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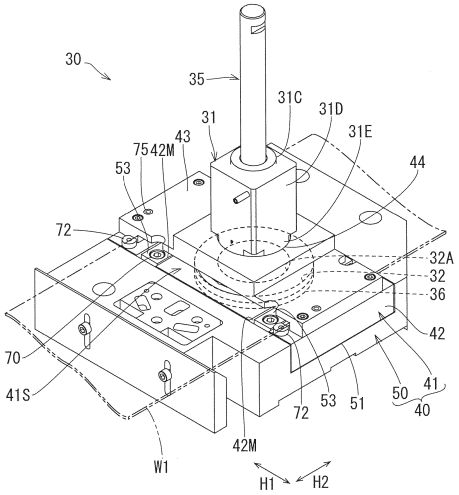
# (54) DIE SUPPORT MECHANISM, CYLINDRICAL WORKPIECE GENERATION DEVICE, AND TRANSFER PRESS MACHINE

(57) [Problem] Provided is a technique for preventing a failure in which a blanking punch is pressed against an opening edge of a punch hole.

[Solution] A die support mechanism 40 of the present disclosure includes a die holding member 41 through which a slit 41S passes, and a lower side of the die holding member 41 with respect to the slit 41S forms a die holding base 42 that holds a blanking die 32, and an upper side with respect to the slit 41S forms a ceiling portion 43 having a ceiling hole 44 concentric with a punch hole 32A of the blanking die 32. Then, the die holding member 41 is supported by the support base 50 in a horizontally slidable manner, and a guide portion of the ceiling hole 44 is in sliding contact with the blanking punch 31, whereby the die holding member 41 slides to a position where the punch hole 32A is centered on the blanking punch 31.

FIG. 3

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## Description

### TECHNICAL FIELD

**[0001]** The present disclosure relates to a die support mechanism, a cylindrical workpiece generation device that forms a cylindrical workpiece, and a transfer press machine that performs drawing and ironing forming of a cylindrical workpiece.

### BACKGROUND ART

**[0002]** As a die support mechanism, there is known a mechanism that supports a blanking die for punching out a blank from a sheet metal (see Patent Document 1, for example).

### RELATED ART DOCUMENTS

### PATENT DOCUMENT

**[0003]** Patent Document 1: JP 2016-203212 A (Fig. 1)

### SUMMARY OF THE INVENTION

### PROBLEMS TO BE SOLVED BY THE INVENTION

**[0004]** By the way, the above die support mechanism or a support portion of the blanking punch corresponding to the die support mechanism is provided with a position adjustment mechanism, and a centering adjustment for aligning the center of the blanking punch and the center of a punch hole is performed before continuous operation of continuously punching out blanks. However, there is a case where the center of the blanking punch and the center of the punch hole gradually deviate from each other due to some cause such as thermal deformation during continuous operation, and there may be caused a failure that the blanking punch is pressed against an opening edge of the punch hole; therefore, there is a demand for development of a technique that reduces the occurrence of such failure.

### MEANS OF SOLVING THE PROBLEMS

**[0005]** A die support mechanism according to one aspect made to solve the above problem includes: a die holding member including a slit that horizontally passes through the die holding member, wherein a lower side of the die holding member with respect to the slit forms a die holding base configured to hold a blanking die having a punch hole, an upper side of the die holding member with respect to the slit forms a ceiling portion having a ceiling hole concentric with the punch hole, a part of a sheet metal inserted in the slit is punched out as a blank by a blanking punch descending to the punch hole through the ceiling hole, and the ceiling portion separates the sheet metal from the ascending blanking punch; a support base configured to support the die holding member in a horizontally slidable manner; and a guide portion formed on an inner surface of the ceiling hole and configured to come into sliding contact with the blanking punch and to slide the die holding member to a position where the punch hole is centered on the blanking punch.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0006]**

Fig. 1 is a front view of a transfer press machine according to a first embodiment of the present disclosure.
Fig. 2 is a sectional side view of a cylindrical workpiece generation device.
Fig. 3 is a perspective view of the cylindrical workpiece generation device.
Fig. 4 is a sectional front view in a state where a blanking punch is apart from a die holding member.
Fig. 5 is an exploded perspective view of a die support mechanism.
Fig. 6 is a sectional front view of the cylindrical workpiece generation device in a state where the die holding member is locked.
Fig. 7 is a partially enlarged sectional front view of the blanking punch and a ceiling hole.
Fig. 8 is a partially enlarged sectional front view of the blanking punch and the ceiling hole immediately before punching out a blank.
Fig. 9 is a partially enlarged sectional front view of the blanking punch and the ceiling hole immediately after punching out the blank.
Fig. 10 is a sectional front view of a cylindrical workpiece generation device according to a second embodiment.

### MODE FOR CARRYING OUT THE INVENTION

[First embodiment]

**[0007]** Hereinafter, a transfer press machine 10 according to a first embodiment of the present disclosure will be described with reference to Figs. 1 to 9. As illustrated in Fig. 1, the transfer press machine 10 includes a plurality of punches (see reference signs 31, 25, and 25X in Fig. 1) laterally arranged in a row at a lower end part of a ram 12 supported by a support frame 11 in a vertically movable manner. Hereinafter, an arrangement direction of the plurality of punches is referred to as a "lateral direction H1", and a horizontal direction perpendicular to the lateral direction H1 is referred to as a "front-back direction H2". In addition, the side of the transfer press machine 10 shown in Fig. 1 is referred to as a "front side", and the side opposite to the front side is referred to as a "rear side". In addition, the right side of the transfer press machine 10 as viewed from the front side is simply referred to as a "right side", and the side opposite to the

right side is simply referred to as a "left side".

**[0008]** The leftmost punch, of the plurality of punches at the lower end part of the ram 12 is a blanking punch 31 having a cylindrical shape as illustrated in Fig. 4, and houses a lower end part of a drawing punch 35 therein. The blanking punch 31 and the drawing punch 35 constitute a part of a cylindrical workpiece generation device 30 included in the transfer press machine 10. As illustrated in Fig. 9, the blanking punch 31 punches out a blank W2 from a sheet metal W1, and as illustrated in Fig. 2, the drawing punch 35 forms the blank W2 into a cylindrical workpiece W3. That is, the cylindrical workpiece W3 is generated from the sheet metal W1 by the cylindrical workpiece generation device 30.

**[0009]** As illustrated in Fig. 1, a plurality of punches other than the leftmost and rightmost punches in the ram 12 are additional-machining punches 25, and a plurality of additional-machining dies 26 corresponding to the additional-machining punches 25 are provided in a support block 24 below the ram 12. Then, each additional-machining punch 25 presses the cylindrical workpiece W3 into a forming hole (not illustrated) of its corresponding additional-machining die 26, thereby drawing or ironing the cylindrical workpiece W3. The cylindrical workpiece W3 having been pushed into each forming hole is pushed out above the forming hole while being sandwiched between a knockout pin (not illustrated) and the additional-machining punch 25, and is pulled out from the additional-machining punch 25 by a cylindrical workpiece stripper 25S fitted to each additional-machining punch 25. The cylindrical workpiece W3 disposed above each forming hole is conveyed to above the forming hole on its right side by a transfer device 18. This operation is repeated, and the cylindrical workpiece W3 is additionally machined a plurality of times by the plurality of additional-machining punches 25 and additional-machining dies 26. The rightmost punch in the ram 12 is a shake-off punch 25X, and the cylindrical workpiece W3 conveyed by the transfer device 18 is shaken off to a discharge path (not illustrated). The cylindrical workpiece W3 fallen in the discharge path is collected in a collection box (not illustrated).

**[0010]** As illustrated in Fig. 2, the above transfer device 18 has the following structure. A plurality of pairs of fingers 20 facing each other in the front-back direction H2 are supported by a pair of support rails 19 extending in the lateral direction H1 such that the fingers 20 can approach and separate from each other, and the fingers 20 are biased toward each other by coil springs (not illustrated). Then, the plurality of pairs of fingers 20 grip the cylindrical workpieces W3 and move the cylindrical workpieces W3 from respective ones of the additional-machining dies 26 to the additional-machining dies 26 on the right side thereof to hand over the cylindrical workpieces W3 to the additional-machining punches 25, whereby the cylindrical workpieces W3 are intermittently conveyed to the right side in the lateral direction H1.

**[0011]** Note that a space between the blanking punch 31 and the leftmost additional-machining punch 25 is a so-called dummy stage having no punch or die, and the cylindrical workpiece W3 conveyed to the dummy stage by the transfer device 18 is temporarily held by being sandwiched by a knockout pin (not illustrated) and a lower surface of a support base 50 (to be described later) from the upper and lower directions.

**[0012]** The ram 12, the transfer device 18, the plurality of knockout pins, and the plurality of workpiece strippers 25S are driven by the same drive source. Specifically, as illustrated in Fig. 1, an upper shaft 13 and a lower shaft 17 extending in the lateral direction H1 are respectively rotatably supported at an upper part and a lower part of the support frame 11, and a side shaft 14 extending in the vertical direction is rotatably supported on the left side of the support frame 11. Then, a bevel gear 14G at an upper end part of the side shaft 14 and a bevel gear 14G at one end of the upper shaft 13 are gear-connected to each other, and a lower end part of the side shaft 14 and one end part of the lower shaft 17 are connected to each other with a gear (not illustrated) incorporated in a gear box 17G, so that the upper shaft 13, the side shaft 14, and the lower shaft 17 are rotationally driven by a common drive source.

**[0013]** The ram 12 moves up and down by receiving power from a pair of cams 13A that rotate integrally with the upper shaft 13, and the plurality of knockout pins move up and down by receiving power from a plurality of cams (not illustrated) that rotate integrally with the lower shaft 17. The plurality of workpiece strippers 25S move up and down by receiving power from a plurality of cams (not illustrated) on the lower shaft 17 via a link mechanism (not illustrated) disposed behind the support block 24. In addition, a cam 14A is also integrally rotatably provided at an intermediate part of the side shaft 14. Then, the cam 14A is housed between a pair of communication bars (not illustrated) inserted between one ends of the pair of support rails 19 described above and between positions near the one ends, and this arrangement reciprocally moves the pair of support rails 19 in the lateral direction H1 in synchronization with a lifting operation of the ram 12. Note that the ram 12, the transfer device 18, the plurality of knockout pins, and the plurality of workpiece strippers 25S may be driven by different drive sources, or, for example, only the plurality of workpiece strippers 25S may be driven by a different drive source.

