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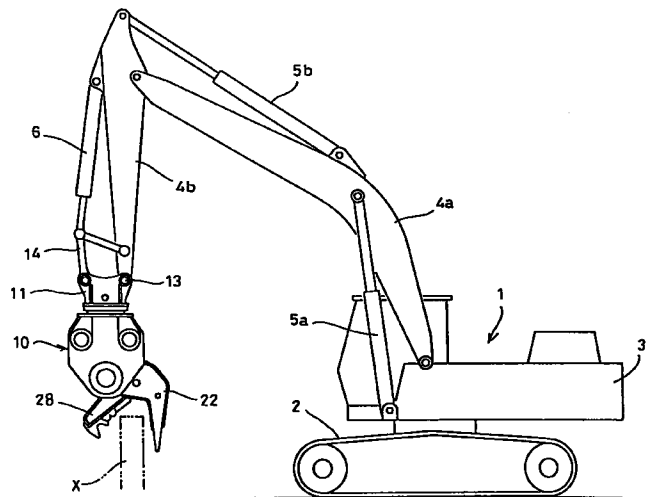
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### (54) Crusher

(57) A crusher having a bracket pivotally mounted on a free end of an arm of a civil engineering machine, a frame having a pair of support plates and rotatably mounted on the bracket, a fixed arm (22) having a pair of arm plates and pivotally mounted between the pair of support plates, the fixed arm (22) carrying at one end thereof a crushing jaw (24), a movable arm (28) mounted between the arm plates (23) of the fixed arm (22) so as to be pivotable, a trunnion type drive cylinder (29) mounted between the arm plates (23) for pivoting the movable arm (28) toward and away from the crushing jaw (24), the drive cylinder (29) being mounted so as to be pivotable around pivots (30) and pivotally supporting the fixed arm (22), the shaft (25) being coaxial with the pivots (30), and a fixing means (31) for fixing the fixed arm to the frame at both ends of the pivoting motion of the fixed arm about the shaft. The ends of the pivoting motion are separated a predetermined angle from each other.

FIG. 1



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## Description

### BACKGROUND OF THE INVENTION

This invention relates to a crusher used to demolish building walls, roadbeds, bridges and so on.

Figs. 10A and 10B show a conventional crusher mounted on the free end of an arm of a self-propelled civil engineering machine. This crusher comprises a bracket 60 pivotally mounted on the free end of the arm 54b of the civil engineering machine by means of a pin 65, a frame 61 rotatably mounted on the bracket 60 and having a crushing jaw 62, and a movable arm 63 having its rear end pivotally mounted on the frame 61 by means of a pin 64. An object X placed between the arm 63 and the crushing jaw 62 is crushed by pivoting the arm 63 with a driving cylinder (not shown). Otherwise, the object X is crushed by swinging the bracket 60 with the object gripped.

This crusher has its crushing jaw 62 integrally formed on the end of the frame 61. Thus, provided the arm 54b is fixed, its angular working range within which the jaw 62 and the movable arm 63 can crush an object X is equal to the angle by which the bracket 60 can be swung about the pin 65 by a cylinder 56 mounted on the arm 54b, i.e. from the position shown in Fig. 10A to the position shown in Fig. 10B. In Figs. 10A and 10B, the line a-a' indicates the axis of an object X clutched by the crushing jaw 62 and the movable arm 63.

Fig. 10C diagrammatically shows the above angular working range  $\alpha_0$ . In order to crush an object X that is disposed out of this range, the arm 54b and the boom (not shown) have to be moved while moving the entire machine. This extremely lowers the working efficiency. Particularly, the work was difficult at limited space, e.g. on a bridge.

To crush a bed of a bridge with the crusher shown in Figs. 10A and 10B, the civil engineering machine is placed on the bridge bed and moved to crush it from one end toward the other.

If the bridge bed 70 is supported by a plurality of longitudinal beams 71 as shown in Fig. 11, the wide portions 72 of the bed between the adjacent beams 71 are crushed first, and then the narrow portions 73 remaining on the beams 71 are crushed.

In order to crush such a bridge bed 70 with the conventional crusher, the wide portions 72 between the beams 71 are crushed by the crushing jaw 62 and the movable arm 63 with the opening defined therebetween turned horizontally (position A in Fig. 11). In order to crush the narrow portions 73 on the beams 71 thereafter, the bracket 60 is pivoted to turn the above opening downward (vertical direction) and the frame 61 is turned 90 to position B. By turning the opening downward, its position will change markedly in the longitudinal and vertical directions of the bed 70 (Fig. 12). This makes it necessary to move the civil engineering machine itself in order to crush the remaining narrow portions 73 from

their ends. Since the civil engineering machine has to be moved back and forth repeatedly to crush the portions 72 and 73, it is impossible to crush the bed 70 continuously with high efficiency.

An object of this invention is to increase the working range within which the crushing jaw and the movable arm can crush an object.

Another object is to reduce the necessity of moving the civil engineering machine itself to minimum and increase the efficiency of work.

### SUMMARY OF THE INVENTION

According to this invention, there is provided a crusher comprising a bracket pivotally mounted on a free end of an arm of a civil engineering machine, a frame having a pair of support plates on both sides thereof and rotatably mounted on the bracket, a fixed arm having a pair of arm plates on both sides thereof and pivotally mounted between the pair of support plates of the frame, the fixed arm carrying at one end thereof a crushing jaw, a movable arm mounted between the arm plates of the fixed arm so as to be pivotable, a trunnion type drive cylinder mounted between the arm plates of the fixed arm for pivoting the movable arm toward and away from the crushing jaw, the drive cylinder being mounted so as to be pivotable around pivots and pivotally supporting said fixed arm, said shaft being coaxial with said pivots, and a fixing means for fixing the fixed arm to the frame at both ends of the pivoting motion of the fixed arm about the shaft, the ends being separated a predetermined angle from each other.

The fixing means may comprise a pin hole formed in a rear end of the fixed arm, and two pairs of engaging cylinders each having a rod, each pair of the engaging cylinders being mounted on the support plates of the frame opposite to each other so as to be disposed along the circular locus of the axis of the pin hole while being separated from the other pair by an angle equal to the predetermined angle, the rods of one of the two pairs of engaging cylinders being adapted to engage in the pin hole when the pin hole comes into alignment with the rods of each one pair of engaging cylinders.

Otherwise, it may comprise two pin holes formed in a rear end of the fixed arm, the holes being disposed on a circumference having its center on the pivots and separated from each other by an angle equal to the predetermined angle, and a pair of engaging cylinders each having a rod and mounted on the support plates of the frame opposite to each other, the rods of the engaging cylinders being adapted to engage in one of the pin holes when the one of the holes comes into alignment with the rods.

With this arrangement, the angular working range of the crusher within which an object can be crushed by gripping it with the crushing jaw and the movable arm is equal to sum of the angle by which the bracket can pivot

about a point at which the bracket is coupled to the arm and the angle by which the fixed arm can pivot. Namely, the crusher of the present invention has an angular working range which is greater than that of conventional crushers by an angle equal to the angle by which the fixed arm can pivot.

By using single-acting or double-acting cylinder in the fixing means, the rods of the cylinders can be inserted into or pulled out of the pin holes formed in the rear end of the fixed arm to lock or unlock the fixed arm by remote control. Once locked in position, the fixed arm can be held in the locked position reliably.

Other features and objects of the present invention will become apparent from the following description made with reference to the accompanying drawings, in which:

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is side view of a crusher according to this invention, showing how it is used;

Fig. 2 is a sectional view of the crusher of Fig 1;

Fig. 3 is a vertical sectional side view of Fig. 2;

Fig. 4 is a sectional view of its fixed arm in a different position;

Figs. 5A and 5B show the working angle of the crusher when the arm is fixed;

Fig. 5C diagrammatically shows the working angle of the crusher;

Figs. 6A-6C are views showing how a bridge bed is crushed;

Fig. 7 is a sectional view of a different type of crushing jaw;

Fig. 8 is a sectional view of a different fixing means;

Fig. 9 is a side view in vertical section of Fig 8;

Figs. 10A and 10B show the working angle of a conventional crusher;

Fig. 10C diagrammatically shows the working angle of this crusher;

Fig. 11 is a view showing how a bridge bed is crushed; and

Fig. 12 is a view showing how the position of the crusher is changed.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

We will now describe the embodiment of this invention with reference to Figs. 1-9.

