United States Patent

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[54] **AIR SLIDES**

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[52] **U.S. Cl.** **302/31**

[51] **Int. Cl.** **B65g 53/30**

[58] **Field of Search** 302/31

[56] **References Cited**

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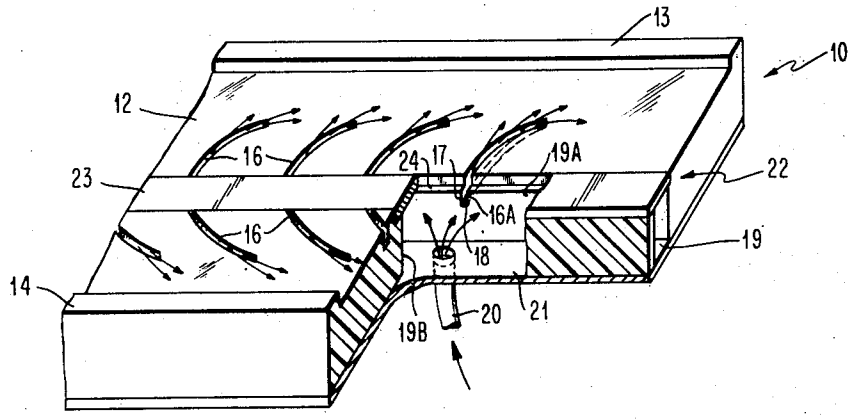
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[57] **ABSTRACT**

An air slide for imparting both lift and direction to a semiconductor wafer, the air slide comprising a guide plane having a plurality of arcuate recesses in the surface thereof, the recesses having side and bottom walls with the bottom wall of each of the recesses having an upward slope which merges into the surface of the guide plane substantially in the direction of intended motion of the semiconductor wafer. In the embodiment shown, a longitudinally extending plenum chamber may be connected so as to underlie the track or be positioned at opposite lateral edges of the track, the edge connection of the plenum chambers enhancing the ability for close spacing and thus tiering of the guide planes. Additionally, disclosed are two basic track structures which permit of alternate air supply sources, such as a fan or high pressure air.

14 Claims, 7 Drawing Figures



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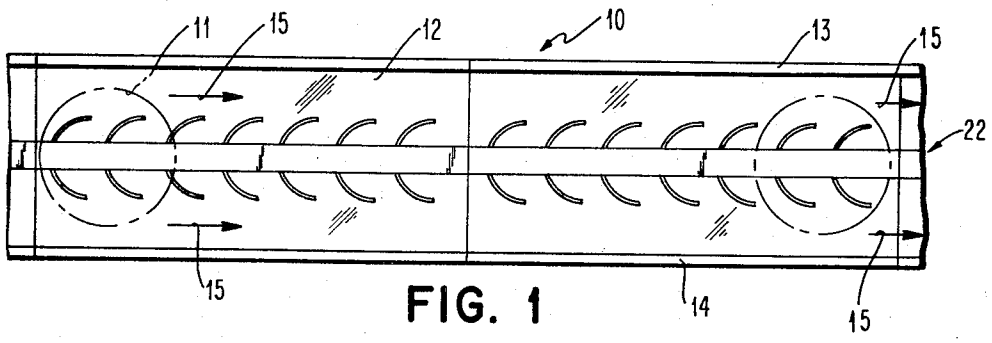


