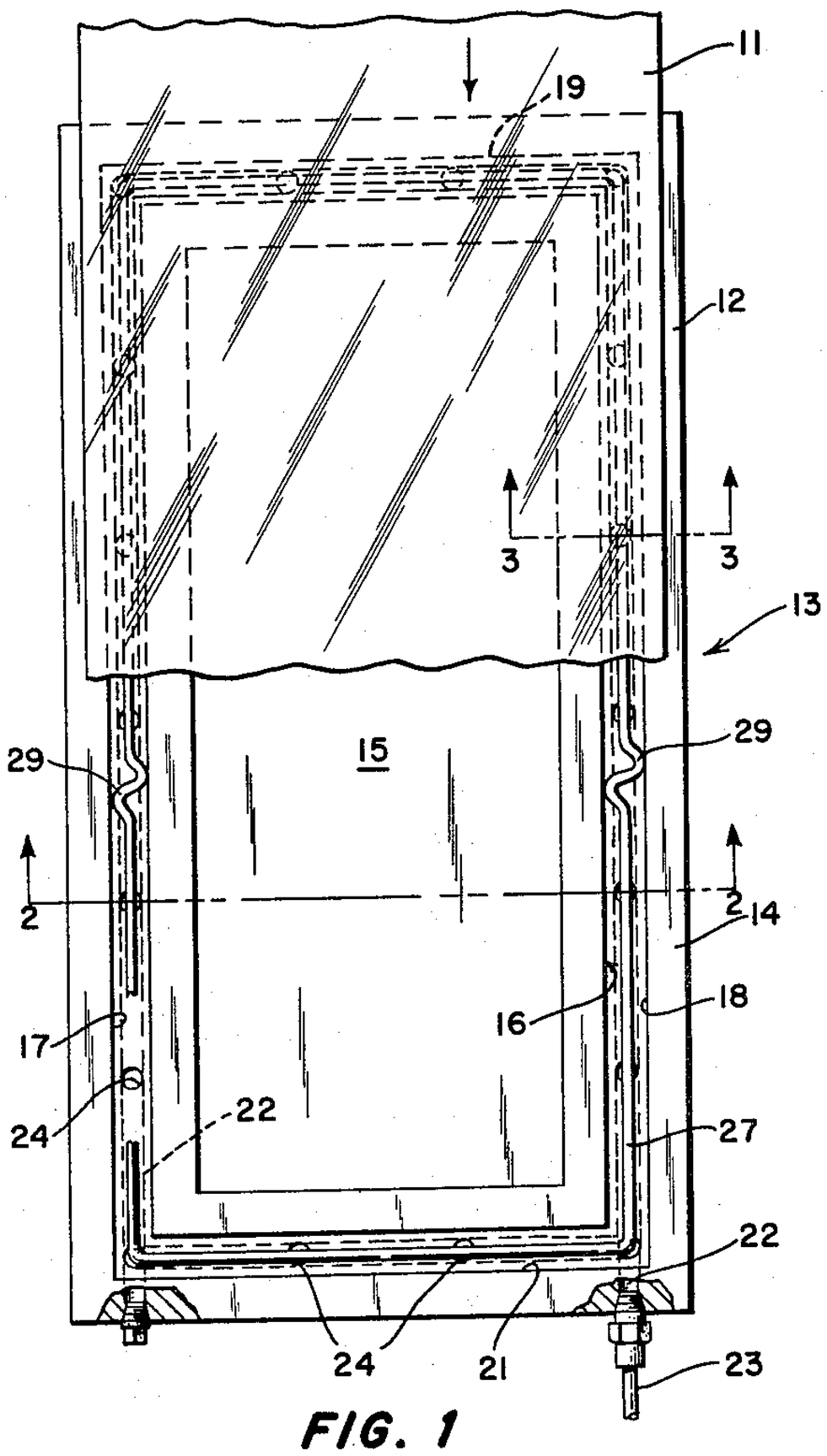

FIG. 1

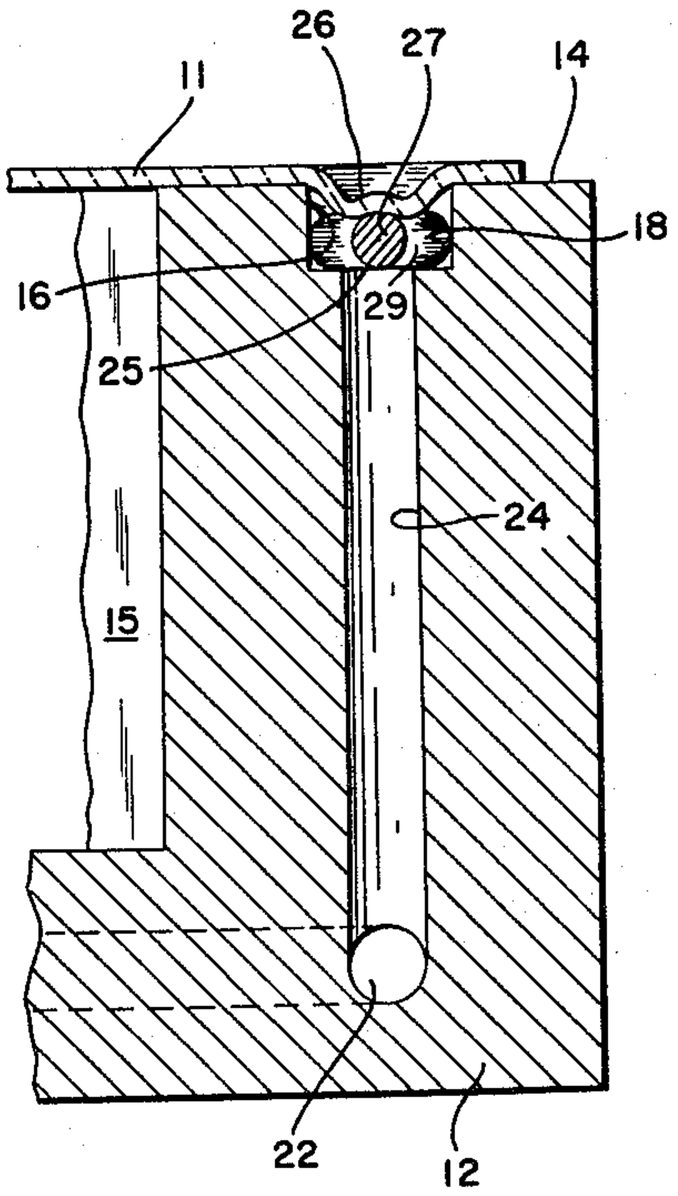

FIG. 3

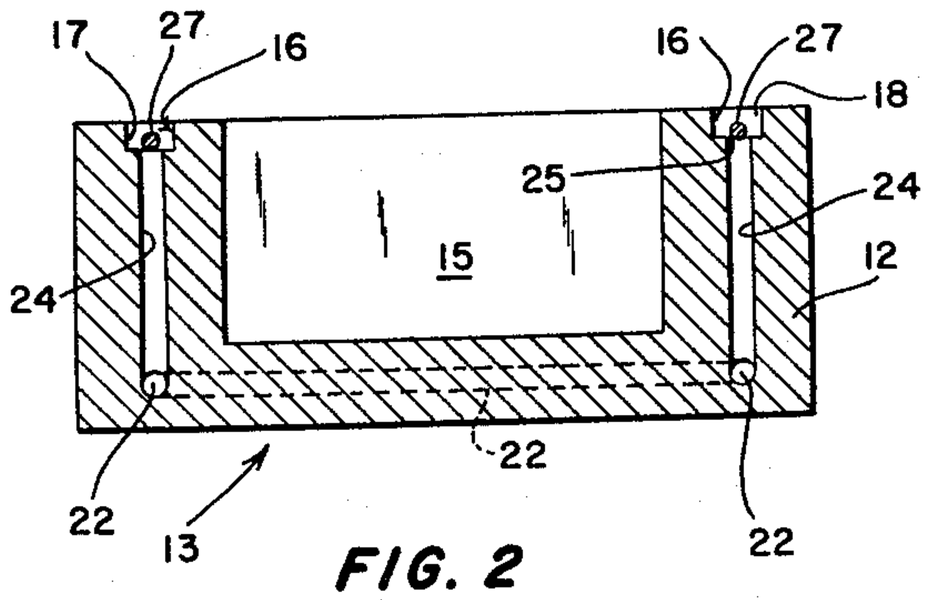

