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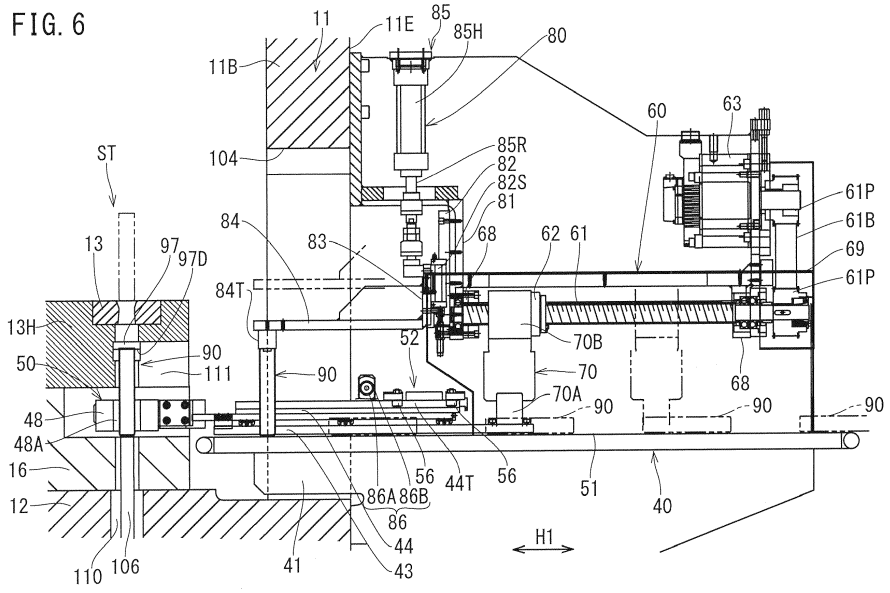
(54) WORKPIECE TAKING-OUT APPARATUS AND TRANSFER PRESS MACHINE

(57) To provide a workpiece taking-out apparatus configured to take out a cylindrical workpiece to a position more spaced apart from the lateral surface of a transfer press machine as compared to the conventional apparatuses, and a transfer press machine including such a workpiece taking-out apparatus.

In a workpiece taking-out apparatus (40) of the present disclosure, a pair of arm parts (50) configured to clamp a cylindrical workpiece (90) extends from a pair of second movable bases (44) toward a bolster (16). By the pair of second movable bases (44) being shifted in a second horizontal direction H2 by a pair of open-close driving parts (52) relative to a pair of first movable bases (43), a pair of arm parts (50) opens and closes. The pair of first movable bases (43) is shifted by a ball screw mechanism (60) relative to a fixed base (41), to convey the cylindrical workpiece (90). That is, in the workpiece taking-out apparatus (40) of the present disclosure, a mechanism portion for causing the pair of arm parts (50) to open and close and to convey is provided as being spaced apart from the pair of arm parts (50).

FIG. 6



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Description

Technical Field

[0001] The present disclosure relates to a workpiece taking-out apparatus configured to take out a cylindrical workpiece having been pressed by a transfer press machine to the outside of a frame which supports a ram and a bolster of the transfer press machine, and a transfer press machine including such a workpiece taking-out apparatus.

Background Art

[0002] As conventional workpiece taking-out apparatuses of this type, what are known are an apparatus formed as part of a transfer apparatus of a transfer press machine, and an apparatus housed below a final-process die of a transfer press machine (for example, see Patent Literatures 1 and 2).

Citation List

Patent Literature

[0003]

Patent Literature 1: Japanese Patent Application No. 2015-088297 (paragraphs [0035] to [0038])
Patent Literature 2: Japanese Patent Application No. 2016-206683 (FIG. 2)

Summary of Invention

Technical Problem

[0004] Recent years, there has been growing demand for a production line which includes a transfer press machine and an apparatus of the next process, such as a trimming apparatus disposed beside the transfer press machine. On the other hand, with the conventional workpiece taking-out apparatuses, a cylindrical workpiece can only be taken out just to a position in close proximity to the outer surface of the frame of the transfer press machine. Additionally, since various components including a flywheel for example are disposed at the outer surface of the frame, it is often difficult to dispose the next-process apparatus adjacent to the outer surface of the frame. Accordingly, what is desired is developing a workpiece taking-out apparatus configured to take out a cylindrical workpiece to a position spaced apart from the lateral surface of the transfer press machine as compared to the conventional apparatuses, and a transfer press machine including such a workpiece taking-out apparatus.

Solution to Problem

[0005] A first aspect of the present invention for solving the problem is a workpiece taking-out apparatus configured to transfer a cylindrical workpiece having been pressed by a plurality of punches of a transfer press machine in a first horizontal direction in which the plurality of punches are arranged, and to take out the cylindrical workpiece to an outside of a frame supporting a ram and a bolster of the transfer press machine, the workpiece taking-out apparatus including: a fixed base fixed to the frame and projecting from an outer surface of the frame; a pair of first movable bases supported by the fixed base so as to be shiftable in the first horizontal direction, the first movable bases being juxtaposed to each other in a second horizontal direction perpendicular to the first horizontal direction; a pair of second movable bases supported by the pair of first movable bases so as to be shiftable in the second horizontal direction; a pair of arm parts extending from the pair of second movable bases to the bolster side in the first horizontal direction; a ball screw mechanism disposed at a higher level than the first movable bases and the second movable bases, supported by the fixed base, and including a ball screw extending in the first horizontal direction and a ball nut screwing with the ball screw; a shiftable-coupling member coupling the pair of first movable bases and the ball nut to each other so as to be integrally shiftable; a forward-rearward driving part configured to rotate the ball screw so that the pair of arm parts shifts between a forward position where the arm parts are positioned on both sides of the cylindrical workpiece in the frame and a rearward position where the arm parts are spaced apart from the frame in the first horizontal direction; a pair of open-close driving parts coupled to the pair of second movable bases and configured to shift the pair of arm parts between a closed position where the arm parts clamp the cylindrical workpiece and an open position where the arm parts are spaced apart from the cylindrical workpiece; a conveyor part extending in the first horizontal direction or a direction inclined upward or downward relative to the first horizontal direction, and configured to receive the cylindrical workpiece from the pair of arm parts and convey the cylindrical workpiece to a side becoming far from the bolster from beneath the shiftable-coupling member; and a workpiece holding apparatus including a workpiece holding part configured to press the cylindrical workpiece clamped by the pair of arm parts in the rearward position against the conveyor part from above, and to shift upward upon the pair of arm parts leaving the cylindrical workpiece.

Brief Description of Drawings

[0006]

FIG. 1 is a front view of a transfer press machine according to an embodiment of the present disclo-

sure.

FIG. 2 is a horizontal sectional view of the transfer press machine.

FIG. 3 is a vertical sectional view of the transfer press machine.

FIG. 4 is a vertical sectional view of the transfer press machine.

FIG. 5 is a vertical sectional view of the transfer press machine.

FIG. 6 is a front sectional view of a workpiece taking-out apparatus.

FIG. 7 is a front sectional view of part of the workpiece taking-out apparatus in an enlarged manner.

FIG. 8 is a plan view of the workpiece taking-out apparatus.

FIG. 9 is a vertical sectional view of the workpiece taking-out apparatus taken along plane A-A in FIG. 8.

FIG. 10 is a front view of an open-close driving part.

Description of Embodiments

First Embodiment

[0007] In the following, with reference to FIGS. 1 to 10, a description will be given of an embodiment of a transfer press machine 10 of the present disclosure. FIG. 1 shows a press system 120 in which the transfer press machine 10 and a workpiece feeding apparatus 100 are coupled to each other. The transfer press machine 10 includes a plurality of punches 15 which are horizontally aligned in line at a certain interval at the lower end of a ram 14. Hereinafter, the alignment direction of the plurality of punches 15 is referred to as "the first horizontal direction H1", and the horizontal direction perpendicular to the first horizontal direction HI is referred to as "the second horizontal direction H2".

[0008] A frame 11 of the transfer press machine 10 includes: a pair of side walls 11A and 11B, the side walls 11A and 11B standing vertically and opposing to each other in the first horizontal direction HI; and a ram supporting wall (not shown), a bolster supporting wall 12 and the like which are extending between the side walls 11A and 11B. The ram supporting wall supports, via a not-shown slide guide, the ram 14 so as to be vertically shiftable. Between the side walls 11A and 11B, a cam shaft 17 extends at a higher level than the ram supporting wall. The ram 14 engages with cams 17A of the cam shaft 17.

[0009] One end of the cam shaft 17 projects laterally from one side wall 11B. To the projecting portion, a not-shown servomotor is coupled via a pulley 18A and a not-shown timing belt. The servomotor rotates the cam shaft 17, whereby the ram 14 reciprocates vertically. To one end of the cam shaft 17, a flywheel 18B is mounted together with the pulley 18A. The flywheel 18B and the pulley 18A are covered with a side cover 11C which is fixed to the outer surface of the side wall 11B.

[0010] The bolster supporting wall 12 extends between the lower ends of the pair of side walls 11A and 11B. To the upper surface of the bolster supporting wall 12, a bolster 16 is fixed. To the upper surface of the bolster 16, a plurality of dies 13 (see FIG. 3) are fixed via a plurality of die holders 13H. The plurality of dies 13 and the plurality of punches 15 are paired to constitute a plurality of process stages ST.

[0011] As shown in FIG. 2, a transfer apparatus 91 is provided at the upper surfaces of the die holders 13H. The transfer apparatus 91 is provided with a pair of rails 92 which extends in the first horizontal direction HI across the plurality of process stages ST. The rails 92 oppose to each other in the second horizontal direction H2. In the rails 92, a plurality of pairs of fingers 94 are oppositely disposed. The fingers 94 of each pair approach and become spaced apart from each other using an air cylinder 93 as a drive source.

[0012] The fingers 94 adjacent to each other in the longitudinal direction in each rail 92 are arranged at a certain interval, which is identical to the interval of the punches 15 and that of the dies 13. In synchronization with the up-and-down operation of the ram 14, the pair of rails 92 repeatedly reciprocates at a certain pitch in the first horizontal direction HI and the pairs of fingers 94 repeatedly open and close, whereby cylindrical workpieces 90 are intermittently conveyed by the transfer apparatus 91 from the left side to the right side in FIGS. 1 and 2.

