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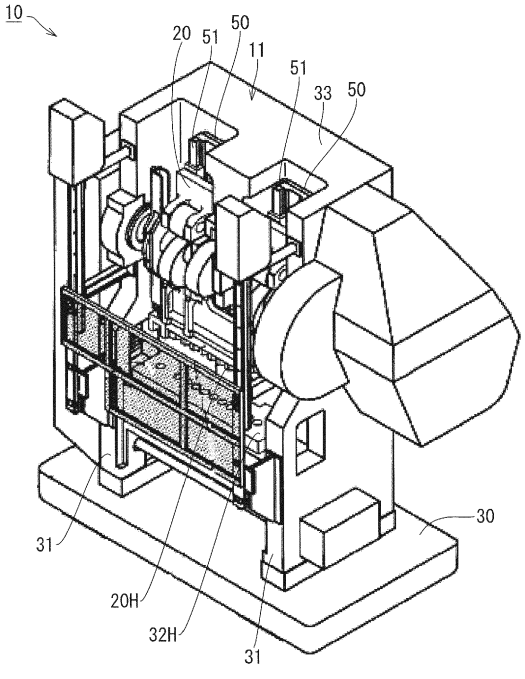
(54) **PRESS MACHINE**

(57) A press machine whose parallelism between the lower surface of a ram and the upper surface of a bolster is improved at lower costs is provided.

In a press machine 10 of the present disclosure, movable bases 50 are mounted on the front surface of a ram supporting wall 34 above a bolster 32 in a supporting frame 11. A pair of rails 51 is provided to the front surface of each movable base 50. Sliders 52 engaging with the rails 51 are fixed to the rear surface of the ram 20. Each movable base 50 is supported so as to be capable of tilting in the lateral direction about a coupling pin 70, and fixed to any desired tilted position by fixing bolts B1.

Fig. 1



EP 3 708 351 A1

Description

BACKGROUND OF THE INVENTION

(1) Field of the Invention

[0001] The present disclosure relates to a press machine in which a ram is supported vertically movably above a bolster of a supporting frame.

(2) Description of Related Art

[0002] In this type of press machine, holders are respectively overlaid and fixed onto the lower surface of the ram and the upper surface of the bolster. The holders hold a punch and a die (for example, see FIG. 1 of Japanese Unexamined Patent Application Publication No. 4-123900).

[0003] In order for the punch to be smoothly inserted into the molding hole of the die, the parallelism between the lower surface of the ram and the upper surface of the bolster must be excellent. Improving the parallelism necessitates high work precision, which unfortunately increases the manufacturing cost of the press machine. Thus, there exists demand for the technique which can provide improved parallelism between the lower surface of the ram and the upper surface of the bolster at lower costs.

SUMMARY OF THE INVENTION

[0004] A press machine (10, 10A) according to one embodiment of the present invention for solving the problem includes: a supporting frame (11) including a bolster (32); a ram (20) vertically movably supported above the bolster (32); a slider (52) to which the ram (20) is fixed; a rail (51) extending in a top-bottom direction to be slidably engaged with the slider (52); a movable base (50) provided with the rail (51) at its front surface and including a rear surface being a flat surface; a front flat surface (35F) provided to the supporting frame (11) on which the rear surface of the movable base (50) is overlaid; a coupling pin (70) whose central axis is perpendicular to the rear surface of the movable base (50) and the front flat surface (35F), the coupling pin (70) coupling the movable base (50) to the supporting frame (11) so as to be capable of tilting about the central axis; and a plurality of fixing bolts (B1) perpendicular to the front flat surface (35F) and fixing the movable base (50) to any desired tilted position.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005]

FIG. 1 is a perspective view of a press machine according to a first embodiment;
FIG. 2 is a perspective view of the press machine without part of its components;
FIG. 3 is a rear view of the press machine;
FIG. 4 is a front view of a supporting frame;
FIG. 5 is a front view of the supporting frame on which movable bases are mounted;
FIG. 6 is a vertical sectional view of the upper part of the press machine;
FIG. 7 is a vertical sectional view of a motion converting unit;
FIG. 8 is a perspective view of a ram; and
FIG. 9 is a rear view of a press machine according to a second embodiment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

First embodiment

[0006] In the following, with reference to FIGS. 1 to 8, a description will be given of a press machine 10 according to a first embodiment. FIG. 1 shows the whole press machine 10 according to the present embodiment. The press machine 10 is a so-called transfer press machine, and holds a plurality of punches (not shown) aligned laterally in line on the lower surface of a ram 20, and dies (not shown) respectively corresponding to the punches aligned laterally in line on the upper surface of a bolster 32. By a transfer apparatus (not shown), workpieces each being cylindrical and having one end bottomed are intermittently transferred from one end to other end in the lateral direction of the press machine 10. The delivered workpieces are pressed by corresponding punches and dies, to be formed into pressed products of a predetermined shape.

[0007] The plurality of punches is held by a punch holder 20H mounted on a lower surface 20K (see FIG. 2) of the ram 20. The plurality of dies is held by a die holder 32H mounted on an upper surface 32J (see FIG. 2) of the bolster 32. Accordingly, in order for the punches to be respectively smoothly inserted into the molding holes of the dies, excellent parallelism must be attained between the lower surface 20K of the ram 20 and the upper surface 32J of the bolster 32. A mechanism for adjusting the parallelism is provided between the ram 20 and the supporting frame 11 as follows.

[0008] Firstly, a description will be given of the structure of the supporting frame 11. As shown in FIG. 2, the supporting frame 11 includes a pair of side supporting walls 31, which side supporting walls 31 rise from a mount 30 and oppose to each other in the lateral direction. The bolster 32 has a quadrangular cross-sectional shape and extends in the lateral direction, across the pair of side supporting walls 31 at a lower position. The upper surface 32J of the bolster 32 is leveled and includes a plurality of screw holes (not shown).

[0009] Note that, at the center in the front-rear direction of the bolster 32, a slit 32S for allowing knockout pins (not shown) to vertically penetrate through is formed.

[0010] A ram supporting wall 34 is provided so as to divide the space between the pair of side supporting walls 31 into front and rear halves, extending upward from the substantial center in the top-bottom direction of the pair of side supporting walls 31. The upper edge of the ram supporting wall 34 and the upper edges of the pair of side supporting walls 31 on the rear side than the ram supporting wall 34 are connected to each other by a ceiling wall 33. A central projecting wall 33F projects frontward from the center in the lateral direction of the front surface upper part of the ram supporting wall 34.

[0011] As shown in FIG. 4, a pair of base supporting parts 35 is provided on both sides of the central projecting wall 33F in the front surface of the ram supporting wall 34. Each base supporting part 35 is formed of a band-like region extending from the bottom edge to the vicinity of the upper edge in the front surface of the ram supporting wall 34, which band-like region projects frontward. A front surface 35F (corresponding to "a front flat surface" in the scope of claims) of each base supporting part 35 is a vertical plane perpendicular to the upper surface 32J of the bolster 32. In the ram supporting wall 34, at the position right behind the pair of base supporting parts 35, a pair of rear projecting parts 36 shown in FIG. 3 is provided. Each rear projecting part 36 is formed of a band-like region extending from the bottom edge to the vicinity of the upper edge in the rear surface of the ram supporting wall 34, which band-like region projects rearward. A rear surface 36R of each rear projecting part 36 is a vertical plane parallel to the front surface 35F of the base supporting part 35. As shown in FIG. 6, a pair of pin holes 38, 39 and a plurality of bolt insert holes 37 penetrate through the front surface 35F of the base supporting part 35 and the rear surface 36R of the rear projecting part 36. As shown in FIG. 4, one pin hole 38 is disposed at the center in the lateral direction and in the vicinity of the upper edge of the base supporting part 35, and the other pin hole 39 is disposed at the center in the lateral direction and in the vicinity of the bottom edge of the base supporting part 35. The plurality of bolt insert holes 37 are vertically arranged in two rows on both sides of the pair of pin holes 38, 39.

