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(71) Applicant: **SEIKO PRECISION INC.**
Narashino-shi,
Chiba 275-8558 (JP)

(72) Inventor: **Mitsuharu, Shishido**
Narashino-shi
Chiba 275-8558 (JP)

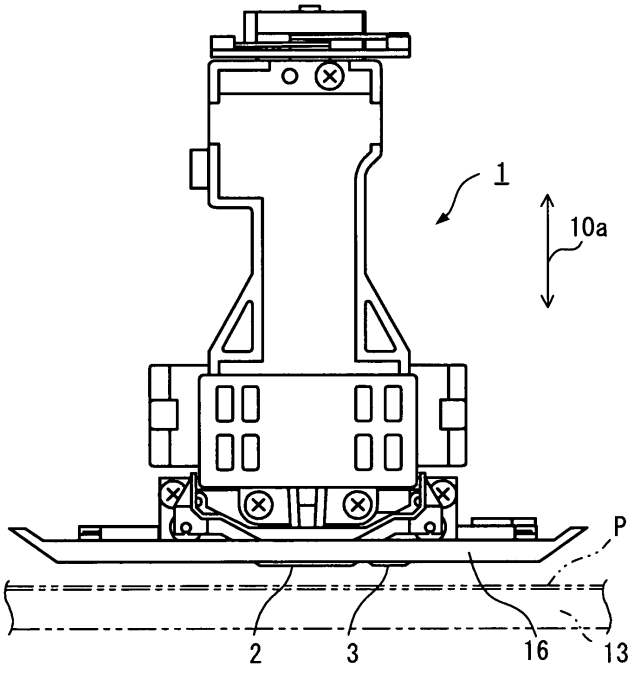
(74) Representative: **Hertz, Oliver**
v. Bezold & Partner
Patentanwälte
Akademiestrasse 7
80799 München (DE)

(54) **Printer**

(57) Provided is a printer that includes a print head, to which a carrier stopper which is low-cost and excellent in antiwear property is attached.

A carrier stopper (3) is provided on a print head (1) such that the carrier stopper (3) is at a position closer to a print sheet (P) than a ribbon mask (2) is. When the print head (1) moves in a direction toward a platen that supports the print sheet (P), the carrier stopper (3) is pressed onto the print sheet (P). As a result, the position of the print sheet (P) and the interval between the print head (1) and the print sheet (P) are detected. The base of the carrier stopper (3) is made of an aluminum material, and a diamond-like carbon (DLC) film is formed on at least a surface of the carrier stopper (3) that contacts the print sheet (P).

FIG.1A



EP 2 088 002 A2

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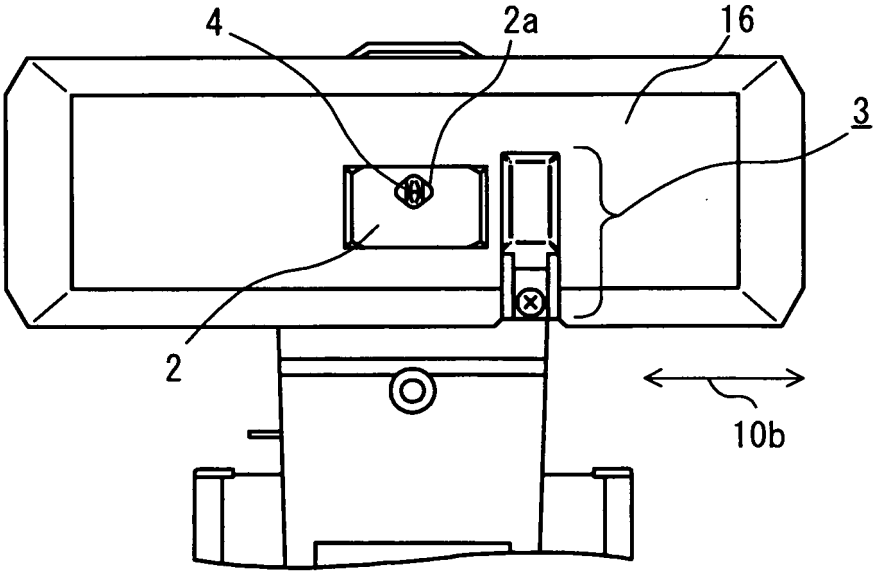
FIG.1B



Description

[0001] The present invention relates to a printer in which a print medium is supported between a print head and a platen.

