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(54) **BASE PLATE, AND METHOD OF MANUFACTURING THE SAME AND DISK DRIVE INCLUDING THE SAME**

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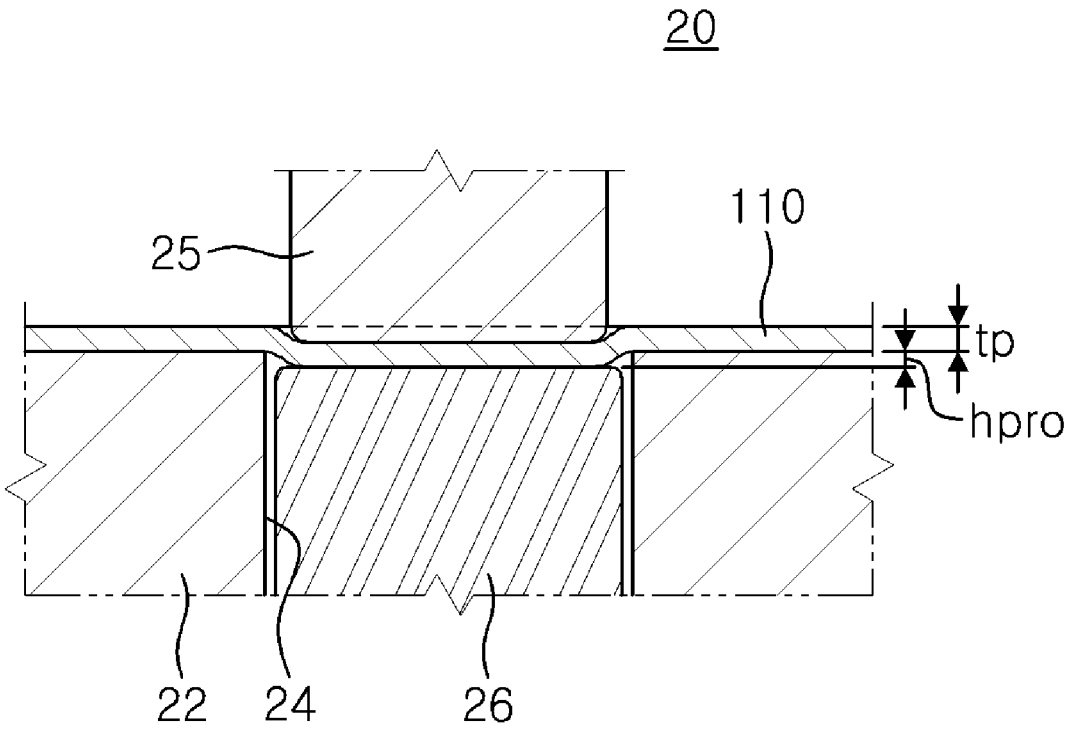
(57) **ABSTRACT**

There is provided a base plate including a body part formed of a metal plate, a pocket part including a recess formed in one surface of the body part by decreasing a thickness of the body part, a center plate part forming the pocket part and corresponding to the recess, a pocket periphery part forming the body part in a periphery of the pocket part, and a pocket edge part formed between the pocket periphery part and the center plate part and having a thickness different from that of the center plate part, wherein a height from a bottom surface of the body part to a top surface of the center plate part is identical to a height of the pocket periphery part, and a thickness of the pocket periphery part is greater than a thickness of the center plate part.



