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(71) Applicant: **SHINKO ELECTRIC INDUSTRIES CO., LTD.**
Nagano-shi, Nagano 381-2287 (JP)

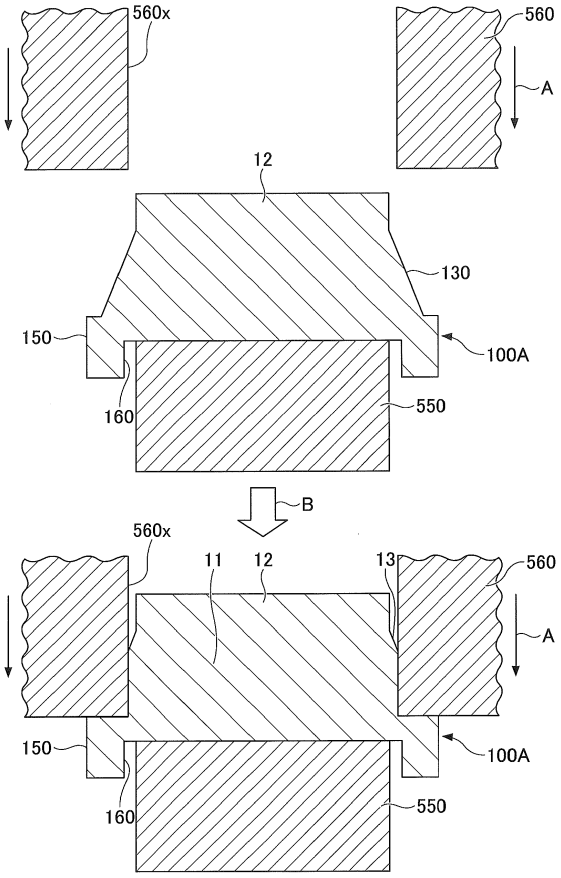
(72) Inventor: **WATANABE, Akihisa**
Nagano-shi, Nagano 381-2287 (JP)

(74) Representative: **Regimbeau**
20, rue de Chazelles
75847 Paris Cedex 17 (FR)

(54) METHOD OF MANUFACTURING EYELET

(57) A method of manufacturing an eyelet includes: a first processing step of preparing a metal member having a plate shape and pressing the metal member to form a first processed product; and a second processing step of removing an outer peripheral portion of the first processed product by shaving to form a second processed product, wherein, in the first processing step, the first processed product is formed to have a first outer diameter portion having a first outer diameter, a second outer diameter portion having a second outer diameter larger than the first outer diameter, and a tapered portion whose outer diameter gradually increases from the first outer diameter portion toward the second outer diameter portion, the first outer diameter portion, the second outer diameter portion, and the tapered portion being concentric, and wherein, in the second processing step, an area outside a portion of an inclined surface of the tapered portion is cut in a direction, from the first outer diameter portion toward the second outer diameter portion along a center line of the first processed product.

FIG.3



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Description

FIELD

[0001] The embodiments discussed herein relate to a method of manufacturing an eyelet.

BACKGROUND

[0002] A metal eyelet is used, for example, in a light emitting device including a laser diode. In such a light emitting device, an eyelet is generally in a disk shape, and a laser diode is mounted on the eyelet, and a heat sink or the like is provided as needed. Also, a lead electrically insulated from the eyelet and electrically connected to the laser diode is provided. Eyelets may be used for products other than light emitting devices.

[0003] For manufacturing an eyelet, for example, a metal member having a plate shape is prepared, the metal member is pressed to form a first processed product, and the outer peripheral portion of the first processed product is removed by shaving to form a second processed product. Also, a thorough hole is formed as needed.

[0004] In the method of manufacturing the eyelet described above, the first processed product is formed to have a disk-shaped portion having a smaller diameter than that of the metal member before being processed. Then, the disc-shaped portion having the small diameter is shaved from the outer peripheral portion of the upper surface in a direction perpendicular to the upper surface to form the second processed product. A shear surface and a fracture surface are formed on the outer peripheral surface of the eyelet, which is the second processed product. In order to enhance the reliability of their joint with a member such as a cap joined to the outer peripheral surface of the eyelet, it is preferable for the shear surface to be longer.

[0005] However, in the method of manufacturing the eyelet described above, because stresses in forming the second processed product readily occur in stretching directions, the fracture surface readily forms on the outer peripheral surface of the second processed product, which makes it difficult to make the shear surface longer.

[0006] In view of the above, an object in one aspect of the embodiments is to provide a method of manufacturing an eyelet that can increase a shear surface of an outer peripheral surface.

[Related-Art Documents]

[Patent Document]

[0007] [Patent Document 1] International Publication Pamphlet No. WO 2015/113746

SUMMARY

[0008] According to an aspect of the embodiments, a method of manufacturing an eyelet includes: a first processing step of preparing a metal member having a plate shape and pressing the metal member to form a first processed product; and a second processing step of removing an outer peripheral portion of the first processed product by shaving to form a second processed product, wherein, in the first processing step, the first processed product is formed to have a first outer diameter portion having a first outer diameter, a second outer diameter portion having a second outer diameter larger than the first outer diameter, and a tapered portion whose outer diameter gradually increases from the first outer diameter portion toward the second outer diameter portion, the first outer diameter portion, the second outer diameter portion, and the tapered portion being concentric and wherein, in the second processing step, an area outside a portion of an inclined surface of the tapered portion is cut in a direction from the first outer diameter portion toward the second outer diameter portion along a center line of the first processed product.

BRIEF DESCRIPTION OF DRAWINGS

[0009]

FIG. 1 is a diagram illustrating an example of an eyelet according to a first embodiment;
FIG. 2 is a diagram illustrating an example of a step of manufacturing the eyelet according to the first embodiment (part 1);
FIG. 3 is a diagram illustrating an example of a step of manufacturing the eyelet according to the first embodiment (part 2);
FIG. 4 is a diagram illustrating an example of a step of manufacturing an eyelet according to a comparative example (part 1);
FIG. 5 is a diagram illustrating an example of a step of manufacturing the eyelet according to the comparative example (part 2);
FIG. 6 is a diagram illustrating an example of a step of manufacturing the eyelet according to a variation example 1 of the first embodiment (part 1);
FIG. 7 is a diagram illustrating an example of a step of manufacturing the eyelet according to the variation example 1 of the first embodiment (part 2); and
FIG. 8 is a diagram illustrating an example of a light emitting device according to a second embodiment.

DESCRIPTION OF EMBODIMENTS

[0010] In the following, embodiments will be described with reference to the accompanying drawings. In these drawings, the same elements are referred to by the same references, and duplicate descriptions may be omitted as appropriate.

<First Embodiment>

[Structure of Eyelet According to First Embodiment]

[0011] First, a structure of an eyelet 10 according to a first embodiment will be described. FIG. 1 is a diagram illustrating an example of the eyelet 10 according to the first embodiment. FIG. 1 (a) is a plan view of the eyelet 10, and FIG. 1 (b) is a cross-sectional view of the eyelet 10 taken along the line A-A of FIG. 1 (a).

[0012] With reference to FIG. 1, the eyelet 10 according to the first embodiment is a member having a disk shape, and has a large diameter portion 11, a small diameter portion 12, a tapered portion 13, and a tapered portion 14. The tapered portion 13 and the small diameter portion 12 are sequentially located on one side of the large diameter portion 11, and the tapered portion 14 is located on the other side of the large diameter portion 11. For example, the large diameter portion 11, the small diameter portion 12, and the tapered portions 13 and 14 can be concentrically formed. The eyelet 10 may be provided with a through hole penetrating the eyelet 10 in the thickness direction.

