United States Patent [19]

Ploeckelmann

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[54] **TWEEZERS**

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[52] **U.S. Cl.** ..... **294/99 R,** 81/43, 128/354, 294/33

[51] **Int. Cl.** **B25b 9/02**

[58] **Field of Search** 294/7, 33, 99, 3; 81/43; 128/354, 321

[56] **References Cited**

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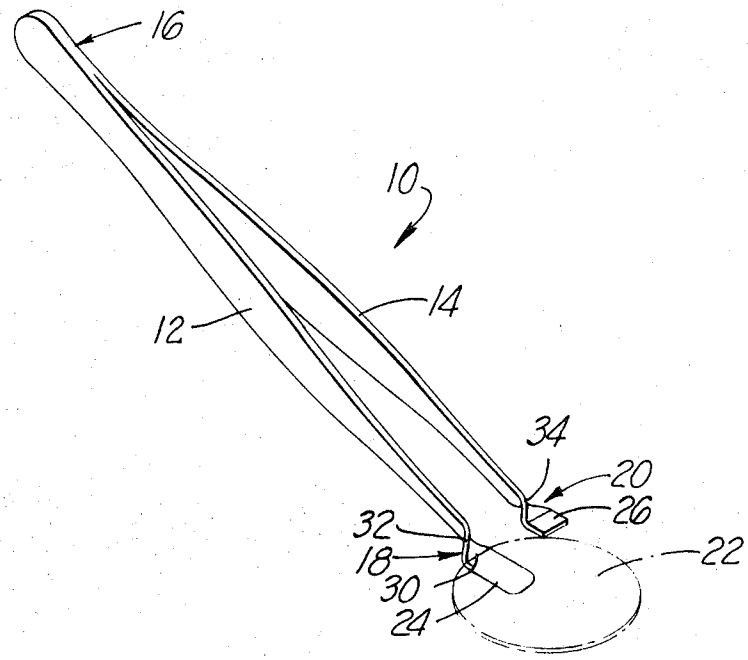
[57] **ABSTRACT**

Tweezers for holding a fragile unit including two arm members having respective free ends movable upon the application of horizontal pressure from an open position of nonvertical alignment to a closed position of vertical alignment, the arm ends include gripping surfaces for engaging and securely holding the fragile unit at its periphery when the tweezers are in a closed position.

4 Claims, 7 Drawing Figures



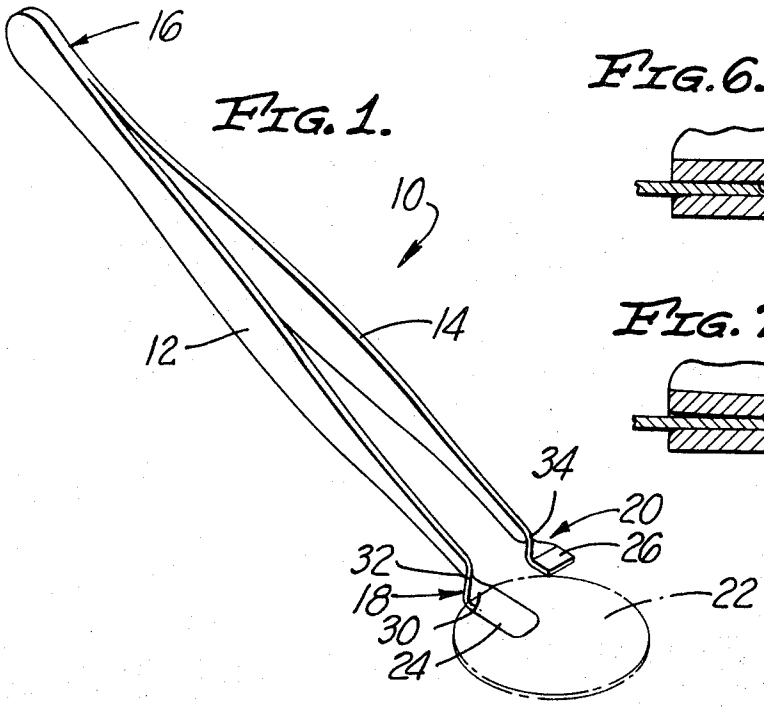


FIG. 1.

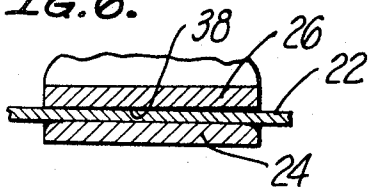


FIG. 6.

