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2,198,765	4/1940	Featherstone.....	51/235
2,666,979	1/1954	Van Dusen.....	29/148.2
2,910,265	10/1959	Anander.....	248/363
2,920,989	1/1960	Cochran.....	156/556
3,158,381	11/1964	Yamamura.....	248/362X
3,180,604	4/1965	Hammer.....	248/206
3,295,810	1/1967	Kintish.....	248/206

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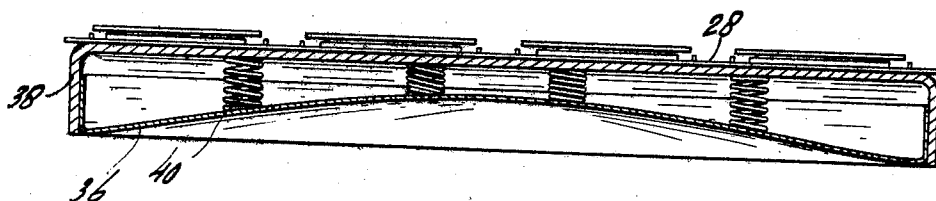
[54] **VACUUM MEMORY HOLDING DEVICE**
9 Claims, 9 Drawing Figs.

[52] U.S. Cl..... **248/362,**
269/21
 [51] Int. Cl..... **F16m 13/00**
 [50] Field of Search..... **248/362,**
363, 206; 269/21; 51/235

[56] **References Cited**
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ABSTRACT: A vacuum memory holding device of the type used as a tray for rigidly supporting a plurality of waferlike objects in a spray-coating chamber. The device includes a top plate having a plurality of apertures as a support for each one of the wafers and a bottom vacuum chamber from which the vacuum is drawn. The vacuum chamber includes a resilient wall which is collapsed as the vacuum is drawn and serves to hold the vacuum independently and rigidly support the waferlike objects during the spray-coating operation without being connected to the vacuum-drawing source.



