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Jelich

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[54] **HOT TUBE HANDLING DEVICE**

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[52] **U.S. Cl.** ..... **294/27 R,** 224/45 W, 248/153, 294/1 R, 294/31.2

[51] **Int. Cl.** **B65d 61/00**

[58] **Field of Search** ..... 294/1, 15, 16, 27, 28, 294/31.2, 104, 113, 67 BA; 224/45 R, 45 A, 45 P, 45 W, 50-55; 16/110.5, 119, 120, DIG. 24, DIG. 25; 248/96, 146, 153, 311, 312, 313, 471, 175; 215/100 A; 220/95, 96

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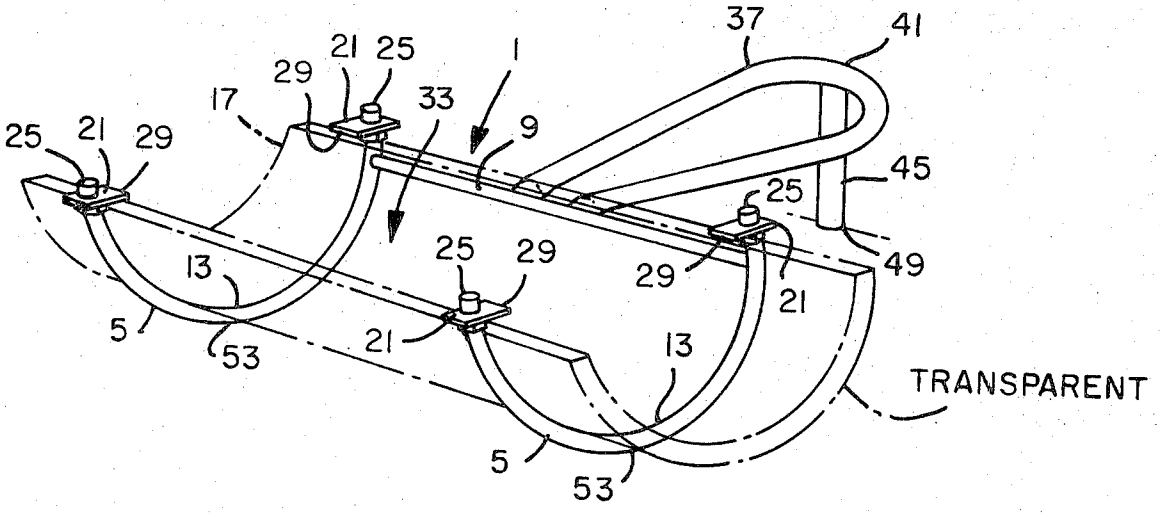
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[57] **ABSTRACT**

The invention comprises a device for handling, transporting and positioning hot quartz cradles or "boats" containing hot semi-conductor wafers in cylindrical or hemi-cylindrical tubes wherein the tubes are kept in such position that the axis of the tubes and also the axis of the cradles are kept substantially parallel to a horizontal surface. The device includes a frame which will matably receive the cylindrical surface of a body having a cylindrical surface, means for securing the cylindrical surface of the body to the frame and a handle attached to the frame for moving the device.