[0013] Note that in the present application, the "disc shape" refers to one whose planar shape is a substantially circular shape and having a predetermined thickness. The size of the thickness with respect to the diameter is not limited. Also, one on which a recess, a protrusion, or the like is partially formed may be included as the "disc shape".

[0014] The maximum outer diameter of the eyelet 10 (which is the diameter of the large diameter portion 11) is not particularly limited and can be determined as appropriate according to the purpose. For example, the maximum outer diameter of the eyelet 10 may be approximately φ 5.6 mm. The thickness of the eyelet 10 is not particularly limited and can be determined as appropriate according to the purpose. For example, the thickness of the eyelet 10 may be approximately in a range of 1.0 mm to 5.0 mm.

[0015] The eyelet 10 can be made of a metal material such as Kovar (which is a nickel-cobalt ferrous alloy), iron, an iron-nickel alloy, or SUS (stainless steel), for example. A plating process may be applied to the surface of the eyelet 10.

[0016] In the eyelet 10, the outer peripheral surfaces of the large diameter portion 11, the small diameter portion 12, and the tapered portion 13 are shear surfaces, and the outer peripheral surface of the tapered portion 14 is a fracture surface. Here, a shear surface is a smooth surface cut and punched by the cutting edge of a die for pressing, and a diameter that is practically as designed can be obtained. Also, a fracture surface is a rough surface cut, in a tearing manner, by a material pushed by the cutting edge of a die for pressing, and a diameter that is as designed cannot be obtained.

[0017] A cap (which will be described later below) is joined to the outer peripheral surface of the eyelet 10 by, for example, laser welding or the like. In such a case, for a longer shear surface, the contact area between the smooth surface of the eyelet 10 and the cap increases accordingly, thus, the reliability of their joint is enhanced. Therefore, for the eyelet 10, a manufacturing method is devised so as to increase (lengthen), on the outer peripheral surface, the shear surface to be as long as possible.

[Method of Manufacturing Eyelet According to First Embodiment]

[0018] Next, a method of manufacturing the eyelet 10 according to the first embodiment will be described. FIG. 2 and FIG. 3 are diagrams illustrating an example of the manufacturing steps of the eyelet 10 according to the first embodiment.

[0019] The step illustrated in FIG. 2 is a first processing step of preparing a metal member 100 having a plate shape (a disk shape, for example) and pressing the metal member 100 to form a first processed product 100A.

[0020] First, as illustrated in the part above the arrow B, the metal member 100 having a plate shape (a disk shape, for example) made of a metal material such as Kovar, iron, an iron-nickel alloy, or SUS is prepared, and the metal member 100 is placed on the upper surface of a die 510 that is a lower die. Because the die 510 has a cylindrical shape and has a diameter smaller than that of the metal member 100, the outer peripheral portion of the metal member 100 protrudes horizontally from the die 510.

[0021] Next, as illustrated in the part below the arrow B, a punch 520 that is an upper die is lowered in the direction of the arrow A to apply pressure to (press) the metal member 100 placed on the upper surface of the die 510. Note that the direction of the arrow A is a direction along the center line of the metal member 100, and is the vertical direction when the metal member 100 is horizontally placed.

[0022] The punch 520 has a columnar opening portion 520x and a tapered opening portion 520y forming a part of a cone. The opening portion 520x and the opening portion 520y are concentrically formed in communication with each other. The maximum inner diameter (which is the inner diameter of the lowermost portion) of the opening portion 520y is smaller than the outer diameter of the metal member 100.

[0023] Upon the metal member 100 being pressed (half-cut) by the die 510 and the punch 520 having the above-described shapes, the first processed product 100A is formed as illustrated in the part below the arrow B. The first processed product 100A is formed to have a cylindrical small diameter portion 12 having a first outer diameter, a cylindrical large diameter portion 150 having a second outer diameter larger than the first outer diameter, and a tapered portion 130 having a circular truncated cone shape and whose outer diameter gradually increases from the small diameter portion 12 toward the

large diameter portion 150. The small diameter portion 12, the large diameter portion 150, and the tapered portion 130 are concentric. Also, on the large diameter portion 150, a cylindrical recessed portion 160 recessed toward the tapered portion 130 from the opposite side surface with respect to the tapered portion 130 is formed.

[0024] As illustrated in FIG. 2, in the first processing step, the punch 520 having the tapered portion 520y can be used to press the metal member 100 such that the tapered portion 130 of the first processed product 100A is formed by the tapered portion 520y of the punch 510.

[0025] Next, the step illustrated in FIG. 3 is a second processing step of removing an outer peripheral portion of the first processed product 100A by shaving to form a second processed product (a trimming step of removing unnecessary portions).

[0026] First, as illustrated in the part above the arrow B, the first processed product 100A, for which the step of FIG. 2 has been completed, is placed on a cylindrical punch 550 that is a lower die such that the bottom surface of the recessed portion 160 is supported. Because the outer diameter of the punch 550 is smaller than the inner diameter of the recessed portion 160, a clearance is present between the side wall of the punch 550 and the inner wall of the recessed portion 160.

[0027] Next, as illustrated in the part below the arrow B, a die 560 that is an upper die is lowered in the direction of the arrow A to apply pressure to (press) the first processed product 100A arranged on the upper surface of the punch 550. Note that the direction of the arrow A is a direction along the center line of the first processed product 100A, and is the vertical direction when the first processed product 100A is horizontally placed.

[0028] The die 560 has a columnar opening portion 560x. The inner diameter of the opening portion 560x is larger than the outer diameter of the small diameter portion 12 and smaller than the outer diameter of the large diameter portion 150. Upon lowering the die 560 in the direction of the arrow A, the outer edge portion on the lower end side of the opening portion 560x contacts a portion of the inclined surface of the tapered portion 130.

[0029] Upon lowering the die 560 in the direction of the arrow A by using the punch 550 and the die 560 having the above-described shapes, as illustrated in the part below the arrow B, the large diameter portion 11, the small diameter portion 12, the tapered portion 13, the large diameter portion 150, and the recessed portion 160 are formed on the first processed product 100A. The large diameter portion 11 and the tapered portion 13 are formed by cutting (shaving) an area outside a portion of the inclined surface of the tapered portion 130 in the direction along the arrow A.

[0030] As illustrated in FIG. 3, in the second processing step, the first processed product 100A is cut such that the inclined surface of the tapered portion 130 partially remains in the second processed product.

[0031] By further lowering the die 560 in the direction of the arrow A from the state illustrated in the part below the arrow B, the large diameter portion 150 and the recessed portion 160 located in an area outside a portion of the inclined surface of the tapered portion 130 are cut, in a tearing manner, along the direction of the arrow A. As a result, the tapered portion 14 (see FIG. 1) is formed. Thereby, the eyelet 10 illustrated in FIG. 1 is completed. In the completed eyelet 10, the outer peripheral surfaces of the large diameter portion 11, the small diameter portion 12, and the tapered portion 13 are shear surfaces, and the outer peripheral surface of the tapered portion 14 is a fracture surface.

[0032] FIGS. 4 and 5 are diagrams illustrating an example of steps of manufacturing an eyelet according to a comparative example. The step illustrated in FIG. 4 is a first processing step, but unlike FIG. 2, a metal member 100 is pressed by using a punch 620, having only a cylindrical opening portion 620x, and a die 510 similar to that in FIG. 2. The inner diameter of the opening portion 620x is smaller than the outer diameter of the metal member 100.