FIG. 1

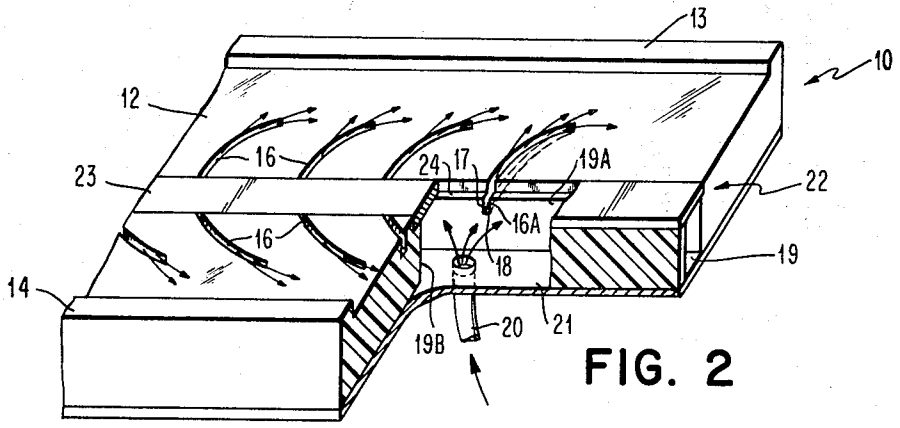


FIG. 2

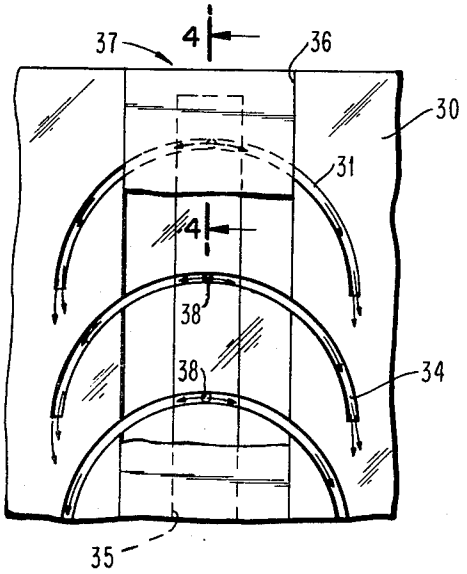


FIG. 3

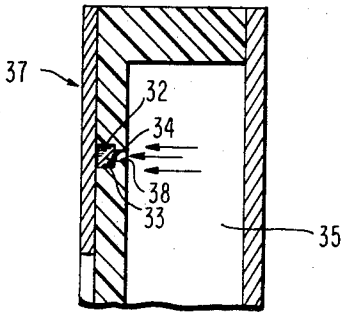


FIG. 4

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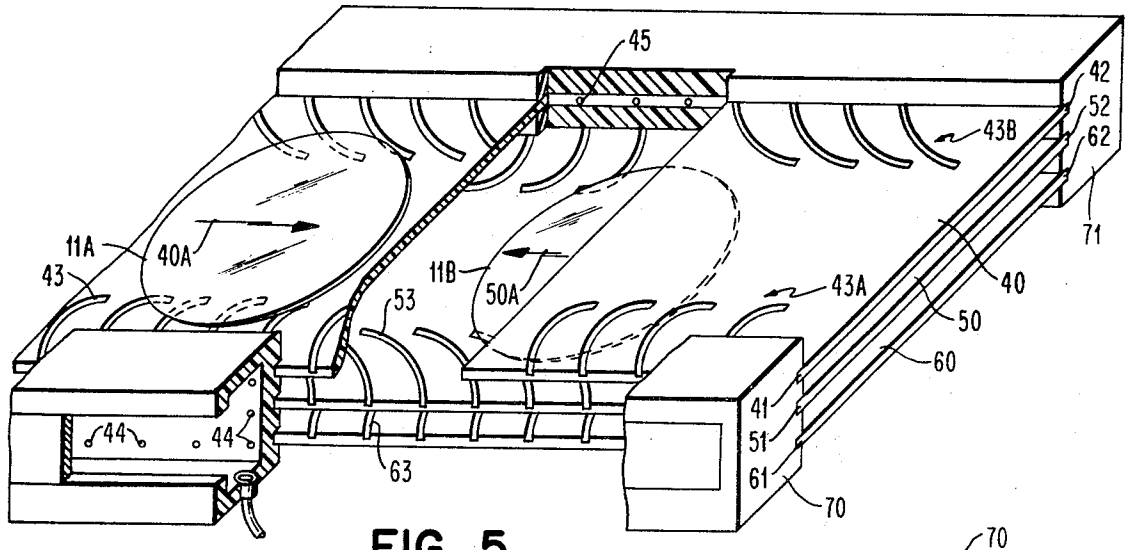