4 Claims, 3 Drawing Figures



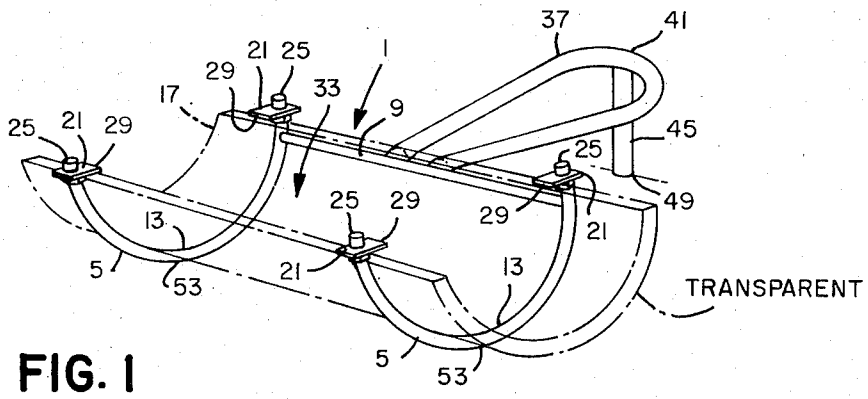


FIG. 1

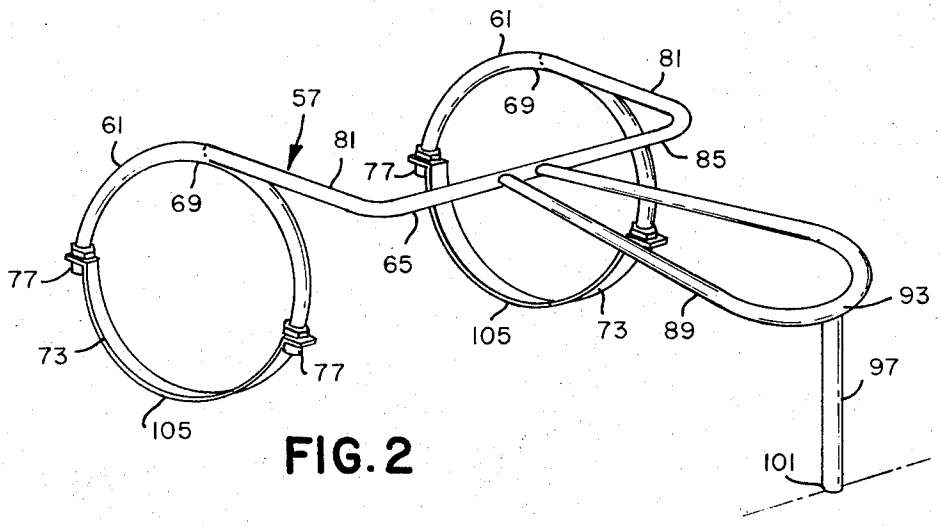


FIG. 2

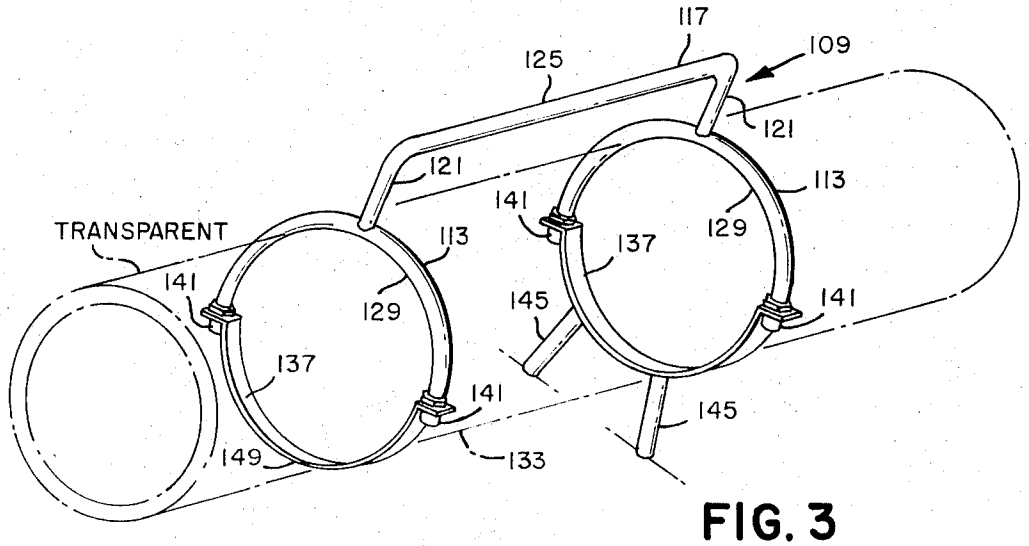


FIG. 3

HOT TUBE HANDLING DEVICE

BACKGROUND OF THE INVENTION

The invention relates to the art of supporting and transporting quartz tubes in which hot semi-conductor wafers are removed from furnaces, carried about, and cleaned with chemicals.