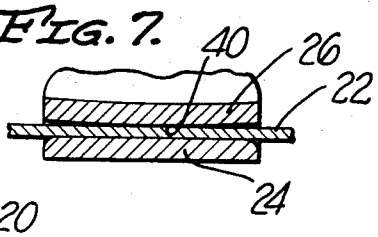


FIG. 7.

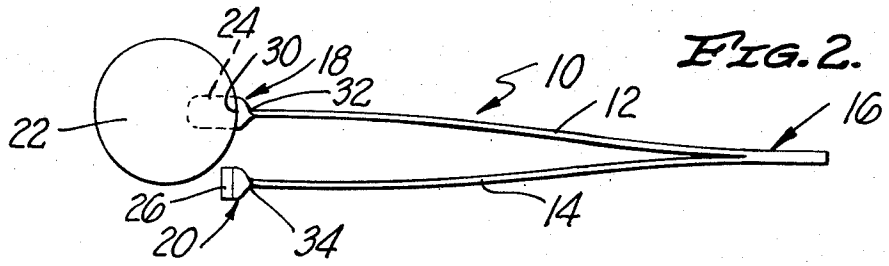


FIG. 2.

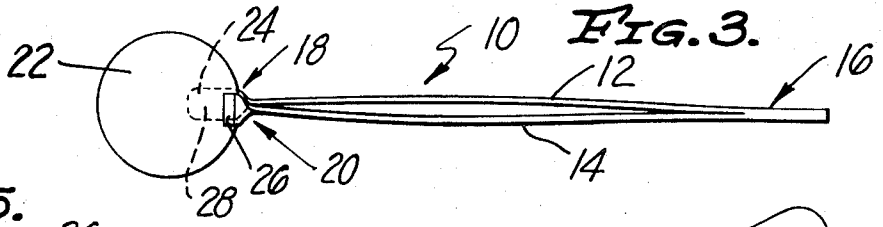


FIG. 3.

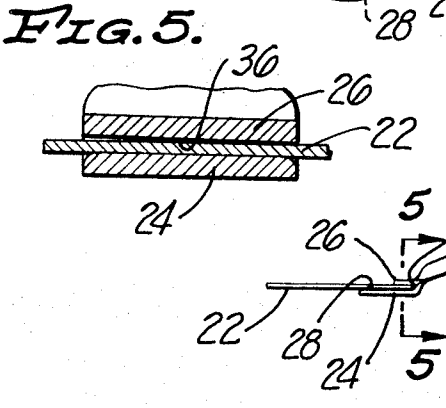


FIG. 5.

FIG. 4.

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TWEEZERS

This invention relates generally to tweezers and more particularly to tweezers of the type used to hold and/or manipulate fragile units such as micro-circuit wafers and the like.

The recent development of miniature circuitry has created numerous problems with respect to the manipulation of various fragile components thereof such as, for example, tiny disc-like wafers and the integrated circuits therein. Conventional tweezers and other pincer-type tools have proved unsatisfactory because of their damaging contact to the circuitry on the interior portion of the discs. Some tweezers have been designed to grip only the periphery of the disc to avoid such damaging contact, but even those devices are deficient, often fracturing the wafer to make it unfit for use. Such fracturing often results from excessive pressure being applied through the tweezer arms to the wafer. Furthermore, such peripheral tweezers have been awkward and inefficient because they have not held the wafer securely and have required cumbersome hand positions for manual operation.

The foregoing deficiencies of the prior art have caused undue expense arising from damaged wafers and imprecise and inefficient assembly operations with respect to those wafers which were not damaged. Accordingly, it is a primary object of the present invention to eliminate the aforementioned deficiencies and develop new improved tweezers specifically designed for efficient, easy, dextrous manipulation of fragile units such as micro-circuit wafers without the risk of fracturing or otherwise damaging them.

Another primary object of the present invention is to provide tweezers having two arm members for securely gripping such wafers at their periphery only, thereby eliminating any stress on the interior portion of the wafers.

A further primary object is to provide tweezers of the foregoing character which apply only limited gripping pressure to the wafer itself, notwithstanding any excessive force applied to the arm members by the person operating the tweezers.

A more specific object is to provide tweezers of the foregoing character having gripping areas of appreciable surface area on each of the arm members for contacting the wafer and holding it therebetween, in order to securely hold the wafer stationary and to prevent concentration of the gripping force at any one point on the surface of the wafer.