[0033] Next, as illustrated in the part below the arrow B in FIG. 4, the punch 620 that is an upper die is lowered in the direction of the arrow A to press the metal member 100 placed on the upper surface of the die 510. Thereby, on the first processed product 100B, a small diameter portion 120A, a large diameter portion 150 having an outer diameter larger than that of the small diameter portion 120A, and a recessed portion 160 are formed, and a tapered portion is not formed.

[0034] Next, the step illustrated in FIG. 5 is a second processing step, which is basically the same as the step illustrated in FIG. 3. However, the shape of the first processed product 100B to be processed differs from that in FIG. 3. The inner diameter of the opening portion 560x is smaller than the outer diameter of the small diameter portion 120A.

[0035] As illustrated in the part below the arrow B, upon lowering the die 560 that is an upper die in the direction of the arrow A to press the first processed product 100B arranged on the upper surface of the punch 550, the outer peripheral area of the cylindrical small diameter portion 120A is shaved from an upper surface 125, and a columnar small diameter portion 120B is formed. By further lowering the die 560 in the direction of the arrow A from the state illustrated in the part below the arrow B, the large diameter portion 150 and the recessed portion 160 located in an area outside with respect to a predetermined diameter of the small diameter portion 120B are cut, in a tearing manner, along the direction of the arrow A. As a result, an eyelet according to the comparative example is completed.

[0036] In order to increase the shear surface, it is better for the shaved area (portion removed in the second processing step) to be small at the start of shaving. If the shaved area is small, and if the shaved area is continuously constant as in the comparative example, the shaving becomes unstable when the shaving approaches the end. As a result, in the latter part of shaving, a shear

surface cannot be formed.

[0037] Conversely, in the method of manufacturing the eyelet according to the present embodiment, unlike the method of manufacturing the eyelet according to the comparative example, the tapered portion 130 is formed on the metal member 100 by pressing in the first processing step illustrated in FIG. 2. Then, in the second processing step illustrated in FIG. 3, an area outside a portion of the inclined surface of the tapered portion 130 is cut in the direction along the center line of the first processed product 100A.

[0038] According to the method of manufacturing the eyelet according to the present embodiment, because the shaved area is small at the starting position of the inclined surface of the tapered portion 130, suitable shaving is possible. Also, because the shaved area gradually increases, shaving does not become unstable even when the shaving approaches the end, and stable shaving is possible up to the end. As a result, a shear surface can be made larger than that of the comparative example. Also, because stable shaving is possible up to the end, occurrence of burrs can be reduced.

[0039] In a case where SUS is used as the material of the eyelet 10, it is difficult to increase the shear surface on SUS as compared to iron or the like. Therefore, in a case where SUS is used as the material of the eyelet 10, the method of manufacturing the eyelet according to the present embodiment is particularly effective in that a shear surface can be increased.

[0040] Note that, between the first processing step and the second processing step, a step such as a step of forming a through hole on the first processed product by punching may be added.

<Variation Example 1 of First Embodiment>

[0041] A method of manufacturing an eyelet according to a variation example 1 of the first embodiment different from that of the first embodiment will be described. Note that in the variation example 1 of the first embodiment, descriptions of constituent elements the same as or similar to those of the previously provided descriptions may be omitted as appropriate.

[0042] FIG. 6 and FIG. 7 are diagrams illustrating an example of the manufacturing steps of the eyelet according to the variation example 1 of the first embodiment.

[0043] The step illustrated in FIG. 6 is a first processing step of preparing a metal member 100 having a plate shape (a disk shape, for example) and pressing the metal member 100 to form a first processed product 100C, and differs, from that in FIG. 2, in that the die 510 is replaced with a die 530. Because the die 530 has a cylindrical shape and is larger in diameter than the metal member 100, the outer peripheral portion of the upper surface of the die 530 is exposed around the metal member 100.

[0044] Upon pressing the metal member 100 by the die 530 and the punch 520 having the above-described shapes, as illustrated in the part below the arrow B, the first processed product 100C is formed. The first processed product 100C is formed to have a cylindrical small diameter portion 12 having a first outer diameter, a cylindrical large diameter portion 150 having a second outer diameter larger than the first outer diameter, and a tapered portion 130 having a circular truncated cone shape and whose outer diameter gradually increases from the small outer diameter portion 12 toward the large outer diameter portion 150. The small diameter portion 12, the large diameter portion 150, and the tapered portion 130 are concentric. Note that a recessed portion 160 as illustrated in FIG. 2 is not formed on the first processed product 100C.

[0045] Next, the step illustrated in FIG. 7 is a second processing step of removing an outer peripheral portion of the first processed product 100C by shaving to form a second processed product (a trimming step of removing unnecessary portions). Although the step illustrated in FIG. 7 is basically the same as the step illustrated in FIG. 3, as illustrated in the part above the arrow B, the object to be processed is changed from the first processed product 100A to the first processed product 100C.

[0046] Upon placing the first processed product 100C on the punch 550 such that the bottom surface of the large diameter portion 150 is supported and lowering the die 560 in the direction of the arrow A, as illustrated in the part below the arrow B, the outer edge portion on the lower end side of the opening portion 560x contacts a portion of the inclined surface of the tapered portion 130. Thereby, similarly to FIG. 3, the large diameter portion 11, the small diameter portion 12, the tapered portion 13, and the large diameter portion 150 are formed on the first processed product 100C.

[0047] By further lowering the die 560 in the direction of the arrow A from the state illustrated in the part below the arrow B, the large diameter portion 150 located in an area outside a portion of the inclined surface of the tapered portion 130 is cut, in a tearing manner, along the direction of the arrow A. As a result, the tapered portion 14 (see FIG. 1) is formed. Thereby, the eyelet 10 illustrated in FIG. 1 is completed. In the completed eyelet 10, the outer peripheral surfaces of the large diameter portion 11, the small diameter portion 12, and the tapered portion 13 are shear surfaces, and the outer peripheral surface of the tapered portion 14 is a fracture surface.

[0048] In this manner, in the first processing step, the die 530 having a diameter larger than that of the metal member 100 may be used. In this case, although the processing load in the first processing step increases, the thickness of the large diameter portion 150 of the first processed product 100C can be made thinner than that of the large diameter portion 150 of the first processed product 100A. As a result, because the large diameter portion 150 can be easily removed in the second processing step, the fracture surface can be further reduced and the shear surface can be further increased.

[0049] Note that in the first processed product 100A according to the first embodiment, although the thickness

of the large diameter portion 150 is thicker than that of the first processed product 100C, the first embodiment is preferable in that the processing load is small and processing is easy in the first processing step.

<Second Embodiment>

[0050] In a second embodiment, an example of a light emitting device 1 using the eyelet 10 according to the first embodiment will be described. Note that in the second embodiment, descriptions of constituent elements the same as or similar to those of the previously provided descriptions may be omitted as appropriate.

[0051] FIG. 8 is a diagram illustrating an example of the light emitting device 1 according to the second embodiment. FIG. 8 (a) is a plan view of the light emitting device 1, and FIG. 8 (b) is a cross-sectional view of the light emitting device 1 taken along the line B-B of FIG. 8 (a).

[0052] With reference to FIG. 8, the light emitting device 1 includes the eyelet 10, a light emitting element 20, a lead 30, sealing portions 40, metal wires 50, a cap 60, and a transparent member 70. The light emitting device 1 can be used for, for example, an optical disk device, an optical communication device, or the like. Note that, in FIG. 8 (a), illustration of the cap 60 and the transparent member 70 are omitted.

[0053] The light emitting element 20 is, for example, a semiconductor laser chip with a wavelength of 780 nm and is mounted on the upper surface of the eyelet 10 in a state of being insulated from the eyelet 10.