THE PRIOR ART

Flat semi-conductor wafers are usually put in cradles or "boats" which hold them separate from one another and with both sides exposed to the surrounding air. The boats are placed within cylindrically shaped recesses in an oven. The use of the cylindrically shaped recesses assures equal heating from all directions of the wafers. The boats are made of quartz because of its high melting point, thermal shock resistance, contamination resistance, and transparency. The legs of the boats are shaped to stably rest the boat within the cylindrically shaped furnace recesses.

The boats are loaded with wafers and placed within a cylindrical or hemi-cylindrical tube. The boat containing tube is then placed parallel to and with one of its ends mating with a cylindrically shaped oven recess. The boat is then slid from the tube into the recess using a quartz rod or the like. Because the boat rests on a cylindrical surface both within the tube and within the recess the transfer is carried out without disturbing the wafers and the boat is kept substantially parallel to the ground throughout the operation. The boats are removed from the oven by reversing this operation.

The tubes are made of quartz because of its high melting point, high resistance to thermal shock, contamination resistance, and transparency. Some of the quartz tubes have quartz handles of one sort or another sealed to them to aid the operator in grasping them and/or to keep them in a substantially horizontal position when they are transported from near the oven to their cooling place. Unfortunately quartz handles often snap off just when they are being used because of strains in the seals between the handles and the tubes. Also, working with quartz in both difficult and time-consuming.

To maintain a horizontal position for the articles within the tubes while cooling them, it is necessary that cooling racks be provided externally of the oven which hold the tube from rotating or that the quartz cylinders have sealed to them in some manner or other appurtenances which prevent the cylindrical tubes from rotating when placed upon a horizontal surface. The first expedient is obviously expensive in requiring specially constructed drying racks. The second expedient is also expensive in that it requires working with quartz and forming quartz seals which (as previously mentioned) is both difficult and time-consuming. Also, when appurtenances are sealed to quartz, they sometimes snap off because of the development of strains in the seals between the tube and the appurtenances.

Thus, it would be highly desirable to provide a simple and inexpensive device which could be used to hold quartz tubes in a horizontal and non-rotating position both when transporting wafer boats and when placed upon a horizontal surface for cooling wafers and wafer boats. This invention provides just such a device.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be better understood by reference to the drawings which are incorporated herein by reference thereto and wherein:

FIG. 1 illustrates in a perspective view an embodiment of the present invention.

FIG. 2 illustrates in a perspective view a second embodiment of the present invention.

FIG. 3 illustrates in a perspective view yet a third embodiment of the present invention.

SUMMARY OF THE INVENTION

In one sense the invention comprises a tube handling device. The device comprises a frame adapted to matably receive a cylindrical surface of a body having at least a partial cylindrical surface; means for securing the cylindrical surface of the body to the frame; means affixed to the frame for holding the frame above a horizontal plane in such a manner that the axis of the cylindrical surface is substantially parallel to the plane, a handle attached to the frame for moving the device; and means for preventing the body from rotating about the axis of the cylindrical surface.

The invention further includes the lightweight hot tube handling device discussed above in combination with a quartz cylindrical or hemi-cylindrical tube secured against the frame thereof.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawing, it will be seen that one embodiment of the hot tube handling device designated generally by the reference numeral **1** is shown in FIG. **1**. The hot tube handling device **1** includes a pair of ribs **5** and a rigid member **9** which spans the distance between the ribs. The ribs **5** and the rigid member **9**, comprise the frame of the device **1**. The upper surfaces **13** of the ribs **5** are curved so as to matably accept a cylindrical body having at least a partial cylindrical surface such as the transparent hemi-cylindrical quartz tube **17**.

Attached to each end of the ribs **5** are the washers **21** which serve as means for securing the hemi-cylinder **17** to the ribs **5**. The washers **21** are each held in place by a bolt **25** which passes through each washer **21** and into the end of each of the ribs **5**. The washers **21** are preferably made to be non-symmetrical about the hole which passes therethrough so that the elongated portion thereof **29** can be rotated away from the tube holding cavity indicated generally by the numeral **33** whereby a tube can be easily placed upon the ribs **5**. The washers **21** can then be rotated again so that the long portion **29** thereof extends over the cutoff wall of the hemi-cylinder **17** and the bolts **25** can be tightened downwardly until the bottom surface of the long portion **29** of the washer **21** forms a firm hold upon the hemi-cylinder **17**. The washers **21** also serve to keep the hemi-cylinder **17** from rotating. Thus, because of the adjustability inherent in the combination formed by the washers **21** and the bolts **25**, the hot tube handling device **1** can be adjusted to handle a number of slightly different sized quartz hemi-tubes **17**. This is important since commercial quartz tubing often varies somewhat in size.