[0002] There has conventionally been proposed a technique for adjusting the interval between a print head and a platen by pressing the print head onto a print sheet on the platen, and moving the print head from the position where this pressing occurs by a predetermined distance in a direction opposite to the direction in which the print head is pressed onto the platen. Such a technique is described in, for example, Unexamined Japanese Patent Application KOKAI Publication No. 2005-262807. The printer disclosed in Unexamined Japanese Patent Application KOKAI Publication No. 2005-262807 calculates a difference between periods, caused by pressing the print head onto a print sheet, of pulses that are input to and output from a drive motor. The printer adjusts the interval between the print head and the platen by calculating a position at which this difference of period starts, based on the numbers of pulses representing the amount of the disagreement, which are each counted when the amount of the disagreement exceeds either of two set values that are determined preliminarily.

[0003] However, in a case where the above technique is applied to, for example, a wire dot-matrix printer, the print head as pressed onto a print sheet often leaves some surface imprint of a wire or an opening of the print unit on the print sheet. To mitigate this, the print head is provided with a member called carrier stopper that is set ahead of the print head to be closer to a print sheet, such that the carrier stopper contacts the print sheet.

[0004] Fig. 2 is a perspective view showing a carrier stopper. Fig. 5B is an exemplary diagram showing a state of the carrier stopper being made to contact a print sheet. As shown in Fig. 2, the carrier stopper 3 has a contact surface 6 that is flat. The carrier stopper is attached to the print head (only the print head body 1a is shown in Figs. 5A and 5B) such that the contact surface 6 faces the print sheet P as shown in Fig. 5B.

[0005] In order that the interval between the print head and the platen is adjusted, the contact surface 6 of the carrier stopper 3 is first pressed onto the print sheet P, and then based on the position where this pressing occurs, the print head is moved by a predetermined distance in a direction opposite to the direction in which the print head is pressed onto the platen. Since the contact surface 6 of the carrier stopper 3 is flat, it leaves no such surface imprint as described above on the print sheet P.

[0006] Used as such a carrier stopper is one whose base material, which is aluminum or an aluminum alloy (hereinafter called aluminum material generically), is superficially plated with nickel (Ni).

[0007] Since the interval between the print head and the platen is very small, the print sheet P might contact the carrier stopper 3 that is closer to it than the print head is, when the sheet is fed forward for a printing operation. Accordingly, as the printer serves longer, the carrier stopper 3 has its surface that makes contact with the print sheet worn out. As the wear gets heavier, the ink ribbon that is set in the print head gets nearer to the print sheet P. As a result, the ribbon mask, the ink ribbon, and the print sheet P are all in contact and the print sheet P gets stained. Further, there is a fear that the ink ribbon might be stuck in a gap. Replacing the carrier stopper 3 with a new one to avoid such problems is a factor of increasing the cost. Hence, it is preferred that the contact surface 6 of the carrier stopper 3 that contacts the print sheet P have as high an antiwear property as possible.

[0008] The present invention was made in view of the above circumstances, and an object of the present invention is to provide a printer that includes a print head, to which a low-cost carrier stopper excellent in the antiwear property is attached.

[0009] To achieve the above object, a printer according to the present invention includes: a platen that supports a print medium; a print head that is movable in a direction in which the print head comes into and out of contact with the platen, and that performs printing on the print medium; and a spacing member that is fixed to the print head, and that spaces the print medium and the print head from each other by a predetermined distance by contacting the print medium when the print head moves in a direction toward the platen. The spacing member has, on at least its surface that faces the print medium, a hard layer whose Vickers hardness is Hv 2000 or higher.

