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(54) **PAD CONDITIONER FOR CHEMICAL MECHANICAL POLISHING**

(76) Inventors: **Chun-Liang Lin**, Tai-Chung City (TW); **Shen-Cheng Wu**, Hsinchu City (TW); **Win-Sun Lin**, Hsinchu City (TW)

Correspondence Address:
**NORTH AMERICA INTELLECTUAL PROPERTY CORPORATION**
**P.O. BOX 506**
**MERRIFIELD, VA 22116 (US)**

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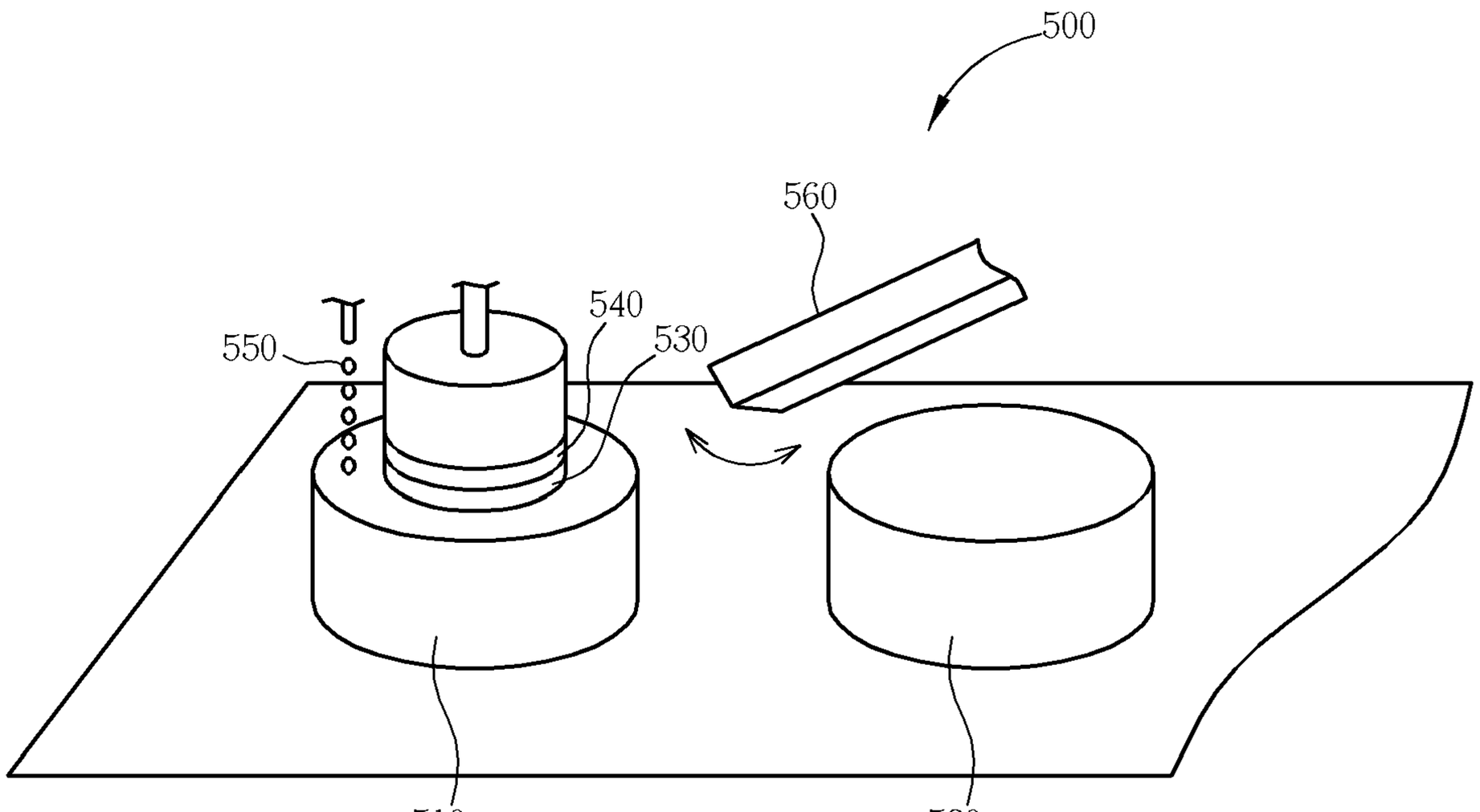
(57) **ABSTRACT**

A pad conditioner for chemical mechanical polishing includes a dressing component for conditioning a pad and a housing for accommodating the dressing component. The housing includes at least one fluid hole surrounding the dressing component for providing at least a fluid.



