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(71) Applicant: **SHINHOKOKU STEEL CORPORATION**
Kawagoe-shi, Saitama-ken 350 (JP)

(72) Inventors:
- **Kunioka, Saburo**
  Kawagoe-shi, Saitama-ken (JP)
- **Muramatsu, Eijiro**
  Tsurugashima-shi, Saitama-ken (JP)

(74) Representative: **Abbie, Andrew Kenneth et al**
R.G.C. Jenkins & Co.
26 Caxton Street
London SW1H 0RJ (GB)

(54) System for guiding works to be rolled

(57) A work guide system comprises a section (41 to 48, 70, 103, 114) left substantially stationary relative to a work (2), a movable section (60, 104) slidable independent of the stationary section (41 to 48, 70, 103, 114) in a direction in which the work (2) advances, at least a pair of guide rollers (66a, 66b, 112a, 112b) attached to the movable section (60, 104) to position just before rolling rollers (33a, 33b) and having shafts substantially perpendicular to an axis of the rolling roller (33a, 33b), and a compression spring (52, 113) arranged in the movable section (60, 104) to absorb most of impact energy imparted to guide rollers (66a, 66b, 112a, 112b) when a tip (2a) of the work (2) passes between the guide rollers (66a, 66b, 112a, 112b).

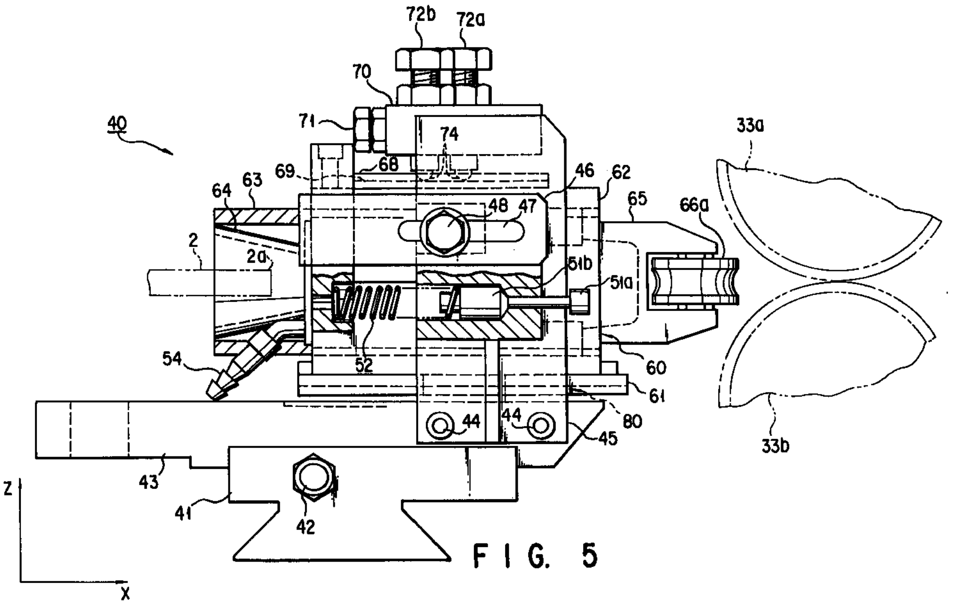


FIG. 5

EP 0 767 013 A1

Description

The present invention relates to a system for guiding works such as line and rod materials, which are to be rolled, to metal rolling rollers.

When products, excellent in the accuracy of dimension, are to be made, it is important that a long work is correctly caught between rolling rollers. This is quite important particularly when lines and rods having specific sections such as oval, hexagon and rectangle are to be made.

Usually, guide rollers are arranged on the entrance side of the line rolling machine and a work is guided to a gap between the rolling rollers. The guide rollers are contacted directly with the hot line work at high speed and their roll faces are thus worn away and thermally damaged. Those of the guide rollers disclosed in Jpn. Pat. Appln. KOKAI Publication No. 2-66135 are therefore coated with ceramics and cermet to enhance wear- and heat-resistance.

In order to introduce the work, which is supplied at high speed, to the gap between the rolling rollers while holding it, the guide rollers are supported by a spring to change their positions. In short, the paired guide rollers are supported by the spring to make their gap (or roll gap) larger when they catch the work between them. When the elastic modulus of the spring is too large (or the spring is too strong), however, the guide rollers 3a cannot change their positions quickly to thereby allow the front of the work 2 to be struck against them, as shown in FIG. 1. Impact force added is thus increased and their roll faces are chipping-damaged.

Jpn. Pat. Appln. KOKAI Publication No. 2-42006 discloses a mechanism for adjusting the roll gap between the guide rollers. In the case of these guide rollers, their roll gap is previously adjusted according to the size of a work rolled, and they are supported by a spring which has a small elastic modulus so as to allow them to change their positions quickly. When the elastic modulus of the spring is made too small (or the spring is too weak), however, the guide rollers 3b are separated from each other to an excessive extent and their roll gap becomes too large accordingly. As the result, the work 2 is guided between the rolling rollers while being kept tilted, as shown in FIG. 2. The work 2, therefore, is not correctly rolled and it becomes a fault accordingly. Further, it is not regularly contacted with the guide rollers 3b and this causes local stress to be concentrated somewhere on their roll faces. As the result, the roll faces of the guide rollers 3b are thus damaged.

The object of the present invention is therefore to provide a system for guiding a work between rolling rollers while keeping it at right state but without chipping-damaging roll faces of the rolling rollers.

According to the present invention, there can be provided a system for guiding a long work between rolling rollers comprising a section left substantially stationary independent of the work; a movable section slidable relative to the stationary section in a direction in which the work advances, at least a pair of guide rollers attached to the movable section to position just before or after the rolling rollers and having shafts substantially perpendicular to an axis of the rolling roller; and buffer means arranged in the movable section to absorb most of impact energy imparted to the guide rollers in the work advancing direction when the work passes between the guide rollers.

It is preferable that the guide system further includes adjuster means for changing the stroke of a compression spring which serves as the buffer means.

It is preferable that the guide system further includes a gap adjuster mechanism for adjusting a gap between the guide rollers and that the roll gap between the guide rollers is previously set by the gap adjuster mechanism according to the size of a work rolled.

It is preferable that the movable section in the guide system includes a frame box opened at its front and rear ends, a lower slider assembly attached to the underside of the frame box to slide relative to the stationary section in an X-axis direction, and an upper slider assembly arranged in the top of the frame box to slide relative to the stationary section in the X-axis direction.

In the case of the guide system according to the present invention, impact force is added to the guide rollers when a tip of the work is introduced into the roll gap between them, and the movable section is moved in the work supply direction (or in the X-axis direction). Most of impact energy is absorbed this time by the buffer mechanism and the impact energy imparted to them can be thus reduced to a greater extent. Therefore, their roll faces can be less damaged. Further, the roll gap is previously set not to cause them to change their positions in a direction perpendicular to the work supply direction (or in a Y-axis direction). The work, therefore, can keep its state correct or right.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a sectional view showing guide rollers and a work;

FIG. 2 is a sectional view showing guide rollers and a work held tilted between them;

FIG. 3 is a layout showing the whole of a metal rolling line along which line works are rolled;

FIG. 4 is a partly-sectioned view showing a part of the rolling machine provided with a guide system;

FIG. 5 is a side view showing the guide system for works according to a first embodiment of the present invention;

FIG. 6 is a plan view showing the guide system according to a second embodiment of the present invention;

FIG. 7 is a front view showing the second guide system;

FIG. 8 is a plan view showing a base provided with a slider assembly;

FIG. 9 is a front view showing the base provided with the slider assembly;

FIG. 10 is a perspective view showing the slider assembly dismantled and partly cut away;

FIG. 11 shows a slide ball of the slider assembly enlarged;

FIG. 12 shows how the guide system is operated;

FIG. 13 is a side view showing the guide system for works according to the second embodiment of the present invention;

FIG. 14 is a plan view showing the second guide system; and

FIG. 15 is a front view showing the second guide system.

Some embodiments of the present invention will be described with reference to the accompanying drawings. A first embodiment will be described at first, referring to FIGS. 3 through 12.

