ABSTRACT

Provided is a clamp jig which includes: a workpiece bonding member in which a curved workpiece is bonded to one end thereof to be held; one clamping member and the other clamping member between which an end of the workpiece bonded to the workpiece bonding member to be held is sandwiched from both sides thereof; an elastic member made of an elastic material that comes in contact with an end of the one clamping member; and a plurality of holding members that push the workpiece by supporting the end of the workpiece at multiple points of the elastic member. In the clamp jig, the end of the workpiece is supported at multi-contacts in a state where curvature of the workpiece is maintained.
FIG. 2

FIG. 3

WORKPIECE

PUSHING FORCE
CLAMP JIG AND METHOD OF POLISHING WORKPIECE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention
[0002] The present invention relates to a clamp jig and a method of polishing a workpiece that can prevent the decrease in torsion accuracy caused by residual stress generated during polishing of a magnetic head element.
[0003] 2. Description of the Related Art
[0004] In recent years, a magnetic head element used in a magnetic disk device is manufactured as follows: A number of workpieces (also referred to as a lower bar) are disposed on a disk-like wafer substrate by a semiconductor manufacturing technique as illustrated in FIG. 5A; the workpiece is cut from the wafer substrate 2 by a semiconductor manufacturing technique as illustrated in FIG. 5A; and a clamp jig 5 grasping the workpiece 3 is attached to the workpiece bonding member 4 as illustrated in FIG. 5B, and a clamp jig 5 grasping the workpiece 3 is attached to the workpiece bonding member 4 as illustrated in FIG. 5B, and a clamp jig 5 grasping the workpiece 3 is attached to the workpiece bonding member 4 as illustrated in FIG. 5B, and a clamp jig 5 grasping the workpiece 3 is attached to the workpiece bonding member 4 as illustrated in FIG. 5B, and a clamp jig 5 grasping the workpiece 3 is attached to the workpiece bonding member 4 as illustrated in FIG. 5B, and a clamp jig 5 grasping the workpiece 3 is attached to the workpiece bonding member 4 as illustrated in FIG. 5B, and a clamp jig 5 grasping the workpiece 3 is attached to the workpiece bonding member 4 as illustrated in FIG. 5B, and a clamp jig 5 grasping the workpiece 3 is attached to the workpiece bonding member 4 as illustrated in FIG. 5B, and a clamp jig 5 grasping the workpiece 3 is attached to the workpiece bonding member 4 as illustrated in FIG. 5B, and a clamp jig 5 grasping the workpiece 3 is attached to the workpiece bonding member 4 as illustrated in FIG. 5B, and a clamp jig 5 grasping the workpiece 3 is attached to the workpiece bonding member 4 as illustrated in FIG. 5B.

[0005] A technique associated with a magnetic head machining apparatus according to the related art is disclosed in JP 5-20643 A. In JP 5-20643 A, a plurality of cuts are formed on a floating surface of a workpiece at regular intervals to alleviate internal stress during polishing.

SUMMARY OF THE INVENTION

[0006] In a method of polishing the workpiece for a magnetic head element according to the related art described above, since the workpiece 3 is slightly curved before polishing and the workpiece 3 is polished in a state where the workpiece bonding member 4 corrects the curvature, there have been problems that residual stress remains in the workpiece 3 after the polishing and torsion accuracy decreases to the extent of several nanometers.

[0007] In the technique disclosed in JP 5-20643 A, the internal stress can be alleviated by the plurality of cuts formed on the floating surface of the workpiece during the polishing, but there have been problems that multiple times of cutting are difficult with high accuracy and internal stress may remain in the workpiece during the cutting.

[0008] An object of the invention is to solve the above problems according to the related art and is to provide a clamp jig and a method of polishing a workpiece that can prevent the decrease in torsion accuracy caused by residual stress.