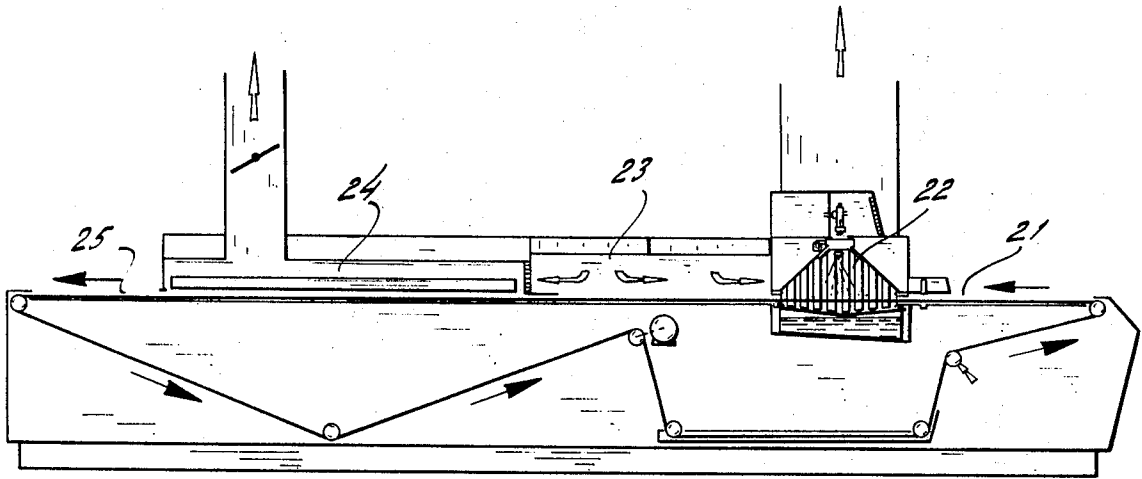


FIG. 1

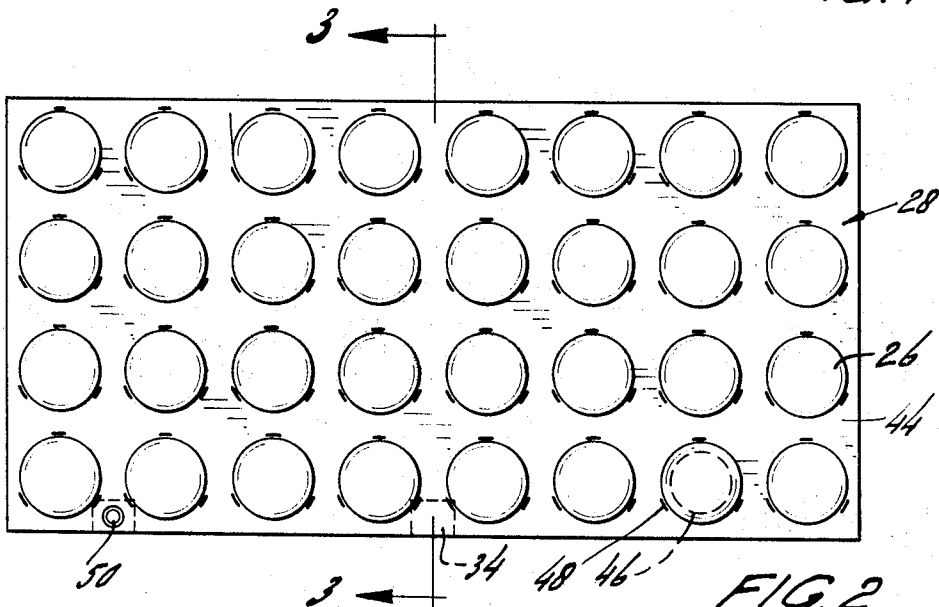


FIG. 2

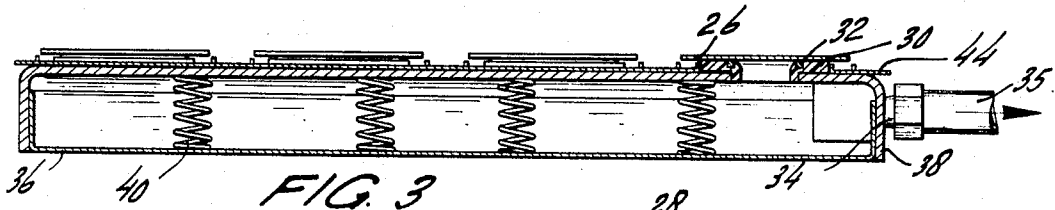


FIG. 3

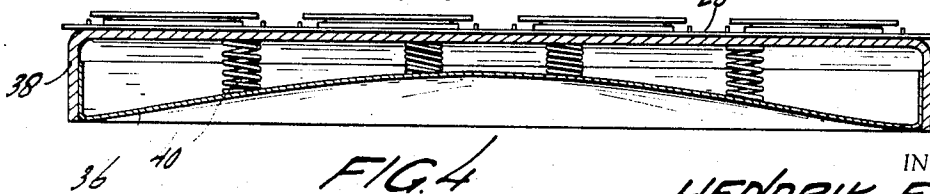


FIG. 4

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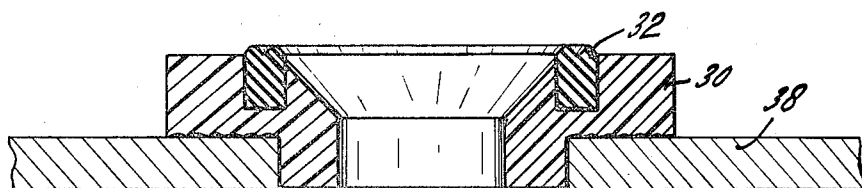


