

Title of the Invention**SUBSTRATE POLISHING METHOD AND DEVICE  
THEREOF**BACKGROUND OF THE INVENTIONField of the Invention

The present invention relates to a substrate polishing device used for polishing an inner peripheral end surface of a round hole of a circular substrate having the round hole at a center part, where the circular substrate is, for example, a substrate for a magnetic recording medium such as a glass substrate, aluminum substrate or the like, which is used as a platter for a hard disk, a substrate for an optical recording medium such as a CD, a DVD, a BD or the like.

Description of the Conventional Art

The circular substrate mentioned herein is, for example, a substrate having a diameter of 2.5 inches, a diameter of 1.8 inches, a diameter of 1.0 inch, or a diameter of 0.85 inches. Among these substrates, the substrate having a diameter of 2.5 inches has an outer peripheral diameter of 65 mm, an inner peripheral diameter of a round hole of 20 mm, and a thickness of 0.635 mm. Further, the substrate having a diameter of 1.8 inches has an outer peripheral diameter of 48 mm,



an inner peripheral diameter of a round hole of 12 mm, and a thickness of 0.508 mm. Further, the substrate having a diameter of 1.0 inch has an outer peripheral diameter of 27.4 mm, an inner peripheral diameter of a round hole of 7 mm, and a thickness of 0.381 mm. Furthermore, the substrate having a diameter of 0.85 inches has an outer peripheral diameter of 21.6 mm, an inner peripheral diameter of a round hole of 6 mm, and a thickness of 0.381 mm.

Conventionally, as a method for polishing an inner peripheral surface of a round hole of such a kind of the circular substrate, a polishing method of rotary contact to a polishing brush or a polishing pad with polishing liquid containing free abrasive grains has been known. Refer to Japanese Patent Application Laid-Open No. 11-221742

#### SUMMARY OF THE INVENTION

##### Problems to be Solved by the Invention

However, the above-mentioned conventional structure has a problem in removability of impurities, such as glasses, particles of a resin and the like, which adhere to the inner peripheral end surface of the circular substrate. In addition, the conventional structure may have a problem that it cannot achieve an improvement in machining qualities, such as a mirror-polishing

performance and the like, according to increasing of a recording density, thinning, and high-speed rotation of the circular substrate in recent years. The mirror-polishing performance includes a surface roughness of a chamfered surface or a round surface of an inner peripheral end surface or an outer peripheral end surface, which is determined depending on the specification of the circular substrate.

#### Means for Solving the Problem

An objective of the present invention is to solve the problems. According to a method of a first aspect of the present invention, a substrate polishing method, which is applied at a time of polishing an inner peripheral end surface of a round hole of a circular substrate having the round hole at a center part, includes using a polishing tape, wherein the polishing tape is guided to be outward/return-transferred, a turning portion of the polishing tape guided to be outward/return-transferred is guided to detour sideward, and a sideward detouring portion of the polishing tape is made to be a detour polishing part capable of polishing an inner peripheral end surface of the round hole, and further includes holding and rotating the circular substrate, transferring the polishing tape intermittently or continuously, pressure-contacting the detour polishing

part to the inner peripheral end surface of the round hole, rocking intermittently or continuously the detour polishing part in a direction opposite to the inner peripheral end surface of the round hole, and thereby polishing the inner peripheral end surface of the round hole to be a chamfered surface or a round surface.

Further, according to a method of a second aspect of the present invention, an inner peripheral end surface and an outer peripheral end surface of the circular substrate are polished by switching and moving from an inner pressure-contacting position, at which the detour polishing part and the inner peripheral end surface of the round hole are pressure-contacted, to an outer pressure-contacting position, at which the detour polishing part and the outer peripheral end surface of the circular substrate are pressure-contacted.