Arranged in a hot rolling line 10 are a heating furnace 11, an extracter 12, a roughing stand 13, a tilting table 14, intermediate rolling machines 15, 16, 17, finish rolling machines 18, take-up winders 19 and a coil conveyer 20. The hot rolling line 10 extends as a line from the heating furnace 11 to the roughing stand 13 and then as two lines from the intermediate rolling machines 15 to the take-up winders 19. A line material 2 is heated in the heating furnace 11, extracted on the tilting table 14 by the extracter 12, and roughed and divided into two by the roughing stand 13. They are then heat-rolled by the intermediate and finish rolling machines 15, 16, 17 and 18 and wound like coils by the take-up winders 19. These coils are then to a hook conveyer (not shown) by the coil conveyer 20. The guide system 40 for works according to an embodiment of the present invention is attached to each of the intermediate and finish rolling machines 15, 16, 17 and 18.

Referring to FIGS. 4 through 9, description will be made about the guide system 40 attached to the finish rolling machine 18, for example.

As shown in FIG. 4, the finish rolling machine 18 is a double horizontal stand of the closed head type and the guide system 40 is arranged at an entrance side of it. A housing 31 of the rolling machine 13 is clamp-fixed to a sole plate 28 by oil pressure units 29. Arranged in the housing 31 are a roll chock 32, rolling rollers 33a, 33b, a draft screw 34 and a path line adjusting screw 35. The guide system 40 is fixed to the housing 31 by a rest bar 36. Further, roll balance and thrust adjusting units 37 and 38 are attached to the rolling rollers 33a and 33b.

As shown in FIG. 5, guide rolls 66a and 66b of the guide system 40 are arranged just before the rolling rollers 33a and 33b to cause the work 2 to be caught between the rolling rollers 33a and 33b at once when it comes out of the guide rolls 66a and 66b. Shafts for guide rolls 66a and 66b are perpendicular to those for rolling rollers 33a and 33b. Each of guide rolls 66a and 66b is freely rotatably held by a holder 65 through a vertical shaft. The guide rollers 66a and 66b are made mainly of ceramics or cermet. Alternatively, they may be made heat-resistant pig casting steel and may have their roll surfaces coated with ceramics or cermet. Their roll surfaces may be either concaved or flat. In the present embodiment, the rollers 66a and 66b are made of ceramics and have a concaved roll surface each.

The guide system 40 comprises a fixed section and a movable section 60. The fixed section includes a fixing base 41, a horizontal level block 43, a bracket 45, a side plate 46 and a cap block 70. The fixing base 41 is firmly fixed to the housing 31. Even when the work 2 is passing through the guide system 40, therefore, the fixed members 41, 43, 46 and 70 of the system 40 can be kept unmoved. The horizontal block 43 is connected and fixed to the fixing base 41 by bolts 42, the bracket 45 to the horizontal block 43 by bolts 44, the side plate 46 to the brackets 45 by a bolt 48 and the cap block 70 to the bracket 45 by a bolt 71. A slot 47 is formed in the side plate 46 to enable the side plate 46 to change its attached position along an axis X (or in a direction parallel to the path line). The cap block 70 has three cap bolts 72a and 72b and a slide ball 74 is attached to the lower end of each of the cap bolts 72a and 72b and it is fitted into a V-shaped groove 69 in an upper slide base 68 of the movable section 60. The V-shaped groove 69 extends along the axis X.

The movable section 60 includes a lower slide base 61, a main block 62, a frame 63, an entrance 64, guide rolls 66a, 66b and the upper slide base 68. Four lower slider assemblies 80 are attached to the underside of the lower slide base 61. Each slider assembly 80 can slide on a slider rail 84 which is attached to the top of the horizontal level block 43. A push block 51b, a compression spring 52 and a cooling water passage (not shown) are arranged in the main block 62. The push block 51b is connected to an adjuster screw 51a. When the adjuster screw 51a is turned, the push block 51b is reciprocated in the direction of the axis X (or in the direction parallel to the path line) to push and release the compression spring 52.

In the embodiment described above, the compression spring 52 is used as a shock absorber or a buffer. Instead, a leaf spring, a hydraulic shock absorber, or the like may be employed in the present invention.

It is preferable that the spring constant of the compression spring 52 is set in a range of 5 to 20 kg, or the spring modulus of the spring 52 is set in a range of 0.517 to 0.667 kgf/mm. It is preferable in this case that spring constants of the compression springs in the guide systems are set about 19 kg (0.667×28) in the intermediate rolling machine 15, about 15 kg (0.667×22), in the intermediate rolling machine 16, about 12 kg (0.667×18), in the intermediate rolling machine 17, and about 5.17 (0.517×10), in the finish rolling machine 18. These values are employed under those conditions that the cross area of the work 2 is 490 mm^2 in the machine 15, 254 mm^2 in the machine 16, 132 mm^2 in the machine 17 and 78.5 mm^2 in the machine 18.

The adjuster screw 51a has a stroke of 15 mm, and the movable section 60 has a total weight of about 11.5 kg. Further, each of three V-shaped grooves 69 in the upper slider assembly has a face angle of 45° and a depth of 3.25 mm and each slide ball 74 has a diameter of 9.525 mm. Furthermore, thrust load added to the lower slider assembly 80 is 11 kg.

Two supply pipes 54, the frame 63 and the entrance 64 are attached to the front of the movable section 60. The two supply pipes 54 are communicated with their corresponding internal passages (not shown) in the main block 62. When cooling water is supplied from a cooling water supply source (not shown) into the internal passages through the supply pipes 54, water is sprayed to the work 2 and the guide rolls 66a, 66b. The frame 63 serves as a member for reinforcing the front of the movable section 60. The entrance 64 has a conical shape and a guide hole 64a is formed in a smaller-diameter portion of this entrance 64. The guide hole has such a shape that allows the work 2 having an oval section to pass through it.

As shown in FIG. 6, the paired right and left guide rolls 66a and 66b have a gap G_1 of about 3 mm between their outermost circumferences and a gap G_2 of about 8 mm between their recess bottoms. Each of them has an outer diameter of 45 mm and a width of 24.5 mm. Further, each of ceramics rolls 66a 66b has a weight of about 0.1 kg.

Although the guide rolls 66a and 66b are exchanged with others having a different size to change their gaps G_1 and G_2 in this example, they may be moved in the direction of an axis Y by a roll gap adjuster mechanism (not shown). It is preferable in this case that they are arranged to change their positions together with their holders 65.

As shown in FIG. 6, it is desirable that three cap bolts 72a and 72b are arranged in the upper slider assembly to position at vertexes of a triangle. In short, the center bolt 72a is positioned behind the other two bolts 72b in the direction of the axis X to thereby arrange the slide balls 74 in a triangle. This makes it quite possible to prevent the guide rolls 66a and 66b from oscillating their heads (or reciprocating their heads in the direction of the axis Y).

Referring to FIGS. 8 through 11, the lower slider assemblies 80 will be described in detail.

As shown in FIGS. 8 and 9, two rails 84 are arranged on the horizontal level block 43, extending in the X-axis direction, so that the movable section 60 supported by four lower slider assemblies 80 can move along the rails 84. Each of the rails 84 is fixed to the block 43 by bolts 88. A main member 81 of each lower slider assemblies 80 are attached to the underside of the movable section by four bolts 87.

As shown in FIG. 10, grooves 84a are formed in both sides of each rail 84 and bearing balls 86 are fitted in each of the grooves 84a. On the other hand, a groove 82a is formed in a side of each of sub-members 82 and the bearing balls 86 are also fitted into the groove 82a. As shown in FIG. 11, the bearing balls 86 are held in both grooves 82a and 84a to thereby a linear bearing movable in the X-axis direction. Further, the bearing balls 86 are held by a thin plate 85 not to come out of the grooves 82a and 84a.

Referring to FIG. 12, it will be described how the work 2 is rolled by the finish rolling machine 18 which is provided with the above-described guide system 40.

The work 2 which is just about to be finish-rolled is a steel line material having an oval section which is 13 mm long in a Z-axis direction and 8 mm long in the Y-axis direction. Its surface temperature is about 1050°C. It is continuously supplied to the rolling machine 18 at a speed of 6m per second. Its supply speed can be variously changed in a range of 1 to 100m per second. When its supply speed is in this range, it can be correctly rolled by the rolling machine 18 which is provided with the guide system 40.