FIG. 5

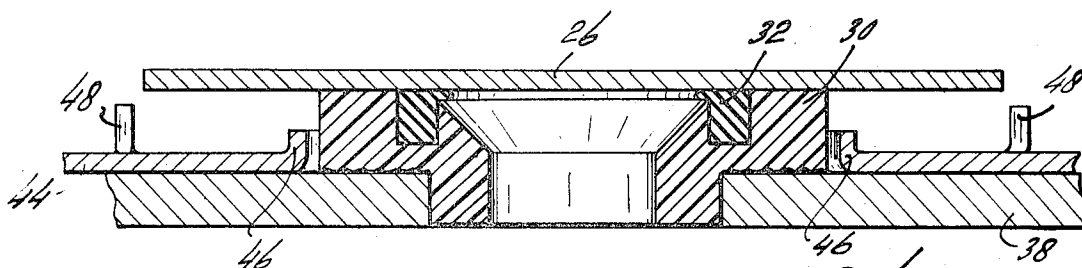


FIG. 6

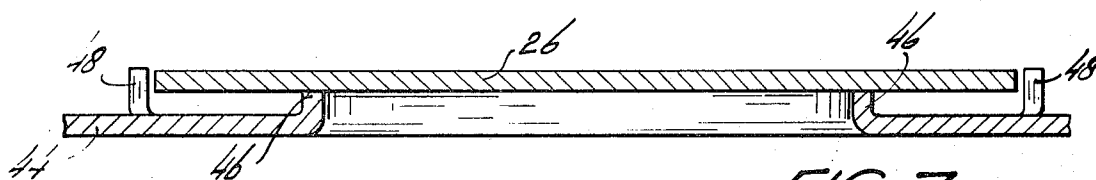


FIG. 7

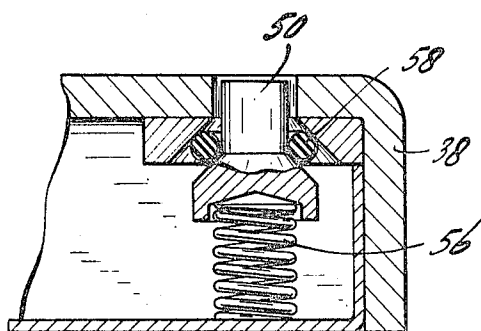


FIG. 8

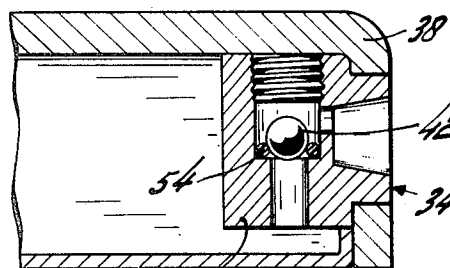


FIG. 9

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VACUUM MEMORY HOLDING DEVICE

BACKGROUND OF THE INVENTION

Spray-coating substrates such as silicon wafers, glass, and ceramic chips used in the electronic industry are handled in a conveyORIZED spray-coating and drying system. The substrates to be coated are extremely light and thin with a relatively large, flat surface and are thus subject to easy displacement by the spray pattern of the reciprocating spray-coating gun, as well as the forced air flow in the air-drying section and infrared oven. Conventional processing fixtures utilize vacuum chucks, suction cups, and the like. However, these fixtures require continuous suction by a vacuum source and, if processed on a conveyORIZED system, require a flexible hose extending from the vacuum to the individual substrate tray as it is processed through the spray-coating and drying portions of the conveyor. However, the use of the connecting hoses is difficult in both environments, and the infrared drying cycle in itself is highly deleterious to the hose.

DESCRIPTION OF THE PRIOR ART

Prior art searching has developed the following:

Featherstone	2,198,765
Van Dusen	2,666,979
Anander	2,910,265
Cochran	2,920,989
Hammer	3,180,604
Kintish	3,295,810

The prior art has principally concerned itself with devices requiring drawing of a continuous vacuum. Anander and Featherstone are typical in this respect. The Featherstone device is used for handling glass plate. The Anander device is used for supporting a photographic sheet and includes a ball check valve adjacent the aperture. Kintish has developed a tape having a plurality of carefully spaced suction cups for use in underwater applications. Van Dusen draws a vacuum between the two walls in an ice chest (FIG. 3) and utilizes a peripheral seal to hold the vacuum.