FIG. 2

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April 27, 1965 C. F. FISCHER 3,180,608

VACUUM HOLDING OF THIN PLIABLE MATERIAL

Filed Nov. 5, 1963 2 Sheets-Sheet 2

FIG. 4

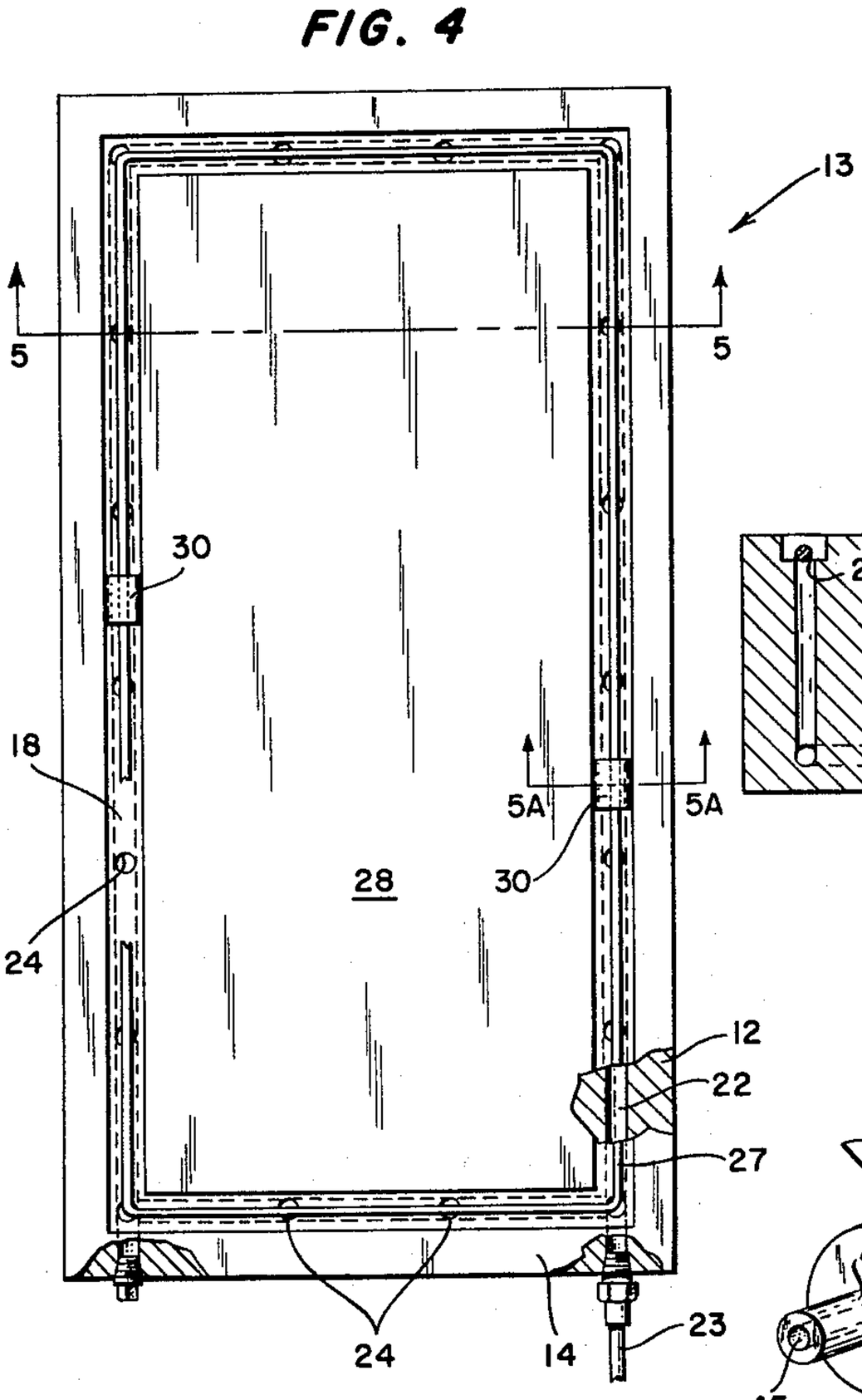
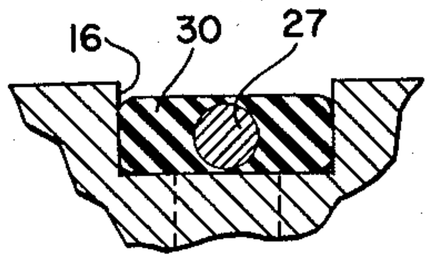