[0012] As shown in FIG. 6, a coupling pin 70 fits into the upper pin hole 38. The coupling pin 70 includes, in sequence from the front edge to the rear edge, a first shaft part 71, a second shaft part 72, and a flange part 73. The first shaft part 71 is smaller in diameter than the second shaft part 72. In the state where the whole second shaft part 72 fits into the pin hole 38, the flange part 73 is overlaid on the rear surface 36R of the rear projecting part 36 and fixed with bolts. In this state, the first shaft part 71 projects frontward from the front surface 35F of the base supporting part 35. A screw hole 73N is formed at the rear surface center of the coupling pin 70. By the user inserting a bolt into the screw hole 73N and pulling the bolt, the coupling pin 70 can be easily removed from the pin hole 38.

[0013] Note that, in the second shaft part 72, the front side of the midway position in the axial direction constitutes a great diameter part 72A whose outer diameter is slightly greater than the rear side, whereas the rear side of the midway position in the axial direction constitutes a small diameter part 72B. In contrast, in the pin hole 38, the front side constitutes a small diameter part 38A, and the rear side constitutes a great diameter part 38B. The great diameter part 72A of the second shaft part 72 fits into the small diameter part 38A of the pin hole 38, with high precision. The great diameter part 38B of the pin hole 38 and the small diameter part 72B of the second shaft part 72 fit with each other with a clearance (what is called loose fit). This facilitates fitting work of the coupling pin 70 into the pin hole 38.

[0014] An eccentric pin 60 is fitted into the lower pin hole 39. As shown in FIG. 7, the eccentric pin 60 includes, in sequence from the front edge to the rear edge, a first shaft part 61, a second shaft part 62, a flange part 63, and a rotary operation part 64. Similarly, to the second shaft part 72 of the coupling pin 70, the second shaft part 62 includes a great diameter part 62A and a small diameter part 62B, and the pin hole 39 includes a small diameter part 39A and a great diameter part 39B. In the state where the whole second shaft part 62 fits into the pin hole 39, the flange part 63 is overlaid on the rear surface 36R of the rear projecting part 36 and fixed with bolts. In this state, the first shaft part 61 projects frontward from the front surface 35F of the base supporting part 35. In the flange part 63, each portion through which a bolt B2 penetrates is a long hole 63A which is curved arc-like about the central axis of the eccentric pin 60.

[0015] The rotary operation part 64 is provided with a pair of engaging surfaces 64A at the circumferential surface of its cylindrical body projecting rearward from the center of the eccentric pin 60. The pair of engaging surfaces 64A is flat parallel surfaces obtained by cutting two portions spaced apart from each other by 180 degrees in the circumferential surface rear end of the rotary operation part 64. This allows the user to engage a tool such as a wrench with the pair of engaging surfaces 64A thereby rotating the eccentric pin 60.

[0016] The first shaft part 61 is cylindrical and smaller in diameter than the second shaft part 62. The first shaft part 61 is eccentric downward relative to the second shaft part 62. That is, a central axis J2 of the first shaft part 61 is off-centered downward relative to a central axis J1 of the second shaft part 62. Thus, when the eccentric pin 60 is rotated, the first shaft part 61 laterally shifts.

[0017] In the front surface of the first shaft part 61, a hexagonal tool hole 61A (corresponding to "a rotary operation part" in the claims) is bored on the axis of the central axis J1 of the second shaft part 62. By the user engaging a tool such as a hexagonal wrench with the tool hole 61A, the eccentric pin 60 can be rotated also from the front side.

[0018] On the front surface 35F of each base supporting part 35, a movable base 50 shown in FIG. 5 is mounted. The movable base 50 is band-like elongated in the

top-bottom direction. As shown in FIG. 6, a rear surface 50R of the movable base 50 is processed to be flat. At the center in the lateral direction of the movable base 50, on the upper end side, a pin hole 53 into which the first shaft part 71 of the coupling pin 70 fits is formed. On the lower end side, an engagement hole 54 accommodating the first shaft part 61 of the eccentric pin 60 is formed. In the movable base 50, on both sides of the pin hole 53 and the engagement hole 54, a plurality of screw holes 55 are vertically arranged in two rows. Fixing bolts B1 inserted from the rear side into the plurality of bolt insert holes 37 of the supporting frame 11 are screwed into the plurality of screw holes 55, whereby the movable base 50 is fixed to the supporting frame 11.

[0019] Here, relative to the size of each fixing bolt B1 screwed into the screw hole 55, the inner diameter of the bolt insert hole 37 is greater than the inner diameter of a hole specified by JIS and others. Thus, by loosening the plurality of fixing bolts B1, the movable base 50 tilts in any desired direction about the first shaft part 71 within the range of the clearance between each fixing bolt B1 and the inner surface of the bolt insert hole 37. By tightening the fixing bolt B1, the movable base 50 is fixed to any desired tilted position.

[0020] The first shaft part 61 engages with the engagement hole 54 via a relay block 59. Specifically, as shown in FIG. 6, the engagement hole 54 is formed by recessing the rear surface 50R of the movable base 50, and slightly longer in vertical direction than horizontal direction as shown in FIG. 5. As shown in FIG. 7, on the deeper part of the engagement hole 54, a visual inspection hole 54A smaller than the engagement hole 54 is formed to penetrate through.

[0021] Correspondingly, as shown in FIG. 5, the relay block 59 has a rectangle prism-shape which is substantially identical to the engagement hole 54 in horizontal width and shorter than the engagement hole 54 in vertical width, and slidably housed in the engagement hole 54. As shown in FIG. 6, the first shaft part 61 fits into a fitting hole 59A penetrating through the relay block 59 in the front-rear direction. Thus, the movable base 50 tilts according to the rotation of the eccentric pin 60. That is, in the present embodiment, the eccentric pin 60, the relay block 59, and the engagement hole 54 constitute a motion converting unit 100 which converts the rotation of the eccentric pin 60 into tilting of the movable base 50. The tool hole 61A of the first shaft part 61 is positioned on the front side via the visual inspection hole 54A. This allows the user to engage any tool with the tool hole 61A, to rotate the eccentric pin 60 from the front side.

[0022] As shown in FIG. 5, on the front surface of the movable base 50, a pair of rails 51 extending in parallel in the top-bottom direction is provided. A pair of sliders 52 slidably engages with each rail 51. A plurality of screw holes 52N are formed at each slider 52.