[0054] The lead 30 includes a first lead 31, a second lead 32, and a third lead 33. The first lead 31 and the third lead 33 are inserted into through holes 10x penetrating the eyelet 10 in the thickness direction such that their longitudinal directions are directed in the thickness direction, and their outer peripheries are sealed by the sealing portions 40. Parts of the first lead 31 and the third lead 33 protrude downward from the lower surface of the eyelet 10. The amounts of protrusion of the first lead 31 and the third lead 33 from the lower surface of the eyelet 10 may be, for example, approximately 6 mm to 7 mm.

[0055] The first lead 31 and the third lead 33 are made of a metal such as Kovar or an iron-nickel alloy, for example. The sealing portions 40 are made of an insulating material such as a glass material, for example. The first lead 31 and the third lead 33 are electrically connected to the light emitting element 20. In a case where a light receiving element is also mounted on the light emitting device 1, the light emitting device 1 may include a lead that is electrically connected to the light receiving element. Also, the number of leads connected to the light emitting element and the light receiving element may be further increased.

[0056] The second lead 32 is joined to the lower surface of the eyelet 10 by welding or the like such that its longitudinal direction is directed in the thickness direction to protrude downward from the lower surface of the eyelet 10. The second lead 32 is made of a metal such as Kovar or an iron-nickel alloy, for example, and is used for grounding, for example. Note that the second lead 32 is joined so as to be electrically connected to the eyelet 10, and upon the second lead 32 being grounded, the eyelet 10 is also grounded.

[0057] Electrodes (not illustrated) of the light emitting element 20 are connected to upper ends of the first lead 31 and the third lead 33, through the metal wires 50 such as gold wires or copper wires. The electrodes of the light emitting element 20, the first lead 31, and the third lead 33 can be connected through, for example, wire bonding.

[0058] The cap 60 is made of, for example, a metal such as iron or copper. The transparent member 70 (window) is provided substantially at the center of the cap 60 in plan view. The transparent member 70 is made of glass or the like, for example, and is bonded to the cap 60 by an adhesive (not illustrated) made of low melting point glass or the like. The cap 60 is joined to the outer peripheral surface of the large diameter portion 11 of the eyelet 10 by, for example, welding or the like, and hermetically seals the light emitting element 20. Light emitted from the light emitting element 20 is emitted passing through the transparent member 70.

[0059] In this manner, in the light emitting device 1, the cap 60 is joined to the outer peripheral surface of the large diameter portion 11 of the eyelet 10 by welding or the like. Because the eyelet 10 is manufactured by the manufacturing method described in the first embodiment or the variation example 1 of the first embodiment, the outer peripheral surface of the large diameter portion 11 is a relatively large shear surface. Therefore, because the contact area between the smooth surface of the eyelet 10 and the cap 60 is increased, the reliability of their joint can be enhanced.

[0060] According to the disclosed technique, it is possible to provide a method of manufacturing an eyelet that can increase a shear surface of an outer peripheral surface.

[0061] Further, although the preferred embodiments and the variation example have been described above in detail, the present invention is not limited to these embodiments and the variation example, and various variations and modifications may be made without departing from the scope of the present invention.

[0062] For example, although an example in which the eyelet 10 is used for the light emitting device 1 is described in the second embodiment, the eyelet 10 is not limited to this, and may be used for various sensors, inflators, or the like.

Claims

1. A method of manufacturing an eyelet (10), the method comprising:

a first processing step of preparing a metal mem-

ber (100) having a plate shape and pressing the metal member (100) to form a first processed product (100A, 100C); and
a second processing step of removing an outer peripheral portion of the first processed product (100A, 100C) by shaving to form a second processed product,
wherein, in the first processing step, the first processed product (100A, 100C) is formed to have a first outer diameter portion (12) having a first outer diameter, a second outer diameter portion (150) having a second outer diameter larger than the first outer diameter, and a tapered portion (130) whose outer diameter gradually increases from the first outer diameter portion (12) toward the second outer diameter portion (150), the first outer diameter portion (12), the second outer diameter portion (150), and the tapered portion (130) being concentric, and
wherein, in the second processing step, an area outside a portion of an inclined surface of the tapered portion (130) is cut in a direction from the first outer diameter portion (12) toward the second outer diameter portion (150) along a center line of the first processed product (100A, 100C).

2. The method of manufacturing the eyelet (10) according to claim 1,
wherein, in the first processing step, the first outer diameter portion (12) is formed in a cylindrical shape, and the second outer diameter portion (150) is formed in a cylindrical shape having a recessed portion (160) recessed toward the tapered portion (130) from an opposite side surface with respect to the tapered portion (130), and the tapered portion (130) is formed in a circular truncated cone shape, and
wherein, in the second processing step, the first processed product (100A, 100C) is placed on a die (550) such that a bottom surface of the recessed portion (160) is supported, and the first processed product (100A, 100C) is cut.

3. The method of manufacturing the eyelet (10) according to claim 1,
wherein, in the first processing step, the first outer diameter portion (12) and the second outer diameter portion (150) are formed in cylindrical shapes, and the tapered portion (130) is formed in a circular truncated cone shape, and
wherein, in the second processing step, the first processed product (100A, 100C) is placed on a die (550) such that a bottom surface of the second outer diameter portion (150) is supported, and the first processed product (100A, 100C) is cut.

4. The method of manufacturing the eyelet (10) according to any one of claims 1 to 3, wherein the metal member (100) is made of stainless steel.

5. The method of manufacturing the eyelet (10) according to any one of claims 1 to 4,
wherein, in the first processing step, a punch (520) having a tapered portion (520y) is used to press the metal member (100) such that the tapered portion (130) of the first processed product (100A, 100C) is formed by the tapered portion (520y) of the punch (520).

6. The method of manufacturing the eyelet (10) according to any one of claims 1 to 5,
wherein, in the second processing step, the first processed product (100A, 100C) is cut such that the inclined surface of the tapered portion (130) partially remains in the second processed product.