Fig. 1A is a side elevation showing the appearance of one side of a print head used in a printer according to a first embodiment of the present invention.

Fig. 1B is a front elevation of the print head shown in Fig 1A.

Fig. 2 is a perspective view of a carrier stopper according to the present embodiment.

Fig. 3A is a front elevation of the carrier stopper according to the present embodiment as seen from a platen.

Fig. 3B is a side elevation of the carrier stopper shown in Fig. 3A.

Fig. 4A is a partial cross section as taken along a line A-A of Fig. 3A.

Fig. 4B is a partial cross section showing a part B of Fig. 4A in enlargement.

Figs. 5A and 5B are exemplary diagrams showing printer operations according to the first embodiment of the present invention, where Fig. 5A shows a state of a printing operation underway and Fig. 5B shows a state of a ceramic plate and a print sheet being in contact.

[0010] Embodiments of the present invention will now be specifically explained with reference to the attached drawings. To begin with, a first embodiment of the present invention will be explained. Fig. 1A is a side elevation showing one aspect of a print head used in a printer ac-

cording to the present embodiment. Fig. 1B is a front elevation of the print head shown in Fig. 1A, as seen from a platen side.

[0011] The print head 1 shown in Fig. 1A is of a wire dot-matrix type. The print head 1 is seated in a carrier (unillustrated) of the printer body, and can be moved in a moving direction 10a indicated by the double-headed arrow.

[0012] The print head 1 has a ribbon guide 16 at a side facing a print sheet P. A ribbon mask 2 and a carrier stopper 3 are provided such that they protrude to be closer to the print sheet P than the ribbon guide 16 is. The ribbon mask 2 and the carrier stopper 3 are set at positions at which they can face a platen 13 via the print sheet P. The platen 13 that constitutes the printer according to the present embodiment is shown in Fig. 1A by a two-dot chain line for convenience.

[0013] The ribbon mask 2 has an opening 2a, which has a rough rhomboidal shape. A plurality of print wires 4 are provided to be able to go out from the opening 2a toward the print sheet P.

[0014] The carrier stopper 3 is screwed to the print head 1 as shown in Fig. 1B. In this state, the print head 1 can move in a moving direction 10b indicated by the double-headed arrow. The moving direction 10b is orthogonal to the direction in which the print sheet P is fed forward.

[0015] Fig. 2 shows a perspective view of the carrier stopper 3. The base of the carrier stopper 3 is made of an aluminum material. A surface of the carrier stopper 3 that faces the print sheet P when the carrier stopper 3 is attached to the print head 1 is a rectangular contact surface 6. Each surface that adjoins the contact surface 6 is a slanted surface 8. The boundaries between each slanted surface 8 and the contact surface 6 and the boundaries between the slanted surfaces 8 are chamfered roundly (as shown by a thin solid line in the drawing).

[0016] Fig. 3A is a front elevation of the carrier stopper 3 seen from the print sheet (platen). Fig. 3B is a side elevation of the carrier stopper 3. As shown in Fig. 3A, the carrier stopper 3 has an attachment hole 7 through which the carrier stopper 3 is screwed to the print head 1. The carrier stopper 3 further has a positioning pin 9 as shown in Fig. 3B. The positioning pin 9 sets the carrier stopper 3 to come to a predetermined position of the print head 1 for attachment.

[0017] Fig. 4A is a diagram showing the contact surface 6 of the carrier stopper 3 having the above-described structure, as a cross section taken along a line A-A of Fig. 3A. Fig. 4B is a view of a part (part B) of Fig. 4A in enlargement. As shown in Fig. 4B, the carrier stopper 3 has its contact surface 6 formed by a Diamond-Like Carbon (DLC) film 15, which is a hard layer, covering over a base 14. A DLC film is also called i-carbon film, amorphous carbon film, or hard carbon film, and whose carbon (C) atom bonds may contain, for example, hydrogen (H) atoms or the like.