As shown Fig. 1, the self-propelled engineering machine 1 comprises a crawler 2, a swivel base 3 pivotally mounted on the crawler 2, a boom 4a pivotally mounted on the swivel base 3, and an arm 4b pivotally mounted on the free end of the boom 4a. The boom 4a is pivoted by a first cylinder 5a, while the arm 4b is pivoted by a second cylinder 5b.

The crusher 10 of this invention is mounted on the free end of the arm 4b. As shown in Figs. 2 and 3, the

crusher 10 has a bracket 11 with a pair of side plates 12 having one end thereof pivotally coupled to the free end of the arm 4b by means of pins 13.

As shown in Fig. 1, the side plates 12 are connected at their other ends to the free end of the arm 4b through a link 14 having an intermediate joint. A third cylinder 6 is connected to the intermediate joint of the link 14, so that the bracket 11 can be pivoted about the pin 13 by the third cylinder 6.

A bearing ring 15 is fixed to the underside of the bracket 11. A ring gear 17 fixed to the top of a frame 16 fits in the bearing ring 15. Balls 19 are received in ball grooves 18 formed in the outer periphery of the ring gear 17 and the inner periphery of the bearing ring 15. The frame 16 is thus supported so as to be pivotable relative to the bracket 11.

The bracket 11 carries a motor 20 having a rotary shaft with a pinion 21 that meshes with the ring gear 17. Thus, by driving the motor 20, the frame 16 rotates.

The frame 16 has a pair of support plates 16a on both sides. A fixed arm 22 is mounted between the support plates 16a.

The fixed arm 22 has a pair of arm plates 23 on both sides. It has one end protruding from the frame 16 and carries on this protruding end a crushing jaw 24.

Shafts 25 are bolted to the respective arm plates 23 of the fixed arm 22. They extend through the arm plates 23. Their outer ends are rotatably supported by bearings 26 mounted on the support plates 16a as by bolts.

A pin 27 extends between the arm plates 23 of the fixed arm 22 at a position nearer to the tip of the arm than the shafts 25.

A movable arm 28 has its rear end inserted between the arm plates 23 of the fixed arm 22 and supported on the fixed arm 22 through the pin 27 so as to be pivotable about the pin 27 toward and away from the crushing jaw 24. It is pivoted by a drive cylinder 29 mounted between the arm plates 23.

The drive cylinder 29 is a trunnion type cylinder having pivots 30 on both sides near its front end. The pivots 30 are arranged coaxially with the shafts 25 and are rotatably received in holes formed in the inner ends of the shafts 25. The drive cylinder 29 has a piston rod 29a having its leading end coupled through a pin 38 to the movable arm 28 at its intermediate point.

The fixed arm 22 is pivotable about the shafts 25. A pair of stoppers 37 are provided on the inner side surfaces of the frame 16 to limit the angle (60° in the embodiment) by which the fixed arm 22 can pivot. The fixed arm 22 can be fixed in position in abutment with either of the stoppers 37 by a fixing means 31 (Fig. 3).

The fixing means 31 comprises a pin hole 36 formed in the rear end of the fixed arm 22, and two pairs of engaging cylinders 32, each pair being mounted on the support plates 16a of the frame 16 opposite to each other so as to be disposed along the circular locus passing the center of the axis of the pin hole 36 around the shafts 25. The engaging cylinders 32 have rods 35

adapted to engage in the pin hole 36 when the pin hole come into alignment with the rods 35.

The engaging cylinders 32 are single-acting cylinders each comprising a cylinder tube 32a bolted to the support plates 16a of the frame 16, and a piston 33 carrying the rod 35 and slidably mounted in the cylinder tube 32a. Front and rear chambers are defined in the cylinder tube 32a by the piston 33. The rod 35 is adapted to be pushed into the cylinder tube by the pressure of oil supplied into the front chamber and pushed out biased by a spring 34 mounted in the rear chamber.

Instead of mounting the spring 34 in the rear chamber, it may be filled with gas to urge the piston 33 out of the cylinder tube 32a. Also, such single-acting cylinders may be replaced with double-acting cylinders in which the pressure oil is supplied selectively into the front and rear chambers to move the piston 33 back and forth.

Though not shown in the figures, various parts are fixed together by bolts or the like.

Now in operation, the movable arm 28 and the crushing jaw 24 are moved to both sides of an object X by pivoting the boom 4a and the arm 4b. Then, the drive cylinder 29 is activated to move the arm 28 toward the jaw 24 to crush the object X. Otherwise, the object X is broken by swinging the boom 4a or the arm 4b while gripping the object X between the crushing jaw 24 and the movable arm 28.

Fig. 5A shows the state in which the third cylinder 6 supported on the arm 4b has been shrunk to the limit, with the fixed arm 22 fixed in position by inserting the rods 35 of the pair of cylinders 32 on the righthand side of the frame 16 (in Fig. 4) in the pin hole 36 formed in the rear end of the fixed arm 22. Line a-a' in Fig. 5A indicates the position of the object X clamped by the crushing jaw 24 and the movable arm 28.

By expanding the third cylinder 6 from the position shown in Fig. 5A, the bracket 11 is pivoted counterclockwise about the pin 13. It can be pivoted to maximum to the position shown by chain line P1 in Fig. 5A. Thus, the line a-a' pivots an angle  $\alpha_0$  as shown in Fig. 5C. By pivoting the bracket 11 around the pin 13, the object X can be demolished. This angle  $\alpha_0$  is exactly the same as the angle  $\alpha_0$  by which the conventional crusher shown in Fig. 10C can pivot.

Now referring back to Fig. 5A, by pulling the rods 35 out of the pin hole 36 in the fixed arm 22 when the bracket 11 is in the position shown by chain line P1, pivoting the fixed arm 22 about the shafts 25, and inserting the rods 35 on the left in Fig. 4 into the pin hole 36, the fixed arm 22 can be fixed in the position shown in Fig. 5B. Thus, the line a-a' is pivoted an additional angle of  $\alpha_1$  (Fig. 5C) to the position P2 shown in Fig. 5A.

As a whole, the line a-a' can be pivoted, with the arm 4b fixed, by an angle  $\alpha_2$  which is the sum of the angle  $\alpha_0$  by which the bracket 11 can pivot and the angle  $\alpha_1$  by which the fixed arm 22 can pivot. Thus, provided the angle  $\alpha_0$  by which the bracket 60 of the conventional crusher shown in Fig. 10C can pivot is equal to

the angle  $\alpha_0$  by which the bracket 11 of the embodiment can pivot, the working range of the crusher of the embodiment is larger than that of the conventional crusher shown in Fig. 10C by an angle  $\alpha_1$ , i.e. the angle the fixed arm 22 can pivot.

Figs. 6A-6C show how the bridge bed 70 shown in Fig. 11 is crushed. As shown in Fig. 6A and 11, the wide (horizontal) portion 72 between the beams 71 is crushed from its end by the crushing jaw 24 of the fixed arm 22 and the movable arm 28 with the opening defined therebetween turned sideways. While crushing the wide portion 72, the crushing point is moved gradually toward the civil engineering machine 1, which is kept stationary, by pivoting the boom 4a and the arm 4b while adjusting the inclination of the bracket 11.

When the wide portion 72 of the bridge bed 70 has been crushed by a predetermined length, the position of the boom 4a and the arm 4b has to be adjusted because with the position shown in Fig. 6A the beam 71 is a hindrance to crush the remaining portion 73. Thus, the arm 4b are turned back to the starting position (shown in Fig. 6A), the rods 35 are pulled out of the pin hole 36, and the fixed arm 22, which is now pivotable, is pivoted about the shafts 25 until the pin hole 36 aligns with the other pair of rods 35, and the rods 35 are inserted into the pin hole 36. In this state, the opening defined by the fixed arm 22 and the movable arm 28 is turned downward to vertical as shown in Fig. 6B. Then, the frame 16 is turned 90° to the position shown in Fig. 6C to crush the narrow portion 73 on each longitudinal beam 71 from its end by opening and closing the movable arm 28 or by swinging the arm 4b or the boom 4a.

When the opening defined by the crushing jaw 24 and the arm 28 is turned from the position shown in Fig. 6A, in which it faces sideways, to face downward as shown in Fig. 6B, and then to the position shown in Fig. 6C by rotating the frame 16 by 90°, its longitudinal position little changes. Thus, it is possible to crush the wide portion 72 between the longitudinal beams 71 by a predetermined length, and then the narrow portion 73 on each beam 71, without moving the machine 1. This makes it possible to crush the bridge bed 70 continuously with high efficiency.

