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(54) **Apparatus for adjusting tool length of bending machine.**

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Description

This invention relates to an apparatus for adjusting the tool length of a bending machine according to the prior art portion of claim 1, i.e. wherein the effective length of the upper tool can be changed to the dssired bending length according to the bending width of a sheet metal plate.

Such an apparatus is known from EP—A—0105091.

Rectangular sheet metal plates having the edges at the four sides bent at least one or two times so as to have L- or U-rims are used for cabinets, display cases, refrigerators, freezers, air conditioners, computer units, various office machines, etc. To prepare such plates, wiping benders, folding machines or press brakes are used which bend each side edge of the sheet metal previously cut into a quadrilateral. For example, in order to bend each side edge in the U-shaped form, the edge of one short side of the sheet metal is bent by two steps (short side bending) and then, after the sheet metal is turned 180° on a handling table, the edge of the other short side is bent. Next, the sheet metal is turned 90° and the edge of one long side is bent (long side bending) by a clamp die or punch set to the bending width adjusted to the inside of the short side bending. Further, the sheet metal is turned 180° and the other long side is bent so that the rectangular metal plate having the four sides bent in the U-shaped form is obtained from the first step bending and the following second step bending.

In the above working, when the long side of the metal is bent, rising portions are produced by bending the previously bent short side, so that the upper die should have the length of the long side obtained by subtracting the thickness corresponding to two sheets and avoid the interference with the rising rim of the short side. Thus, a plurality of the upper dies having different die widths are prepared and every time the sheet width is changed, the die is interchanged which formerly had been carried out manually. To overcome the defects caused by such manual operation, an apparatus for adjusting the tool length has been developed (EP—A 105 091) in which the upper die consists of several die segments having different die widths, which segments are combined such that unnecessary upper die segments are retreated or inverted according to the sheet metal length to be adjusted to a desired upper die length. While broader lateral die segments are retreated in longitudinal direction of the die, narrower auxiliary die segments can be inverted, i.e. pivoted into or out of alignment of the active die segments. Longitudinally offsetting the lateral die segments results in any one of them being used as corner die segments, which is not always satisfactory since the corner die segments are sometimes required to present special performance, particularly in case of a U-rim.

When the respective side edges of the metal plate are bent in the U-shaped form, since the edges of the short sides are previously bent into the rise having the U-shaped section, the upper corner dies should avoid the interference with this rise to approach the sheet metal. Furthermore, when the die is withdrawn after the U-shaped bending of the long side edge, the upper corner die should not interfere with said rise. Thus, normally, a special corner die segment is to be used which can be one comprising an openable die portion (or rotary die portion) mounted at the upper corner die segements by the use of a pin. And to pivot this openable die portion without any troubles, a clearance is provided in an edge portion of the upper corner die body to avoid the contact with the pivotal part of the openable die portion. However, since in such case this clearance provides a cut-out portion of the edge line of the upper die, the bending line of the sheet metal has irregularites on the clearance portion so that an accurate being form cannot be obtained.

An object of the present invention is to provide an apparatus for adjusting the tool length of a bending machine in which the tool length can be changed easily and quickly, leaving the possibility of special corner constructions of the upper die. This can be realized by the invention characterized in claim 1. Of special interest is also the construction of claim 6 which provides an upper bending die in which the edge lines of the upper corner die segment body and the openable die portion are interconnected continuously.

In working the present invention, for example, there are arranged two upper central die segments having 75 mm thickness each, twenty-one upper lateral die segments having 50 mm width each outside the central die, two upper corner die segments having 100 mm width each at the left and right side, and further ten thin upper auxiliary die segments having 5 mm width each. When all these die segments are used, the total tool length reaches 2,500 mm, the maximum length. By leaving the central die segments and the corner die segments as they are and selecting the combination of the segments of left and right lateral die segments and auxiliary die segments to be used, the tool lenth can be freely adjusted between the maximum and the minimum by 100 mm or 5 mm pitch. Further, since the thickness of the sheet metal is normally 1 to 3 mm, the upper die length has each 2.5 mm pitch at both ends, assuming each auxiliary die is 5 mm thick, so that the change in the work length within said extent can be substantially coped with. Also, the operation of said drive mechanism, reversing mechanism, etc. permits the bending operation of differently sized sheet metal to be flexibly carried out by employing the NC control. By moving the corner die segments inwardly or outwardly along the line of the lateral die segments, only those of which becoming active which are kept between the central die segment and the corner die segment at each side, the upper tool corners are always constituted by the upper corner die segments so that these can be constructed according to any special desire. E.g. according to claim 6, the upper

corner die segments at both ends of the upper die group are improved to make the bending operation of the four sides of sheet metal very easy and fast.

The present invention can be applied not only to press brakes, but also to bending machines such as folding machines, wiping benders, etc.

A preferred embodiment of the invention—illustrative of the bending mode in which applicants have contemplated applying the principles—is set forth in the following description and shown in the drawings.

Fig. 1 is a perspective view showing a bending machine provided with rockable corner die segments and an apparatus for adjusting the tool length according;

Fig. 2 is an enlarged front view showing the upper die segments of the machine in Fig. 1;

Fig. 3 is a side view showing the same as Fig. 2;

Fig. 4 is an enlarged sectional view taken along the line IV-IV in Fig. 2;

Fig. 5 is a cross-sectional view taken along the line V—V in Fig. 4;

Fig. 6 is a sectional view taken along the line VI—VI in Fig. 5 and showing the condition of one of the upper lateral die segments having a wedge (Fig. 4) removed;

Fig. 7 is a sectional view showing the condition of one of the upper lateral die segments reversed from the condition in Fig. 6;

Fig. 8 is a sectional view taken along the line VIII—VIII in Fig. 5;

Fig. 9 is a front view showing an upper corner die segment;

Figs. 10 to 13 are schematic front views showing an apparatus operated for changing the tool length;

Fig. 14 is a sectional view of an embodiment of the present invention applied to a goose-neck-shaped press brake;

Fig. 15 is a front view showing the upper corner die segment of the apparatus shown in Fig. 14;

Fig. 16 is a sectional view showing an embodiment of the present invention applied to a folding machine.

Fig. 17 is a perspective view showing a sheet metal; and

Fig. 18 is a perspective view showing a finished bent product.

Referring now to the drawings, a preferred embodiment of the present invention is illustrated therein and reference numeral 10 designates left and right frames, 11 is a front plate stretched in front of the frames, 12 press cylinders mounted on the upper ends of the frames, and 13 a ram moved vertically to the front plate 11 by the actuation of the press cylinders 12. Reference numeral 14 designates a bed on the upper surface of the front plate, 15 a slide member provided on the bed 14, 16 a lower die, 17 a V-shaped groove formed in the lower die 16, 18 a back gauge, 19 a T-shaped groove formed in the lower end of the ram and 20 a group of upper die segments (punch).

As shown in Figs. 2 to 5, the group of upper die segments 20 are constituted from a pair of left and right central die segments 1A, 1B slidable longitudinally of the tool length, a pair of left and right upper corner die segments 7A, 7B slidable similarly, a plurality of upper slit, lateral die segments 2A to 6A and 2B to 6B which are inserted between the central die segments and the upper corner die segments and a plurality of thin upper auxiliary die segments 8 which are inserted between the left and right central die segments. Said upper lateral die segments and the upper auxiliary die segments cannot slide and are supported by the shaft to be inverted rearwardly, i.e. rotated out from the line of the tool, thereby adjusting the tool length i.e., the lateral die segments and the auxiliary die segments each have two stable positions, one of which is the working position wherein the respective segment is in alignment with the central die segments, and the other one is the inverted position wherein the respective segment is spaced from alignment with the central die segments.

As shown in Figs. 5 and 8, the central die segments 1A, 1B have the upper portions inserted into a groove 19 in the lower end of the ram to be slidably supported thereby. Brackets 21, 22 extend to the back of the central die segments to hold the thin auxiliary die segments 8 group and spline cylinders 23, 24 having a split respectively, as will be later described. The left and right upper corner die segments 7A, 7B have the upper portions inserted into the groove 19, while being supported slidably by a drive mechanism 30 (Fig. 10—13). That is, each upper corner die segment is formed in the interior with a female thread 31 (Fig. 4) into which is screwed a left and right threaded rod 32 extending through the groove 19 so that the left and right upper corner die segments are moved in the opposite directions to each other by driving a rotary unit 33 on the rod 32 end. Further, each upper corner die segment 7A, 7B has an openable die segment portion 72 pivotably connected to the upper corner die segment body; the constitution and features of the openable die segment portion will be described later.

As shown in Figs. 3 and 10, a pair of left and right shafts 35, 36 are disposed on the back of said central die segments 1A, 1B and provided near the ends with a reversing drive unit 34 such as a rack-pinion or gear mechanism so as to be supportably rotated about 180°. The shafts 35, 36 are provided at the ends with cylinders 38, 39 operated when the number of the thin auxiliary die segments 8 to be reversed is selected, and further at an end of one cylinder with a shift cylinder 40 for centering the whole upper die segment group when an odd number of the upper lateral die segments are used. Further, on the way of the shafts 35, 36 are provided cylinders 41, 42 for fastening the upper lateral die segments group in the inverted, ascended state.

As shown in Fig. 6 the upper lateral die segments 2A, 2B—6A, 6B are constituted respectively from body portions 57 and die segment portions 58, and the shafts 35, 36 are inserted into a hole 45

laterally provided in the body portions 57 and are provided with a longitudinal key way 46 on a portion supporting the upper lateral die segments (Figs. 5 and 10). To the lower portion of the body portion 57 is attached a movable body 51 urged normally to advance by a spring 48. A wedge 50 is provided which is bent and inserted into the key way 46 in said shafts 35, 36 from the upper end of this movable body 51.

On the other hand, the upper corner die segments 7A, 7B have a tool length of integral times that of the upper lateral die segments (two times in the drawing), and as shown in Figs. 5 and 10, the upper portions thereof each have such tool length plus the length of one upper lateral die segment (one corresponding to three upper lateral die segments in the drawing). In the upper corner die segments are each provided three wedge releasing mechanisms 55 (Fig. 4, 5) each consisting of a piston 53 and a cylinder 54 to release the wedges 50 of the adjacent upper lateral die segments, for maintaining said upper lateral die segments in the inverted positions while turning the other ones into the non-inverted condition of Fig. 2 by pivoting the shafts 35, 36.