**[0014]** Hereinafter, a configuration of the cylindrical workpiece generation device 30 will be described in detail. Fig. 3 illustrates the blanking punch 31, the drawing punch 35, and the die support mechanism 40, which are main parts of the cylindrical workpiece generation device 30. As illustrated in Fig. 2, the drawing punch 35 is structured such that a punch main body portion 35B having a columnar shape whose outer diameter is larger than the diameter of a shaft portion 35A having a circular cross-section is fixed to the lower end of the shaft portion 35A. A corner part where a lower surface and a side surface of the punch main body portion 35B intersect is cham-

fered in an arc shape. In the present embodiment, the punch main body portion 35B has, for example, a flat shape in the vertical direction, but does not need to be flat.

**[0015]** As illustrated in Fig. 3, the blanking punch 31 includes in order from the top, for example, an upper end columnar portion 31C, a first prismatic portion 31D, a second chamfered prismatic portion 31E, and a punch main body portion 31F (see Fig. 4). The upper end columnar portion 31C protrudes from the center of an upper surface of the first prismatic portion 31D. The second chamfered prismatic portion 31E has a shape in which corner parts of the first prismatic portion 31D are chamfered to have a chamfering width wider than a chamfering width of the first prismatic portion 31D. The punch main body portion 31F (see Fig. 4) has a substantially columnar shape. Note that the blanking punch 31 only needs to include the punch main body portion 31F at a lower end part, and an upper part of the blanking punch 31 with respect to the punch main body portion 31F may have any shape. The blanking punch 31 does not need to include the upper end columnar portion 31C, the first prismatic portion 31D, or the second chamfered prismatic portion 31E described above.

**[0016]** In detail, as shown in Fig. 4, in the punch main body portion 31F, for example, a lower side of the punch main body portion 31F with respect to an intermediate part in the vertical direction is slightly reduced stepwise in diameter such that the upper side forms a large diameter portion 31G and the lower side forms a small diameter portion 31H. In addition, as illustrated in Fig. 7, a step surface 31J between the large diameter portion 31G and the small diameter portion 31H has, for example, a quarter arc shape whose radius is the same as the difference between the radius of the large diameter portion 31G and the radius of the small diameter portion 31H, and an upper end part of the step surface 31J is continuous with the large diameter portion 31G. In addition, a corner part between the lower surface 31K of the blanking punch 31 and a side surface of the punch main body portion 31F (in more detail, the side surface of the small diameter portion 31H) is an edge portion 31L, where both the lower surface 31K and the side surface of the punch main body portion 31F are orthogonal to each other and forms a sharp edge. The step surface 31J does not need to be the above-described quarter arc shape whose diameter is the difference between the radius of the large diameter portion 31G and the radius of the small diameter portion 31H, and may have an arc shape of any size or a tapered shape.

**[0017]** As shown in Fig. 2, the blanking punch 31 has a cylindrical shape as described above, and the inside of the blanking punch 31 has, for example, a small-diameter hole portion 31A at an upper end part, and the part other than the upper end part is a large-diameter hole portion 31B. Then, the shaft portion 35A of the drawing punch 35 passes through the small-diameter hole portion 31A in a linearly movable manner, and the punch main body portion 35B of the drawing punch 35 is housed in the large-diameter hole portion 31B.

**[0018]** As illustrated in Fig. 1, while the blanking punch 31 is fixed to the ram 12 and moves up and down together with the ram 12, the drawing punch 35 moves up and down by receiving power from, for example, a lever 16 having a seesaw shape rotatably supported by the support frame 11.

**[0019]** Specifically, one end part of the lever 16 is hinge-connected to an upper end part of the drawing punch 35 movably in the lateral direction H1. A cam follower (not illustrated) protruding in a direction toward the rotation axis is provided at the other end part of the lever 16. The cam follower is engaged with a cam groove 15A in an outer peripheral surface of a columnar body 15 that rotates integrally with the side shaft 14. In the initial stage where the blanking punch 31 descends, the punch main body portion 35B of the drawing punch 35 is housed in the blanking punch 31, for example, and after the blanking punch 31 reaches a bottom dead center, the punch main body portion 35B of the drawing punch 35 appears below from the blanking punch 31 and descends to reach the bottom dead center.

**[0020]** The blanking punch 31 and the drawing punch 35 of the present embodiment both have a circular planar cross-section, but may have an elliptical or oval planar cross-section, and the cylindrical workpiece generation device 30 may generate an elliptical or oval cylindrical workpiece. The drawing punch 35 may be configured to operate by receiving power from a power source different from the ram 12.

**[0021]** As illustrated in Fig. 3, the die support mechanism 40 has, for example, a structure in which a die holding member 41 is supported by a support base 50. As illustrated in Fig. 5, the die holding member 41 has a slit 41S passing through in the front-back direction H2. For example, a die holding base 42, which is on the lower side with respect to the slit 41S, holds a blanking die 32 and a drawing die 36. A ceiling portion 43, which is on the upper side with respect to the slit 41S, has a ceiling hole 44 through which the blanking punch 31 and the drawing punch 35 pass.

**[0022]** In detail, as a whole, the die holding base 42 has a rectangular plate shape whose planar shape is horizontally long, and the whole ceiling portion 43 has, for example, a rectangular plate shape that has the same size as the die holding base 42 in the lateral direction H1 and that is smaller than the die holding base 42 in the front-back direction H2. Further, on both end edges in the lateral direction H1 on a lower surface of the ceiling portion 43, for example, there are provided a pair of rectangular protrusions 43T having a rectangular cross-section and extending in the front-back direction H2. Then, for example, the ceiling portion 43 is disposed at the center of the die holding base 42 in the front-back direction H2, the ceiling portion 43 is fixed to the die holding base 42 with a plurality of bolts vertically penetrating the pair of rectangular protrusions 43T and a pair of pins 75, so that the above-described slit 41S is formed between the

upper surface of the die holding base 42 and the lower surface of the ceiling portion 43. Instead of the pair of rectangular protrusions 43T of the ceiling portion 43, a pair of rectangular protrusions may be provided at both ends of the die holding base 42 in the lateral direction H1.

**[0023]** A central part of the ceiling portion 43 in the lateral direction H1 forms, for example, a thick portion 43U that is thickened stepwise upward, and the ceiling hole 44 vertically passes through the thick portion 43U. The ceiling hole 44 has, for example, a circular cross-section. As illustrated in Fig. 7, an upper side of the ceiling hole 44 with respect to a middle position in the vertical direction forms, for example, a tapered guide portion 44A whose diameter increases upward, and the lower side forms, for example, a straight guide portion 44B having the same inner diameter as the lower end of the tapered guide portion 44A and having a uniform inner diameter (reference sign D4 in Fig. 7) wholly.

**[0024]** As illustrated in Fig. 4, in the die holding base 42, there is formed a die housing hole 46 coaxially with the ceiling hole 44. For example, a diameter of the die housing hole 46 is reduced stepwise at a middle position in the vertical direction, a step surface of the step forms a horizontal die support surface 46B, and the blanking die 32 and the drawing die 36 are fitted in a large diameter portion 46A, which is on the upper side with respect to the die support surface 46B, with the drawing die 36 positioned under the blanking die 32. Furthermore, the blanking die 32 and the drawing die 36 are fixed to the die holding base 42 with, for example, a plurality of bolts (not illustrated) vertically penetrating therethrough.

**[0025]** The drawing die 36 has a disk shape and has a circular drawing hole 36A at the center of the disk shape. In addition, a corner part where an inner side surface of the drawing hole 36A and a horizontal upper surface 36B of the drawing die 36 intersect is a chamfered surface 36C having an arc shape. Furthermore, the drawing hole 36A has a smaller inner diameter than, for example, a small diameter portion 46C of the die housing hole 46, which is below the die support surface 46B.

**[0026]** The blanking die 32 has, for example, a disk shape having the same outer diameter as the drawing die 36, and includes, at its central part, a circular punch hole 32A larger than the drawing hole 36A. The upper surface 36B of the drawing die 36 is exposed at the lower end of the punch hole 32A. Further, for example, an annular protrusion 32T protrudes stepwise from an opening edge of the punch hole 32A on an upper surface 32B of the blanking die 32. An upper surface 32C of the annular protrusion 32T is horizontal, and an inclined surface 32D is formed between the upper surface 32C and the upper surface 32B. A corner part between the upper surface 32C of the annular protrusion 32T and an inner surface of the punch hole 32A is, for example, an edge portion 32L at which the upper surface 32C and the punch hole 32A are orthogonal to each other and forms a sharp edge. Note that the annular protrusions 32T does not need to be provided.

**[0027]** As illustrated in Fig. 5, on the upper surface of the die holding base 42, a pair of upper surface grooves 42M extending in the front-back direction H2 are formed, for example, at two positions disposed between a pair of rectangular protrusions 43T and the die housing hole 46. Each of the upper surface grooves 42M has a quadrangular cross-section, and, for example, a pair of support column insertion holes 42A vertically passing through the die holding base 42 are opened at positions near both ends in the longitudinal direction of a bottom surface of each upper surface groove 42M. Note that, for example, cutout portions 43A for avoiding interference with a tool for tightening bolts 70 (to be described later) to be inserted through the support column insertion holes 42A are formed at edge parts of the ceiling portion 43.

**[0028]** For example, at both end parts, in a left-right direction, of a part of the die holding base 42 on the front side with respect to the ceiling portion 43, there are formed a pair of pin holes 42P vertically passing through the die holding base 42. Both the pin holes 42P are partially disposed in front of the slit 41S, for example.

**[0029]** As illustrated in Fig. 5, the support base 50 has, in its upper surface, a receiving groove 51 having a rectangular groove structure extending in the lateral direction H1. Then, as illustrated in Fig. 3, the die holding base 42 is received in the receiving groove 51. In addition, as illustrated in Fig. 5, for example, two pairs of support columns 52, that is, four support columns 52 in total to be received in the support column insertion holes 42A of the die holding base 42 stand from a bottom surface of the receiving groove 51. Furthermore, for example, a pair of beams 53 having a quadrangular cross-section and extending in the lateral direction H1 are placed on and fixed to upper surfaces of the pairs of support columns 52, and the support columns of each pair are facing each other in the front-back direction H2.