In order to crush any concrete 74 that may remain in the H-sectioned longitudinal beams 71, a cemented carbide bit 39 may be screwed or otherwise detachably fastened to the tip of the crushing jaw 24 as shown in Fig. 7.

Figs. 8 and 9 show another embodiment of the fixing means 31. This fixing means 31 comprises a pair of engaging cylinders 40 bolted to the support plates 16a of the frame 16 opposite to each other, stoppers 37 mounted in the frame 16 for limiting the movement of the fixed arm 22 and two pin holes 41 and 42 formed in the rear end of the fixed arm 22 and positioned such that when the fixed arm 22 is in abutment with one of the stoppers 37 fixed to the frame 16, rods 43 of the engaging cylinders 40 are inserted in the corresponding one

of the pin holes 41 and 42.

The engaging cylinders 40 are single-acting cylinders each comprising a cylinder tube 44, and a piston 45 carrying the rod 43 and slidably mounted in the cylinder tube 44. Front and rear chambers are defined in the cylinder tube 44 by the piston 45. The rod 43 is adapted to be pushed into the cylinder tube by the pressure of oil supplied into the front chamber and pushed out by the pressure of gas filling the rear chamber.

The fixing means 31 used in the embodiment is of the type in which the rods 35, 43 of the engaging cylinders 32, 40 are inserted in and pulled out of the pin holes 36, 41, 42 formed in the rear end of the fixed arm 22 to fix the arm 22 in a desired position. But it is not limited to this type.

For example, it is possible to use a fixing means comprising engaging pins slidably mounted on the support plates 16a of the frame 16 and adapted to be manually inserted in a pin hole formed in the rear end of the fixed arm so as not to be come out of the hole.

It is possible to crush a bridge bed continuously and efficiently with the movement of the civil engineering machine kept to a minimum.

#### Claims

1. A crusher comprising a bracket pivotally mounted on a free end of an arm of a civil engineering machine, a frame having a pair of support plates on both sides thereof and rotatably mounted on said bracket, a fixed arm having a pair of arm plates on both sides thereof and mounted between said pair of support plates of said frame so as to be pivotable around a shaft (25), said fixed arm carrying at one end thereof a crushing jaw, a movable arm mounted between said arm plates of said fixed arm so as to be pivotable, a trunnion type drive cylinder mounted between said arm plates of said fixed arm for pivoting said movable arm toward and away from said crushing jaw, said drive cylinder being mounted so as to be pivotable around pivots (30) and pivotally supporting said fixed arm, said shaft (25) being coaxial with said pivots (30), and a fixing means for fixing said fixed arm to said frame at both ends of the pivoting motion of said fixed arm about said shaft, said ends being separated a predetermined angle from each other.
2. A crusher as claimed in claim 1 wherein said fixing means comprises a pin hole formed in a rear end of said fixed arm, and two pairs of engaging cylinders each having a rod, each pair of said engaging cylinders being mounted on said support plates of said frame opposite to each other so as to be disposed along the circular locus of the axis of said pin hole while being separated from the other pair by an angle equal to said predetermined angle, said rods of one of said two pairs of engaging cylinders being

adapted to engage in said pin hole when said pin hole comes into alignment with said rods of said each one pair of engaging cylinders.

3. A crusher as claimed in claim 1 wherein said fixing means comprises two pin holes formed in a rear end of said fixed arm, said holes being disposed on a circumference having its center on said pivots and separated from each other by an angle equal to said predetermined angle, and a pair of engaging cylinders each having a rod and mounted on said support plates of said frame opposite to each other, said rods of said engaging cylinders being adapted to engage in one of said pin holes when said one of said holes comes into alignment with said rods.
4. A crusher as claimed in claim 2 or 3 wherein said each engaging cylinder is a single-acting cylinder comprising a cylinder tube fixed to said support plates of said frame, a piston carrying said rod and slidably mounted in said cylinder tube, said piston defining front and rear chambers in said cylinder tube, said piston being pushed into said cylinder tube by supplying pressure oil into said front chamber, and a spring mounted in said rear chamber for biasing said piston to push it out of said cylinder tube.
5. A crusher as claimed in claim 2 or 3 wherein said each engaging cylinder is a single-acting cylinder comprising a cylinder tube fixed to said support plates of said frame, and a piston carrying said rod and slidably mounted in said cylinder tube, said piston defining front and rear chambers in said cylinder tube, said piston being pushed into said cylinder tube by supplying pressure oil into said front chamber, said rear chamber being filled with pressurized gas to bias said piston to push it out of said cylinder tube.
6. A crusher as claimed in claim 2 or 3 wherein said each engaging cylinder is a double-acting cylinder comprising a cylinder tube fixed to said support plates of said frame, and a piston carrying said rod and slidably mounted in said cylinder tube, said piston defining front and rear chambers in said cylinder tube, said piston being pushed into and out of said cylinder tube by supplying pressure oil selectively into said front and rear chambers.