FIG. 5

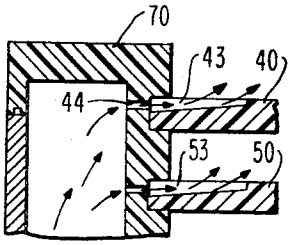


FIG. 6

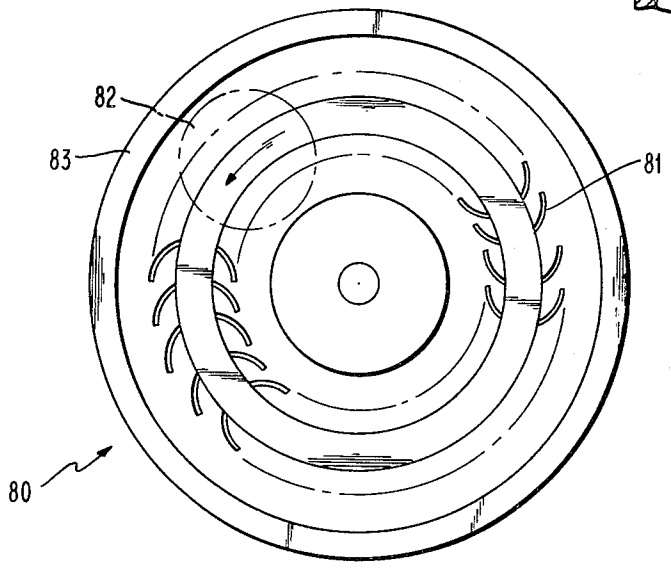


FIG. 7

AIR SLIDES

SUMMARY OF THE INVENTION AND STATE OF THE PRIOR ART

The present invention relates to air slides and more particularly relates to air slides for imparting both lift and direction to a workpiece positioned on the track, the slides being characterized by arcuate recesses with upwardly sloped bottom walls to permit air to egress with both a lift and direction component.

In the transport of semiconductor wafers, i.e. thin slices of silicon, it is desirable to eliminate, or at least reduce, human contact with the wafer wherever possible to prevent contamination or injury to the surface of the wafer. Conventional air lift and directional movement equipment is hampered by a high cost per foot and because of the volume of air requirements and/or pressure requirement require expensive auxiliary air supply equipment regardless of the length of track required. Additionally, existing state of the art slides conventionally require large bulky plenum chambers which creates problems in tiering the slides for multidirectional transport, especially where close spacing requirements are demanded.

In view of the above it is a principal object of the present invention to provide a novel air slide for imparting both lift and direction to a workpiece placed thereon.

Another object of the present invention is to provide an air slide which is adaptable for both long and short runs to permit the supply of air thereto to be accomplished by existing in house air supply systems or a simple fan.

Yet another object of the present invention is to provide an air slide which may be easily tiered so as to permit simultaneous sending and receiving of workpieces in which the limitation of tier spacing is the height of the object.

Still another object of the present invention is to provide an air slide which is simple in operation and manufacture and which may be fabricated from inexpensive materials.

Other objects and a fuller understanding of the invention may be had by referring to the following specification and claims taken in conjunction with the accompanying drawings in which:

FIG. 1 is a fragmentary schematic plan view of an air slide constructed in accordance with the present invention;

FIG. 2 is an enlarged fragmentary perspective view of a portion of the air slide shown in FIG. 1;

FIG. 3 is an enlarged fragmentary plan view of another embodiment of an air slide constructed in accordance with the present invention;

FIG. 4 is a fragmentary sectional view taken along line 4—4 of FIG. 3;

FIG. 5 is a fragmentary perspective view of another embodiment of the air slide of the present invention;

FIG. 6 is a fragmentary side elevational view of a portion of the slide shown in FIG. 5; and

FIG. 7 is a plan view of another embodiment of the air slide of the present invention being used as a turntable transport.

Referring now to the drawings, and particularly FIG. 1 thereof, an air slide or track 10 particularly adapted for imparting lift and direction to a workpiece, in the illustrated instance a semiconductor wafer 11, is illustrated therein. The air slide or track, in the embodiment illustrated in FIGS. 1 and 2 includes a guide plane 12 bounded on opposite longitudinal edges, in the present instance with low upstanding walls 13 and 14 which serve to prevent the workpiece or wafer 11 from being laterally discharged off of the slide.

In accordance with the invention, means are provided in the guide plane 12 for imparting lift to the workpiece while propelling the same (when provided with a suitable flow of gaseous media) along the direction shown by the arrows 15 in FIG 1. To this end, a plurality of arcuate narrow recesses 16, each having closely spaced upstanding side walls 17 and an upwardly sloped bottom wall joining the side wall 18, is provided. In the illustrated instance, and for reasons which will become evident hereinafter, the bottom wall 18 of each of the recesses merges into the guide plane at a point so as to cause air to flow substantially in the direction of intended motion of the workpiece.

