



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
24.05.2023 Bulletin 2023/21

(21) Application number: **22207013.8**

(22) Date of filing: **11.11.2022**

(51) International Patent Classification (IPC):
B21D 28/02 (2006.01) **B21D 28/26** (2006.01)
B21D 43/00 (2006.01) **B21D 43/05** (2006.01)
B21D 43/09 (2006.01) **B30B 15/00** (2006.01)
B21D 28/04 (2006.01) **B21D 28/22** (2006.01)
H02K 15/02 (2006.01)

(52) Cooperative Patent Classification (CPC):
B21D 28/02; B21D 28/04; B21D 28/26;
B21D 43/006; B21D 43/05; B21D 43/09;
B30B 15/00; B21D 28/22

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **19.11.2021 JP 2021189038**

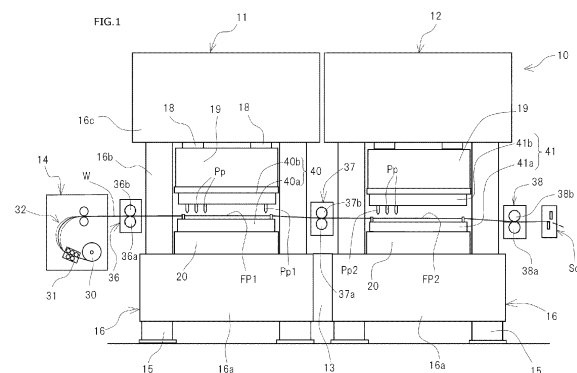
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(54) **TANDEM PRESS LINE**

(57) A tandem press line 10 is provided in which the possibility of occurrence of a breakage of a coil strip W can be suppressed even in a case where there is no loose in a coil strip W fed intermittently. The tandem press line 10 is provided with: a first press machine 11 configured to perform punching on the coil strip W fed intermittently; a second press machine 12 configured to further perform punching on the coil strip W fed from the first press machine 11, in synchronization with the first press machine 11; and an intermediate feeding device 37 provided between the first press machine 11 and the second press machine 12, the intermediate feeding device being configured to grip the coil strip W when feeding the coil strip W and release when performing pressing. The first press machine 11 and the second press machine 12 are provided with a first forming die 40 and a second forming die 41, respectively, the first forming die 40 and the second forming die 41 being each provided with a material lifter 45 having the same stroke length h on a lower die 40a, 41a. A lower die upper surface height of the first forming die 40 and a lower die upper surface height of the second forming die 41 are the same, and the feeding line of the intermediate feeding device 37 is higher than the upper surface of the forming dies by 1/2 of the stroke length h of the material lifter 45.



Description**Technical Field**

5 [0001] The present invention relates to a tandem press line, more particularly to a tandem press line in which two press machines for performing punching are tandemly arranged.

Background of the Invention

10 [0002] In Patent Document 1, a laminated iron core punching device is disclosed in which a rotor punching press machine and a stator punching press machine are tandemly arranged. In this device, the two press machines are configured to be operated synchronously by directly connecting the crankshafts of the two press machines. Therefore, there is no need to provide an accumulator between both the press machines to absorb the difference between the stopping timings thereof and/or between the feeding speeds thereof. Further, Patent Document 1 discloses an intermediate loop portion for adjusting the coil strip length between the press machines in accordance with the die pitch when replacing the dies.

15 [0003] Paragraph [0009] of Patent Document 2 discloses a tandem line composed of an automatic feeding device for intermittently feeding a coil strip fed by a leveler at a predetermined rate and a punching press machine in which two press machines are arranged so as to sandwich the automatic feeding device at its front and rear ends. To adjust the die pitch and the feeding center, a technique is disclosed in which press machines are installed in a position-adjustable manner forward and rearward (in the width direction of the coil strip) or leftward and rightward (in the feeding direction of the line).

20 [0004] Patent Document 3 discloses that in a tandem press line in which each processing, such as, e.g., drawing, trimming, piercing, and cutting, is performed by a single press machine, a press pitch adjustment device for adjusting the distance between press machines is provided.

Prior Art Documents**Patent Documents**

30 [0005]

Patent Document 1: Japanese Unexamined Patent Application Publication No. 2011-205836

35 Patent Document 2: Japanese Unexamined Patent Application Publication No. H09-108898

Patent Document 3: Japanese Unexamined Patent Application Publication No. 2009-233673

SUMMARY OF THE INVENTION

40 **Problems to be Solved by the Invention**

[0006] In the tandem press line described in Patent Document 1, an intermediate loop portion is provided to adjust the material length between press machines, and therefore, the feeding path of the material is greatly curved. A total of four feeding devices (feeders 51 to 54), two for each press machine, are provided. Therefore, the entire device is large in scale, and the line length is long. For this reason, the transfer mass of the material is also large.

45 [0007] In the tandem press line described in Patent Document 2, only one feeding device (automatic feeding device 30) is provided for two press machines, and no intermediate loop portion is required, and therefore, the line length can be shortened. However, the operation timings of the two press machines and the feeding device should be adjusted to coincide with each other, and therefore, a high-speed operation cannot be achieved. In the tandem press line described in Patent Document 3, each processing step, such as, e.g., a drawing step and a punching step, is performed with one press machine. Therefore, it is difficult to perform a high-speed operation.

50 [0008] Further, in a conventional tandem press line, a coil strip is generally transferred in a state of being lifted above the upper surface of the lower die by a material lifter provided on the lower die. When performing processing with the press machine, the pressing is performed while pushing down the material lifted by the material lifter to the lower die upper surface. Therefore, in the case of not providing loosening of the coil strip by an accumulator or intermediate loop, there is possibility that the coil strip between the first press machine and the second press machine interferes with the feeding rollers of the feeding device, the movement of the coil strip is hindered, and the coil strip breaks in the middle

due to excessive tension.

[0009] The present invention aims to provide a tandem press line capable of shortening a line length, suppressing the possibility of occurrence of a breakage of a coil strip even with little looseness in the coil strip, and allowing a high-speed operation.

Means for Solving the Problem

[0010] A tandem press line 10, 10A, 10B, and 60 according to the present invention is provided with a first press machine 11 configured to perform punching on a coil strip W fed intermittently, a second press machine 12 configured to further perform punching on the coil strip W fed from the first press machine 11, in synchronization with the first press machine 11, and an intermediate feeding device (second feeding device) 37, 50, 50A, and 50B provided between the first press machine 11 and the second press machine 12, the intermediate feeding device being configured to grip the coil strip W when feeding the coil strip W and release the coil strip W when performing pressing. The first press machine 11 and the second press machine 12 are provided with a first forming die 40 and a second forming die 41, respectively, the first forming die 40 and the second forming die 41 being each provided with a material lifter 45 having the same stroke length on a lower die 40a, 41a. A lower die upper surface height of the first forming die 40 and a lower die upper surface height of the second forming die 41 are the same each other and a feeding line height of the intermediate feeding device 37 is higher than the lower die height by $1/2$ of a lift stroke length h of the material lifter 45 or the lower die upper surface height of the first and the second forming dies 40, 41 are different from each other by the stroke height h of the material lifter, and a feeding line height of the intermediate feeding device 37, 50, 50A, 50B is the same as a higher lower die upper surface height out of the lower die upper surface height of the first forming die 40 and the lower die upper surface height of the second forming die 41.

[0011] And a length along the coil strip W from the material lifter 45 provided at a rear end of the first forming die 40 to the material lifter 45 provided at a front end of the second forming die 41 is the same before performing the pressing and when performing the pressing.

[0012] In such tandem press line, it is preferable that the intermediate feeding device 37, 50, 50A, 50B be composed of a roll feeder provided with upper and lower rollers 37a, 37b, 50a, 50b, the upper and lower rollers being configured to rotate with the coil strip gripped therebetween when feeding the coil strip and release the gripping when performing pressing. Further, it is preferable that the intermediate feeding device 50, 50A, 50B be provided with a material guide 52, 53, the material guide 52, 53 being configured to change a feed angle corresponding to lift/down movements of the coil strip W caused by operations of the press machines 11, 12.

[0013] It is preferable that the tandem press line be further provided with: a feeding device 36 arranged on an upstream side of the first press machine 11; and a feeding device 38 arranged on a downstream side of the second press machine 12, wherein the feeding devices are each composed of upper and lower rollers 36a, 36b, 38a, 38b and configured to grip the coil strip W between the upper and lower rollers 36a, 36b, 38a, 38b when feeding the coil strip W and release the gripping of the coil strip W when performing pressing. Further, it is preferable that the first press machine 11 and the second press machine 12 be coupled to each other by connecting the frames 16, 16, beds 16a, 16a, or bolsters 20, 20 thereof.

Effects of the Invention

[0014] In the tandem press line of the present invention, in such case that the height of the upper surface of the lower die of the first forming die and the height of the upper surface of the lower die of the second forming die are the same each other and the feeding height of the intermediate feeding device 37, 50, 50A, 50B is higher than the upper surface of the lower die by $1/2$ of the lift stroke h of the material lifter, the height of the feeding line of the intermediate feeding device is lower than the material lifter of the first and second dies by $1/2$ stroke of the material lifter before stamping, and the height of the feeding line of the intermediate feeding line is conversely higher than the material lifter during stamping. Therefore, before and during press processing (stamping), only the direction of the inclination of the coil strip is different, but the angle of the coil strip is the same before and during of processing, and a length along the coil strip W from the material lifter 45 provided at a rear end of the first forming die 40 to the material lifter 45 provided at a front end of the second forming die 41 is the same before stamping and during stamping.