[0013] As shown in FIG. 1, the workpiece feeding apparatus 100 is disposed adjacent and upstream to the transfer press machine 10 in the workpiece conveying direction. Similarly to the frame 11 of the transfer press machine 10, a frame 107 of the workpiece feeding apparatus 100 includes a pair of side walls 107A and 107B which opposes to each other in the first horizontal direction HI, and a ram supporting wall 108S, a bolster supporting wall 109S and the like which are extending between the side walls 107A and 107B. A ram 108 supported by the ram supporting wall 108S so as to be vertically shiftable receives motive power from a not-shown servomotor via a cam shaft 101 and shifts vertically. Note that, one end of the cam shaft 101 of the workpiece feeding apparatus 100 projects outside penetrating through the side wall 107A on the side opposite to the transfer press machine 10. To the projecting end, a pulley 101A and a flywheel 101B are coupled, and covered with a side cover 102.

[0014] In the workpiece feeding apparatus 100, a die holder 103 supported on the bolster supporting wall 109S via a bolster 109 has a two-stage structure, in which the upper surface of the lower stage is disposed to be flush with the upper surfaces of the die holders 13H of the transfer press machine 10. The upper stage of the die holder 103 of the workpiece feeding apparatus 100 is disposed above and spaced apart from the upper surface of the lower stage, and supports a not-shown die. Not-shown punch and die supported by the ram 108 punch out a blank member from a sheet metal, which blank member is caused to pass through the die to be shaped into a cylindrical workpiece 90 having an oval cross sec-

tion. The cylindrical workpiece 90 is pushed down to reach the upper surface of the lower stage of the die holder 103.

[0015] As shown in FIG. 2, at each of the side walls 11A, 11B, 107A, and 107B of the frames 11 and 107 of the transfer press machine 10 and the workpiece feeding apparatus 100, a through hole 104 is formed for conveying the cylindrical workpieces 90 in the first horizontal direction HI. The transfer apparatus 91 of the transfer press machine 10 extends across the transfer press machine 10 and the workpiece feeding apparatus 100 through the through holes 104. The cylindrical workpieces 90 formed by the workpiece feeding apparatus 100 are intermittently conveyed to the transfer press machine 10 at a certain pitch by the transfer apparatus 91. To this end, between the transfer press machine 10 and the workpiece feeding apparatus 100, a plurality of dummy stages DST are provided for tentatively stopping the cylindrical workpieces 90 without processing. Note that, as shown in FIG. 1, a driving part 105 configured to drive the pair of rails 92 in the transfer apparatus 91 is disposed on the side opposite to the transfer press machine 10 in the workpiece feeding apparatus 100.

[0016] As shown in FIG. 2, each cylindrical workpiece 90 has an oval cross section when fed from the workpiece feeding apparatus 100 to the transfer press machine 10. The cylindrical workpiece 90 then is drawn or ironed at a plurality of process stages ST of the transfer press machine 10, to ultimately become a rectangular cylinder having an elongated cross section. In each of the process stages ST other than the final process stage ST which is farthest from the workpiece feeding apparatus 100, the cylindrical workpiece 90 is pushed into a forming hole 13A (see FIG. 3) of the corresponding die 13 and shifted above the die 13, and then conveyed to the adjacent process stage ST by the transfer apparatus 91.

[0017] On the other hand, in the final process stage ST, as shown in FIG. 6, the cylindrical workpiece 90 is pushed below the bottom of the die 13, and shifted in the first horizontal direction HI to be discharged outside the frame 11. The workpiece taking-out apparatus 40 for carrying out the task is mounted on an outer surface 11E of the transfer press machine 10.

[0018] Specifically, as shown in FIG. 3, a through hole 110 is formed on the extension of the forming hole 13A below every die 13 of the transfer press machine 10, to vertically penetrate through the die holder 13H, the bolster 16, and the bolster supporting wall 12. A knockout pin 106 is housed in each through hole 110 so as to be vertically shiftable. Below each knockout pin 106, for example, a not-shown compression coil spring, cylinder or the like is provided. The punch 15 pushes the knockout pin 106 and the cylindrical workpiece 90 to compress the compression coil spring. By the resilience, the knockout pin 106 presses the bottom wall of the cylindrical workpiece 90 thereby preventing the bottom wall from bulging downward.

[0019] Note that, when the punch 15 shifts upward, the knockout pin 106 also shifts upward following the punch 15. To each of the punches 15 of the process stages ST except for the final process stage ST, a not-shown cylindrical stripper is fitted. When the cylindrical workpiece 90 having been processed returns to the position above the forming hole 13A, the stripper abuts on the upper end of the cylindrical workpiece 90. Then, the punch 15 further shifts upward to leave the cylindrical workpiece 90. Thus, the cylindrical workpiece 90 is taken out to the transfer apparatus 91.

[0020] As shown in FIG. 3, in the final process stage ST, a pair of strippers 97 is provided to the die holders 13H. The strippers 97 are provided juxtaposed to each other in the second horizontal direction H2 at a lower level than the die 13 in the die holder 13H, and supported so as to be slidable in the second horizontal direction H2. The respective opposing surfaces of the strippers 97 each have a stepped structure, in which the upper portion with reference to a step surface 97D is projecting than the lower portion. The strippers 97 are shifted to the closed position where they are close to each other and the open position where they are spaced apart from each other, by a pair of air cylinders 96 provided on the outer surface side of the die holder 13H. Then, as shown in FIG. 4, when the punch 15 pushes down the cylindrical workpiece 90 to the taking-out standby position which is lower than the step surfaces 97D of the strippers 97, the strippers 97 shift to the closed position and have their step surfaces 97D opposed to the upper surface of the cylindrical workpiece 90. In this state, the punch 15 shifts upward and leaves the cylindrical workpiece 90. Here, in order to prevent the knockout pin 106 from pushing up the cylindrical workpiece 90, a not-shown latch mechanism is provided below the bolster supporting wall 12 in the final process stage ST.

[0021] Specifically, the knockout pin 106 in the final process stage ST includes a not-shown engaging flange which laterally extends from the lower end. The latch mechanism includes a latch member which shifts between the position where it engages with the engaging flange and the position where it cancels the engagement. The latch member is driven by a not-shown actuator. The operation thereof will be described later in conjunction with clamping operation of the cylindrical workpiece 90 performed by a pair of arm parts 50.

[0022] As shown in FIG. 6, the cylindrical workpiece 90 in the taking-out standby position is disposed across the die holder 13H and the bolster 16. In the through hole 110 of the final process stage ST, the space where the cylindrical workpiece 90 in the taking-out standby position is housed (hereinafter referred to as "the lower space 111") opens to one side in the first horizontal direction HI of the die holder 13H and the bolster 16 and to the outside of the frame 11 through the through hole 104 of the side wall 11B. In order to take out the cylindrical workpiece 90 in the lower space 111 to the outside of the frame 11, the workpiece taking-out apparatus 40 is used.

[0023] The workpiece taking-out apparatus 40 clamps,

with the pair of arm parts 50, the cylindrical workpiece 90 in the second horizontal direction H2 and takes out the cylindrical workpiece 90 to the outside of the lower space 111. The cylindrical workpiece 90 is conveyed by a belt conveyor 51 in the direction to be away from the frame 11. Note that, in order for the pair of arm parts 50 to be inserted on the both sides of the cylindrical workpiece 90 in the taking-out standby position, the lower part of the lower space 111 is wider than the upper part thereof.

[0024] Specifically, the workpiece taking-out apparatus 40 includes a fixed base 41 fixed to the frame 11 for supporting the pair of arm parts 50, the belt conveyor 51 and the like. The fixed base 41 is fixed by bolts at, for example, the upper side and the lower side relative to the through hole 104 of the side wall 11B in the outer surface 11E of the side wall 11B. The fixed base 41 laterally projects from the outer surface 11E of the side wall 11B and partially inserted inside the through hole 104.

[0025] Note that, the fixed base 41 may be fixed to the side wall 11B by welding. The position to fix the fixed base 41 in the frame 11 may be the inside of the frame 11 (for example, the inner surface of the through hole 104 of the side wall 11B).

[0026] The belt conveyor 51 is supported by the fixed base 41 and extends in the first horizontal direction HI, and has its one end abutted on the side surface of the bolster 16. The upper surface of the belt conveyor 51 is disposed at a position slightly lower than the lower surface of the cylindrical workpiece 90 in the taking-out standby position. As shown in FIG. 8, the width of the belt conveyor 51 (the width in the second horizontal direction H2) is slightly greater than the cylindrical workpiece 90.

[0027] Note that, the upper surface of the belt conveyor 51 may be inclined upward or downward relative to the first horizontal direction HI, or may be bent midway in the longitudinal direction.

[0028] As shown in FIG. 9, on both sides of the belt conveyor 51 in the second horizontal direction H2, a pair of rails 42 is provided so as to extend in the first horizontal direction HI. The rails 42 are supported from beneath by the fixed base 41. With each of the rails 42, a plurality of sliders 42S (FIG. 9 shows one slider 42S each) are slidably engaged. A pair of first movable bases 43 which is band-plate like and extends in the first horizontal direction HI is fixed to the slider 42S by being overlaid on the pair of rails 42.

[0029] As shown in FIGS. 8 and 9, at the upper surfaces of the pair of first movable bases 43, rails 45 extending in the second horizontal direction H2 are provided at a plurality of positions in the first horizontal direction HI. With the rails 45, sliders 45S are slidably engaged. Then, a pair of second movable bases 44 which is band-plate like and extends in the first horizontal direction HI is overlaid on the pair of first movable bases 43, and fixed to the sliders 45S. Note that, as will be described in detail later, the pair of arm parts 50 extends on the bolster 16 side in the first horizontal direction HI from the pair of second movable bases 44.

[0030] In the pair of first movable bases 43, the ends away from the pair of arm parts 50 project further from the pair of second movable bases 44 toward the side away from the bolster 16. To the ends, a shiftable-coupling member 70 is fixed. As shown in FIG. 9, the shiftable-coupling member 70 includes a crank part 70A, a nut fixing part 70B, and a pair of slider fixing parts 70C. The crank part 70A extends in the second horizontal direction H2, and has its both ends bent downward and stepwise. The nut fixing part 70B stands from the center of the upper stage portion of the crank part 70A. The slider fixing parts 70C extend in the opposite sides in the second horizontal direction H2 from the position near the upper edge of the nut fixing part 70B.