Further, according to a device of a third aspect of the present invention, a substrate polishing device includes a holding/rotating mechanism for holding and rotating a circular substrate having a round hole at a center part, and a polishing/machining mechanism for polishing at least an inner peripheral surface of the round hole of the circular substrate. The polishing/machining mechanism includes a tape transfer mechanism for transferring a polishing tape

intermittently or continuously; a tape polishing mechanism having an outward guide part and a return guide part, which can guide the polishing tape to be outward/return-transferred, having a detour guide part which can guide a turning portion of the polishing tape guided to be outward/return-transferred to detour sideward, and having a detour polishing part which can polish the inner peripheral end surface of the round hole and consists of a sideward detouring portion of the polishing tape guided to detour sideward by the detour guide part; a pressure-contacting mechanism capable of pressure-contacting the detour polishing part to the inner peripheral end surface of the round hole by moving the detour polishing part or the circular substrate with pressure-contacting; and a polishing part rocking mechanism for rocking the detour polishing part intermittently or continuously in a direction opposite to the inner peripheral end surface of the round hole and polishing the inner peripheral end surface of the round hole to be a chamfered surface or a round surface by the detour polishing part.

Further, according to a device of a fourth aspect of the present invention, the device further includes, in the holding/rotating mechanism or the polishing/machining mechanism, a switching/moving

mechanism which is for switching and moving at least the tape polishing mechanism and the polishing part rocking mechanism from an inner pressure-contacting position to an outer pressure-contacting position, and thereby polishing an inner peripheral end surface and an outer peripheral end surface of the circular substrate, where the detour polishing part and the inner peripheral end surface of the round hole are pressure-contacted at the inner pressure-contacting position, and the detour polishing part and the outer peripheral end surface of the circular substrate are pressure-contacted at the outer pressure-contacting position. Further, according to a device of a fifth aspect of the present invention, the device includes a rocking mechanism for rocking the tape polishing mechanism in a direction crossing a transferring direction of the polishing tape in the detour polishing part. Further, according to a device of a sixth aspect of the present invention, the detour guide part includes two turning face parts, which are for turning sideward a outward-side portion, in a outward-side portion and a return-side portion of the polishing tape, from the outward guide part, and for turning the return-side portion from the sideward position to the return guide part, and further includes a pressure-receiving face part for guiding the polishing

tape turned sideward by the both turning face parts to detour and for receiving polishing pressure. Further, according to a device of a seventh aspect of the present invention, the pressure receiving face part is made of an elastic material such as rubber, a synthetic resin or the like, or a hard material. Furthermore, according to a device of an eighth aspect of the present invention, a polishing structure with the detour polishing part consisting of the polishing tape is a dry type structure or a wet type structure.

#### Effect of the Invention

As mentioned above, according to the first or third aspect of the present invention, the inner peripheral end surface of the round hole can be polished to be a chamfered surface or a round surface by holding and rotating the circular substrate by the holding/rotating mechanism, transferring the polishing tape intermittently or continuously by the tape transfer mechanism, pressure-contacting the detour polishing part of the tape polishing mechanism and the inner peripheral end surface of the round hole by the pressure-contacting mechanism, and rocking the detour polishing part intermittently or continuously in the direction opposite to the inner peripheral end surface of the round hole by the polishing part rocking mechanism.

Therefore, the invention can improve removability of impurities such as glasses, particles of a resin and the like, which adhere to the inner peripheral end surface of the circular substrate, and can improve machining qualities, such as a mirror-polishing performance of the inner peripheral end surface and the like. Further, the invention can easily polish the inner peripheral end surface to be a chamfered surface or a round surface. Furthermore, the polishing tape is guided to be outward/return- transferred by the outward guide part and the return guide part, and the turning portion of the polishing tape is guided to detour sideward by the detour guide part. In addition, the sideward detouring portion of the polishing tape guided to detour sideward by the detour guide part is made to be the detour polishing part capable of polishing the inner peripheral end surface of the round hole, and thus, a compact and small detour polishing part can be formed. Therefore, the inner peripheral end part of the round hole of the circular substrate can be polished properly without being disturbed by surrounding members, so that flexibilities in a machining position and a layout can be improved.

Further, according to the second or forth aspect of the invention, in the holding/rotating mechanism or the polishing/machining mechanism, the switching/moving

mechanism for switching/moving at least the tape polishing mechanism and the polishing part rocking mechanism from an inner pressure-contacting position to an outer pressure-contacting position, and thereby polishing an inner peripheral end surface and an outer peripheral end surface of the circular substrate, where the detour polishing part and the inner peripheral end surface of the round hole are pressure-contacted at the inner pressure-contacting position, and the detour polishing part and the outer peripheral end surface of the circular substrate are pressure-contacted at the outer pressure-contacting position. Thus, the outer peripheral end surface of the circular substrate can be also polished to be a chamfered surface or a round surface, and both the inner peripheral end surface and the outer peripheral end surface of the circular substrate can be polished. Therefore, machining operability can be improved.