FIG.1

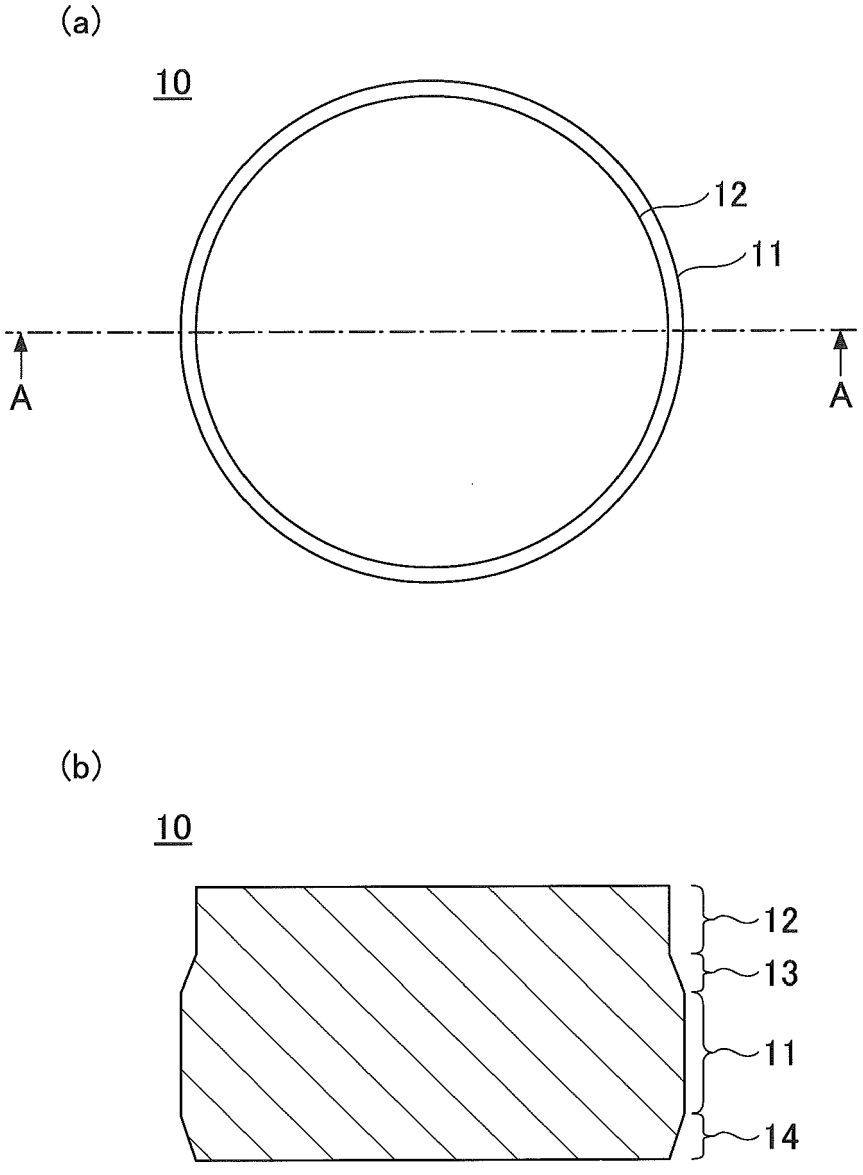


FIG.2

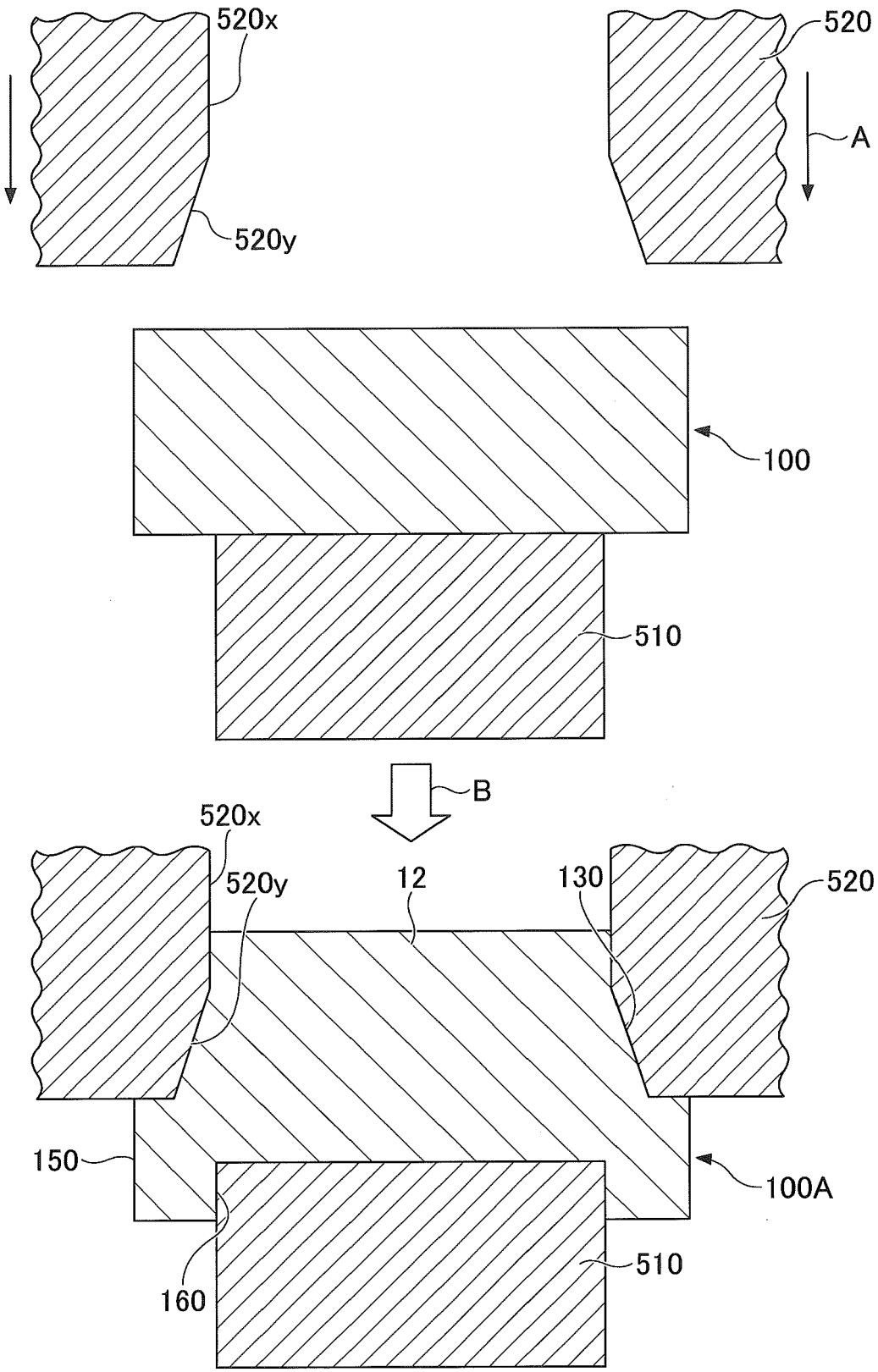


FIG.3

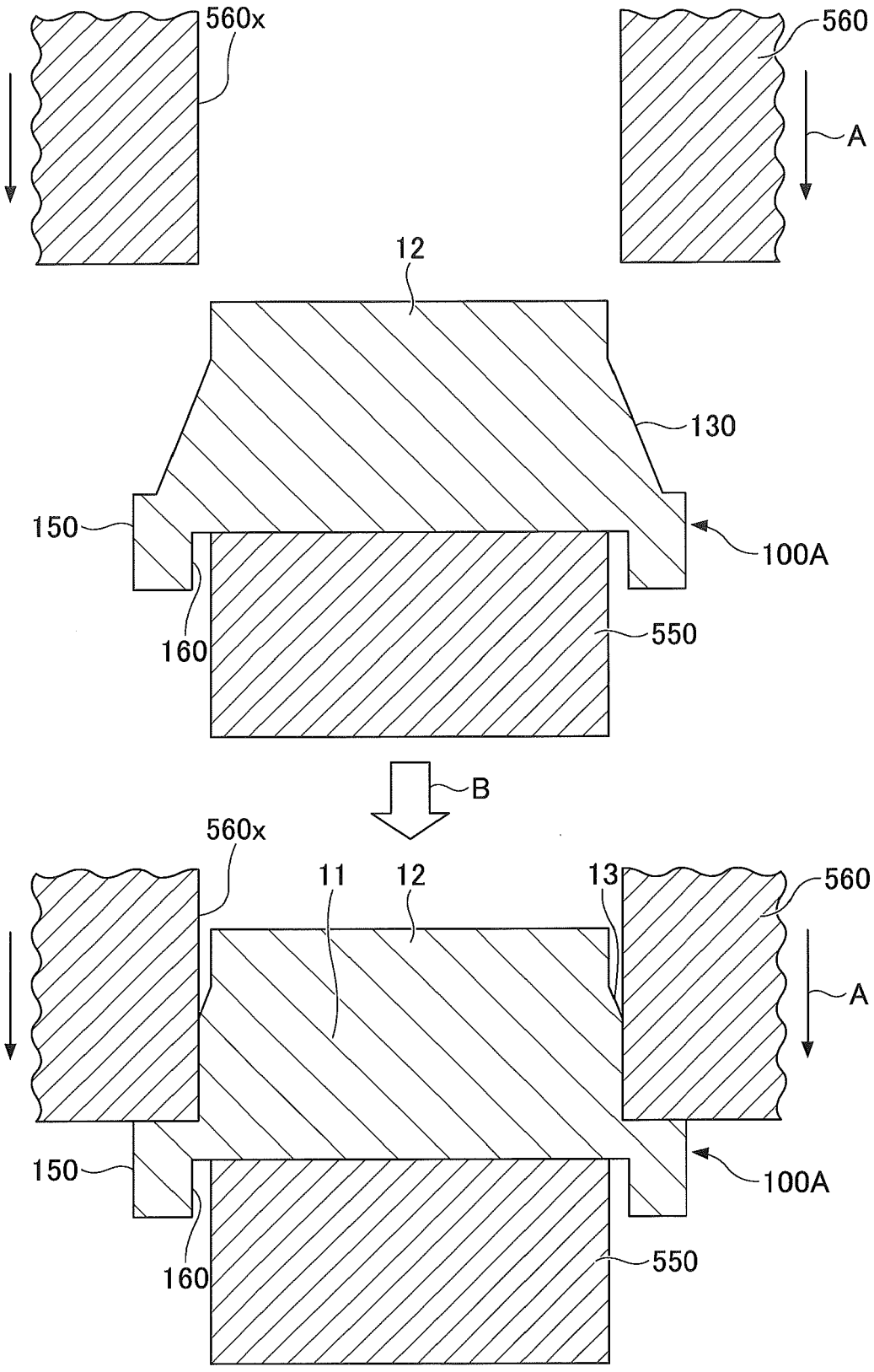

560x
560
A
12
130
150
100A
160
550
B
560x
11
12
13
560
A
150
100A
160
550

FIG.4

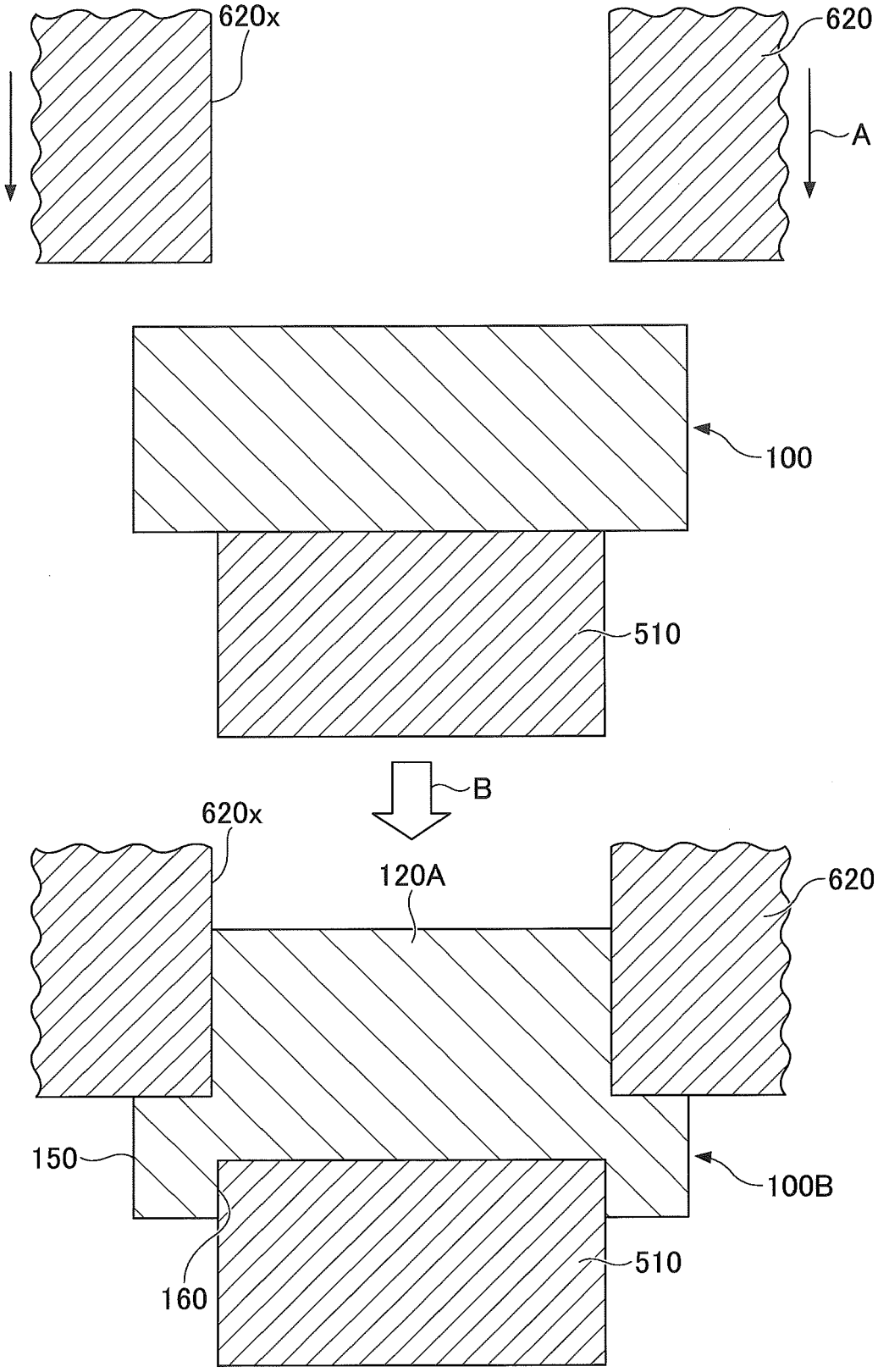


FIG.5

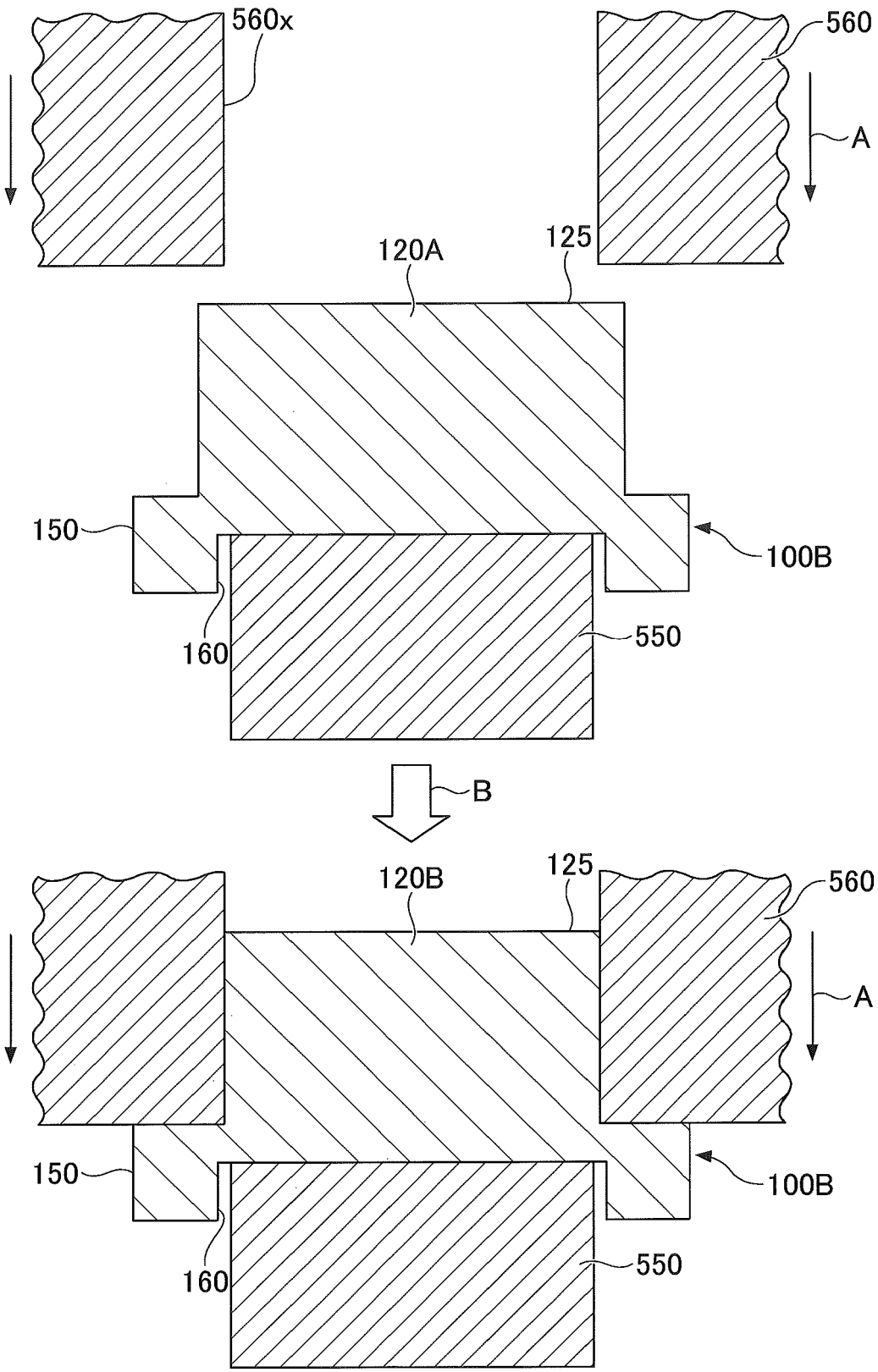

560x
560
A
120A
125
150
100B
160
550
B
120B
125
560
A
150
100B
160
550

FIG.6

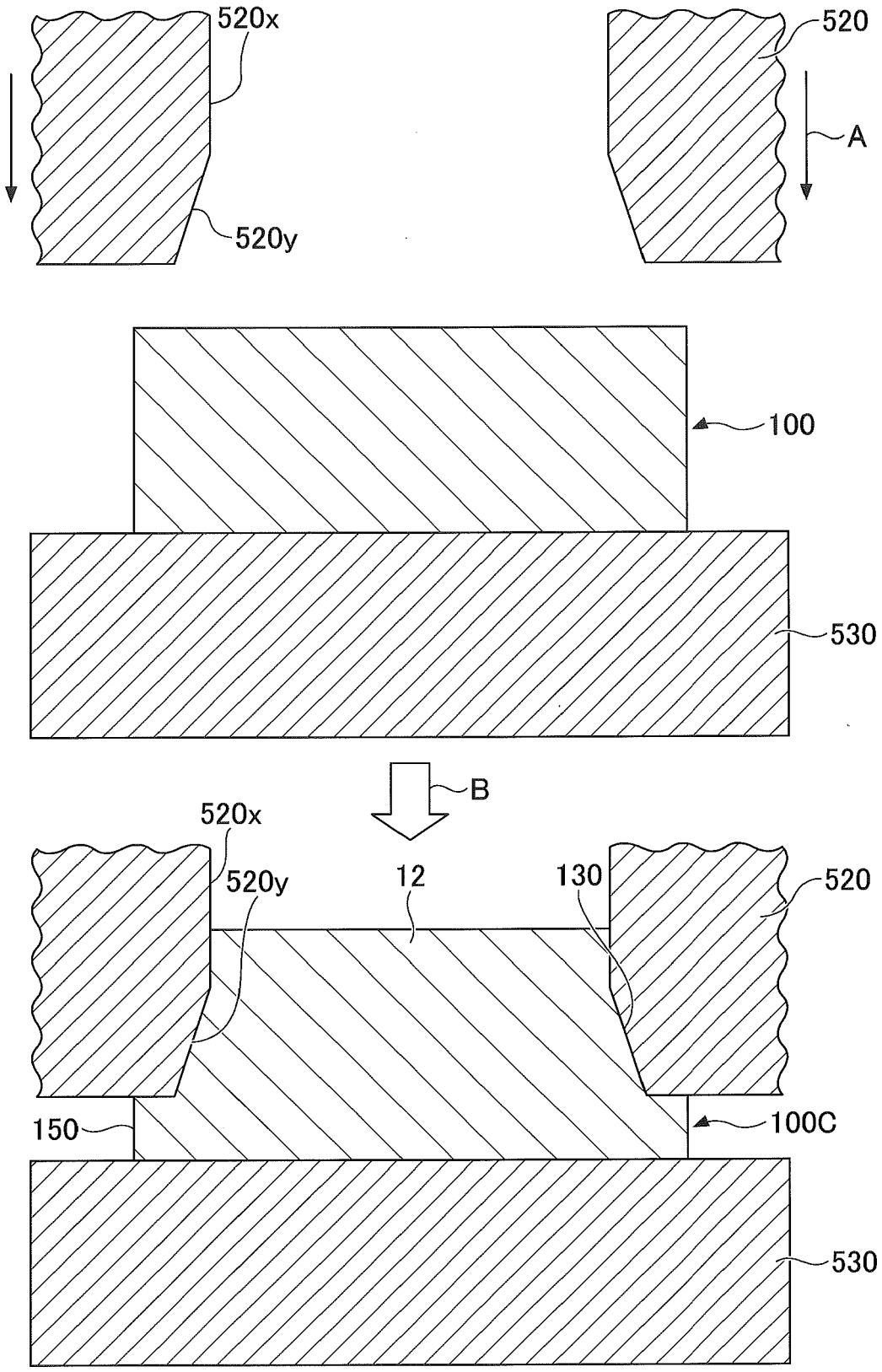