[0015] Another side, in case that the lower die upper surface height of the first forming die and the lower die upper surface height of the second forming die are different from each other, and the height difference is the same as a stroke length of the material lifter, during the transferring of the coil strip, the coil strip is arranged in an inclined state in the section between the higher forming die (material lifter) and the intermediate feeding device (roll center), while the coil strip is arranged in an approximately horizontal state in the section between the lower forming die (material lifter) and the intermedial feeding device (roll center).

[0016] When performing processing with the press machine, the material lifter of the first forming die and the material

lifter of the second forming die are simultaneously moved down to the upper surface level of the lower die. For this reason, between the lower forming die (material lifter) and the intermediate feeding device (roll center), the coil strip becomes an inclined state from the horizontal state, which applies tension to the coil strip. However, in the section between the higher forming die (material lifter) and the intermediate feeding device (roll center), the coil strip becomes a generally horizontal state from the inclined state, which causes loosening of the coil strip.

[0017] That is, the change in the length of the coil strip in the section from the material lifter at the rear end of the first forming die to the intermediate feeding device and the change in the length of the coil strip in the section from the intermediate feeding device to the material lifter at the front end of the second forming die are canceled before and after the pressing. Therefore, the tension of the coil strip can be relieved, which reduces the possibility of occurrence of a fracture of the coil strip during the operation. In addition, since the length of the coil strip between the press machines can be shortened, the transfer mass can be reduced, which makes it possible to increase the transfer speed.

[0018] In a specific example, in progressive processing, after completion of the feeding of the coil strip by the feeding device, the coil strip is positioned with respect to the lower die by fitting a pilot pin provided on an upper die of a first press machine or upper dies of first and second press machines to a positioning hole formed by punching a coil strip in a first step. Note that "after completion of the feeding and before positioning of the coil strip to the die" means a period from the completion of the feeding of the coil strip by the feeding rollers of the intermediate feeding device to the completion of the positioning of the coil strip to the die.

[0019] Then, the feeding device releases the feeding rollers prior to the positioning of the coil strip to make the coil strip in a free state to thereby prevent the disturbance of the positioning by the pilot pin. After being positioned, the coil strip is pushed down by the stripper plate provided on the upper die prior to the punching by the press machine. Therefore, the coil strip is pressed against the upper surface of the die plate of the lower die while being drawn into the die, and punching is performed in that state. After completion of the punching, the stripper plate, and the pilot pin are separated sequentially from the coil strip, and the feeding device starts feeding the coil strip, which has become in a free state again, gripped by the feeding rollers.

[0020] In a case where the height of the lower die of the first forming die and the height of the lower die of the second forming die are the same and the feeding line height of the intermediate feeding device is 1/2 of the lift stroke length of the material lifter, there is no need to provide a height difference between the dies. Therefore, the setting of the dies can be performed easily. In another side, in a case where the feeding line height of the intermediate feeding device is the same as the lower die upper surface height of the first forming die or the lower die upper surface height of the second forming die, the bent or curved angle of the coil strip at the intermediate feeding device is gentle, resulting in smooth feeding of the coil strip.

[0021] According to the tandem press line of the present invention, the length along the coil strip from the material lifter at the rear end of the first forming die to the material lifter at the front end of the second forming die is the same before and during the pressing. Therefore, at the time of the pressing, the forming die will not pull the coil strip at the time of the pressing, or even if one of the forming dies pulls the coil strip, the other die allows the feeding of the coil strip. This suppresses the occurrence of a breakage of the coil strip.

[0022] In either tandem press line, in a case where the intermediate feeding device is composed of a roll feeder provided with upper and lower rollers that rotate with the coil strip gripped when feeding the coil strip and release the coil strip by releasing the gripping when performing pressing, the feeding of the coil strip can be performed smoothly. Further, in a case where the intermediate feeding device is provided with a material guide configured to change the angle corresponding to the lift/down movements of the material caused by the operations of the press machines, there is no fluttering of the coil strip. Therefore, it is possible to feed the coil strip stably from the first forming die to the intermediate feeding device and from the intermediate feeding device to the second forming die, respectively.

[0023] In a case where a feeding device configured to grip the coil strip with the upper and lower rollers when feeding the coil strip is arranged on the upstream side of the first press machine and on the downstream side of the second press machine, it is possible to smoothly feed the coil strip in a stable manner as a whole.

[0024] In a case where the frames, beds, or bolsters of the first press machine and the second press machine are coupled with each other, there is less fluctuation in the distance between the press machines, i.e., the distance between the dies, or there is less difference in the vertical movements of the press machines. Therefore, the tandem press line can be stably operated.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

FIG. 1 is a front view showing an embodiment of a tandem press line according to the present invention.

FIG. 2A and FIG. 2B are a cross-sectional view and a plan view showing an example of punching dies, respectively.

FIG. 3A and FIG. 3B are explanatory diagrams showing the operation of the tandem press line.

FIG. 4A and FIG. 4B are explanatory diagrams showing the operation of another embodiment of a tandem press line. FIG. 5 is an explanatory diagram showing the operation of still another embodiment of a tandem press line. FIG. 6A, FIG. 6B, and FIG. 6C are a plan view, a front view, and a side view of an embodiment of an intermediate feeding device, respectively.

FIG. 7A is a front view of an intermediate feeding device according to another embodiment. FIG. 7B and FIG. 7C are a front view and a side view of an intermediate feeding device according to still another embodiment, respectively. FIG. 8A, FIG. 8B, and FIG. 8C are explanatory diagrams of a lower die height adjusting device.

EMBODIMENTS FOR CARRYING OUT THE INVENTION

[0026] The tandem press line 10 shown in FIG. 1 is provided with a first press machine 11, a second press machine 12, and a connection member 13 for connecting the press machine 11 and the press machine 12 to each other. On the upstream side of the tandem press line 10, a coil feeder 14 for feeding a coil strip W to the line is arranged. This tandem press line 10 is for punching the coil strip W with the dies 40 and 41, and in particular, can continuously produce a laminated motor core and the like at high speed. In this case, the first press machine 11 sequentially performs punching on the coil strip W a plurality of times, and finally performs outer shape punching and laminating to produce a rotor of a motor. The second press machine 12 performs punching a plurality of times, outer shape punching, and laminating on the remaining portion of the coil strip W used in the first press machine 11 to produce a stator.

[0027] The first press machine 11 is composed of a frame 16 fixed to the floor via a base 15, a crankshaft rotatably provided on the upper portion of the frame 16, two connecting rods 18 attached to the crankshaft, a slide 19 suspended by the connecting rods 18 and vertically guided by the frame 16, a bolster 20 attached to the frame 16, and the like. The frame 16 has a bed 16a, columns 16b erected from the bed 16a, and a crown 16c supported by the columns 16b, and they are coupled by tie rods (not shown). A bolster 20 for fixing the lower die 40a is attached to the bed 16a.

[0028] The connecting rods 18 are connected to the slide 19 via a plunger (not shown), and the slide 19 is vertically stroked in accordance with the rotation of the crankshaft. In the die 40, the lower die 40a is fixed to the bolster 20, and the upper die 40b is fixed to the slide 19. The upper die 40b is vertically stroked in accordance with the vertical movements of the slide 19.

[0029] The type of the press machine belongs to a so-called high-speed automatic press suitable for high-speed blanking. For example, the press machine is provided with a high rigidity frame that can withstand blanking of a silicon steel sheet at a stroke of 10 to 30 mm and a rate of 200 to 600 spm (stroke per minute), and a pre-loaded precision slide guide, etc. The base 15 has a built-in vibration proof mechanism.

[0030] Since the second press machine 12 is substantially the same as the first press machine 11, the same symbol is assigned thereto, and the explanation thereof will be omitted.

[0031] Between the frame 16 of the first press machine 11 and the frame 16 of the second press machine 12, specifically between both the beds 16a, a connection member 13 described above is interposed, and the frames 16 are integrally connected with tie rods or the like. The reason why the press machines 11 and 12 are integrally connected as described above is to reduce the fluctuations of the distance between the press machines 11 and 12, i.e., the fluctuations of the distance between the dies 40, 41, as small as possible and reduce the difference of the vertical movements of the press machines 11 and 12, to thereby stably operate the tandem press line 10. Note that it may be configured such that both the press machines 11, 12 are fixedly arranged on a common plate and that the common plate is supported by the bases 15. Alternatively, the bolsters 20 may be coupled to each other, and the columns 16b may be coupled to each other.

[0032] The coil strip W is punched to form a position determination hole in the first step of the first press machine 11. Then, when the coil strip W has been fed to the die in the second or subsequent step, the pilot pin Pp of the upper die 40b is fitted into the position determination hole, so that the coil strip W is positioned with respect to the lower die 40a. Therefore, in the tandem press line 10 in which the coil strip W is fed substantially straight in the feeding direction to perform progressive processing, the center-to-center distance L between the pilot pin Pp1 positioned on the most downstream side of the die (first forming die) 40 installed on the first press machine 11 and the pilot pin Pp2 positioned on the most upstream side of the die (second forming die) 41 installed on the second press machine 12.

[0033] A rotation driving source, such as, e.g., an electric motor (not shown), is connected to the crankshaft of each of the first press machine 11 and the second press machine 12. The electric motors are synchronously controlled such that the rotational speed and the rotational angle are the same to each other. Each electric motor is an induction motor. However, the electric motor is not limited to an induction motor, but a DC motor, an AC servo motor, a DC servo motor, etc., can be used.