FIG. 1

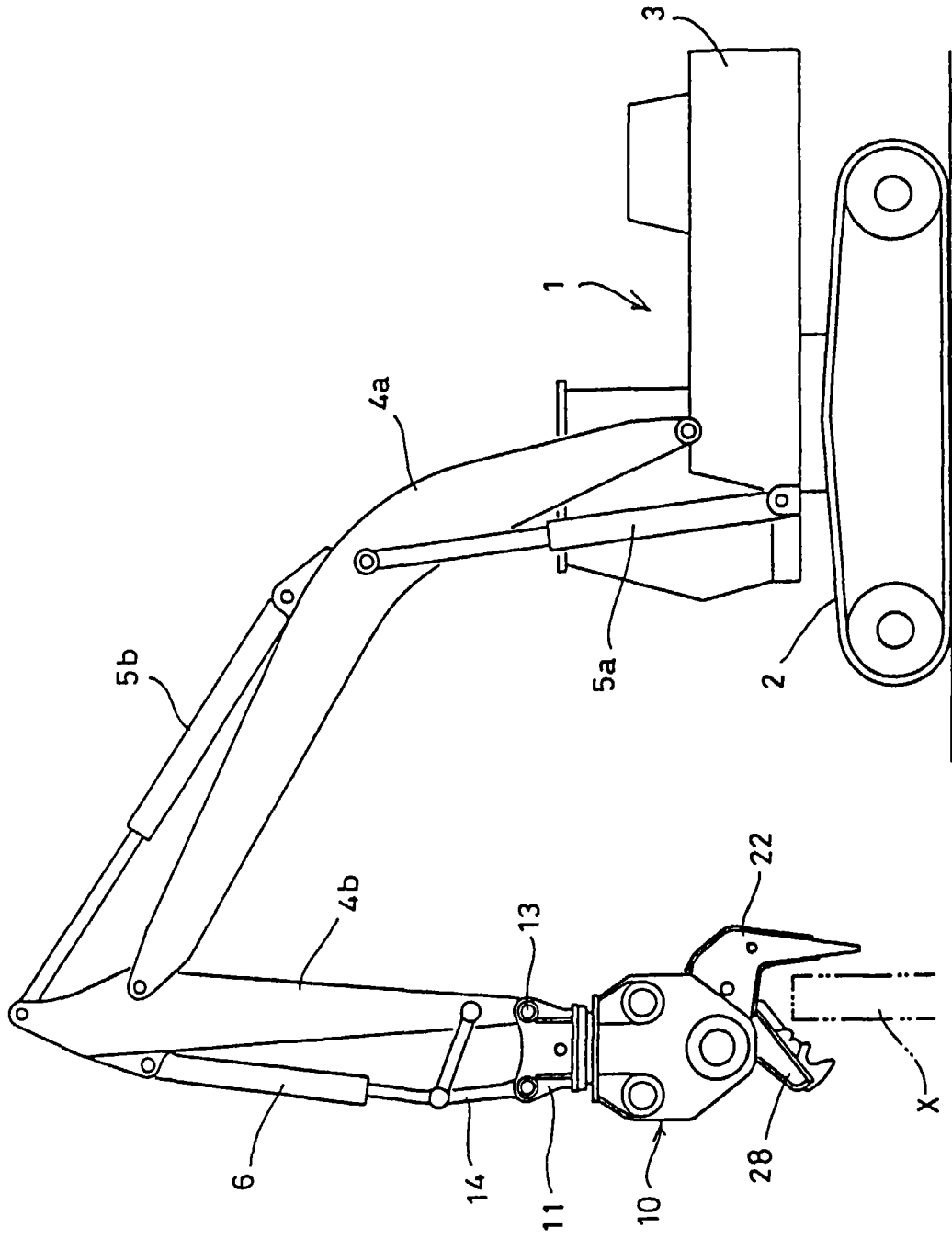


FIG. 2

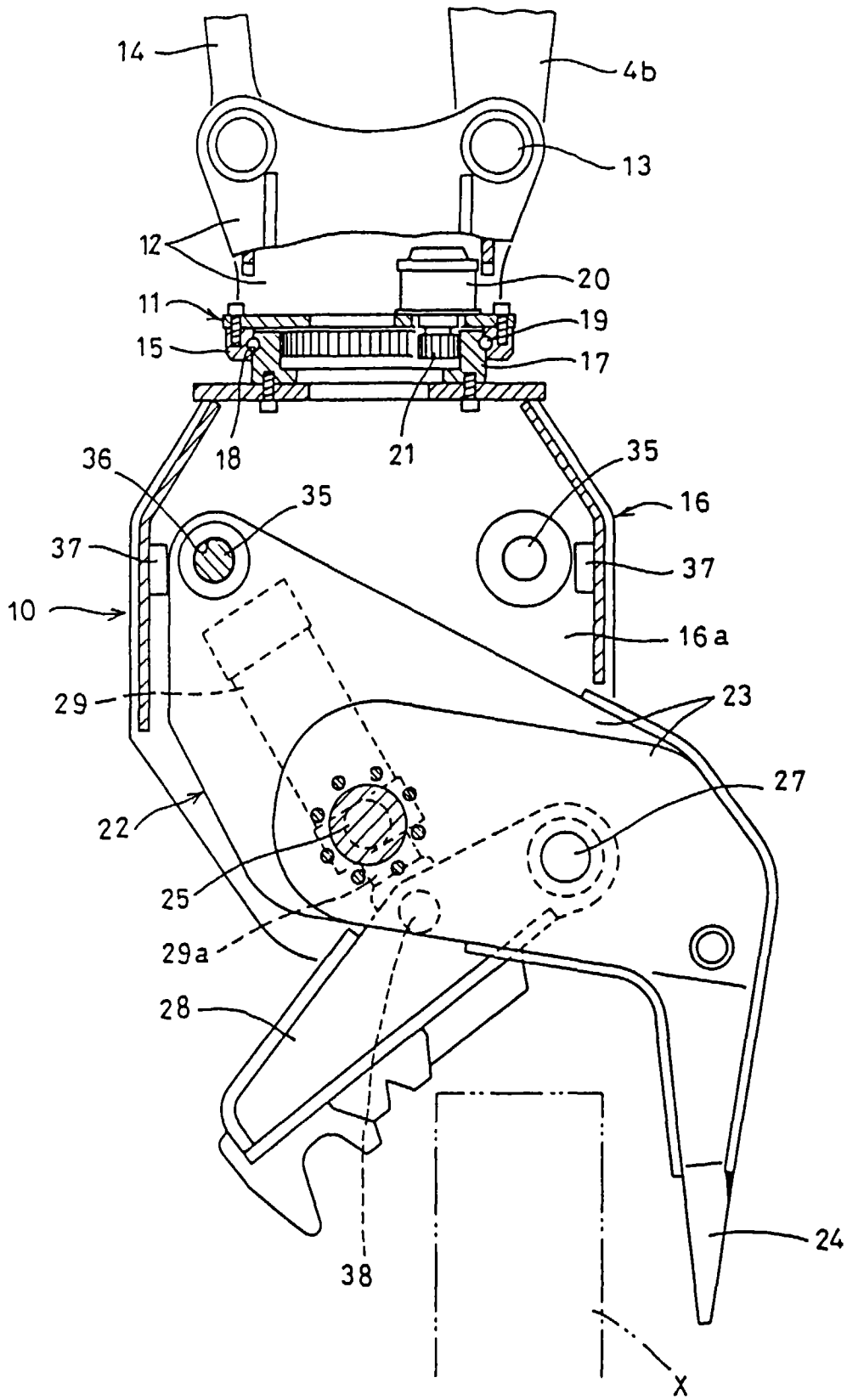


FIG. 3

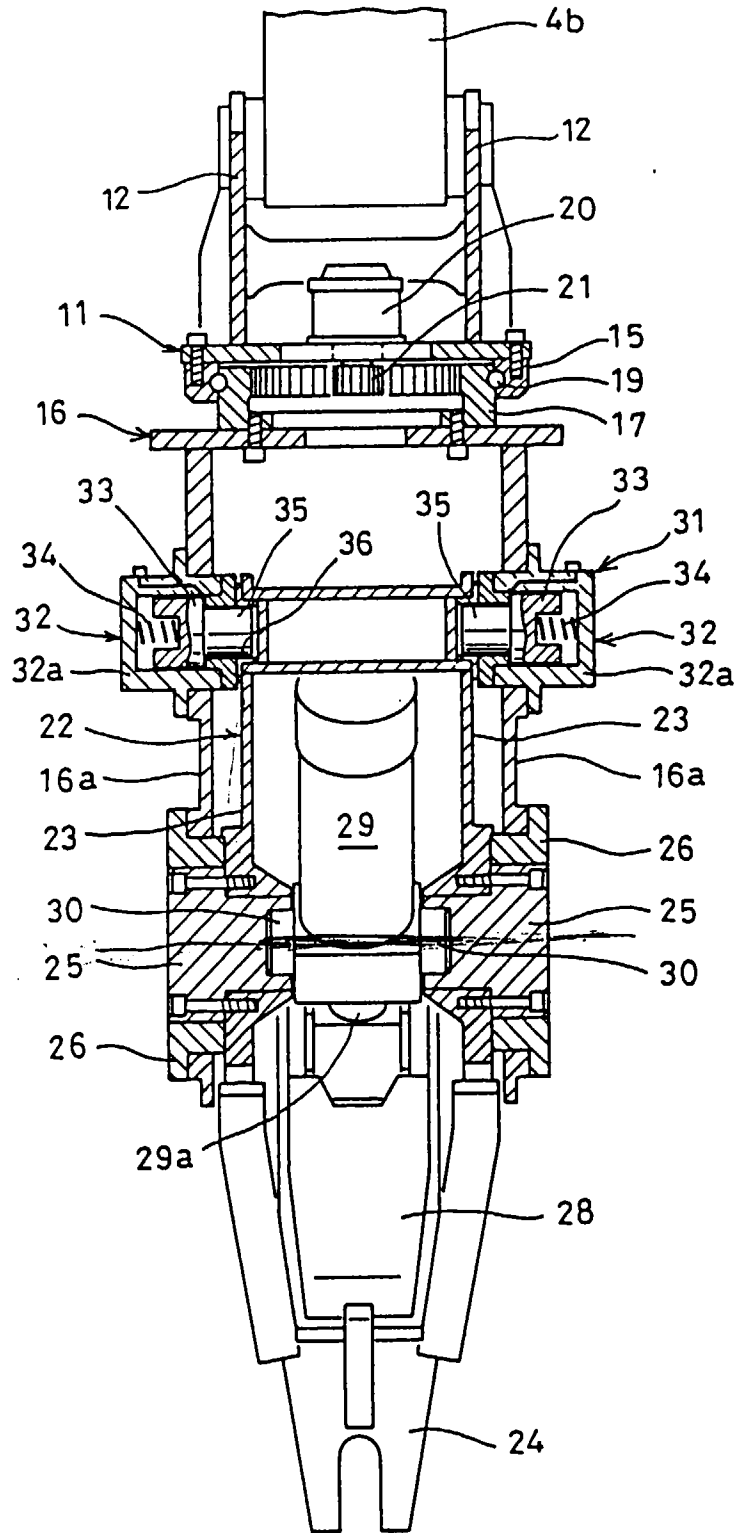


FIG. 4

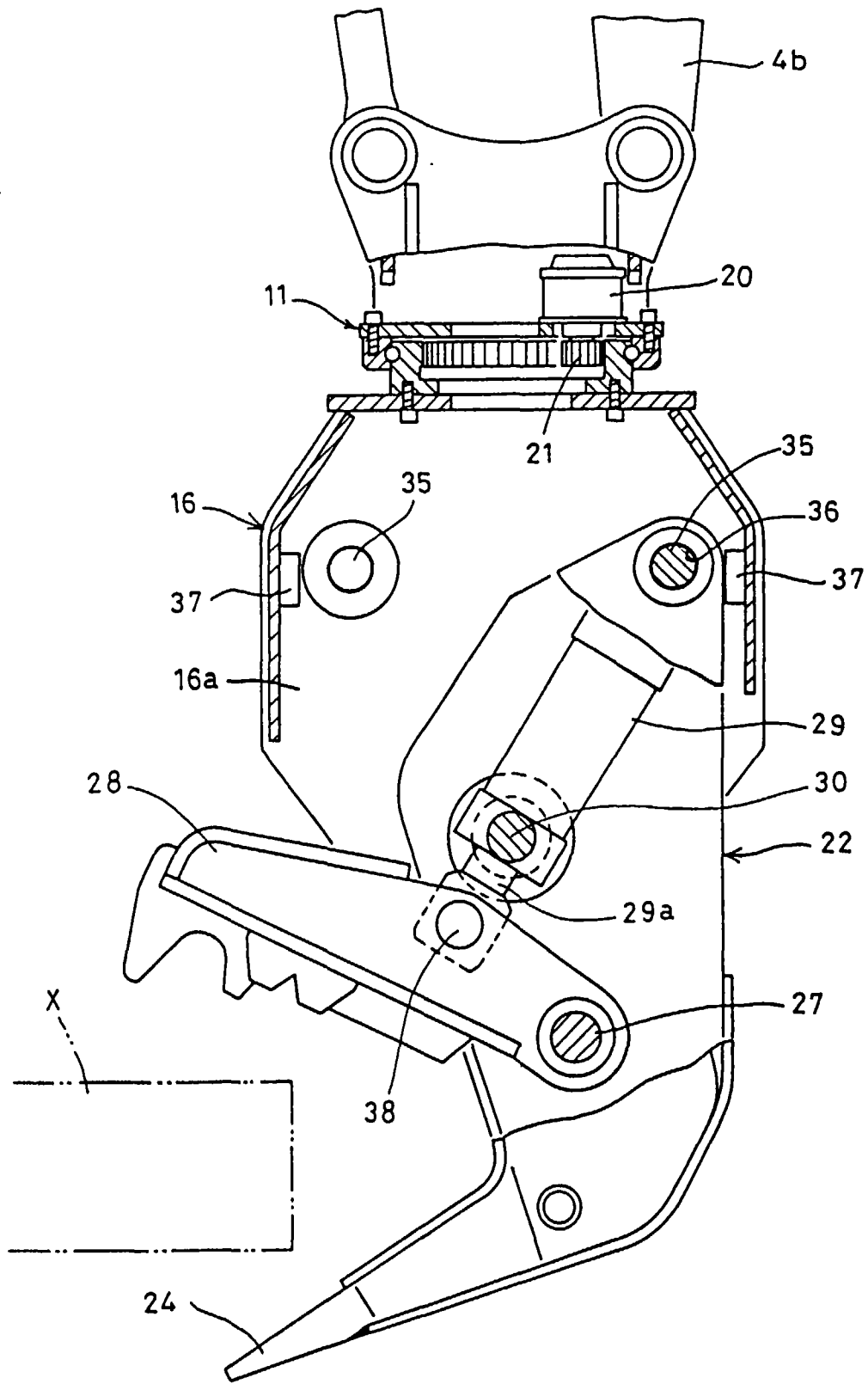


FIG. 5A

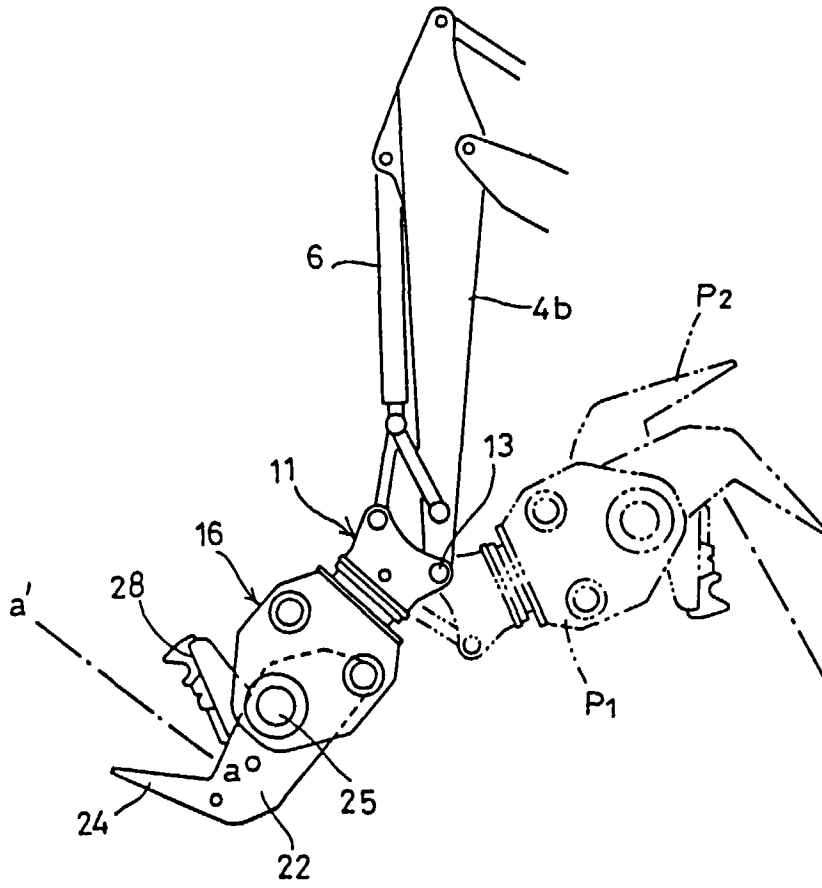


FIG. 5B

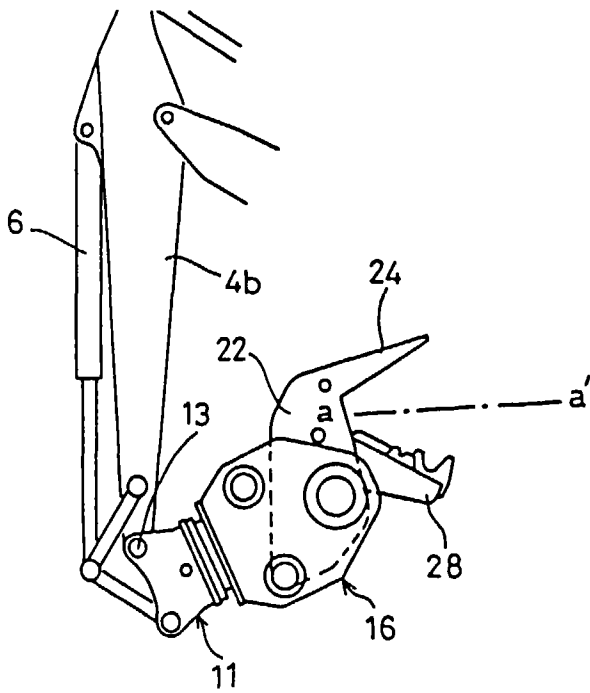


FIG. 5C