FIG.7

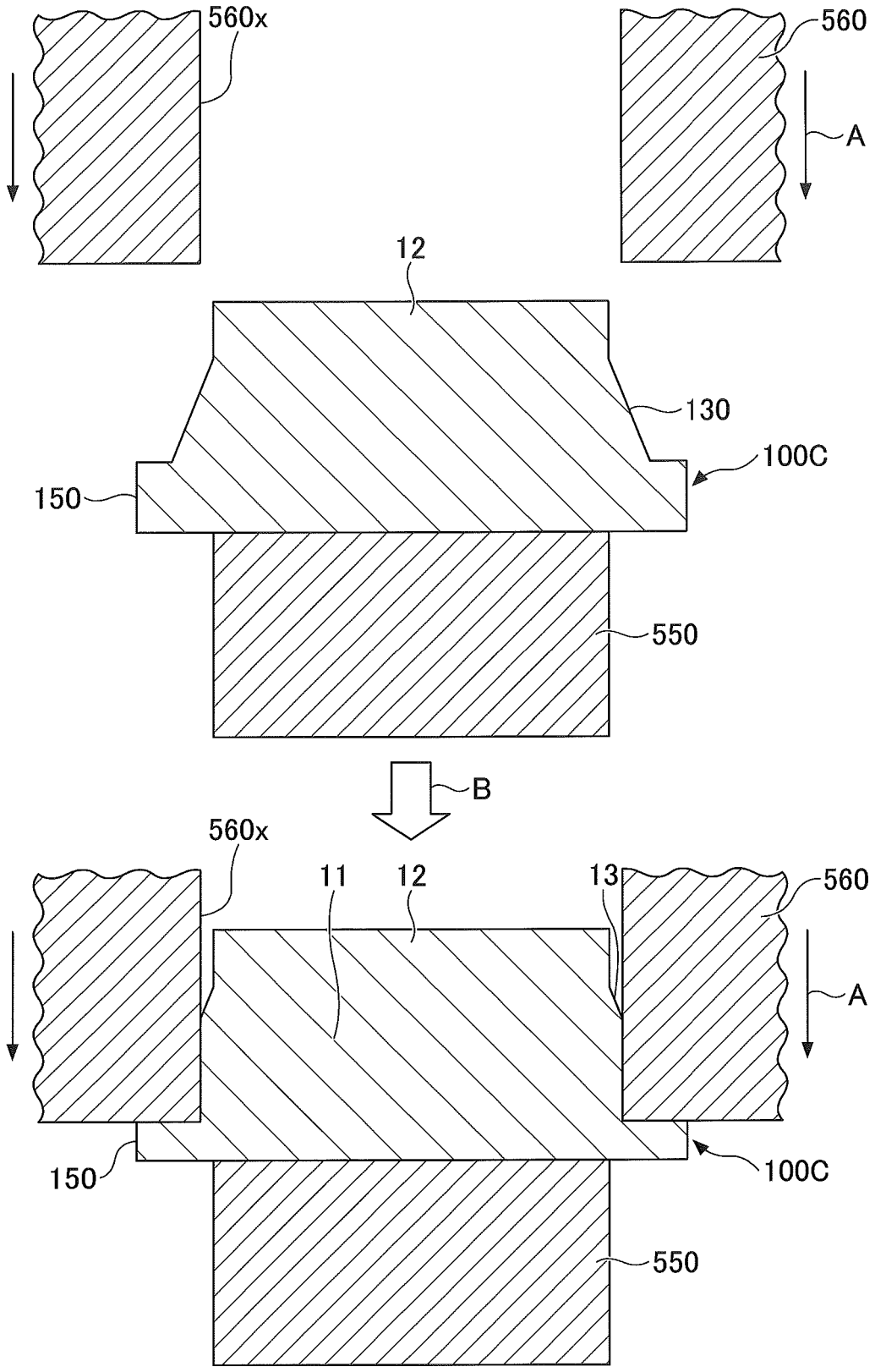
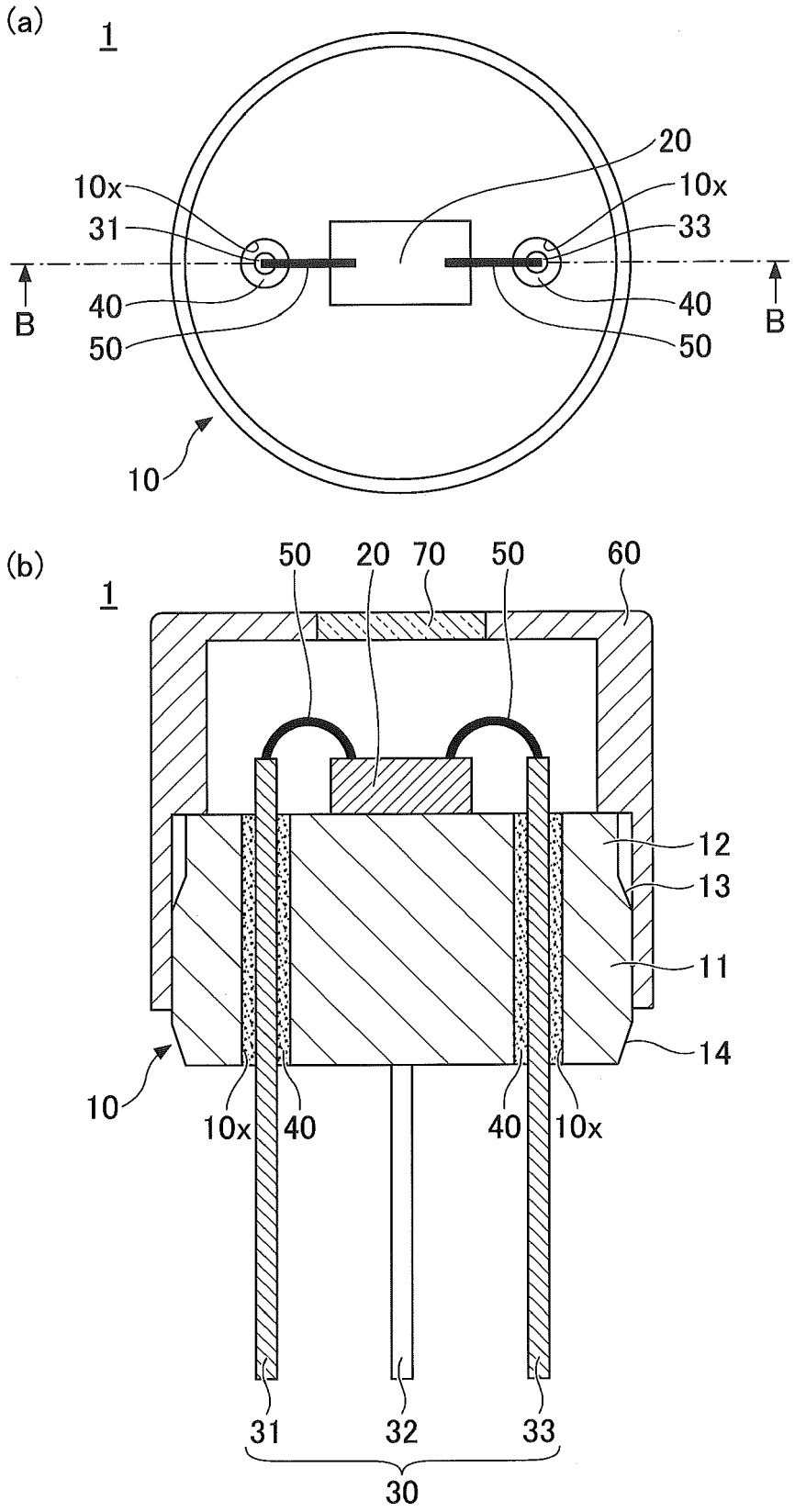


FIG.8


(a)
1
20
10x
10x
31
33
B
B
40
40
50
50
10
(b)
1
50
20
70
50
60
12
13
11
14
10
10x
40
40
10x
31
32
33
30

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EUROPEAN SEARCH REPORT

Application Number
EP 18 20 1377

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,D	WO 2015/113746 A1 (ELECTROVAC HACHT & HUBER GMBH [DE]) 6 August 2015 (2015-08-06) * page 5, lines 5-25; figures 1-7 * * page 10, lines 1-20 *	1-6	INV. B21D28/16
A	US 3 583 266 A (KONDO KAZUYOSHI) 8 June 1971 (1971-06-08) * figures 1, 2 *	1-6	

TECHNICAL FIELDS SEARCHED (IPC)

B21D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	10 April 2019	Vassoille, Philippe

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10-04-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2015113746 A1	06-08-2015	AT 515349 A1	15-08-2015
		EP 3099999 A1	07-12-2016
		WO 2015113746 A1	06-08-2015
US 3583266 A	08-06-1971	BE 731432 A	15-09-1969
		CH 531377 A	15-12-1972
		DE 1918780 A1	16-10-1969
		FR 2006097 A1	19-12-1969
		GB 1271377 A	19-04-1972
		NL 6905511 A	14-10-1969
		SE 403978 B	18-09-1978
		US 3583266 A	08-06-1971

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Patent documents cited in the description

- WO 2015113746 A **[0007]**