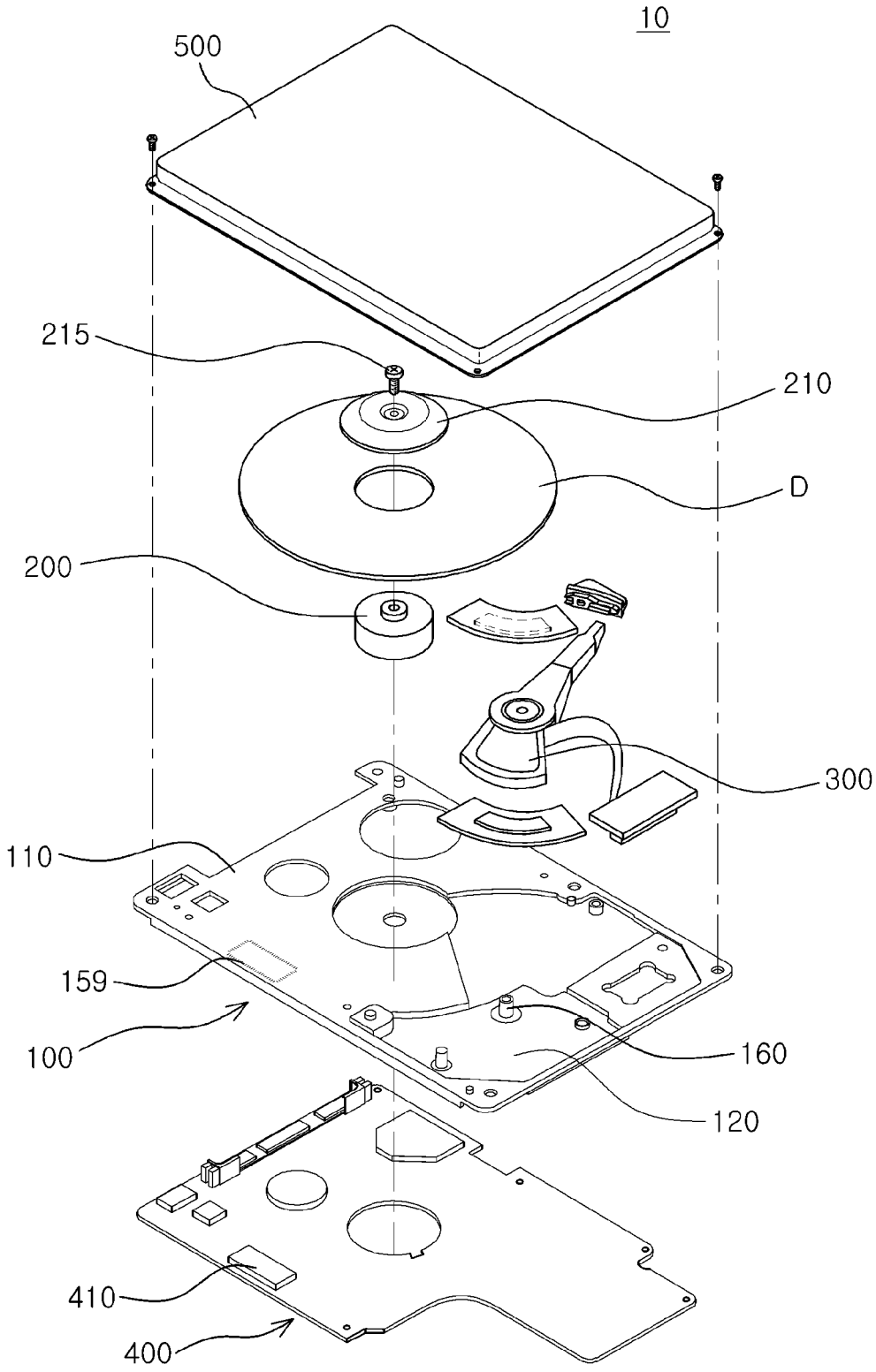


FIG. 1

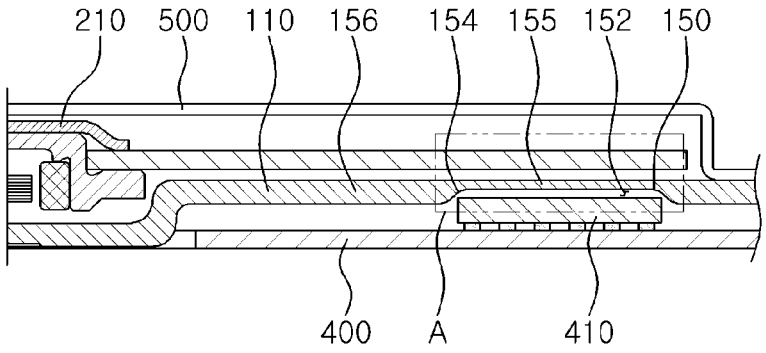


FIG. 2

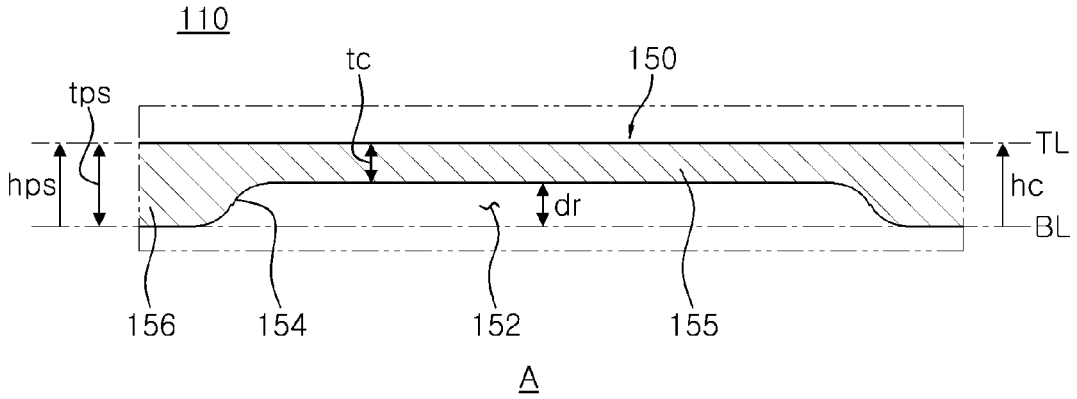


FIG. 3

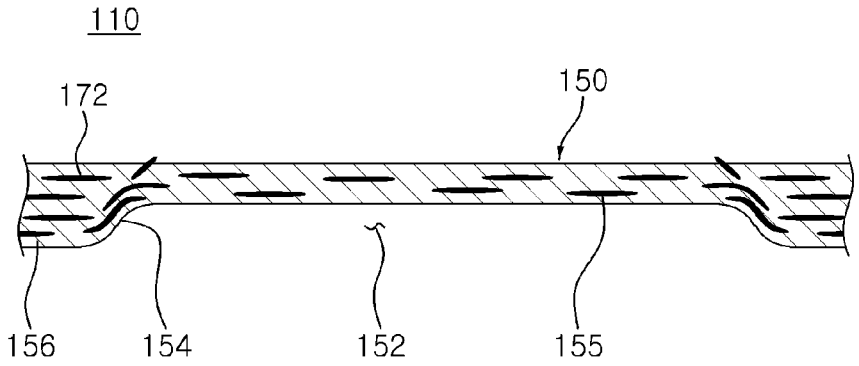


FIG. 4

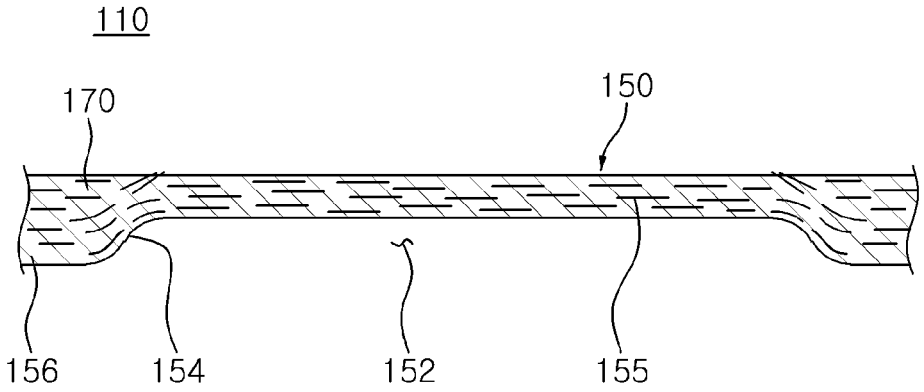


FIG. 5

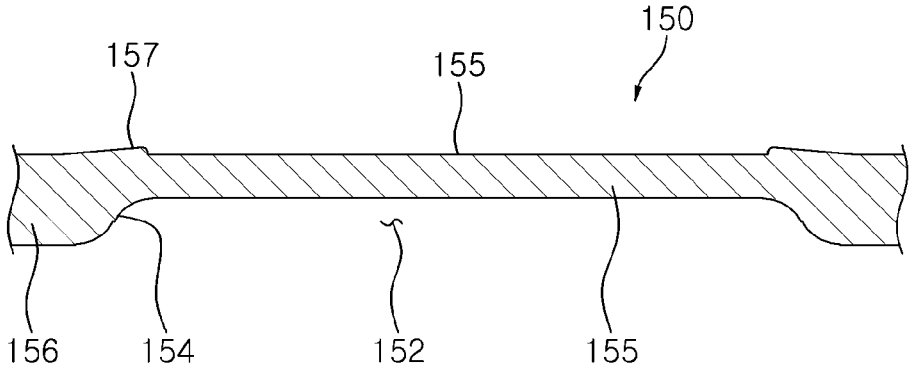


FIG. 6

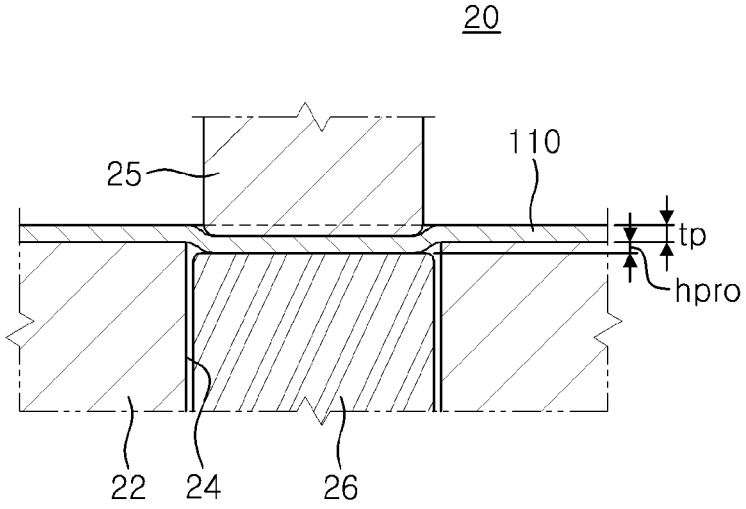


FIG. 7

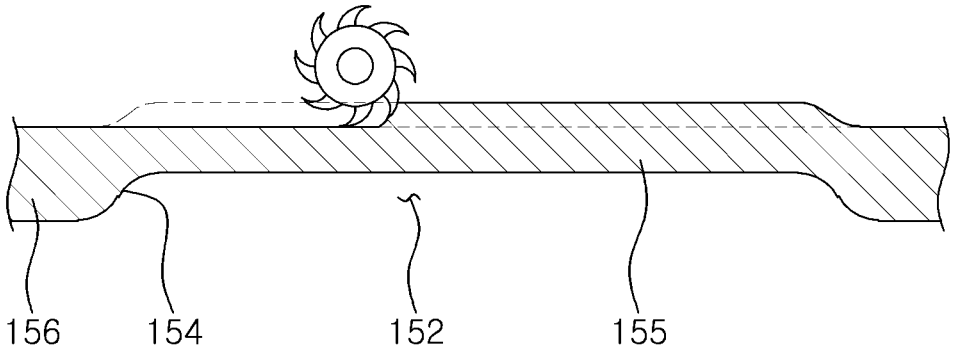


FIG. 8

BASE PLATE, AND METHOD OF MANUFACTURING THE SAME AND DISK DRIVE INCLUDING THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the priority of Korean Patent Application No. 10-2012-0155303 filed on Dec. 27, 2012, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a base plate, and a method of manufacturing the same and a disk drive including the same.

[0004] 2. Description of the Related Art

[0005] A hard disk drive (HDD) reads data stored on a disk or writes data to a disk using a magnetic head.

[0006] A base plate of the hard disk drive has a head driver, that is, a head stack assembly (HSA), capable of moving a position of the magnetic head on the disk, installed thereon.

[0007] Generally, a base plate provided in the hard disk drive is manufactured by die-casting aluminum (Al) and then removing burrs, or the like, generated due to the die-casting, therefrom.