[0023] As shown in FIG. 8, the ram 20 includes a rear surface 20R and the lower surface 20K which are processed to be flat and perpendicular to each other. The eight pieces of the sliders 52 in total are overlaid on the rear surface 20R of the ram 20, and fixed by a plurality of bolts (not shown) penetrating through the ram 20 in the front-rear direction. As shown in FIG. 6, on the rear surface 20R of the ram 20, step reference surfaces 20D to be overlaid in the top-bottom direction on step surfaces 52D of the sliders 52 are formed. The step reference surfaces 20D and the lower surface 20K of the ram 20 are parallel to each other.

[0024] The foregoing is the description of the mechanism for adjusting the parallelism between the lower surface 20K of the ram 20 and the upper surface 32J (see FIG. 2) of the bolster 32 in the press machine 10. Next, a description will be given of the method of assembling the press machine 10 in conjunction with the method of adjusting the parallelism.

[0025] The sliders 52 are previously mounted on the rails 51 of each movable base 50. A pair of movable bases 50 is mounted on the supporting frame 11 before the sliders 52 are fixed to the ram 20, as shown in FIG. 5. Specifically, the relay block 59 is fitted to the engagement hole 54 of each movable base 50, and the rear surfaces 50R of the pair of movable bases 50 are overlaid on the front surfaces 35F of the base supporting parts 35 in the supporting frame 11. A plurality of fixing bolts B1 are inserted into the bolt insert holes 37 and lightly screwed into the screw holes 55 from behind the supporting frame 11, so as to establish a so-called temporary fastened state. In the temporary fastened state, the coupling pin 70 and the eccentric pin 60 are hammered into the pin holes 38, 39 of the supporting frame 11. Thus, the first shaft part 71 of the coupling pin 70 fits into the pin hole 53 of the movable base 50, and the first shaft part 61 of the eccentric pin 60 fits into the fitting hole 59A of the relay block 59.

[0026] Next, the tilt angle of the movable base 50 is adjusted so that the squareness between each rail 51 of the movable base 50 and the upper surface 32J of the bolster 32 falls within a predetermined allowable value range. Here, the user may engage any tool from the front side of the supporting frame 11 with the tool hole 61A of the eccentric pin 60 to rotate the eccentric pin 60. Alternatively, the user may rotate the rotary operation part 64 of the first shaft part 61 using a tool, from the rear side of the supporting frame 11.

[0027] When adjusting the squareness has completed, the plurality of fixing bolts B1 are further fastened tightly from behind the ram supporting wall 34, to attain a complete tightened state. Then, the ram 20 is overlaid on the slider 52, and the sliders 52 are fixed to the ram 20 with the bolts, in the state where the step surfaces 52D of the sliders 52 abut on the step reference surfaces 20D at the rear surface 20R of the ram 20. Then, whether or not the parallelism between the lower surface 20K of the ram 20 and the upper surface 32J of the bolster 32 falls within a predetermined allowable value range is determined.

[0028] Here, when variations in finish quality among the components of the press machine 10 are small, the

parallelism stably falls within the predetermined allowable value range by the above-described adjustment of squareness. However, when variations in finish quality among the components of the press machine 10 are great, the parallelism may fail to be within the predetermined allowable value range. When the parallelism falls within the predetermined allowable value range, all of the remaining components of the press machine 10 are mounted. When the parallelism fails to be within the predetermined allowable value range, the following adjustment is performed.

[0029] That is, the coupling pin 70 and the eccentric pin 60 are pulled off from one of the movable bases 50, and all the fixing bolts B1 of both of the movable bases 50 are loosened, so that the temporary fastened state is entered. Then, the eccentric pin 60 of the other movable base 50 is rotated and adjusted so that the parallelism between the lower surface 20K of the ram 20 and the upper surface 32J of the bolster 32 attains the design value. When the parallelism falls within the predetermined allowable value range, the plurality of fixing bolts B1 are tightly fastened again from behind the ram supporting wall 34, and all the remaining components of the press machine 10 are mounted.

[0030] Further, the parallelism may become poor after the assembly of the press machine 10 has completed and as shown in FIG. 1, and the press machine 10 has been used. In this case, the parallelism can be adjusted to improve in accordance with the above-described procedure. In this case, the fixing bolt B1 and the eccentric pin 60 should be operated on the rear surface side of the press machine 10.

[0031] In this manner, in the press machine 10 according to the present embodiment, the angle formed between the lower surface 20K of the ram 20 and the upper surface 32J of the bolster 32 is adjusted by loosening the plurality of fixing bolts B1 to tilt the movable base 50 so that the parallelism improves. Thus, when the parallelism is not precise due to variations in finish quality of the components of the press machine 10, the parallelism can be improved by adjustment on site (so-called on-site adjustment). That is, the press machine 10 according to the present embodiment tolerates variations in finish quality of the components thereby achieving reduced manufacturing cost in improving parallelism.

[0032] Without the necessity of removing various components on the front surface of the ram 20, the parallelism can be adjusted by the user loosening the fixing bolts B1 and operating the rotary operation part 64 of the eccentric pin 60 on the rear surface side of the press machine 10. Since the rotary operation part 64 and the tool hole 61A are provided on the front and rear sides of the eccentric pin 60, the rotary operation part 64 can be operated from the front side as necessary, during the assembly of the press machine 10 to adjust the tilt angle of the movable base 50.

[0033] Furthermore, since a pair of movable bases 50 supporting the ram 20 is coupled to the supporting frame 11 by the coupling pins 70 so as to be capable of tilting, the squareness between the rail 51 of each movable base 50 and the upper surface of the bolster 32 can be adjusted by the tilting of the movable base 50 during the assembly of the press machine 10.

Second embodiment

[0034] As shown in FIG. 9, a press machine 10A according to the present embodiment is different from the first embodiment just in that the shape of the bolt insert holes 37 is arc-shaped about the coupling pin 70. According to the present embodiment, a greater tilting range of the movable base 50 by rotation of the eccentric pin 60 is attained, that is, the flexibility in adjusting improves.

Other embodiment

[0035]

(1) In place of the eccentric pin 60 of the press machine 10 according to the first embodiment, for example, the following structure may be employed: an operational window penetrating through the ram supporting wall 34 in the front-rear direction may be provided; an adjusting projection part projecting rearward from the movable base 50 may project rearward from the operational window; the movable base 50 may be tilted by hitting or pressing the adjusting projection part in the lateral direction.
Alternatively: a support projecting part may be projected from the rear surface of the ram supporting wall 34; an adjusting bolt may be inserted through a screw hole penetrating through the support projecting part in the lateral direction, to push the adjusting projection part; and the adjusting projection part may be pushed by the screwing of the adjusting bolt.
(2) In the press machine 10 according to the first embodiment, while the coupling pin 70 and the eccentric pin 60 are coupled to each of the paired movable bases 50, the coupling pin 70 and the eccentric pin 60 may be coupled to just one movable base 50.
(3) While the press machine 10, 10A according to the embodiments is a so-called transfer press machine, the present disclosure is applicable to a press machine just punching out a workpiece from a metal sheet or a press machine pressing a workpiece just once, which machines include the tilting mechanism of the movable base 50.
(4) In the embodiments, while one ram 20 is supported by the supporting frame 11, a plurality of rams may be supported by the supporting frame, and at least one of the plurality of movable bases supporting the plurality of rams may be coupled by the coupling pin so as to be capable of tilting and fixed by the plurality of fixing bolts as in the embodiments.