The work 2 advances to the finish rolling machine 18 after it passed through the intermediate rolling machine 17. Its front 2a enters into the system 40 through the entrance hole 64a and reaches the guide rollers 66a and 66b. Water sprayed prevents the guide rollers 66a and 66b from being overheated and also raises the lubrication of it between the guide rollers 66a and 66b. When it passes through the guide rollers 66a and 66b, it adds impact to them.

When the guide rollers 66a and 66b receives impact, they change their positions in the Y-axis direction (or in the direction in which the work 2 is supplied). Impact force added directly to their roll faces can be thus reduced to a greater extent. This impact reduction can be achieved with a higher response. When impact is reduced like this at the initial rolling process, the spring 52 returns to its original state.

Position changing of the guide rollers 66a and 66b in the Y-axis direction (or in the direction perpendicular to the direction in which the work 2 is supplied) can be made less or none. Therefore, the work 2 can be more correctly held and caught between the guide rollers 66a and 66b. It is then rolled from above and below by the rolling rolls 33a and 33b to thereby reduce its sectional area. After this finish rolling process, the work 2 becomes round, and the diameter of the work 2 is about 9.5 mm.

According to the above-described embodiment, the movable section 60 can move in the supply direction of the work 2 (or in the X-axis direction) and most of impact energy added can be absorbed by the compression spring 52 when impact is added to the guide rollers 66a and 66b. As the result, impact energy added directly to the guide rollers 66a and 66b themselves can be reduced to a greater extent and this more effectively prevents their roll faces from being chipping-damaged.

The roll gaps G_1 and G_2 are previously set not to cause the guide rollers 66a and 66b to change their positions in the supply direction of the work 2 (or in the Y-axis direction). Therefore, the state of the work 2 can be kept more correct. As the result, it can be more correctly caught between the rolling rolls 33a and 33b. It can be thus rolled without any distortion.

Further, three slide balls 74 of the upper slider assembly are arranged in a triangle. The guide rollers 66a and 66b can be thus more effectively prevented from oscillating their heads (or reciprocating in the Y-axis direction) when the work 2 is passing through them.

Although a pair of guide rollers have been used in the above-described example, plural pairs of them may be used.

Although the work 2 rolled has been a carbon steel line material in the above example, it may be other materials such as stainless steel and titanium lines.

Although the work 2 rolled has had an oval section, it may has other sections such as hexagon and rectangle.

Still further, the guide rollers may be located at the outlet of the rolling rollers, not at the inlet thereof as in the embodiment described above. The rolling machine incorporating the guide rollers is of closed-head type. Nonetheless, the guide rollers may be incorporated in a rolling machine of open-heat type.

Referring to FIGS. 13 through 15, the guide system 100 according to a second embodiment of the present invention will be described.

Reference numeral 101 represents a guide box which is opened at its front and rear ends and having a reversed-U shaped section. A passage 101a having a rectangular section is formed in it. Thick side plates 102 are attached to its both sides and it is fixed to a horizontal level block 103 through these side plates 102. A movable section 104 having a work introducing space 104a is inserted into its passage 101a to freely reciprocate along the passage 101a. A collar stopper 105 is arranged integral at the rear end portion of the movable section 104 and a tapered entrance 106 of an introduction member for introducing the work 2 into the guide system 100 is projected backwards from the collar stopper 105.

As shown in FIG. 15, a slide key 107 having a rectangular section is formed in the center top of the block 103. Plural freely-rotatable balls 108 are projected from the top of the block 103 on both sides of the slide key 107. A ball 108b is projected downwards from the top ceiling of the guide box 101. The movable section 104 is held between the balls 108a and the ball 108b and the slide key 107 is fitted into a groove 109 in the bottom of the movable section 104, so that the movable section 104 can be reciprocated in the X-axis direction. The balls 108a and 108b are urged by coil springs 108c.

As shown in FIG. 14, a pair of roller supports 110 are attached to the front of the movable section 104, projecting their front portions from it. Guide rollers 112a and 112b are freely rotatably supported by the roller supports 110 through shafts 111. The base end of each roller support 110 is adjustably attached to the movable section 104 by a torsion element (not shown) to adjust a roll gap G_3 between the guide rollers 112a and 112b.

Recesses 105a are formed in the inner face of the stopper 105 at the lower portion thereof. Recesses 102a are also formed in the inner faces of the thick side plates 102 at those portions thereof which correspond to the recesses 105a in the stopper 105. Both ends of a coil spring 113 are embedded in and fixed to bottoms of these recesses 105a and 102a to separate the stopper 105 and the side plate 102 from each other.

As shown in FIG. 13, the base of a movement adjuster plate 114 having a stopper 114a which is bent like a fallen L at the front thereof is fixed to the top of the guide box 101. A movement adjuster pin 116 is projected from the rear face of the guide box 101 at the upper portion thereof, corresponding to the stopper 114a of the plate 114. The movement adjuster pin 116 is fitted into a torsion element hole 101 in the rear face of the guide box 101 at the upper portion thereof, thereby adjusting the extent to which the pin 116 is projected from the rear face of the guide box 101. In short, the stopper 105 can be reciprocated between the stopper 114a and the head of the pin 116. Its stroke "S" can be adjusted by the pin 116. Its stroke "S" is decided depending upon such conditions as the diameter and supply speed of a work 2. The stopper 105 is usually urged against the stopper 114a by a coil spring 113.

Although the coil spring 113 has been used as a damper member in the above-described example, other elastic means such as the plate spring and air cushion may be used instead.

When the front of the work 2 is introduced into the roll gap G_3, impact force is added to the guide rollers 112a and 112b and the movable section 104 is moved in the X-axis direction, as shown in FIG. 13. Most of the impact energy is absorbed by the coil spring 113 this time and the impact energy added to the guide rollers 112a and 112b themselves can be thus reduced to a greater extent. This prevents their roll faces from being damaged. Further, the stopper 105 is struck against the head of the movement adjuster pin 116. The movable section 104, therefore, is not allowed to move further and it can be stopped there.

Furthermore, the roll gap G_3 is previously set not to cause the guide rollers to change their positions in the direction perpendicular to the work supply direction (or in the Y-axis direction). The state of the work 2 can be thus kept more correct. Therefore, the work 2 can be more correctly caught between the rolling rollers 33a and 33b and rolled without any distortion by them.

According to the above-described guide system of the present invention, the movable section is moved in the work supply direction (or in the Y-axis direction) and most of impact energy can be absorbed by the damper mechanism, when impact is added to the guide rollers. As the result, impact energy added to the guide rollers themselves can be reduced to a greater extent. This prevents their roll faces from being damaged.

Further, the roll gap is previously set not to cause the guide rollers to change their positions in the work supply direction (or in the Y-axis direction). The state of the work can be thus kept more correct.

Claims

1. A system for guiding a long work (2) into and between rolling rollers (33a, 33b) comprising,

    a section (41 to 48, 70, 103, 114) left substantially stationary independent of the work (2);
    a movable section (60, 104) slidable relative to the stationary section (41 to 48, 70, 103, 114) in a direction in which the work (2) advances;
    at least a pair of guide rollers (66a, 66b, 112a, 112b) attached to the movable section (60, 104) to position just before or after the rolling rollers (33a, 33b) and having shafts substantially perpendicular to an axis of the rolling roller (33a, 33b); and
    buffer means (52, 113) arranged in the movable section (60, 104) to absorb most of impact energy imparted to the guide rollers (66a, 66b, 112a, 112b) in the work (2) advancing direction when a tip (2a) of the work (2) passes between the guide rollers.

2. The guide system according to claim 1, characterized in that said buffer means is a compression spring (52, 113) which can be shrunk in the work (2) advancing direction.

3. The guide system according to claim 1, characterized by further comprising adjuster means (51a, 51b) by which the stroke of the compression spring (52) can be changed.

4. The guide system according to claim 1, characterized by further comprising a gap adjuster mechanism (48, 65, 110) for adjusting a gap between the guide rollers (66a, 66b, 112a, 112b), wherein said gap is previously set by the gap adjuster mechanism (48, 65, 110), depending upon a size of the work rolled.

5. The guide system according to claim 1, characterized in that said movable section (60, 104) includes a frame box (62, 104) opened at front and rear ends thereof, a lower slider assembly (80) attached to the underportion of the frame (62, 104) box to slide relative to the stationary section (41 to 48, 70) in an X-axis direction, and an upper slider assembly (68 to 71, 72a, 72b, 74) arranged in the top of the frame box (62, 104) to slide relative to the stationary section (41 to 48, 70, 103, 114) in the X-axis direction.