A handle **37** is attached perpendicularly to the rigid member **9** adjacent the center of said rigid member **9**. The end **41** of the handle **37** which is furthest from the

rigid member 9 has a post 45 attached thereto. The bottom 49 of the post 45 in conjunction with the bottoms 53 of the ribs 5 define a plane upon which the hot tube handling device 1 can stably rest with the axis of the quartz tube 17 being substantially parallel to the plane defined by the bottom 49 of post 45 and the bottoms 53 of the ribs 5. It should be further noted that the washers 21 hold the quartz tube 17 in such a manner that the quartz tube 17 cannot rotate about its axis.

FIG. 2 illustrates an alternative embodiment of the invention. In FIG. 2 the hot tube handling device designated generally by 57 is shown in detail. The hot tube handling device 57 comprises the ribs 61 held in spaced relationship by the rigid member 65. The frame of the device 57 then comprises the ribs 61 and the rigid member 65. The bottoms 69 of the ribs 61 are bent in such a shape as to matably receive the cylindrical surface of, for example, a cylindrical quartz tube, which tube is not illustrated in FIG. 2. Attached to the end of each of the ribs 61 is a band 73 which serves to fasten the quartz tube against the ribs 61. The band 73 is detachably and adjustably attached to the ribs 61 by use of the bolts 77. Since the bolts 77 need be screwed into the ends of the ribs 61 only sufficiently enough to tighten about a quartz cylinder held between the ribs 61 and the bands 73, it is clear that the combination of the ribs 61 and the bands 73 is adjustable for cylinders of slightly differing diameter. This is important since commercial quartz tubing often varies somewhat in size. In the embodiment shown in FIG. 2, it is clear that the rigid member 65 is made up of the two arms 81 along with the bridge 85.

A handle 89 is attached to the bridge 85 at the center thereof and perpendicularly thereto. The end 93 of the handle 89 has a post 97 attached thereto. The bottom 101 of the post 97 in conjunction with the bottoms 105 of the bands 73 provide a 3-point support for the hot tube handling device 57 whereby a cylindrical body held by the device 57 is positioned so that its axis is substantially parallel to the plane defined by the bottom 101 of the post 97 and the bottoms 105 of the bands 73. The fastening of the cylinder against the ribs 61 by the bands 73 also frictionally assures that the cylinder cannot rotate about its axis.

It will be apparent from the examination of FIGS. 1 and 2, that the bands 73 can be used in conjunction with the embodiment shown in FIG. 1 in place of the washers 21 when it is desired to hold a complete cylinder in the device illustrated in FIG. 1.

A third embodiment of the invention is illustrated in FIG. 3. In this embodiment the hot tube handling device is designated generally by the numeral 109. In this embodiment a pair of ribs 113 are held in spaced relationship by rigid member 117. The frame of the device 109 then comprises the ribs 113 and the rigid member 117. The rigid member includes the two arms 121 and the bridge 125. The bridge 125 serves a dual purpose in that it also acts as a handle for the lifting and transporting of the device 109.

The bottoms 129 of the ribs 113 are shaped to matably receive a cylindrical quartz tube 133. Bands 137 are detachably and adjustably attached to the ends of the ribs 113 by the bolts 141 which pass through holes appropriately placed adjacent each end of the bands 137.

Adjacent the bottom of one of the bands 137 there is attached a pair of legs 145. The bottoms of the legs 145 along with the bottom 149 of the other band 137 or a portion of a quartz tube held by the device 109 define a plane upon which the device 109 can sit. Further, when there is a quartz tube 133 held within the device 109, it is apparent that the tube 133 will be held so that its axis is substantially (although not exactly) parallel to the surface upon which the device 109 sits. Also, the combination of the ribs 113 and the bands 137 frictionally hold the quartz tube 133 so that it will not rotate about its axis.