As shown in Figs. 5 and 8, the thin auxiliary die segments 8 are provided respectively with a spline hole 26 meshing with a spline cylinder and supported on a mechanism 25 for selecting the number of the upper lateral die segments to be inverted. This mechanism 25 consists of the spline cylinders 23, 24 having splits near the position in which the shafts 35, 36 are butted against each other, and the cylinders 38, 39 for shifting each shaft outward. The spline cylinder 23 is secured fixedly to an end of the shaft 36 by the use of a pin 27 to invert the auxiliary die segments 8 engaging the corresponding spline cylinder 23 in rotating the shaft. The other spline cylinder 24 is secured fixedly to the bracket 22 for one central die segment to support the auxiliary upper die segments 8 engaging the corresponding spline cylinder 24 under the non-inverted condition.

Now will be described in detail the upper corner die segments 7A, 7B.

The upper corner die segments are arranged left and right of the upper lateral die segment row and moved in the opposite directions to each other by the left and right reversely threaded rod 32. As shown in Figs. 2, 4, 5, 9 and 10, the upper corner die segments 7A, 7B consist of main bodies 71 having the height equal about a half of that of the adjacent upper lateral die segments, and the openable die segment portions 72 mounted on the lower part of each main body 71. A T-shaped part formed on the upper portion of the main body 71 is inserted into the T-shaped groove 19 in the lower portion of the ram 13 and is screwed onto the screw rod 32 extending through the T-shaped groove 19.

Said openable die segment portion 72 is mounted removably on the main body 71 through a link 75 provided on the lower portion of the main body 71. That is, a bracket 76 is suspended from the lower corner of the main body 71 at the side contacting the upper lateral die segment, and a pin 77 extends through this bracket 76 in the direction orthogonal to the bending line to mount said link 75, on the end of which is supported the openable die segment portion 72 by the use of a pin 78 (Figs. 9, 15). As shown in Fig. 9, the openable die segment portion 72 has a recess 79 to avoid the interference with a rise 95 at the work end side as viewed from the front and is formed with a cavity 80 at the side adjacent the upper lateral die segment. The cavity 80 has a side oblique surface 82 abutting against an end face 81 of the adjacent upper lateral die segment upon withdrawing the die segment upwardly, preventing the openable die segment portion 72 from further pivoting. Furthermore, a side oblique surface 83 extending from the lower end of the side oblique surface 82 toward the edge of said upper die segment portion is designed so as to form a vertical flat surface 84 in the lower end of said side oblique surface, surface 84 contacting closely said end face 81 of the upper lateral die segment in the non-opened condition of the die segment portion 72. When the openable die segment portion 72 contacts closely the adjacent lateral die segment, no clearances appear between edges 85, 86 of both die segments by the presence of the flat surface 84 to hold a continuous edge line at the same level. Further, a rod 88 with a head 87 is planted into the upper surface of the openable die segment portion 72. A guide hole 89 corresponding to the rod 88 is provided in the main body 71. When the openable die segment portion 72 begins to be opened, the rod 88 descends vertically through the guide hole 89 before the link pivots about the fulcrum, and after said flat surface 84 is spaced from the adjacent upper lateral die segment, the link is allowed to pivot about the horizontal fulcrum and brought down to the position shown by the chain line in Fig. 9. As can be seen from the drawing, the fulcrum which is determined by the axis of the pin 77 is at the innermost end of the segment.

Next will be described the operation of said apparatus with reference to Figs. 10 to 13.

Four side edges of a sheet metal 90 which has been cut previously into an approximately rectangular shape as shown in Fig. 17 are bent into the U-shaped form as follow: First, the edge of one short side 91 is bent in two steps into the U-shaped form and then the work is turned 180° in a plane on a handling table (not shown). The other short side 92 of the metal 90 is thus bent similarly. In bending these short sides, adjustment of the tool length is not needed and a length of the upper die segment group 20 larger than that of the short side will do. Next, the work is turned 90° and the edge of one long side 93 is bent. The work is then further turned 180°, and the other long side 94 is bent. As a result, as shown in Fig. 18, a product of rectangular shape having a width W and a length L with the four sides bent in a U shape by the first bends E and the second bends H is obtained. In the above working, since a U-

shaped rise 95 is produced by bending the short said edge, the length of the upper die must be adjusted in bending the long side. The upper corner die segments 7A, 7B should avoid the interference with the rise 95 in approaching the work and in withdrawing the die segments after bending the long sides. The present invention can cope with all these requirements.

Now, to simplify the description, the change of work length (length of long side) will be described with reference to two central die segments having 75 mm width each; five times two upper split lateral die segments having 50 mm width each, two upper corner die segments having 100 mm width each, and ten thin upper auxiliary die segments having 5 mm width each.

Fig. 10 shows the tool length of 850 mm using all die segments except for the upper auxiliary die segments 8, and Fig. 11 shows the tool length of 350 mm with the central and corner die segments only.

Now will be described the case in which a 350 mm tool length shown in Fig. 11 is changed to 475 mm. First, the rotary unit 33 is driven by an NC control to rotate the screw rod 32 and move left and right the corner die segments 7A, 7B each by 12.5 mm, so as to be aligned with the lateral die segments 3A to 5A and 3B to 5B, respectively. After this movement, the three pistons 53 (Fig. 4, 6) of the wedge releasing mechanisms 55 in the upper corner die segments 7A, 7B are moved to hit and offset the respective movable bodies 51 of the wedges 50 for the upper lateral die segments 3A to 5A, 3B to 5B. Here, the cylinder 54 is operated to move left in Fig. 4, 6 the movable body 51 and remove the wedge 50 at the upper end out from the key way 46 by the extension of the piston 53 as shown in Fig. 6. Then under this condition the shafts 35, 36 are withdrawn each 12.5 mm left and right by the cylinders 38, 39, the central die segments 1A, 1B are moved away from each other by the same dimension, as shown in Fig. 12. Then the inverting drive unit 34 is driven to pivot the shafts 35, 36, resulting in five thin upper die segments 8 being inserted into the 25 mm gap between the central die segments 1A, 1B. At the same time, the upper lateral die segments 2A, 2B and 6A, 6B other than those turned off by the releasing mechanism 55 are rotated by 180° so that the 475 mm tool length can be set as shown in Fig. 13.

Thereafter, the ram 13 is lowered to bend the proximity of the edge of the sheet metal 90 and to bend the long and short sides for providing a completed product as shown in Fig. 18. After the completion of bending, when the tool length is again changed, the inverting drive unit 34 is driven in the opposite direction to the previous one to invert simultaneously the five upper auxiliary die segments 8 inserted beween the central die segments 1A, 1B and the upper lateral die segments 2A, 2B left wedged in the shafts 35, 36 to the condition shown in Fig. 12. Next, after the rotary drive mechanism 30 is reversely rotated and the left and right threaded screw rod 32 is rotated to return the upper corner die segments 7A, 7B to the original positions, the piston 53 is retreated to insert the wedges 50 of all upper lateral die segments into the key way 46, and the shafts 35, 36 are rotated for returning them to the condition shown in Fig. 10.

The upper corner die segments 7A, 7B before and after the bending are operated as follows:

As shown in Figs. 2 and 9, until the openable die segment 7A, 7B portion 72 of each upper corner die segment descends from the ram lifting position and touches the sheet metal 90, it is supported and brought down inwardly slanted by the link 75 as shown by the chain line in said drawings. When the ram 13 is lowered in such state, it does not abut against the rise 95 of the sheet metal. When the ram 13 is then further lowered, the openable die segment portion 72 touches the work before the upper lateral die segments 2A, 2B—6A, 6B touch same, and begins to pivot clockwise in Fig. 9. Then, when the edges 86 of the upper lateral die segments touch the work, as shown by the solid line in the same drawing, the flat surface 84 of the openable die segment contact closely the end face 81 of the adjacent upper lateral die segment 6A or 6B, while the edges 85, 86 are arranged on the same line. Since the edge line does not have any gaps, it can withstand a large load so that the sheet metal can be bent along a clear even bending line by pressing it under such condition.

After the completion of bending when the ram 13 is raised, while the openable die segment portion 72 hung by the link 75 tends to pivot about the pin 77 with its own weight, the rod 88 guided by the hole 89 is regulated to descend for example 3 to 5 mm vertically at the beginning of the pivoting. Since the flat surface 84 of the openable die segment portion is moved out of the end face 81 by that vertical descend, the openable die segment portion is thereafter pivoted about the pin 77 and the side oblique surface 82 abuts against the end face of the upper lateral die segment and stops so that it can return to the condition shown by the chain line and be withdrawn without interfering with the rise 95 of the work.

Figs. 14 and 15 are respectively sectional and front views showing a modification of the upper corner die segment. In this example, applied to a goose-neck-shaped press brake, same parts as those in Fig. 9 are designated by the same symbols. As shown in Figs. 10 and 15, a main body 101 is provided on the lower corner with the backet 76 for supporting the goose-neck-shaped openable die segment portion 102 through a link 103. An arm 104 is provided upward from the pivotal fulcrum side of the link 103, while an air cylinder 105 parallel to the edge line is provided in the main body 101 and an end of a piston 106 inserted into the cylinder 105 is disposed to abut against an end of said arm 104. Before entering the bending process, presurized air is supplied from an approach port 107 of the cylinder to move the piston 106 right, hold the link 103 horizontally

and make the openable die segment portion 102 contact closely the main body 101 and the upper lateral die segment. Before and after the bending process, air in the cylinder 105 is vented to slant the openable die segment 102 by its own weight and avoid the interference with the rise 95 of the sheet metal similarly to the previously mentioned embodiment. Also, similarly, the edge line is formed without any gaps between the openable die segment portion and the adjacent upper lateral die segments.

Fig. 16 shows a further modification of the upper corner die segment applied to a folding machine according to the present invention. This upper corner die segment is almost the same as that in Figs. 14 and 15. The die itself applies to a clamp die segment 110 of the folding machine which is opposed to a lower die 111 and lowered by the press cylinder of the ram to clamp the sheet metal 90 and bend the sheet metal edge by pivoting a rotary die segment 112 in the direction of arrow. In this case, while all of the upper lateral die segments, central die segments and thin upper die segments have the same shape as the clamp die segment 110, the illustration of them is omitted. The operational effect of the upper corner die segment is the same as that of the before-mentioned embodiment.