**[0030]** In detail, as illustrated in Fig. 6, the support columns 52 each have, for example, a cylindrical shape, and are fitted in circular recesses 55A formed in the bottom surface of the receiving groove 51. Further, for example, female threaded holes 55B vertically pass through the center of the bottom surface of the corresponding recesses 55A. Furthermore, for example, counterbore holes 53Z are formed at two positions of each beam 53 immediately above the support columns 52, and lower end parts of the bolts 70 having head portions received in the counterbore holes 53Z are tightened to the female threaded holes 55B described above, so that the beams 53 are fixed to the receiving grooves 51 together with the support columns 52. Then, the die holding base 42 is held by the support base 50 with the beams 53 and the support columns 52. Note that upper surfaces of the beams 53, the upper surface of the die holding base 42, and an upper surface of the support base 50 are disposed, for example, substantially flush with each other, but any one of the upper surfaces may be disposed higher than the other upper surfaces.

**[0031]** As illustrated in Figs. 2 and 5, the support base

50 is provided with a through-hole 54 vertically passing through in a coaxial manner with the die housing hole 46 of the die holding base 42. The through-hole 54 has, for example, an inner diameter substantially the same as the diameter of the small diameter portion 46C on the lower end part of the die housing hole 46. In addition, the support base 50 is provided with one recess 54A that faces each other in the front-back direction H2 and is opened to an inner surface of the through-hole 54. Furthermore, the pair of recesses 54A house a pair of workpiece strippers 60, and the workpiece strippers 60 are biased toward such sides that the strippers 60 approach to each other.

**[0032]** As illustrated in Fig. 5, for example, on each of both ends of the support base 50 in the front-back direction H2, there are provided a pair of fixing holes 59. As illustrated in Fig. 2, the support base 50 is placed on a pair of base portions 24K that are fixed to an upper surface of the support block 24 and face each other in the front-back direction H2. For example, the support base 50 is fixed by tightening base fixing bolts 71 having passed through the fixing holes 59 to threaded holes 24N of the base portion 24K. As a result, the entire support base 50 is held above the upper surface of the support block 24 with a space therebetween and the above-described transfer device 18 penetrates between the support base 50 and the support block 24.

**[0033]** As illustrated in Fig. 4, when the ram 12 is located at a top dead center, the above-mentioned blanking punch 31 is disposed at a position away upward from the ceiling portion 43 together with the drawing punch 35. Then, in a state where the sheet metal W1 inserted through the slit 41S covers the punch hole 32A of the blanking die 32, the blanking punch 31 passes through the ceiling hole 44 of the ceiling portion 43 and enters the punch hole 32A, so that a part of the sheet metal W1 is punched out as a blank W2 as illustrated in Fig. 9. In detail, the sheet metal W1 is cut into a circular shape by the edge portion 31L of the blanking punch 31 and the edge portion 32L of the blanking die 32, and the blank W2 is separated from the sheet metal W1. Then, the ram 12 reaches the bottom dead center when the lower surface 31K of the blanking punch 31 comes adjacent to the upper surface 36B of the drawing die 36. An outer edge part of the blank W2 is sandwiched between the lower surface 31K of the blanking punch 31 and the upper surface 36B of the drawing die 36.

**[0034]** The drawing punch 35 descends downward from the blanking punch 31 in a state where the outer edge part of the blank W2 is sandwiched between the blanking punch 31 and the drawing die 36, and pushes the blank W2 into the drawing hole 36A to form a cylindrical workpiece W3 as illustrated in Fig. 2.

**[0035]** The drawing punch 35 then descends to below the support base 50 together with the cylindrical workpiece W3, passes between the pair of workpiece strippers 60, and reaches the bottom dead center when further entering between the pair of fingers 20 at the left end part of the transfer device 18 (see Fig. 2). When the drawing punch 35 ascends, the cylindrical workpiece W3 is separated from the drawing punch 35 by the pair of workpiece strippers 60. In addition, for example, the blanking punch 31 ascends prior to the drawing punch 35, and at that time, the sheet metal W1 disposed outside the blanking punch 31 comes into contact with the ceiling portion 43 and is separated from the blanking punch 31. Note that the blanking punch 31 and the drawing punch 35 may be configured to ascend at any timing. For example, the blanking punch 31 and the drawing punch 35 may be configured to ascend simultaneously after the drawing punch 35 reaches the bottom dead center.

**[0036]** The cylindrical workpiece W3 generated by the cylindrical workpiece generation device 30 as described above and passed to the pair of fingers 20 of the transfer device 18 is sequentially conveyed onto the plurality of additional-machining dies 26 via the dummy stage, and is additionally machined by the plurality of additional-machining punches 25 and the additional-machining dies 26 as described above.

**[0037]** The operation of punching out the blank W2 from the sheet metal W1 with the blanking punch 31 and the blanking die 32 is smoothly performed as long as a central axis of the blanking punch 31 and a central axis of the punch hole 32A coincide with each other, but there is a case where the central axis of the blanking punch 31 and the central axis of the punch hole 32A deviate from each other beyond an allowable range during continuous operation of the transfer press machine 10 for some reason. This causes a failure that the edge portion 31L of the blanking punch 31 hits the edge portion 32L of the opening edge of the punch hole 32A and is thus damaged (hereinafter, the failure is referred to as an "off-axis failure").

**[0038]** In order to prevent the off-axis failure, the cylindrical workpiece generation device 30 is provided with, for example, a floating mechanism, a guide mechanism, a positioning and fixing mechanism, and an origin adjustment mechanism. In the floating mechanism, there is provided a clearance in a part where the support base 50 holds the die holding member 41. The support base 50 slidably supports the die holding member 41 in any desired horizontal direction within a range of the clearance. In the guide mechanism, the die holding member 41 is guided so as to move in a direction in which the central axis of the punch hole 32A coincides with the central axis of the blanking punch 31 by sliding contact between the die holding member 41 and the blanking punch 31. In the positioning and fixing mechanism, the die holding member 41 is fixed at the origin position in a slidable range on the support base 50. The origin adjustment mechanism is a mechanism for adjusting the position of the support base 50 with respect to the support block 24 such that the central axis of the blanking punch 31 and the central axis of the punch hole 32A coincide with each other within an allowable range in a state where the die holding member 41 is fixed to the origin position on the

support base 50. Hereinafter, specific configurations of such mechanisms will be described. Note that, for example, the cylindrical workpiece generation device 30 may include only a floating mechanism and a guide mechanism, may include a floating mechanism, a guide mechanism, and a positioning and fixing mechanism, or may include a floating mechanism, a guide mechanism, and an origin adjustment mechanism.

**[0039]** The positioning and fixing mechanism of the die support mechanism 40 of the present embodiment includes, for example, the above-described pair of pin holes 42P of the die holding member 41 illustrated in Fig. 6, a pair of pin holes 51P of the support base 50 provided immediately below the pin holes 42P, and a pair of positioning pins 72. Then, the positioning pins 72 are inserted into respective ones of pairs of vertically disposed pin hole 42P and pin hole 51P, and the die holding member 41 is two-dimensionally positioned in the horizontal direction with respect to the support base 50. Furthermore, the position at which the die holding member 41 is thus positioned serves as the origin position of the die holding member 41 with respect to the support base 50.

**[0040]** In addition, an upper part of each positioning pin 72 is increased in diameter, for example, in a stepped manner, is in contact with an opening edge of the corresponding pin hole 42P, and protrudes from the upper surface of the die holding base 42. Furthermore, as illustrated in Fig. 3, the upper parts of the pair of positioning pins 72 are both disposed at positions facing the slit 41S from the front-back direction H2. As a result, in a state where the pair of positioning pins 72 are attached, the sheet metal W1 interferes with the positioning pins 72 when the sheet metal W1 is inserted through the slit 41S, and it is possible to notice that the positioning pins 72 are left forgotten to be removed. That is, it is prevented that a continuous operation of the transfer press machine 10 is started while the die holding member 41 is still fixed to the support base 50.

**[0041]** Note that the positioning and fixing mechanism may have the following structure, for example. At two positions on the die holding member 41 and at two positions on the support base 50, there are provided such alignment surfaces that are disposed to be vertically flush with each other when the die holding member 41 is disposed at the origin position on the support base 50. When each pair of alignment surfaces are fixed with a flat member being commonly applied to the pair of alignment surfaces, the die holding member 41 is fixed at the origin position on the support base 50

**[0042]** As illustrated in Fig. 6, the floating mechanism has a structure in which, for example, a first clearance $\delta 1$ having a predetermined dimension (for example, 0.5 mm to 2 mm) or more is formed along the entire circumferences between outer peripheral surfaces of all the support columns 52 and inner peripheral surfaces of all the support column insertion holes 42A in a state where the die holding member 41 is positioned at the origin position on the support base 50. That is, the difference between a radius of the outer peripheral surfaces of the support columns 52 and a radius of the inner peripheral surfaces of the support column insertion holes 42A is the first clearance $\delta 1$ of the predetermined dimension or more. In addition, in a state where the die holding member 41 is positioned at the origin position on the support base 50, a clearance having a size equal to or larger than the first clearance $\delta 1$ is formed, for example, between each beam 53 and a pair of inner side surfaces of the corresponding upper surface groove 42M and between the die holding member 41 and a pair of inner side surfaces of the receiving groove 51. Furthermore, for example, a clearance (not illustrated) is provided between the lower surface of each beam 53 and a bottom surface of the corresponding upper surface groove 42M, so that the beam 53 does not press the die holding member 41 against the bottom surface of the receiving groove 51. As a result, in a state where the pair of positioning pins 72 are removed, the die holding member 41 can slide with respect to the support base 50 in any desired horizontal direction within a range of the first clearance 51.