[0018] The DLC film 15 according to the present embodiment is deposited by Physical Vapor Deposition (PVD). Depositions by PVD include, for example, sputtering, ion plating, etc. In the case of depositing the DLC film 15 by PVD, the processing temperature can be set to, for example, 200°C. Therefore, this method is suitable as a method for forming the DLC film 15 on the carrier stopper 3 whose base is an aluminum material, which has a low melting point.

[0019] An operation of the printer according to the present embodiment having the print head 1 of the above construction will be explained with reference to Figs. 5A and 5B. Fig. 5A is an exemplary diagram showing a state of a printing operation underway. Fig. 5B is an exemplary diagram showing a state of the carrier stopper 3 and the print sheet P being in contact. Figs. 5A and 5B show these states as seen from a direction orthogonal to the direction in which the print sheet P is fed forward, and show the print head body 1a and the carrier stopper 3 side by side for drawing convenience.

[0020] In the state of the printing operation shown in Fig. 5A, the print wires 4 stick out from the print head body 1a toward the print sheet P. As a result, the print wires 4 make an ink ribbon 11 contact the print sheet P on the platen 13 to print desired data on the print sheet P. At this time, the print wires 4 and the ink ribbon 11 get inserted through the opening 2a provided in the ribbon mask 2 as shown in Figs. 1A and 1B. At this time, the carrier stopper 3 does not contact the print sheet P.

[0021] According to the present embodiment, when the contact surface 6 of the carrier stopper 3 contacts the print sheet P as shown in Fig. 5B, the interval between the print head 1 and the print sheet P is detected. This operation aims for maintaining the interval between the print head 1 and the print sheet P constant in order to provide a uniform print quality even when print sheets P of different thicknesses are used. For example, the interval between the print head 1 and the print sheet P can be calculated from a relationship between the numbers of pulses input and output, when the carrier stopper 3 is pressed onto the print sheet P, to and from a motor that drives the carrier in which the print head 1 is seated. After the contact surface 6 of the carrier stopper 3 is pressed onto the print sheet P, the print head 1 moves by a predetermined distance in a direction opposite to the direction in which the print head 1 is pressed onto the platen 13, from the position where the pressing of the contact surface 6 onto the print sheet P occurs. As a result, the interval between the print head 1 and the platen 13 is adjusted.

[0022] As shown in Fig. 5B, the print sheet P on the platen 13 and the contact surface 6 of the carrier stopper 3 contact each other. The carrier stopper 3 is attached to the print head 1 such that its contact surface 6 is nearer to the print sheet P than the ribbon mask 2 is. This makes only the carrier stopper 3 be pressed onto the print sheet P in the operation shown in Fig. 5B.

[0023] As described above, if the carrier stopper 3 is

worn, the print head 1 and the print sheet P become nearer, making it easier for the print sheet P to be stained by the ink ribbon 11. Hence, it is preferred that the contact surface of the carrier stopper 3 that contacts the print sheet P have an excellent antiwear property. The antiwear property tends to be higher as, for example, the Vickers hardness (Hv) is greater.

[0024] Conventionally, the contact surface of a carrier stopper that contacts a print sheet P is plated with, for example, Ni. The Vickers hardness of plated Ni is roughly around Hv 500, though it varies according to the processing conditions.

[0025] As compared with this, a carrier stopper that is made of a ceramic material such as Al_2O_3 can have a contact surface whose Vickers hardness is, for example, about Hv 1500. In this case, if the carrier stopper is used to the full of a general product life of a printer, the amount by which the carrier stopper is worn is about 10 μm.

[0026] However, cost-wise, it is preferred that the base of the carrier stopper be at least an inexpensive and easy-to-machine material.

[0027] According to the present embodiment, the base 14 that constitutes the carrier stopper 3 is made of an aluminum material and the DLC film 15 is formed on the surface of the base 14, thereby the contact surface 6 that faces the print sheet P is formed. Hence, the carrier stopper can have its base made of a material that is inexpensive and easy to machine and at the same time can have a hard layer on its surface that makes contact with the print sheet. The hardness of the DLC film 15 of this embodiment can be very high. For example, the DLC film 15 can have a Vickers hardness of Hv 2500 or higher. In this case, a thickness of about 3 to 5 μm is enough as a required thickness of the DLC film for the carrier stopper to be used to a general product life of a printer.