[0036] It is explicitly stated that all features disclosed

in the description and/or the claims are intended to be disclosed separately and independently from each other for the purpose of original disclosure as well as for the purpose of restricting the claimed invention independent of the composition of the features in the embodiments and/or the claims. It is explicitly stated that all value ranges or indications of groups of entities disclose every possible intermediate value or intermediate entity for the purpose of original disclosure as well as for the purpose of restricting the claimed invention, in particular as limits of value ranges.

Claims

1. A press machine (10, 10A) comprising:

a supporting frame (11) including a bolster (32);
a ram (20) vertically movably supported above the bolster (32);
a slider (52) to which the ram (20) is fixed;
a rail (51) extending in a top-bottom direction to be slidably engaged with the slider (52);
a movable base (50) provided with the rail (51) at its front surface and including a rear surface being a flat surface;
a front flat surface (35F) provided to the supporting frame (11) on which the rear surface of the movable base (50) is overlaid;
a coupling pin (70) whose central axis is perpendicular to the rear surface of the movable base (50) and the front flat surface (35F), the coupling pin (70) coupling the movable base (50) to the supporting frame (11) so as to be capable of tilting about the central axis; and
a plurality of fixing bolts (B1) perpendicular to the front flat surface (35F) and fixing the movable base (50) to any desired tilted position.

2. The press machine (10, 10A) according to claim 1, further comprising:

a rotary operation part (64); and
a motion converting unit (100) converting a rotation operation on the rotary operation part (64) into tilting of the movable base (50), wherein
a head part of the fixing bolt (B1) and the rotary operation part (64) are disposed on a rear surface of the supporting frame (11).

3. The press machine (10, 10A) according to claim 2, further comprising:

a pin hole (39) penetrating through the supporting frame (11) in a front-rear direction;
an eccentric pin (60) including a first shaft part (61) and a second shaft part (62), the second shaft part (62) being rotatably supported by the pin hole (39), the first shaft part (61) eccentrically projecting frontward from the second shaft part (62); and
a relay block (59) supported slidably relative to the movable base (50) in a tilting radius direction of the movable base (50), and including a fitting hole (59A) into which the first shaft part (61) rotatably fits, wherein
the rotary operation part (64) is provided on a rear end of the eccentric pin (60), and
the motion converting unit (100) includes the eccentric pin (60), the relay block (59), and a support part (54) of the relay block (59) in the movable base (50).

4. The press machine (10, 10A) according to claim 3, wherein the rotary operation part (64) is provided to each of the rear end and a front end of the eccentric pin (60).

5. The press machine (10, 10A) according to any one of claims 1 to 4, wherein
a plurality of the movable bases (50) are provided to the common ram (20), and
all of the plurality of movable bases (50) are coupled to the supporting frame (11) by the coupling pin (70) so as to be capable of tilting, and fixed by the plurality of fixing bolts (B1).

6. The press machine (10, 10A) according to any one of claims 1 to 5, wherein
a plurality of the rams (20) are provided to the common supporting frame (11), and
at least one of the plurality of the movable bases (50) supporting the plurality of rams (20) is coupled to the supporting frame (11) by the coupling pin (70) so as to be capable of tilting, and fixed by the plurality of fixing bolts (B1).