[0008] In addition, recently, in accordance with demand for miniaturization and thinning of hard disk drives, a base plate has been manufactured by performing plastic working on a steel-based thin plate (a steel sheet) having a reduced thickness.

[0009] In manufacturing the base plate, there is a need to allow a circuit component formed on a printed circuit board to be received in a groove of the steel sheet to thereby miniaturize and thin the entire hard disk drive.

[0010] Particularly, unlike a die-casting method, in the case of performing plastic working on a steel sheet, as a thickness of the steel sheet is reduced, it may be difficult to perform plastic working thereon.

[0011] The following Patent Document 1 discloses a method of performing embossing on a housing of a sleeve, but does not disclose a structure in which a recess is formed in abase plate and a circuit element of a printed circuit board is received in the recess in order to decrease a thickness of a disk drive as disclosed in the present invention.

[0012] In addition, the following Patent Document 2 discloses a burring part protruded by processing a rotor frame using a press in order to determine a position of a permanent magnet, but does not disclose a structure in which a circuit element of a printed circuit board is received in a recess of a base plate having a uniform thickness as disclosed in the present invention.

Related Art Document

[0013] (Patent Document 1) Japanese Patent Laid-open Publication No. 2008-303989

[0014] (Patent Document 2) Japanese Patent Laid-open Publication No. 2004-282912

SUMMARY OF THE INVENTION

[0015] An aspect of the present invention provides a base plate including a pocket part having a recess formed in one surface of a metal plate by decreasing a thickness of the metal plate.

[0016] An aspect of the present invention also provides a method of manufacturing a base plate including a pocket part having a recess formed in one surface of a metal plate by decreasing a thickness of the metal plate.

[0017] An aspect of the present invention also provides a disk drive including a base plate including a pocket part having a recess formed in one surface of a metal plate by decreasing a thickness of the metal plate and a printed circuit board on which a circuit component received in the recess is mounted.