As above mentioned, since the apparatus for adjusting the tool length of a bending machine according to the present invention has the invertible upper lateral die segments together with the invertible thin upper auxiliary die segments for fine adjustment of the tool length, it can sufficiently cope with the change of the sheet metal length and easily accurately carry out the working to bend four sides.

Claims

1. An apparatus for adjusting the tool length of a bending machine, comprising:

a ram (13) having a lower end;

a top tool mounted on the lower end of said ram (13);

a bottom tool (16) mounted below the top tool;

the top tool including:

a pair of central die segments (1A, 1B) mounted longitudinally slidable on the lower end of the ram (13),

a plurality of lateral die segments (2A, 2B, ..., 6A, 6B) arranged outside the central die segments (1A, 1B) and longitudinally movable therewith,

a plurality of auxiliary die segments (8) selectively insertable inbetween the central die segments (1A, 1B) so as to be in longitudinal alignment therewith, and invertible out of longitudinal alignment with the central die segments (1A, 1B) and being thinner than the lateral die segments (2A, 2B, ..., 6A, 6B), and

corner die segments (7A, 7B) arranged longitudinally shiftable left and right of the central die segments (1A, 1B);

a shift mechanism (38, 39, 40) for sliding said central die segments (1A, 1B) in opposite directions along the central portion of the lower portion of the ram (13);

a drive mechanism (30, 33) for sliding the corner die segments (7A, 7B) to longitudinally symmetrical positions along the lower portion of the ram (13);

rotatable coaxial shafts (35, 36) pivotally disposed at the back of said central die segments (1A, 1B) and corner die segments (7A, 7B) and supporting the auxiliary die segments (8);

and a mechanism (25) for selecting the number of the auxiliary die segments (8) supported by the shafts, to be inverted out of longitudinal alignment with the central die segments (1A, 1B); characterized in that

the lateral die segments (2A, 2B, ..., 6A, 6B) are attachable each by a wedge (50) to the said shafts (35, 36) for rotational movement therewith, the lateral die segments being pivotable about said shafts such as to be inverted out of longitudinal alignment with the central die segments (1A, 1B) and also being selectively insertable between said central die segments (1A, 1B) and said corner die segments (7A, 7B) such as to be in longitudinal alignment with the central die segments (1A, 1B); and wedge releasing mechanisms (55) are provided for releasing the wedges (50) of adjacent lateral die segments (2A, 2B, ..., 6A, 6B) from their corresponding shaft, said wedge releasing mechanisms (55) being located in the bodies (71) of each of the corner die segments (7A, 7B) which bodies are each longitudinally dimensioned such as to correspond to the longitudinal dimension of an integral number of lateral die segments which by said wedge releasing mechanisms (55) can be simultaneously released from rotation with their corresponding shaft.

2. The apparatus for adjusting the tool length of a bending machine according to claim 1, characterized in that the central die segments (1A, 1B) are slidable fitted into a groove (19) in the lower portion of the ram (13) and provided on the back with brackets (21, 22) for holding a spline cylinder (23, 24) supporting the thin upper die segments (8).

3. The apparatus for adjusting the tool length of a bending machine according to claim 2, characterized in that the drive mechanism (30, 33) for the upper corner die segments (7A, 7B) comprises a left and right threaded rod (32) provided in the groove (19) of the lower portion of the ram (13), female screws (31) provided in the corner die segments (7A, 7B) and a rotary unit (33) provided on an end of the rod.

4. The apparatus for adjusting the tool length of a bending machine according to claims 2 or 3, characterized in that the mechanism (25) for selecting the number of the auxiliary die segments (8) to be inverted comprises spline cylinders (23, 24) having a split near a position in which the shafts (35, 36) are butted against each other, and cylinders (38, 40) for shifting each shaft outward, one spline cylinder (23) being secured fixedly to an end of one shaft (36) to invert the auxiliary die segments (8) engaging the corre-

sponding spline cylinder (23) in pivoting the shaft and the other spline cylinder (24) being secured fixedly to the bracket (22) of one of the central die segments (1A, 1B) to support the auxiliary die segment (8) engaging the corresponding spline cylinder (24) in non-inverting condition.

5. The apparatus for adjusting the tool length of a bending machine according to any of claims 1 to 4, characterized in that the wedge releasing mechanism (55) to temporarily release each opposed upper lateral die segment (2A, 2B, ..., 6A, 6B) from the shaft (35; 36) consists of a plurality of sets of cylinder (54) and piston (53).

6. The apparatus for adjusting the tool length of a bending machine according to any of claims 1 to 5, characterized in that each corner die segment (7A, 7B) includes a main body (71, 101) and a die segment portion (72, 102, 110); a link (75, 103) mounted inside the lower portion of the main body of the upper corner die segment supports pivotably about a horizontal axis the die segment portion on the end of the link; and a rod (88) is erected on the center of the upper surface of the die segment portion to be inserted into a guide hole (89) in the corner die segment main body.

7. The apparatus according to claim 6, characterized in that the die segment portion (72, 102, 110) at its side directed toward the central die segments (1A, 1B) has a cavity (80) for avoiding the interference with an end face (81) of the adjacent die segment (2A, 2B, ..., 6A, 6B) when rotated inwardly, and the lower portion of the cavity has a flat surface (84) contacting the end face of said adjacent die segment to form a continuous edge line (85, 86).

Patentansprüche

1. Vorrichtung zum Einstellen der Werkzeuglänge einer Biegemaschine, mit folgenden Teilen:

einer ein unteres Ende aufweisenden Ramme (13); einem am unteren Ende der Ramme (13) montierten oberen Werkzeug;

einem unterhalb des oberen Werkzeugs montierten unteren Werkzeug (16);

wobei das obere Werkzeug folgende Teile umfaßt:

zwei zentrale Stempelsegmente (1A, 1B), die in Längsrichtung verschiebbar am unteren Ende der Ramme (13) motiert sind,

eine Mehrzahl von seitlichen Stempelsegmenten (2A, 2B, ..., 6A, 6B), die außerhalb der zentralen Stempelsegmente (1A, 1B) angeordnet und mit diesen in Längsrichtung bewegbar sind,

eine Mehrzahl von Hilfs-Stempelsegmenten (8), die selektiv zwischen die zentralen Stempelsegmente (1A, 1B) so einsetzbar sind, daß sie mit diesen in Längsrichtung fluchten, und aus der Längs-Fluchtung mit den zentralen Stempelsegmenten (1A, 1B) herausschwenkbar sind, und die dünner sind als die seitlichen Stempelsegmente (2A, 2B, ..., 6A, 6B), und

Eck-Stempelsegmente (7A, 7B) die in Längsrichtung verschiebbar links und rechts von den zentralen Stempelsegmenten (1A, 1B) angeordnet sind;

einem Schiebemechanismus (38, 39, 40) zum gleitenden Verschieben der zentralen Stempelsegmente (1A, 1B) in entgegengesetzte Richtungen entlang dem Mittelteil des unteren Teils der Ramme (13);

einem Antriebsmechanismus (30, 33) zum gleitenden Verschieben der oberen Eck-Stempelsegmente (7A, 7B) zu in Längsrichtung symmetrischen Stellungen entlang dem unteren Teil der Ramme (13),

drehbaren koaxialen Wellen (35, 36), die verdrehbar im Bereich hinter den zentralen Stempelsegmenten (1A, 1B) und Eck-Stempelsegmenten (7A, 7B) angeordnet sind und die Hilfs-Stempelsegmente (8) tragen;

und einem Mechanismus (25) zum Wählen der Anzahl der von den Wellen getragenen Hilfs-Stempelsegmente (8), die aus der Längs-Fluchtung mit den zentralen Stempelsegmenten (1A, 1B) ausgeschwenkt werden sollen; dadurch gekennzeichnet,

daß die seitlichen Stempelsegmente (2A, 2B, ..., 6A, 6B) jeweils mit Hilfe eines Keils (50) an den Wellen (35, 36) für eine Drehbewegung mit diesen festlegbar sind, wobei sie um diese Wellen so drehbar sind, daß sie aus der Längs-Fluchtung mit den zentralen Stempelsegmenten (1A, 1B) ausschwenkbar sind und auch selektiv zwischen die zentralen Stempelsegmente (1A, 1B) und die Eck-Stempelsegmente (7A, 7B) so einfügbar sind, daß sie dann in Längs-Fluchtung mit den zentralen Stempelsegmenten (1A, 1B) sind;

und daß Keillösemechanismen (55) zum Lösen der Keile (50) benachbarter seitlicher Stempelsegmente (2A, 2B, ..., 6A, 6B) von ihrer entspechenden Welle vorhanden, und zwar in den Körpern (71) jedes der Eck-Stempelsegmente (7A, 7B) angeordnet sind, wobei diese Körper jeweils in Längsrichtung so dimensioniert sind, daß sie der Längsdimension einer ganzzahligen Anzahl von seitlichen Stempelsegmenten entsprechen, die durch diese Keillösemechanismen (55) gleichzeitig von der Drehung mit ihrer entsprechenden Welle freisetzbar sind.

2. Vorrichtung zum Justieren der Werkzeuglänge einer Biegemaschine nach Anspruch 1, dadurch gekennzeichnet, daß die zentralen Stempelsegmente (1A, 1B) gleitfähig in eine Nut (19) im unteren Teil der Ramme (13) passen und an der Rückseite mit Klammern (21, 22) zum Halten eines Keilzylinders (23, 24) versehen sind, der die oberen dünnen Hilfs-Stempelsegmente (8) trägt.

3. Vorrichtung zum Justieren der Werkzeuglänge einer Biegemaschine nach Anspruch 2, dadurch gekennzeichnet, daß der Antriebsmechanismus (30, 33) für die oberen Eck-Stempelsegmente (7A, 7B) eine Stange (32) mit Linksgewinde und Rechtsgewinde umfaßt, die sich in der Nut (19) des unteren Teils der Ramme (13) befindet, ferner Innengewinde (31) in den Eck-Stempelsegmenten (7A, 7B) und eine am Ende der Stange befindliche Dreheinheit (33).