The device of the present invention in any of its embodiments is preferably fabricated out of commercially available stainless steel tubing. When such tubing is used, it can easily be bent into a shape whereby it will matably receive a cylinder or hemi-cylinder. Further, such tubing combines the properties of lightness, relatively low heat conductance, easy bendability, resistance to corrosion and high strength. Pieces of stainless steel tubing can be easily sealed to one another by use of silver solder, heliarc or the like. Still further, the use of hollow tubing is desirable since when a cold quartz tube is fastened within one of the devices of the present invention and a hot boat with wafers pulled from the furnace, the quartz will expand at generally a somewhat different rate than will the stainless steel tubing that is holding the tube. Since the tubes are hollow they are relatively easily bent if the quartz expands at a greater rate than does the stainless steel tubing. Thus, any tendency to crack the quartz tubing is minimized.

In practice, a cylindrical or hemi-cylindrical quartz tube is fastened in the device of FIG. 1 or a cylindrical quartz tube is fastened in the embodiment shown in FIG. 2 or FIG. 3. The hot tube handling device plus tube is placed up to the furnace and the wafer containing boat is pulled onto the tube and the device-tube combination, with the boat and wafers therein, is placed on an appropriate surface to cool. The material in the quartz tube is prevented from spilling since the tube is held against rotational and tipping motion both when inside the oven and when removed from the oven for cooling. Quartz tubes are used just as they come from the factory and it is not necessary to seal any appurtenances to the quartz tubes.

While the invention has been described in connection with specific embodiments thereof, it will be understood that it is capable of further modification, and this application is intended to cover any variations, uses or adaptations of the invention following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice in the art to which the invention pertains and as may be applied to the essential features hereinbefore set forth, and as fall within the scope of the invention and the limits of the appended claims.

That which is claimed is:

1. A device for holding a semi-conductor wafer containing boat in a substantially horizontal and non-rotating position within a tubular or hemi-tubular recess while transporting the boat and for holding the tubular or hemi-tubular recess and the boat in a substantially horizontal position upon a horizontal plane or surface, comprising:

a frame including two rigid spaced ribs, each of said ribs being adapted to mateably receive a cylindrical surface of a body having at least a partial cylindrical surface, and a rigid member spanning the space between said ribs, said body having a recess

adapted to receive a semi-conductor wafer containing boat;

a plurality of washers, each detachably and adjustably attached to the end of one of said ribs by bolts passing therethrough and into the end of said one of said ribs, each of said washers extending beyond the cross section of the end of each of said ribs, said washers serving to secure said cylindrical surface to said frame and to prevent rotation of said body about the longitudinal axis of said cylindrical surface;

a handle attached orthogonally to said rigid member so that said handle is perpendicular thereto and substantially parallel to a generally horizontal surface and a post attached to the other end of said handle, said post in conjunction with said ribs and said handle serving to hold said frame above said generally horizontal plane in such a manner that the longitudinal axis of said cylindrical surface is above and substantially parallel to said plane.

2. A device as in claim **1**, in combination with a generally hemi-cylindrical quartz tube secured by said washers.

3. A device for holding a semi-conductor wafer containing boat in a substantially horizontal and non-rotating position within a tubular or hemi-tubular recess while transporting the boat and for holding the tubular or hemi-tubular recess and the boat in a substantially horizontal position upon a horizontal planar surface, comprising;

a frame including two rigid spaced ribs, each of said ribs being curved to mateably receive a cylindrical surface of a body having at least a partial cylindrical surface, and a rigid U-shaped member spanning the space between said ribs and serving as a handle for lifting said frame, said body having a recess adapted to receive a semi-conductor wafer containing boat;

a pair of straps each detachably and adjustably attachable from one end of each of said ribs to the other end thereof, said straps serving to secure said cylindrical surface to said frame and to prevent rotation of said body about the longitudinal axis of said cylindrical surface, at least one of said straps including a pair of legs attached thereto, said pair of legs serving to hold said semi-conductor wafer containing boat in a substantially horizontal position above and substantially parallel to a horizontal planar surface.

4. A device as in claim **3**, in combination with a generally cylindrical quartz tube secured by said straps.

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