[0018] According to an aspect of the present invention, there is provided a base plate including: a body part formed of a metal plate; a pocket part including a recess formed in one surface of the body part by decreasing a thickness of the body part; a center plate part forming the pocket part and corresponding to the recess; a pocket periphery part forming the body part in a periphery of the pocket part; and a pocket edge part formed between the pocket periphery part and the center plate part and having a thickness different from that of the center plate part, wherein a height from a bottom surface of the body part to a top surface of the center plate part is identical to a height of the pocket periphery part, and a thickness of the pocket periphery part is greater than a thickness of the center plate part.

[0019] A difference between the thickness of the pocket periphery part and the thickness of the center plate part may correspond to a depth of the recess.

[0020] The pocket edge part may be tapered from the pocket periphery part toward the center plate part.

[0021] When viewed from a cut surface of the body part, a grain flow in the pocket edge part may be directed from the pocket periphery part toward the center plate part.

[0022] The grain flow in the pocket edge part may be discontinuous.

[0023] When viewed from a cut surface of the body part, inclusions in the pocket edge part are directed from the pocket periphery part toward the center plate part.

[0024] Density of metal particles in the pocket periphery part may be lower than that in the pocket edge part.

[0025] Density of metal particles in the body part may be lower than that in the edge pocket part.

[0026] A tooling mark may be formed on the top surface of the center plate part corresponding to the recess.

[0027] A step may be formed on the top surface of the center plate part corresponding to a boundary of the recess.

[0028] According to another aspect of the present invention, there is provided a method of manufacturing a base plate, including: performing plastic working on a rolled steel sheet to only allow a portion of a metal plate to protrude, the protruding portion of the metal plate having a height lower than a thickness of the metal plate; and removing the protruding portion of the metal plate from the metal plate, wherein a pocket part having a recess formed therein is formed in a surface of the metal plate opposite to the protruding portion, a height from a bottom surface of the metal plate to a top surface of the pocket part is identical to a height of a pocket periphery part, and a thickness of the pocket periphery part is greater than that of the center plate part of the pocket part.

[0029] The metal plate may protrude in one direction by press working.

[0030] The method of may further include performing press working such that a pocket edge part is formed between the center plate part and the pocket periphery part so as to have a thickness different from that of the center plate part and be tapered toward the center plate part.

[0031] The protruding portion of the metal plate may be removed by at least one of a milling method, a grinding method, and an electro-polishing method.

[0032] According to another aspect of the present invention, there is provided a disk drive: the base plate as described above; a printed circuit board on which a circuit component received in the recess of the pocket part is mounted; and a spindle motor fixed to the base plate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] The above and other aspects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

[0034] FIG. **1** is a schematic exploded perspective view of a disk drive according to an embodiment of the present invention;

[0035] FIG. **2** is a schematic cross-sectional view showing a portion of the disk drive according to the embodiment of the present invention;

[0036] FIG. **3** is an enlarged cross-sectional view of a base plate in portion A of FIG. **2**;

[0037] FIGS. **4** and **5** are schematic cross-sectional views respectively illustrating a cut-away surface of the base plate according to the embodiment of the present invention;

[0038] FIG. **6** is a schematic cross-sectional view of a cut-away surface illustrating a base plate according to another embodiment of the present invention; and

[0039] FIGS. **7** and **8** are schematic views illustrating a method of manufacturing a base plate according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0040] Hereinafter, embodiments of the present invention will be described in detail with reference to the accompanying drawings. The invention may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In the drawings, the shapes and dimensions of elements may be exaggerated for clarity, and the same reference numerals will be used throughout to designate the same or like elements.

Disk Drive

[0041] FIG. **1** is a schematic exploded perspective view of a disk drive according to an embodiment of the present invention.

[0042] A disk drive **10** according to the embodiment of the present invention may include a base plate **100** for a disk drive (hereinafter, referred to as a 'base plate'), a printed circuit board **400**, and a spindle motor **200**.

[0043] In addition, the disk drive **10** may include a head driver **300** having a magnetic head (not shown) mounted thereon and moving the magnetic head to a surface of a disk D so as to read information from the disk D and write information to the disk D.

[0044] The base plate **100** may form an internal space and an exterior of the disk drive **10** together with a cover plate **500**. The spindle motor **200** allowing the disk D to be rotatable and the head driver **300** may be embedded in the internal space.

[0045] The base plate **100** may be manufactured by performing plastic working such as press working, or the like, on a thin metal plate. In the case in which the base plate **100** is manufactured by plastic working, a cost required for forming a mold and a degree of freedom of deformation may be higher and a processing time may be significantly decreased, as compared with the case in which the base plate **100** is manufactured by die-casting.