**[0043]** Note that, in the present embodiment, the die holding member 41 at the origin position is disposed at the center of the movable range with respect to the support base 50. However, in a case where the blanking punch 31 tends to be displaced to one side in a certain direction with respect to the punch hole 32A during continuous operation of the transfer press machine 10, it is preferable that the die holding member 41 at the origin position be disposed to be displaced from the center of the movable range with respect to the support base 50 in accordance with the tendency.

**[0044]** As illustrated in Fig. 2, the origin adjustment mechanism has the following structure, for example. A clearance having a size equal to or larger than the first clearance $\delta 1$ is provided between the plurality of base fixing bolts 71 for fixing the support base 50 to the base portions 24K and the plurality of fixing holes 59 of the support base 50 through which the base fixing bolts 71 are passed. When all the base fixing bolts 71 are loosened, the support base 50 becomes slidable, and when the base fixing bolts 71 are tightened, the support base 50 is fixed at any desired position on the support block 24. With this arrangement, the origin adjustment of the die support mechanism 40 is completed by the following procedure. The die holding member 41 is fixed at the origin position on the support base 50, and all the base fixing bolts 71 are loosened. In this state, as illustrated in Fig. 6, the blanking punch 31 is inserted into the punch hole 32A by a manual operation, so that the central axis of the blanking punch 31 and the central axis of the punch hole 32A coincide with each other. Then, all the base fixing bolts 71 are tightened, and the pair of positioning pins 72 are removed.

**[0045]** Note that the following structure can be considered as the origin adjustment mechanism. For example, the support base 50 is positioned and fixed to the base portions 24K with pins, keys, or the like, and, in this state,

the blanking punch 31 is adjusted in position with respect to the ram 12.

**[0046]** As illustrated in Fig. 7, the guide mechanism includes as described above, for example: the tapered guide portion 44A and the straight guide portion 44B in the ceiling hole 44 of the die holding member 41; and the large diameter portion 31G, the small diameter portion 31H, and the step surface 31J of the blanking punch 31. Specifically, the difference between the radius ($0.5 \times D3$) of the upper end of the tapered guide portion 44A and the radius ($0.5 \times D2$) of the lower end of the blanking punch 31 is larger than the above-described first clearance 51, which is the range in which the die holding member 41 is slidable with respect to the support base 50. As a result, regardless of where the die holding member 41 is located in the slidable range with respect to the support base 50, the blanking punch 31 enters the ceiling hole 44 without hitting the upper surface of the ceiling hole 44.

**[0047]** As shown in Fig. 8, before the blanking punch 31 enters the punch hole 32A (more specifically, immediately before or at the same time when the sheet metal W1 is sandwiched between the blanking die 32 and the blanking punch 31), the lower end of the large diameter portion 31G of the blanking punch 31 passes through the tapered guide portion 44A of the ceiling hole 44 and enters the straight guide portion 44B, and the blanking punch 31 and the punch hole 32A are centered on each other. As a result, the blanking punch 31 enters thereafter the punch hole 32A without the edge portion 31L of the blanking punch 31 hitting the edge portion 32L of the punch hole 32A. For that purpose, a second clearance $\delta 2$ that is the difference between the radius ($0.5 \times D2$) of the small diameter portion 31H of the blanking punch 31 and the radius ($0.5 \times D5$) of the punch hole 32A is larger than a third clearance $\delta 3$ that is the difference between the radius ($0.5 \times D1$) of the large diameter portion 31G of the blanking punch 31 and the radius ($0.5 \times D4$) of the straight guide portion 44B of the ceiling hole 44.

**[0048]** Note that the guide mechanism may have any structure as long as the blanking punch 31 is guided by the ceiling hole 44 so that the blanking punch 31 enters the punch hole 32A without the edge portion 31L of the blanking punch 31 hitting the edge portion 32L of the punch hole 32A. For example, the following configuration can be considered: a tapered portion corresponding to the tapered guide portion 44A is provided on the blanking punch 31; or the entire inside of the ceiling hole 44 is configured to be the tapered guide portion 44A.

**[0049]** The configuration of the transfer press machine 10 of the present embodiment has been described above. Next, an action and effect of the transfer press machine 10 will be described. As illustrated in Fig. 3 and described above, the die support mechanism 40 of the transfer press machine 10 of the present embodiment includes the die holding member 41 through which the slit 41S passes in the front-back direction H2. In addition, a lower side of the die holding member 41 with respect to the slit 41S forms the die holding base 42 that holds the blanking die 32, and an upper side with respect to the slit 41S forms the ceiling portion 43 having the ceiling hole 44 concentric with the punch hole 32A of the blanking die 32. Then, the die holding member 41 is supported by the support base 50 in a horizontally slidable manner, and the tapered guide portion 44A and the straight guide portion 44B of the ceiling hole 44 are in sliding contact with the blanking punch 31, so that the die holding member 41 slides to a position where the punch hole 32A is centered on the blanking punch 31. As a result, even when the center of the blanking punch 31 and the center of the punch hole 32A are deviated from each other due to thermal deformation or the like, the deviation is eliminated before the blanking punch 31 enters the punch hole 32A, thereby suppressing a failure in which the blanking punch 31 hits the opening edge of the punch hole 32A as in the conventional art, and the durability of the blanking punch 31 and the blanking die 32 is therefore improved.

**[0050]** In addition, when the blank W2 is drawn into the cylindrical workpiece W3 by the drawing punch 35, the blank W2 is stably held by the blank W2, so that the shape of the cylindrical workpiece W3 is also stabilized. Then, the transfer press machine 10 additionally machines the thus generated cylindrical workpiece W3; therefore, the final shape of the cylindrical workpiece W3 is also stabilized.

**[0051]** In addition, since the support base 50 can be fixed after the punch hole 32A and the blanking punch 31 are centered on each other by sliding the support base 50 in the horizontal direction in a state where the die holding member 41 is fixed at the origin position on the support base 50, it is possible to effectively use the slidable range of the die holding member 41 with respect to the support base 50, and the slidable range can be accordingly narrowed so that the punching operation of the blank W2 can be stabilized.

**[0052]** Furthermore, since the pair of positioning pins 72 for positioning the die holding member 41 at the origin position on the support base 50 are disposed at such positions that the positioning pins 72 restrict insertion of the sheet metal W1 into the slit 41S, it is possible to prevent starting of punching of the blank W2 in a state where the pair of positioning pins 72 are left forgotten to be removed.

[Second embodiment]

**[0053]** A cylindrical workpiece generation device 30X of the present embodiment includes, for example, a cylindrical portion 43V standing from a ceiling portion 43, and the entire inside of a ceiling hole 44 inside the cylindrical portion 43V has a uniform inner diameter. That is, the inside of the ceiling hole 44 is the same as the inside of the straight guide portion 44B of the first embodiment. Furthermore, even when the blanking punch 31 reaches the top dead center, the large diameter portion 31G of the blanking punch 31 does not come out of the ceiling

hole 44. The other configurations are the same as the configurations of the first embodiment. The configuration of the present embodiment also achieves the same action and effect as in the first embodiment.

**[0054]** Note that, in the structure of the present embodiment, the same action and effect are achieved also in a case where an upper side of the ceiling hole 44 with respect to a middle position in the vertical direction serves as the tapered guide portion 44A and the lower side serves as the straight guide portion 44B.

[Other embodiments]

**[0055]**

(1) The die support mechanism 40 of the above embodiment is part of the cylindrical workpiece generation device 30 included in the transfer press machine 10, but the die support mechanism 40 may be provided as part of a single cylindrical workpiece generation device not included in a transfer press machine.
(2) The above die support mechanism 40 may be simply applied to a pressing machine for producing a blank.

**[0056]** Although the present specification and the drawings disclose specific examples of the techniques included in the claims, the techniques according to the claims are not limited to these specific examples, and include various variations and modifications of the specific examples, and further include a part alone taken out from the specific examples.

DESCRIPTION OF THE REFERENCE NUMERAL

**[0057]**

| | |
|---|---|
| 10 | Transfer press machine |
| 12 | Ram |
| 18 | Transfer device |
| 24 | Support block |
| 24K | Base portion |
| 25 | Additional-machining punch |
| 30, 30X | Cylindrical workpiece generation device |
| 31 | Blanking punch |
| 32 | Blanking die |
| 32A | Punch hole |
| 35 | Drawing punch |
| 36 | Drawing die |
| 36A | Drawing hole |
| 40 | Die support mechanism |
| 41 | Die holding member |
| 41S | Slit |
| 42 | Die holding base |
| 42P, 51P | Pin hole |
| 43 | Ceiling portion |
| 44 | Ceiling hole |
| 44A | Tapered guide portion |
| 44B | Straight guide portion |
| 50 | Support base |
| 72 | Positioning pin |
| W1 | Sheet metal |
| W2 | Blank |
| W3 | Cylindrical workpiece |

## Claims

**1.** A die support mechanism comprising:

a die holding member including a slit that horizontally passes through the die holding member, wherein

a lower side of the die holding member with respect to the slit forms a die holding base configured to hold a blanking die having a punch hole,
an upper side of the die holding member with respect to the slit forms a ceiling portion having a ceiling hole concentric with the punch hole,
a part of a sheet metal inserted in the slit is punched out as a blank by a blanking punch descending to the punch hole through the ceiling hole, and
the ceiling portion separates the sheet metal from the ascending blanking punch;

a support base configured to support the die holding member in a horizontally slidable manner; and
a guide portion formed on an inner surface of the ceiling hole and configured to come into sliding contact with the blanking punch and to slide the die holding member to a position where the punch hole is centered on the blanking punch.

**2.** The die support mechanism according to claim 1 further comprising:

a positioning and fixing mechanism being capable of changing between a fixed state where the die holding member is fixed on the support base while being positioned at a predetermined origin position and a fixation-released state where the fixation of the die holding member is released; and
an origin adjustment mechanism being capable of supporting the support base in a horizontally slidable manner and of fixing the support base at any desired position.

**3.** The die support mechanism according to claim 2, wherein the positioning and fixing mechanism in-

cludes:

two pairs of pin holes coaxially aligned at the origin position, the pin holes of each pair of the two pairs of pin holes being formed in respective ones of the die holding member and the support base, and
a pair of positioning pins being fitted in respective ones of the two pairs of pin holes that are coaxially aligned.

**4.** The die support mechanism according to claim 3, wherein the pair of positioning pins are disposed at positions where the pair of positioning pins restrict insertion of the sheet metal into the slit.