[0028] As explained above, according to the present embodiment, a simple structure, which is obtained by forming a wear-proof hard film on an inexpensive easy-to-machine aluminum alloy, as embodied by forming the DLC film 15 on the contact surface 6 of the carrier stopper 3 that contacts the print sheet P, can realize a printer operation that is stable over a long term.

[0029] Next, a second embodiment of the present invention will be explained. The carrier stopper to be used for the printer of the present embodiment has not the DLC film explained in the first embodiment but a nitride compound, e.g., a titanium nitride (TiN) film formed on at least its contact surface that contacts the print sheet P. Except this point, the structure of the printer including the carrier stopper and the print head is the same as the first embodiment.

[0030] A TiN film according to the present embodiment can be formed by various methods. For example, it can be formed by plasma CVD. According to this method, since a TiN film can be formed at a relatively low processing temperature, even a base made of an aluminum material, which has a low melting point (e.g., aluminum has a melting point of about 660°C), can have a preferable TiN film formed thereon. Other than this, PVD, etc. can also be used to form a TiN film. Therefore, the film may be formed by a method that is conditionally suitable for the base material.

[0031] The hardness of the TiN film formed on the carrier stopper can be Hv 2000 or higher of a Vickers hardness, depending on the processing conditions. In this case, a thickness of about 3 to 5 μm is enough as a required thickness of the TiN film for the carrier stopper to be used to a general product life of a printer. With a film of a high degree of hardness provided on the contact surface that contacts the print sheet, the operation for detecting the interval between the print head of the printer and the print sheet can be stably performed against a long term service, likewise the first embodiment.

[0032] Next, a third embodiment of the present invention will be explained. The carrier stopper to be used for the printer of the present embodiment has its base made of not an aluminum material but polyphenylene sulfide (hereinafter referred to as PPS resin).

[0033] PPS resin is one kind of engineering plastics, and is a thermoplastic resin that is excellent in heat stability and mechanical properties. According to the present embodiment, the base of the carrier stopper is made of PPS resin, and a DLC film is formed on the surface of this base. The shapes of the carrier stopper and the DLC film are the same as the structure shown in Fig. 2 to Fig. 4B.

[0034] The PPS resin used in the present embodiment measures a deflection temperature under load of, for example, 260°C, under a stress condition of 1.82 MPa. This PPS resin is molded into a base 14 that has the shape of the carrier stopper 3 shown in Fig. 2 to Fig. 4B. Then, a DLC film 15 is deposited on the surface of the base 14 likewise the first embodiment.

[0035] As described above, the DLC film 15 is deposited at a processing temperature of about 200°C. Therefore, it is possible to constitute a carrier stopper by using an engineering plastic such as PPS resin used in the present embodiment, for the base of the carrier stopper. Hence, it is possible to fabricate a carrier stopper at a low cost. Further, since a plastic material, which has a fine moldability, is used in the present embodiment, the base can be easily molded even into a shape other than that shown in this specification. This can improve arbitrariness of designing.

[0036] Next, a fourth embodiment of the present invention will be explained. The carrier stopper used for the printer of the present embodiment has its base made of liquid crystal polymer (hereinafter referred to as LCP resin).

[0037] The LCP resin used in the present embodiment is a thermoplastic resin that enters a liquid crystal state when melting. The LCP resin measures a deflection temperature under load of, for example, 250°C, under a stress condition of 1.82 MPa. This LCP resin is molded into a base 14 that has the shape of the carrier stopper 3 shown in Fig. 2 to Fig. 4B, likewise the third embodi-

ment. Then, a DLC film 15 is deposited on the surface of the base 14 likewise the first embodiment.