Another object is to provide tweezers of the foregoing character which include stop means for limiting the depth of engagement of the wafer by the arm members in order that the opposing gripping forces are applied to the periphery of the wafer rather than the interior thereof.

Still another object is to provide tweezers of the foregoing character which are actuated by application of horizontal pressure to the arm members, and which can be operated manually without placing the hand, thumb and fingers in an awkward and cumbersome position.

A further object is to provide tweezers of the foregoing character which hold the wafer between the arm members without having to apply any vertical pressure to the arm members. A related object is to provide a vertical distance between the two gripping surfaces of slightly less magnitude than the thickness of the wafer so that when the two contact surfaces are vertically aligned with the wafer therebetween, the wafer is frictionally held thereby a small spring force resulting from slight vertical flexing of the arm members.

Yet another object is to provide tweezers of the foregoing character in which the application of horizontal pressure to the arms moves them from an open position to a closed position to vertically align the gripping surfaces with a portion of the periphery of the wafer therebetween.

Further objects and advantages of the invention will be evident to those skilled in the art from the following description of the preferred embodiment.

In the drawing:

FIG. 1 is a perspective view of tweezers incorporating a preferred embodiment of the invention, in connection with an exemplary fragile unit, such as a wafer;

FIG. 2 is a top plan view showing the arm members in open position;

FIG. 3 is a top plan view similar to FIG. 2 showing the arm members in closed position;

FIG. 4 is a side view of FIG. 3 showing the arm member in closed position;

FIG. 5 is a sectional view taken along line 5—5 in FIG. 4 showing one way of beveling a gripping surface of an arm member;

FIG. 6 is a sectional view similar to FIG. 5 showing an alternate way of beveling a gripping surface; and

FIG. 7 is a sectional view similar to FIG. 5 showing another alternate way of beveling a gripping surface.

Generally speaking, the tweezers **10** include two arms **12, 14,** which are connected together, as at their ends **16,** so that their respective free ends **18, 20,** can be moved from the open position of FIG. **2** to the closed position of FIG. **3.** A fragile unit, such as the wafer **22,** defining a horizontal reference plane, can be securely gripped between the free ends **18, 20,** of the tweezers whenever sufficient horizontal pressure is applied to bring the free ends into substantial vertical alignment. The structural details of the gripping features of the free ends **18, 20,** and the structural connection of the two arms **12, 14,** provide for secure gripping of the wafer **22** at its periphery, while at the same time minimizing the possibility of damage to the wafer because of excessive manual pressure being applied to the arms of the tweezers, all of which will be described in detail hereinafter.

More particularly, as best shown in FIG. **1,** the free end **18** of the arm **12** terminates in a support member, shown as a thin rectangular plate **24,** adapted to slide under a wafer **22** resting on a work table or the like. The plate **24** extends under the wafer **22** and is wide enough to provide an appreciable flat surface area on its top for contacting an underneath portion of the wafer. The free end **20** of the arm **14** terminates in a similar but truncated rectangular plate **26** which has an appreciable surface area on its bottom for contacting an upper portion of the wafer. When the arms **12, 14,** are moved from the open position of FIG. **2** to the closed position of FIG. **3,** to vertically align the free ends **18, 20,** with the wafer **22** therebetween, the contact surface of the plate **26** and a portion of the contact surface of the plate **24** frictionally engage directly opposite sides of a portion of the periphery of the wafer **22** to securely grip it, thus preventing any rotation or other movement of the wafer while the arms remain in the closed position. It will be appreciated that the resulting stress on the wafer created by the opposed gripping sur-

faces is spread over an appreciable area of the wafer periphery rather than being concentrated at any single point, and thereby minimizes the possibility of fracturing the wafer during the holding and/or manipulation operation.

The remainder **28** of the contact surface of the plate **24** which contacts a portion of the interior of the wafer **22** serves to further minimize damage to the wafer by spreading the pressure created by the opposing gripping surfaces over a larger area. The absence of any opposing force opposite the remainder **28** of the plate **24** eliminates the danger of circuit damage to the wafer interior which might otherwise result from opposing gripping engagement in such interior portion. In order to prevent any such opposing gripping engagement, stop means are provided, shown in the exemplary form as a transverse ledge **30** on the arm side of the contacting surface of the plate **24**, for abutting the edge of the fragile unit. Accordingly, the depth of engagement of the wafer by the support plate **24** is limited to an optimum predetermined distance.