[0031] To respective ends of the first movable bases 43, the both ends of the crank part 70A are respectively fixed. The distance between the stepwise parts of the crank part 70A is wider than the width of the belt conveyor 51. Between the crank part 70A and the belt conveyor 51, a space for the cylindrical workpiece 90 to pass through is formed. The space is sized just enough for the cylindrical workpiece 90 fallen down on the belt conveyor 51 to pass through, and sized to prevent the standing cylindrical workpiece 90 from passing through.

[0032] As shown in FIG. 6, above the belt conveyor 51, a ball screw mechanism 60 is provided. The ball screw mechanism 60 is disposed above the range in the belt conveyor 51 from the midway position in the first horizontal direction HI to the position near the end on the side away from the arm part 50. The ball screw mechanism 60 includes a ceiling base part 69 which is fixed to the fixed base 41. A ball screw 61 of the ball screw mechanism 60 is disposed immediately above the center in the width direction of the belt conveyor 51, and has its both ends rotatably supported by a pair of bearing parts 68 suspended from the ceiling base part 69. In the ceiling base part 69, above the end on the side away from the arm part 50, a servomotor 63 (corresponding to "the forward-rearward driving part" in the claims) is mounted. A rotation output shaft of the servomotor 63 and one end of the ball screw 61 are coupled to each other by a pair of pulleys 61P and a timing belt 61B.

[0033] As shown in FIG. 9, a ball nut 62 screwing with the ball screw 61 is fixed to the upper end of the nut fixing part 70B of the aforementioned shiftable-coupling member 70. On both sides of the ball screw 61, a pair of rails 64 extending in the first horizontal direction HI is provided and fixed to the lower surface of the ceiling base part 69. To the sliders 64S slidably coupled to the pair of rails 64, the pair of slider fixing parts 70C of the shiftable-coupling member 70 is fixed. Thus, using the servomotor 63 as the drive source, the pair of first movable bases 43 shifts between the forward position which is on the bolster 16 side in the first horizontal direction HI, and the rearward position which is on the side away from the bolster 16 than the forward position. The pair of second movable

bases 44 and the pair of arm parts 50 also shift between the forward position and the rearward position in the first horizontal direction HI together with the pair of first movable bases 43.

[0034] As shown in FIG. 8, on both sides of the pair of second movable bases 44 away from the belt conveyor 51, a pair of open-close driving parts 52 is provided for driving the pair of second movable bases 44 in the second horizontal direction H2. The open-close driving parts 52 are disposed on the bolster 16 side with reference to the ball screw mechanism 60. As shown in FIG. 9, the open-close driving parts 52 each have a mount part 52A fixed to the fixed base 41. The upper surface of the mount part 52A is a horizontal mount surface 52B. To the mount surface 52B, a pair of rail parts 53 (see FIG. 8, FIG. 10) extending in the second horizontal direction H2 is fixed as juxtaposed to each other in the first horizontal direction HI. Between the rail parts 53, a body part 54H of an air cylinder 54 (corresponding to "the first actuator" in the claims) is fixed. Then, a junction member 55 extends across and fixed to a pair of sliders 53S slidably engaging with the pair of rail parts 53. To the junction member 55, a linear-motion rod 54R which is an output part of the air cylinder 54 is fixed.

[0035] To the upper surface of the pair of sliders 53S, a pair of band plates 55P is fixed via the junction member 55. As shown in FIG. 9, the pair of band plates 55P projects in a cantilever manner to the position above the second movable base 44. To the lower surface of the tip of each band plate 55P, a pair of rollers 56 is mounted. Each of the rollers 56 has a rotation axis aligned in the vertical direction. The rollers 56 of each band plate 55P oppose to each other in the second horizontal direction H2. Note that, the junction member 55, the band plates 55P and the rollers 56 constitute "the slide coupling part" in the claims.

[0036] To each pair of rollers 56, a projecting wall 44T stands from the edge of the second movable base 44 on the side away from the belt conveyor 51 and extends in the first horizontal direction HI. The projecting wall 44T is interposed between the rollers 56 in the second horizontal direction H2. Thus, the pair of second movable bases 44 shifts, by the motive power of the air cylinder 54 in an arbitrary position in the first horizontal direction HI, between the closed position close to each other in the second horizontal direction H2, and the open position spaced apart from each other from the closed position. The pair of arm parts 50 also shifts between the closed position and the open position together with the pair of second movable bases 44.

[0037] Note that, the open-close driving parts 52 may be mounted on the first movable base 43 to drive the second movable base 44 in the second horizontal direction H2 relative to the first movable base 43. In place of providing the projecting wall 44T of the second movable base 44, for example, a groove extending in the first horizontal direction HI may be formed at the second movable base 44, and the roller 56 or a pin may be engaged on the inner side of the groove.

[0038] As shown in FIG. 8, on the ends of the pair of second movable bases 44 on the bolster 16 side, a pair of connection members 46 whose plan shape is L-shaped is fixed. Each of the connection members 46 is formed of a first band plate part 46A and a second band plate part 46B crossing perpendicular to each other. The first band plate parts 46A of respective connection members 46 are disposed in an identical plane perpendicular to the first horizontal direction HI, and fixed to the ends of the pair of second movable bases 44 by welding or the like. From the ends close to each other in the first band plate parts 46A, the second band plate parts 46B project toward the bolster 16 side, and oppose to each other in the second horizontal direction H2.

[0039] On the other sides of the opposing surfaces of the second band plate parts 46B, extension plates 47 are respectively overlaid and fixed with bolts. The pair of extension plates 47 is band plate-like extending in the first horizontal direction HI, and projects toward the bolster 16 side than the pair of second band plate parts 46B. In the extension plates 47, on the opposing surfaces projecting further than the second band plate part 46B, pressing members 48 are respectively overlaid and supported by not-shown pair of bolts so as to be capable of becoming near to or far from the extension plates 47. On the outer side of each bolt, a compression coil spring 49 is inserted between the extension plate 47 and the pressing member 48, to bias the pressing member 48 in the direction away from the extension plates 47. To the opposing surfaces of the respective pressing members 48, buffer members 48A such as urethane foam sheets or the like are bonded. Each of the arm parts 50 is formed of the extension plate 47, the pressing member 48, the buffer member 48A and a component coupling them.

[0040] Note that, replacing the pair of arm parts 50 by other pair of arm parts 50 and fixing to the second band plate parts 46B will deal with a change in the shape of the cylindrical workpiece 90.

[0041] While the cylindrical workpiece 90 is positioned higher than the lower space 111, the pair of arm parts 50 shifts from the rearward position to the forward position in the open state (the state where the pair of arm parts 50 is disposed in the open position), and as shown in FIG. 3, the arm parts 50 are inserted into the lower space 111. Then, as shown in FIG. 4, the cylindrical workpiece 90 comes down to be set between the arm parts 50, and disposed in the taking-out standby position. Then, as shown in FIG. 5, the pair of arm parts 50 enters the closed state (the state where the pair of arm parts 50 is disposed in the closed position), and clamps the cylindrical workpiece 90 in the second horizontal direction H2.

[0042] In detail, when the pair of arm parts 50 shifts from the open position to the closed position, the buffer members 48A respectively provided at the pressing members 48 of the pair of arm parts 50 are pressed against the cylindrical workpiece 90. At this time, the buffer members 48A warp and the compression coil springs

49 are compressively deformed. These avoid application of excessive clamping force onto the cylindrical workpiece 90 and hence avoid any possible damage to the cylindrical workpiece 90.

[0043] While the pair of arm parts 50 is clamping the cylindrical workpiece 90, the above-described latch member engages with the engaging flange at the lower end of the knockout pin 106 thereby restricting the upward shift of the knockout pin 106; and the pair of strippers 97 shifts forward to engage with the upper surface of the cylindrical workpiece 90 thereby restricting the upward shift of the cylindrical workpiece 90. In this state, the punch 15 shifts upward and leaves the cylindrical workpiece 90.

[0044] When the punch 15 has left the cylindrical workpiece 90, the pair of arm parts 50 shifts to the rearward position while remaining in the closed state, to take out the cylindrical workpiece 90 from the lower space 111. When the cylindrical workpiece 90 is no longer positioned on the knockout pin 106, the pair of strippers 97 opens outward. Thereafter, the engagement of the knockout pin 106 by the latch member is released, and the knockout pin 106 shifts upward to reach the upper end of the forming hole 13A.

[0045] The pair of arm parts 50 clamping the cylindrical workpiece 90 shifts to the rearward position, where the cylindrical workpiece 90 is positioned above the belt conveyor 51. Then the pair of arm parts 50 enters the open state, whereby the cylindrical workpiece 90 is passed to the belt conveyor 51. In the present embodiment, at the end on the bolster 16 side in the through hole 104 of the side wall 11B of the frame 11, the cylindrical workpiece 90 is passed from the pair of arm parts 50 to the belt conveyor 51.

[0046] As shown in FIG. 7, in order to stably pass the cylindrical workpiece 90 from the pair of arm parts 50 to the belt conveyor 51, the transfer press machine 10 includes a workpiece holding apparatus 80. The workpiece holding apparatus 80 includes: a standing base 81 standing from the end on the bolster 16 side in the ceiling base part 69 of the ball screw mechanism 60; a pair of rail parts 82 (see FIG. 8) fixed to the surface oriented to the bolster 16 side in the standing base 81 and extending in the vertical direction; a pair of sliders 82S slidably engaging with the pair of rail parts 82; and an up-and-down base 83 fixed to the sliders 82S. As shown in FIG. 7, from the lower end of the up-and-down base 83, the workpiece holding part 84 extends in a cantilever manner toward the bolster 16 side. From the tip of the workpiece holding part 84, a workpiece abutting part 84T formed of a buffer member projects downward. As shown in FIG. 6, the workpiece holding apparatus 80 further includes an air cylinder 85 as the drive source. A body part 85H of the air cylinder 85 is fixed to the fixed base 41 and extends in the vertical direction. From the lower end thereof, a rod 85R extends downward and fixed to the upper end of the up-and-down base 83.

[0047] Then, when the pair of arm parts 50 clamping the cylindrical workpiece 90 shifts to reach the rear end position, the workpiece holding part 84 shifts downward having its workpiece abutting part 84T abutted on the cylindrical workpiece 90, thereby pressing the cylindrical workpiece 90 against the belt conveyor 51. Thereafter, the pair of arm parts 50 shifts to the open position. Thereafter, the workpiece abutting part 84T shifts upward. Then, the pair of arm parts 50 returns to the forward position and clamps the next cylindrical workpiece 90, to repeatedly perform the same subsequent operations.