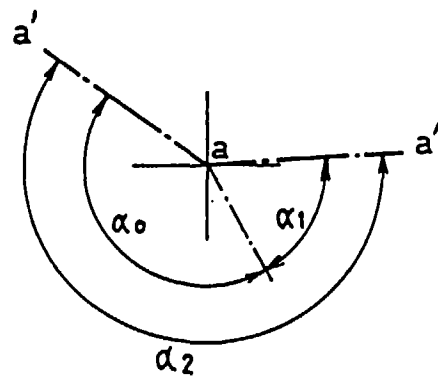


FIG. 6A

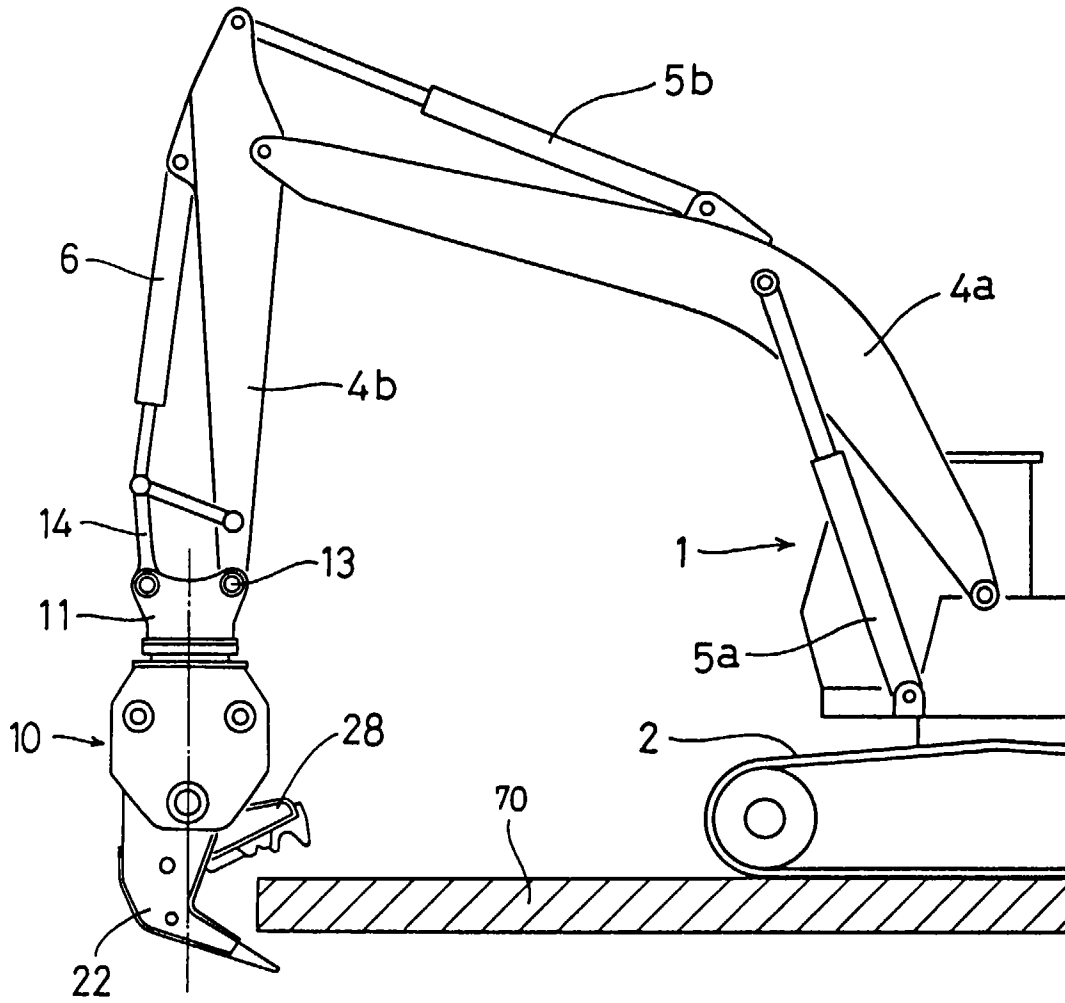


FIG. 6B

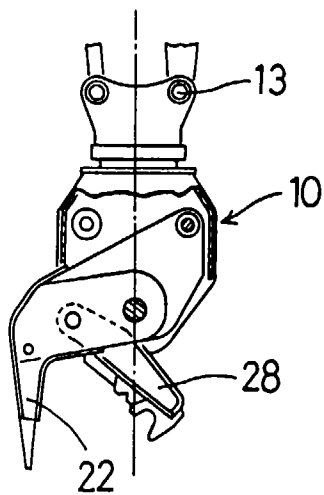


FIG. 6C

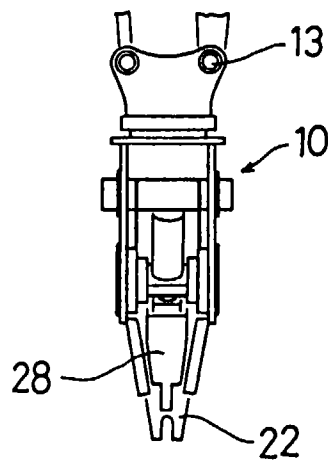


FIG. 7

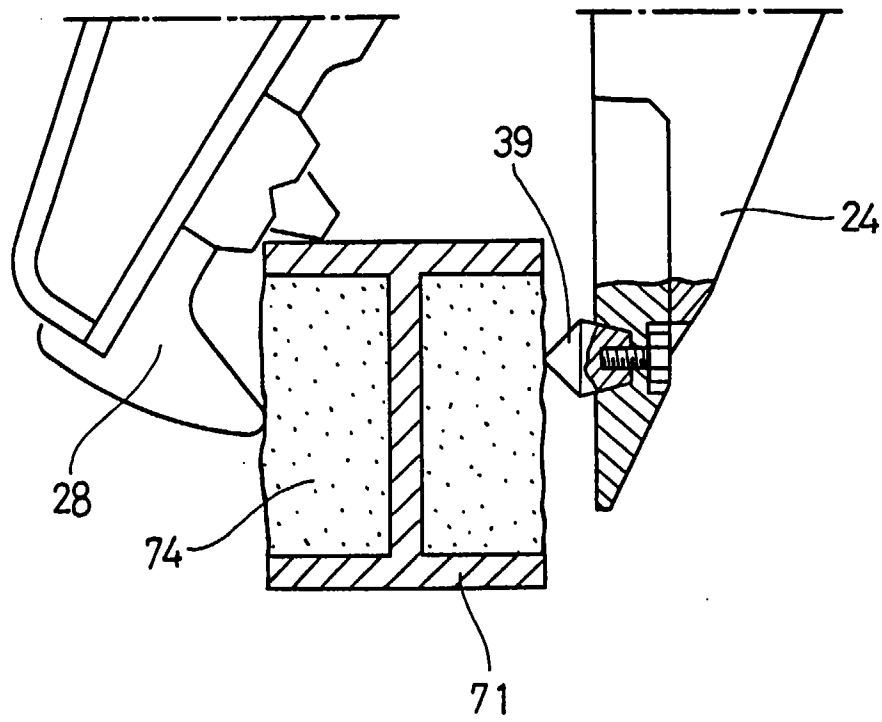


FIG. 8

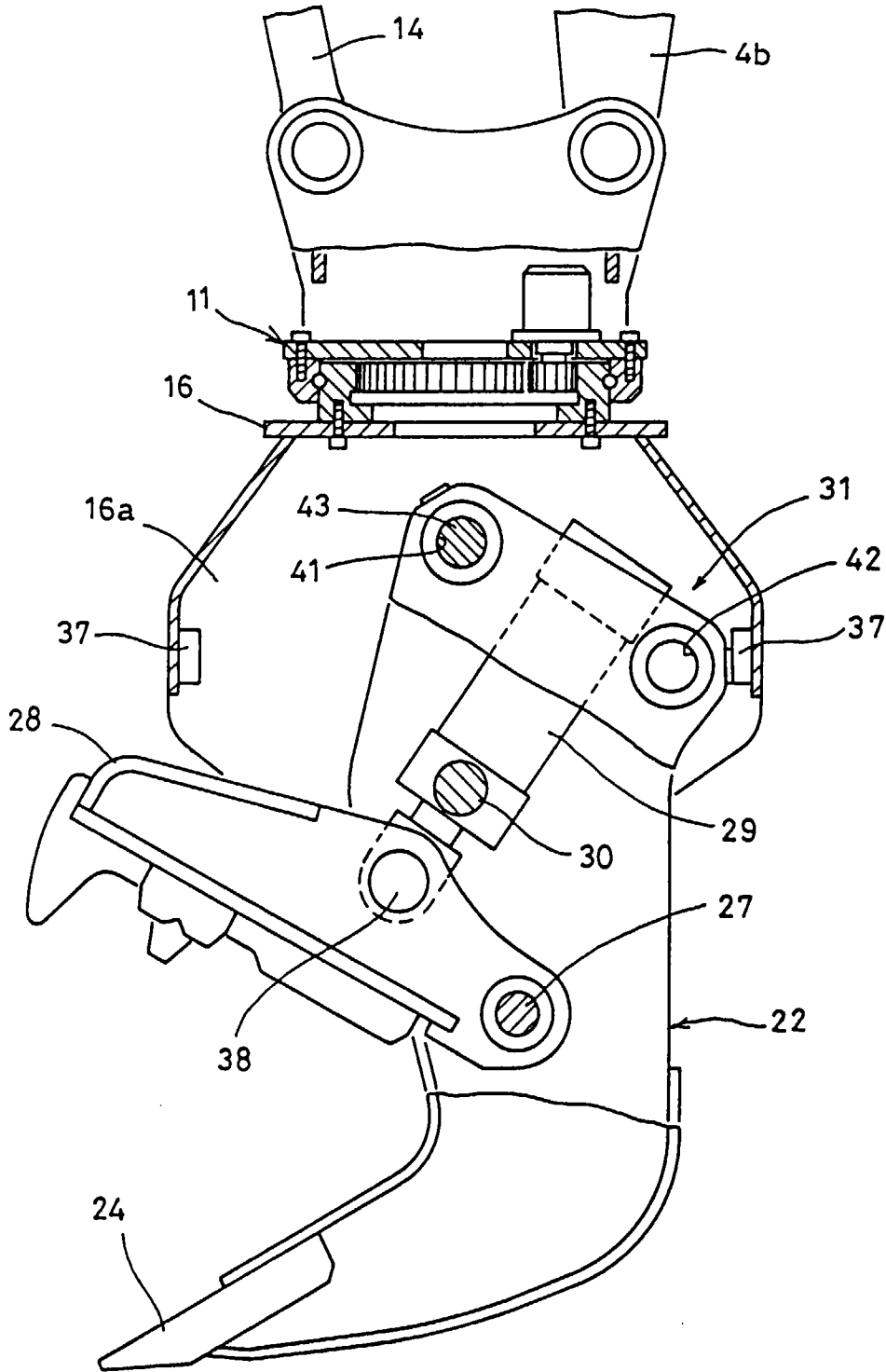


FIG. 9