6. The guide system according to claim 5, characterized in that said lower slider assembly (80) includes rails arranged at the stationary section (41 to 48, 70), and linear bearings (82, 82a, 84, 84a, 85, 86) arranged at the movable section (60) to slide on the rails (84).

7. The guide system according to claim 5, characterized in that said upper slider assembly (68 to 71, 72a, 72b, 74) includes plural guide grooves (69), slide balls (74) slide-rotated along the guide grooves (69), and push bolts (72a, 72b) for pushing the slide balls (74) into the guide grooves (69).

8. The guide system according to claim 7, characterized in that each of the slide balls (72a, 72b) is pushed into each of three guide grooves (69) and each of said three slide balls (72a, 72b) is positioned at each of vertexes of a triangle.

9. The guide system according to claim 1, characterized in that said movable section (60) further includes means (54, 55) for cooling the work (2) and the guide rollers (66a, 66b).

10. A system for guiding a long work to and between rolling rollers comprising

    a guide box (62, 104) having a passage (64a) to pass through the work (2), said passage (64a) opens at front and rear ends of said guide box (62, 104);
    a pair of guide roller supports (65, 111) arranged along the passage (64a);
    guide roller (66a, 66b, 112a, 112b) freely rotatably arranged at a tip portion of said guide roller support (65, 111) to guide the work (2); and
    a buffer mechanism (52) for elastically moving the guide roller supports (65) in the passage (64a) in the work (2) advancing direction.

11. The guide system according to claim 10, characterized in that said guide roller supports (65) are fixed to a fixing member (63) to fix the interval between the guide rollers (66a, 66b, 112a, 112b) and said buffer mechanism includes elastic members (52, 113) interposed between the fixing member (63) and the guide box (62, 104).

12. The guide system according to claim 10, characterized by further comprising a stopper (51b) is attached to the guide box (62) to regulate the extent to which the guide roller supports (65) are moved by elastic members (52).

13. In or for use in an apparatus for rolling an elongate workpiece (2), a device for guiding such a workpiece between rolling rollers (33a, 33b) of the apparatus and comprising guide rollers (66a, 66b; 112a, 112b) adapted to be mounted upstream or downstream of said rolling rollers in the direction of passage of said elongate workpiece therebetween, characterised in that said guide rollers are mounted on mounting means (60, 104) for sliding movement in said direction of passage on engagement by a

leading end of an elongate workpiece and in that said device comprises shock absorbing means (52, 113) associated with said mounting means (60, 104) for absorbing shock loads on such engagement.

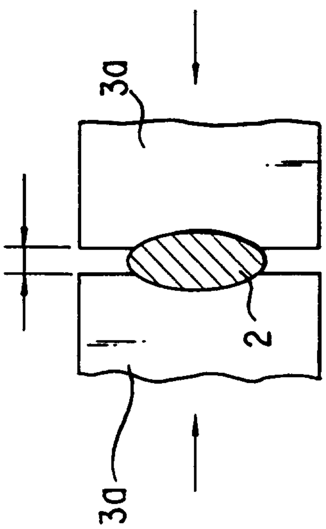


FIG. 1

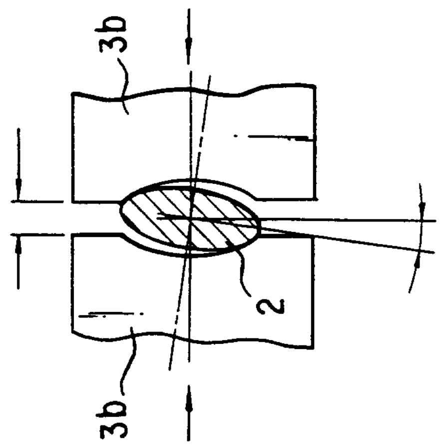


FIG. 2

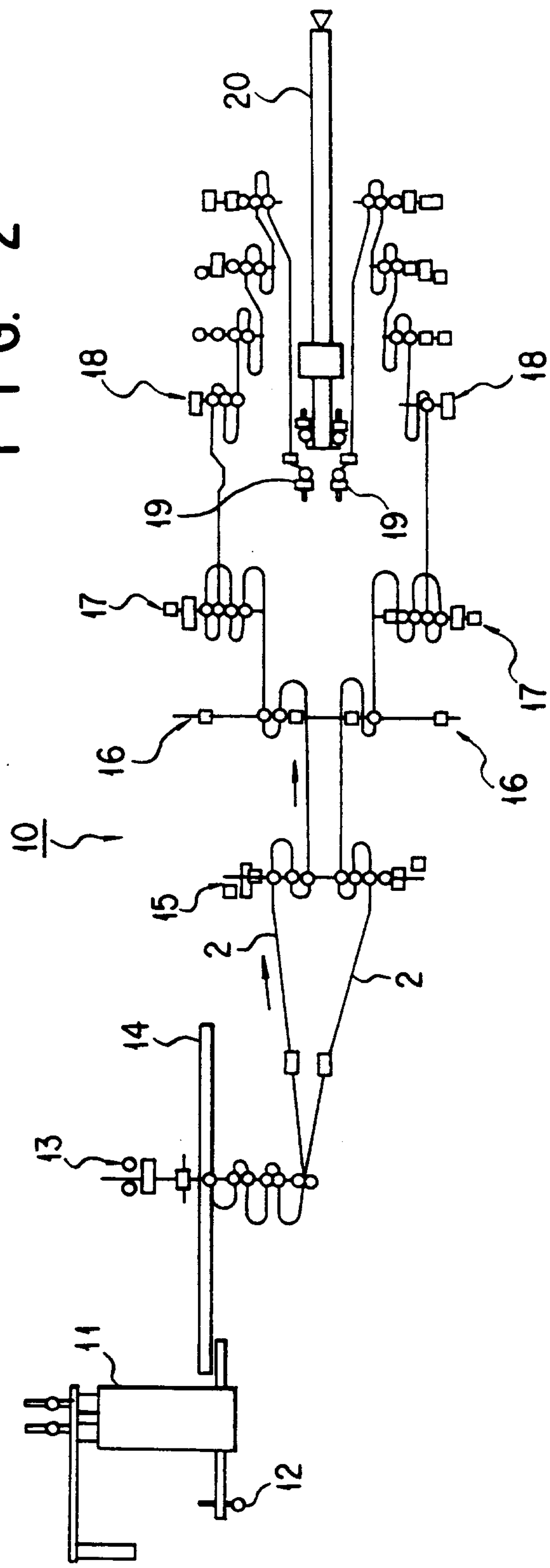
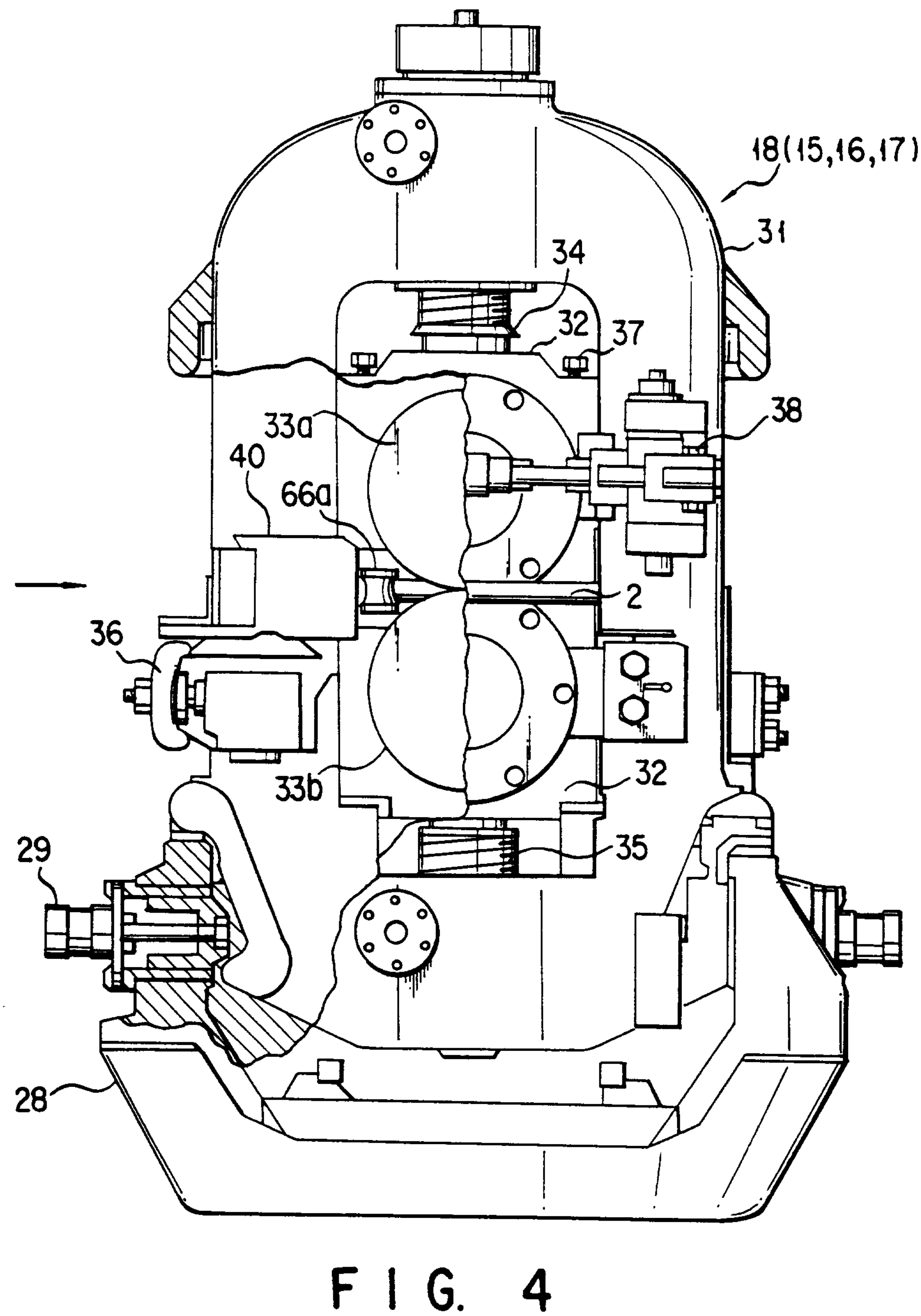