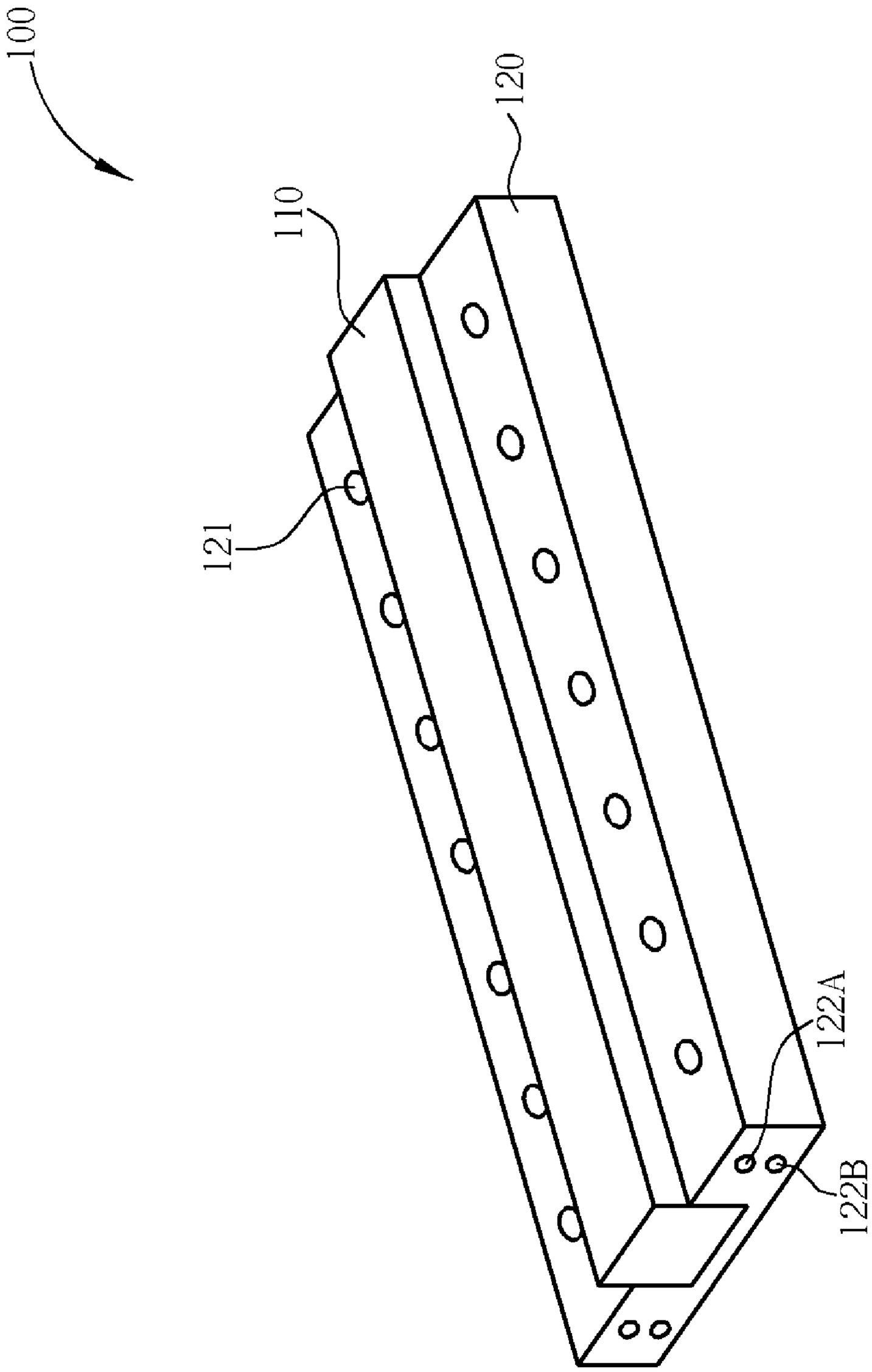



Fig. 1

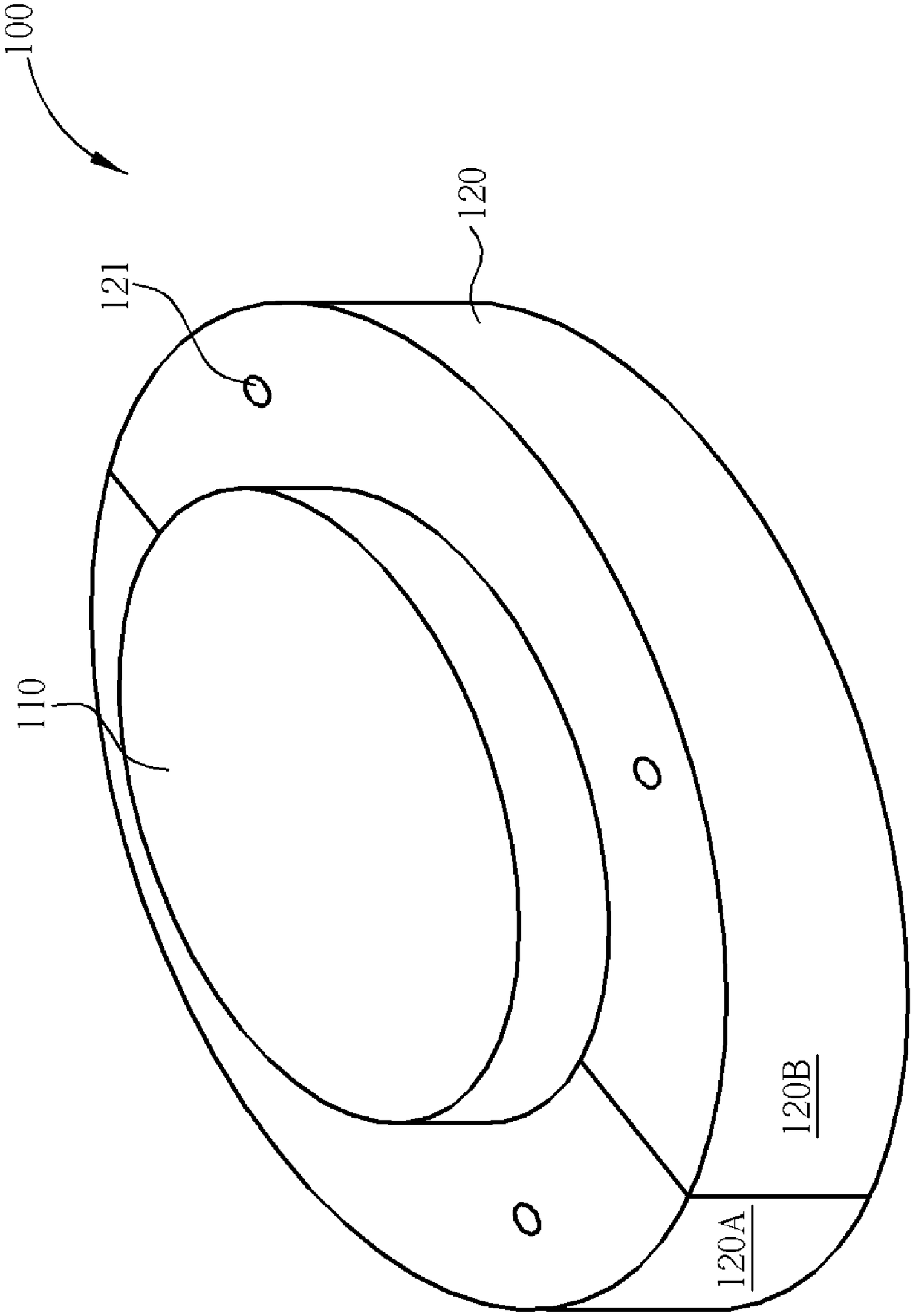



Fig. 2

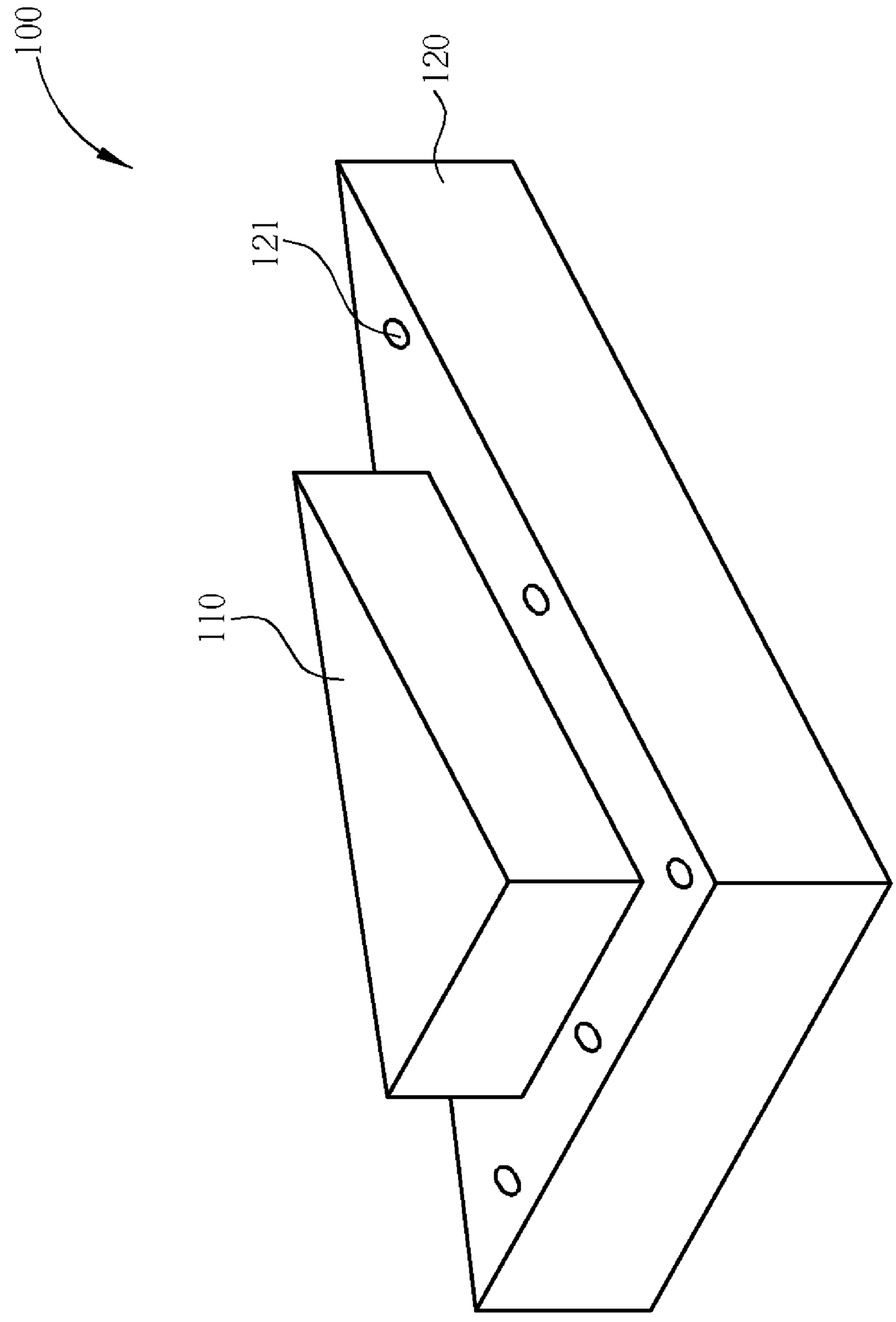



Fig. 3

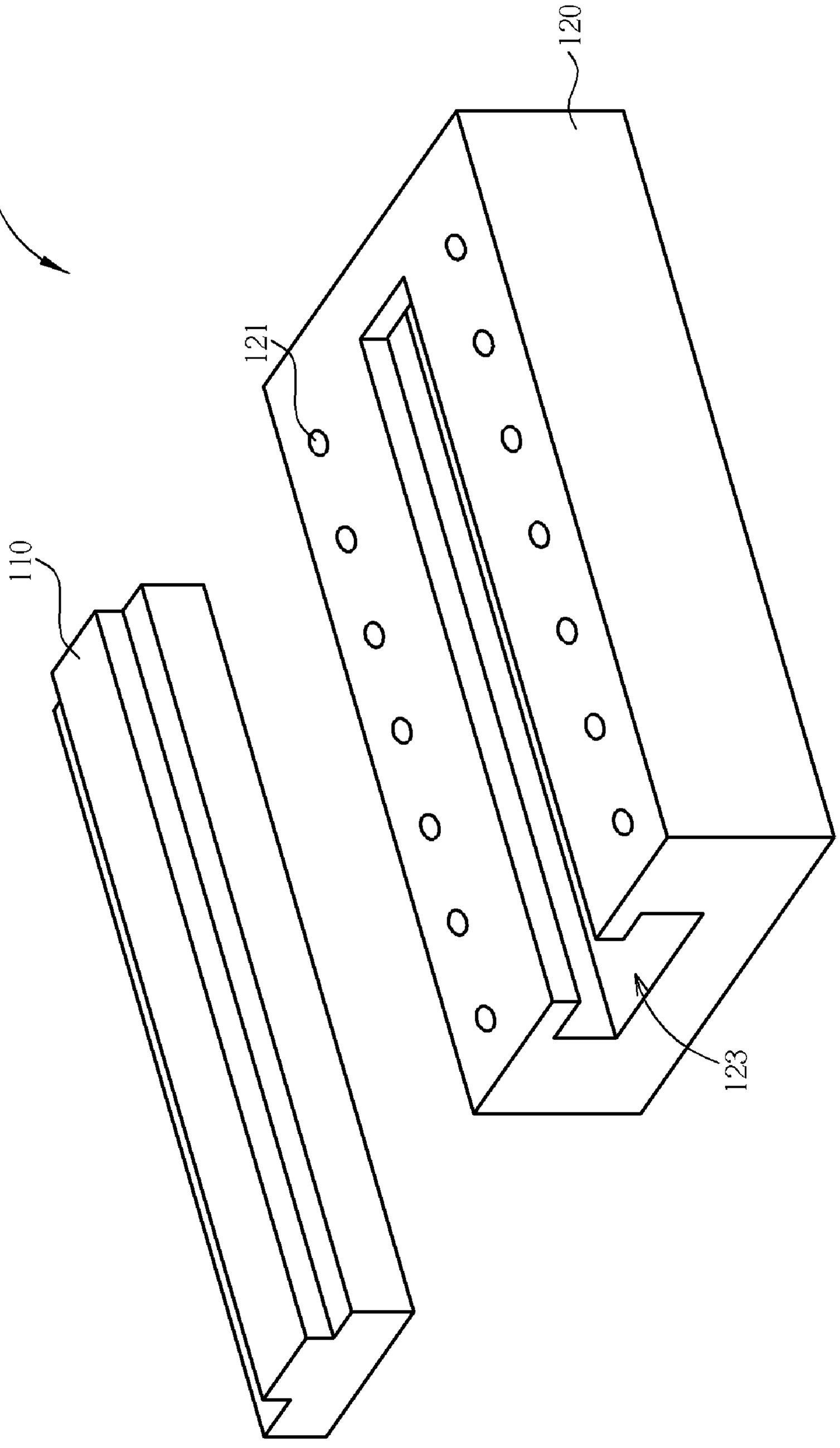



Fig. 4

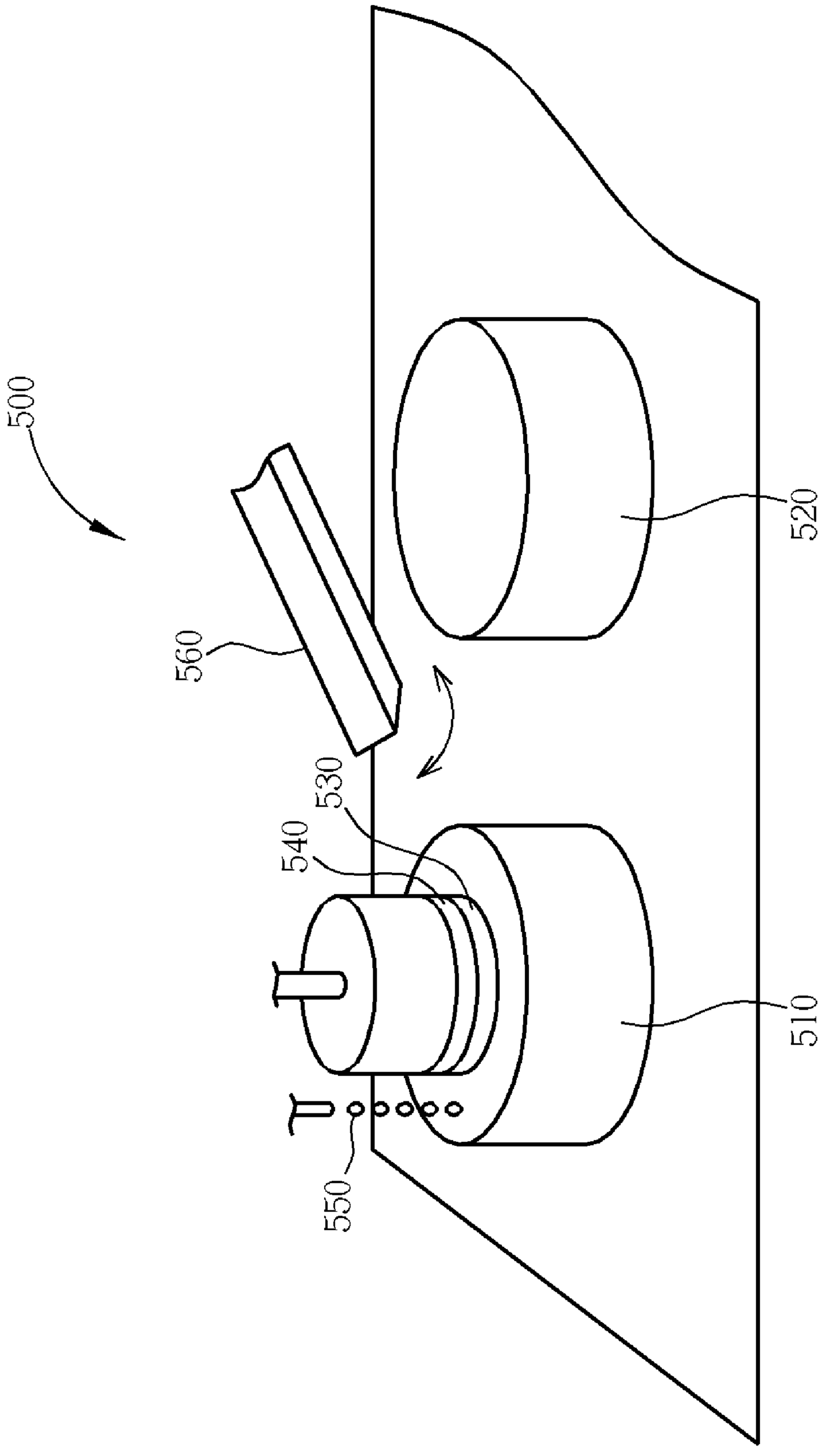



Fig. 5

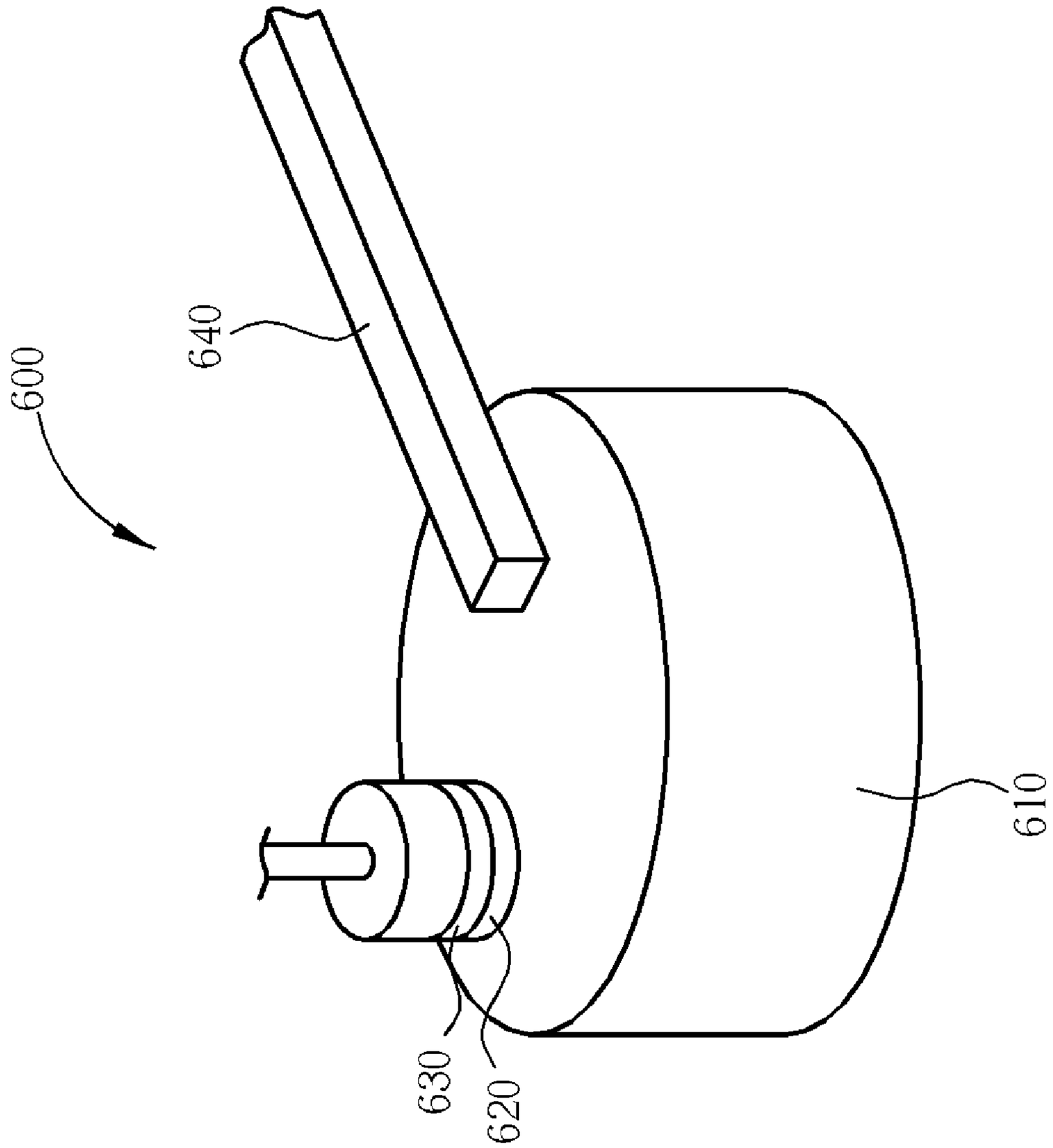



Fig. 6

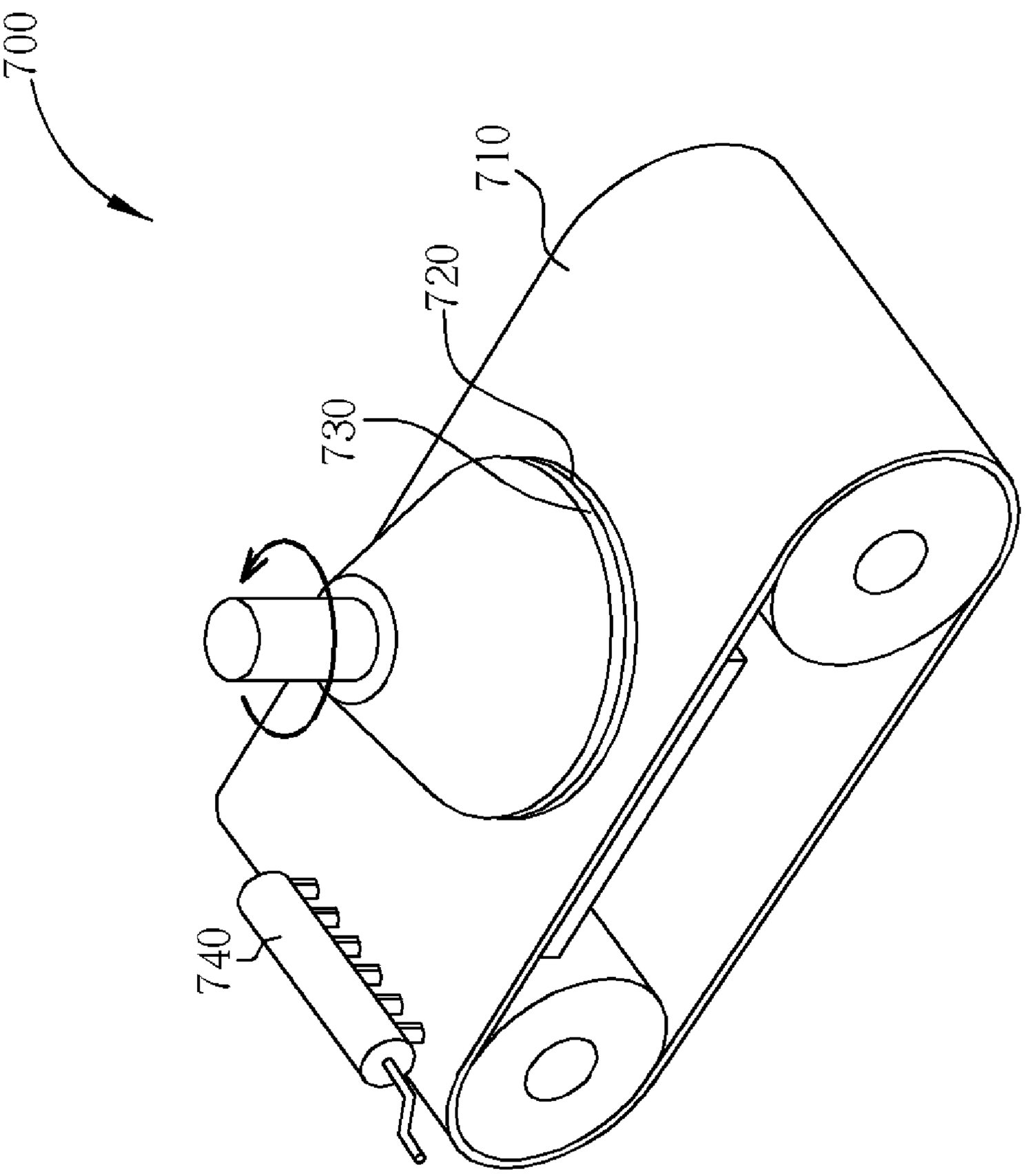



Fig. 7

# PAD CONDITIONER FOR CHEMICAL MECHANICAL POLISHING

## BACKGROUND OF THE INVENTION

**[0001]** 1. Field of the Invention

**[0002]** The present invention relates to a polishing pad conditioner for chemical mechanical polishing. More particularly, the present invention relates to a polishing pad conditioner that is capable of providing a fluid for chemical mechanical polishing.