Cochran and Hammer show movable vacuum cups provided with conventional resilient liners, pulled away from the surface which they contact. The Hammer device is used for supporting an x-ray cassette, and the Cochran upper and lower cups 224 and 240 (FIG. 2 and FIG. 7) are used for handling plate glass. In FIG. 7, the flexing of the resilient member away from the glass plate is illustrated in phantom.

SUMMARY OF THE INVENTION

The present invention is directed to a fixture for independently supporting such substrates during the spray-coating and drying cycles without being connected to the vacuum source. The holding fixture permits processing through a spray-coating and drying cycle with a vacuum holding memory of at least ten minutes.

The invention includes a relatively rigid top plate apertured as a support for a plurality of wafers and a flexible bottom interconnected with the top plate by a plurality of compression springs. As a vacuum is drawn through the sides of the device, the bottom plate is collapsed towards the top plate and the substrates are secured on the individual apertures. A separate vacuum release valve is provided to return the environment to atmospheric.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of a conveyORIZED system embodying, from left to right, substrate loading area, spray-coating station, air drying section, infrared drying oven, and unloading area;

FIG. 2 is a top plan of the device, supporting 32 silicon wafers;

FIG. 3 is a transverse section, taken along section line 3-3 prior to drawing of the vacuum through the vacuum port;

FIG. 4 is a similar transverse section after drawing of the vacuum, showing the bottom as collapsed towards the top plate;

FIG. 5 is a fragmentary enlarged section of an individual vacuum port, showing the nonconducting resilient liner prior to placing the tray and drawing of the vacuum;

FIG. 6 is a like fragmentary sectional view showing the positioning of the wafer upon the resilient liner and the positioning of the tray relative to the liner, as the vacuum is drawn;

FIG. 7 is a fragmentary elevation of the tray supporting a wafer apart from the top plate and its resilient liner;

FIG. 8 is a fragmentary elevational view of the vacuum release valve 50 extending through the top plate; and

FIG. 9 is a fragmentary vertical sectional view of the vacuum port extending through the fixture side.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Each substrate 26 is placed on a specially formed substrate support 30 as shown in FIGS. 4 and 5. The individual support 30 has a low diameter, solvent resistant, special rubber ring 32 for vacuum seal. During loading (FIG. 3), the substrates 26 are placed onto the holding fixture while a vacuum source 34 evacuates the air from inside the fixture. After the last substrate has been placed, all substrates 26 are pulled down to lay flat on the substrate supports 30. Seal ring 32 is compressed to form even a larger seal area, capable to hold the formed vacuum. Vacuum source then is removed from the holding fixture 34.

The bottom plate 36, made of much lighter stainless steel than top plate 38, is pulled in by the vacuum, and, because of its capability to return to a flat condition, aided by springs 40, it can compensate for any slight leak through either the seal rings 32 or check valve 42 for a reasonable time, thus forming a vacuum hold or "memory." In order to protect the holding fixture surface from being coated, a stainless steel cover tray 44 is placed onto top plate 32 in such a way that the substrate supports 30 protrude through the round hold flanges 46, FIGS. 3 and 6.

As illustrated in FIG. 6, after the coating/drying cycle, valve 50 is momentarily pushed in, thus relieving the vacuum. The cover tray 44 then is pulled up, lifting all the substrates from the holding fixture for further processing (FIG. 7).

Cover plate 44 can also be used in combination with automatic loading of substrates 26. This is important when automatic substrate cleaning procedures are being used. For this purpose, cover plate 44 has, besides the punched out, round flanges 46, which fit over the substrate supports 30, also groups of three punched out lips, FIG. 7. This allows proper centering of the substrate. In case the substrates are square, groups of four punched out lips 48 would be used.

The substrate supports 30 are made of a nonheat conducting material such as Delrin, Teflon, Nylon etc. After the spray and air dry cycle, the substrates are heated in the infrared oven 25. It is important that this substrate support 30 be made of a material which would not conduct heat to the holding fixture as not to delay the proper drying of the substrate. It was found that the substrate supports 30 can be made economically by molding. This would allow easy makeup of the top plate 44 by simply drilling tight fit holes and epoxy gluing the substrate supports 30 to the top plate 38.