4. Vorrichtung zum Justieren der Werkzeu-

glänge einer Biegemaschine nach Anspruch 2 oder 3, dadurch gekennzeichnet, daß der Mechanismus (25) zum Wählen der Anzahl der auszuschwenkenden Hilfs-Stempelsegmente (8) Keilzylinder (23, 24) mit einer Grenzfläche nahe einer Stellung, in der die Wellen (35, 36) aneinander anliegen, und Zylinder (38, 40) zum Auswärtsschieben jeder der Wellen umfaßt, wobei einer der Keilzylinder (23) fest mit einem Ende der einen Welle (36) verbunden ist, um die an entsprechenden Keilzylinder (23) angreifenden Hilfs-Stempelsegmente (8) bei einer Drehung der Welle auszuschwenken, und der andere Keilzylinder (24) fest mit der Klammer (22) eines der zentralen Stempelsegmente (1A, 1B) verbunden ist, um die Hilfs-Stempelsegmente (8) zu halten, die in ihrem nichtausgeschwenkten Zustand am entsprechenden Keilzylinder (24) angreifen.

5. Vorrichtung zum Justieren der Werkzeuglänge einer Biegemaschine nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die Keillösemechanismen (55), die dazu dienen, vorübergehend die einzelnen gegenüberliegenden oberen seitlichen Stempelsegmente (2A, 2B, ..., 6A, 6B) von der Welle (35, 36) zu lösen, aus einer Mehrzahl von Zylinder-Kolben-Einheiten (54, 53) bestehen.

6. Vorrichtung zum Justieren der Werkzeuglänge einer Biegemaschine nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß jedes Eck-Stempelsegment (7A, 7B) einen Hauptkörper (71, 101) und einen Stempelsegmentteil (72, 102, 110) umfaßt; daß ein im unteren Teil des Hauptkörpers des oberen Eck-Stempelsegments montierter Lenker (75, 103) an seinem Ende um eine horizontale Achse (77) verdrehbar den Stempelsegmentteil haltert; und daß eine Stange (88) im Zentrum der oberen Fläche des Stempelsegmentteils aufgerichtet ist, die in eine Führungsbohrung (89) im Hauptkörper des Eck-Stempelsegments eingesetzt ist.

7. Vorrichtung nach Anspruch 6, dadurch gekennzeichnet, daß der Stempelsegmentteil (72, 102, 110) an seiner den zentralen Stempelsegmenten (1A, 1B) zugewandten Seite eine Aushöhlung (80) zum Vermeiden einer gegenseitigen Kollision mit einer Endfläche (81) des benachbarten Stempelsegments (2A, 2B, ..., 6A, 6B) bei seiner Einwärtsdrehung aufweist und der untere Teil der Aushöhlung eine ebene Fläche (84) aufweist, die die Endfläche des benachbarten Stempelsegments berührt, um eine zusammenhängende Kantenlinie (85, 86) zu ergeben.

Revendications

1. Appareil pour ajuster la longueur de l'outil d'une machine de pliage, comprenant:

—un coulisseau (13) ayant une extrémité inférieure,

—un outil supérieur monté sur l'extremité inférieure du coulisseau (13),

—un outil inférieur (16) monté sous l'outil supérieur, l'outil supérieur incluant:

—une paire de segments centraux de matrice (1A, 1B) montés longitudinalement glissants sur l'extrémité inférieure du coulisseau,

—plusieurs segments latéraux de matrice (2A, 2B, ..., 6A, 6B) disposés à l'extérieur des segments centraux (1A, 1B) et mobiles longitudinalment avec ceux-ci,

—plusieurs segments auxiliaires de matrice (8) sélectivement inserrés entre les segments centraux (1A, 1B) de manière à être longitudinalement alignés avec ces derniers, qui puissent être dégagés hors de l'alignement longitudinal des segments centraux (1A, 1B) et ayant une épaisseur moindre que les segments latéraux (2A, 2B, ..., 6A, 6B), et

—des segments de coin ou d'extrémité de matrice (7A, 7B) disposés longitudinalement déplaçables à gauche et à droite des segments centraux (1A, 1B);

—un mécanisme de décalage (38, 39, 40) pour faire glisser les segments centraux (1A, 1B) suivant des directions opposées le long de la zone centrale de l'extrémité inférieure du coulisseau (13),

—un mécanisme de commande (30, 33) pour déplacer les segments d'extrémité en des positions symétriques longitudinalement le long de la zone centrale de la partie inférieure du coulisseau (13);

—des arbres rotatifs coaxiaux (35, 36) montés pivotants à l'arrière des segments centraux (1A, 1B) et des segments d'extrémité (7A, 7B), et supportant les segments auxiliaires (8); et

—un méchanisme por sélectionner le nombre de segments auxiliaires (8) supportés par les arbres, qui sont à dégager hors de l'alignement des segments centraux (1A, 1B), caractérisé en ce que les segments latéraux (2A, 2B, ..., 6A, 6B) sont chacun fixés par une cale (50) aux arbres (35, 36) pour un mouvement à rotation avec ces derniers, les segments latéraux étant pivotant sur ces arbres de manière à être dégagés hors de l'alignement longitudinal des segments centraux (1A, 1B), et étant sélectivement inserrés entre les segments centraux (1A, 1B) et les segments d'extrémité (7A, 7B) de manière à être en alignement longitudinal avec les segments centraux (1A, 1B); et en ce que des mécanismes de retrait (55) de cales sont prévus pour dégager les cales (50) des segments latéraux adjacents (2A, 2B, ..., 6A, 6B) de leurs arbres respectifs, ces mécanismes (55) étant situés dans les corps (71) de chacun des segments d'extrémité (7A, 7B) corps (71) qui sont chacun dimensionnés longitudinalement pour correspondre à la dimension longitudinale d'un nombre entier de segments latéraux qui, par lesdits mécanismes de retrait (55), peuvent êntre désolidarisés en rotation de leur arbre correspondant.

2. Appareil pour ajuster la longueur de l'outil d'une machine de pliage selon la revendication 1, caractérisé en ce que les segments centraux (1A, 1B) sont montés glissant dans une rainure (19) à la parite inférieure du coulisseau (13) et sont équipés de pattes (21, 22) pour maintenir un cylindre canelé (23, 24) supportant les segments auxiliaires supérieurs (8).

3. Appareil pour ajuster la longueur de l'outil

d'une machine de pliage selon la revendication 2, caractérisé en ce que le mécanisme de commande (30, 33) pour les segments d'extrémité supérieurs (7A, 7B) comprennent une tige (32) fileté à gauche et à driote prévue dans la rainure (19) de la partie inférieure du coulisseau (13), des vis femelles (31) prévues dans les segments d'extrémité (7A, 7B), et une unité rotative (33) prévue à une extrémité de la tige.

4. Appareil pour ajuster la longueur de l'outil d'une machine de pliage selon la revendication 2 ou 3, caractérisé en ce que le mécanisme (25) pour sélectionner le nombre de segments auxiliaires (8) à dégager, comprend des cylindres canelés (23, 24) ayant une butée proche d'une position pour laquelle les arbres (35, 36) sont en contact l'une avec l'autre, et des cylindres (38, 40) pour décaler chaque arbre vers l'extérieur, un cylindre canelé (23) étant solidaire d'une extrémité d'une arbre (36) pour dégager les segments auxiliaires (8) engageant le cylindre canelé (23) correspondant par pivotement de l'arbre, et l'autre cylindre canelé (24) étant solidaire de la patte (22) de l'un des segments centraux (1A, 1B) pour supporter le segment auxiliaire (8) engageant le cylindre canelé (24) correspondant dans une position non-dégagée.

5. Appareil pour ajuster la longueur de l'outil d'une machine de pliage selon l'une quelconque des revendications 1 à 4, caractérisé en ce que les mécanismes (55) de retrait des cales pour dégager temporairement chaque segment latéral supérieur opposé (2A, 2B, ..., 6A, 6B) de l'arbre (35; 36) comprend plusieurs jeux de cylindre (54) et de piston (53).

6. Appareil pour ajuster la longueur de l'outil d'une machine de pliage selon l'une quelconque des revendications 1 à 5, caractérisé en ce que chaque segment d'extrémité (7A, 7B) comprend un corps principal (71, 101) et une partie formant segment de matrice (72, 102, 110), un bras (75, 103) monté à l'intérieur de la partie inférieure de corps principal du segment de coin supérieur supporte de façon pivotante autour d'un axe horizontal (77) la partie de segment à l'extrémité du bras, et une tige (88) se dresse au centre de la surface supérieure de la partie de segment pour l'insérer dans un trou de guidage (89) dans le corps principal du segment de coin.

7. Appareil pour régler la longueur de l'outil d'une machine plieuse selon la revendication 6, caractérisé en ce que la partie de segment (72, 102, 110) sur son côté dirigé vers les segments centraux (1A, 1B) présente une cavité (80) pour éviter l'interférence avec la face d'extrémité (81) du segment adjacent (2A, 2B, ... 6A, 6B) lorsqu'il tourne vers l'intérieur, la partie inférieure de la cavité ayant une surface plane (84) en contact avec la face d'extrémité du segment adjacent pour former une ligne d'arête continue (85, 86).

FIG. 1

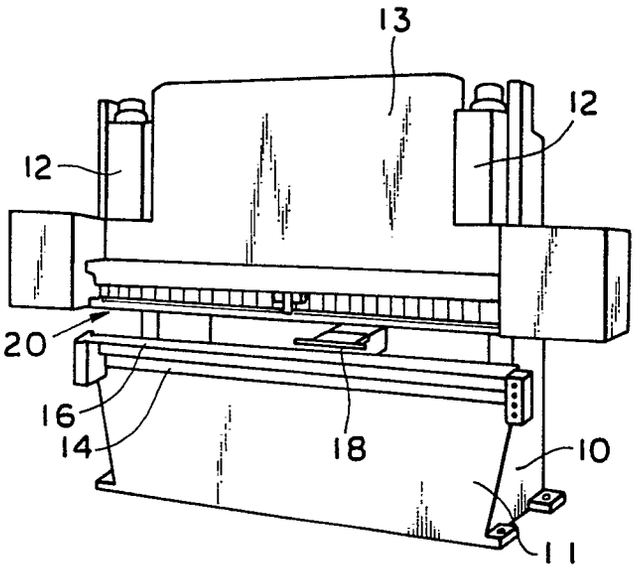
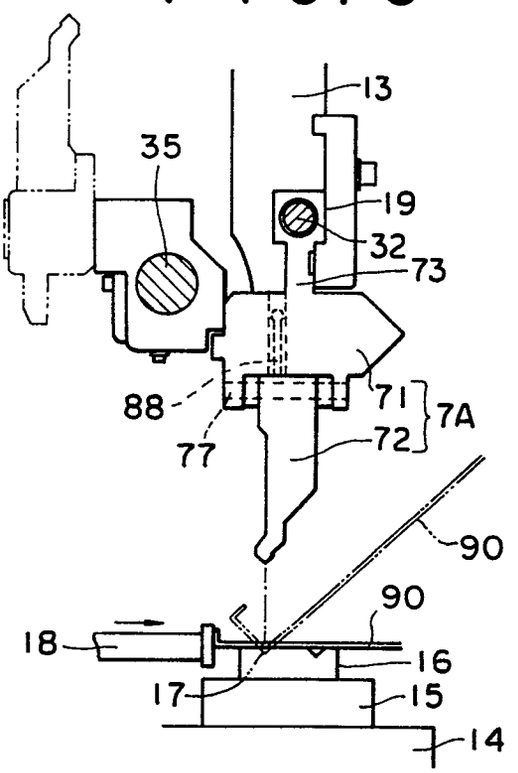