FIG. 3



F I G. 4

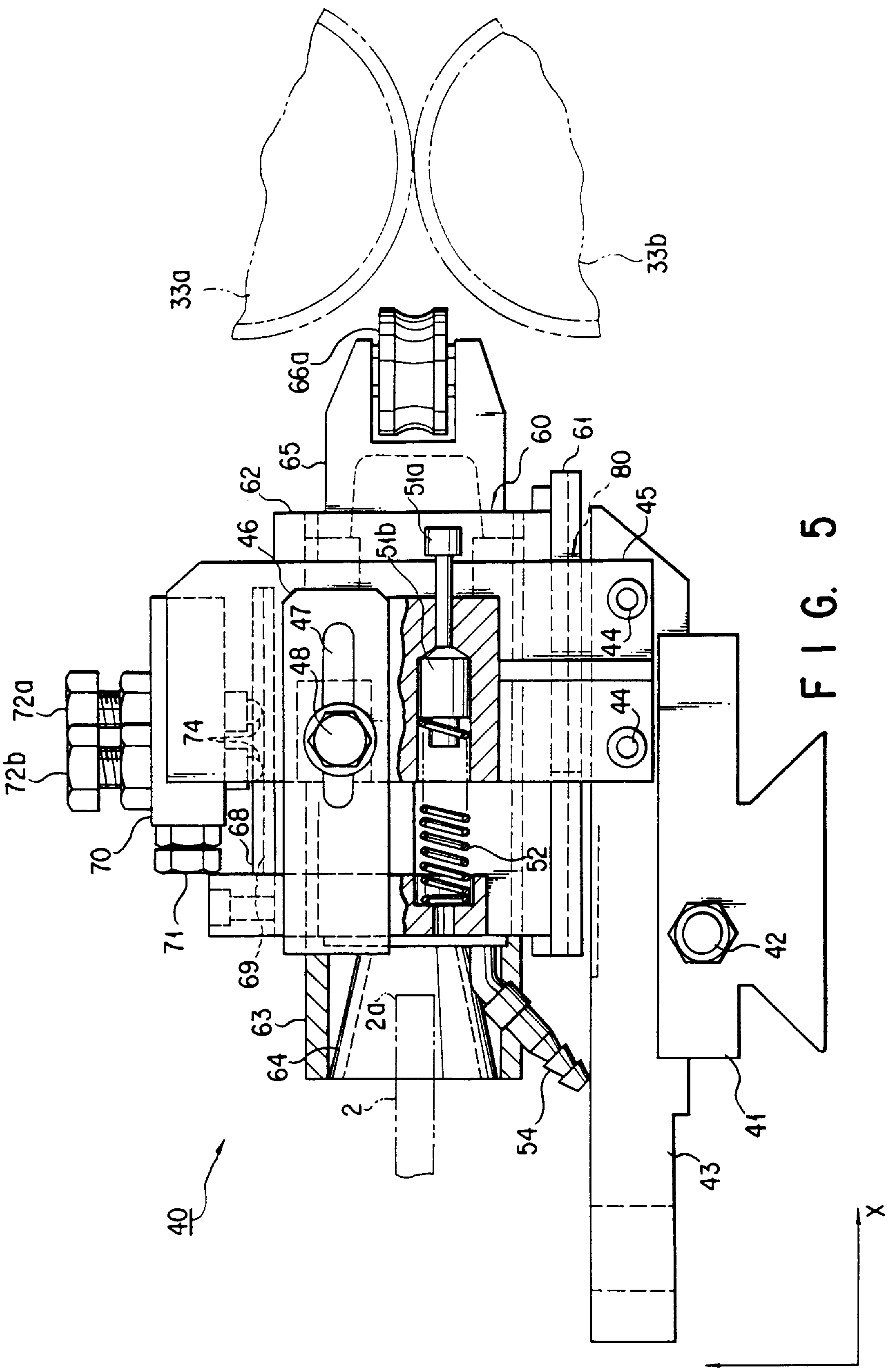

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FIG. 5

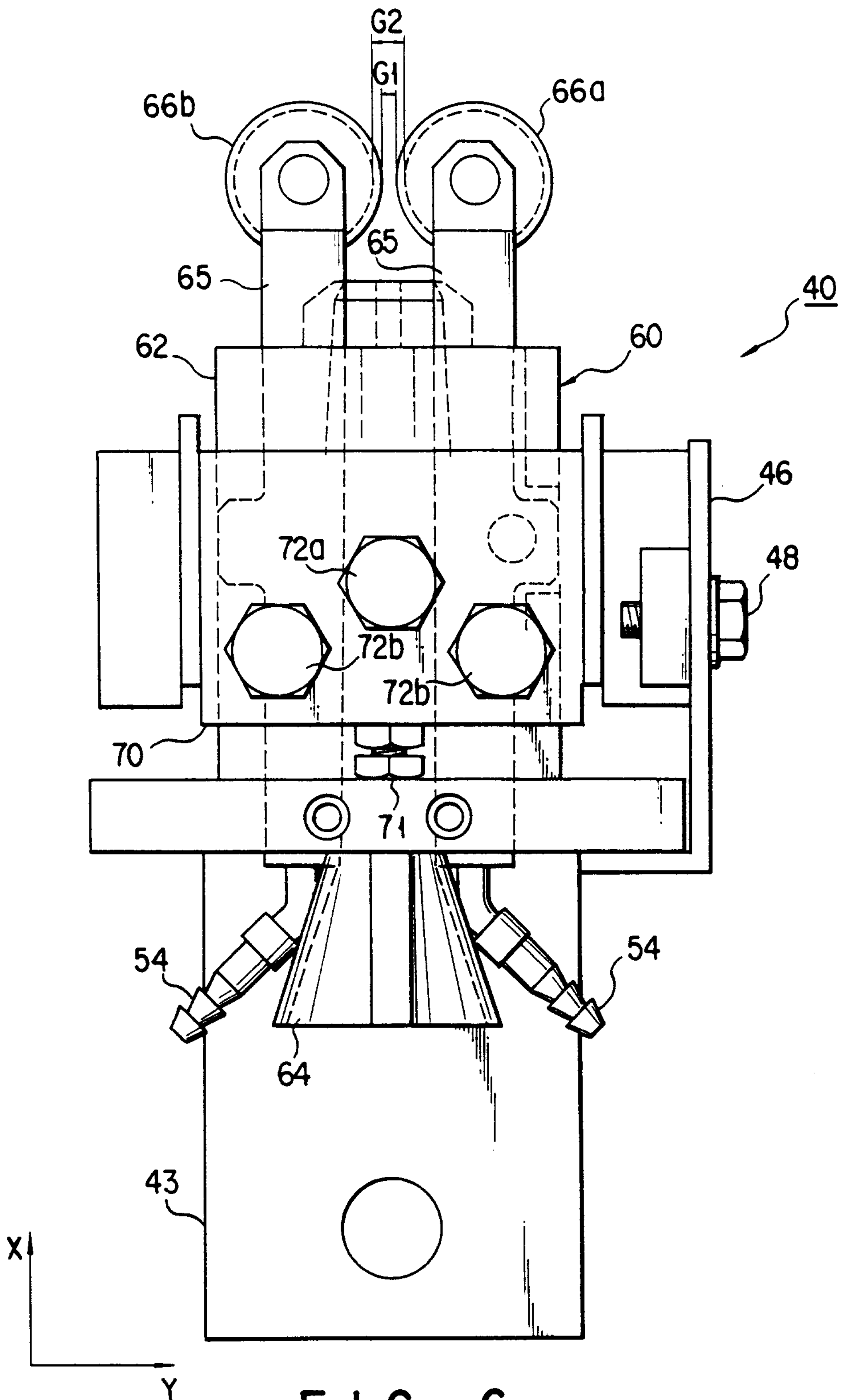