FIG. 5A



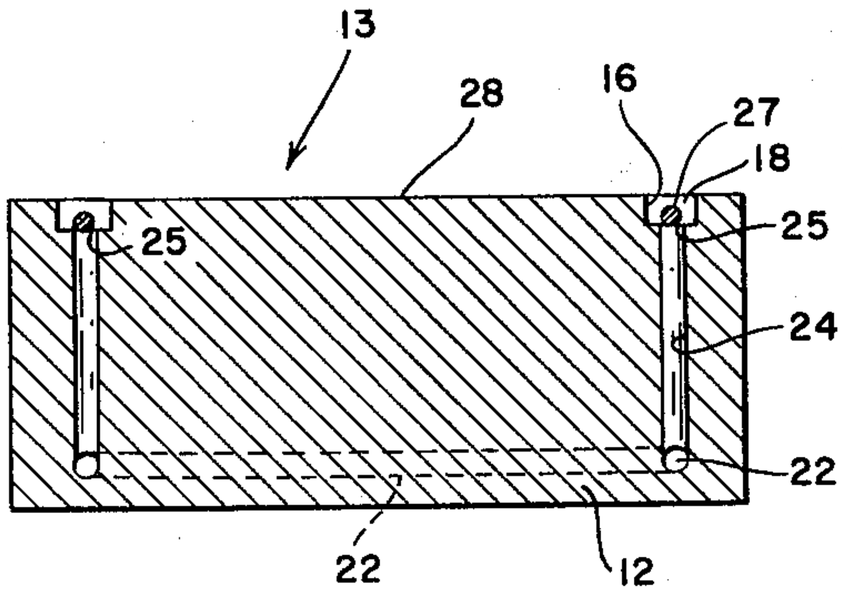


FIG. 5

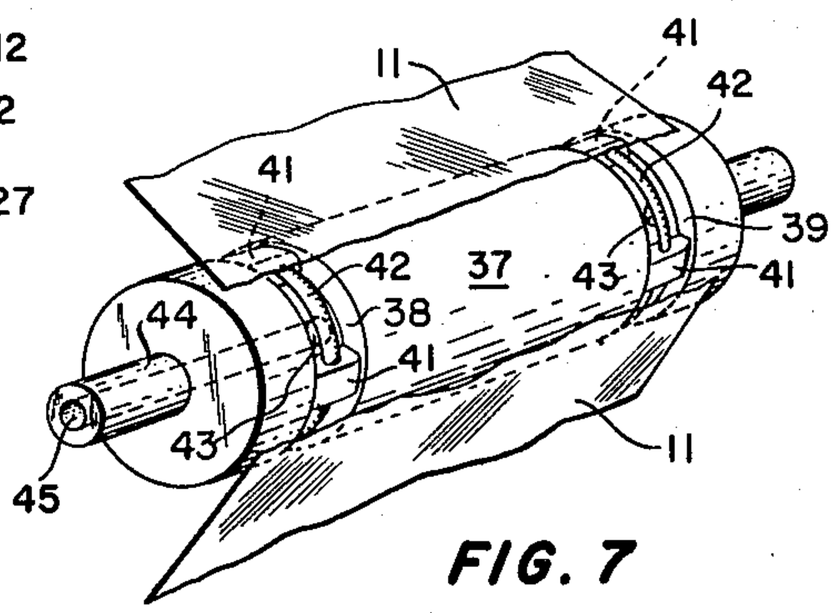


FIG. 7

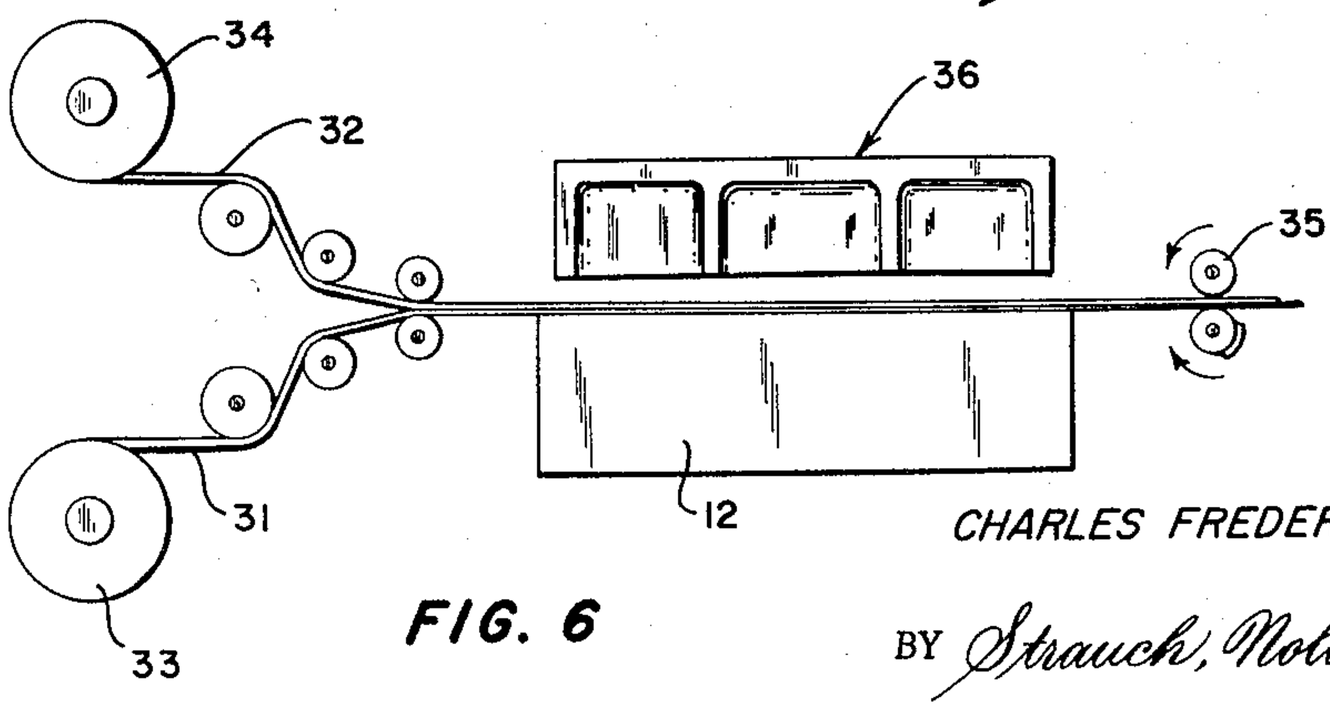


FIG. 6

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VACUUM HOLDING OF THIN PLIABLE MATERIAL

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11 Claims. (Cl. 248—363)

This invention relates to an arrangement for immovably holding flat in a fixed position without permanent stretching large area or endless sheets or webs of very thin pliable dry gas impervious material of film thickness and particularly to special vacuum holding apparatus for the purpose.