**[0003]** 2. Description of the Prior Art

**[0004]** The chemical mechanical polishing process is currently widely used in the semiconductor field. In a chemical mechanical polishing process, the polishing property of the surface of the polishing pad deteriorates after a period of time because the slurry is not able to evenly disperse on the polishing pad any more. To solve the problem, the polishing pad conditioner is employed to condition the polishing pad to restore the polishing property of the surface of the polishing pad.

**[0005]** The conditioning property of the polishing pad conditioner usually resides in the dressing component and nowadays the dressing component is mostly composed of diamonds. Therefore, the conditioning property of the dressing component is key to the process stability and the wafer removal rate. A decent dressing component should meet the following requirements: stable wafer removal rate, properly conditioning the polishing pad, regenerating the conditioning property of the polishing pad and extending the operational life of the polishing pad.

**[0006]** During the chemical mechanical polishing process, slurry is usually employed to facilitate the chemical mechanical polishing. When the polishing pad conditioner conditions the polishing pad, particles brought about from the slurry and from the chemical mechanical polishing process may transfer to the dressing component during the conditioning process. After a while, the particles crystallize and attach to the dressing component, which shortens the operational life of the dressing component and causes the diamonds to come off the dressing component. Such diamonds will scratch the wafer and cause defects. This is a problem which needs to be solved.