Further, according to the fifth aspect of the invention, the device includes the rocking mechanism for rocking the tape polishing mechanism in the direction crossing the transferring direction of the polishing tape in the detour polishing part. Thus, a polishing action made by rocking of the polishing tape can be added, so that polishing machining can be carried out properly.

Further, according to the sixth aspect of the invention, the detour guide part includes two turning face parts, which are for turning sideward the outward-side portion, in the outward-side portion and the return-side portion of the polishing tape, from the outward guide part, and for turning the return-side portion from the sideward position to the return guide part, and further includes the pressure-receiving face part for guiding the polishing tape turned sideward by the turning face parts to detour and for receiving polishing pressure. Thus, the polishing tape can be guided to detour sideward and transferred properly, and the polishing tape can be transferred smoothly. Further, according to the seventh aspect of the invention, the pressure-receiving face part is made of an elastic material such as rubber, a synthetic resin, or the like, or a hard material. Thus, the pressure-receiving face part can receive polishing pressure properly. Furthermore, according to the eighth aspect of the invention, a polishing structure with the detour polishing part consisting of the polishing tape is a dry type structure or a wet type structure. Thus, the polishing structure can adapt to specifications of materials of the circular substrate, polishing conditions and the like.

## BRIEF EXPLANATION OF DRAWINGS

Fig. 1 is an entire front view of an exemplary embodiment of the present invention.

Fig. 2 is an entire plan view of an exemplary embodiment of the present invention.

Fig. 3 is a partial side view of an exemplary embodiment of the present invention.

Fig. 4 is a partial enlarged perspective view of an exemplary embodiment of the present invention.

Fig. 5 is a partial enlarged perspective view of an exemplary embodiment of the present invention.

Fig. 6 is a partial perspective view of a polishing tape of an exemplary embodiment of the present invention.

Fig. 7 is a partial perspective view of a polishing tape of an exemplary embodiment of the present invention.

Fig. 8 is a sectional view illustrating polishing of an inner peripheral end surface with an exemplary embodiment of the present invention.

Fig. 9 is a sectional view illustrating polishing of an inner peripheral end surface with an exemplary embodiment of the present invention.

Fig. 10 is a sectional view illustrating polishing of an inner peripheral end surface with an exemplary embodiment of the present invention.

Fig. 11 is a sectional view illustrating polishing

of an inner peripheral end surface with an exemplary embodiment of the present invention.

Fig. 12 is a sectional view illustrating polishing of an outer peripheral end surface with an exemplary embodiment of the present invention.

Fig. 13 is a sectional view illustrating polishing of an outer peripheral end surface with an exemplary embodiment of the present invention.

Fig. 14 is a sectional view illustrating polishing of an outer peripheral end surface with an exemplary embodiment of the present invention.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Figs. 1 to 14 illustrate an exemplary embodiment of the present invention. The exemplary embodiment has a structure for polishing an inner peripheral end surface M and an outer peripheral end surface N of a glass substrate, which is a circular substrate W having a round hole Q at a center part, to a chamfered surface or a round surface. As illustrated in Fig. 1, the exemplary embodiment, roughly speaking, includes a holding/rotating mechanism A for holding and rotating the circular substrate W and a polishing/machining mechanism B for polishing the inner peripheral end surface M of the round hole Q and the outer peripheral end surface N of the circular substrate W. The