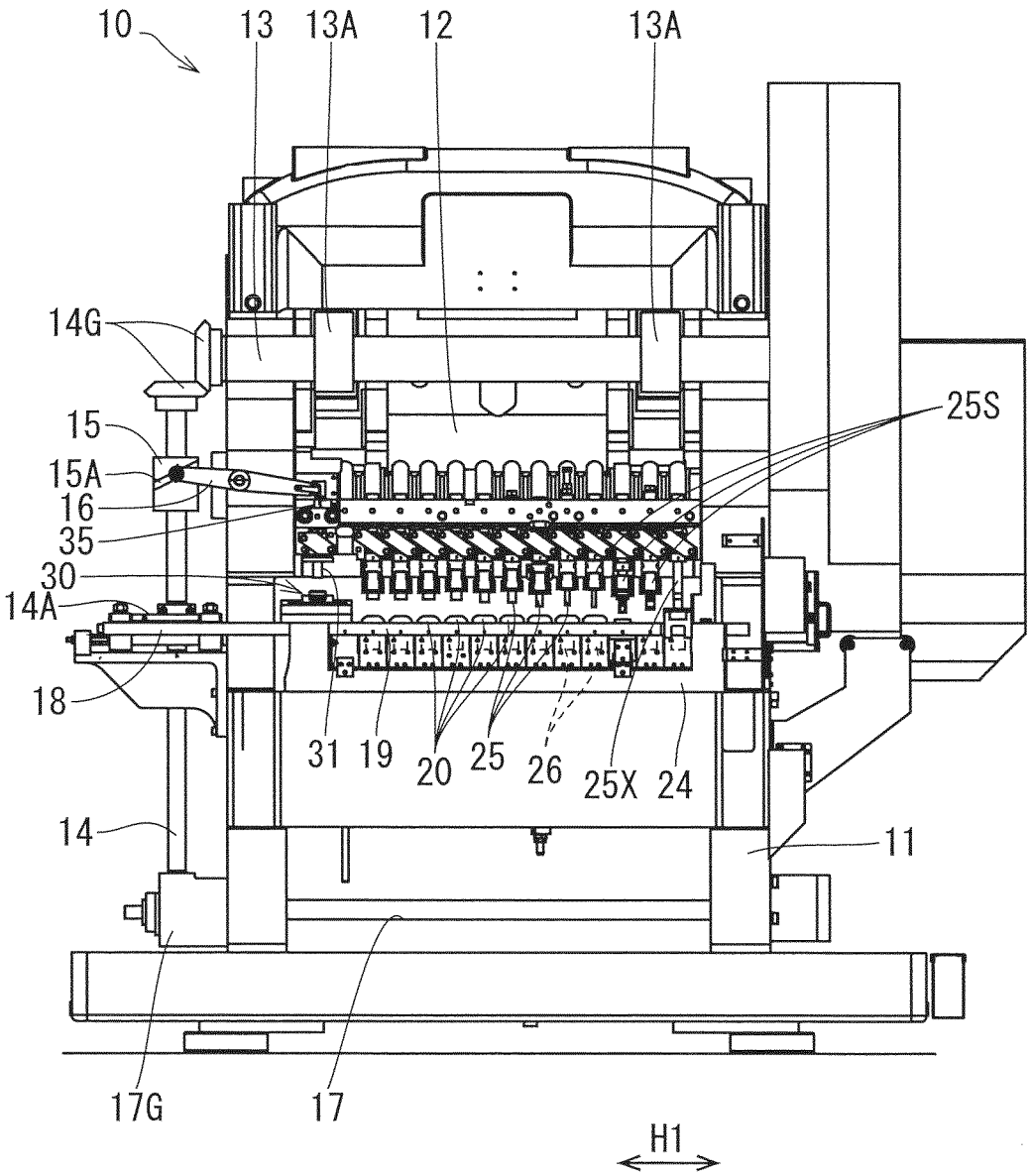
**5.** A cylindrical workpiece generation device comprising:

the die support mechanism according to any one of claims 1 to 4;
a blanking punch having a cylindrical shape and configured to punch out a blank in cooperation with the die support mechanism;
a drawing punch vertically movably housed inside the blanking punch; and
a drawing die disposed under the blanking die and held by the die holding base, the drawing die having a drawing hole smaller than the punch hole,
wherein a cylindrical workpiece is formed by the drawing punch pushing the blank into the drawing hole in a state where the blank is pressed against an opening edge of the drawing hole by the blanking punch.

**6.** A transfer press machine comprising:

the cylindrical workpiece generation device according to claim 5;
a ram supporting the blanking punch and a plurality of additional-machining punches aligned in a row with the blanking punch positioned at a head of the row;
a support block incorporating a plurality of dies corresponding to the plurality of additional-machining punches;
a base portion supporting the die holding member of the cylindrical workpiece generation device above the support block with a space therebetween; and
a transfer device configured to intermittently convey the workpiece that is punched down to an upper surface of the support bed by the drawing punch, to the plurality of additional-machining punches.

FIG. 1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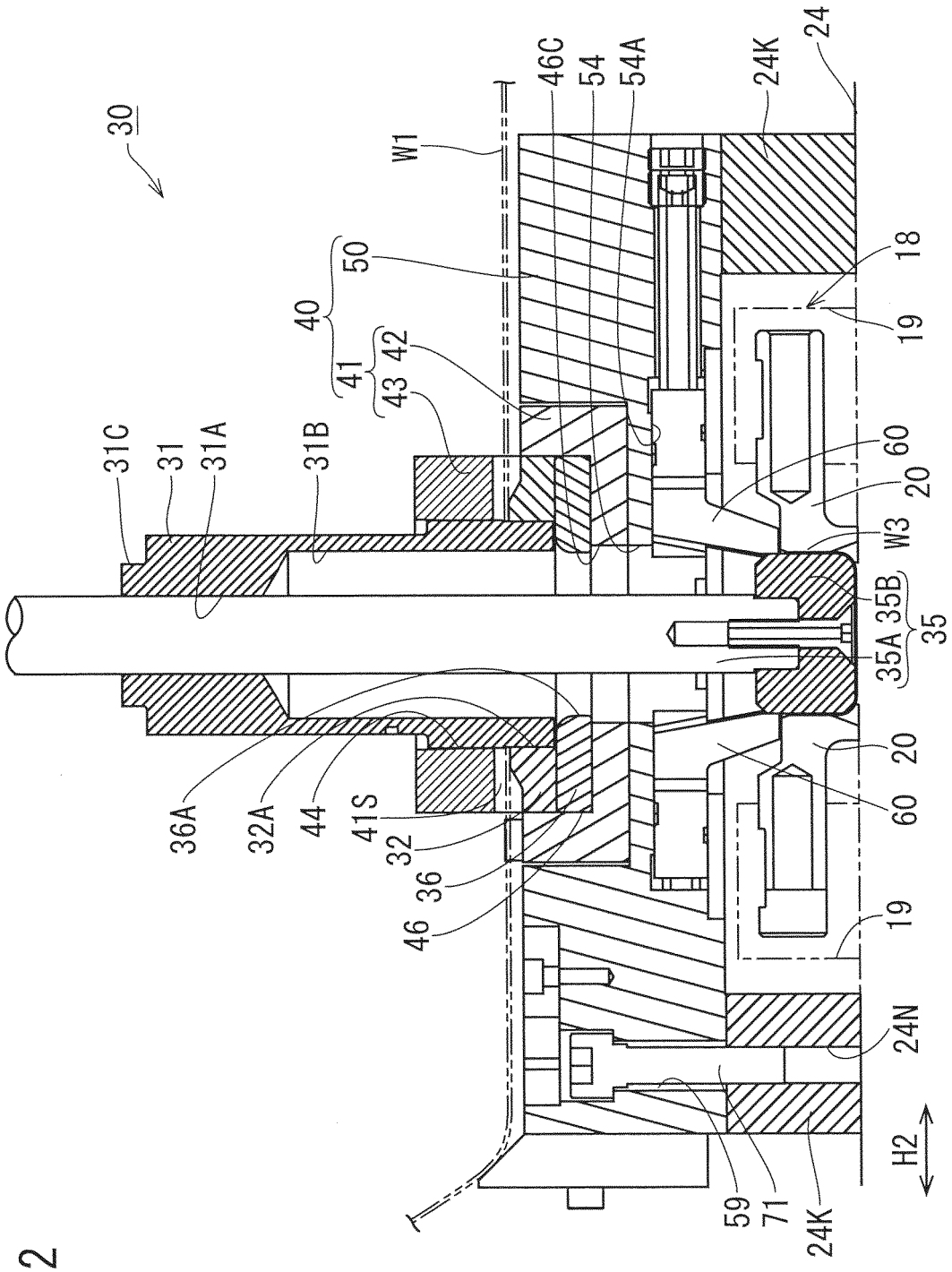
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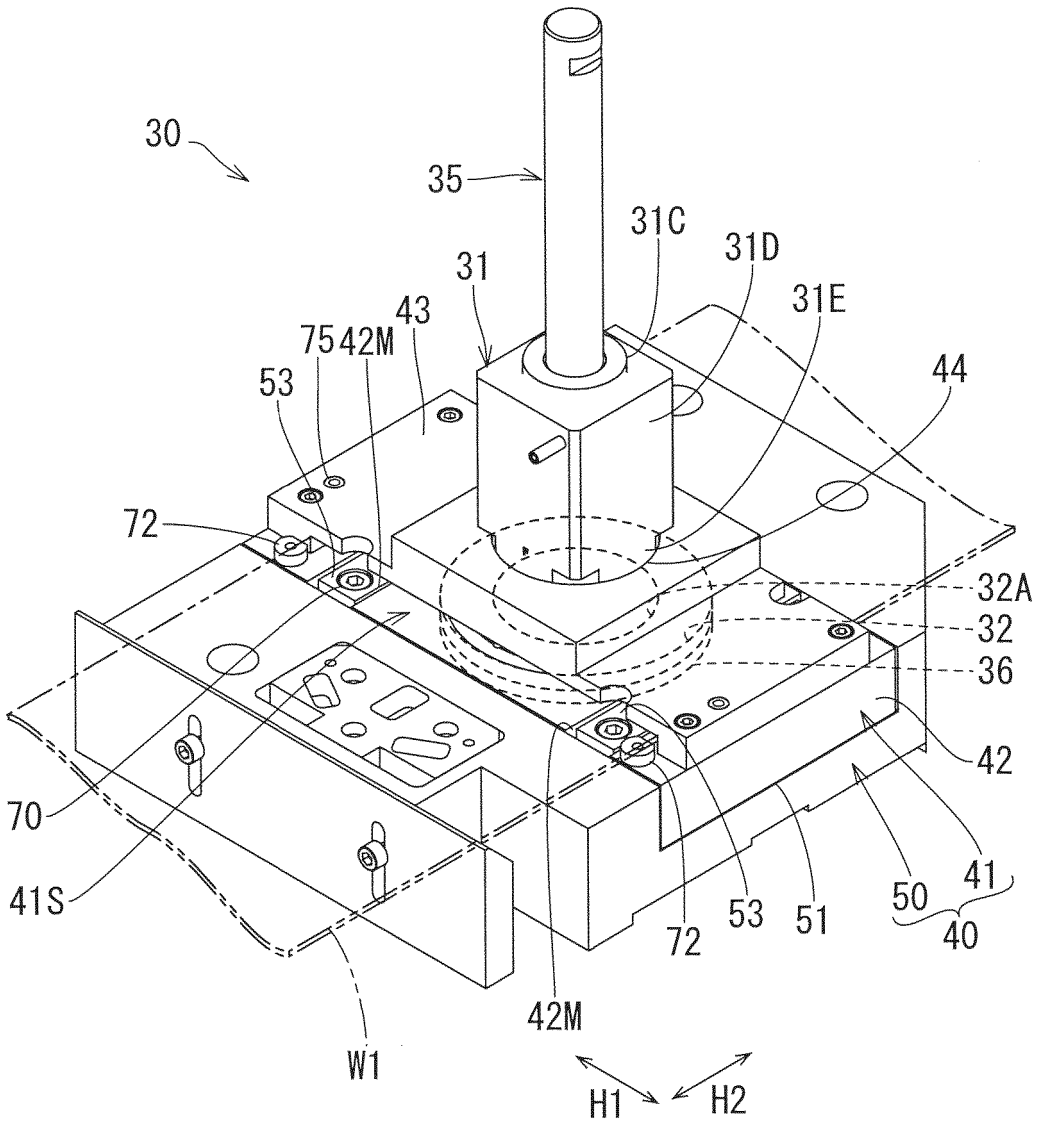
FIG. 2