[0048] While the workpiece abutting part 84T presses the cylindrical workpiece 90 against the belt conveyor 51 and then leaves upward from the cylindrical workpiece 90, the belt conveyor 51 shifts the lower end of the cylindrical workpiece 90 toward the side away from the bolster 16. Thus, the cylindrical workpiece 90 is caused to fall down and lie on the belt conveyor 51. Then, the cylindrical workpiece 90 passes beneath the ball screw mechanism 60, and passed from the belt conveyor 51 to the next process at the position further away from the bolster 16 than the ball screw mechanism 60.

[0049] Furthermore, taking into consideration of the case where the workpiece holding apparatus 80 and the belt conveyor 51 fail to cause the cylindrical workpiece 90 to fall down, as shown in FIG. 6, there is provided an abutment bar 86 in the belt conveyor 51 upstream to the ball screw mechanism 60. The abutment bar 86 is supported by the fixed base 41 in a cantilever manner, and extends in the second horizontal direction H2 so as to cross above the belt conveyor 51. In detail, the abutment bar 86 includes a supporting shaft 86A having its one end fixed to a not-shown stand which is fixed to the fixed base 41 and stands from one side of the belt conveyor 51, and a roller 86B formed of a buffer member rotatably supported by the supporting shaft 86A. The abutment bar 86 abuts on the cylindrical workpiece 90 which stands on the belt conveyor 51 so as to lay the cylindrical workpiece 90 on the belt conveyor 51. The abutment bar 86 is disposed so as to prevent interference between the cylindrical workpiece 90 laid by the abutment bar 86 on the belt conveyor 51 and the subsequent cylindrical workpiece 90.

[0050] The foregoing is the description of the transfer press machine 10 and its workpiece taking-out apparatus 40 according to the present embodiment. Next, a description will be given of the operation and effect of the transfer press machine 10 and the workpiece taking-out apparatus 40. In the workpiece taking-out apparatus 40 according to the present embodiment, a pair of arm parts 50 configured to clamp a cylindrical workpiece 90 extends from a pair of second movable bases 44 toward the bolster 16. By the pair of second movable bases 44 being shifted in the second horizontal direction H2 relative to a pair of first movable bases 43 by a pair of open-close driving parts 52, the pair of arm parts 50 opens or closes. The pair of first movable bases 43 is shifted by the ball screw mechanism 60 relative to the fixed base 41, to convey the cylindrical workpiece 90. That is, in the work-

piece taking-out apparatus 40 according to the present embodiment, a mechanism portion for causing the pair of arm parts 50 to perform the open-close operation and the convey operation is provided spaced apart from the pair of arm parts 50. This allows the workpiece taking-out apparatus 40 according to the present embodiment to clamp the cylindrical workpiece 90 in the space which is smaller than that of the conventional apparatus in which the mechanism portion is provided inside the transfer press machine 10. Additionally, by the mechanism portion being increased in size or elongated outside the transfer press machine 10, the cylindrical workpiece 90 is taken out to the position more spaced apart from the side surface of the transfer press machine 10 than in the conventional case.

[0051] In the workpiece taking-out apparatus 40 according to the present embodiment, the belt conveyor 51 receives the cylindrical workpiece 90 from the pair of arm parts 50, and conveys the cylindrical workpiece 90 through beneath the ball screw mechanism 60 toward the side away from the bolster 16. Thus, the convey distance of the cylindrical workpiece 90 is further increased.

[0052] Due to the foregoing, a trimming apparatus for trimming the opening edge of the cylindrical workpiece 90, a processing apparatus for painting or cleaning the cylindrical workpiece 90 and the like can be easily connected to the transfer press machine 10, which facilitates structuring the production line. In particular, in a case where the transfer press machine 10 and the apparatus downstream to the transfer press machine 10 are of different manufacturers, it is often difficult to connect them to each other. Here, the transfer press machine 10 according to the present embodiment solves such a problem.

[0053] In the workpiece taking-out apparatus 40, the arm parts 50 and the belt conveyor 51 cooperate to convey the cylindrical workpiece 90. Accordingly, as compared to the case where just the arm parts 50 convey the cylindrical workpiece 90, the burden on the arm parts 50 in terms of the convey distance is alleviated, and an operation of the transfer press machine in a high speed 10 is realized.

[0054] In the workpiece taking-out apparatus 40 according to the present embodiment, instead of the drive source for the open-close driving parts 52 being fixed to the first movable bases 43, the air cylinder 54 being the drive source is fixed to the fixed base 41 and the output part being the drive source is coupled to the second movable bases 44. This reduces the weight of the components which shift together with the first movable bases 43, and contributes to realizing a high-speed operation.

[0055] Furthermore, in a case where the cylindrical workpiece 90 is not easily removable from the pair of arm parts 50 because of the lubricant attaching to the outer surface thereof, the workpiece holding part 84 presses the cylindrical workpiece 90 against the belt conveyor 51. Therefore, the arm parts 50 are surely separated from the cylindrical workpiece 90, and the position of the cylindrical workpiece 90 when released from the pair of arm parts 50 stabilizes. The cylindrical workpiece 90 laid on the belt conveyor 51 by the workpiece holding part 84 realizes stabilized conveyance. Provided that the workpiece holding part 84 fails to lay the cylindrical workpiece 90 down on the belt conveyor 51, the abutment bar 86 lays the cylindrical workpiece 90 down on the belt conveyor 51. Thus, stabilized conveyance is realized.

[0056] Note that, by being laid on the belt conveyor 51, the cylindrical workpiece 90 can pass through beneath the ball screw mechanism 60, which allows the ball screw mechanism 60 and the belt conveyor 51 to be disposed close to each other. Thus, the whole workpiece taking-out apparatus 40 is downsized.

[0057] In the transfer press machine 10 including the workpiece taking-out apparatus 40, the cylindrical workpiece 90 is shifted to the lower space 111 below the die 13 and the cylindrical workpiece 90 is taken out to the outside the frame 11 from the lower space 111. Therefore, as compared to the case where the cylindrical workpiece 90 is returned over the die 13 and taken to the outside the frame 11, the cylindrical workpiece 90 becomes less likely to be damaged. Additionally, the cylindrical workpiece 90 is taken out to the outside the frame 11 by the workpiece taking-out apparatus 40. This stabilizes the conveying the cylindrical workpiece 90. In this regard also, the cylindrical workpiece 90 becomes less likely to be damaged.

[Other embodiment]

[0058]

(1) The workpiece taking-out apparatus 40 of the transfer press machine 10 according to the embodiment takes out the cylindrical workpiece 90 from beneath the die 13 in the final process stage ST. Here, the cylindrical workpiece 90 may be taken out from above the die 13 in the final process stage ST by the workpiece taking-out apparatus 40.

(2) The workpiece taking-out apparatus 40 of the transfer press machine 10 according to the embodiment includes the belt conveyor 51 as a conveyor part. Here, the workpiece taking-out apparatus 40 may include, as the conveyor part, a roller conveyor or a chute which is inclined upward or downward relative to the first horizontal direction HI and on which the cylindrical workpiece 90 shifts by its own weight.

(3) The cylindrical workpiece 90 taken out by the workpiece taking-out apparatus 40 is a quadrangular cylinder. Here, the cylindrical workpiece 90 may have any shape so long as it is cylindrical, and for example, it may be circular cylindrical or oval cylindrical. It may have its one end bottomed as the cylindrical workpiece 90 according to the embodiment, or may have its both ends opened.

(4) In the workpiece taking-out apparatus 40 accord-

ing to the embodiment, the second movable base 44 shifts in parallel to the second horizontal direction H2 relative to the first movable base 43. Here, the second movable base 44 may rotate in the second horizontal direction H2 relative to the first movable base 43 so that the pair of arm parts 50 opens and closes.

(5) In the workpiece taking-out apparatus 40 according to the embodiment, as shown in FIG. 7, the abutment bar 86 extends in the second horizontal direction H2 so as to cross above the belt conveyor 51. Here, the abutment bar 86 may be suspended from above.

[0059] 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 workpiece taking-out apparatus (40) configured to transfer a cylindrical workpiece (90) having been pressed by a plurality of punches (15) of a transfer press machine (10) in a first horizontal direction (HI) in which the plurality of punches (15) are arranged, and to take out the cylindrical workpiece (90) to an outside of a frame (11) supporting a ram (14) and a bolster (16) of the transfer press machine (10), the workpiece taking-out apparatus (40) comprising:

a fixed base (41) fixed to the frame (11) and projecting from an outer surface of the frame (11);

a pair of first movable bases (43) supported by the fixed base (41) so as to be shiftable in the first horizontal direction (HI), the first movable bases (43) being juxtaposed to each other in a second horizontal direction (H2) perpendicular to the first horizontal direction (HI);

a pair of second movable bases (44) supported by the pair of first movable bases (43) so as to be shiftable in the second horizontal direction (H2);

a pair of arm parts (50) extending from the pair of second movable bases (44) to the bolster (16) side in the first horizontal direction (HI);

a ball screw mechanism (60) disposed at a higher level than the first movable bases (43) and the second movable bases (44), supported by the fixed base (41), and including a ball screw (61) extending in the first horizontal direction (HI) and a ball nut (62) screwing with the ball screw (61);

a shiftable-coupling member (70) coupling the pair of first movable bases (43) and the ball nut (62) to each other so as to be integrally shiftable;

a forward-rearward driving part (63) configured to rotate the ball screw (61) so that the pair of arm parts (50) shifts between a forward position where the arm parts (50) are positioned on both sides of the cylindrical workpiece (90) in the frame (11) and a rearward position where the arm parts (50) are spaced apart from the frame (11) in the first horizontal direction (HI);

a pair of open-close driving parts (52) coupled to the pair of second movable bases (44) and configured to shift the pair of arm parts (50) between a closed position where the arm parts (50) clamp the cylindrical workpiece (90) and an open position where the arm parts (50) are spaced apart from the cylindrical workpiece (90);

a conveyor part (51) extending in the first horizontal direction (HI) or a direction inclined upward or downward relative to the first horizontal direction (HI), and configured to receive the cylindrical workpiece (90) from the pair of arm parts (50) and convey the cylindrical workpiece (90) to a side away from the bolster (16) beneath the shiftable-coupling member (70); and

a workpiece holding apparatus (80) including a workpiece holding part (84) configured to press the cylindrical workpiece (90) clamped by the pair of arm parts (50) in the rearward position against the conveyor part (51) from above, and to shift upward upon the pair of arm parts (50) leaving the cylindrical workpiece (90).