In order to permit entry of a gaseous media into the arcuate recesses, a plenum chamber is connected to the recesses to thereby permit a flow of air along the recesses in a direction substantially along the axis of the recess, i.e. up the sloped bottom wall 18. To this end, the air slide or track 10, in the embodiment illustrated in FIG. 2, includes a longitudinally extending channel 19 which serves as the plenum chamber for the air slide. In the illustrated instance the channel 19 bisects the arcuate recesses forming a clear passage for air or other gaseous media to enter into the plenum chamber as by inlet means 20. The lower portion of the channel 19 may be closed as by a support plate 21 or the channel may be formed directly in the material of the track 10.

In order to cause the air entering the inlet means to flow in a direction substantially along the axis of the arcuate recesses, cover means 22 close off the upper surface of the channel 19 forming the upper surface of the plenum chamber. In the illustrated instance (FIG. 2) the cover means includes a longitudinally extending strip 23 which is fittable into a ledge-shaped recess 24 cut into the side walls 19A and 19B of the channel 19. In this manner the air inlet openings from the plenum chamber into the recess form an orifice 16A defined by the underside of the strip 23, and the side and bottom walls 17 and 18 respectively of the recesses 16. Thus the cover means 22 serves as a baffle to cause air to flow from the plenum chamber into the air recesses in a direction substantially along the axis of the recesses.

In the embodiment illustrated in FIGS. 1 and 2 a simple muffin fan may be connected to the inlet means 20 and effect sufficient air flow to cause the workpieces to be lifted above the surface or guide plate 12 while imparting direction to the workpiece. For example, using a "Rotron" muffin fan with approximately 100 C.F.M. at zero (0) static pressure, approximately 10 feet of track may be serviced. With ten (10) feet of track length the static pressure restricts the fan output to roughly twenty (20) C.F.M. Of course multiple fans may be utilized spaced along the track at appropriate intervals depending upon, of course, the cubic feet per minute rating of the fan, the size of the recesses and of course the orifice 16A.

In the event that it is desired to utilize the air track of the present invention for long runs while utilizing the in-house plant air system, a more efficient air flow or reduced air flow is required.

To this end the embodiment illustrated in FIGS. 3 and 4 may be employed. Referring now to those figures, a guide plane **30** includes a plurality of arcuate recesses **31**, each having upstanding side walls **32** and **33** and upwardly sloped bottom walls **34**. The bottom wall of each of the arcuate recesses merges into the guide plane at a point so as to cause air to flow substantially in the direction of intended motion of the workpiece. The nature of the recess is in effect the same as that disclosed in FIGS. 1–2 and above described. In order to permit entry of a gaseous media such as air into the arcuate recesses **31** a plenum chamber **35** is formed in a similar manner as described hereinbefore. A longitudinally extending recess **36** is provided in the guide plane **30** and adapted for receiving cover means **37** identical to the cover means **22** described relative to FIGS. **1** and **2**. However, the depth of the arcuate recesses in such that the recesses do not intersect the plenum chamber **35**. Accordingly, an aperture or orifice **38** may be formed through the arcuate recess into the plenum chamber substantially along the center line of the recess **36** thus providing fluid communication between the plenum chamber **35** and the recesses **31**. The small orifices **38** then lie in a plane substantially perpendicular to the guide plane such that when the cover means **37** is in position, air is directed along the axis of the arcuate recesses causing the air flow to egress in a forward and upward direction out of the guide plane **30**.

As the apertures or orifices **38** may be relatively small, the volume of air flow is reduced but of necessity the air pressure interiorally of the plenum chamber must be increased due to the increase in resistance. Thus with an air slide of this construction, a low pressure in-house air supply may be used.

The structure of the present invention permits the tiering of the air slides so that a multiplicity of workpieces may be transported simultaneously in the same or opposite directions. To this end and as best illustrated in FIGS. **5** and **6**, a plurality of guide planes **40**, **50** and **60** are shown in superimposed juxtaposition relation, in the illustrated instance each of the guide planes being connected to a plenum chamber **70**, **71** disposed along the opposite longitudinally extending edges **41**, **42**, **51**, **52**, **61**, **62** of the guide planes.