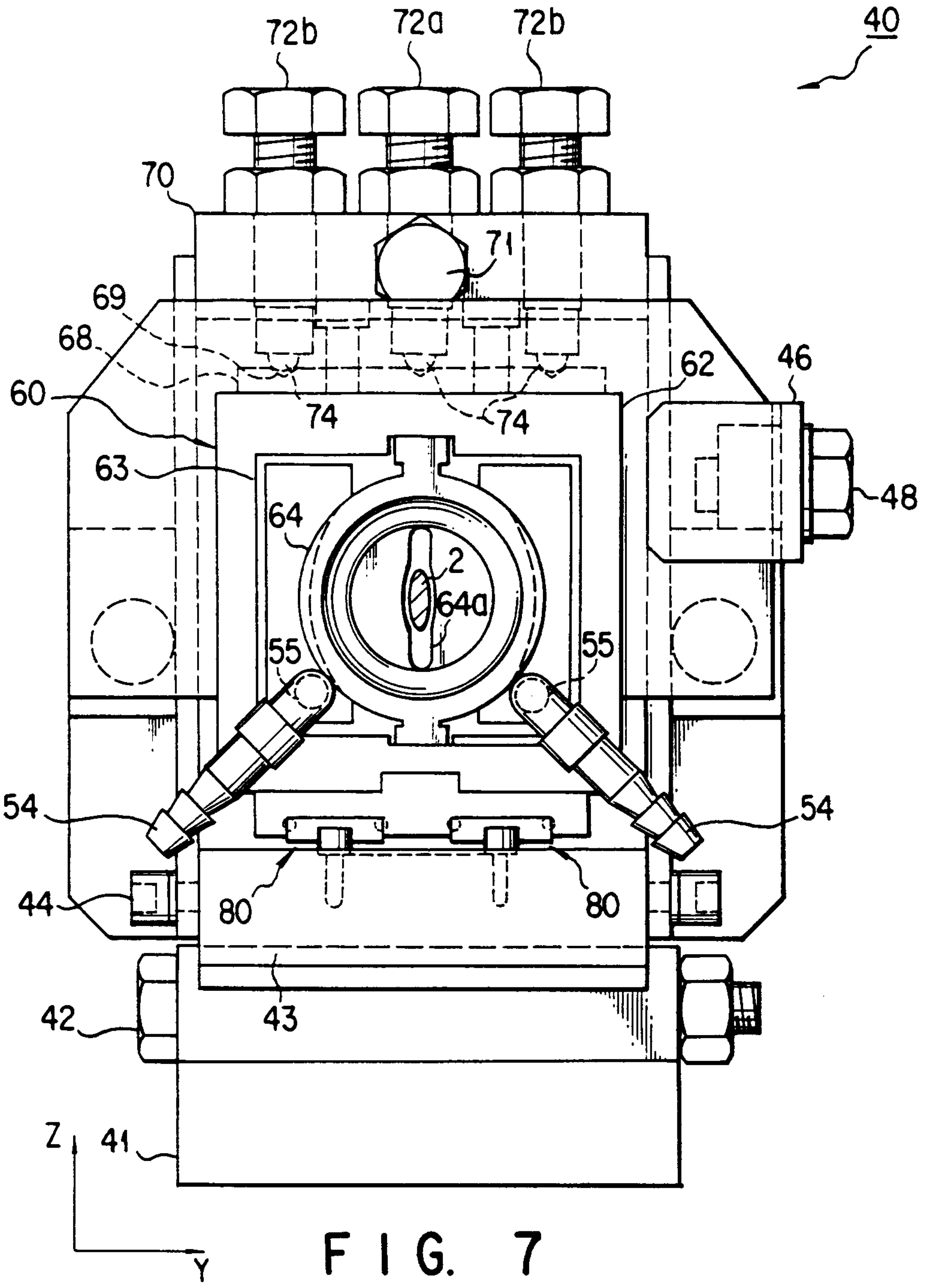


FIG. 6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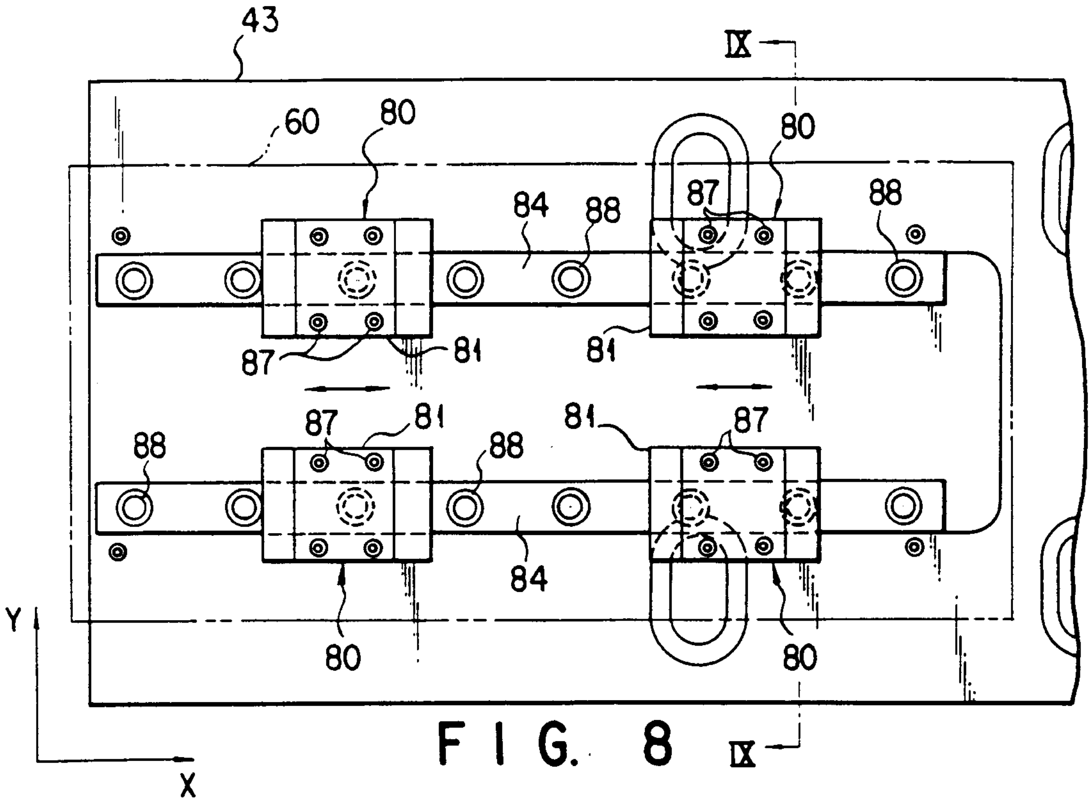
Y