Fig. 1

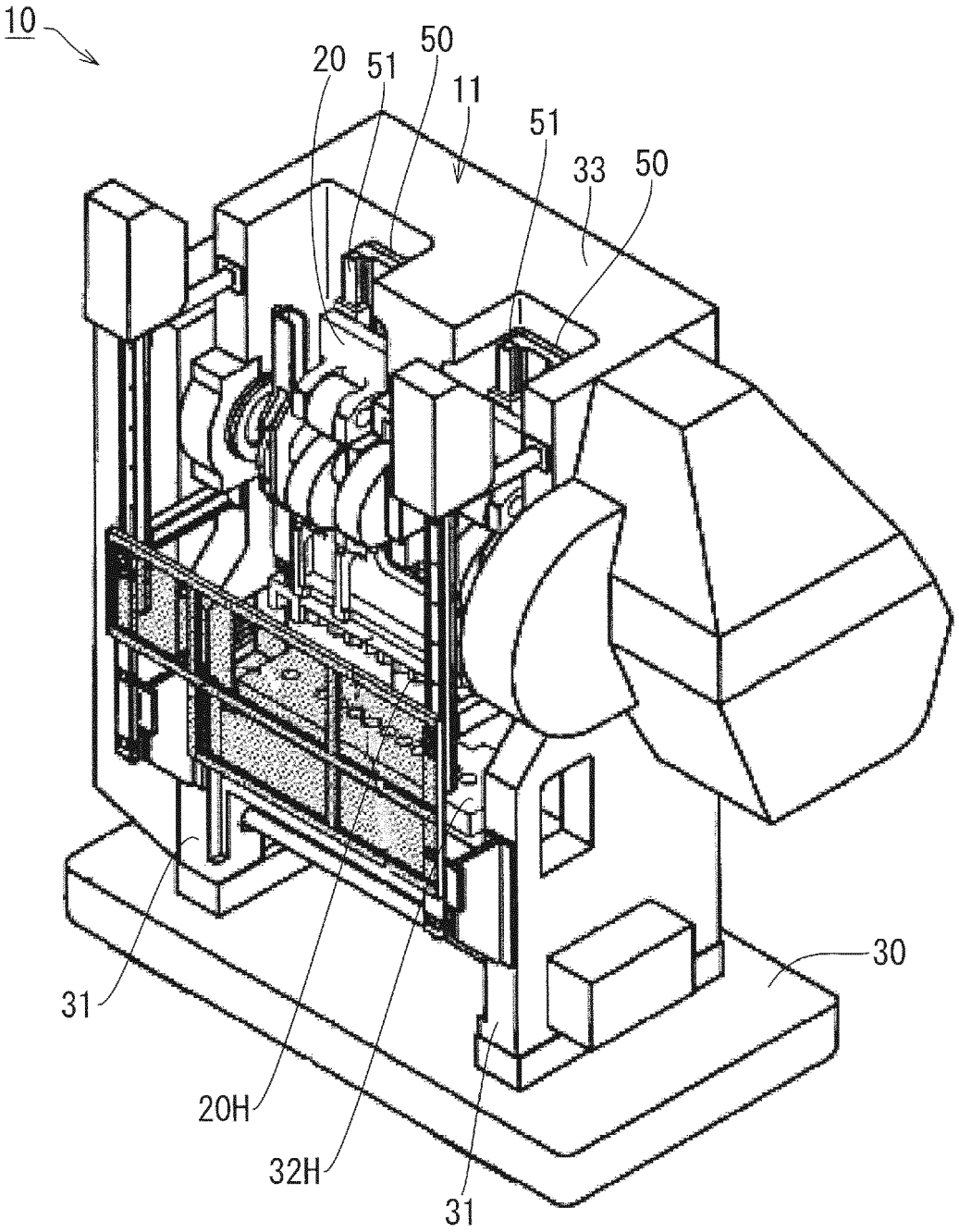


Fig. 2

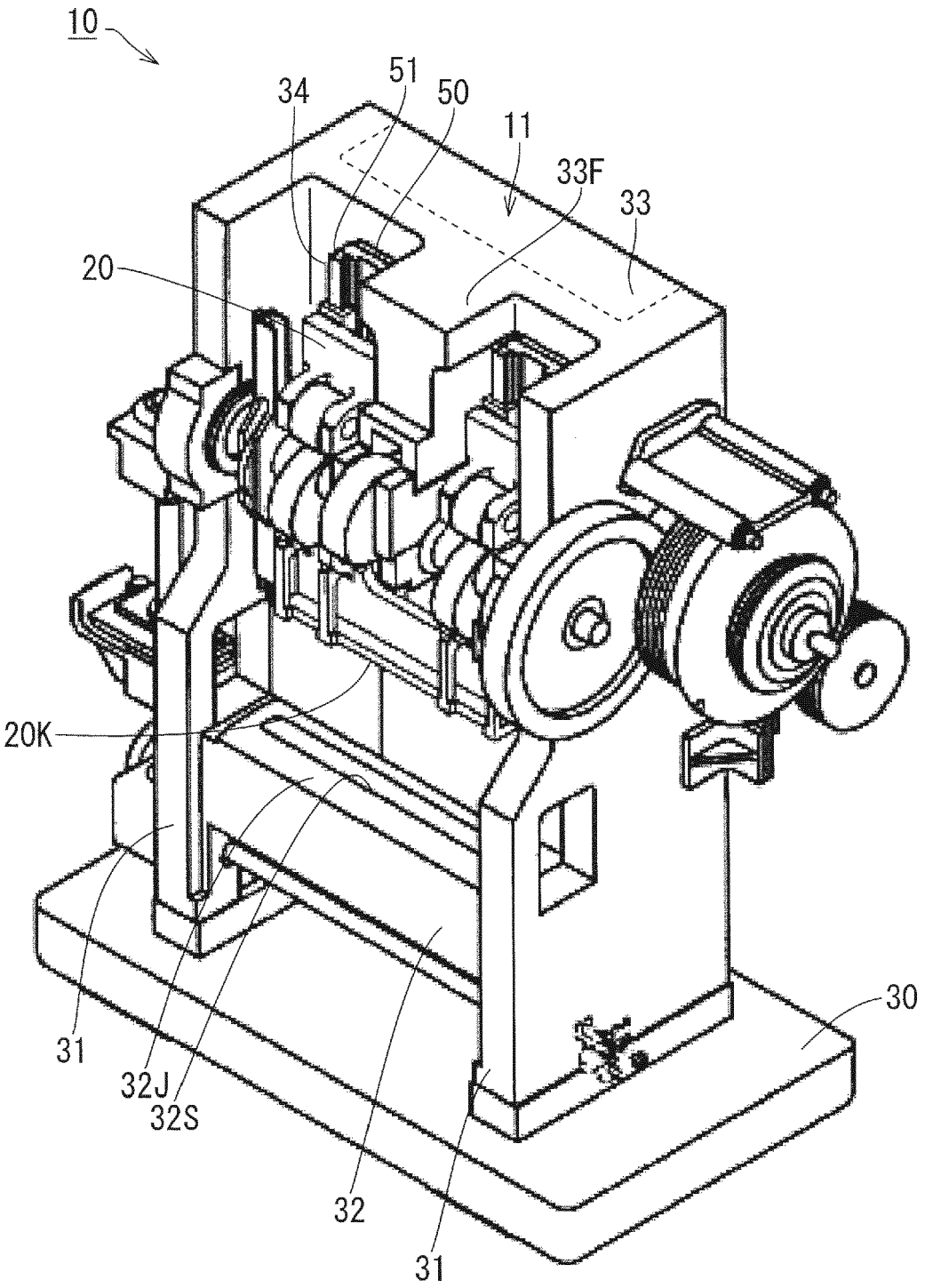


Fig. 3

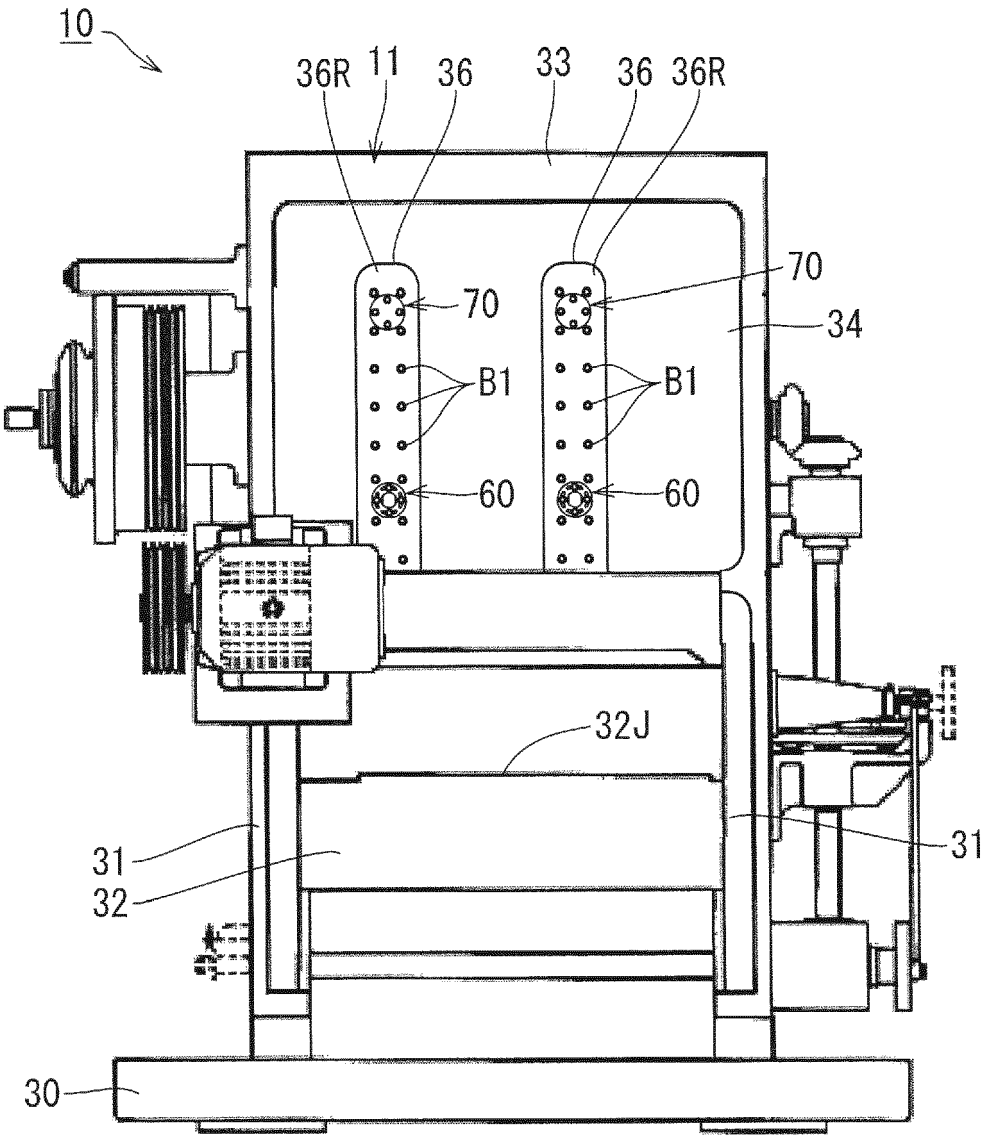


Fig. 4