The arcuate recesses **43**, **53**, **63** formed in the surface of each of the guide planes **40**, **50** and **60** each have upwardly sloped bottom walls which merge into the surface of the respective guide planes so as to impart both lift and direction to workpieces such as wafers **11** in the direction of intended motion (see arrows **40A**, **50A**). As illustrated the recesses in each of the planes is formed in left and right hand sets, for example, the left hand set **43A** in guide plane **40** being connected to plenum chamber **70** through suitable orifice-like apertures **44**, and the recesses **43B** in the right hand set being connected through apertures or orifices **45** to the plenum chamber **71**. Inasmuch as the plenum chambers are positioned along the longitudinal edges of the guide planes, the guide planes may be spaced one from the other in juxtaposition or superimposed relation at very close intervals. Additionally, the recesses may be formed in opposite directions, such that the wafer **11A** supported above guide plane **40** is caused to be transported from left to right, while the wafer **11B** which is supported above guide plane **50** intermediate guide plane **40** and **50** is caused to be transported in the opposite direction.

In certain instances where it is desirable to inspect workpieces or objects as they move by a variety of work stations, an inexpensive air slide constructed in accordance with the present invention may be utilized in lieu of a turntable. For example, the air slide may be constructed in the form of a circular track **80** having a plurality of arcuate recesses **81** similar to that heretofor described. In that event the workpiece **82** may be transported in a circular fashion about the track by placing the workpiece **82** on the slide and transported from one station to any other station disposed about the perimeter of the track without rotation thereof. Of course means, in the present instance an upstanding annular wall **83**, must be provided to prevent centrifugal force from ejecting the workpiece radially outward from the track.

The slide of the present invention may be constructed of any convenient material such as nylon, "Delrin" (trademark of DuPont de Nemours) etc. the recesses being formed either by molding, or even angulating a circular hole saw.

Thus the present invention provides a novel air slide for imparting both lift and direction to a workpiece, the air slide being readily adapted for both long and short runs to permit the supply of air thereto to be accomplished by existing in-house air supply systems or a simple fan arrangement. Additionally, the present invention is easily adapted to permit simultaneous sending and receiving of workpieces at or by tiering the slides thereby effecting spatial economies.

Although the invention has been described with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be made without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. An air slide for imparting lift and direction to a workpiece placed thereon; said air slide comprising: a track including a guide plane having a plurality of narrow elongated arcuate recesses in the surface thereof, each of said recesses having closely spaced side walls and a bottom wall joining said side walls, said bottom wall being sloped upwardly and merging into said guide plane substantially in the direction of intended motion of said workpiece, a longitudinally extending plenum chamber connected to said track, and means connecting said plenum chamber to said recesses, and means to cause air to flow from said plenum chamber into said arcuate recesses in a direction substantially along the axis of said recesses.

2. An air slide in accordance with claim **1** wherein said plenum chamber underlies said track.

3. An air slide in accordance with claim **2** including a longitudinally extending recess in the upper surface of said air slide, a channel underlying said recess and extending longitudinally along said track, said channel

being in fluid communication with said arcuate recesses.

4. An air slide in accordance with claim 3 wherein said channel extends from said longitudinally extending recess and forms part of said plenum chamber.

5. An air slide in accordance with claim 3 including a bottom wall in said longitudinally extending recess, and a plurality of apertures in said bottom wall extending through said bottom wall and providing said means for fluid communication between said plenum chamber and said longitudinally extending recess.

6. An air slide in accordance with claim 3 including cover means overlying said longitudinally extending recess.

7. An air slide in accordance with claim 1 wherein said plenum chamber is disposed along at least one longitudinal edge of said guide plane.

8. An air slide in accordance with claim 7 including a second plenum chamber disposed along the opposite longitudinally extending edge of said guide plane.

9. An air slide in accordance with claim 7 including a plurality of guide planes in superimposed juxtapositioned relation, each of said guide planes being connected to said plenum chamber.

10. An air slide in accordance with claim 8 wherein said arcuate recesses are arranged in a set, one of said set being coupled to one of said plenum chambers and the other of said set being coupled to the other of said plenum chambers.

11. An air slide in accordance with claim 10 including a plurality of guide planes in superimposed juxtapositioned relation, each of said guide planes being connected to each of said plenum chambers and having recesses arranged in sets.

12. An air slide in accordance with claim 11 wherein said set of recesses in one of said guide planes is disposed to impart direction to a workpiece opposite to the direction of a second workpiece supported by another of said guide planes.

13. An air slide in accordance with claim 1 wherein said track is circular in shape, forming a turntable.

14. An air slide in accordance with 13 including wall means along the periphery of said track.

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