polishing/machining mechanism B includes a tape transfer mechanism C for transferring a polishing tape T intermittently or continuously; a tape polishing mechanism D having an outward guide part C<sub>1</sub> and a return guide part C<sub>2</sub> which can guide the polishing tape T to be outward/return-transferred, having a detour guide part C<sub>3</sub> which can guide a turning portion of the polishing tape T guided to be outward/return-transferred to detour sideward, and having a detour polishing part K which is capable of polishing the inner peripheral end surface M of the round hole Q, and consists of the sideward detouring portion of the polishing tape T guided to detour sideward by the detour guide part C<sub>3</sub>; a pressure-contacting mechanism E capable of pressure-contacting the detour polishing part K to the inner peripheral end surface M of the round hole Q and the detour polishing part K to the outer peripheral end surface N of the circular substrate W by moving the circular substrate W with pressure-contacting; and a polishing part rocking mechanism F for rocking the detour polishing part K intermittently or continuously in the direction opposite to the inner peripheral end surface M of the round hole Q and polishing the inner peripheral end surface M of the round hole Q and the outer peripheral end surface N to be a chamfered surface or a round surface

by the detour polishing part K. In addition to this, the exemplary embodiment is configured with a switching/moving mechanism G for switching and moving the holding/rotating mechanism A from an inner pressure-contacting position H, at which the detour polishing part K and the inner peripheral end surface M of the round hole Q are pressure-contacted, to an outer pressure-contacting position L, at which the detour polishing part K and the outer peripheral end surface N of the circular substrate W are pressure-contacted, and for polishing the inner peripheral end surface M and the outer peripheral end surface N of the circular substrate W.

In this case, the aforementioned holding/rotating mechanism A has the following configuration. As illustrated in Figs. 1 and 3, the holding/rotating mechanism A includes a laterally moving base 2 slidably provided on a machine base 1 with guide parts 2a and 2a and slide parts 2b and 2b. A three roll set 3 is located on the laterally moving base 2, where the three roll set 3 includes a fixing roll 3a, a drive roll 3b, and a press roll 3c which can hold the outer peripheral end surface N of the circular substrate W. Among these rolls, the fixing roll 3a is free-rotatably supported by a free-rotating shaft 3d axially supported on the

laterally moving base 2. The drive roll 3b is driven and rotated by a rotating motor 3f provided at the laterally moving base 2 via a driving shaft 3e. The press roll 3c is provided by a free-rotating shaft 3i on a supporting arm 3h which can retreat, rock, and move around a fulcrum shaft. Accordingly, the outer peripheral end surface N of the circular substrate W is supplied to the fixing roll 3a and the drive roll 3b manually or by a feeding and taking-out mechanism not illustrated, and is supported by those. Rocking the supporting arm 3h from an imaginary line position to a solid line position in Fig. 3, the press roll 3c comes to be in contact with the outer peripheral end surface N of the circular substrate W, and three points of the circular substrate W are held by the three roll set 3 including the fixing roll 3a, the drive roll 3b, and the press roll 3c. In the holding state, the rotating motor 3f is driven so that the circular substrate W is rotated around a center  $Q_1$  of the round hole Q by the driving roll 3b.

In the exemplary embodiment, the tape transfer mechanism C has the following configuration. As illustrated in Figs. 1 and 2, the tape transfer mechanism C includes a delivering reel 5 and a winding reel 6 which are free-rotatably located at a tape machine body 4 at an upper part of the machine base 1. Giving back tension

to the polishing tape T wound around the delivering reel 5 by a back-tension motor 7a in a back tension mechanism 7, a feeding roll 8b rotated by a feeding motor 8a and a narrowing pressure roll 8c in a feeding mechanism 8, transfer the polishing tape T intermittently or continuously from the delivering reel 5 side to the winding reel 6 side through the tape polishing mechanism D, and the feeding motor 8a rotates the winding reel 6 via a belt mechanism 8d so that the polishing tape T is wound around the winding reel 6.

The polishing tape T used in the exemplary embodiment is made by, for example, coating or coupling fixed abrasive grains having a predetermined particle size of aluminum oxide, chromic oxide, silicon carbide, diamond, or the like on a base material such as a polyester film, a metal, a cloth, a foam film, a flocked fabric, or the like. In addition, the exemplary embodiment may use a dry type polishing structure using a polishing tape with a structure in which the fixed abrasive grains adhere to such the material and not using a lubricant, a wet type polishing structure using a polishing tape with a structure in which the fixed abrasive grains adhere to the material and supplying a lubricant to perform polishing, or a wet type polishing structure using, as a polishing tape, a woven fabric, a nonwoven fabric,

a foam film ,or a flocked fabric, in which the abrasive grains are not fixed, and supplying an abrasive containing free abrasive grains. Therefore, the polishing tape T described herein includes a polishing tape with a structure in which the fixed abrasive grains adhere, and a polishing tape with a structure in which the fixed abrasive grains do not adhere.