2. The workpiece taking-out apparatus (40) according to claim 1, **characterized in that**
the conveyor part (51) is a belt conveyor (51), and
in a state where an upper part of the cylindrical workpiece (90) is stopped by the workpiece holding part (84), a lower part of the cylindrical workpiece (90) is shifted by the belt conveyor (51) in the first horizontal direction (HI) whereby the cylindrical workpiece (90) is laid down on the belt conveyor (51).

3. The workpiece taking-out apparatus (40) according to claim 2, **characterized in that** a gap in a vertical direction between the shiftable-coupling member (70) and the belt conveyor (51) is sized to allow the cylindrical workpiece (90) being laid down on the belt conveyor (51) to pass through and to prevent the cylindrical workpiece (90) standing on the belt conveyor (51) from passing through.

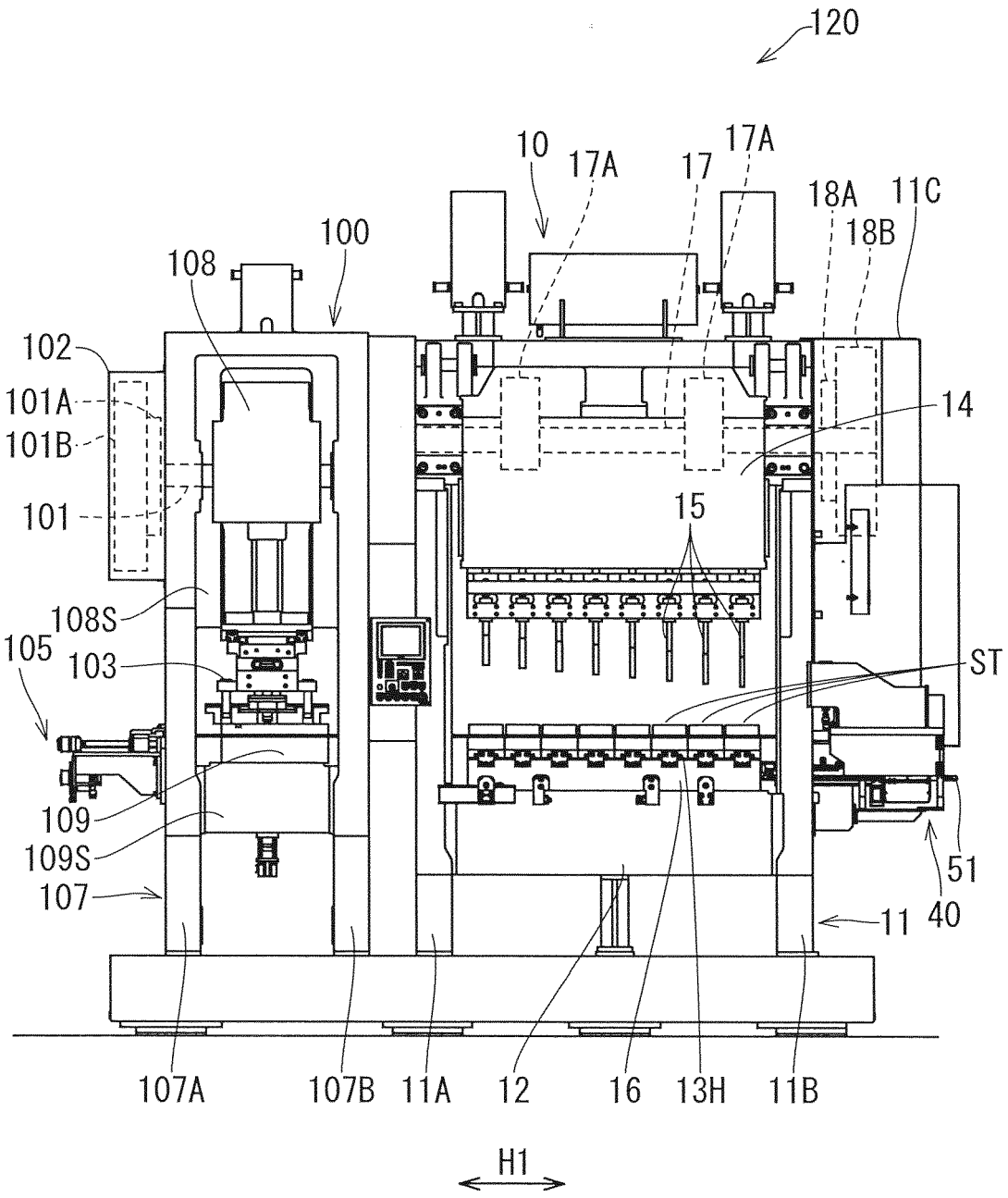
4. The workpiece taking-out apparatus (40) according to any one of claims 1 to 3, **characterized in that** each of the open-close driving parts (52) includes:

a first actuator (54) including a body part (54H) fixed to the fixed base (41) and an output part (54R) configured to shift in a reciprocating manner in the second horizontal direction (H2); and
a slide coupling part (55, 55P, 56) configured to couple the output part (54R) of the first actuator (54) to the second movable bases (44) so as to be integrally shiftable in the second horizontal direction (H2) while being capable of relatively shifting in the first horizontal direction (HI).

5. A transfer press machine (10) comprising:

the workpiece taking-out apparatus (40) according to any one of claims 1 to 4;
a lower space (111) formed below a die (13) of the transfer press machine (10) and opening toward the outer surface of the frame (11), wherein the cylindrical workpiece (90) having passed through the die (13) being disposed in the lower space (111); and
a pair of strippers (97) configured to approach the cylindrical workpiece (90) in the second horizontal direction (H2) in the lower space (111) to engage with an upper surface of the cylindrical workpiece (90) and cause the cylindrical workpiece (90) to leave the punch (15).

FIG. 1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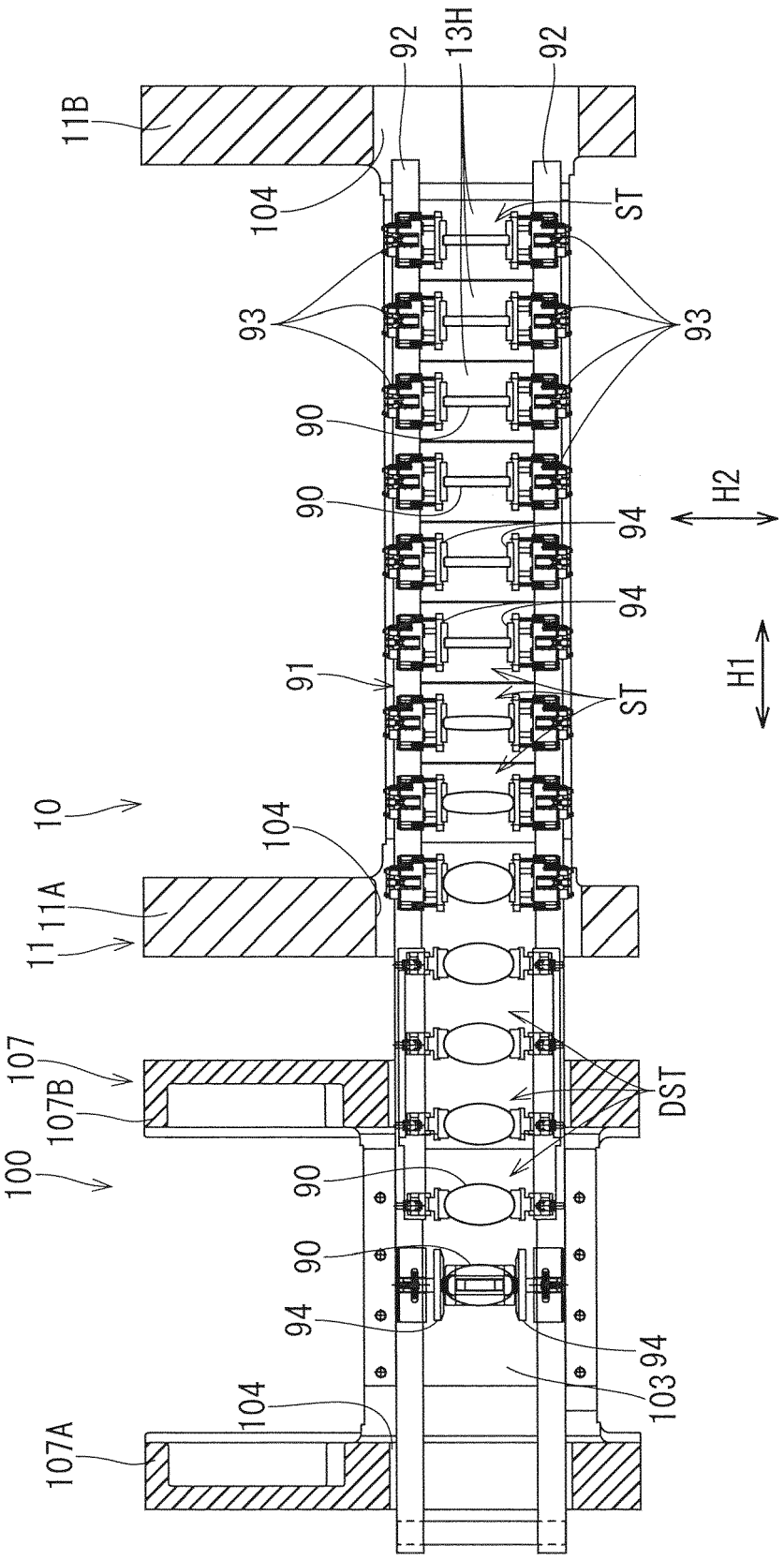
11B
H1