## SUMMARY OF THE INVENTION

**[0007]** The present invention therefore provides a polishing pad conditioner for chemical mechanical polishing. The polishing pad conditioner provides a fluid to continuously clean the dressing component for conditioning the polishing pad to avoid particles and to maintain the conditioning property of the dressing component, which can stabilize the wafer removal rate and regenerate the conditioning property of the polishing pad.

**[0008]** The polishing pad conditioner for chemical mechanical polishing of the present invention includes a dressing component for conditioning a pad and a housing for accommodating the dressing component. The housing includes at least one fluid hole surrounding the dressing component for providing at least one fluid.

**[0009]** The present invention again provides a method for polishing a substrate. The method of the present invention first provides a substrate. Then the substrate is polished by a polishing tool which is provided with at least a polishing pad and at least a polishing pad conditioner. The polishing pad conditioner includes a dressing component for conditioning a pad and a housing for accommodating the dressing component. The housing includes at least one fluid hole surrounding the dressing component for providing at least a fluid.

**[0010]** Because the polishing pad conditioner for chemical mechanical polishing of the present invention includes the fluid hole(s) surrounding the dressing component for providing at least a fluid, the fluid hole(s) may provide a fluid to clean the dressing component on the polishing pad conditioner for chemical mechanical polishing, which avoids the crystallization of the particles. This will maintain the conditioning property of the dressing component and help to diminish the defects on the wafer.