[0034] The coil feeder 14 is provided with an uncoiler 30, a leveler 31, and a loop control 32. The uncoiler 30 holds the coil strip W, feeds the coil strip W by rotating, or rotates when the coil strip W is pulled out. The leveler 31 corrects the winding habit of the coil strip W fed from the uncoiler 30 into a flat shape.

[0035] In the tandem press line 10 shown in FIG. 1, on the upstream side (left side) of the frame 16 of the first press machine 11, a first feeding device 36 is provided. On the upstream side (left side) and the downstream side (right side)

of the second press machine 12, a second feeding device (intermediate feeding device) 37 and a third feeding device 38 are provided, respectively. The first feeding device 36, the second feeding device 37 and the third feeding device 38 are each configured to sandwich the coil strip W with the upper and lower rollers and intermittently feed the coil strip W to the downstream side in accordance with the operations of the press machines 11 and 12.

[0036] These feeding devices 36, 37, 38 are set to feed the coil strip W along the feeding lines FP1, FP2 of the respective press machines 11, 12 or dies 40, 41. The first feeding device 36 is arranged such that the upper surface of the lower roller 36a coincides with the feeding line FP1 that is higher than the lower die 40a of the die 40 of the first press machine 11 by the stroke length h of the guide lifter 45. The second (intermediate) feeding device 37 is arranged such that the upper surface of the lower roller 37a coincides with the height of the lower die 40a of the die 40 of the first press machine 11, i.e., the feeding line FP2 higher than the upper surface of the lower die 41a of the die 41 of the second press machine 12 by the stroke length h of the guide lifter 45 (see FIG. 3). The third feeding device 38 is arranged such that the upper surface of the lower roller 38a coincides with the height of the upper surface of the lower die 41a of the die 41 of the second press machine 12 (see FIG. 3).

[0037] In all of the feeding devices 36, 37, 38, the lower roller 36a, 37a, 38a is rotatably driven by a motor. On the other hand, the upper roller 36b, 37b, 38b is driven vertically in response to a signal from a control device to sandwich the coil strip W between the upper roller and the lower roller by lowering when feeding the coil strip W and release the coil strip W by rising when pressing or facilitate the passing of the coil strip W through the line. Note that it may be configured such that the coil strip W is released (can be pulled out) by idling the upper and lower rollers. Further, it may be configured such that a roller driving motor is provided only to the second feeding device 37 and that the rollers of the first feeding device 36 and the third feeding device 38 are configured to only guide the coil strip W, for example, the rollers are configured to idle. The reference symbol SC on the downstream side of the third feeding device 38 denotes a scrap cutter that cuts the coil strip W (scrap) to a constant length after punching the product.

[0038] In the tandem press line 10 shown in FIG. 1, as will be described later, the coil strip W pulled into the die 40 of the first press machine 11 when performing the pressing and the coil strip W fed from the lower die 41a of the die 41 of the second press machine 12 are balanced. Therefore, there is no need to provide an accumulator between the dies 40 and 41. This makes it possible to narrow the distance between the press machine 11 and the press machine 12, and therefore, it is possible to provide a downstream side feeding device of the first press machine 11 and an upstream side feeding device of the second press machine 12 by a single feeding device (second feeding device 37 (intermediate feeding device)). Therefore, the equipment cost can be reduced, and the line length can be further shortened.

[0039] Now with reference to FIG 2A and FIG 2B, an example of a die 40 used in the tandem press line 10 is described. FIG. 2A shows an example of a punching die used for the tandem press line 10, etc., shown in FIG. 1. The left half shows the state when the press machine is at rest or when the material is being fed, and the right half shows the state when the material is being processed. The punching die (first forming die) 40 is composed of a lower die 40a and an upper die 40b. The lower die 40a includes a base 42, a lower die plate 42a provided on the base, a guide lifter (material lifter) 45 fitted in a through-hole 42b formed in the die plate 42a in a vertically freely slidable manner, and a spring 44 accommodated in the hole 43 of the base 42 to urge the guide lifter 45 upward. The guide lifter 45 guides the side edge of the coil strip W to regulate the vertical position.

[0040] The guide lifter 45 is provided at the lower end thereof with a flange 45a. The upper surface of the flange 45a is brought into contact with the lower surface of the die plate 42a, thereby regulating the rising end of the guide lifter 45. The lower surface of the flange 45a is in contact with the spring 44. The guide lifter 45 is provided in the vicinity of the upper end thereof with an annular groove 45b for slidably guiding the side edge of the coil strip W. Note that a lifter which comes into contact with the lower surface of the coil strip W to lift the coil strip W (see the reference symbol 45c in FIG. 3) may also be used in conjunction with the guide lifter 45.

[0041] The guide lifter 45 is configured to hold the coil strip W at a position lifted slightly (e.g., about 10 mm) from the lower die upper surface to avoid the contact between the coil strip W and the lower die upper surface, when feeding the coil strip W. Therefore, the coil strip W is lifted somewhat (e.g., about 10 mm) from the upper surface of the lower die 40a and is transferred along the feeding line FP1.

[0042] The upper die 40b includes a base 46, a punch 47, a stripper plate 48, and a spring 49 for urging the stripper plate 48 downward. In the die plate (die) 42a of the lower die 40a, a through-hole having the same shape as the punching die or a hole 42c having the same shape as the contour of the core (rotor or stator) to be punched from the coil strip W is formed. The punch 47 of the upper die 40b is mated with the hole 42c to punch the coil strip W. The stripper plate 48 is for detaching the coil strip W from the punch 47 of the upper die 40b and is provided on the lower surface thereof with a hole 47a for fitting the upper portion of the guide lifter 45.

[0043] Therefore, as shown in the right side of FIG. 2A, at the time of processing the coil strip W, the stripper plate 48 presses the coil strip W on the upper surface of the die plate 42a and pushes down the guide lifter 45. Therefore, as shown on the left side of FIG. 2A, the coil strip W is held along the feeding line FP which is high than the upper surface of the lower die 40a during the transfer and is pushed down to the height (processing height) Ho of the upper surface of the lower die 40a at the time of processing as shown in the right side of FIG. 2A.

[0044] According to the tandem press line 10 shown in FIG. 1, as shown in FIG. 3, in the die 40 of the first press machine 11, the coil strip W is transferred along the feeding line FP1 which is higher than the upper surface of the lower die 40a by the stroke length h of the guide lifter 45 during the transfer due to the relation between the first feeding device 36 and the dies 40a and 40b. At the time of the pressing, the upper die 40b presses down the corresponding portion of the coil strip W to the upper surface (Ho) of the lower die 40a. Consequently, in the section S1 from the first feeding device 36 to the die 40, the coil strip W becomes inclined such that the tip side is lowered. In this way, in the tandem press line 10, at the time of the pressing, the coil strip W passes through a somewhat longer path as compared with the straight path at the time of the transfer, and therefore, the upstream side and the downstream side of the coil strip W in the range between the dies 40a and 40b are drawn by the length difference of the paths.

[0045] During the processing, the upper rollers 36b, 37b, and 38b of the feeding devices 36, 37, and 38 are raised to release the coil strip W, respectively. Therefore, the coil strip W is drawn from the upstream side of the first press machine 11 as shown by the arrow R1 to compensate for the length difference of the paths described above.

[0046] On the other hand, in the section S2 between the die 40 of the first press machine 11 and the second feeding device 37, the coil strip W is inclined forwardly downward in the traveling direction at the time of the transfer, and the coil strip W becomes horizontal at the time of the pressing. For this reason, the coil strip W becomes excessive by the length difference of the paths, and the coil strip W is transferred to the second press machine 12 through the gap of the released rollers 37a and 37b (see the arrow R2).

[0047] In the section S3 between the second feeding device 37 and the die 41 of the second press machine 12, the coil strip W is horizontal at the time of the transfer and is inclined forwardly downward in the traveling direction at the time of the pressing. Therefore, the coil strip W becomes insufficient by the length difference of the paths. However, as described above, since the material is excessive in the die 40 of the first press machine 11, this amount is compensated for by the die 41 of the second press machine 12 and both the lengths are balanced in front and rear of the second feeding device 37. That is to say, the length along the coil strip W ($S2a+S3$ (FIG.3A)) from the rear material lifter 45 of the forming die 40 of the first press machine 11 to the front material lifter 45 of the forming die 41 of the second press machine 12 before pressing is the same as the length at the time of pressing ($S2+S3a$ (FIG.3B)), (i.e.: $S2a+S3=S2+S3a$). Therefore, there occurs no tensile of the coil strip W between the first press machine 11 and the second press machine 12, thereby suppressing the risk of occurrence of breakage of the coil strip W.

[0048] Note that between the die 41 of the second press machine 12 and the third feeding device 38, the coil strip W becomes inclined forwardly downward at the time of the transfer and becomes horizontal at the time of the pressing. Therefore, the coil strip W will become excessive by the length difference of the paths but is transferred forward (toward the scrap cutter side) through the gap between the released rollers 38a and 38b, thereby suppressing the excessiveness.

[0049] Incidentally, as in a conventional tandem press line, in a case where the height of the upper surface of the lower die 40a of the first press machine 11 and the upper surface of the lower die 41a of the second press machine of the lower die 41a are the same and that the feeding line heights of the first, second, and third feeding devices 36, 37, 38 are the same, the first press machine 11 and the second press machine 12 are operated synchronously, and the processing is performed simultaneously. Therefore, there is no extra material that can be drawable in the vicinity of the second feeding device 37, and therefore, the length difference of the paths cannot be compensated for. Therefore, there is a possibility that the coil strip W is broken by being pulled from both sides.