F I G. 7


43
IX
60
80
80
84
88
87
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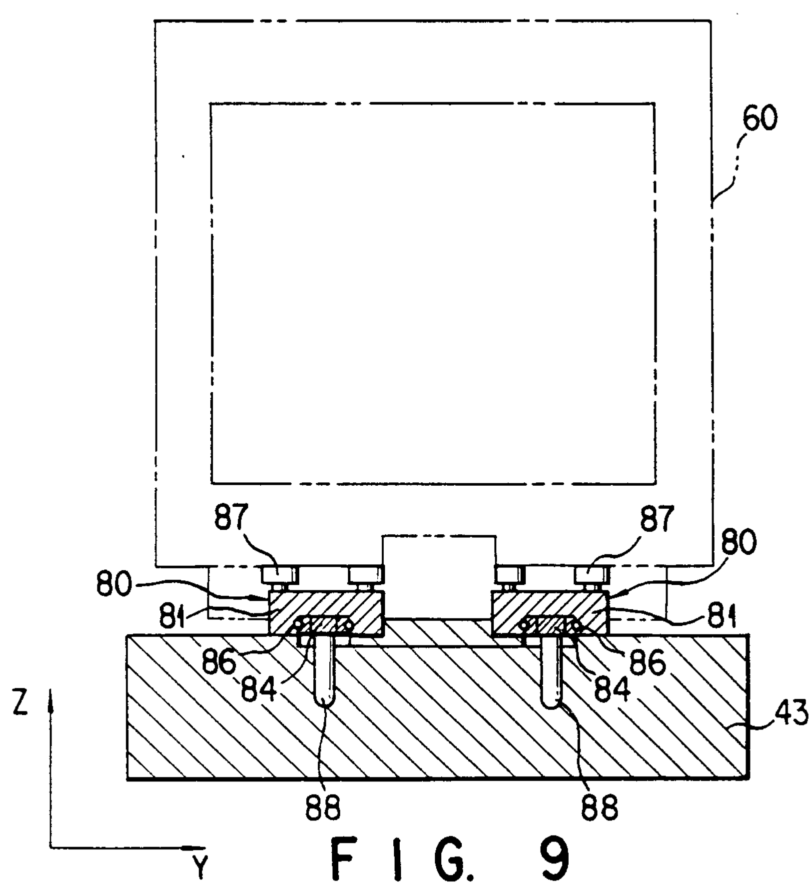
87
81
81
81
88
87
88
81
87
84
Y
80
80
X
IX

FIG. 8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87
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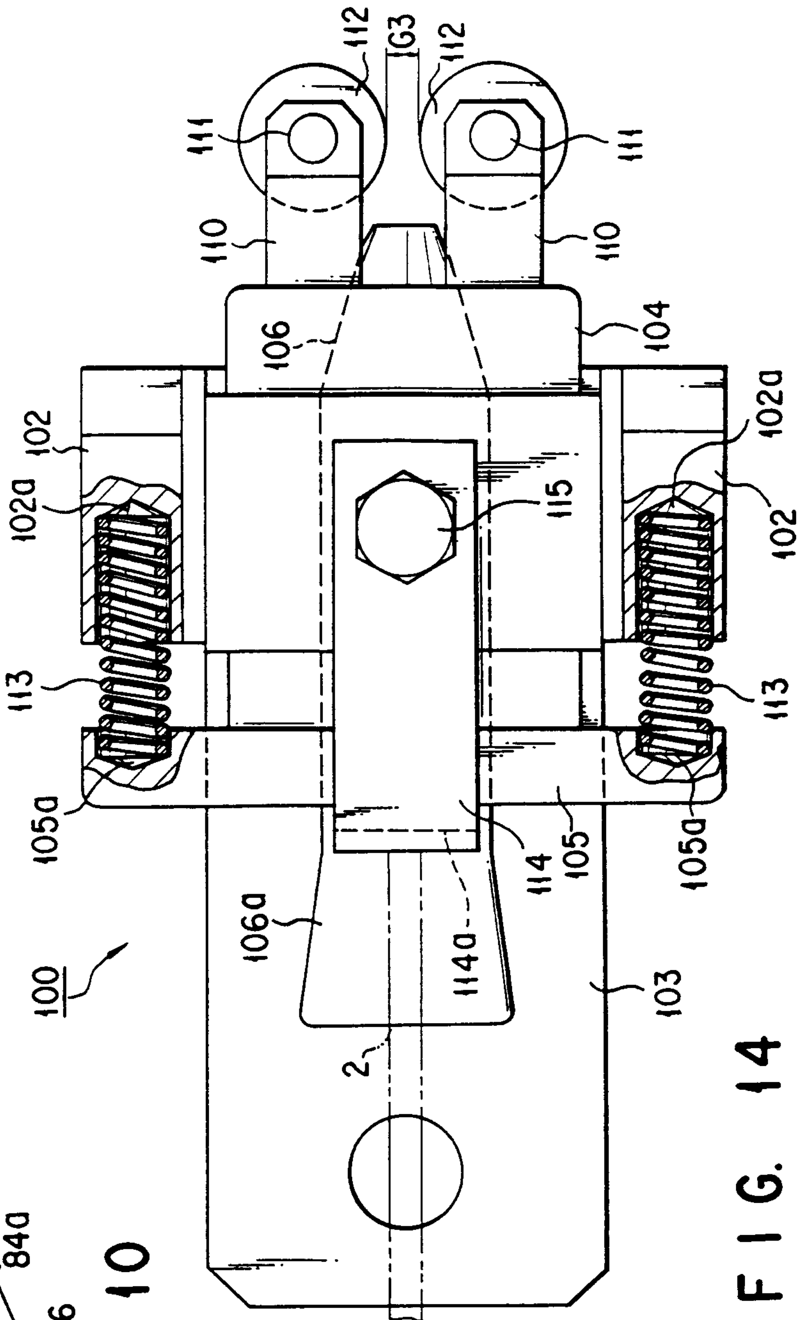
86
84
86
84
43
Z
88
88
Y

FIG. 9


100
112
G3
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104
106
102
102a
115
113
105a
114
105
106a
114a
103
2