In the exemplary embodiment, the tape polishing mechanism D has the following configuration. A mounting base 9 is mounted on the tape machine body 4 located at an upper part of the machine base 1. As illustrated in Figs. 4 and 5, the tape polishing mechanism D has, at the mounting base 9, a groove-shaped outward guide part C<sub>1</sub> and a groove-shaped return guide part C<sub>2</sub> which can guide the polishing tape T to be outward/return-transferred, and has a quadrangular prism-shaped detour guide part C<sub>3</sub> which can guide a turning portion of the polishing tape T guided to be outward/return-transferred, to detour sideward. A sideward detour portion T<sub>3</sub> of the polishing tape T, which is guided to detour sideward by the detour guide part C<sub>3</sub>, comes to be the detour polishing part K capable of polishing the inner peripheral end surface M of the round hole Q. In the exemplary embodiment, the detour guide part C<sub>3</sub> includes two turning face parts 10 and 11 cutout

by 45°, which are for turning sideward a forward-side portion  $T_1$ , in the forward-side portion  $T_1$  and a return-side portion  $T_2$  of the polishing tape  $T$ , from the outward guide part  $C_1$ , and for turning the return-side portion  $T_2$  from the sideward detour position to the return guide part  $C_2$  via the sideward detour portion  $T_3$ . The detour guide part  $C_3$  further includes a pressure-receiving face part 12 having a freely-rotating roll shape, which is for guiding the polishing tape  $T$  turned sideward by the turning face parts 10 and 11 to detour and for receiving polishing pressure.

In the exemplary embodiment, the pressure receiving face part 12 is made of an elastic material such as rubber, a synthetic resin or the like or a hard material. When the pressure receiving face part 12 is made of the elastic material, the pressure receiving face part 12 can absorb excessive polishing pressure.

The pressure-contacting mechanism  $E$  has the following configuration. As illustrated in Figs. 2 and 3, a pressure-contacting base 13 is slidably provided on the guide parts 2a and 2a for sliding and guiding of the lateral moving base 2 with sliding parts 13a and 13a. A cylinder part 13c of a pressure-contacting cylinder 13b is mounted on the pressure-contacting base 13. A cylinder rod 13d of the pressure-contacting

cylinder 13b is connected with the lateral moving base 2. A stopper bolt 13e for adjusting a pressure-contacting position is screwed to the pressure-contacting base 13 penetrating a raised part of the lateral moving base 2. A head part of the stopper bolt 13e is formed at a stopper part capable of adjusting the pressure-contacting position of the lateral moving base 2. The circular substrate W is moved with pressure-contacting so that the detour polishing part K and inner peripheral end surface M of the round hole Q can be pressure-contacted and the detour polishing part K and the outer peripheral end surface N of the circular substrate W can be pressure-contacted.

The polishing part rocking mechanism F has the following configuration. As illustrated in Figs. 1 and 2, a rocking base 14 is provided at the machine body 1 so as to be capable of being rocked with the rocking shaft 14a. In addition, a rocking motor 14b for rocking the rocking shaft 14a is also provided at the machine body 1. A vertically adjusting base 14c is provided at the rocking base 14 so as to be vertically-adjustable with a rocking groove part 14d and an adjustment bolt 14e, and a back-and-forth moving base 14f is provided at the vertically adjusting base 14c so as to be slidable with guide parts 14g and 14g and slide parts 14h and

14h. Further, a back-and-forth moving motor 14i for moving the back-and-forth moving base 14f back and-forth and a ball screw mechanism 14j are provided at the vertically adjusting base 14c, and the tape machine body 4 is mounted on the back-and-forth moving base 14f.

Accordingly, in this configuration, the detour polishing part K is positioned to be opposite to the inner peripheral end surface M of the round hole Q of the circular substrate W by moving forward the back-and-forth moving base 14f, and the detour polishing part K is provided to be capable of being rocked by rocking the rocking base 14 around a center axial line P of the rocking shaft 14a. The detour polishing part K is rocked intermittently or continuously in the direction opposite to the inner peripheral end surface M of the round hole Q, so that the inner peripheral end surface M of the round hole Q is polished to be the chamfered surface or the round surface by the detour polishing part K.