FIG. 3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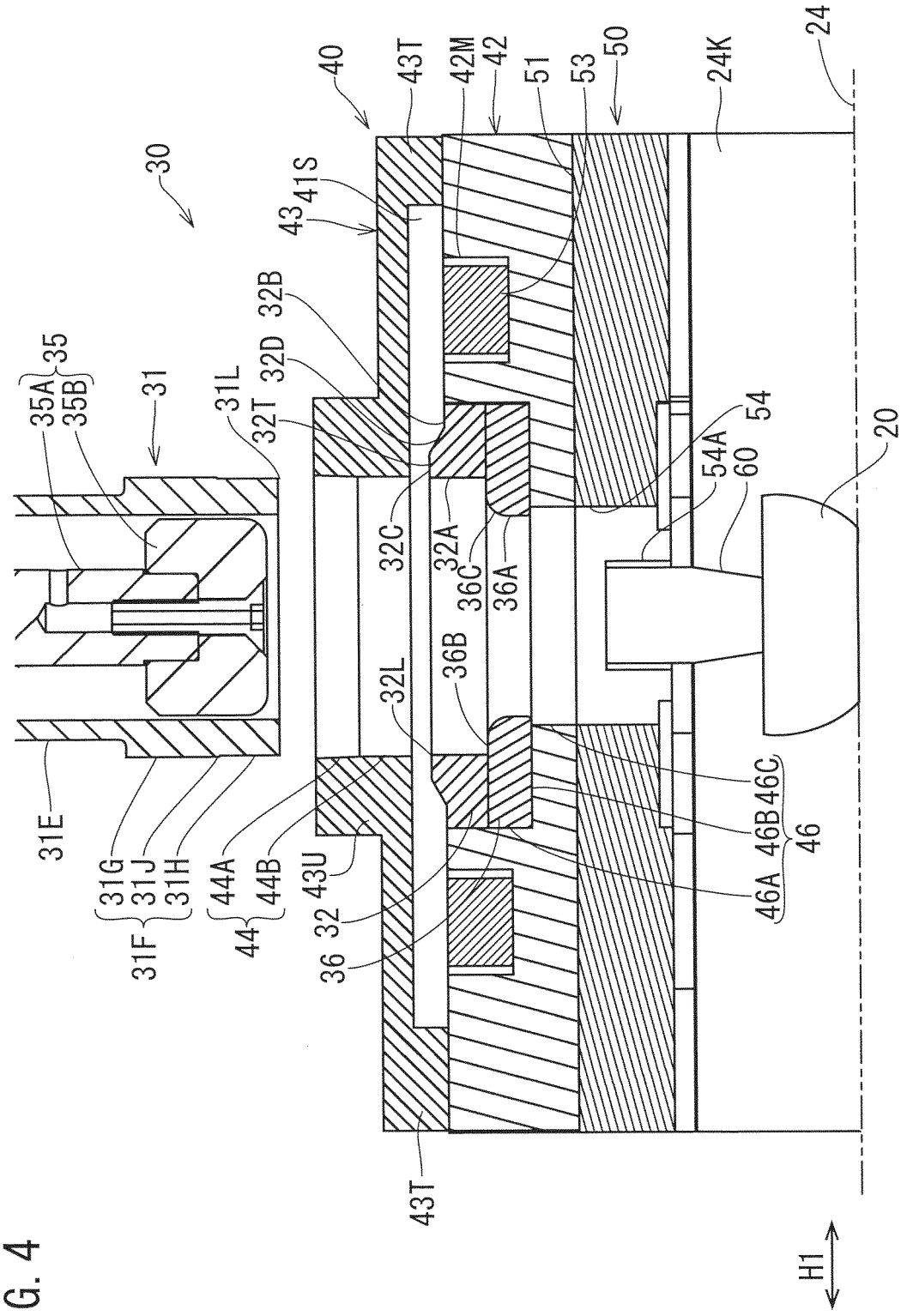
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FIG. 4

FIG. 5

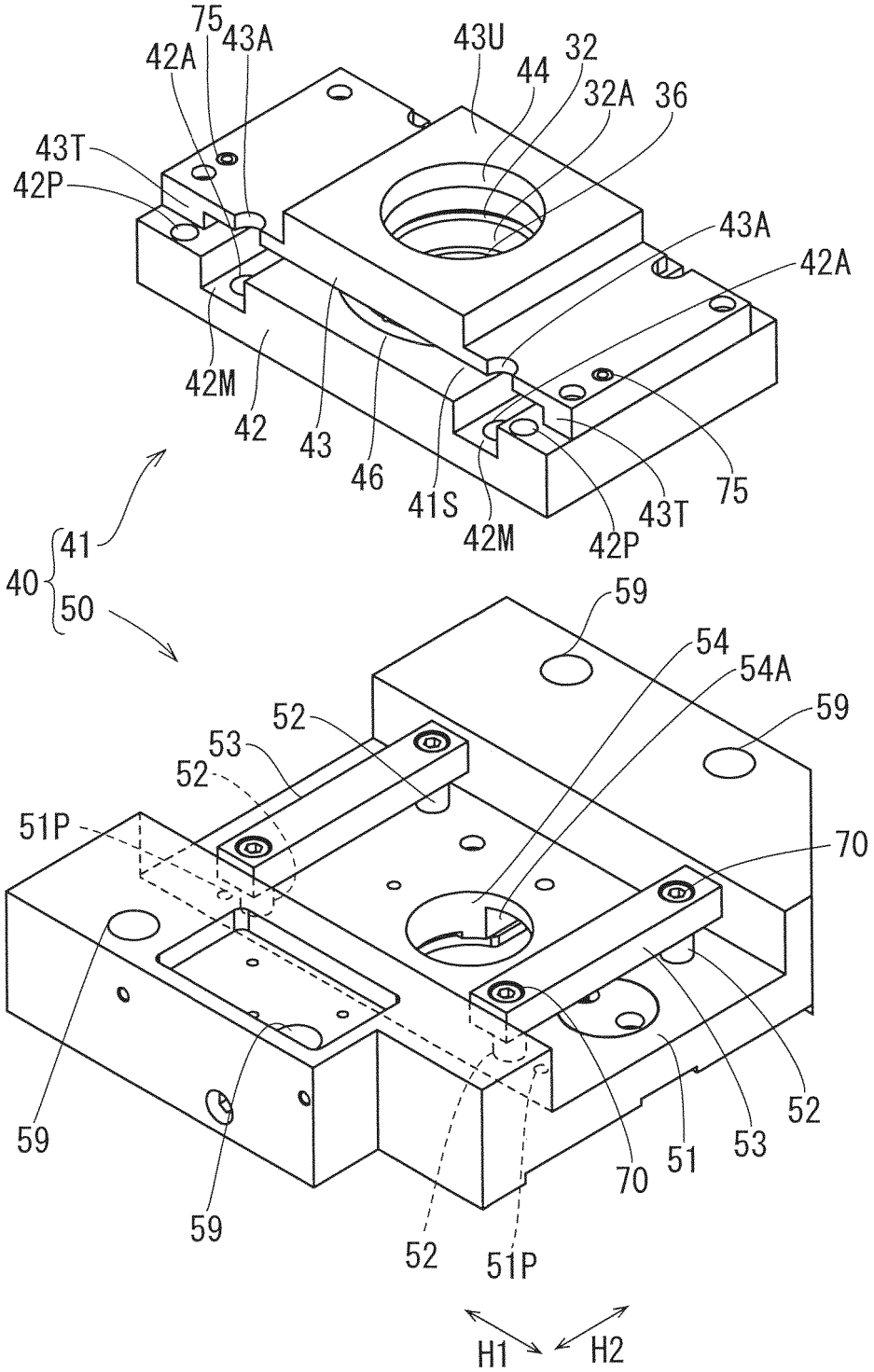
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FIG. 6