[0050] Here, the coil strip W present at the location has a large number of holes formed by the processing with the dies of the first press machine 11 and is in a state susceptible to deformation by an external force. When the processed coil strip W is pulled from both sides in such a condition to be extended, deformation or pitch offset may occur in the positioning hole of the coil strip W. In a case where the positioning hole of the coil strip W is deformed, or in a case where pitch deviation has occurred, when inserting the pilot pin Pp of the die 41 of the second press machine 12 into the positioning hole, the pilot pin Pp is forcibly inserted therein, causing a further deformation of the periphery of the positioning hole. Consequently, the feeding pitch of the coil strip W may become inaccurate, resulting in misfeeding or a defective product.

[0051] However, by balancing the shortage and surplus of the coil strip W occurring between the die 40 of the first press machine 11 and the die 41 of the second press machine 12 are balanced as in the above-described tandem press line 10, it is possible to reduce the risk of occurrence of breakage of the coil strip W without interposing an accumulator. Further, since the distance between the press machines 11, 12 can be shortened, it is possible to reduce the transfer mass of the material, which in turn can attain high-speed processing.

[0052] In the tandem press line 10A shown in FIG. 4A, the feeding line height of the first feeding device 36 and that of the third feeding device 38 are set to be the same as the upper surface height of the lower die 40a of the die 40 of the first press machine 11. This makes it possible to unify the feeding line heights of the first, second, and third feeding devices 36, 37, and 38, which facilitates the line setting. The configurations other than the above are the same as those of the tandem press line 10 shown in FIG. 3. In terms of balancing the shortage and surplus of the coil strip W occurring between the die 40 of the first press machine 11 and the die 41 of the second press machine 12, and in terms of reducing the risk of occurrence of breakage of the coil strip W without interposing an accumulator by the above-described balancing,

the same effect as that in the tandem press line 10 shown in FIG. 3 can be exerted.

[0053] In the tandem press line 10 shown in FIG. 3, the lower die upper surface height of the die 41 of the second press machine 12 is set to be lower than the lower die upper surface height of the die 40 of the first press machine 11 by the stroke of the guide lifter 45. However, it may be configured such that the lower die upper surface height of the die 41 of the second press machine 12 is set to be higher than the lower die upper surface height of the die 40 of the first press machine 11, like the tandem press line 10B shown in FIG. 4B. That is, regardless of whether either die of the press machines is increased in height, by providing a difference in the lower die height between the die 40 of the first press machine 11 and the die 41 of the second press machine 12, it is possible to configure such that the coil strip W between them can take a horizontal state and an inclined state, which can achieve the same effect.

[0054] In the above-mentioned embodiments, the lower die upper surface height of the die 40 of the first press machine 11 and the lower die upper surface height of the die 41 of the second press machine 12 are differentiated. However, as in the tandem press line 10C shown in FIG. 5, the lower die upper surface height of the die 40 of the first press machine 11 and the lower die upper surface height of the die 41 of the second press machine 12 may be made the same. In this case, the feeding line height (the contacted part of the upper and lower rollers) from the lower die upper surface of the second feeding device 37 is set to 1/2 of the stroke h of the guide lifter 45. Thus, the coil strip W between the guide lifter 45 and the second feeding device 37 becomes the same inclination angle at the time of the transfer and at the time of the pressing, although there is a difference such that the leading edge is inclined forwardly downward and the leading edge is inclined forwardly upward. Therefore, even though the height of the die 40 and the height of the die 41 are the same, there occurs no shortage or surplus of the coil strip W.

[0055] FIGS. 6A to C show a preferred embodiment of a second feeding device (intermediate feeding device) that can be adopted in the tandem press line 10, 10A to 10C described above. In this second feeding device 50, a first guide 52 and a second guide 53 each capable of changing the angle of the coil strip W in two ways such that the coil strip W is horizontal or inclined, or in two ways such that the coil strip W is inclined forwardly downward or forwardly upward, on the upstream side and the downstream side of the feeding rollers 50a and 50b (the lower rollers 50a and the upper roller 50b). Each guide 52, 53 is composed of two plates 54 and 54 arranged via a gap through which the coil strip W passes. The two plates 54 and 54 are connected, for example, in the vicinity of the side edges. One end of each guide 52, 53 on the center side is rotatably supported by the left and right bearings (see the reference symbols "55" in FIG. 6C) so that the vicinity of the contact point of the upper and lower rollers 50a and 50b (the pinched portion of the coil strip W) is served as the rotation center P.

[0056] Note that the upper and lower rollers 50a, 50b are substantially in contact with each other in the vicinity of the rotation center P. Therefore, as shown in FIG. 6C, the plates are supported by a pair of bearings (pivot fulcrums) 55, 55 arranged on the left and right sides of the rollers 50a and 50b. Further, as shown in FIG. 6A, bifurcated end portions 52a of the first guide 52 and an end portion 53a of the second guide 53 arranged between the bifurcated end portions 52a and 52a are rotatably mounted around the same rotation shaft 53c.

[0057] Linear jacks 57 and 57 for tilting the first and second guide 52, 53 about the rotation center P are provided at positions away from the rotation center P. The linear jacks 57 and 57 are arranged at the center in the widthwise direction of the coil strip W (see FIG. 7C). The linear jacks 57 and 57 are each composed of, for example, a threaded shaft that is freely movable in the axial direction and constrained in the rotation and a nut member that is rotatably supported by being threadedly engaged with the threaded shaft and constrained in the axial movement. A motor M2, specifically a servo motor, for rotatably driving the nut member is provided to change the angle of the first guide 52 (the second guide 53) by controlling the rotation of the motor M2 with a controller CT. The controller CT rotatably drives the motor M2 based on the signal indicating the start of contact and separation of the stripper plate (the reference symbol 48 in FIG. 2A) of the die to change the angle of the guide 52, 53 each time the press machine is operated.

[0058] In this intermediate feeding device 50, in order to feed the coil strip W, similar to a conventional roll feeder, normally, the lower roller 50a is driven by the motor M1, particularly a servo motor. On the other hand, the upper roller 50b is rotated in synchronous to the lower roller 50a by a gear or the like. Alternatively, the upper roller 50b may be free. Further, the upper roller 51b may be rotatably driven. The supporting shaft of the upper roller 50b is provided in a vertically movable manner with respect to the housing. The supporting shaft is vertically driven by a lifting and lowering drive mechanism to release the coil strip W when being lifted and grip the coil strip W by pressing the upper roller 50b against the lower roller 50a when being lowered. Note that the lifting and lowering stroke is sufficient to be a dimension of such a degree to release the coil strip, i.e., allow the free movements of the coil strip W. For example, the stroke is sufficient to be a thickness of the coil strip W + 0.1 mm to 0.2 mm.

[0059] In the second feeding devices 50A and 50B shown in FIGS. 7A and 7B, the first guide 52 and the second guide 53 are arranged such that their rotation centers P1 and P2 are separated from each other and also separated from the upper roller 50a and the lower roller 50b. In the second feeding device 50A shown in FIG. 7A, bearings each serving as a rotation center P1, P2 are provided to the frame 59. On the other hand, in the second feeding device 50B shown in FIG. 7B, both ends of the shaft 58 provided to the end portion of each of the first guide 52 and the second guide 53 are rotatably supported by support tables 57a and 57a that erect upward from the base 56.

[0060] As described above, by separately providing the rotation center P1 of the first guide 52 and the rotation center P2 of the second guide 53 with the rotation centers P1 and P2 separated from the vicinity of the contact point of the rollers 50a and 50b, the configuration can be simplified, which facilitates the production.

[0061] Next, with reference to FIGS. 8A to 8C, the method of adjusting the upper surface height of the lower die will be described. In the tandem press line 60 in FIG. 8A, dies in which the height of the lower die 40a of the first press machine 11 is different from the height of the lower die 41a of the second press machine 12 are adopted to provide a difference in the upper surface heights of the lower dies corresponding to the stroke h of the guide lifter. According to this method, it can be easily applied to a conventional tandem press line.

[0062] FIG. 8B illustrates the main part of a press machine 62 in which a bolster 20 is mounted on the bed 16a in a height-adjustable manner. In this press machine 62, a vertical guide groove 63 is formed in the bed 16a. Guide rods 64 slidably inserted into the respective guide grooves 63 are attached to the lower surface of the bolster 20. A height-adjusting screw 65 is provided at the center of the lower surface of the bolster 20 to rotatably support a nut 66 threaded with the height-adjusting screw 65. A worm 67 meshed with worm grooves formed on the outer periphery of the nut 66 is provided in a freely rotatable manner, and a motor for rotatably driving the worm 67 is provided. By connecting two press machines 62 in which the height of the bolster 20 can be adjustable, the press machines 62 can be used for a tandem press line according to the present invention.

[0063] In the press machine 68 shown in FIG. 8C, a bed 16a is provided with respect to the base plate 69 in a height-adjustable manner. As the height adjustment mechanism, it is possible to use the guide groove 63, the guide rod 64, the height-adjusting screw 65, the nut 66, the worm 67, and the motor M2 or the like used in the press machine 62 shown in FIG. 8B. In place of the base plate 69, a common plate 70 to which two or more press machines are fixed may be used.