[0046] Since a base body (hereinafter referred to as "a body part") **110** according to the embodiment of the present invention may be manufactured by press working, a processing time and energy consumption are significantly decreased, whereby production capability may be improved.

[0047] Meanwhile, as a material of the base plate **100**, a cold rolled steel sheet (SPCC, SPCE, or the like), a hot rolled steel sheet, stainless steel, or lightweight alloy steel sheet such as a boron or magnesium alloy, or the like, may be used.

[0048] The base plate **100** according to the embodiment of the present invention may include a pocket part **150** formed therein, the pocket part **150** having a circuit component **410** of the printed circuit board **400** received therein. The base plate **100** will be described below with reference to FIGS. **2** through **6**.

[0049] The disk D seated on the spindle motor **200** may be disposed in the internal space between the base plate **100** and the cover plate **500**.

[0050] A top surface of the body part **110** of the base plate **100** may have a height which is varied according to a component received in the internal space. A head seating part **120** on which the head driver **300** is disposed may be formed in a position of the body part **110** in which the top surface thereof is formed to have a low height.

[0051] Here, the head seating part **120** is positioned on a lower portion of a step of the body part **110** to allow the head driver **300** to repeatedly rotate so as to read data from the disk D and write the data to the disk D.

[0052] The spindle motor **200**, provided to rotate the disk D, may be fixedly mounted in a central portion of the body part **110**. Here, the spindle motor **200** may include a clamp **210** coupled to an upper end portion thereof by a screw **215** in order to firmly fix the disk D thereto.

[0053] In addition, although a configuration in which a single disk D is mounted on the spindle motor **200** is shown in FIG. **1**, this configuration is merely provided by way of an example. That is, two or more disks D may be mounted on the spindle motor **200**. In the case in which a plurality of disks D are mounted as described above, a ring shaped spacer for maintaining an interval between the disks D may be disposed between the disks D.

[0054] The head driver **300** may be referred to as a head stack assembly (HAS) and have the magnetic head (not shown) mounted thereon and move the magnetic head (not shown) to a predetermined position to write data to the disk D or read the data written in the disk D.

[0055] In addition, the head driver **300** may be coupled to the base plate **100** in such a manner that the head driver **300** may rotate around a pivot shaft **160** of the head seating part **120** of the base plate **100**.

Base Plate

[0056] FIG. **2** is a schematic cross-sectional view showing a portion of the disk drive according to the embodiment of the present invention; and FIG. **3** is an enlarged cross-sectional view of a base plate in portion A of FIG. **2**.

[0057] In addition, FIGS. **4** and **5** are schematic cross-sectional views respectively illustrating a cut-away surface of the base plate according to the embodiment of the present invention; and FIG. **6** is a schematic cross-sectional view illustrating a cut-away surface of a base plate according to another embodiment of the present invention.

[0058] The base plate **100** according to the embodiment of the present invention refers to a housing forming the exterior of the disk drive, together with the cover plate **500** in the hard disk drive.

[0059] Referring to FIGS. **2** and **3**, the base plate **100** according to the embodiment of the present invention may include the body part **110**, the pocket part **150**, a center plate part **155**, a pocket periphery part **156**, and a pocket edge part **154**.

[0060] The body part **110** may be formed of a metal plate and be formed by performing plastic deformation on a steel sheet as described above. More specifically, the top surface of the body part may have a variable height or a shape of the pocket part **150**, or the like, may be manufactured through press working.

[0061] In addition, the body part **110**, formed of a thin metal plate, may include a recess formed by allowing a portion of the body part **110** to protrude upwardly through press working rather than forging processing and performing a planarization process of removing the protruding portion in order to decrease a thickness of the thin metal plate.

[0062] That is, the embodiment of the present invention is different from a technology of forming the recess in the base plate through forging processing.

[0063] The pocket part **150** may be formed by the recess **152** that is formed by decreasing a thickness of a surface of the body part **110**. A plate of the body part **110** corresponding to the recess **152** in the pocket part **150** may be defined as the center plate part **155**.

[0064] The body part **110** may be divided into the pocket part **150**, the pocket edge part **154**, and the pocket periphery part, **156** based on the pocket part **150**.

[0065] The pocket part **150** may be apart receiving the circuit component **410** mounted on the printed circuit board **400** therein, and a height hc from a bottom surface (BL) of the body part **110** to a top surface (TL) of the center plate part **155** may be identical to a height hps of the pocket periphery part **156**.

[0066] The height hc from the bottom surface (BL) of the body part **110** to the top surface (TL) of the center plate part **155** may be a thickness tps of the pocket periphery part **156**.