FIG. 2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H2
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11A
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DST
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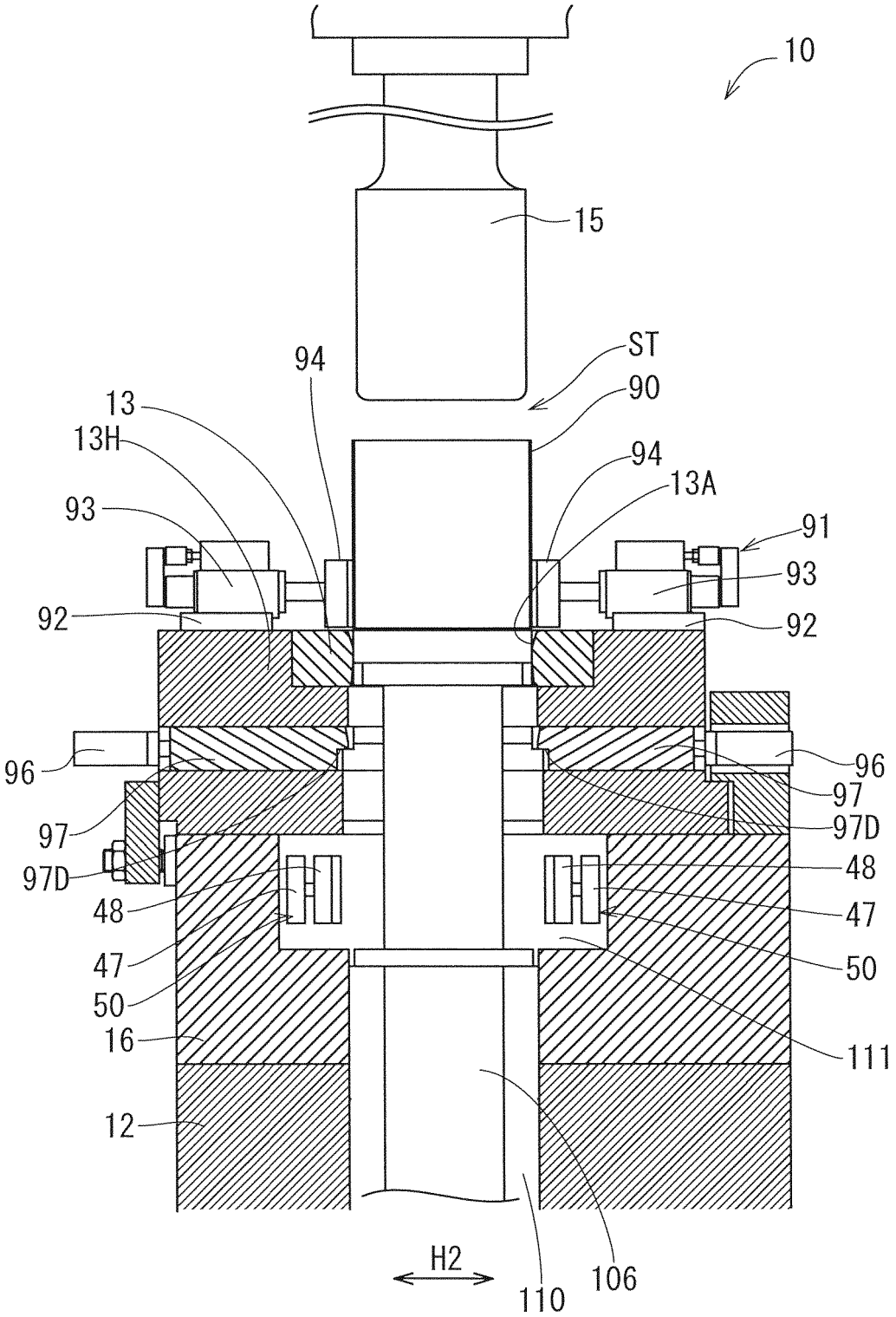
94
94
103
104
107A

FIG. 3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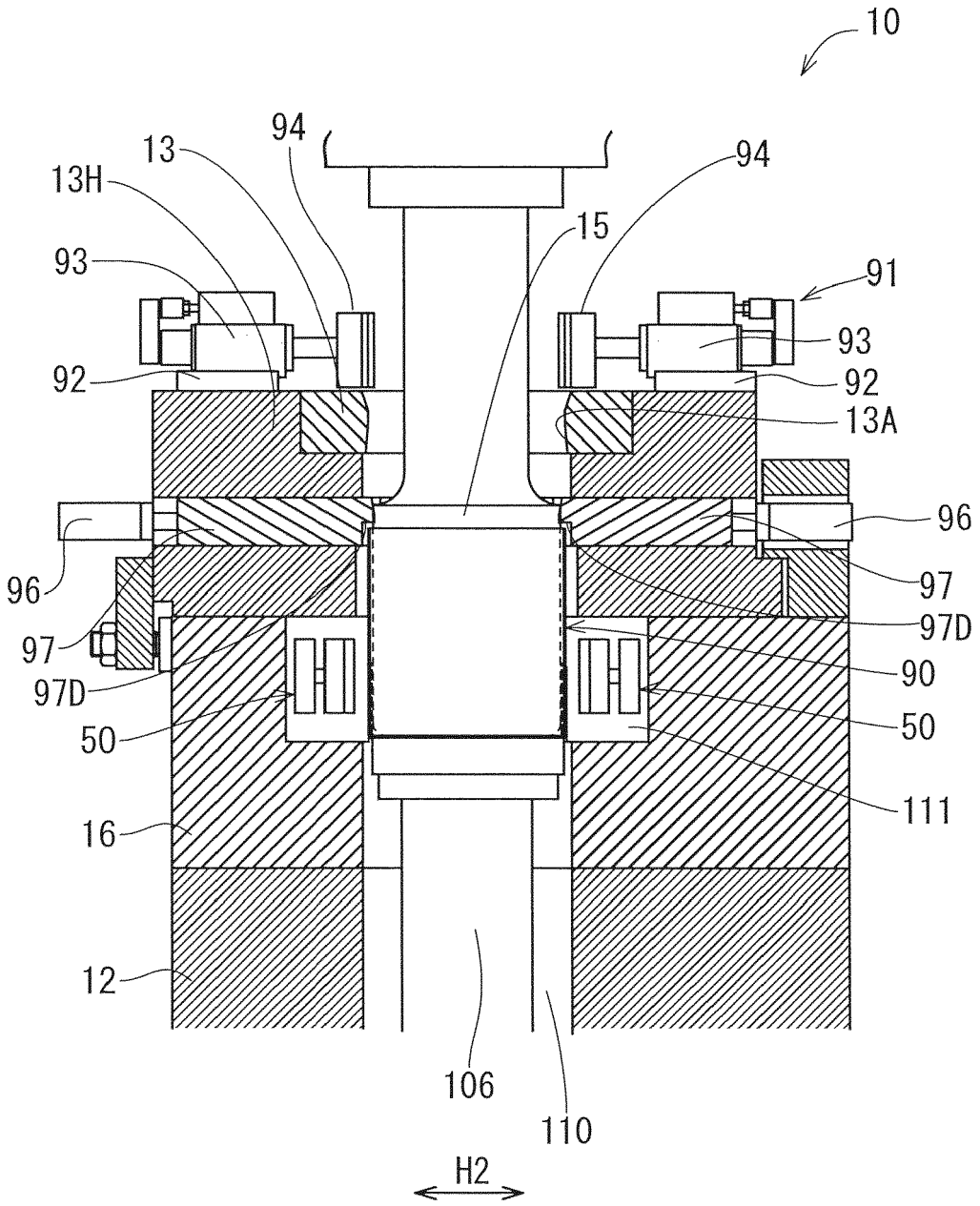
97D
48
48
47
47
50
50
16
111
12
H2
110
106

FIG. 4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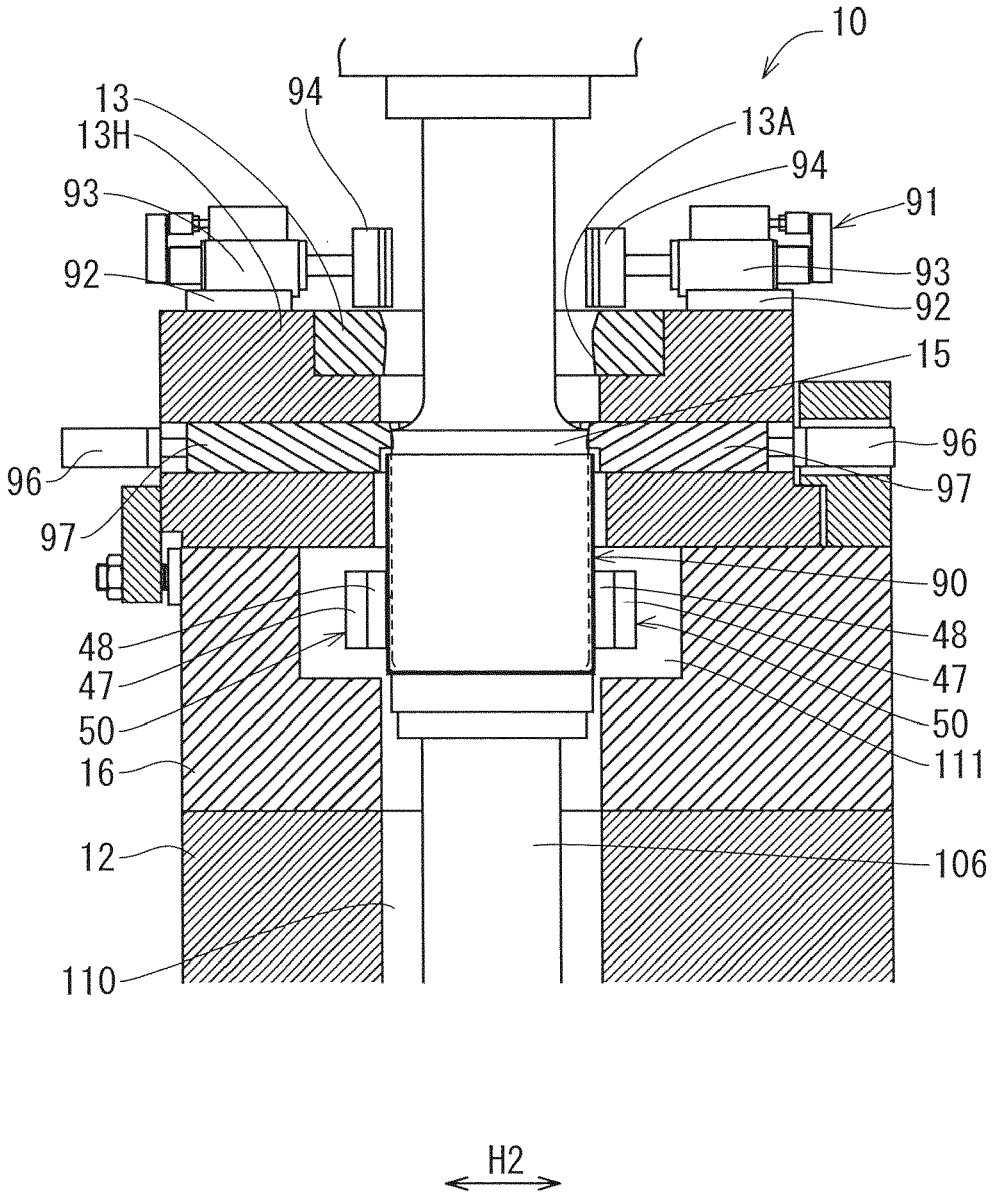
50
111
16
12
106
110
H2