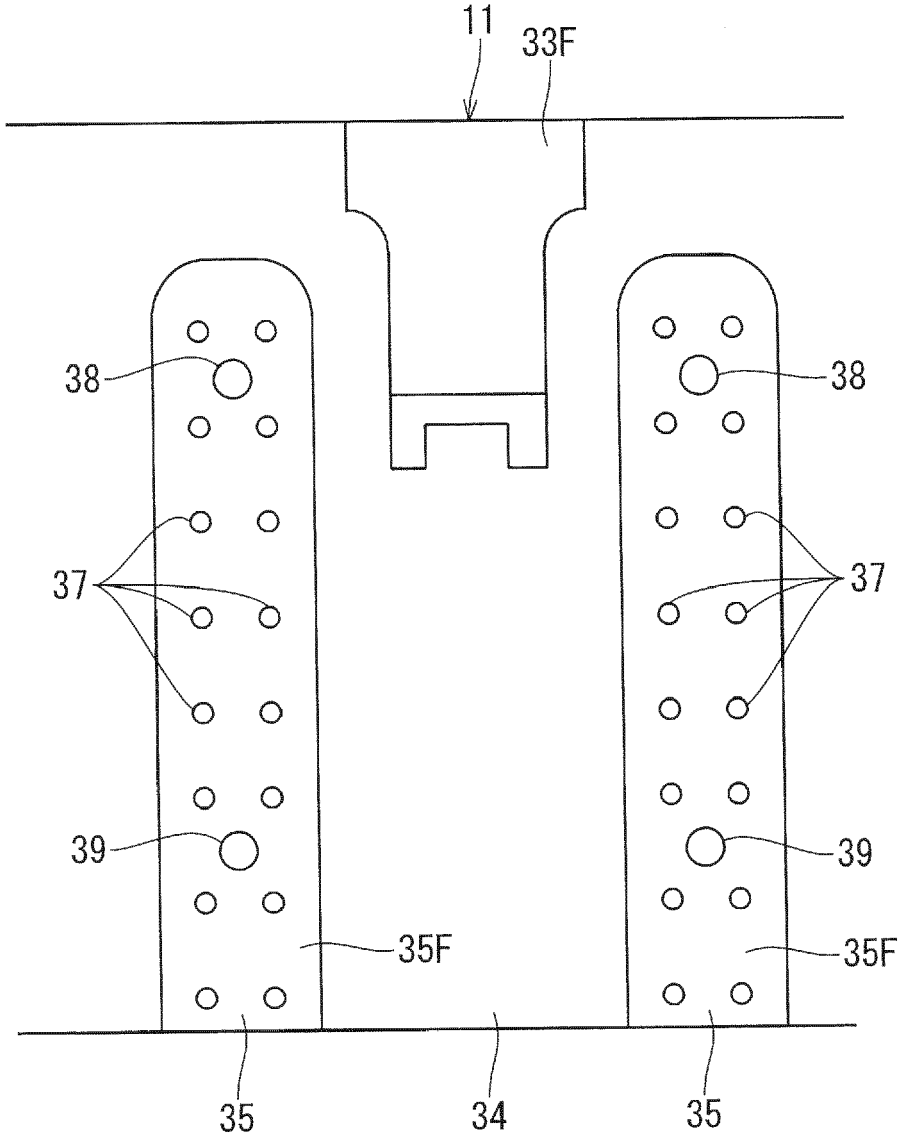


Fig. 5

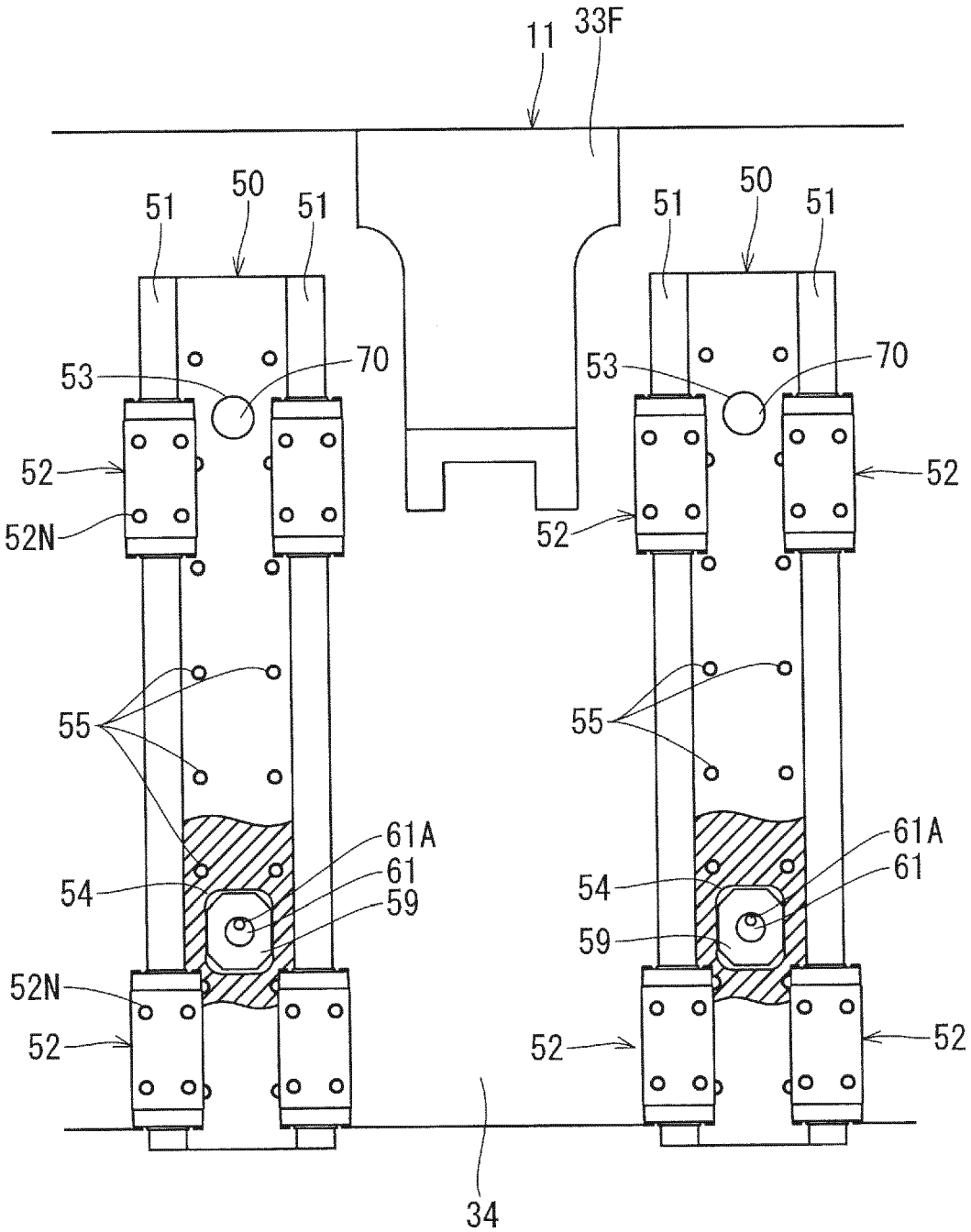

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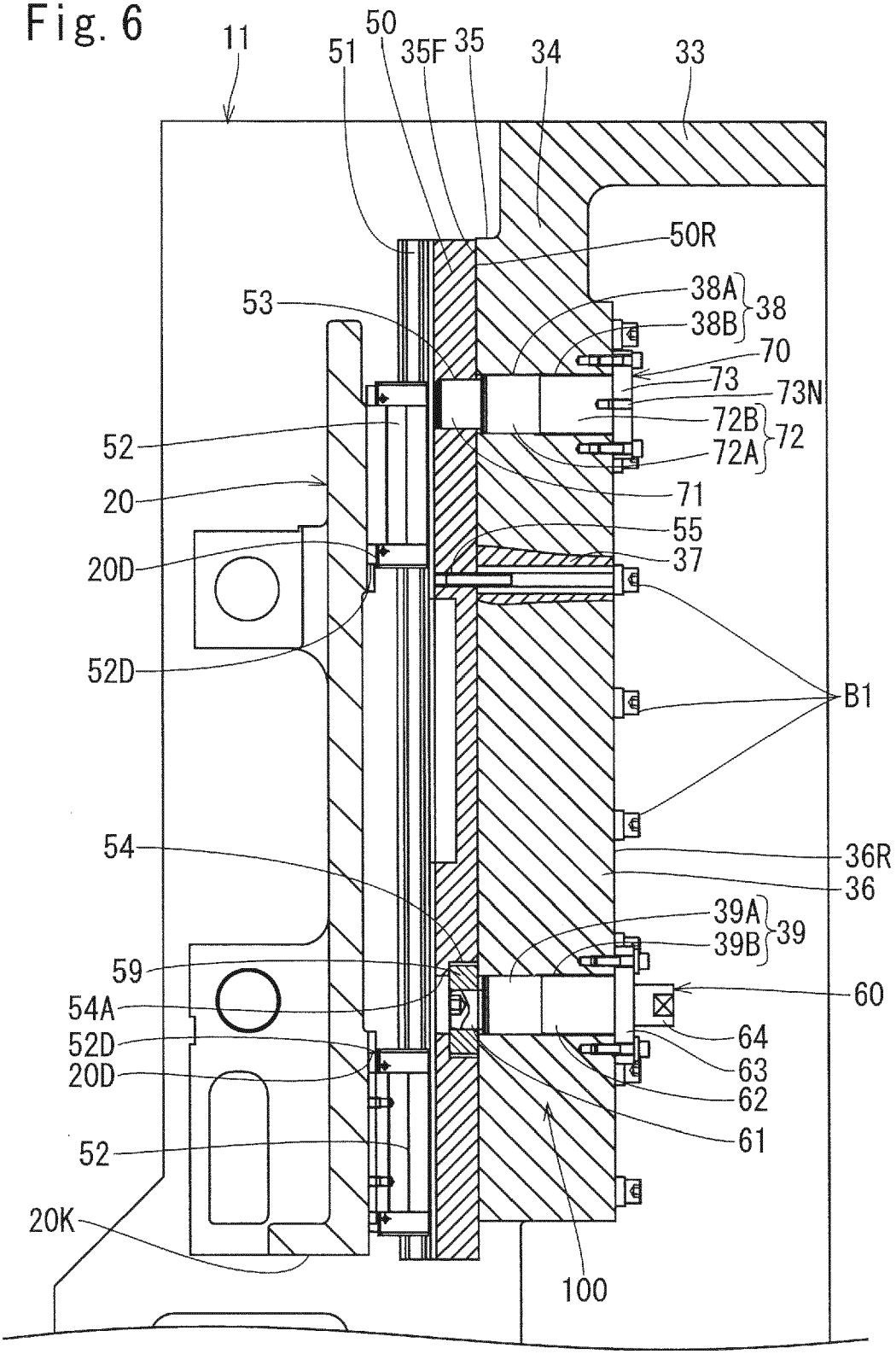