The use of thin pliable sheet material such as polyvinyl alcohol, cellulose acetate, polyethylene and the like having a thickness of only about 0.003" or less is currently common in packaging, and the speedy handling of large area individual sheets and endless webs of this relatively limp material has presented problems difficult of solution.

The present invention is concerned with the holding of such material for a short time in a fixed position where it must be maintained exactly flat over a desired area or surface without permanent stretching by some quickly applied and releasable arrangement that will not damage the material, and it provides a special vacuum locking arrangement whereby the sheet periphery is instantaneously locked upon a support and just as quickly released when desired. For handling water soluble films the apparatus must be moisture-free.

Vacuum holding supports for fairly thin sheets and photographic films for example have long been known, but the present invention provides a novel vacuum holding arrangement that is peculiarly adapted to the high speed handling of large areas of very thin limp pliable sheet material. Mechanical and adhesive types of devices for holding such material are usually too slow in action for high speed handling besides the danger of possibly injuring or marring the delicate sheeting.

It is the major object of the invention to provide a novel uniformly acting vacuum hold down arrangement for quickly peripherally locking and releasing large areas of very thin dry pliable sheet material in fixed flat wrinkle-free condition without permanent stretching.

Another object of the invention is to provide a novel uniformly acting vacuum hold down arrangement for locking large area thin pliable sheet material in fixed position over a surface which is grooved adjacent all or part of the periphery of the sheet and the grooving is connected to a suitable source of vacuum.

A further object of the invention is to provide a novel uniformly acting vacuum hold down arrangement for large area thin pliable gas impervious sheet material such as a sheet of cellulose acetate, polyethylene or like plastic of substantially film thickness wherein the surface underlying the sheet is grooved adjacent all or part of the sheet material periphery with a source of vacuum connected to spaced ports opening into the groove, and special means such as a wire or other stop element or elements in the grooving prevents the material from being drawn into the grooving sufficiently to block the ports without interfering with uniform application of suction to the sheet all along the grooving.

Further objects of the invention will appear as the description proceeds in connection with the appended claims and the annexed drawings wherein:

FIGURE 1 is a top plan view partly broken away showing the invention in a preferred embodiment;

FIGURE 2 is an end elevation in section on line 2—2 of FIGURE 1 showing the suction port and trap wire detail;

FIGURE 3 is an enlarged fragmentary end view in section at a suction port on line 3—3 of FIGURE 1 further showing the invention;

FIGURES 4 and 5 are views like FIGURES 1 and 2 respectively showing another embodiment of the invention where the thin sheet is locked over a continuous flat surface;

FIGURE 5*a* is a fragmentary section on line 5*a*—5*a* of FIGURE 4 showing a detail of the wire holding means;

FIGURE 6 diagrammatically illustrates a use of the invention; and

FIGURE 7 is a generally perspective view showing the invention applied to a cylinder.

Referring to FIGURES 1–3 an elongated transparent web 11 of thin pliable plastic sheet material is illustrated with a portion of its length overlying the rigid base 12 of a vacuum hold down assembly 13. In practicing the invention according to its preferred embodiment, it is required to handle film thickness sheets or webs only about 0.003 inch thick of a water soluble material such as polyvinyl alcohol currently used for premeasured packaging of detergents and the like, so that the package and contents may be thrown into the water and the contents dispersed when the film dissolves.

Base 12 is of the type having a horizontal smooth top web supporting surface 14 lying in a plane around a rectangular central recessed portion 15. Base 12 which is made of metal or some other hard substance is formed on surface 14 with grooving coupled to a source of vacuum. In this embodiment the grooving 16 is continuous all around the recessed portion 15, with parallel side grooves 17 and 18 connected at their adjacent ends by parallel transverse grooves 19 and 21. In some forms of the invention only side grooves 17 and 18 constitute the grooving.

Grooving 16 is relatively shallow and preferably wider than it is deep.