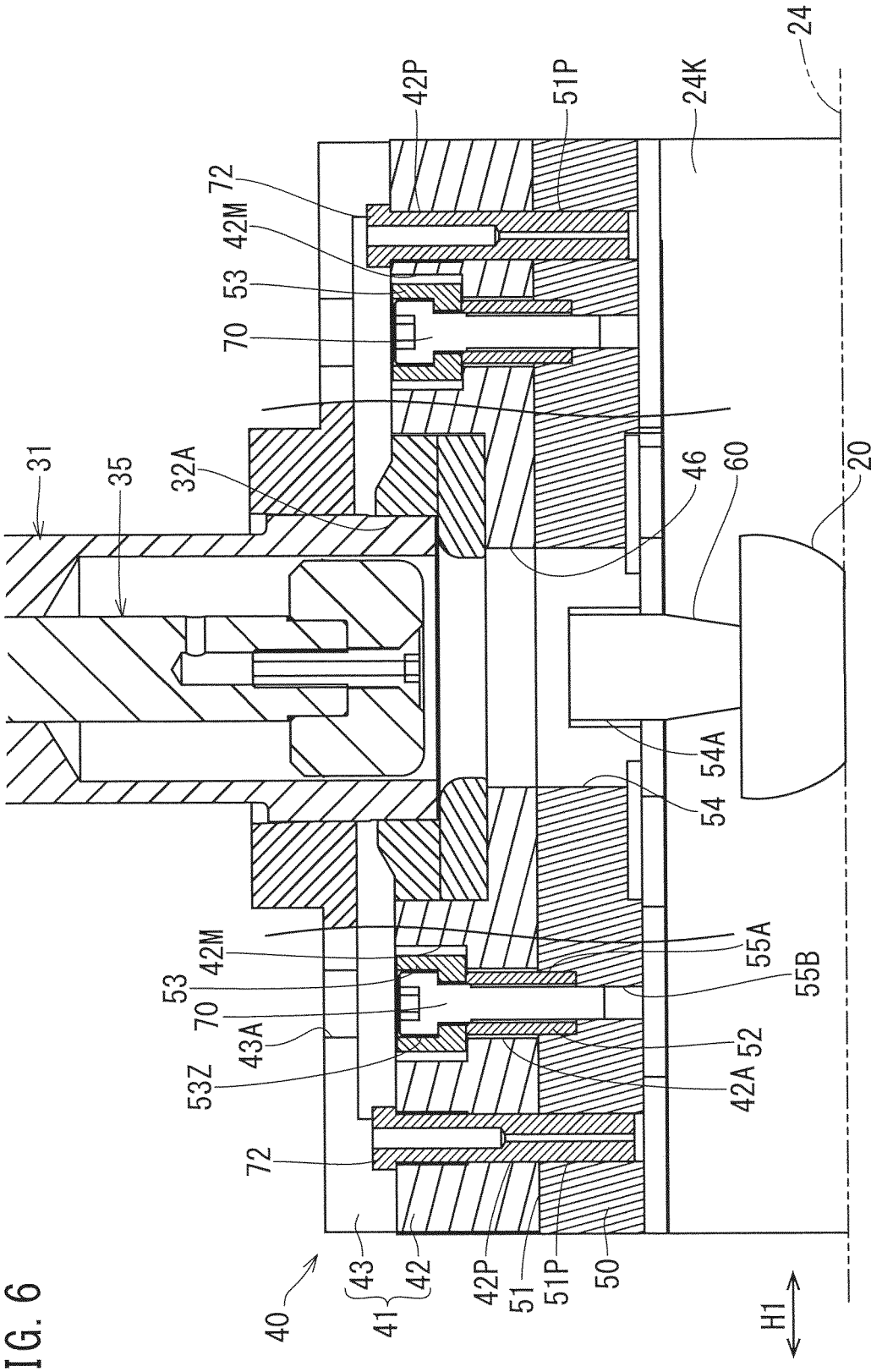
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FIG. 7

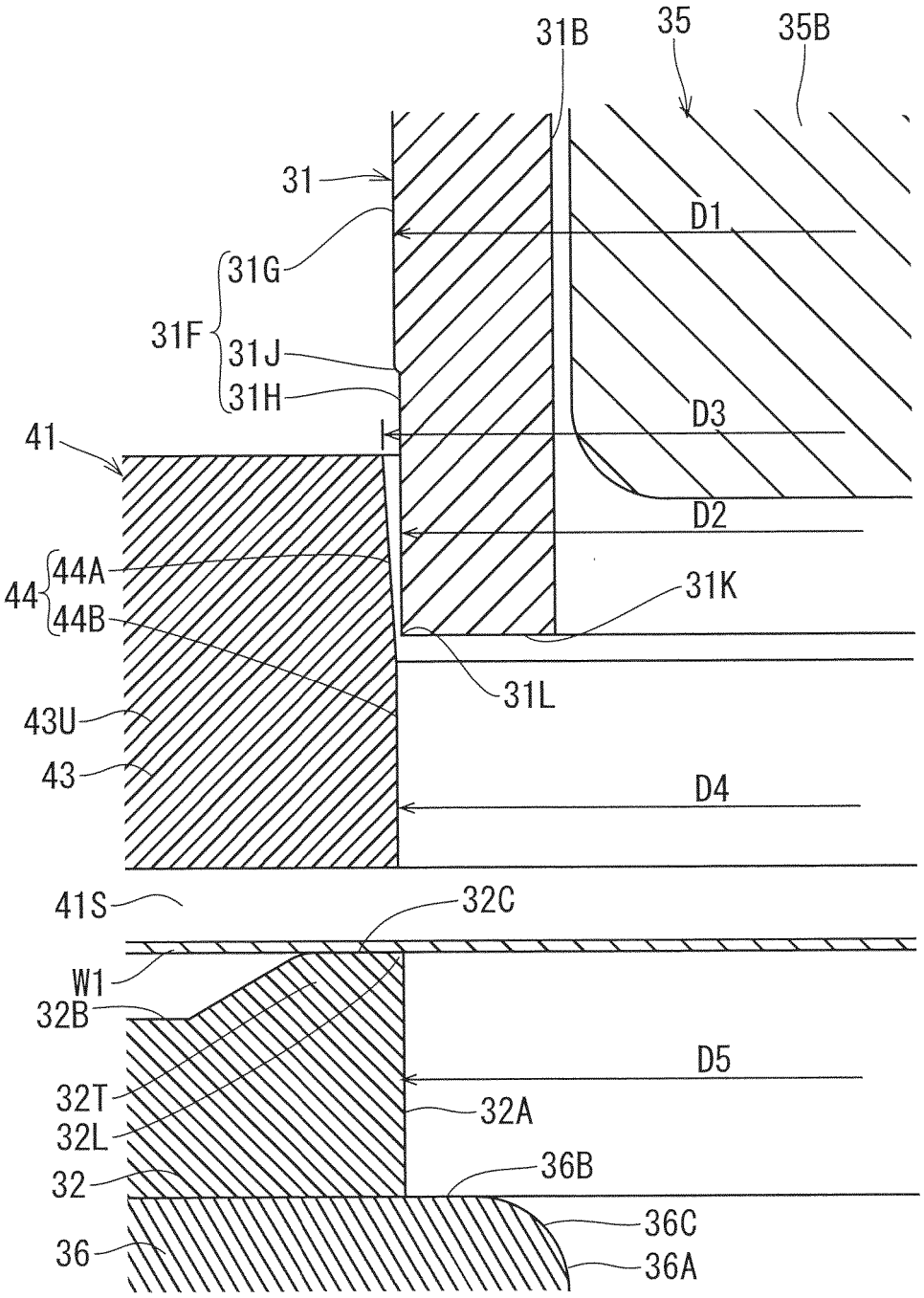
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FIG. 8