FIG. 14

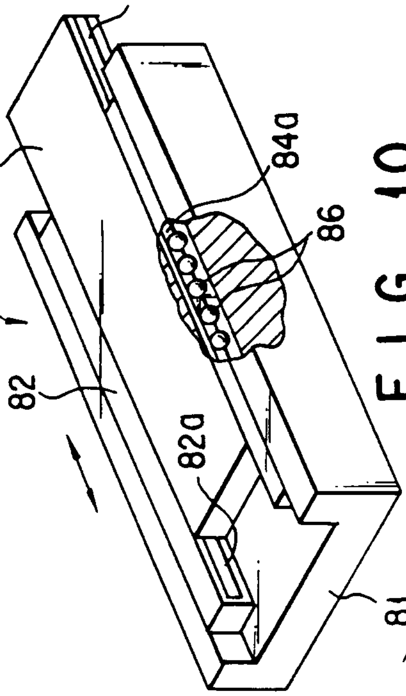

84a
84
86
80
82
82a
81
X
Y

FIG. 10

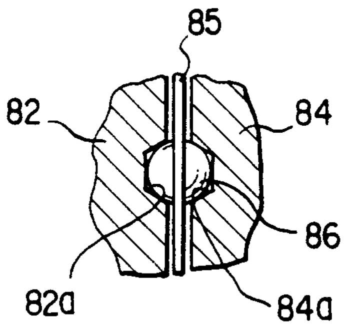


FIG. 11

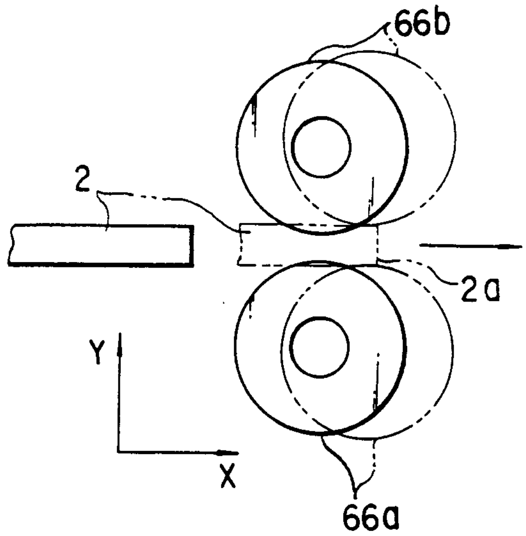


FIG. 12

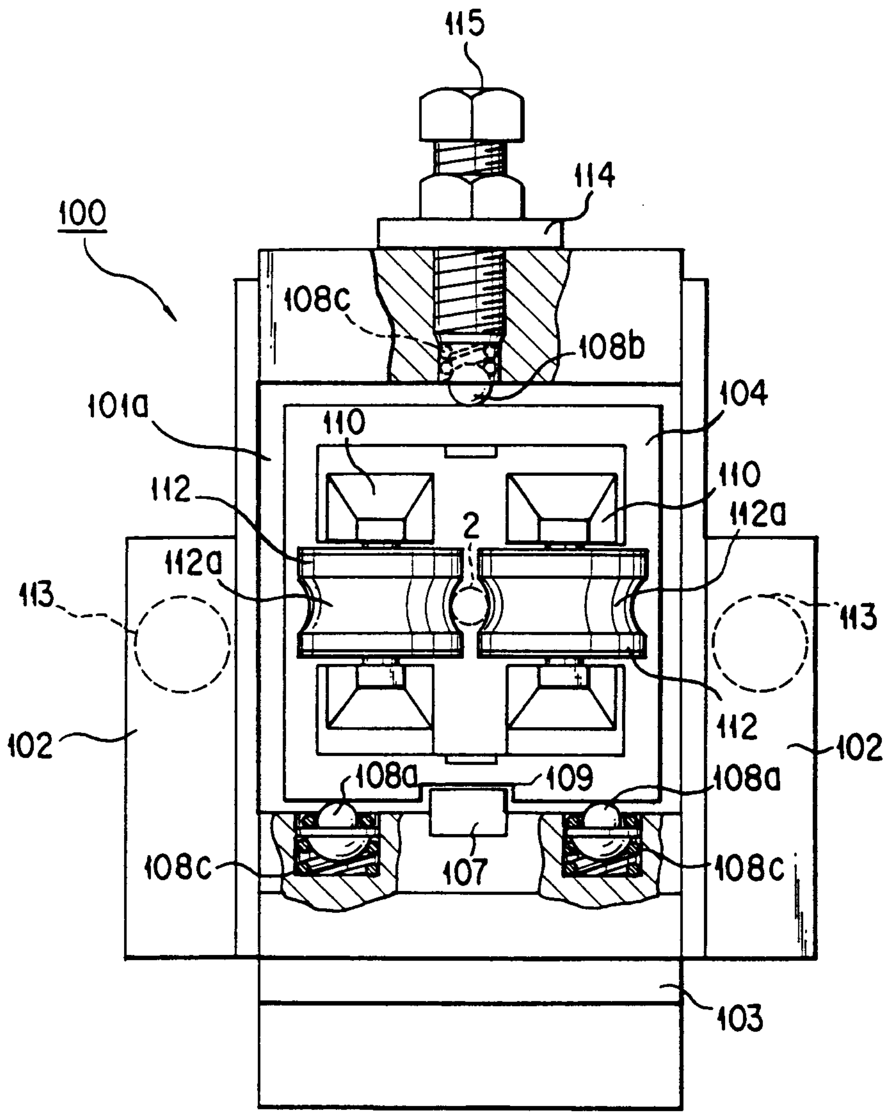
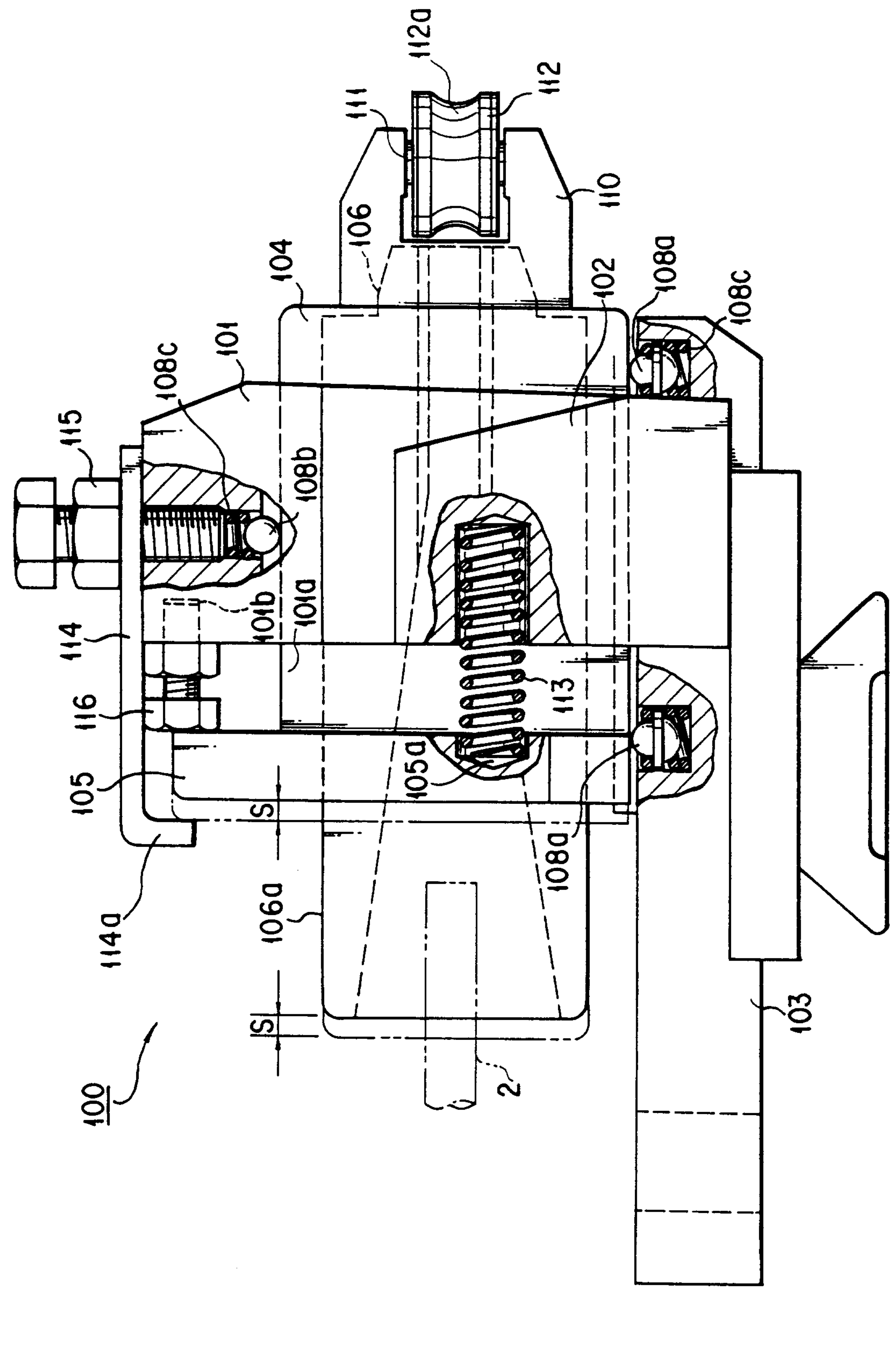


FIG. 15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102
108a
108c
101
108c
115
108b
101b
101a
114
113
116
105a
105
S
108a
114a
106a
S
2
103
100

FIG. 13

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 30 6978

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	DE-A-14 27 188 (NYBY BRUKS) * claims 1,2,4; figures 1,2 * ---	1-3	B21B39/16
A	EP-A-0 013 671 (KOTOBUKI SANGYO) * claim 1; figures 1,2 * ---	1	
A	US-A-4 700 875 (FABRIS) * claim 1; figure 4 * ---	1	
D,A	PATENT ABSTRACTS OF JAPAN vol. 014 no. 246 (C-0722) ,25 May 1990 & JP-A-02 066135 (KOBE STEEL LTD) 6 March 1990, * abstract * -----	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
B21B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	4 March 1996	Schlaitz, J

CATEGORY OF CITED DOCUMENTS

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L : document cited for other reasons

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