[0064] The material guide of the intermediate feeding device is preferably a movable material guide capable of changing the angle corresponding to the lift/down movements of the coil strip as described above, but it may be a substantially horizontal fixed material guide for guiding the upper and lower surfaces of the coil strip. In this case, it is sufficient that the distance from the material lifter at the rear end of the first forming die to the fixed guide inlet is substantially the same as the distance from the fixed guide outlet to the material lifter at the front end of the second forming die.

[0065] Although some preferred embodiments have been described above, the present invention is not limited to these embodiments, and any modifications, deformations, and changes can be made within the scope of the present invention.

Description of Symbols

[0066]

10, 10A, 10B, 10C:	Tandem press line
11:	First press machine
12:	Second press machine
13:	Connection member
14:	Coil feeder
W:	Coil strip
15:	Base
16:	Frame
16a:	Bed
16b:	Column
16c:	Crown
18:	Connecting rod
19:	Slide
20:	Bolster
30:	Uncoiler
31:	Leveler
32:	Loop control
36:	First feeding device
37:	Second feeding device (intermediate feeding device)
38:	Third feeding device
36a, 37a, 38a:	Lower roller
36b, 37b, 38b:	Upper roller
40:	Die (die of the first forming die, and die of the first press machine)
40a:	Lower die
40b:	Upper die
Pp:	Pilot pin

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	Pp1:	Most downstream side pilot pin of the die of the first press machine
	Pp2:	Most upstream side pilot pin of the die of the second press machine
	L:	Center-to-center distance between the most upstream pilot pin and the most downstream pilot pin
	41:	Die (second forming die and die of the second press machine)
5	41a:	Lower die
	41b:	Upper die
	42:	Base (lower die)
	42a:	Die plate
	42b:	Through-hole
10	42c:	Hole
	43:	(Base) hole
	44:	Spring
	45:	Guide lifter (material lifter)
	45a:	Flange
15	45b:	Annular groove
	45c:	Lifter (material lifter)
	46:	Base (upper die)
	47:	Punch
	47a:	Hole
20	48:	Stripper plate
	49:	Spring
	FP:	Feeding line
	Ho:	Upper surface height of the lower die
	h:	Elevating stroke of the guide lifter
25	S1:	Section from the first feeding device to the die of the first press machine
	S2:	Section from the die of the first press machine to the second feeding device
	S3:	Section from the second feeding device to the die of the second press machine
	R1:	Drawing to the press side
	R2:	Feeding to the press side
30	50, 50A, 50B:	Second (intermediate) feeding device
	50a:	Lower roller
	50b:	Upper roller
	52:	First guide
	P, P1, P2:	Rotation center
35	52a:	End portion
	53:	Second guide
	53a:	End portion
	54:	Plate
	55:	Bearing
40	M1:	Motor (feeding roller)
	M2:	Motor (linear jack)
	56:	Base
	57:	Linear jack
	57a:	Support table
45	58:	Shaft
	59:	Frame
	60:	Tandem press line
	62, 68:	Press machine
	63:	Guide groove
50	64:	Guide rod
	65:	Height-adjusting screw
	66:	Nut
	67:	Worm
	69:	Base plate
55	70:	Common plate

Claims

1. A tandem press line (10, 10A, 10B, 60) comprising:

5 a first press machine (11) configured to perform punching on a coil strip (W) fed intermittently;
 a second press machine (12) configured to further perform punching on the coil strip (W) fed from the first press machine (11), in synchronization with the first press machine (11); and
 an intermediate feeding device (37, 50, 50A, 50B) provided between the first press machine (11) and the second
 10 press machine (12), the intermediate feeding device (37, 50, 50A, 50B) being configured to grip the coil strip (W) when feeding the coil strip and release the coil strip when performing pressing,
 wherein the first press machine and the second press machine are provided with a first forming die (40) and a second forming die (41), respectively, the first forming die (40) and the second forming die (41) being each provided with a material lifter (45) having the same stroke length on a lower die (40a, 41a),

15 characterized in that:

the height of a lower dies (40a, 41a) of the first and the second forming dies (40, 41) are the same each other, and a feeding line height of the intermediate feeding device (37) is higher than the upper surface of the lower dies by 1/2 of a lift stroke length h of the material lifter (45) or

20 the lower die upper surface height of the first and the second forming dies (40, 41) are different each other by the stroke length h of the material lifter, and a feeding line height of the intermediate feeding device (37, 50, 50A, 50B) is the same as a higher lower die upper surface height out of the lower die upper surface height of the first forming die (40) and the lower die upper surface height of the second forming die, and a length along the coil strip (W) from the material lifter (45) provided at a rear end of the first forming die (40a) to the material
 25 lifter (45) provided at a front end of the second forming die (41a) is the same before performing the pressing and when performing the pressing.

2. The tandem press line as recited in claim 1,

30 wherein the intermediate feeding device (37, 50, 50A, 50B) is composed of a roll feeder provided with upper and lower rollers (37a, 37b, 50a, 50b), the upper and lower rollers being configured to rotate with the coil strip (W) gripped therebetween when feeding the coil strip and release the gripping when performing the pressing.

3. The tandem press line as recited in claim 1 or 2,

35 wherein the intermediate feeding device (50, 50A, 50B) is provided with a material guide (52, 53), the material guide (52, 53) being configured to change an angle corresponding to lift/down movements of the coil strip caused by operations of the press machines (11, 12).

4. The tandem press line as recited in any one of claims 1 to 3, further comprising:

40 a feeding device (36) arranged on an upstream side of the first press machine (11); and
 a feeding device (38) arranged on a downstream side of the second press machine (12),
 wherein the feeding devices (36, 38) are each composed of upper and lower rollers (36a, 36b, 38a, 38b) and configured to grip the coil strip (W) between the upper and lower rollers when feeding the coil strip (W) and release the gripping of the coil strip (W) when performing the pressing.

5. The tandem press line as recited in any one of claims 1 to 4,

45 wherein the first press machine (11) and the second press machine (12) are coupled to each other by connecting frames (16), beds (16a) or bolsters (20) thereof.