[0067] Here, the thickness tps of the pocket periphery part **156** may be greater than a thickness tc of the center plate part **155**, and a difference between the thickness tps of the pocket periphery part **156** and the thickness tc of the center plate part **155** may correspond to a depth dr of the recess **152**.

[0068] The pocket edge part **154** may be formed between the pocket periphery part **156** and the center plate part **155** and may have a thickness different from that of the center plate part **155**.

[0069] The pocket edge part **154** may be formed by deforming the body part **110** with a punch **25** (See FIG. **7**) in a plastic working process. An edge part of the punch **25** is tapered, such that the pocket edge part **154** corresponding to the edge part of the punch **25** may be tapered from the pocket periphery part **156** toward the center plate part **155**.

[0070] A tooling mark **159** (See FIG. **1**) may be formed on the top surface of the center plate part **155** corresponding to the recess **152**, due to a process such as a milling process, or the like, performed to planarize the pocket periphery part **156**.

[0071] In addition, as shown in FIG. **6**, a step **157** may be formed on the top surface of the center plate part **155** corresponding to the recess **152**.

[0072] The tooling mark **159** and the step **157** may allow a direction in which the circuit component **410** is positioned, to be recognized at the time of assembling the printed circuit board **400**, whereby an assembly defect may be decreased.

[0073] Meanwhile, as described above, as a material of the base plate **100**, a cold rolled steel sheet (SPCC, SPCE, or the like), a hot rolled steel sheet, stainless steel, or lightweight alloy steel sheet such as a boron or magnesium alloy, or the like, may be used.

[0074] The lightweight alloy steel sheet may be formed of a material having excellent machinability and may be easily deformed during press forming. Here, as shown in FIG. **4**, in the stainless steel that is a raw material, inclusions may be extended in a lengthwise direction. The inclusions **172** may facilitate cutting operations at the time of cutting the base plate **100**.

[0075] FIG. **4** schematically shows the inclusions **172** present in a cross section of the base plate after the pocket part **150** is formed by performing plastic working on the stainless steel having a thickness corresponding to that of the body part **110** of the base plate.

[0076] When viewed from a cut surface of the body part **110**, the inclusions **172** present in the pocket edge part **154** may be directed from the pocket periphery part **156** toward the center plate part **155**.

[0077] In addition, the inclusions **172** may have high density, particularly in the pocket edge part **154**, and a cut shape of the inclusions **172** may be seen from the top surface of the body part **110** corresponding to the pocket edge part **154**.

[0078] FIG. **5** is a schematic cross-sectional view showing a direction of a grain flow **170** in a cross section of the base plate after the pocket part **150** is formed by performing plastic working on the stainless steel having a thickness corresponding to that of the body part **110** of the base plate. Here, the direction of the grain flow **170** may be substantially similar to that of the inclusions **172**.

[0079] The grain flow **170** may refer to a cutting line of a material appearing when the stainless steel is cut off.

[0080] Meanwhile, since the pocket edge part **154** may be compressed by the press working, density of metal particles in the pocket periphery part **156** may be lower than that in the pocket edge part **154**. In addition, density of metal particles in the body part **110** may be lower than that in the pocket edge part **154**.

Method of Manufacturing Base Plate

[0081] FIGS. **7** and **8** are schematic views illustrating a method of manufacturing a base plate according to an embodiment of the present invention.

[0082] Referring to FIGS. **7** and **8**, plastic working may be performed on a rolled steel sheet to only allow a portion of the body part to protrude, and in this case, the protruding portion of the base part **110** may have a height hpro lower than a thickness tp of the base part **110**. Here, the base part **110** may be formed of a metal plate.

[0083] A press device **20** for performing plastic working on the rolled steel sheet may include a fixed jig **22** provided with a hole **24** for forming the pocket part.

[0084] An intermediate jig **26** may be disposed within the hole **24** for forming the pocket part inwardly of the fixed jig **22**.

[0085] The intermediate jig **26** may define an upper limit of the height hpro of the protruding portion of the base part **110** and have a top surface disposed lower than a top surface of the fixed jig **22** by an amount equal to the height hpro of the base part **110** protruding inwardly of the hole **24**.

[0086] After the fixed jig **22** and the intermediate jig **26** are disposed as described above and the base part **110** is disposed, the base part **110** may be pressed toward the intermediate jig **26** using the punch **25** having a shape corresponding to that of the recess in the pocket part.

[0087] Here, the base part **110** is subjected to the press working, such that the pocket part may protrude in one direction.

[0088] When the base part **110** is pressed using the punch **25** as described above, the base part **110** may protrude to have the height hpro smaller than the thickness tp of the base part **110**.