**[0011]** These and other objectives of the present invention will no doubt become obvious to those of ordinary skill in the art after reading the following detailed description of the preferred embodiment that is illustrated in the various figures and drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0012]** FIGS. **1-4** illustrate various embodiments of the polishing pad conditioner of the present invention.

**[0013]** FIG. **5** illustrate a chemical mechanical polishing system with multiple polishing pads.

**[0014]** FIG. **6** illustrate a chemical mechanical polishing system with a single large-sized polishing pad.

**[0015]** FIG. **7** illustrates a linear chemical mechanical polishing system.

## DETAILED DESCRIPTION

**[0016]** FIG. **1** illustrates the polishing pad conditioner of the present invention for chemical mechanical polishing. The polishing pad conditioner **100** of the present invention includes a dressing component **110** for conditioning a pad and a housing **120** for accommodating the dressing component **110**. The materials for the dressing component **110** and the housing **120** are known in the field and will not be described in detail. The dressing component **110** may be a diamond bar for example. The surface of the dressing component **110** may preferably be embedded with granules of hardness between 4-10. The granules may be made of SiC, dimond, $ZrO_2$, $Al_2O_3$.

**[0017]** In order to clean the dressing component **110** to avoid the accumulation of the slurry and the particles, the housing **120** includes at least one fluid hole **121** surrounding the dressing component **110** for providing at least one fluid to wash away the slurry and the particles to keep the dressing component **110** clean when the fluid spurts.

**[0018]** The polishing pad conditioner **100** and the dressing component **110** illustrated in FIG. **1** are rectangular, but are not limited to this. For example, the polishing pad conditioner **100** and the dressing component **110** may also be in any shape, such as round or oval, i.e. the disc shape in FIG. **2**, or a polygon, such as the triangle in FIG. **3**. In addition, the housing **120** of the polishing pad conditioner **100** may include a plurality of parts which can be assembled together. For example, in FIG. **2**, the housing **120** is composed of two pieces **120**A/**120**B.

**[0019]** The size of the housing **120** depends on the size of the wafers. For example, for a system for the 8-inch wafer, the length of the housing **120** may be 31-32 cm and the width may be 6-7 cm. Besides, for a system for the 12-inch wafer, the size of the housing **120** may be about 70 cm.

**[0020]** Optionally, the fluid supplied by the fluid hole **121** may be liquids such as water or slurry, or gases such as air or inert gas, or the combination thereof. For example, the slurry may be supplied during the polishing process to facilitate the chemical mechanical polishing and ensure that the slurry will not dry out on the surface of the dressing component **110** of the polishing pad conditioner **100**. Alternatively, water may be supplied during the conditioning of the polishing pad to clean the dressing component **110**, or gas may be supplied to clean the dressing component **110**. Moreover, there may be at least one fluid channel in the housing **120** of the polishing pad conditioner **100**, such as the fluid channels **122**A/**122**B illustrated in FIG. **1** to supply each of the fluid holes **121** surrounding the dressing component **110** with a fluid. The fluid channel(s) and the fluid hole(s) may also be removably attached to the housing **120** of the polishing pad conditioner **100**, for example externally hung on the housing **120** of the polishing pad conditioner **100**.

**[0021]** In order to enhance the fluid to clean the dressing component **110**, the location of the fluid holes **121** can be optionally arranged so that the fluid may substantially contact the dressing component **110** when spurting from the fluid holes **121** to wash away any slurry, particle or crystal possibly attached to the dressing component **110**.

**[0022]** To keep the dressing component **110** secure in the housing **120**, the housing **120** may further include a slot **123** in a shape corresponding to the dressing component **110**, as shown in FIG. **4**, in addition to the conventional screws. The dressing component **110** may engage with the slot **123** of the polishing pad conditioner **100** by sliding thereinto to fix a relation position between the dressing component **110** and the housing **120**. Furthermore, screws may be used to keep the dressing component **110** secure in the housing **120** to enhance the performance of the dressing component **110** and the wafer removal rate.

**[0023]** The polishing pad conditioner of the present invention may be employed in various chemical mechanical polishing systems. In one preferred embodiment of the present invention, the polishing pad conditioner of the present invention may be employed in a chemical mechanical polishing system with multiple polishing pads. FIG. **5** illustrates a chemical mechanical polishing system with multiple polishing pads. The chemical mechanical polishing system **500** includes a first polishing pad **510** and a second polishing pad **520**. A wafer **530** is fixed on the first polishing pad **510** through the back pad **540**, motivated by the rotating back pad **540** and undergoes the chemical mechanical polishing process in the presence of the slurry **550**. On the other hand, the polishing pad conditioner **560** of the present invention conditions the second polishing pad **520** on which a wafer is absent. Or, on the contrary, the wafer **530** is fixed on the second polishing pad **520** through the back pad **540** and undergoes the chemical mechanical polishing process in the presence of the slurry **550**. On the other hand, the polishing pad conditioner **560** of the present invention conditions the surface of the first polishing pad **510** on which a wafer is absent. By doing so, the polishing pad conditioner of the present invention may clean the slurry, particles or crystals on the surface of the dressing component of the polishing pad conditioner and conditions the surface of the polishing pad through the cleaned dressing component.

**[0024]** Or, in another preferred embodiment of the present invention, the polishing pad conditioner of the present invention may be employed in a chemical mechanical polishing system with a single large-sized polishing pad. FIG. **6** illustrates a chemical mechanical polishing system with a single large-sized polishing pad. The chemical mechanical polishing system **600** includes a rotary polishing pad **610**. At least one wafer **620** is fixed on the polishing pad **610** through the back pad **630**, motivated by the rotating back pad **630** and undergoes a chemical mechanical polishing process. Simultaneously, the polishing pad conditioner **640** of the present invention conditions the surface of the polishing pad **610** on another site. Moreover, the polishing pad conditioner of the present invention may be employed in a linear chemical mechanical polishing system, as shown in FIG. **7**. The linear chemical mechanical polishing system **700** includes a polishing pad **710**. A wafer **720** fixed by the back pad **630** and motivated by the rotating back pad **630** undergoes the chemical mechanical polishing process. On the other hand, the polishing pad conditioner **740** of the present invention conditions the surface of the first polishing pad **710** on another side. By doing so, the polishing pad conditioner of the present invention may clean the slurry, particles or crystals on the surface of the dressing component of the polishing pad conditioner and conditions the surface of the polishing pad through the cleaned dressing component.