[0038] According to the present embodiment, it is possible to fabricate the carrier stopper at a low cost and to improve arbitrariness of shape as in the case of using the PPS resin. The third and fourth embodiments take up typical two examples of engineering plastics, but a DLC film can be formed on any other engineering plastics than the above. Particularly, engineering plastics called super engineering plastics that have a high heat stability, such as PPS resin and LCP resin mentioned above, are favorable because a DLC film can be stably formed thereon.

[0039] Embodiments of the present invention have been explained, but the present invention is not limited to these embodiments and design modifications that do not depart from the spirit of the present invention can be applied to the present invention. For example, the present invention may be carried out based on modification examples shown below.

[0040] According to the first embodiment described above, the DLC film 15 is formed by Physical Vapor Deposition (PVD), but it may be formed by a method other than this. A method that can form a stable DLC film on an aluminum alloy, whose melting point is relatively low, is employable. For example, plasma Chemical Vapor Deposition (CVD) may be used to form a DLC film.

[0041] According to each embodiment described above, a DLC film or a TiN film is formed as a hard layer on the contact surface of the carrier stopper that contacts the print sheet. The hard layer may be made of any other material such as carbides, nitrides, carbonitrides, oxides, etc. For example, a hard layer made of, for example, titanium carbonitride (TiCN), titanium aluminum nitride (TiAlN), chromium nitride (CrN), or the like may be formed.

[0042] Further, according to each embodiment described above, a wire dot-matrix type printer has been explained, but the carrier stopper of the present invention may be provided in an inkjet printer.

[0043] Various embodiments and changes may be made thereunto without departing from the broad spirit and scope of the invention. The above-described embodiments are intended to illustrate the present invention, not to limit the scope of the present invention. The scope of the present invention is shown by the attached claims rather than the embodiments. Various modifications made within the meaning of an equivalent of the claims of the invention and within the claims are to be regarded to be in the scope of the present invention.

Claims

1. A printer, **characterized by** comprising:

a platen that supports a print medium;
a print head movable in a direction in which the print head comes into and out of contact with the platen, the print head performing printing on the print medium; and
a spacing member fixed to the print head, the spacing member spacing the print medium and the print head from each other by a predetermined distance by contacting the print medium when the print head moves in a direction toward the platen,
characterized in that the spacing member has, on at least its surface that faces the print medium, a hard layer whose Vickers hardness is Hv 2000 or higher.

2. The printer according to claim 1,
characterized in that the spacing member includes a base that is made of aluminum or an alloy whose main component is aluminum, and the hard layer is formed on the base.

3. The printer according to claim 1 or 2,
characterized in that the hard layer is a diamond-like carbon (DLC) film.

4. The printer according to claim 1 or 2,
characterized in that the hard layer is a nitride compound.

5. The printer according to claim 1,
characterized in that the spacing member includes a base that is made of an engineering plastic, and the hard layer is formed on the base.

6. The printer according to claim 5,
characterized in that the base is made of polyphenylene sulfide (PPS) or liquid crystal polymer (LCP), and the hard layer is a diamond-like carbon (DLC) film.