[0089] Then, the protruding portion of the base part **110** is removed from the base part **110**.

[0090] When the protruding portion is removed from the base part **110**, a surface of the base part **110** opposite to the protruding portion may be the pocket part having the recess formed therein.

[0091] When the above-mentioned process is performed, the height hc from the bottom surface (BL) of the base part **110** to the top surface (TL) of the pocket part **150** is identical to the height hps of the pocket periphery part **156**, and the thickness tps of the pocket periphery part **156** may be greater than the thickness tc of the center plate part **155**, as shown in FIG. **3**.

[0092] Meanwhile, the edge part of the punch **25** may be tapered. Therefore, the pocket edge part **154**, an edge part of the pocket part, may be formed between the center plate part **155** and the pocket periphery part **156** to have a thickness different from that of the center plate part **155** and may be tapered toward the center plate part **155**.

[0093] After the base part **110** is subjected to the press working, the protruding portion of the base part **110** may be removed by at least one of a milling method, a grinding method, and an electro-polishing method.

[0094] As set forth above, the base plate, and the method of manufacturing the same and the disk drive including the same according to the embodiments of the present invention have the following effect.

[0095] That is, in the case of decreasing a thickness of a steel sheet of the base plate by a die-casting method, a mold needs to be replaced. Therefore, according to the embodiment of the present invention, a manufacturing process of the base plate may be facilitated and manufacturing costs of the base plate may be decreased, as compared with the case using die-casting method.

[0096] In addition, since a portion of the circuit component may be inserted into the recess formed in the base plate, the overall size of a thinned disk drive may be further decreased.

[0097] While the present invention has been shown and described in connection with the embodiments, it will be apparent to those skilled in the art that modifications and variations can be made without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A base plate comprising:
- a body part formed of a metal plate;
- a pocket part including a recess formed in one surface of the body part by decreasing a thickness of the body part;
- a center plate part forming the pocket part and corresponding to the recess;
- a pocket periphery part forming the body part in a periphery of the pocket part; and
- a pocket edge part formed between the pocket periphery part and the center plate part and having a thickness different from that of the center plate part,
- wherein a height from a bottom surface of the body part to a top surface of the center plate part is identical to a height of the pocket periphery part, and
- a thickness of the pocket periphery part is greater than a thickness of the center plate part.

2. The base plate of claim **1**, wherein a difference between the thickness of the pocket periphery part and the thickness of the center plate part corresponds to a depth of the recess.

3. The base plate of claim **1**, wherein the pocket edge part is tapered from the pocket periphery part toward the center plate part.

4. The base plate of claim **1**, wherein when viewed from a cut surface of the body part, a grain flow in the pocket edge part is directed from the pocket periphery part toward the center plate part.

5. The base plate of claim **4**, wherein the grain flow in the pocket edge part is discontinuous.

6. The base plate of claim **1**, wherein when viewed from a cut surface of the body part, inclusions in the pocket edge part are directed from the pocket periphery part toward the center plate part.

7. The base plate of claim **1**, wherein density of metal particles in the pocket periphery part is lower than that in the pocket edge part.

8. The base plate of claim **1**, wherein density of metal particles in the body part is lower than that in the pocket edge part.

9. The base plate of claim **1**, wherein a tooling mark is formed on the top surface of the center plate part corresponding to the recess.

10. The base plate of claim **1**, wherein a step is formed on the top surface of the center plate part corresponding to a boundary of the recess.

11. A method of manufacturing a base plate, comprising:
- performing plastic working on a rolled steel sheet to only allow a portion of a metal plate to protrude, the protruding portion of the metal plate having a height lower than a thickness of the metal plate; and
- removing the protruding portion of the metal plate from the metal plate,

wherein a pocket part having a recess formed therein is formed in a surface of the metal plate opposite to the protruding portion,

a height from a bottom surface of the metal plate to a top surface of the pocket part is identical to a height of a pocket periphery part, and

a thickness of the pocket periphery part is greater than that of the center plate part of the pocket part.

12. The method of claim **11**, wherein the metal plate protrudes in one direction by press working.

13. The method of claim **11**, further comprising performing press working such that a pocket edge part is formed between the center plate part and the pocket periphery part so as to have a thickness different from that of the center plate part and be tapered toward the center plate part.

14. The method of claim **11**, wherein the protruding portion of the metal plate is removed by at least one of a milling method, a grinding method, and an electro-polishing method.

15. A disk drive comprising:

the base plate of claim **1**;

a printed circuit board on which a circuit component received in the recess of the pocket part is mounted; and

a spindle motor fixed to the base plate.

* * * * *