FIG. 5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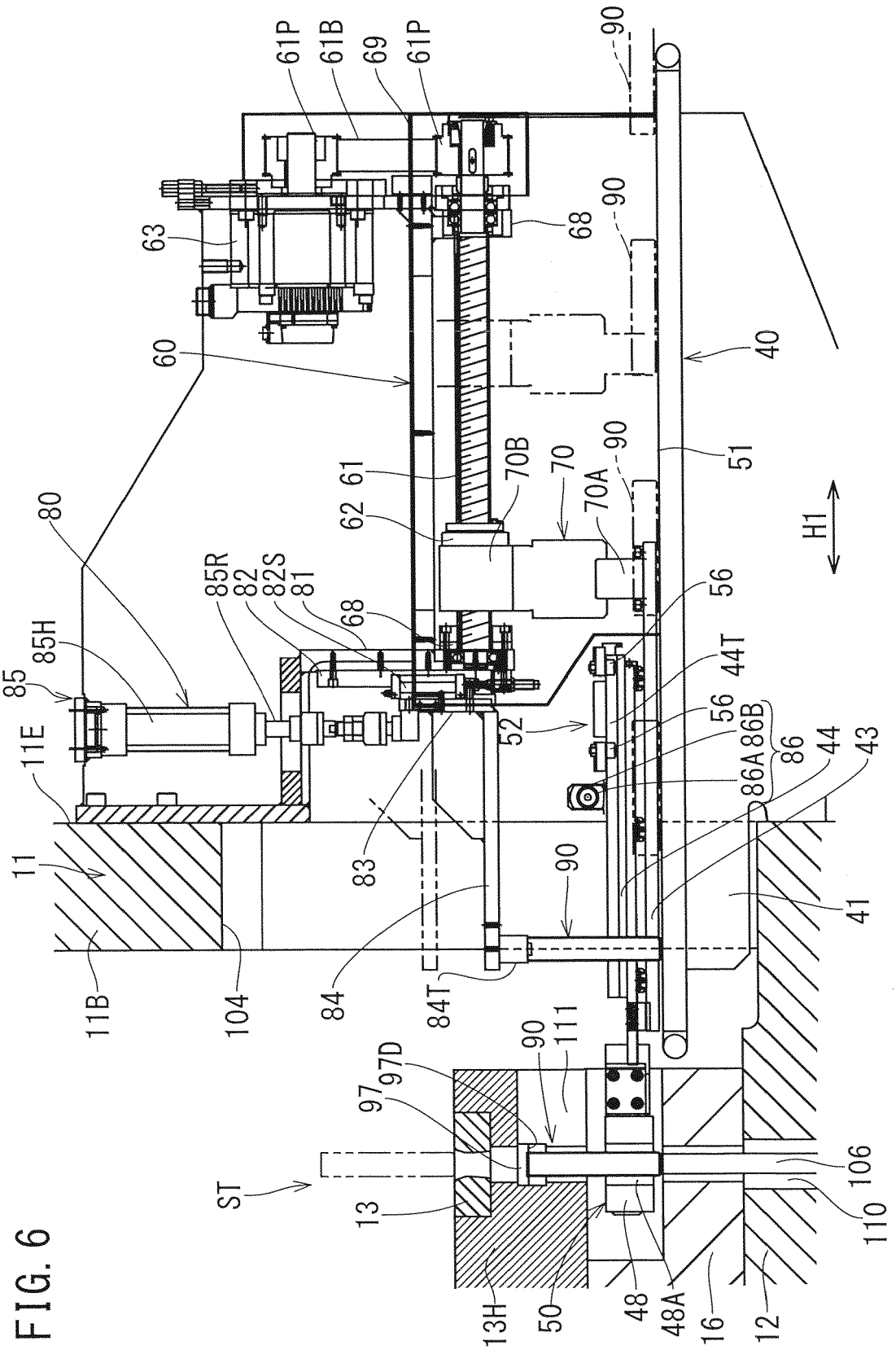
110
H2

FIG. 6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82S
81
68
56
H1
85H
85
44T
56
52
86B
86
44
43
11E
86A
11
83
90
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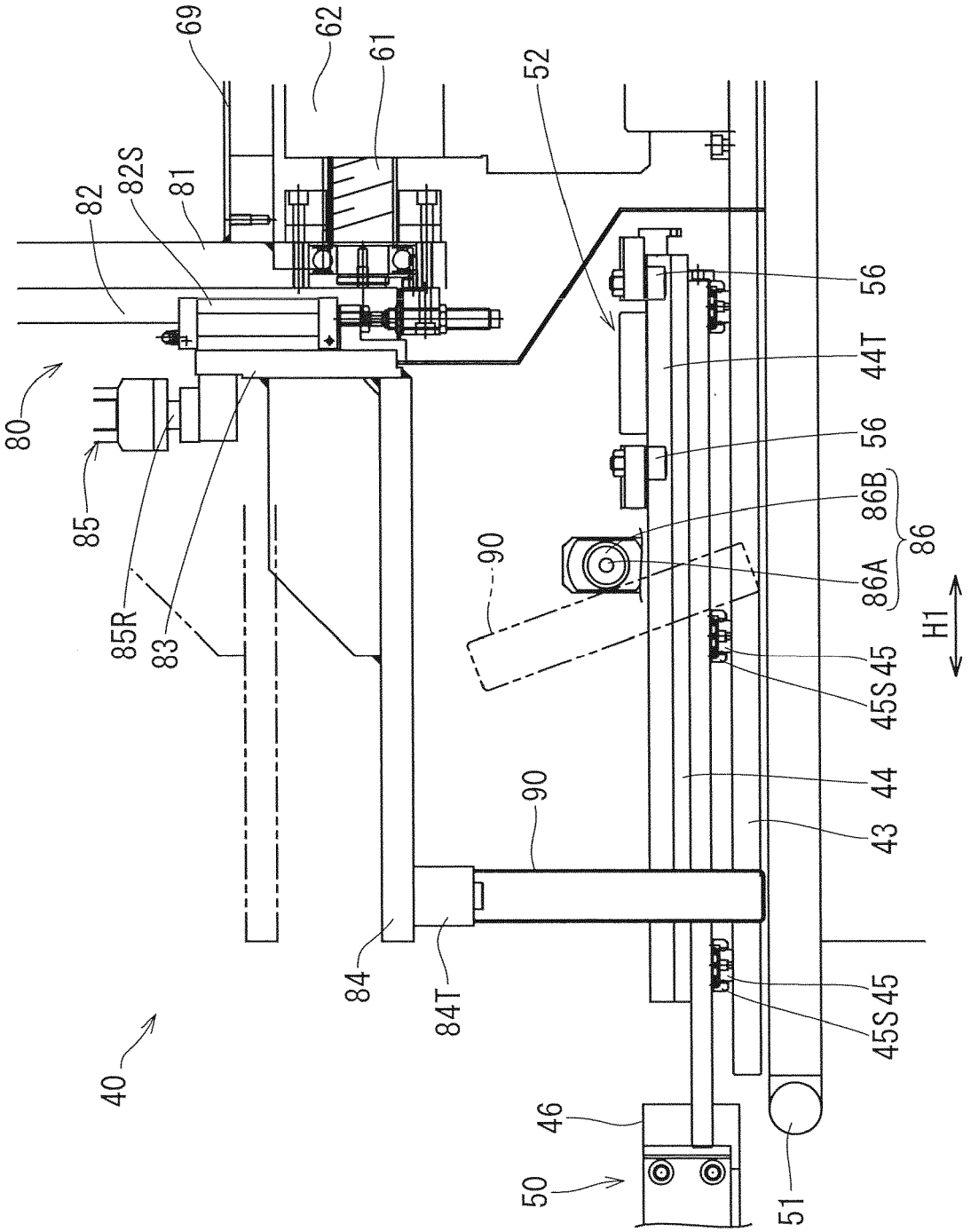
16
12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44T
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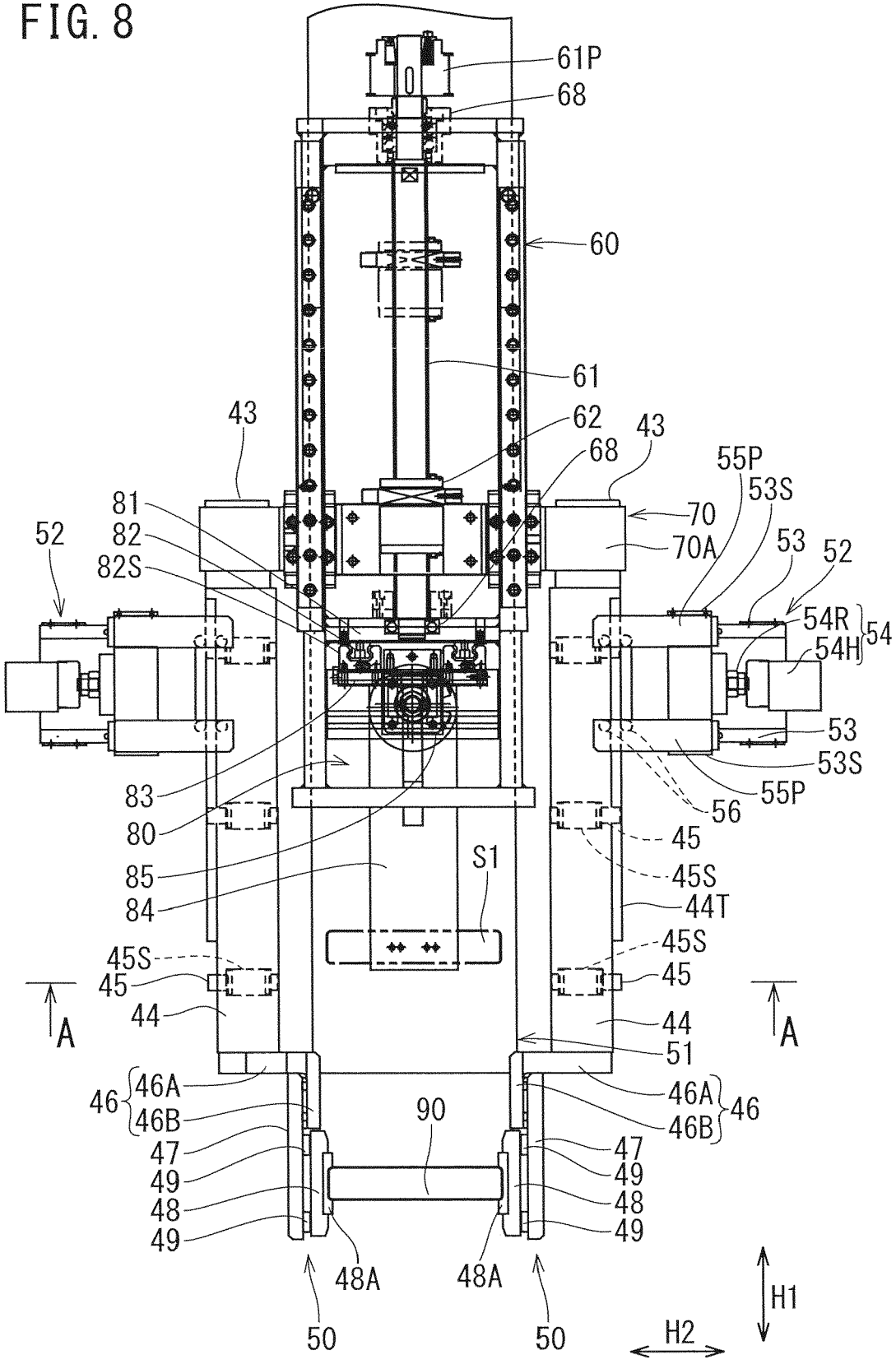
80
85
90
85R
83
H1
45
45S
44
43
90
84
84T
45
45S
40
46
50
51