The contact surfaces of each of the plates **24, 26,** are substantially parallel both in the open and closed position to facilitate the effectuation and release of the gripping engagement of the wafer **22,** as well as the gripping engagement during the manipulation operation. Furthermore, the vertical distance between both contact surfaces is intended to remain fairly constant and is designed to be slightly less than the vertical thickness of the wafer **22.** Thus, when a wafer is placed on the support plate **24** (FIG. **2**) and the arms **12, 14,** are moved to the closed position by manual application of horizontal pressure thereon (FIGS. **3, 4**), the contact surface of the holding plate **26** slides into gripping frictional engagement with the wafer and causes similar frictional gripping engagement to occur directly opposite on a portion of the contact surface of the support plate **24,** as previously described.

It is particularly important to control the pressure upon the wafer throughout the whole operation, since excessive pressure or strain will often fracture or otherwise damage the wafer. In this regard, the junctions **32, 34,** between the plates **24, 26,** and their respective arms **12, 14,** are twisted and bent so that the arms extend upwardly approximately forty-five degrees above the horizontal and converge at the union of their ends **16.** The junction twist is approximately ninety degrees, such that the pincer action inherent in the tweezer construction is horizontal as contrasted to a vertical action which would result if there were no twist at the junctions **32, 34.**

It will be appreciated that the structural details of the foregoing improved connection between the arms **12, 14,** allows the free ends **18, 20,** to slightly flex vertically to allow the wafer to fit between the opposing contact surfaces, the spring action of the arms straining to return to their normal position providing the necessary force to securely hold the wafer in position. Furthermore, only the horizontal component of any manual pressure exerted on the arms **12, 14,** has any significant effect on the free ends **18, 20,** causing them to move laterally in and out of vertical alignment, or in other words, between the open and closed positions. Thus excessive manual pressures of varying directions and magnitudes has little or no effect on the vertical pressure exerted upon the wafer.

In order to make the initial contact and the final release of the wafer **22** by the holding plate **26** smooth and easy, various types of bevels are provided on the contact surface thereof, including an inclined plane contact surface **36** of FIG. **5,** a reverse inclined plane contact surface **38** of FIG. **6,** and a wedge contact surface **40** of FIG. **7,** each of which provides for damage free contact and release while also providing secure gripping of an appreciable area portion of the wafer periphery.

Although an exemplary embodiment of the invention has been disclosed and discussed, it will be understood that other applications of the invention are possible and that the embodiment disclosed may be subjected to various changes, modifications and substitutions without necessarily departing from the spirit of the invention.

I claim as my invention:

1. Improved tweezers comprising

a. a unitary device with first and second arm members having rearward ends joined together and terminating at a junction allowing relative movement between said arms only in a horizontal direction and having respective free ends adapted to hold a fragile disc of predetermined thickness lying in a horizontal reference plane;

b. said free end of said first arm member including support means for engaging an underneath portion of said fragile unit adjacent its periphery;

c. said free end of said second arm member including holding means for engaging an upper portion of said fragile unit adjacent its periphery; and

d. said arm members being connected to position said support means and said holding means in horizontal planes vertically displaced a distance substantially equal to said predetermined thickness of said fragile disc, said free ends of said arms being swingable in a horizontal direction, upon the application of manual pressure upon said arms, from a normally open position of vertical non-alignment of said support means and said holding means to a closed position bringing said support means and said holding means into spaced apart vertical alignment to hold said fragile unit therebetween.

2. The improved tweezers of claim **1** wherein said support means includes a first flat gripping surface and said holding means includes a second flat gripping surface of lesser area than said first flat gripping surface to frictionally engage in opposing relationship said underneath portion and said upper portion, respectively, of said fragile unit adjacent its periphery to prevent rotation of the fragile unit.

3. The improved tweezers of claim **2** wherein said flat gripping surface of said support means is terminated on one side by a stop means for abutting an edge of the fragile unit to limit the depth of engagement of said fragile unit by said support means, thereby preventing any opposing frictional engagement of said gripping surfaces with the interior portion of the fragile unit.

4. The improved tweezers of claim **1** wherein said first and second arm members respectively include elongated strip means lying in a vertical plane and having spring flexibility only in a horizontal direction for controlling the vertical pressure upon said fragile unit by said support means and said holding means even though increased pressures of diverse magnitudes and directions are applied to said arm members.

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