In the exemplary embodiment, the switching/moving mechanism G has the following configuration. As illustrated in Figs. 2 and 3, a cylinder part 15a of a cylinder 15 for switching and moving is provided at the machine body 1. A cylinder rod 15b of the cylinder 15 for switching and moving is connected with the lateral moving base 2, and a control member 16 is provided at

the lateral moving base 2. Further, a control bolt 16a for an inner pressure-contacting position H and a control bolt 16b for an outer pressure-contacting position L are provided at the machine body 1 so as to be adjustable to advance or retreat. Accordingly, in this configuration, the holding/rotating mechanism A is switched and moved from the inner pressure-contacting position H, at which the detour polishing part K and the inner peripheral end surface M of the round hole Q are pressure-contacted, to the outer pressure-contacting position L at which the detour polishing part K and the outer peripheral end surface N of the circular substrate W are pressure-contacted, so that the inner peripheral end surface M and the outer peripheral end surface N of the circular substrate W are polished to be the chamfered surface or the round surface.

In addition, a rocking mechanism for rocking the tape polishing mechanism D in an arrow direction in Fig. 14 may be provided although it is not illustrated in the drawings. The arrow direction is a direction crossing the transfer direction of the polishing tape T in the detour polishing part K. As for the rocking mechanism to be used in this case, for example, a rocking mechanism having an eccentric ring structure can be

adopted. The eccentric ring structure includes a rocking motor between the back-and-forth moving base 14f and the tape machine body 4, an eccentric ring mounted on a main shaft of the rocking motor, and a cam plate having a structure in which an outer peripheral surface of the eccentric ring is pinched at the opposite positions can be used. In addition, the tape polishing mechanism D can be rocked by a rocking mechanism with various kind of structures.

Since the exemplary embodiment has the aforementioned configuration, the circular substrate W is supplied manually or automatically to the holding/rotating mechanism A, the outer peripheral end surface N of the circular substrate W is held by the three roll set 3 in the holding/rotating mechanism A and rotated by the rotating motor 3f, the polishing tape T is transferred intermittently or continuously by the tape transfer mechanism C, and as illustrated in Figs. 8 and 9, the back-and-forth moving base 14 of the tape polishing mechanism D is advanced by the back-and-forth moving motor 14i, so that the detour polishing part K is positioned at a position opposite to the inner peripheral end surface M of the round hole Q. The lateral moving base 2 is pushed by the pressure-contacting cylinder 13b attached to the pressure-contacting base

13 in the pressure-contacting mechanism E so as to pressure-contact the inner peripheral end surface M of the round hole Q of the circular substrate W to the detour polishing part K. The rocking base 14 in the polishing part rocking mechanism F is rocked intermittently or continuously by the rocking motor 14b around the rocking shaft 14a. By rocking of the rocking base 14, the detour polishing part K is rocked intermittently or continuously in the direction opposite to the inner peripheral end surface M of the round hole Q. By rocking of the detour polishing part K intermittently or continuously, the inner peripheral end surface M of the round hole Q can be polished to be the chamfered surface illustrated in Fig. 10 or the round surface illustrated in Fig. 11. Accordingly, the removability of impurities such as glasses, particles of a resin and the like, which adhere to the inner peripheral end surface of the circular substrate, can be improved, and further, the machining qualities such as mirror-polishing performance of the inner peripheral end surface M and the like, can be improved. In addition, the inner peripheral end surface M can be polished easily to be the chamfered surface or the round surface. Furthermore, the polishing tape T is guided to be outward/return-transferred by the outward guide part C<sub>1</sub> and the return guide part C<sub>2</sub>, the

turning portion of the polishing tape T is guided to detour sideward by the detour guide part C<sub>3</sub>, and the sideward detouring portion T<sub>3</sub> of the polishing tape T, which is guided to detour sideward by the detour guide part C<sub>3</sub>, is made to be the detour polishing part K capable of polishing the inner peripheral end surface M of the round hole Q. Thus, the compact and small detour polishing part K can be formed. Therefore, the inner peripheral end surface M of the round hole Q of the circular substrate W can be polished properly without being disturbed by surrounding members, so that flexibilities in a machining position and a layout can be improved.

