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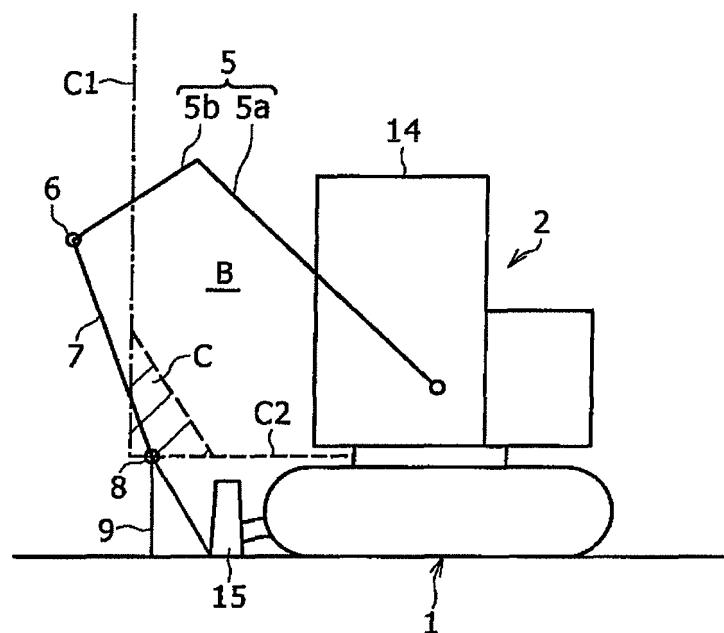
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(54) **Excavator**

(57) In a corner part on the front and lower side of a contact area (B) between a bucket (9) and a cabin (14) formed by an area front surface serving as a front limitation of the contact area and an area lower surface serving as a lower limit of the contact area, an exception area (C) of a right triangle seen from the side taking the area

front surface as a vertical side and the area lower surface as the base is set under a fixed condition. When an arm top pin (8) is within the above exception area (C), a contact prevention function is cancelled and actions of boom raising, arm pulling and left offset are permitted in a decelerating state.

FIG. 1



Description

BACKGROUND OF THE INVENTION

(FIELD OF THE INVENTION)

[0001] The present invention relates to an excavator provided with a function of preventing contact between a bucket and a cabin.

(DESCRIPTION OF THE RELATED ART)

[0002] A description will particularly be given taking an offset type hydraulic excavator in which contact between a cabin and a working attachment is easily generated as an example (Figs. 5 to 7).

[0003] In the hydraulic excavator, a working attachment 3 is installed in a front section of an upper rotating body 2 mounted on a crawler type lower traveling body 1.

[0004] The working attachment 3 is provided with a boom 5 to be raised and lowered taking a boom foot pin 4 as a center, an arm 7 attached to a front end of the boom 5 pivotally around a boom top pin 6 in the up and down direction, and a bucket 9 attached to a front end of the arm 7 pivotally around an arm top pin 8 in the up and down direction. By raising, lowering and bending actions of the working attachment 3, various works such as excavating and loading are performed.

[0005] The boom 5 is formed by a rear boom 5a and a front boom (also called an offset boom) 5b. By turn movement of the front boom 5b in the left and right direction to the rear boom 5a, the arm 7 and the bucket 9 are horizontally moved in the left and right direction (offset) so that an excavating work for ditch or the like is performed. Fig. 6 shows a state that an offset action is performed to the left side, and the symbol α is an offset angle thereof.

[0006] In Figs. 5 and 6, the reference numeral 10 denotes a boom raising and lowering cylinder for raising and lowering the boom 5, the reference numeral 11 denotes an arm cylinder for turning the arm 7 in the up and down direction, the reference numeral 12 denotes a bucket cylinder for turning the bucket 9 in the up and down direction, and the reference numeral 13 denotes an offset cylinder for turning the front boom 5a in the left and right direction.

[0007] In the upper rotating body 2, a cabin 14 is installed on one of the left and right sides in a front section thereof (generally on the left side in the front section as shown in the figure, hereinafter a description will be given with the above configuration). Various operations are performed within the cabin 14.

[0008] By a dozer 15 (not shown in Fig. 6) provided in a front section of the lower traveling body 1, a ground leveling work and a dustpan work with using the bucket 9 are performed.

[0009] Here, since the working attachment 3 is bent towards the cabin 14 side, contact between the bucket

9 and the cabin 14 may be generated. Particularly, in the exemplified offset type excavator, since the bucket 9 is located in front of the cabin 14 in the state that an offset action is performed to the left side as shown in Fig. 6, the contact is highly possibly generated.

[0010] Meanwhile, there is a contact prevention method disclosed in Japanese Patent Laid-Open No. Hei3-156037.

[0011] In Fig. 7 schematically showing the entire excavator, a contact area A serving as an area where the contact between the bucket 9 and the cabin 14 may be generated when the arm top pin 8 intrudes is set in front of the cabin 14. When the arm top pin 8 enters the above contact area A, attachment actions (generally actions of boom raising, arm pulling and left offset) are stopped.

[0012] The contact area A is set in the vicinity of the cabin 14 shown by a double chain line in Fig. 7 in a general attachment with the bucket 9 having standard size and being directly attached to the front end of the arm.

[0013] Meanwhile, in the case where the bucket size is larger than standard, and in the case where the bucket 9 is attached to the front end of the arm through a special bucket attachment device for simplifying an attaching and detaching work called quick hitch or the like (hereinafter, such an attachment is collectively referred to as the special attachment), a distance from the arm top pin 8 to a tooth top of the bucket is longer than the standard attachment.