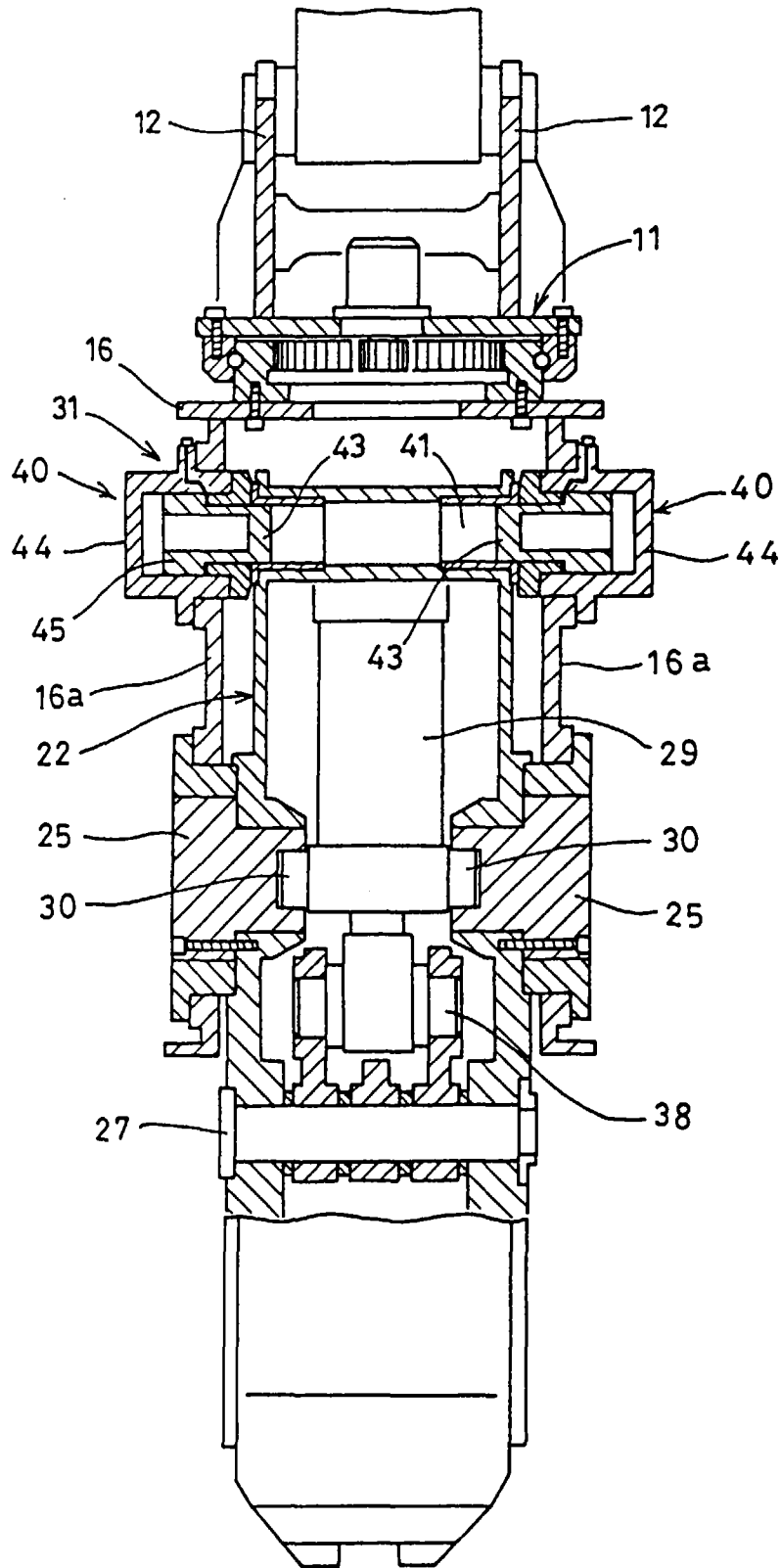


FIG. 10A

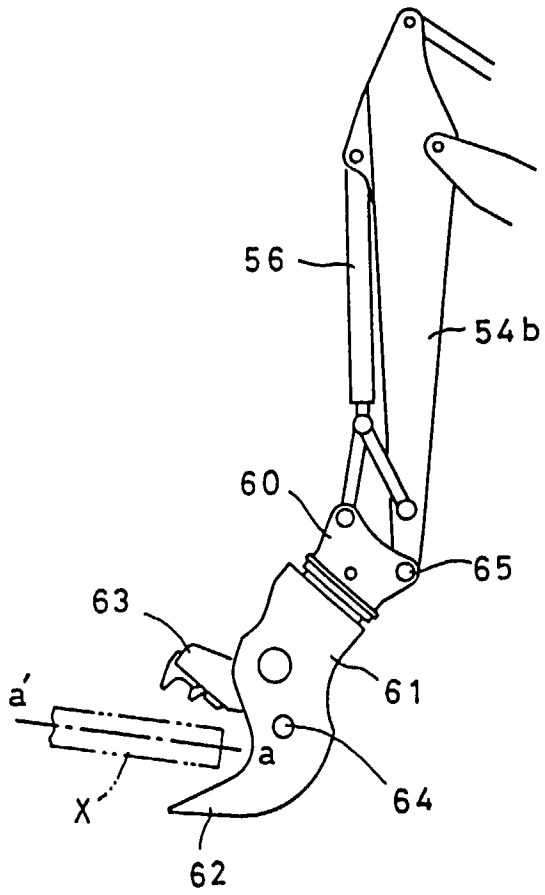


FIG. 10B

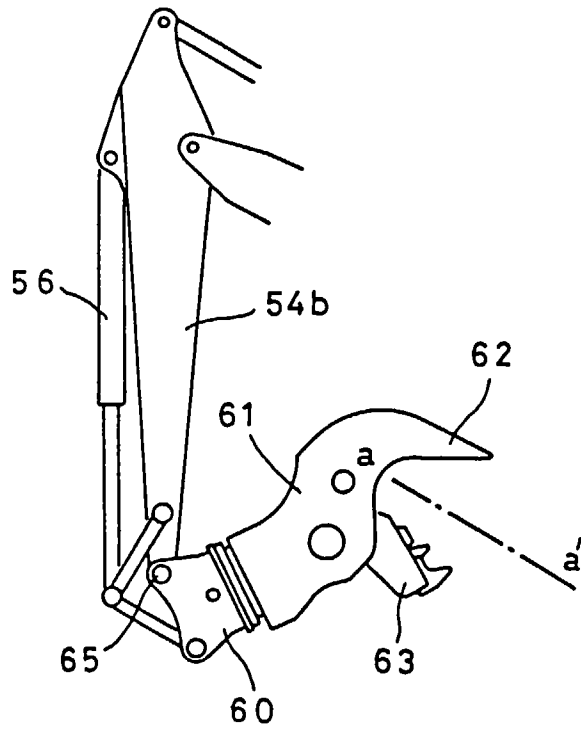


FIG. 10C

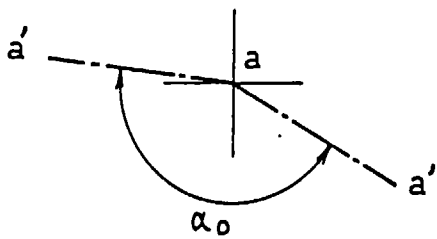


FIG. 11

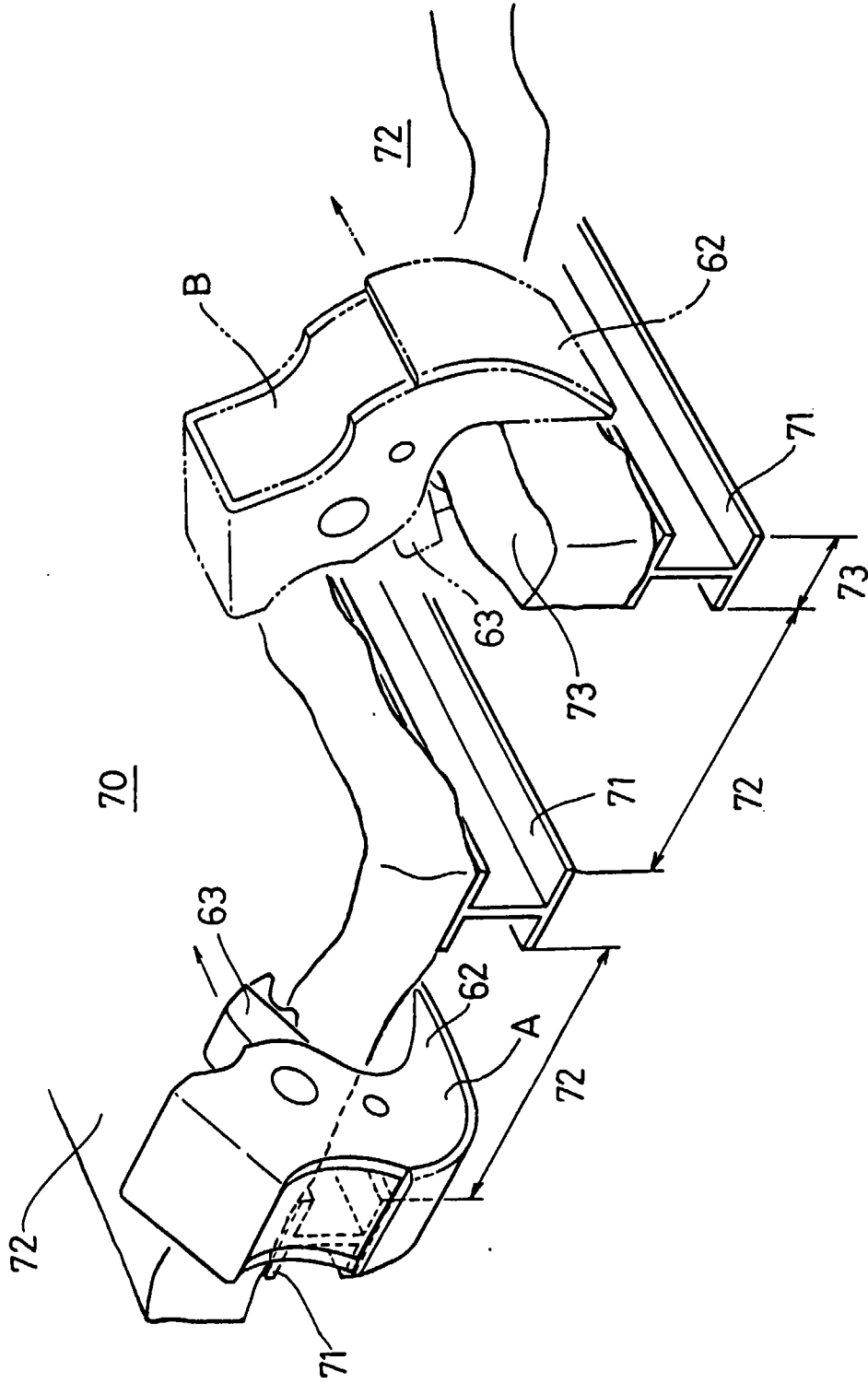
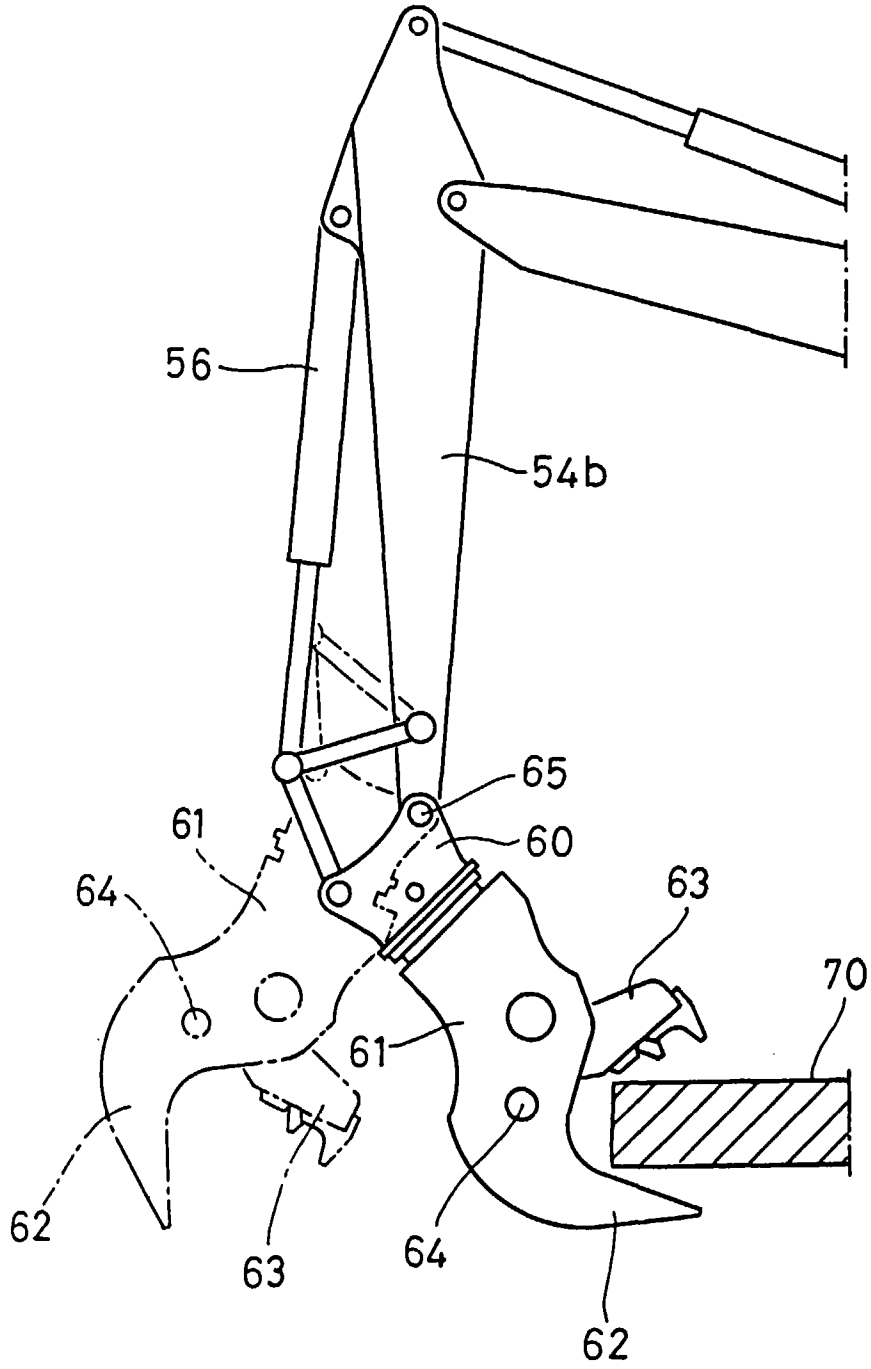


FIG. 12





European Patent Office

EUROPEAN SEARCH REPORT

Application Number  
EP 96 11 3272

DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
A	WO 95 35418 A (FAMBO SWEDEN) * page 3, line 22 - page 4, line 16; claims; figures *	1,2
A	EP 0 613 982 A (HAWKINS) -----	
The present search report has been drawn up for all claims		
Place of search	Date of completion of the search	Examiner
THE HAGUE	3 January 1997	Vijverman, W
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		CLASSIFICATION OF THE APPLICATION (Int.Cl.6)  E04G23/08  TECHNICAL FIELDS SEARCHED (Int.Cl.6)  E04G E02F  T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04CO1)