[0009] In order to achieve the above object, an aspect of the invention is to provide a clamp jig grasping a curved workpiece, the clamp jig including: a workpiece bonding member in which the workpiece is bonded to one end side thereof to be held; one clamping member and the other clamping member between which an end of the workpiece bonded to the workpiece bonding member to be held is sandwiched from both sides thereof; an elastic member made of an elastic material that comes in contact with an end of the one clamping member; and a plurality of holding members that push the workpiece by supporting the end of the workpiece at multiple points of the elastic member, in which the end of the workpiece is supported at multiple contacts in a state where curvature of the workpiece is maintained.

[0010] Another aspect of the invention is to provide a method of polishing a workpiece in which a clamp jig is used and a lower end of the clamp jig is polished by a rotary surface plate, the clamp jig including: a workpiece bonding member in which a curved workpiece is bonded to one end side thereof to be held; one clamping member and the other clamping member between which an end of the workpiece bonded to the workpiece bonding member to be held is sandwiched from both sides thereof; an elastic member made of an elastic material that comes in contact with an end of the one clamping member; and a plurality of holding members that push the workpiece by supporting the end of the workpiece at multiple points of the elastic member, in which, when the surface plate rotates, the clamp jig reciprocally moves in a radial direction of the surface plate in a state where the end of the workpiece is maintained between the one and the other clamping members while being curved by the elastic member and the plurality of holding members.

[0011] According to the clamp jig and the method of polishing the workpiece of the invention, since one and the other clamping members hold the end of the workpiece to maintain the curvature of the workpiece by the elastic member and the plurality of holding members and the polishing is performed without correction of the curvature of the workpiece in this state, residual stress is not generated by the correction, and torsion accuracy can be prevented from deteriorating.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a diagram illustrating an exploded state of a clamp jig according to an embodiment of the invention;
[0013] FIG. 2 is a diagram illustrating an assembled state of the clamp jig according to the embodiment;
[0014] FIG. 3 is an enlarged view illustrating a state of holding a tip portion of a workpiece according to the embodiment;
[0015] FIG. 4 is a diagram illustrating a principle of the clamp jig according to the embodiment;
[0016] FIGS. 5A to 5C are diagrams illustrating a method of polishing a workpiece for a magnetic head element; and
[0017] FIG. 6 is a diagram illustrating a cross section of the workpiece.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] A clamp jig and a method of polishing a workpiece according to an embodiment of the invention will be described below in detail with reference to drawings.

[0019] As illustrated in FIG. 1, a clamp jig 5 according to this embodiment includes: a workpiece bonding member 4 in which a workpiece 3 formed with a circuit element (circuit layer) is bonded to a lower surface thereof to be held; a clamping member 5A and a jig base 5C between which the workpiece bonding member 4 is sandwiched and fixed in a vertical direction; an elastic member 21 that is provided at an end of the clamping member 5A; 19 holding members 8 that have tips formed into a rounded shape by rounding (R-working) so as to push the circuit element portion of the workpiece 3 against the end of the clamping member 5A through the elastic member 21; and a clamping member 5B that is configured such that the holding member 8 is fixed to be pressed against a side end of the clamping member 5A, and can be assembled as illustrated in FIG. 2.

[0020] The holding members 8 are constituted of a substantially U-shaped ceramic material made of, for example, zirconia, and are arranged in a row to press the workpiece 3...
against the elastic member 21 using the elastic repulsive force of the ceramic material. Each of the holding members 8 individually pushes the workpiece 3.

[0021] The elastic member 21 is in a flat shape in a state of not coming in contact with the workpiece 3, but is elastically deformed along the shape of the workpiece 3 when being pressed against the workpiece 3.

[0022] The assembled clamp jig 5 can be assembled such that the end of the workpiece 3 is sandwiched from both sides by the clamping member 5A and the clamping member 5B when a state of holding the tip portion of the workpiece is viewed from a lateral direction as illustrated in FIG. 3 and that the plurality of holding members 8 pressed against the clamping member 5A by the clamping member 5B individually press the workpiece 3 against the elastic member 21 as illustrated in FIG. 4 that is an enlarged front view of a state where the holding members 8 push the end of the workpiece 3 against the elastic member 21 and the tip portion of the workpiece is held.