13
12
12
20
16
14
18
10
11

FIG. 3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35
19
32
73
88
71
7A
77
72
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90
18
16
17
15
14

FIG. 2

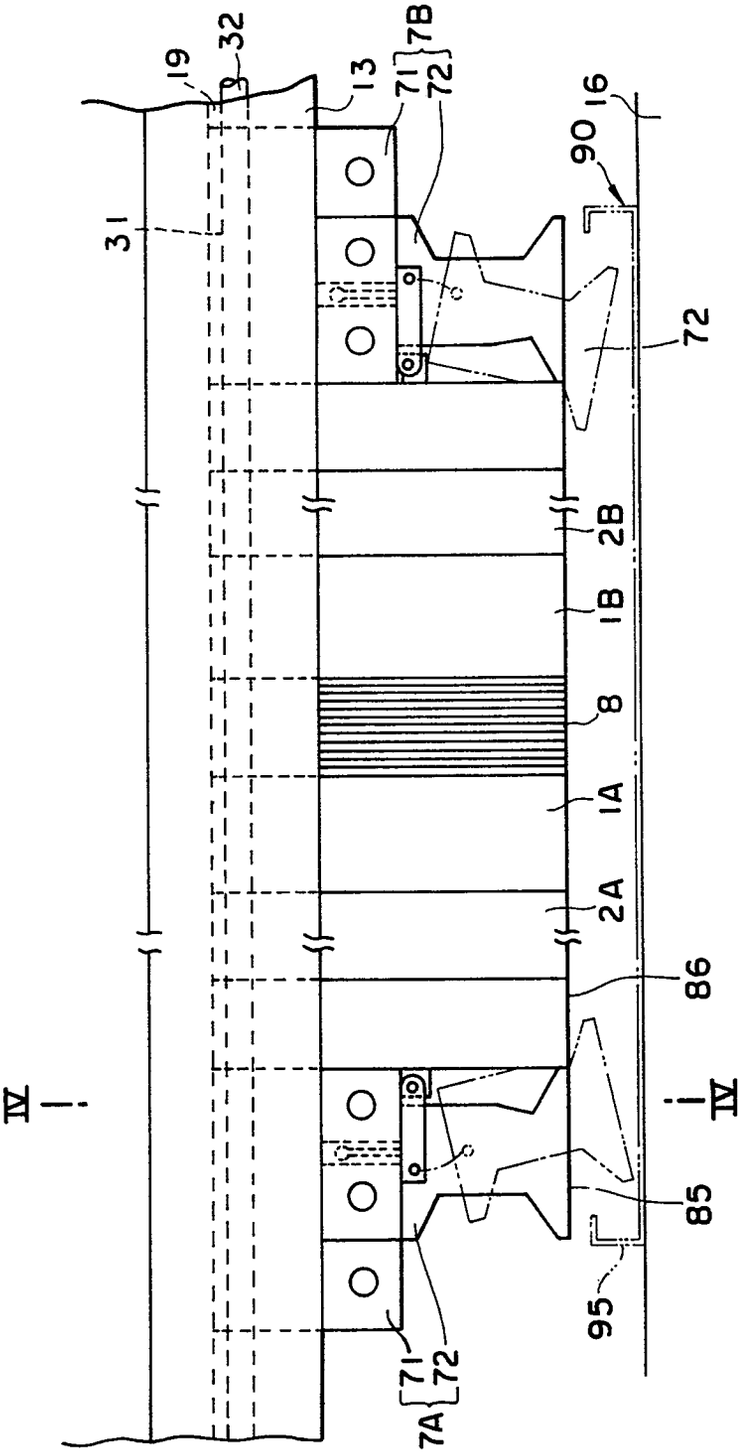


FIG. 4

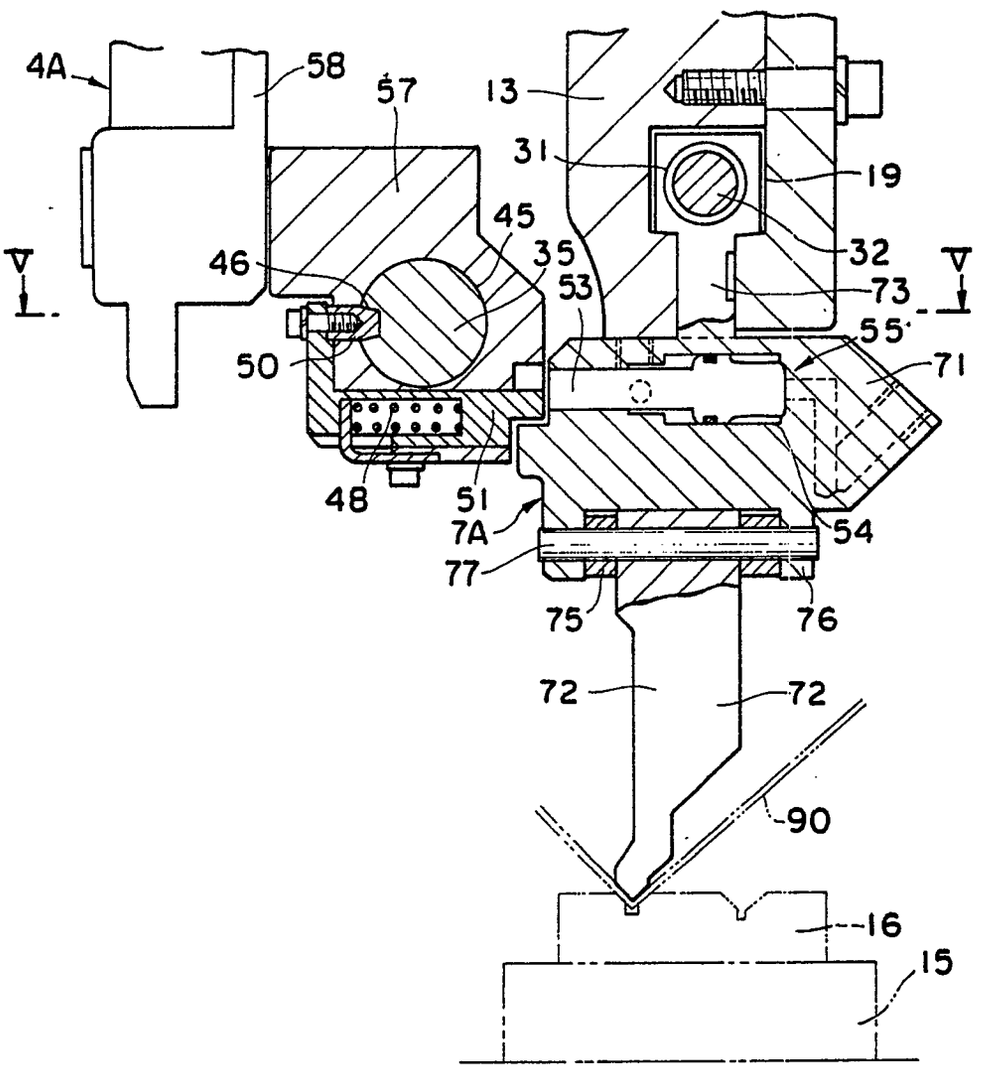

4A
58
57
13
31
19
45
46
35
32
V
V
53
73
55
50
71
48
51
7A
54
77
75
76
72
72
90
16
15

FIG. 5

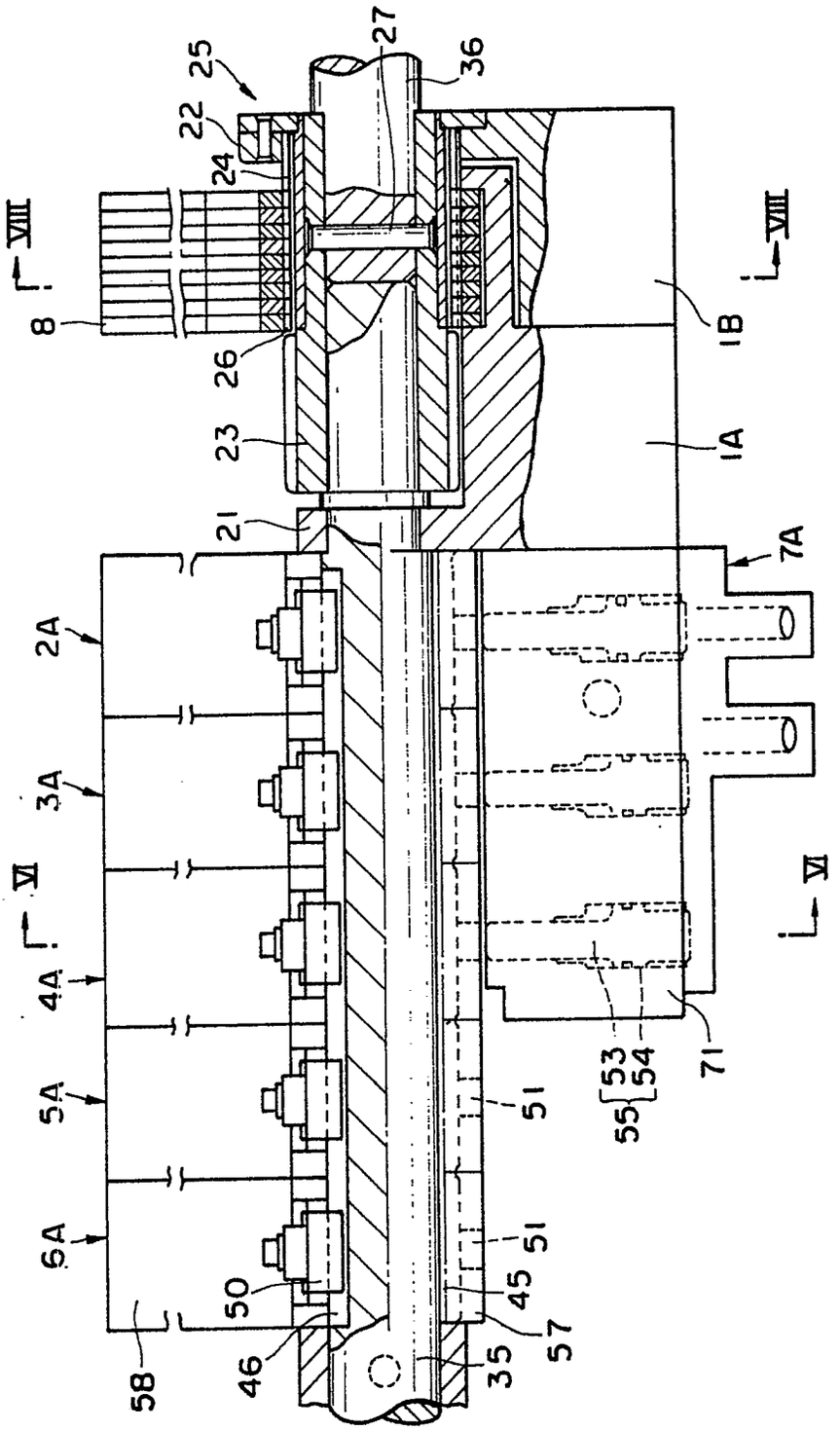