As will be apparent, the vacuum memory is set by the pulling in of the resilient bottom plate 36, as illustrated in FIG. 4, as the vacuum is drawn. After the vacuum hose 35 is disconnected, check valve 42 is urged into compression against O-ring seal 54 supported within valve seat 52. The check valve 42, thus pressurized by atmospheric pressure, prevents air from entering the evacuated area. The vacuum is easily released by depressing valve 50 which extends through the top plate and is urged into compression against O-ring seal 58 by means of compression spring 56.

The substrate supports or liners 30 may be especially molded so that their diameter is smaller than the diameter of

substrate 26. Thus, over-spray onto top plate 38 is prevented. As will be apparent, cover tray 44 fits underneath the wafers 26 as an additional guard against over spray coating. Liners 30 are made of a nonheat conducting material to prevent improper drying of the substrates 26 in the infrared oven. A very soft durometer rubber ring 32 is placed as an annulus in the top of liner 30. Prior to drawing of the vacuum, the top of ring 32 protrudes above the surface of liner 30, as illustrated in FIG. 5. As the vacuum is drawn, ring 32 is flattened as substrate 26 is pulled downwardly to lay flat on top of liner 30, as illustrated in FIG. 6. Top cover tray 44 is made from thin stainless steel punched so as to have round-hole flanges 46 surrounding the support 30 and punched out lips 48 for proper lateral alignment of the substrates for use in automatic loading.

Manifestly, the configuration of the top plate and cover tray, as well as the placement of apertures and valves, may be varied without departing from the spirit of the invention.

I claim:

1. A vacuum memory holding device comprising:

- A. a rigid top plate and downwardly depending sides, the top having a plurality of apertures as a support for a plurality of objects, said apertures including a nonheat conducting resilient liner extending above the top plate as individual supports for said objects and said nonheat conducting liner having a soft inner ring extending above the liner when not compressed and compressible by the force of an object supported thereon, so as to lie flush with said liner, as the vacuum is drawn and the sides having a vacuum port;
- B. a resilient bottom secured to said sides and connected to said top by a compression spring;
- C. a check valve mounted in said vacuum port;
- D. a vacuum source connected to said vacuum port such that drawing of a vacuum through said port secures objects to said apertures and compresses said resilient bottom towards said rigid top; and
- E. a tray removably supported upon said top plate and having a plurality of object apertures corresponding to said

apertures in said top plate, such that objects may be placed upon said top plate apertures by setting said tray with objects covering its apertures, on said top plate.

2. A vacuum memory holding device as in claim 1, said object apertures in said top plate having a vertically raised peripheral lip concentric with and surrounding said apertures in said top plate.

3. A vacuum memory holding device as in claim 2, said object apertures in said tray further including:

- i. inner lips; and
- ii. outer lips, said inner lips being of lower profile than said outer lips, such that when said tray is removed from said top plate, said objects are supported on said inner lips within the peripheral confines of said outer lips.

4. A vacuum memory holding device as in claim 3, including an independent vacuum release valve extending through an ingress port in said top plate, said vacuum release valve including a compression spring urging said valve to close said port and against an O-ring seal.

5. A vacuum memory holding device as in claim 4, said vacuum port including a ball check valve seated upon an O-ring, such that atmospheric pressure closes said valve against said O-ring when said vacuum source is removed.

6. A vacuum memory holding device as in claim 5, said resilient liner including an outer flange extending over said top plate and being laterally inwardly inclined towards the axis of the individual apertures.

7. A vacuum memory holding device as in claim 9, the diameter of the resilient liner being smaller than the object to be supported thereon, so as to prevent spray coating of the top plate.

8. A vacuum memory holding device as in claim 7, the soft inner ring extending vertically above the resilient liner and laterally inwardly of the inclined portion of said liner.

9. A vacuum memory holding device as in claim 8, said tray inner and outer lips for said top plate object apertures respectively including round-hole flanges and three or more punched out lips extending vertically above said hole flanges.