FIG.1A

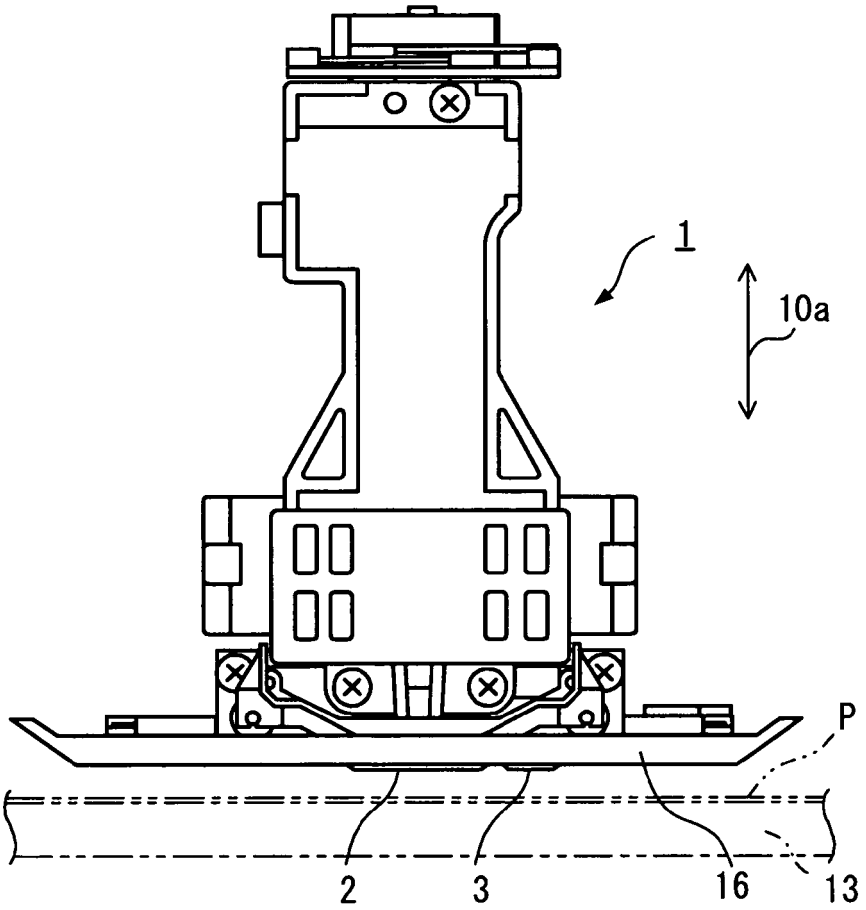


FIG.1B

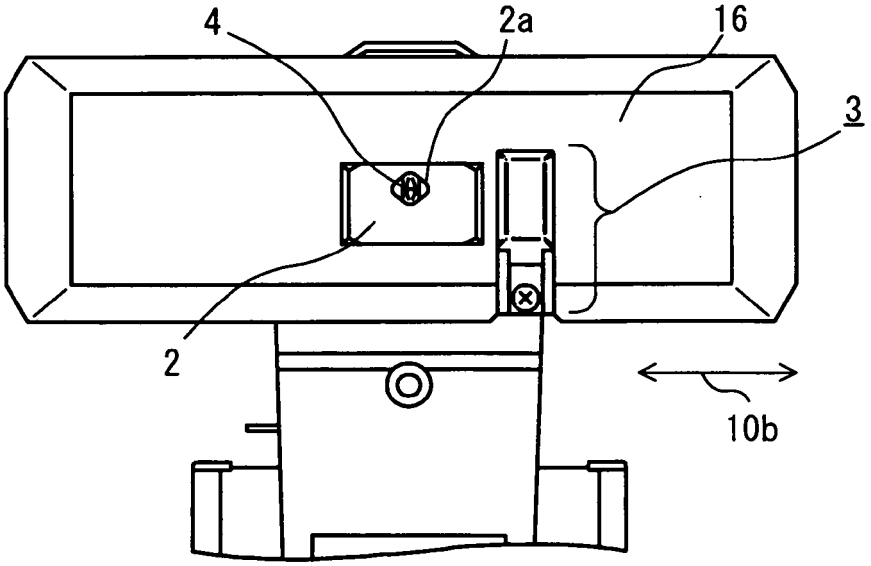


FIG.2

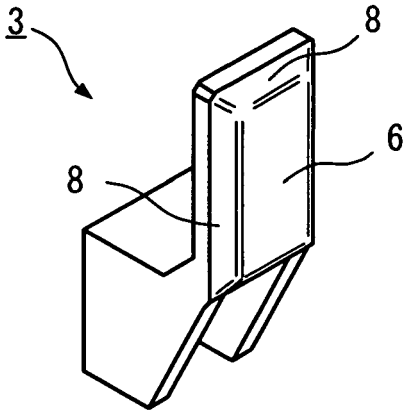


FIG.3A

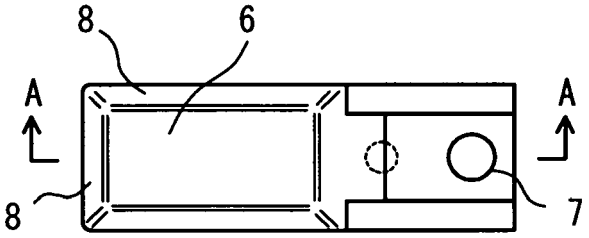


FIG.3B

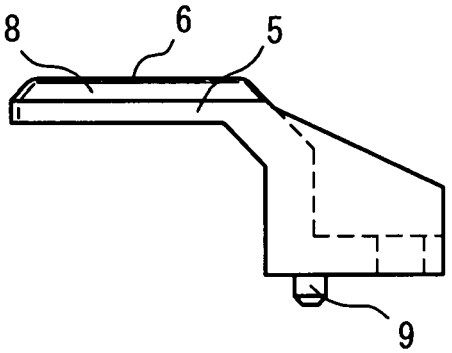