Below the level of grooving 16, base 12 is formed with a continuous suction conduit manifold 22, which extends all the way around recessed portion 15 in a closed loop preferably parallel to and a few inches below the grooving 16. At one corner a pipe 23 is connected into the conduit manifold and leads to a suitable source of vacuum (not shown).

A series of spaced vertical passages 24 connect the conduit manifold 22 to the grooving 16, and each passage enters the bottom of a groove through a port opening 25 which has a diameter much less than the width of the groove. Where only side grooves 17 and 18 are employed the manifold is connected to both side grooves.

As shown in FIGURE 1, the transverse width of base surface 14 is about equal to the width of the sheet material 11 which extends over and bridges both parallel side grooves 17 and 18. Also the sheet material 11 extends over both transverse grooves 19 and 21 so that it covers all of grooving 16.

For speedily locking the sheet material to base 12 suction is applied to manifold 22 through fitting 23, and since sheet material 11 is gas impervious, this draws the material tightly against surface 14. As shown in FIGURE 3, the sheet regions above the grooving are pulled downwardly into the groove as indicated at 26 with a force sufficient to draw the sheet material tight between the grooving sides but not sufficient to permanently stretch or rupture the thin material.

It will be noted, as shown in FIGURE 3, that the depressed sheet regions 26 drawn into the grooves sealingly engage the side edges of the grooving, so that the full suction force is applied to the sheet material 11 and there is no leakage to the grooving. In order to insure uniform holding all along the grooving it has been found desirable,

and usually necessary, to insure that the depressed material regions 26 are not drawn into covering relation with the ports 25. To avoid this the invention provides stop means which in this embodiment is a continuous wire 27 removably extending along the bottom of grooving 16 usually extending across the tops of all of the ports 25. Wire 27 is preferably removable from the grooving for cleaning both the wire itself and the grooving. In one form of the invention reverse lateral bends 29 are integrally formed in the wire. Bends 29 are of such lateral dimension as to have press fit within the groove and thereby provide a friction lock for removably maintaining the wire in the grooving and at the same time centering the wire with respect to the ports. Any suitable number of bends 29 may be provided.

Thus as the material is drawn into the grooving at 16 it encounters the stop wire and cannot seal around ports 25. In practice wire 17 is of much smaller diameter than port 25, so that the wire stop itself does not interfere with the application of suction to the grooving. Where film having only 0.003" thickness is handled, it is preferred to make grooving 16 about 3/16" to 3/32" deep and employ a 1/18" diameter stop wire. The grooving is about twice as wide as it is deep, and ports 25 are of larger diameter than the wire.

By thus providing stop means to prevent the sheet material from closing suction ports 25, the invention insures that a uniform suction force is exerted on the sheet material 11 all along the grooving 16. If one or more ports are blocked the pressure distribution may be uneven and the flimsy material could wrinkle as it is locked to the base.

For some purposes the grooving may consist only of the parallel side grooves 17 and 18 as pointed out above, and in such case the transverse pull on the sheet material exerted by the side grooves is adequate for holding the sheet immovable for a desired operation.

FIGURES 4 and 5 show another embodiment which is similar to FIGURES 1–3 as indicated by parts having the same reference numerals, one difference here being that the horizontal smooth top surface 28 of the base continuously underlies the sheet material 11. The grooving, manifolding and sheet stop arrangements are essentially the same, except that, as shown in FIGURES 4 and 5*a*, the removable friction interlock between the stop wire and the wire 27 may comprise one or more pads 30 of friction material such as rubber or a suitable plastic molded upon the wire 27 and press fitted into grooving 16. This also centers the wire above the ports 25. Also while these pads may divide the grooving by longitudinal partitioning they do not prevent substantially uniform application of suction all along the film edges.

Alternatively wire 27 may be spot anchored by adhesive attachment to the bottom of grooving 16 between ports 25.

While in the above embodiments sheet material 11 is illustrated in the form of a continuous web, the invention is of course equally applicable to holding large area sheets of the material on the base provided each sheet covers the suction grooving.