[0023] In this state, the clamp jig 5 is configured such that when the workpiece 3 is curved, the elastic member 21 is elastically compressed and deformed along curvature of the workpiece 3 and each of the holding members 8 pushes the curved workpiece 3 along the curved surface, whereby the workpiece 3 can be held in the state where the curvature of the workpiece 3 is maintained, and that the workpiece 3 is supported at multiple points with respect to the elastic member 21 in the state where the curvature of the workpiece 3 is maintained. The understanding of the invention is to hold the workpiece 3 without deformation.

[0024] In an example of the embodiment as illustrated in FIG. 4, the workpiece 3 is supported at multiple points by 19 holding members 8. However, the number of the holding members 8 is not set depending on rigidity of the ceramic material, and is not limited to the above number. Preferably, the holding members 8 are constituted by infinite pushing points. For example, the configuration of the infinite pushing points is considered that a portion coming in contact with the workpiece 3 is a flexible bag-shaped member filled with liquid or gas and the bag-shaped member is pressed against the workpiece 3, whereby a uniform pressure is applied to a free curved surface.

[0025] A circuit layer including a magnetic head element is grown in a thin film form on a ceramic layer by a semiconductor forming technique, whereby the above-described wafer substrate 2 is manufactured. Thus, the curvature of the workpiece 3 obtained by cutting of the wafer substrate 2 is caused by difference in coefficient of thermal expansion between a ceramic layer 31 and a circuit layer 3A during the growth of the thin film, as in a cross section illustrated in FIG. 6. In a direction of the curvature, the fact is known that the circuit layer extends and the ceramic layer shrinks.

[0026] For this reason, the clamp jig 5 according to this embodiment uses the plurality of holding members 8 and the elastic member 21 by which the workpiece can be supported at a plurality of multi-contacts, whereby the workpiece 3 can be clamped while being maintained in the curved state.

[0027] In a method of polishing the workpiece according to this embodiment, when a surface plate rotates, the clamp jig 5 reciprocally moves in a radial direction of the surface plate in a state where the workpiece 3 is clamped between the clamping member 5A and the clamping member 5B while being maintained in a curved state by the holding member 8 and the elastic member 21 by which the workpiece can be brought into contact with a plurality of points.

[0028] Therefore, according to the method of this embodiment, since the workpiece 3 is polished in the state of being curved state without correction of the curvature of the workpiece 3, residual stress is not generated by the correction of the curvature, and the decrease in torsion accuracy can be prevented.

[0029] According to the clamp jig and the method of polishing the workpiece of the embodiment, the clamping members 5A and 5B holds the end of the workpiece 3 to maintain the curvature of the workpiece by the elastic member 21 and the plurality of holding members 8, and the polishing is performed without correction of the curvature of the workpiece in this state, whereby residual stress is not generated by the correction, and the decrease in torsion accuracy can be prevented.

What is claimed is:

1. A clamp jig grasping a curved workpiece, comprising: a workpiece bonding member in which the workpiece is bonded to one end side thereof to be held; one clamping member and the other clamping member between which an end of the workpiece bonded to the workpiece bonding member to be held is sandwiched from both sides thereof; an elastic member made of an elastic material that comes in contact with an end of the one clamping member; and a plurality of holding members that push the workpiece by supporting the end of the workpiece at multiple points of the elastic member, wherein the end of the workpiece is supported at multi-contacts in a state where curvature of the workpiece is maintained.

2. A method of polishing a workpiece in which a clamp jig is used and a lower end of the clamp jig is polished by a rotary surface plate, the clamp jig including: a workpiece bonding member in which a curved workpiece is bonded to one end side thereof to be held; one clamping member and the other clamping member between which an end of the workpiece bonded to the workpiece bonding member to be held is sandwiched from both sides thereof; an elastic member made of an elastic material that comes in contact with an end of the one clamping member; and a plurality of holding members that push the workpiece by supporting the end of the workpiece at multiple points of the elastic member, wherein when the surface plate rotates, the clamp jig reciprocally moves in a radial direction of the surface plate in a state where the end of the workpiece is maintained between the one and the other clamping members while being curved by the elastic member and the plurality of holding members.