FIG.4A

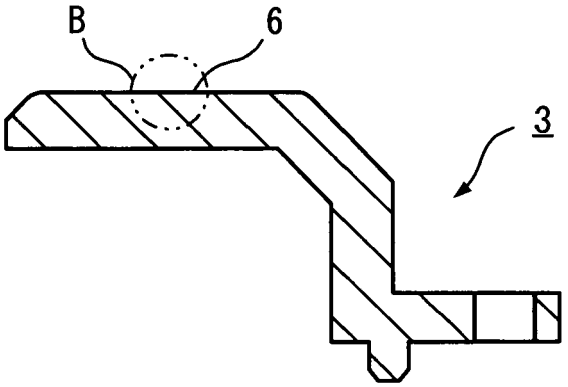


FIG.4B

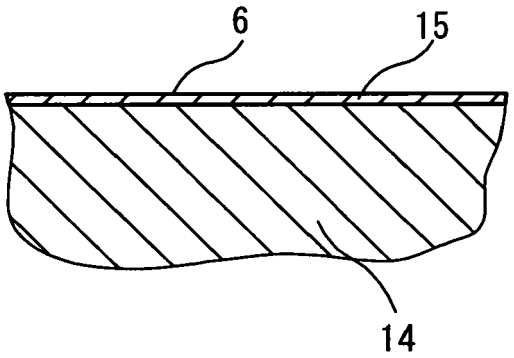


FIG.5A

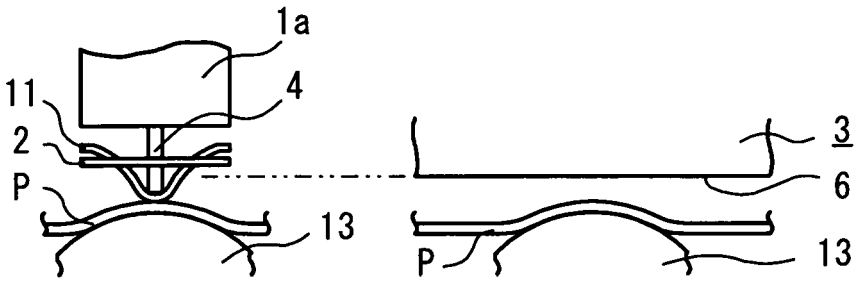
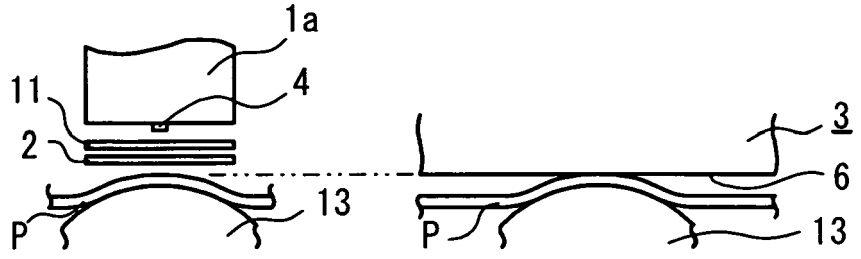


FIG.5B



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