Fig. 6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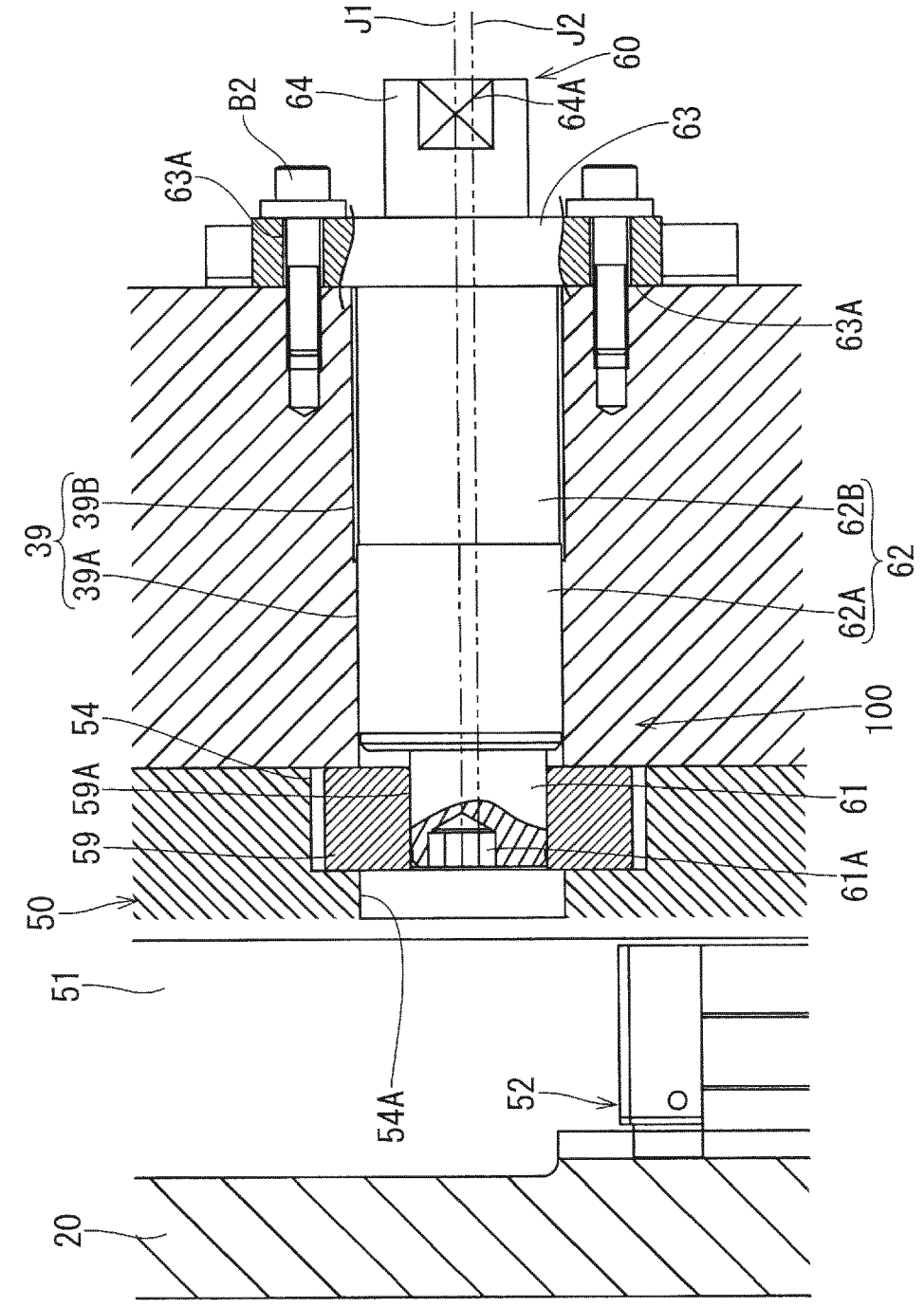
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Fig. 7