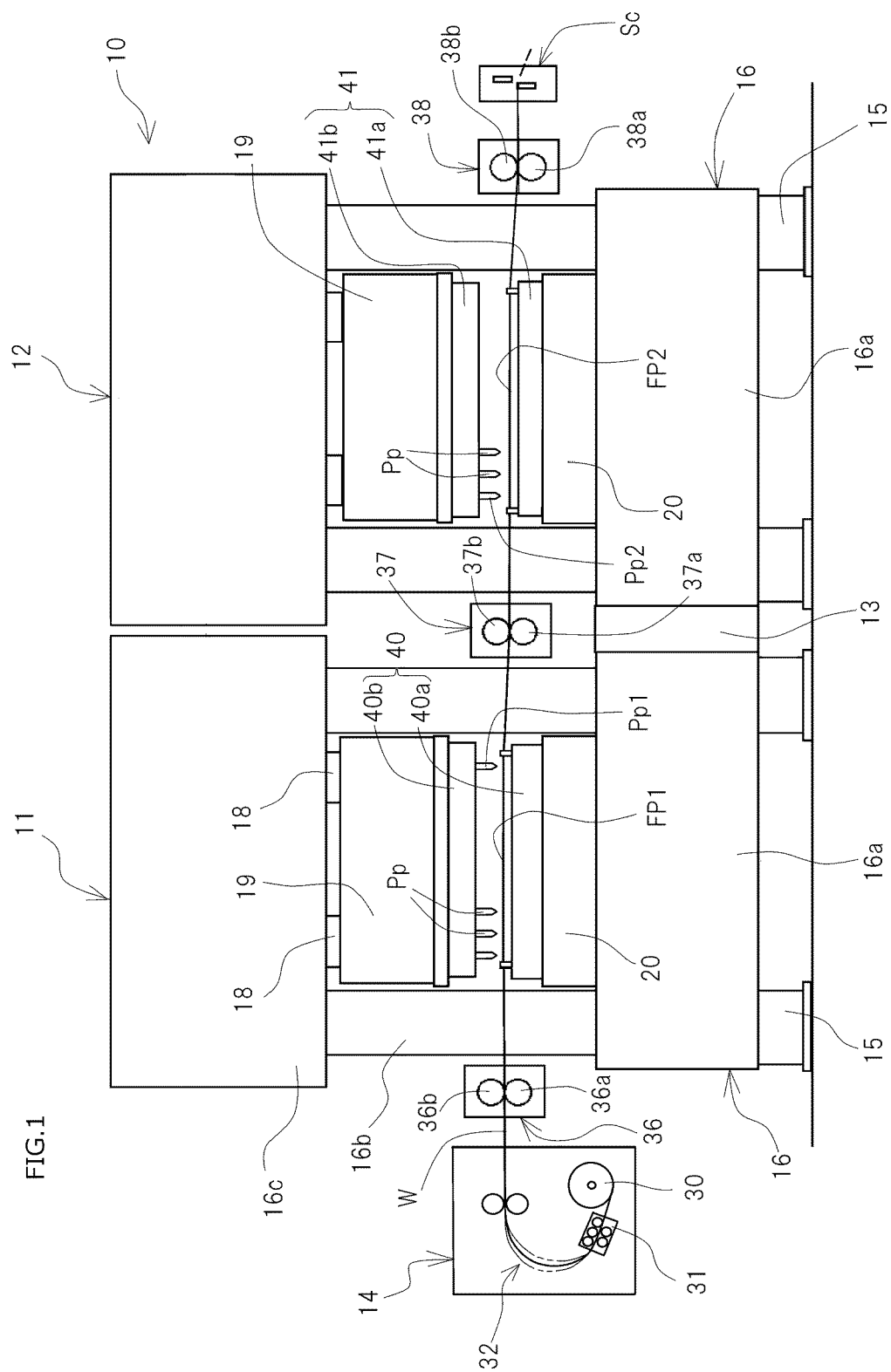


FIG.2A

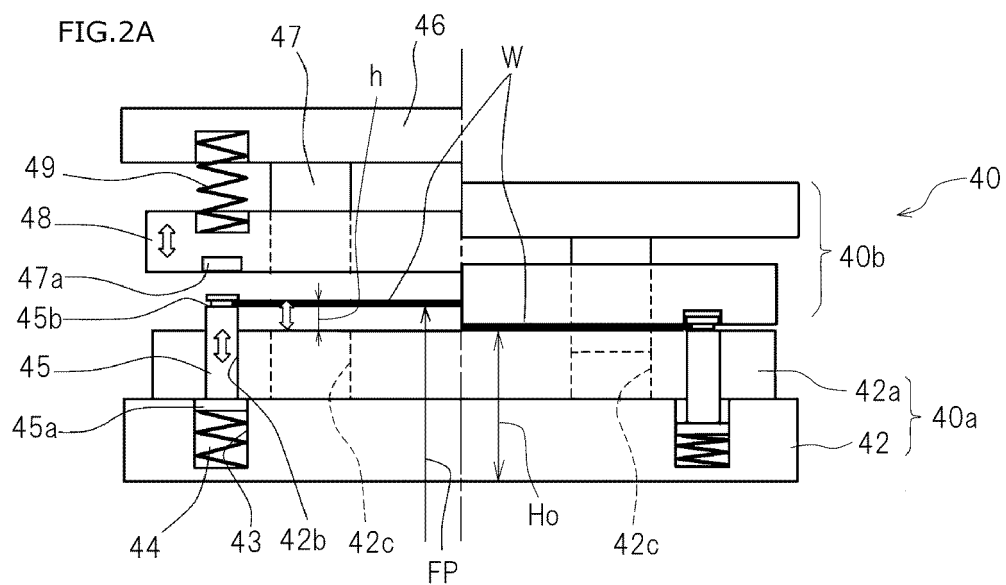
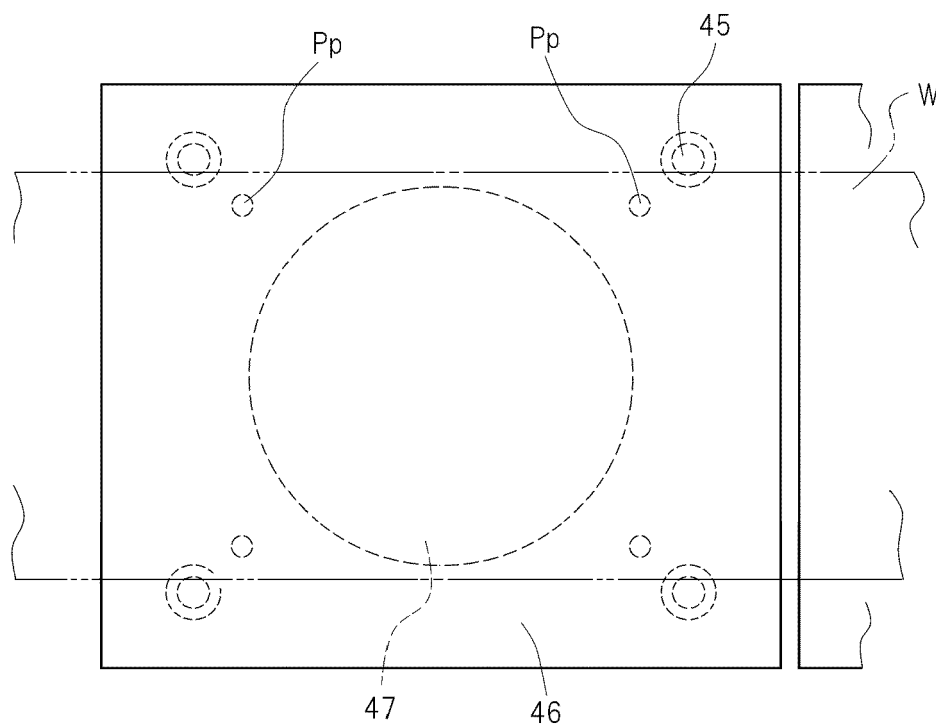


FIG.2B



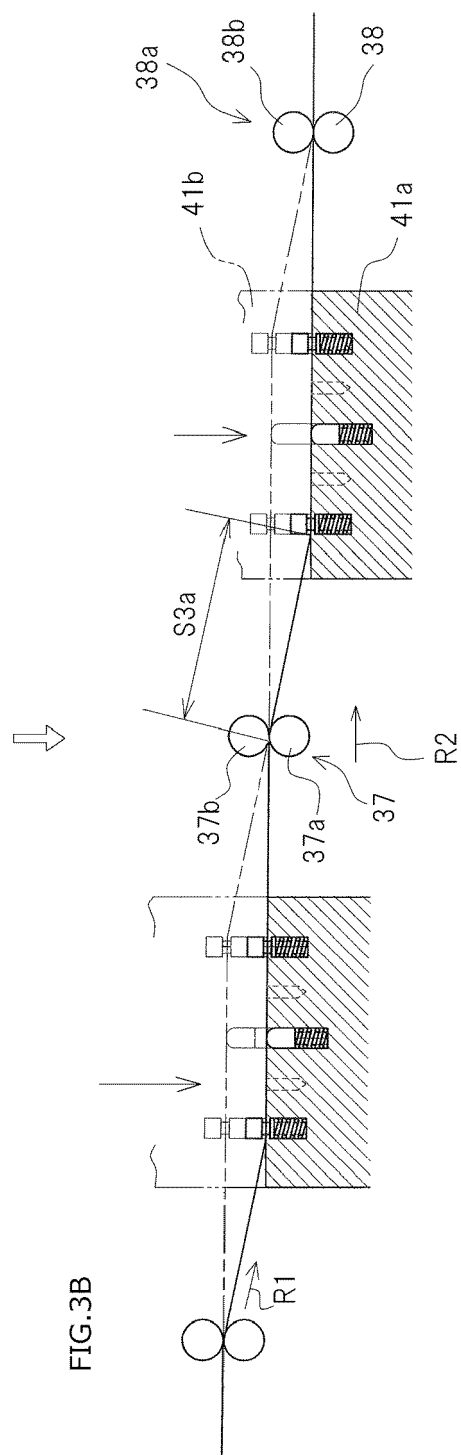
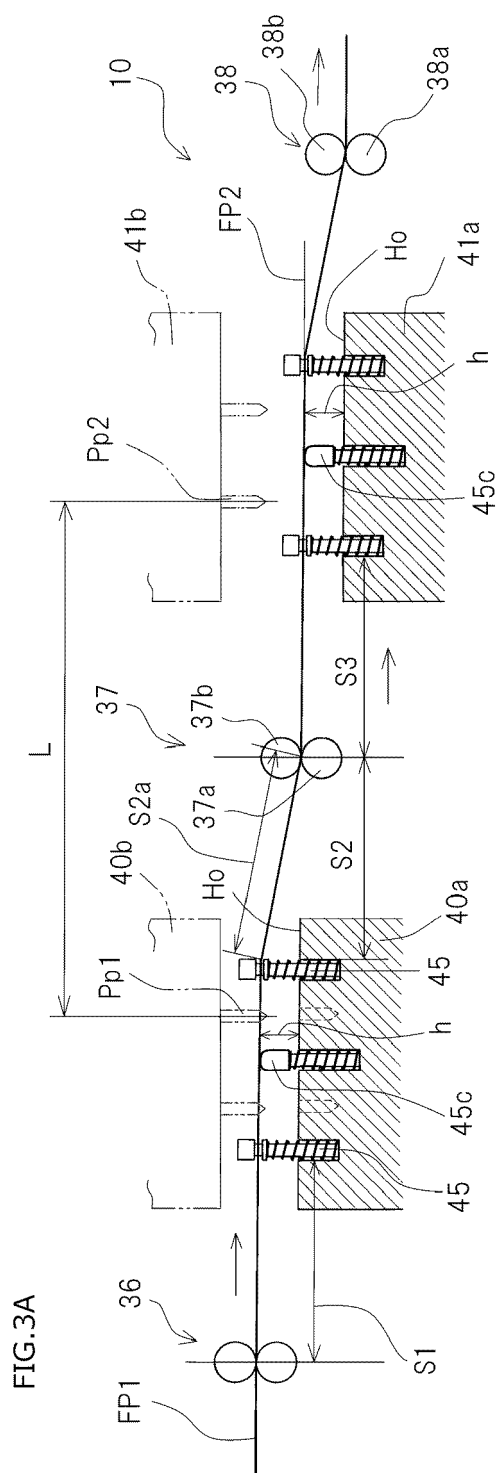