## EXAMPLE

**[0025]** The following example provides a comparison between the polishing pad conditioner of the present invention and the conventional polishing pad conditioner.

**[0026]** The polishing pad conditioner of the present invention and the conventional polishing pad conditioner are operated in a WCMP-5 system under identical recipes to compare the removal rate uniformity (RR_U %). The polishing pad conditioner of the present invention was operated for 8 working days. The conventional polishing pad conditioner was operated for 111 working days.

**[0027]** Conventional polishing pad conditioner

| Conventional polishing pad conditioner | RR_U % |
|---|---|
| 1 | 6.4839 |
| 2 | 6.785 |
| 3 | 6.0343 |
| 4 | 8.093 |
| 5 | 8.3594 |
| 6 | 8.8052 |
| 7 | 6.056 |
| 8 | 7.4234 |
| 9 | 14.0378 |
| 10 | 5.4041 |
| 11 | 6.4756 |
| Average | 7.6325 |

**[0028]** Polishing pad conditioner of the present invention:

| Polishing pad conditioner of the present invention | RR_U % |
|---|---|
| 1 | 5.7648 |
| 2 | 6.4487 |
| 3 | 6.9301 |
| 4 | 5.0689 |
| 5 | 4.4262 |

-continued

| Polishing pad conditioner of the present invention | RR_U % |
|---|---|
| 6 | 5.8628 |
| 7 | 5.2237 |
| 8 | 6.1312 |
| Average | 5.7320 |

**[0029]** The comparison results clearly show that the novel polishing pad conditioner of the present invention indeed efficiently diminish the defects of the wafer during the chemical mechanical polishing process.

**[0030]** Those skilled in the art will readily observe that numerous modifications and alterations of the device and method may be made while retaining the teachings of the invention.

What is claimed is:

**1**. A polishing pad conditioner for chemical mechanical polishing, comprising:

a dressing component for conditioning a pad; and

a housing comprising at least one fluid hole surrounding said dressing component for providing at least one fluid for accommodating said dressing component.

**2**. The polishing pad conditioner for chemical mechanical polishing of claim **1**, wherein said dressing component is round.

**3**. The polishing pad conditioner for chemical mechanical polishing of claim **2**, wherein said housing comprises a plurality of parts.

**4**. The polishing pad conditioner for chemical mechanical polishing of claim **1**, wherein said dressing component is selected from a shape of a polygon consisting of triangle and rectangular.

**5**. The polishing pad conditioner for chemical mechanical polishing of claim **1**, wherein said housing comprises a slot for engaging with said dressing component to fix a relation position between said dressing component and said housing.

**6**. The polishing pad conditioner for chemical mechanical polishing of claim **1**, wherein said fluid is selected from a group consisting of water and slurry.

**7**. The polishing pad conditioner for chemical mechanical polishing of claim **1**, wherein said fluid substantially contacts said dressing component when spurting from said fluid hole.

**8**. The polishing pad conditioner for chemical mechanical polishing of claim **1**, further comprising at least one screw to fix a relation position between said dressing component and said housing.

**9**. A polishing pad conditioner for chemical mechanical polishing, comprising:

a dressing component for conditioning a pad; and

a housing for accommodating said dressing component, said housing comprising at least one fluid hole surrounding said dressing component for providing at least one fluid and a slot for engaging with said dressing component to fix a relation position between said dressing component and said housing.

**10**. The polishing pad conditioner for chemical mechanical polishing of claim **9**, wherein said dressing component is round.

**11**. The polishing pad conditioner for chemical mechanical polishing of claim **10**, wherein said housing comprises a plurality of parts.

**12**. The polishing pad conditioner for chemical mechanical polishing of claim **9**, wherein said dressing component is selected from a shape of a polygon consisting of triangle and rectangular.

**13**. The polishing pad conditioner for chemical mechanical polishing of claim **9**, wherein said fluid is selected from a group consisting of water and slurry.

**14**. The polishing pad conditioner for chemical mechanical polishing of claim **9**, wherein said fluid substantially contacts said dressing component when spurting from said fluid hole.

**15**. The polishing pad conditioner for chemical mechanical polishing of claim **9**, further comprising at least one screw to fix a relation position between said dressing component and said housing.

**16**. A method for polishing a substrate, comprising:

providing a substrate; and

polishing said substrate with a polishing tool, wherein said polishing tool is provided with at least a polishing pad and at least a polishing pad conditioner, and said polishing pad conditioner includes a dressing component for conditioning a pad and a housing for accommodating said dressing component, and said housing includes at least one fluid hole surrounding said dressing component for providing at least a fluid.

**17**. The method of claim **16**, wherein said dressing component is round.

**18**. The method of claim **17**, wherein said housing comprises a plurality of parts.

**19**. The method of claim **16**, wherein said dressing component is selected from a shape of a polygon consisting of triangle and rectangular.

**20**. The method of claim **16**, wherein said housing comprises a slot for engaging with said dressing component to fix a relation position between said dressing component and said housing.

**21**. The method of claim **16**, wherein said fluid is selected from a group consisting of water and slurry.

**22**. The method of claim **16**, wherein said fluid substantially contacts said dressing component when spurting from said fluid hole.

**23**. The polishing pad conditioner for chemical mechanical polishing of claim **16**, further comprising at least one screw to fix a relation position between said dressing component and said housing.

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