The exemplary embodiment is provided with the switching/moving mechanism F, which is for switching and moving the holding/rotating mechanism A from the inner pressure-contacting position H, at which the detour polishing part K and the inner peripheral end surface M of the round hole Q are pressure-contacted, to the outer pressure-contacting position L, at which the detour polishing part K and the outer peripheral end surface of the circular substrate W are pressure-contacted, and is for polishing the inner peripheral end surface M and the outer peripheral end surface N of the circular substrate W. Thus, as

illustrated in Figs. 12 and 13, the outer peripheral end surface N of the circular substrate W can be also polished to the chamfered surface or the round surface. By operating of the switching/moving mechanism F, the inner peripheral end surface M and the outer peripheral end surface N of the circular substrate W can be polished. Therefore, the machining operability can be improved.

Further, the exemplary embodiment includes the rocking mechanism for rocking the tape polishing mechanism D in the direction crossing the transferring direction of the polishing tape T in the detour polishing part K. Thus, a polishing action caused by rocking of the polishing tape can be added, so that polishing machining can be carried out properly more. Further, according to the exemplary embodiment, the detour guide part C<sub>3</sub> includes the two turning face parts 10 and 11 for turning the outward-side portion T<sub>1</sub> in the outward-side portion T<sub>1</sub> and the return-side portion T<sub>2</sub> of the polishing tape T, from the outward guide part C<sub>1</sub> sideward, and for turning the return-side portion T<sub>2</sub> from the sideward position to the return guide part C<sub>2</sub>. The detour guide part C<sub>3</sub> further includes the pressure-receiving face part 12, which is for guiding the polishing tape T turned sideward by the both turning face parts 10 and 11, and receiving polishing pressure.

Thus, the pressure-receiving face part 12 can guide the polishing tape T to detour sideward properly, and transfer the polishing tape T smoothly. Further, according to the exemplary embodiment, since the pressure receiving face part 12 is made of an elastic material such as rubber, a synthetic resin or the like or a hard material, the pressure receiving face part 12 can receive polishing pressure properly. Furthermore, according to the exemplary embodiment, the polishing structure by the detour polishing part K including the polishing tape is a dry type structure or a wet type structure. Having such the structure, the substrate polishing method of the present exemplary embodiment can adapt to specifications of materials of the circular substrate W, polishing conditions, and the like.

Further, as another exemplary embodiment which is omitted in drawings, instead of the pressure-contacting mechanism E in the present embodiment having a structure that the circular substrate W is moved with pressure-contacting so that the detour polishing part K and the inner peripheral end surface M of the round hole Q are pressure-contacted, the pressure-contacting mechanism E can have a structure that the detour polishing part K is moved with pressure-contacting so that the detour

polishing part K and the inner peripheral end surface M of the round hole Q are pressure-contacted. In this case, a similar actional effect can be obtained.

Further, the switching/moving mechanism G has a structure of switching and moving the holding/rotating mechanism A from the inner pressure-contacting position H, at which the detour polishing part K and the inner peripheral end surface M of the round hole Q are pressure-contacted, to the outer pressure-contacting position L, at which the detour polishing part K and the outer peripheral end surface N of the circular substrate W are pressure-contacted, for polishing the inner peripheral end surface M and the outer peripheral end surface N of the circular substrate W. However, the switching/moving mechanism G can adopt a structure of switching and moving at least the tape polishing mechanism D and the polishing part rocking mechanism F in the polishing/machining mechanism B from the inner pressure-contacting position H, at which the detour polishing part K and the inner peripheral end surface M of the round hole Q are pressure-contacted, to the outer pressure-contacting position L, at which the detour polishing part K and the outer peripheral end surface N of the circular substrate W are pressure-contacted, for polishing the inner peripheral end

surface M and the outer peripheral end surface N of the circular substrate.

Furthermore, the present invention is not limited to the aforementioned exemplary embodiment. The structure of the holding/rotating mechanism A, the structures of the polishing / machining mechanism B, the tape transfer mechanism C, the tape polishing mechanism D, the pressure-contacting mechanism E, the polishing part rocking mechanism F, the switching/moving mechanism G and the like, the material, the structure and the like of the polishing tape T can be suitably modified and designed. Further, dry type polishing or wet type polishing can be used according to a machining specification.