Fig. 8

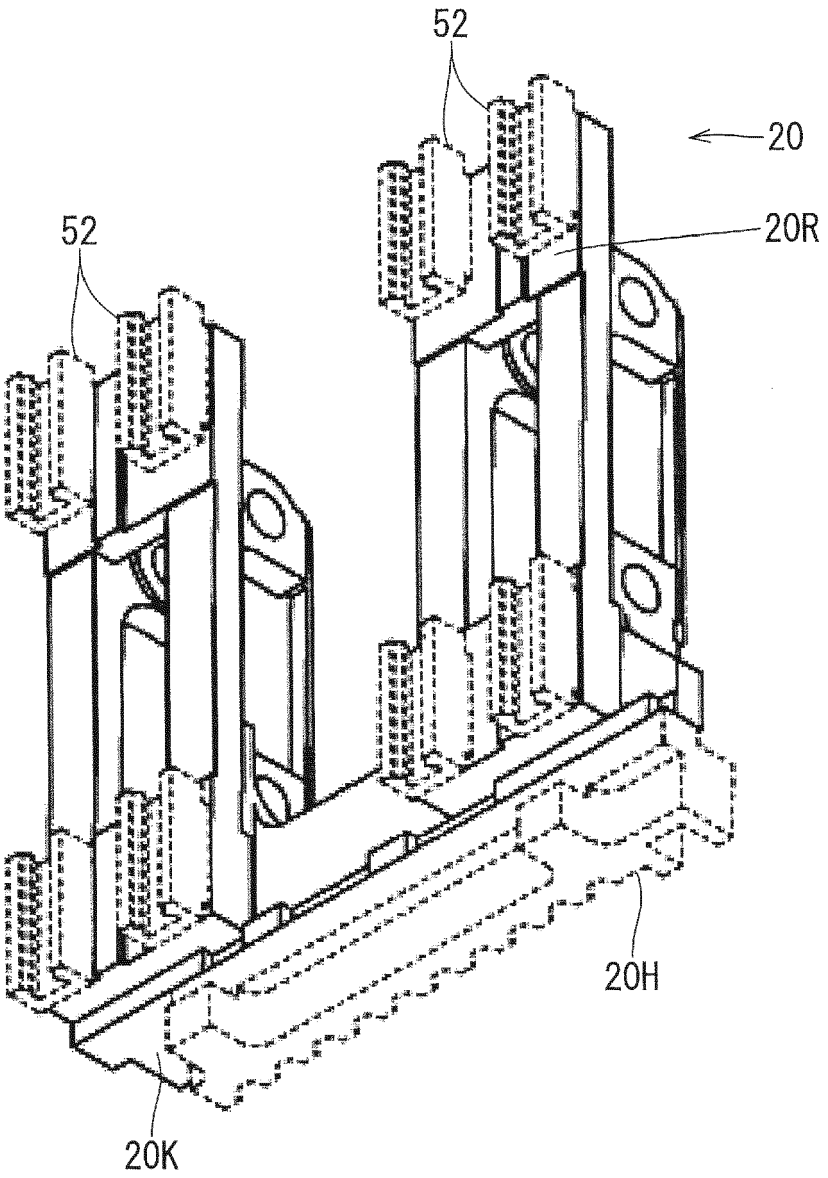
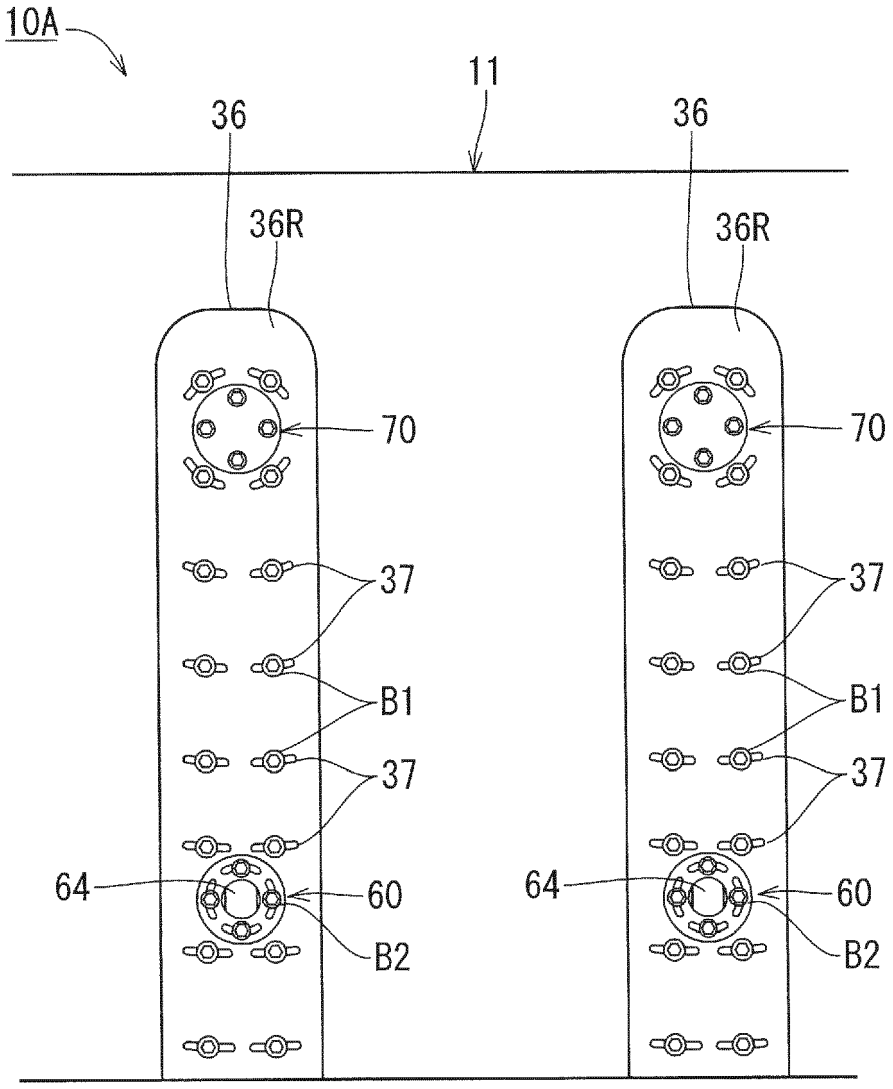


Fig. 9



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EUROPEAN SEARCH REPORT

Application Number
EP 20 15 8428

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The Hague	21 July 2020	Baradat, Jean-Luc

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