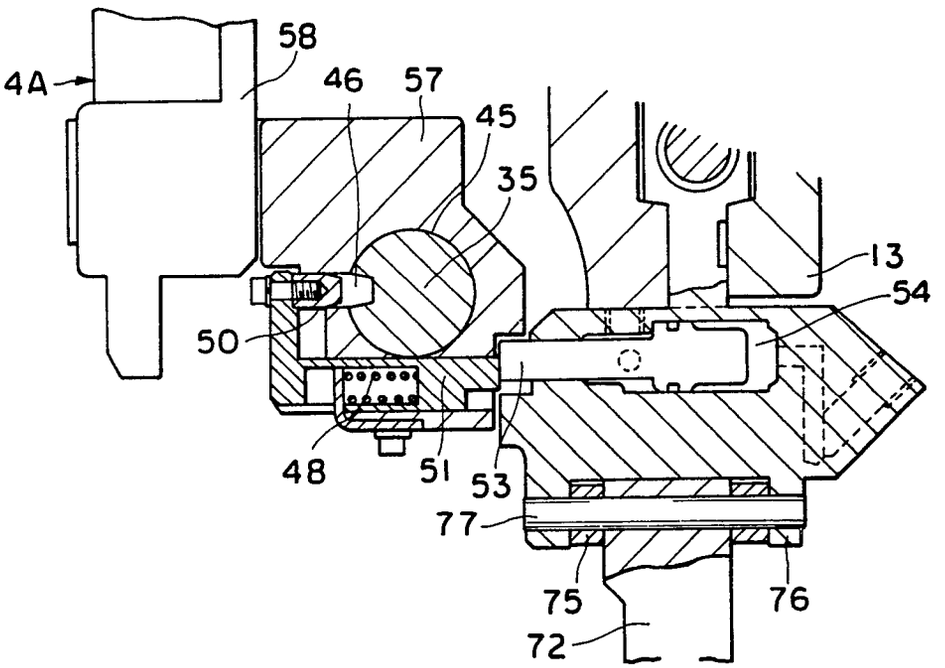

25
27
36
22
24
VIII
8
26
23
21
1B
1A
7A
2A
3A
VI
4A
5A
6A
50
46
58
51
45
57
35
55
53
54
71

FIG. 6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4A
46
57
45
35
13
54
50
48
51
53
77
75
76
72

FIG. 8

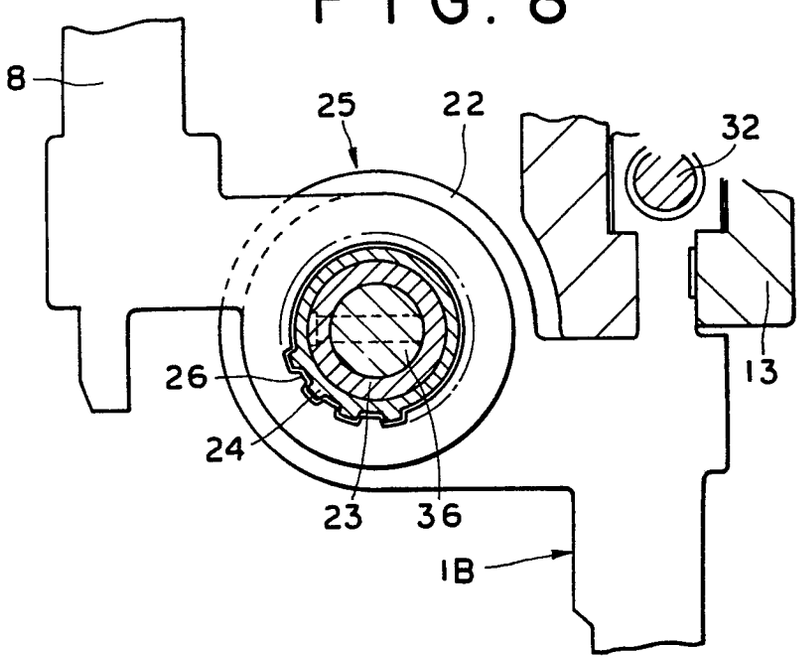

8
25
22
32
26
13
24
23
36
1B

FIG. 7

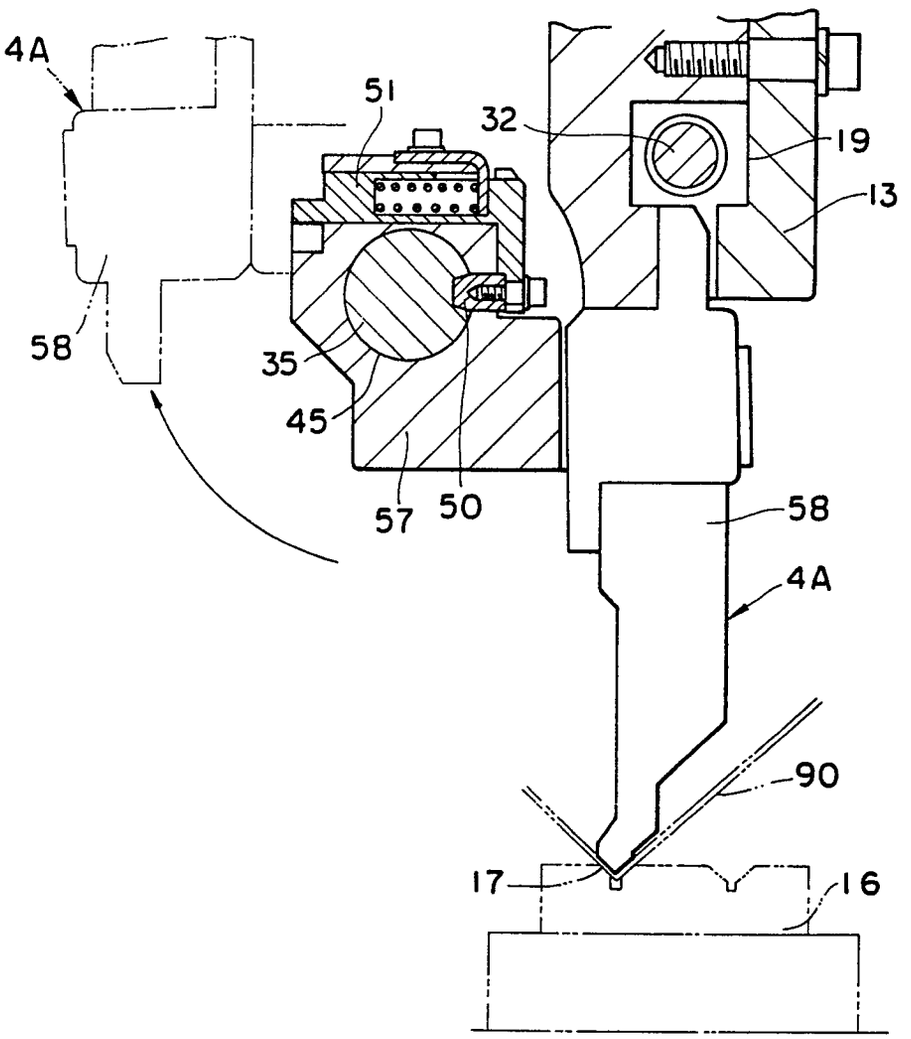
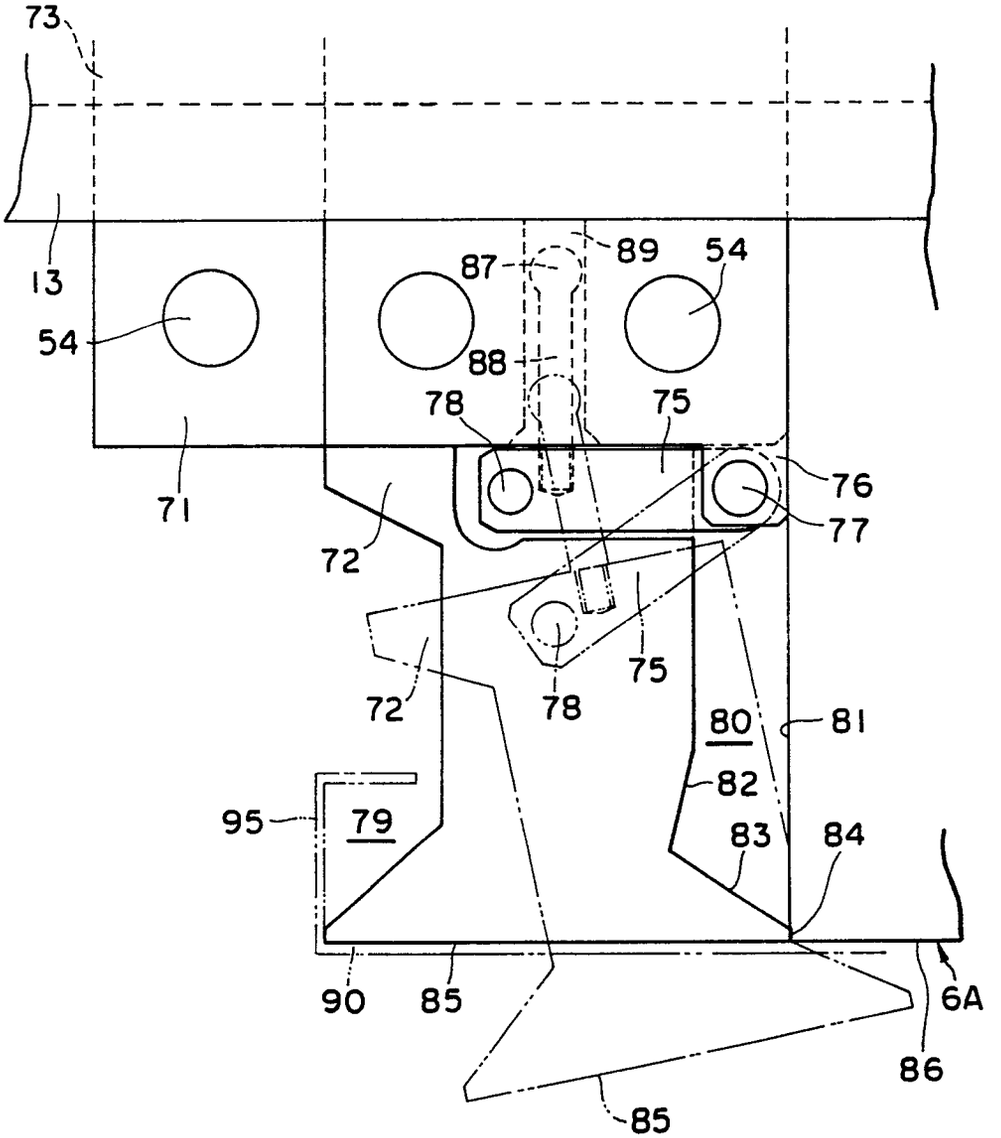