FIG. 4A

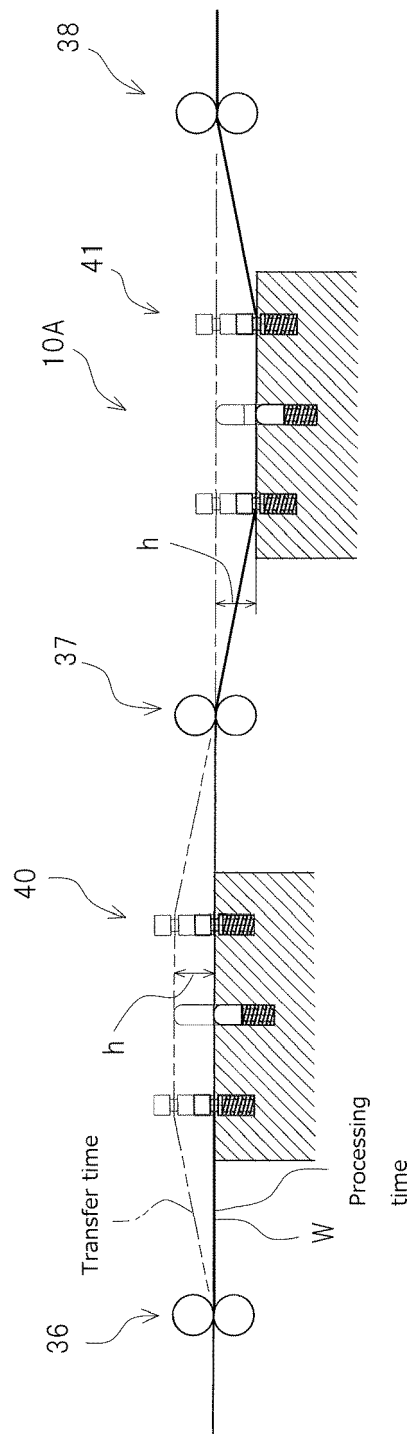


FIG. 4B

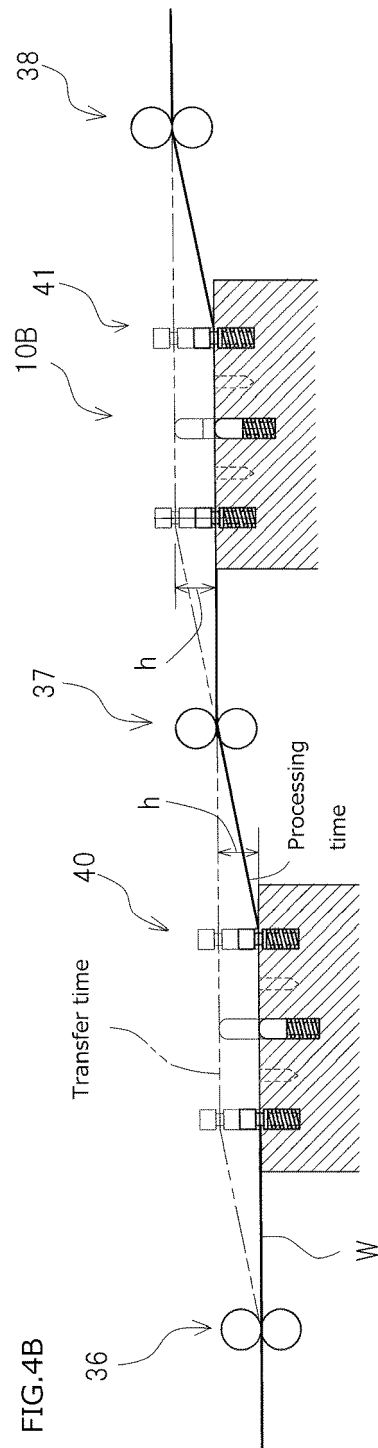


FIG.5

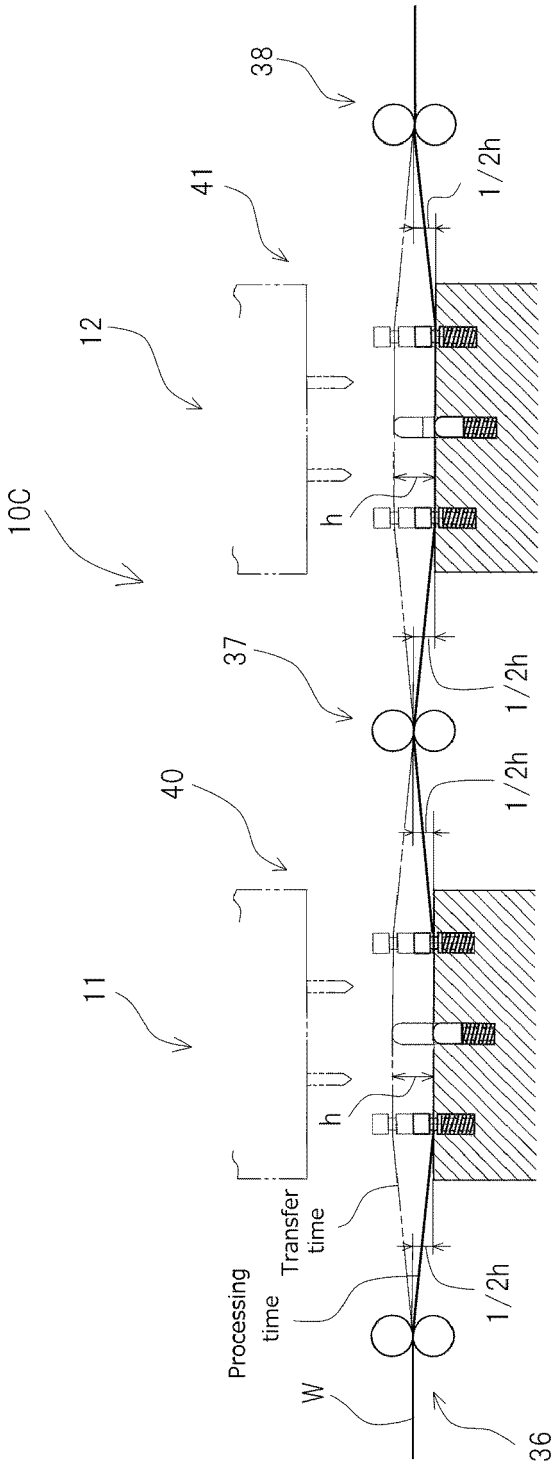


FIG.6A

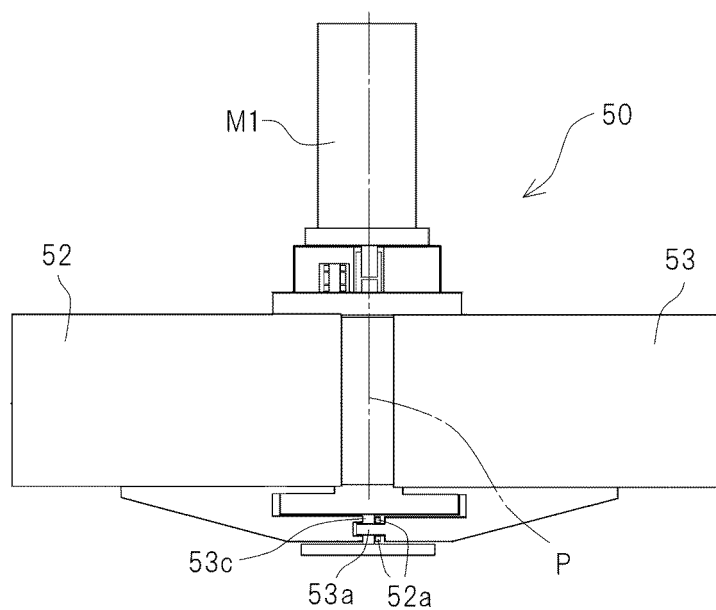


FIG.6B

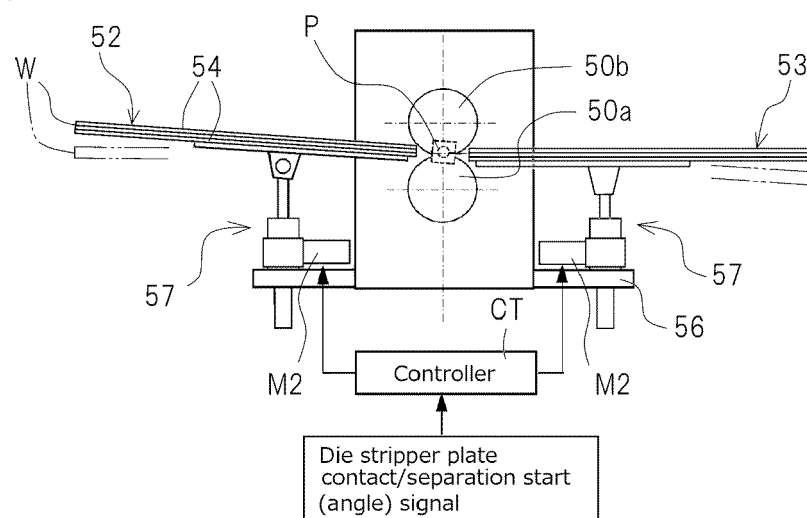


FIG.6C

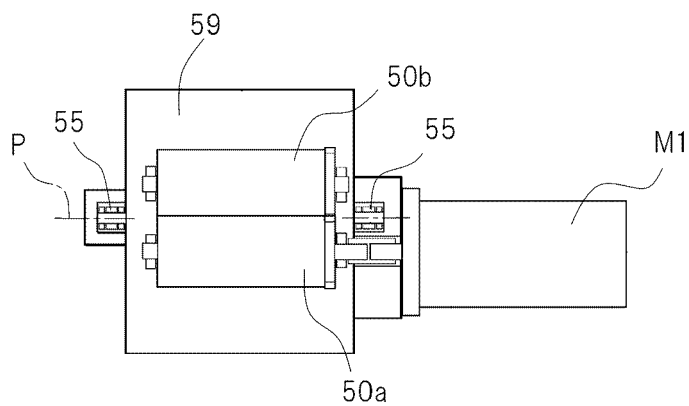


FIG.7A

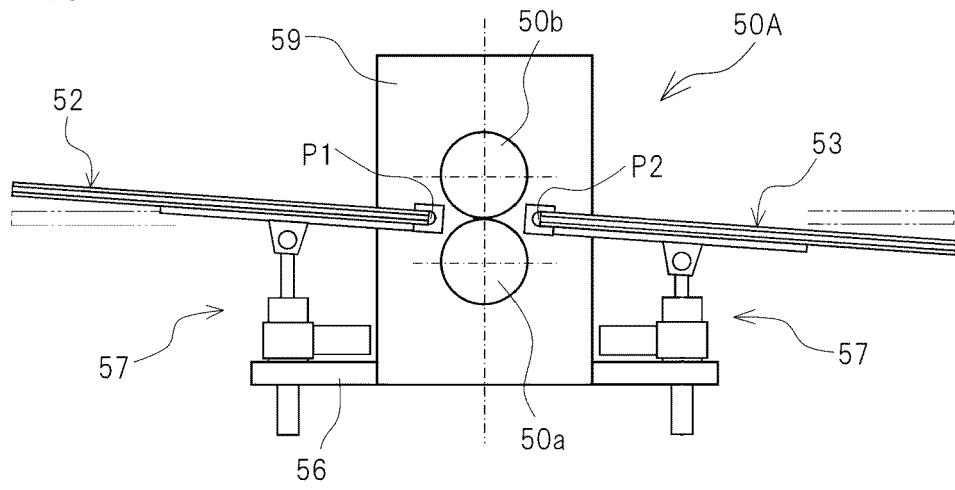


FIG.7B

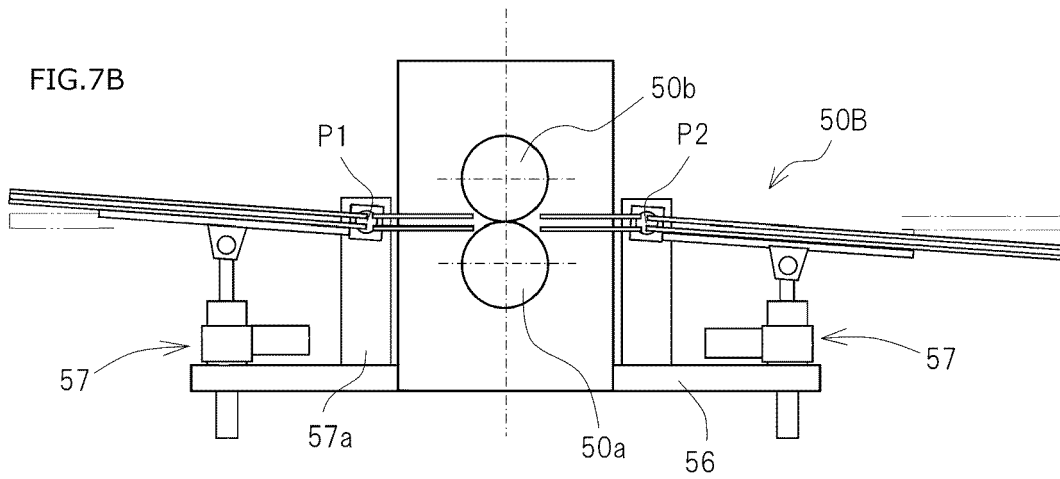
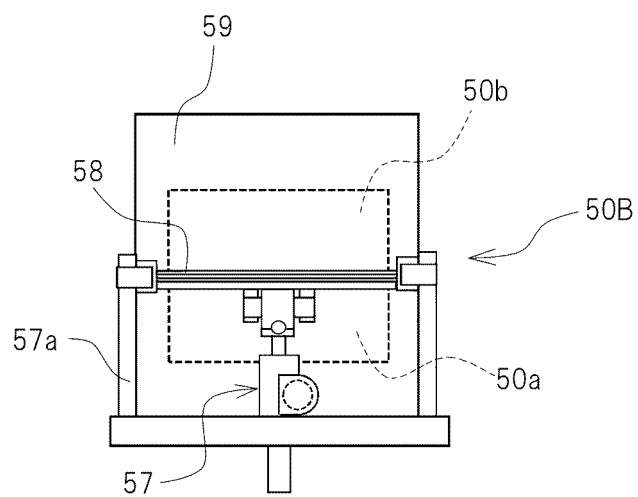
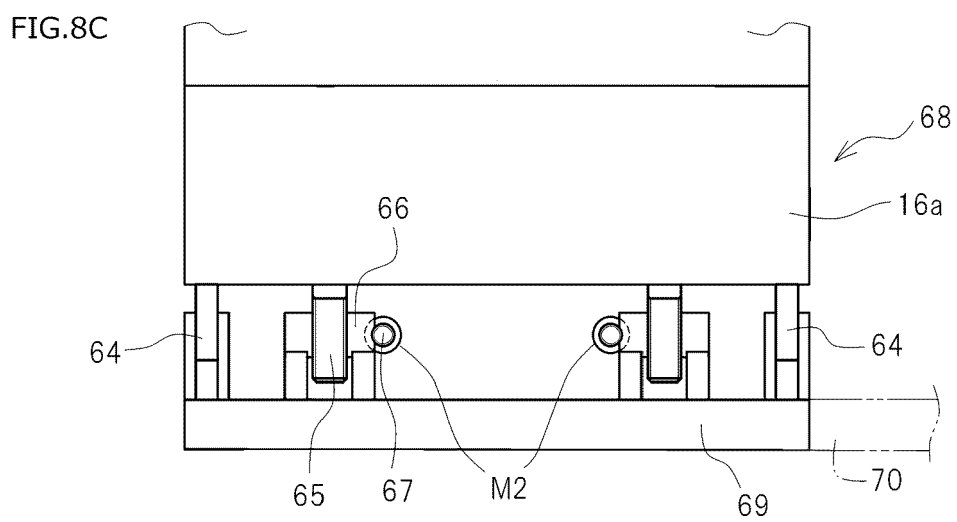