Accordingly, the expected objective can be realized sufficiently.

What is claimed is;

1. A substrate polishing method applied at a time of polishing an inner peripheral end surface of a round hole of a circular substrate having the round hole at a center part, the method comprising:

using a polishing tape, wherein the polishing tape is guided to be outward/return-transferred, a turning portion of the polishing tape guided to be outward/return-transferred is guided to detour sideward, and a sideward detouring portion of the polishing tape is made to be a detour polishing part capable of polishing the inner peripheral end surface of the round hole;

holding and rotating the circular substrate;

transferring the polishing tape intermittently or continuously;

pressure-contacting the detour polishing part to the inner peripheral end surface of the round hole;

rocking the detour polishing part intermittently or continuously in a direction opposite to the inner peripheral end surface of the round hole; and

thereby polishing the inner peripheral end surface of the round hole to be a chamfered surface or a round surface.

2. The substrate polishing method as claimed in claim

1, wherein an inner peripheral end surface and an outer peripheral end surface of the circular substrate are polished by switching and moving from an inner pressure-contacting position, at which the detour polishing part and the inner peripheral end surface of the round hole are pressure-contacted, to an outer pressure-contacting position at which the detour polishing part and the outer peripheral end surface of the circular substrate are pressure-contacted.

3. A substrate polishing device comprising:  
a holding/rotating mechanism for holding and rotating a circular substrate having a round hole at a center part; and  
a polishing/machining mechanism for polishing at least an inner peripheral surface of the round hole of the circular substrate,  
wherein the polishing/machining mechanism comprises:  
a tape transfer mechanism for transferring a polishing tape intermittently or continuously;  
a tape polishing mechanism having an outward guide part and a return guide part which can guide the polishing tape to be outward/return-transferred, having a detour guide part which can guide a turning portion of the polishing tape guided to be outward/return-transferred

to detour sideward, and having a detour polishing part which can polish the inner peripheral end surface of the round hole and consists of a sideward detouring portion of the polishing tape guided to detour sideward by the detour guide part;

a pressure-contacting mechanism capable of pressure-contacting the detour polishing part to the inner peripheral end surface of the round hole by moving the detour polishing part or the circular substrate with pressure-contacting; and

a polishing part rocking mechanism for rocking the detour polishing part intermittently or continuously in a direction opposite to the inner peripheral end surface of the round hole, and polishing the inner peripheral end surface of the round hole to be a chamfered surface or a round surface by the detour polishing part.

4. The substrate polishing device as claimed in claim 3, wherein the device further comprises, in the holding/rotating mechanism or the polishing/machining mechanism, a switching/moving mechanism for switching and moving at least the tape polishing mechanism and the polishing part rocking mechanism from an inner pressure-contacting position to an outer pressure-contacting position, and thereby polishing an

inner peripheral end surface and an outer peripheral end surface of the circular substrate, where the detour polishing part and the inner peripheral end surface of the round hole are pressure-contacted at the inner pressure-contacting position, and the detour polishing part and the outer peripheral end surface of the circular substrate are pressure-contacted at the outer pressure-contacting position.

5. The substrate polishing device as claimed in claim 3 or 4, wherein the device further comprises a rocking mechanism for rocking the tape polishing mechanism in a direction crossing a transferring direction the polishing tape in the detour polishing part.

6. The substrate polishing device as claimed in claim 3, wherein the detour guide part comprises two turning face parts for turning the outward-side portion, in an outward-side portion and a return-side portion of the polishing tape, sideward from the outward guide part, and for turning the return-side portion from the sideward position to the return guide part, and a pressure receiving face part for guiding the polishing tape turned sideward by the two turning face parts to detour, and for receiving polishing pressure.

7. The substrate polishing device as claimed in claim 6, wherein the pressure receiving face part is made of an elastic material such as rubber, a synthetic resin or the like or a hard material.

8. The substrate polishing device as claimed in claim 3, wherein a polishing structure by the detour polishing part comprising the polishing tape is a dry type structure or a wet type structure.