FIG. 9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13
54
87
89
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88
78
75
71
72
76
77
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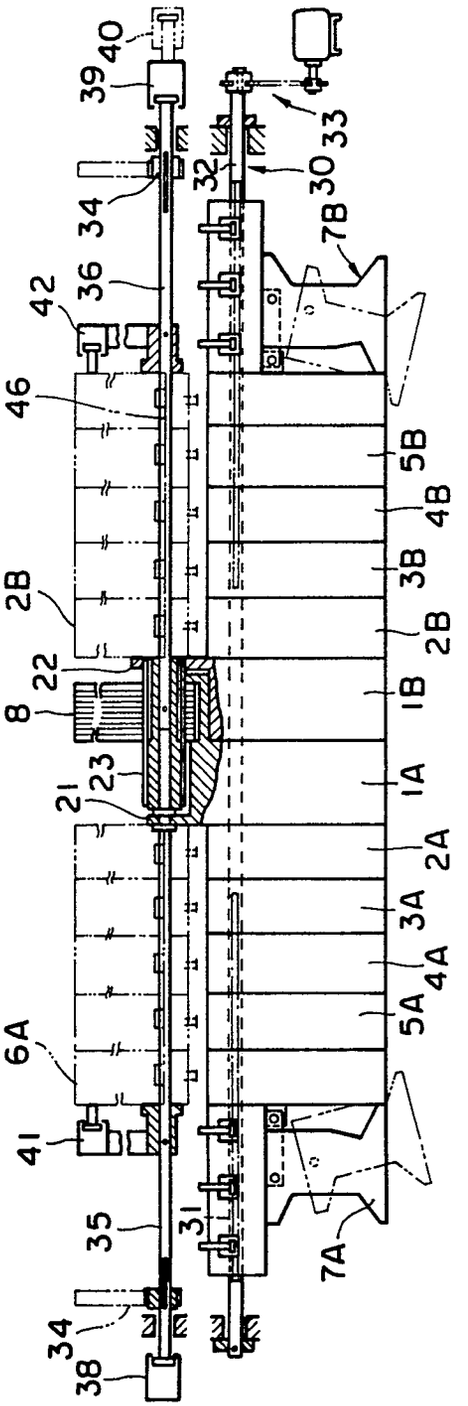
72
78
80
81
82
95
79
83
84
90
85
6A
86
85

FIG. 10


40
39
33
30
32
34
7B
36
42
46
5B
4B
3B
2B
2B
22
1B
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6A
41
35
31
7A
34
38

FIG. 11

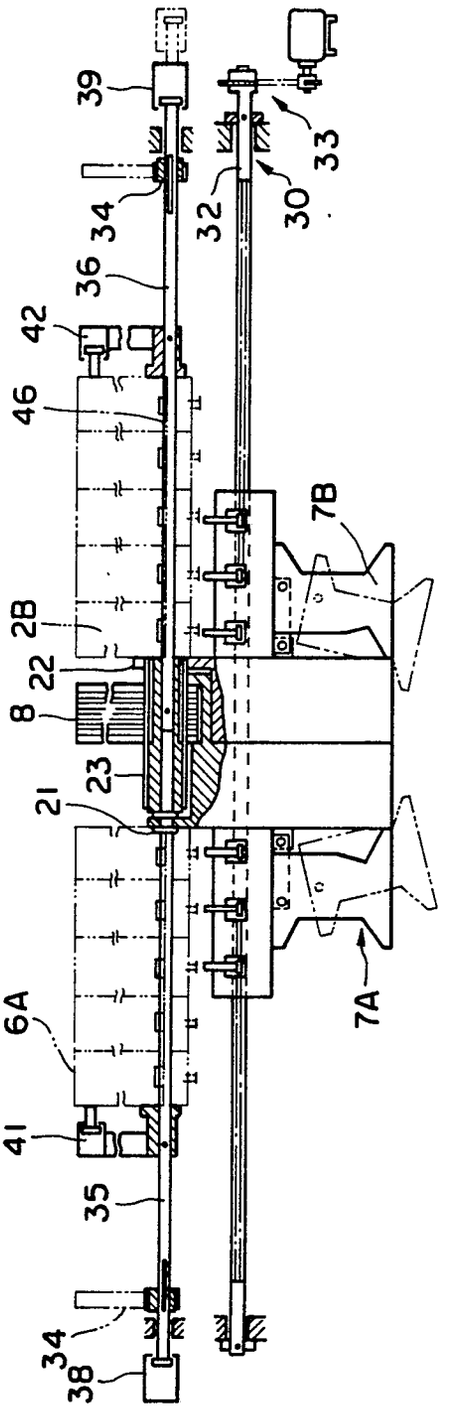


FIG. 12

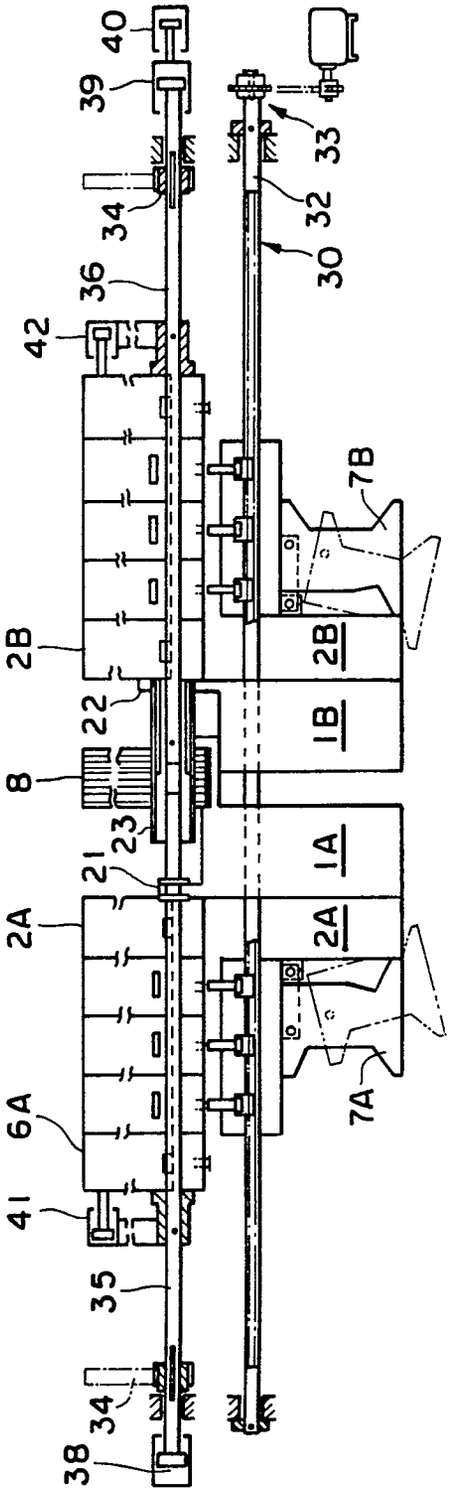
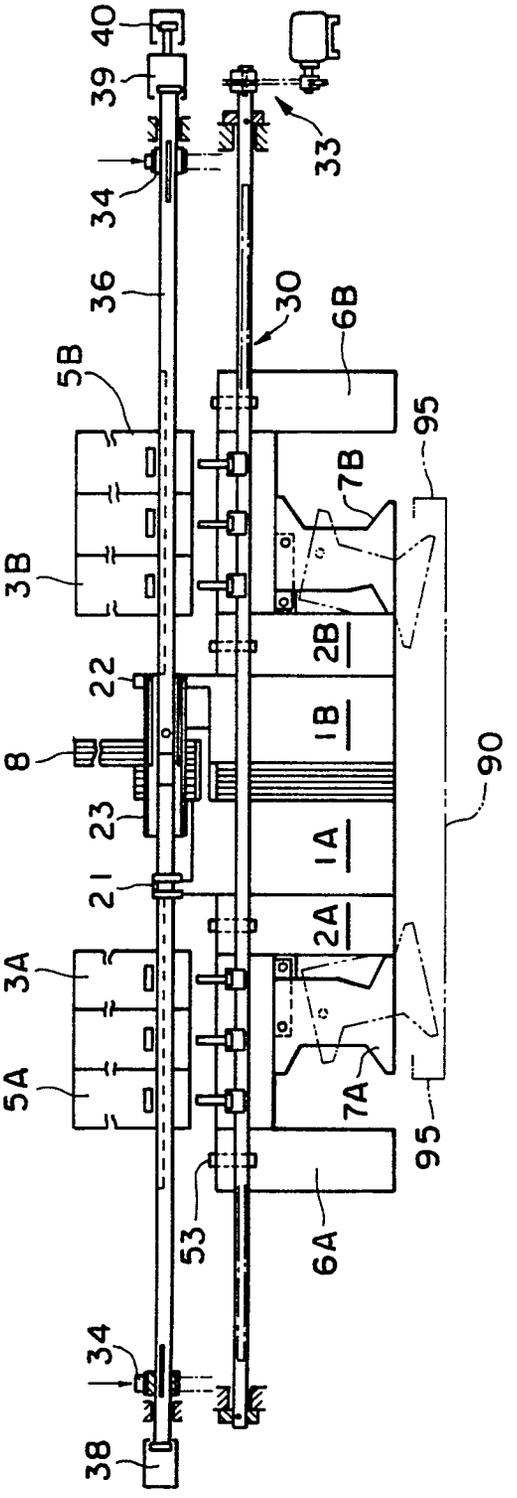