FIGURE 6 shows a usage of the invention, wherein continuous webs 31 and 32 of thin pliable thermosplastic material like that at 11 are drawn off reels 33 and 34 and guided over base 12. The lowermost sheet 31 is intermittently moved by feed rollers 35 the length of base 12 to feed both webs, and then the lowermost sheet 31 is locked to the base by the above-described suction hold down. The upper web will then lie flat on the lower web, possibly by electrostatic attraction. Then the gang heater 36 descends to weld certain web regions in a pattern, securing the web edges together to form a longitudinally tubular structure and imparting transverse welds for separate compartments. This mode of holding thin thermoplastic webs for heat welding has proved particularly valuable where the web material has a dissolving cycle of six seconds or less.

While the invention has been described in the foregoing embodiments as for holding thin sheets or webs upon flat surfaces it is equally applicable to curved surfaces such as cylinders for example as diagrammatically shown in FIGURE 7 wherein the cylindrical roller 37 is formed on its surface with grooving comprising parallel side grooves 38 and 39 adapted to underlie the edge regions of the thin film thickness web 11. In this embodiment the grooving must be partitioned longitudinally because the web 11 does not extend around the entire periphery. As shown in FIGURE 7 partitions 41 extend entirely across and block the grooves at intervals, and stop wires 42 extend between the partitions about suction ports 43. For example in one form these partitions may be tight groove filling blocks 41 wherein a flexible continuous wire 42 is imbedded removably inserted into the grooves, the wire permitting the necessary flexure to extend around the cylinder. Suction may be applied through a suitable coupling attached to the end shaft 44 of the cylinder and connected through axial passage 45 and suitable internal passages to the ports 43.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. A vacuum holding support for thin pliable gas impervious sheet material comprising means on said support defining a surface for underlying said sheet material, grooving in said surface connected to a source of vacuum through porting opening into said grooving whereby suction applied through said porting draws said sheet material against said surface, and means in said grooving blocking entry of said sheet material into said grooving sufficiently to block said porting whereby suction is maintained substantially along the length of said grooving.

2. A vacuum holding support for thin pliable gas impervious sheet material comprising means on said support defining a surface for underlying said sheet material, grooving in said surface adjacent the periphery of said sheet material, suction manifold means on said support connected to said grooving by passages ending in spaced ports along the bottom of the grooving, whereby suction applied through said manifold means draws peripheral portions of said sheet material into said grooving and locks the sheet material upon said surface, and stop means in said grooving preventing said sheet material drawn into the grooving from blocking any of said ports.

3. In the vacuum holding support defined in claim 2, said stop means comprising means in said grooving bridging said ports but not closing them.

4. In the vacuum holding support defined in claim 3, said means in the grooving comprising wire means of smaller transverse dimension than the ports extending along the grooving and across the ports.

5. In the vacuum holding support defined in claim 2, said grooving being continuous.

6. In the vacuum holding support defined in claim 2, said manifold means being a continuous conduit in said support having a coupling for connection to a source of vacuum.

7. In the vacuum holding support defined in claim 2, said stop means having removable frictional interlock with said grooving.

8. In the vacuum holding support defined in claim 7, said stop means being a wire lying along said groove formed with at least one lateral bend section frictionally engaged within said groove.

9. In the vacuum holding support defined in claim 7,

said stop means being a wire lying along said grooving and comprising friction pads mounted on said wire and press fitted into the grooving.

10. A vacuum holding support for large areas of very thin pliable limp sheet plastic material comprising means on said support defining a flat surface for underlying said sheet material, grooving in said surface for peripherally underlying at least two opposed side regions of said material, said grooving being relatively shallow in comparison with its side edges, suction manifold means on said support, a plurality of passages between said suction manifold means and said grooving terminating in spaced ports along the bottom of said grooving, said material being drawn into said grooving when suction is applied to said manifold but maintaining bridging sealing relation across

said grooving, and means in said grooving for preventing entry of said sheet material into said grooving sufficiently to block said ports.

11. In the vacuum holding support defined in claim 10, said last means being a wire extending along the bottom of said grooving.

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