FIG. 7

FIG. 8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54H
53
53S
55P
56
83
80
85
84
45
45S
44T
S1
45S
45
45
44
44
A
A
51
46
46A
46B
46A
46B
46
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48
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49
48
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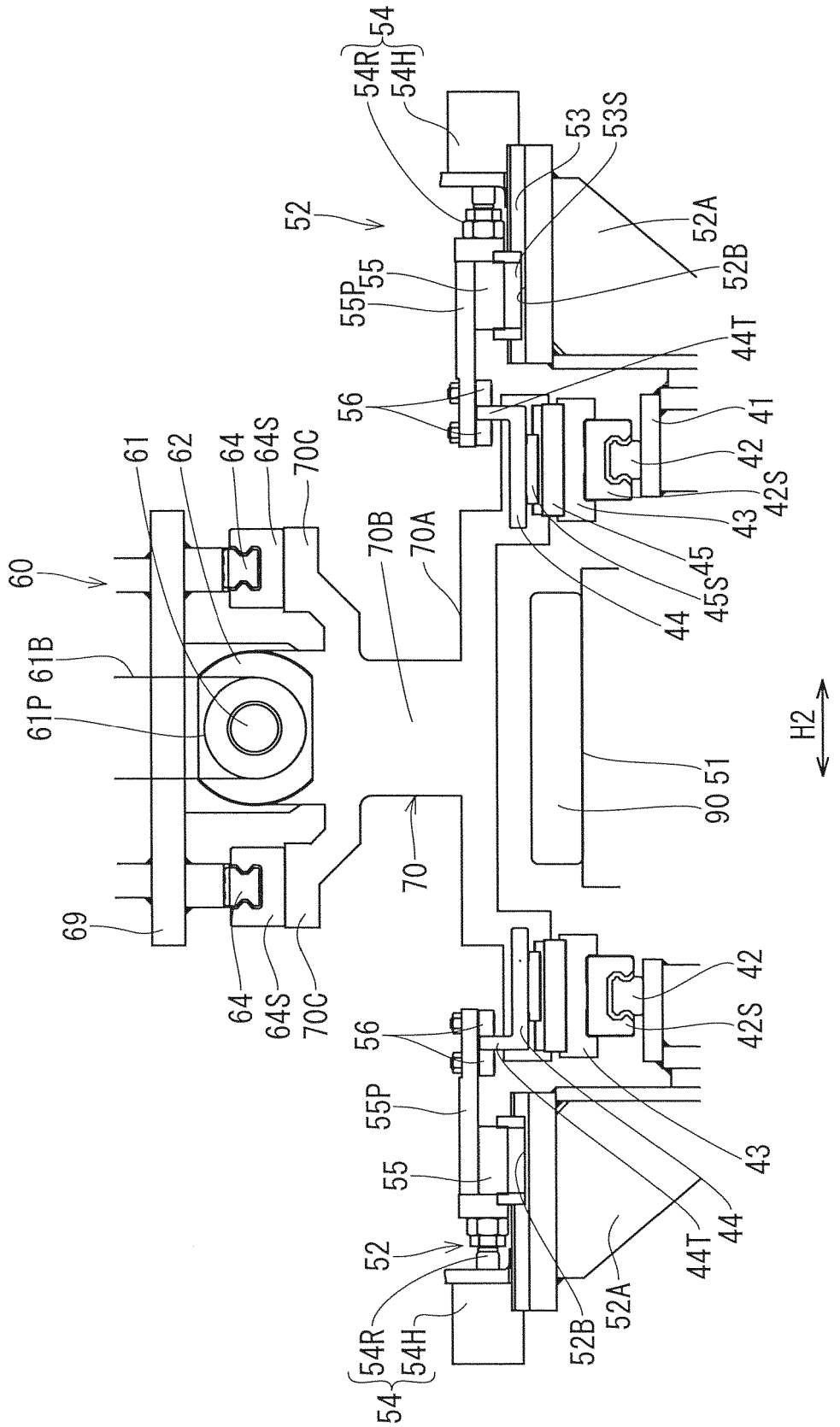
48A
48A
50
50
H2
H1

FIG. 9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60
61B
61P
H2
51
90
70
69

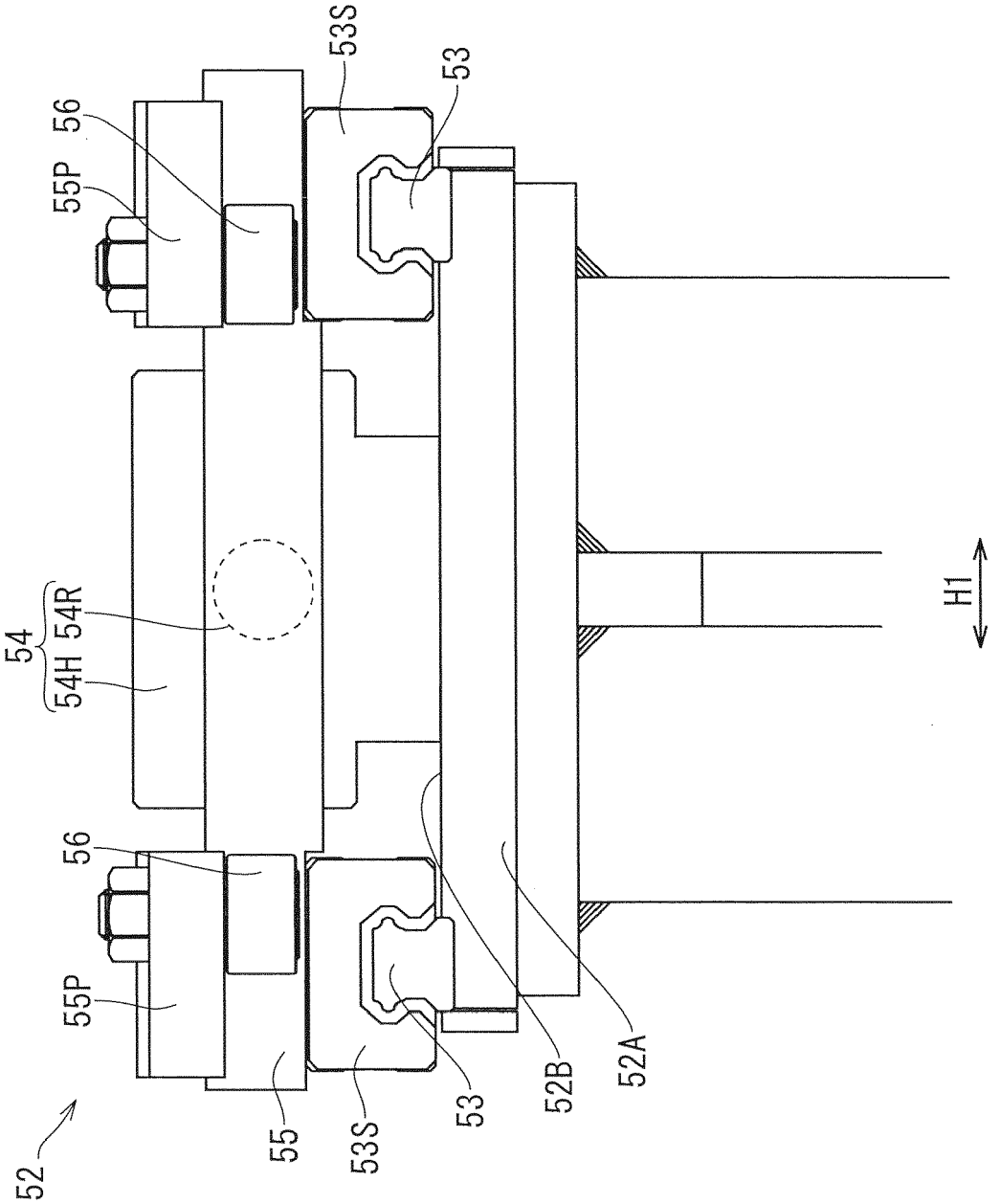

FIG. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 20 16 3994

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 July 2020	Stanic, Franjo

CATEGORY OF CITED DOCUMENTS

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15-07-2020

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