FIG. 13


40
39
34
36
5B
3B
22
8
23
21
3A
5A
38
34
53
33
30
6B
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1A
2A
7A
95
6A
90

FIG. 14

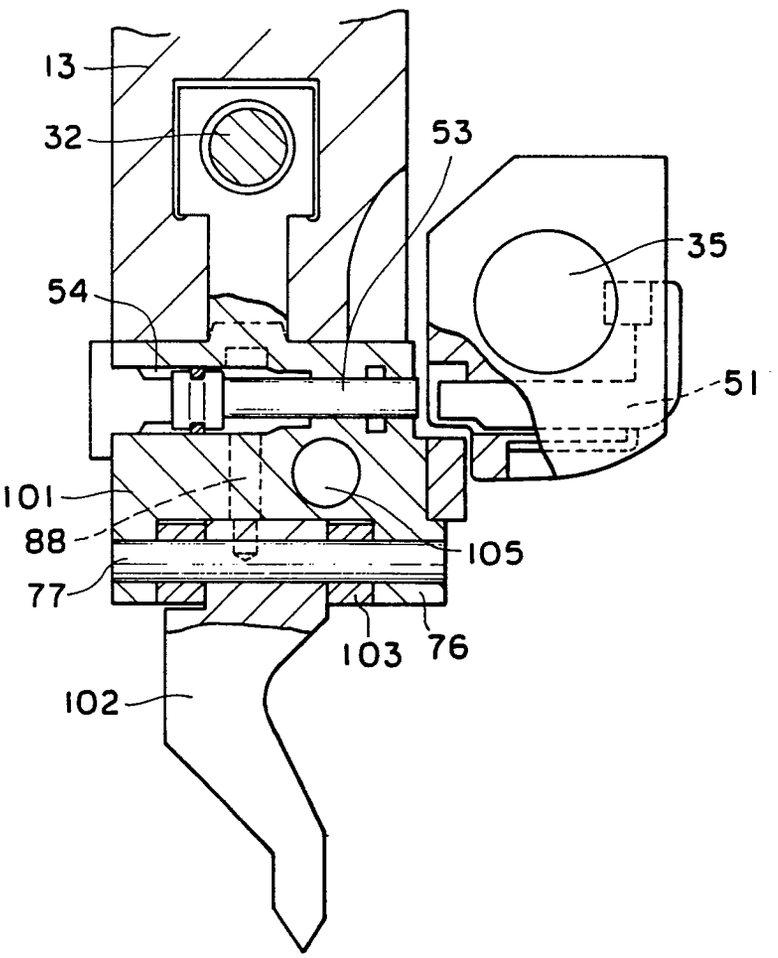

FIG. 15

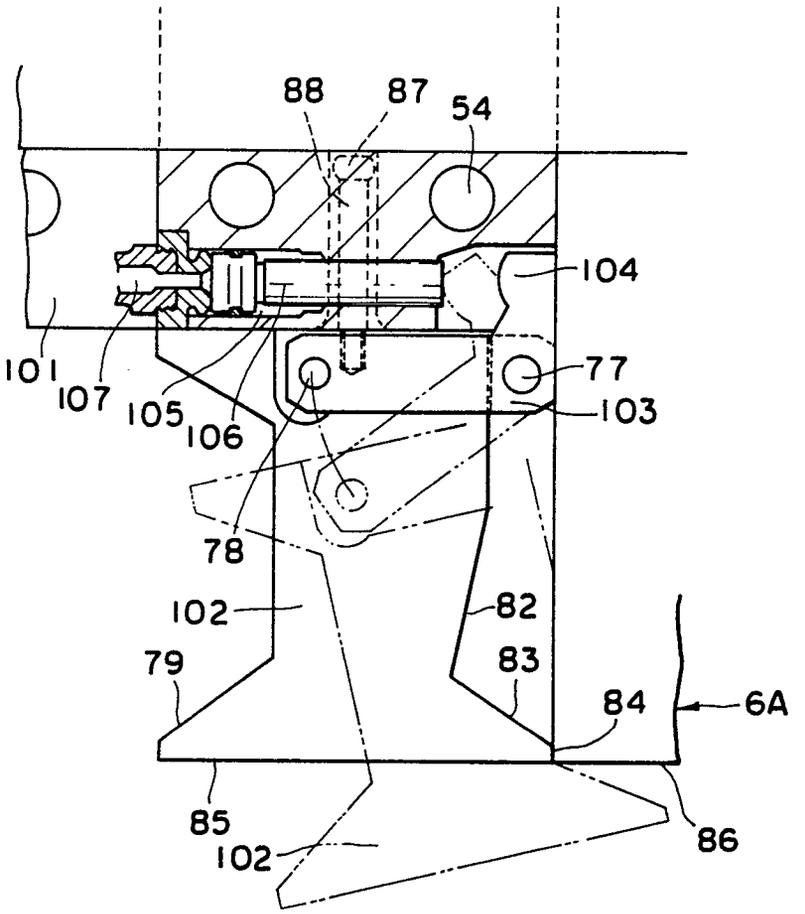

FIG. 16

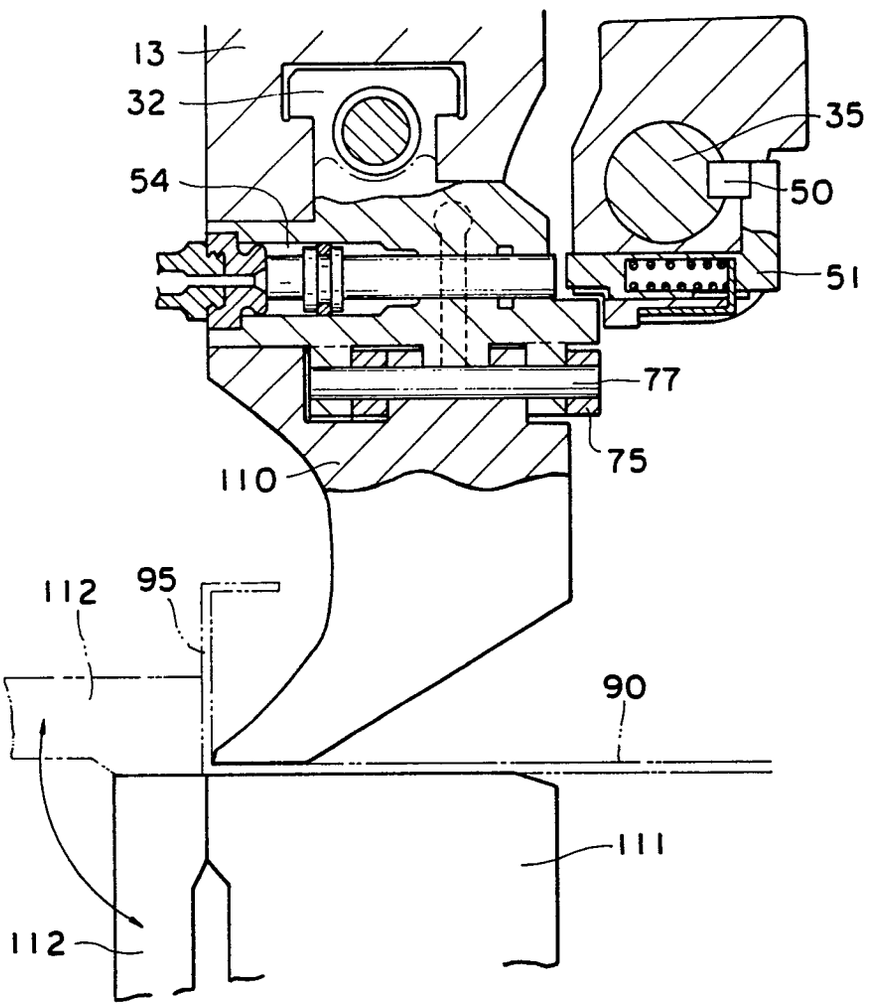

FIG. 17

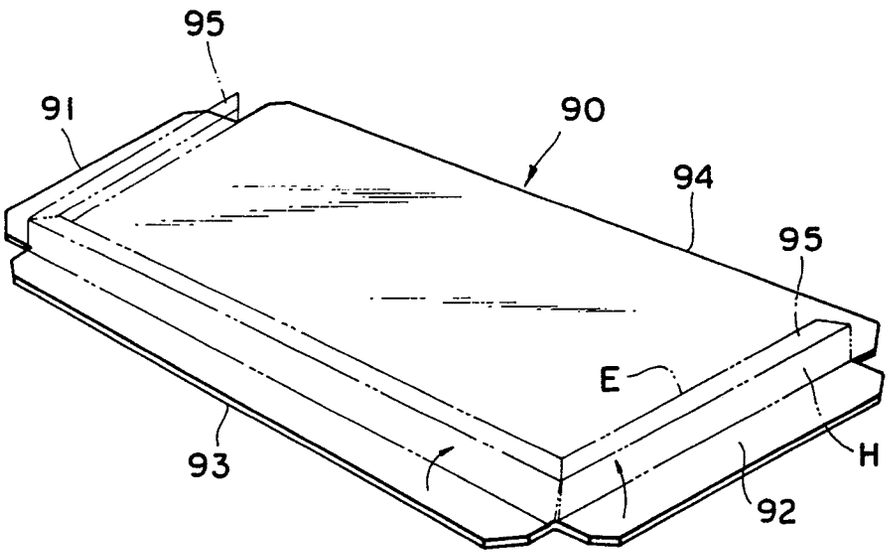

FIG. 18