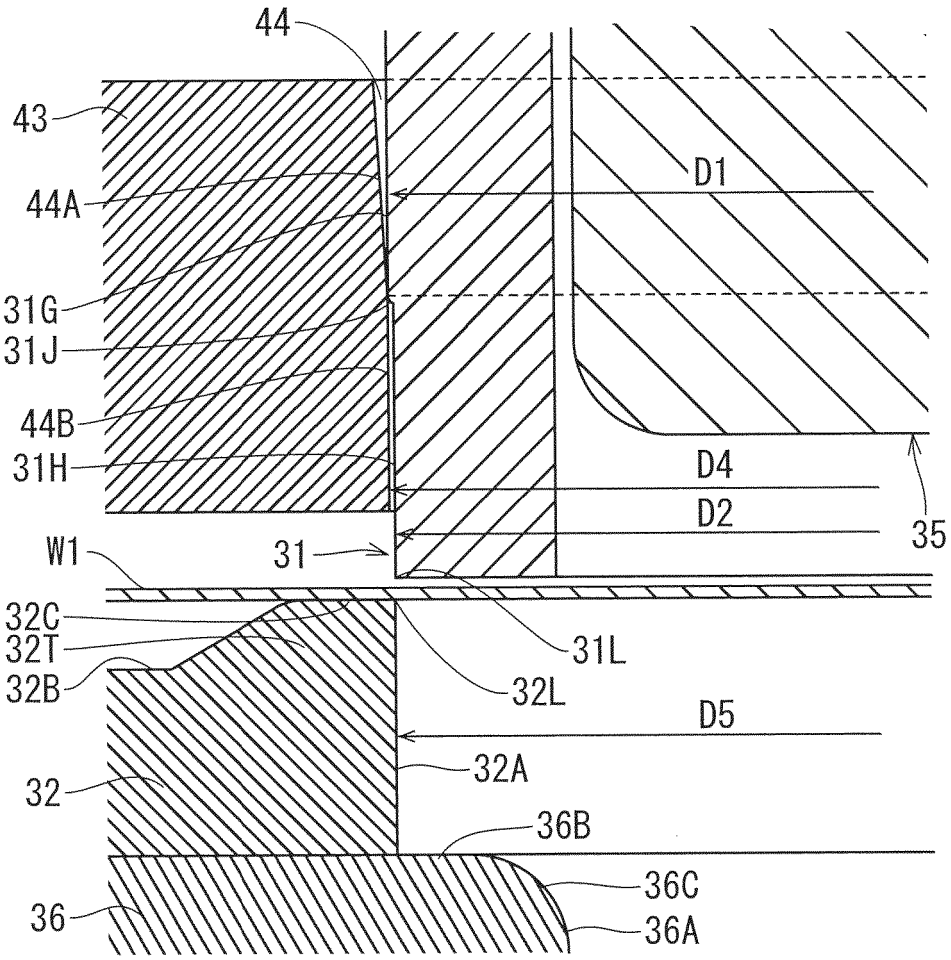
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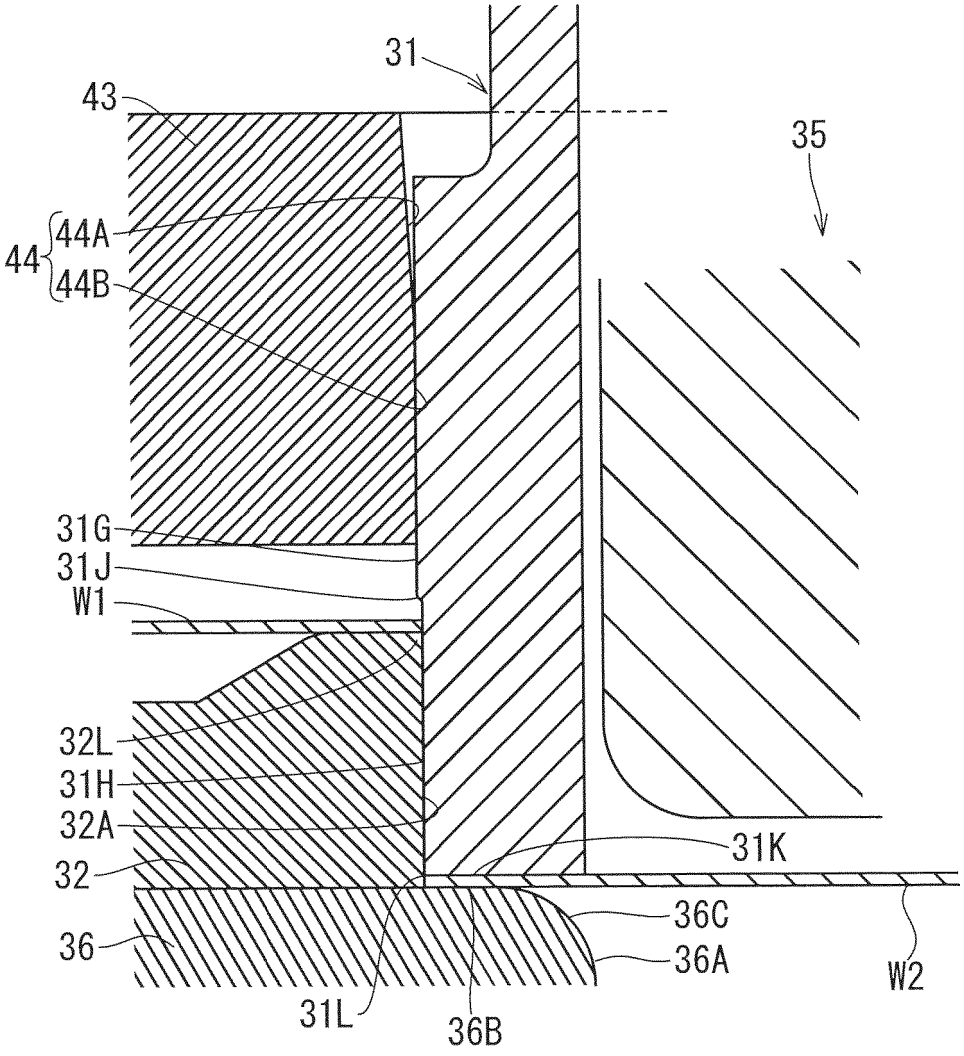
FIG. 9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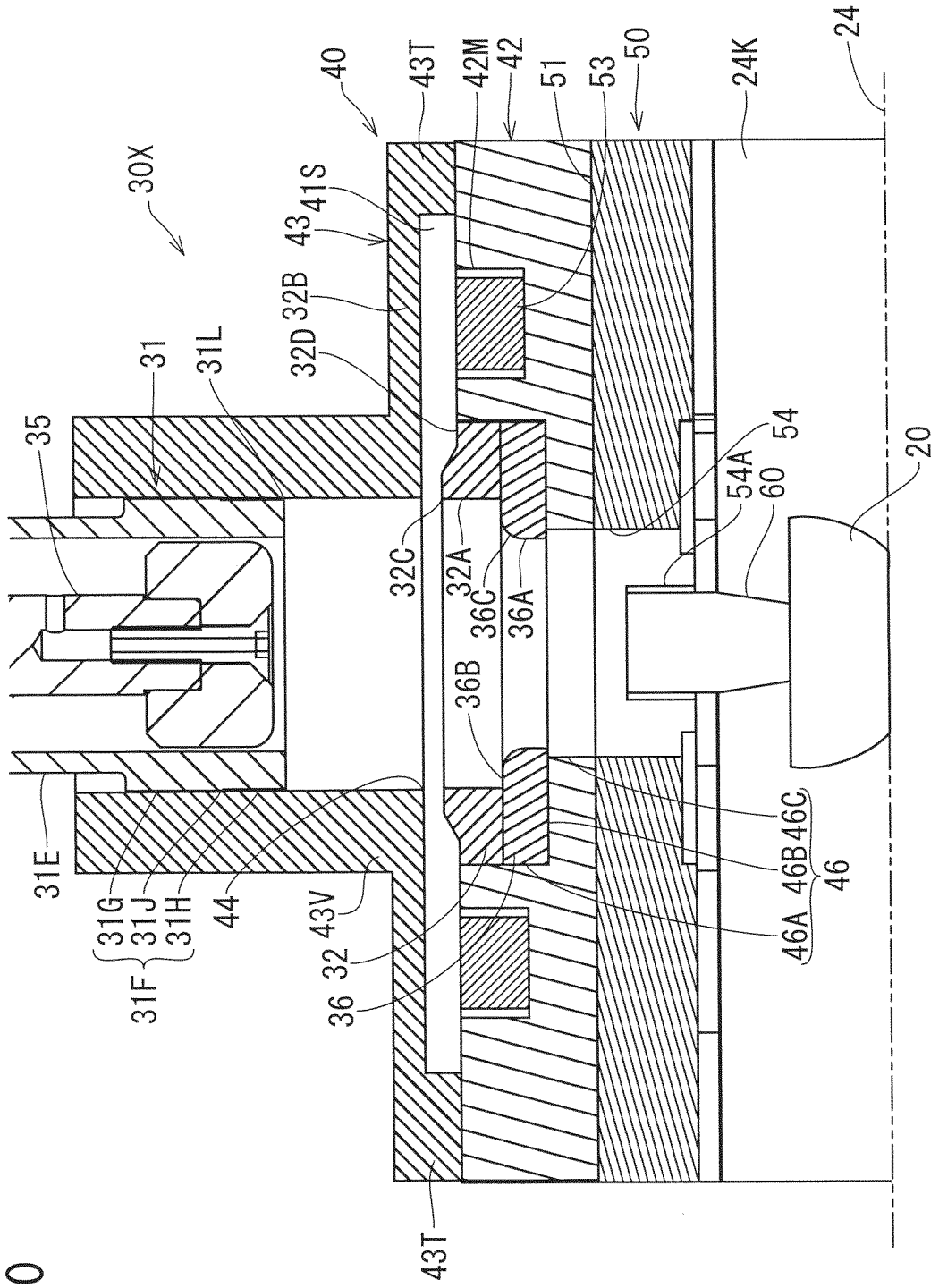
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FIG. 10

# INTERNATIONAL SEARCH REPORT

International application No.
**PCT/JP2021/033174**

## A. CLASSIFICATION OF SUBJECT MATTER

***B21D 22/28***(2006.01)i; ***B21D 28/02***(2006.01)i; ***B21D 43/05***(2006.01)i
FI: B21D28/02 A; B21D43/05 A; B21D22/28 E; B21D22/28 J; B21D22/28 Z

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B21D22/28; B21D28/02; B21D43/05

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2021
Registered utility model specifications of Japan 1996-2021
Published registered utility model applications of Japan 1994-2021

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | JP 57-42572 Y2 (HONDA MOTOR CO LTD) 20 September 1982 (1982-09-20) | 1-6 |
| A | Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 38742/1979 (Laid-open No. 138428/1980) (KOMATSU MFG CO LTD) 02 October 1980 (1980-10-02) | 1-6 |
| A | JP 3-249 Y2 (TOYOTA MOTOR CO LTD) 08 January 1991 (1991-01-08) | 1-6 |
| A | Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 52390/1973 (Laid-open No. 1994/1975) (OGINO, Kiyoshi) 10 January 1975 (1975-01-10) | 1-6 |
| A | Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 143405/1989 (Laid-open No. 81228/1991) (MAZDA MOTOR) 20 August 1991 (1991-08-20) | 1-6 |

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| **22 September 2021** | **12 October 2021** |
| Name and mailing address of the ISA/JP<br>**Japan Patent Office (ISA/JP)**<br>**3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915**<br>**Japan** | Authorized officer<br><br>Telephone No. |

Form PCT/ISA/210 (second sheet) (January 2015)

**INTERNATIONAL SEARCH REPORT**
**Information on patent family members**

International application No.
**PCT/JP2021/033174**

| Patent document cited in search report | Publication date (day/month/year) | Patent family member(s) | Publication date (day/month/year) |
|---|---|---|---|
| JP 57-42572 Y2 | 20 September 1982 | (Family: none) | |
| JP 55-138428 U1 | 02 October 1980 | (Family: none) | |
| JP 3-249 Y2 | 08 January 1991 | (Family: none) | |
| JP 50-1994 U1 | 10 January 1975 | (Family: none) | |
| JP 3-81228 U1 | 20 August 1991 | (Family: none) | |

Form PCT/ISA/210 (patent family annex) (January 2015)

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- JP 2016203212 A **[0003]**