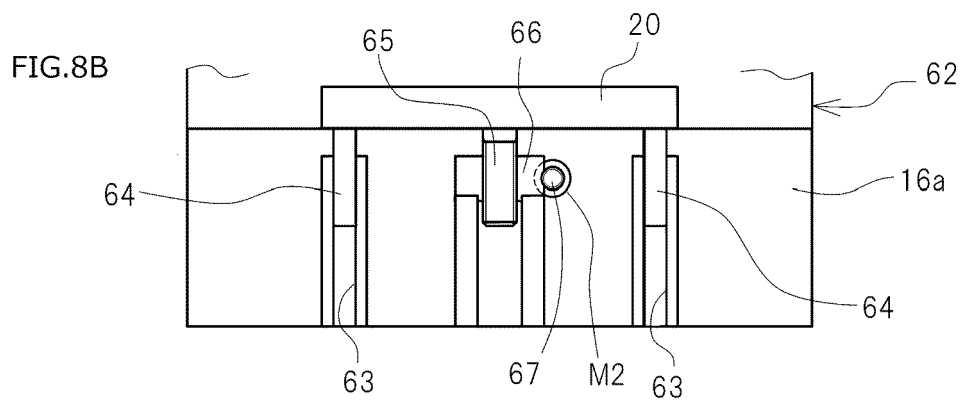
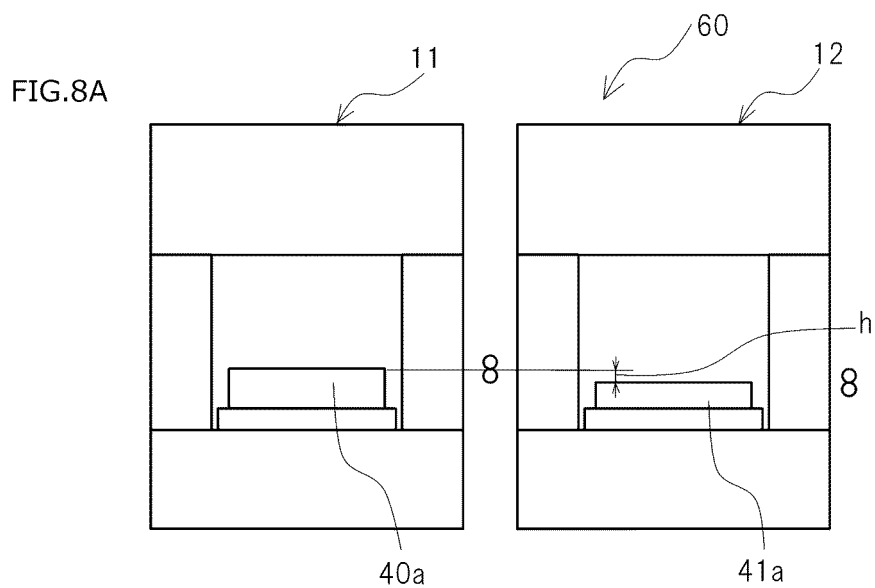


FIG.7C







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Application Number

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			TECHNICAL FIELDS SEARCHED (IPC)
			B21D B30B H02K
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Place of search Munich		Date of completion of the search 3 April 2023	Examiner Stanic, Franjo
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