[0014] In the case of having the above special attachment, a special contact area B which is broader than the standard contact area A towards the front side shown by a broken line in Fig. 7 is set, and when the arm top pin 8 intrudes the above area B, the attachment actions are stopped.

[0015] However, as shown in Fig. 7, a front limitation position of the bucket in a state that the bucket 9 is grounded (a position where the bucket is stopped by a contact prevention function) is displaced towards the front side. Therefore, there is a problem that a work of excavating, soil scooping and the like near a front end of the lower traveling body 1 (hereinafter, referred to as the near-by work) is limited.

[0016] Since the tooth top of the bucket 9 in the above figure does not reach the dozer 15, it is not possible to perform the so-called dustpan work of drawing the soil or the like to the dozer 15 side and scooping by the bucket 9, which is a type of the near-by work. The symbol β in Fig. 7 denotes a distance from the tooth top of the bucket to a front surface of the dozer.

[0017] It should be noted that even in an excavator not performing the offset action, in the case of installing the special attachment in which bucket width is large and there is a fear that the left side of the bucket may be brought in contact with the cabin 14, the same problem is caused.

SUMMARY OF THE INVENTION

[0018] It is an object of the present invention to provide an excavator capable of sufficiently ensuring the nearby work described above while avoiding contact between a bucket and a cabin as much as possible in the case where the special contact area is set.

[0019] An excavator according to the present invention comprises a lower traveling body, an upper rotating body mounted on the lower traveling body and provided with a cabin, and a working attachment installed in a front section of the upper rotating body as a basic configuration. The above working attachment is provided with a boom to be raised and lowered, an arm attached to a front end of the boom pivotally around a boom top pin, and a bucket attached to a front end of the arm pivotally around an arm top pin. Further, the excavator according to the present invention is provided with position detecting means for detecting a position of the arm top pin, and control means for executing a contact prevention function of limiting actions of the working attachment when the arm top pin intrudes a contact area preliminarily set in front of the cabin. Here, the control means is to set, in a corner part formed by an area front surface serving as a front limitation of the contact area and an area lower surface serving as a lower limit of the contact area, an exception area of a right triangle seen from the side taking the area front surface as a vertical side and the area lower surface as the base under the following condition, and to cancel the contact prevention function when the arm top pin is within the exception area.

[0020] The condition for setting the exception area is as follows:

In the case where there is not the exception area, an x-coordinate position where the arm top pin is stopped by the contact prevention function at the time of grounding and horizontally moving the bucket to the rear side is made as a first point, an y-coordinate position determined by adding a maximum value for an increasing amount of a distance from a land surface to be grounded to the arm top pin in accordance with bucket size or the like to an y-coordinate position at the time of stopping the arm top pin at the first point is made as a second point, an x-coordinate position determined by adding a distance from a tooth top of the bucket to a target point set behind the first point to an x-coordinate position at the time of stopping the arm top pin at the first point is made as a third point, and a right triangle area connecting the points mentioned above is made as an exception area.

[0021] According to the present invention, in the corner part (the corner part on the front and lower side of the area) formed by the area front surface serving as the front limitation of the contact area and the area lower surface serving as the lower limit of the contact area, the exception area of the right triangle seen from the side taking the area front surface as the vertical sides and the area lower surface as the base is set under a fixed condition, and the contact prevention function is cancelled

when the arm top pin is within the above exception area. Therefore, it is possible to displace a front limitation position of the arm top pin in a state that the bucket is grounded to the rear side (the machine side).

[0022] Consequently, since the bucket can be brought in the vicinity of the lower traveling body (the bucket reaches a dozer in claim 3), it is possible to sufficiently ensure the near-by work described above (including a dustpan work in the case of the excavator). It should be noted that in the case where the dozer is provided in a front section of the lower traveling body, and taking a front surface of the dozer as a target point, an x-coordinate position determined by adding a distance from the tooth top of the bucket to the dozer to the x-coordinate position at the time of stopping the arm top pin at the first point is made as the third point so as to set the exception area, it is possible for the bucket to reach the dozer.

[0023] Furthermore, the exception area is set to the corner part on the front and lower side of the contact area which is the most distant position from the cabin and an area where a working tool is grounded. Therefore, the contact between the bucket and the cabin is highly unlikely generated.

[0024] The exception area is set as the right triangle seen from the side. Therefore, in comparison to the case where the exception area is set as square, possibility of the contact is further reduced while ensuring the near-by work.

[0025] As mentioned above, while preventing the contact between the bucket and the cabin as much as possible, it is possible to enlarge a working range for the near-by work.

[0026] When the arm top pin is within the exception area, the actions of the working attachment are preferably decelerated. In such a case, when the arm top pin is in the exception area, the actions of the working attachment are decelerated. Therefore, when the contact between the working tool and the cabin seems to be generated by any chance, the actions are stopped without delay so as to avoid the contact.

[0027] Further, when the arm top pin is within the exception area, an alarm is preferably operated. In such a case, since an operator is notified that the arm top pin is in the exception area by an alert so as to take measures, it is possible to enhance safety.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028]

Fig. 1 is a side view schematically showing an excavator according to an embodiment of the present invention and a contact area thereof;

Fig. 2 is an enlarged view showing an exception area in Fig. 1;

Fig. 3 is a block diagram of control means;

Fig. 4 is a flowchart for explaining an effect;

Fig. 5 is a side view showing a schematic configuration of the excavator.

ration of a hydraulic excavator;

Fig. 6 is a plan view showing the schematic configuration of the hydraulic excavator; and

Fig. 7 is a side view schematically showing a contact area in a hydraulic excavator of THE RELATED ART.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0029] A description will be given to an embodiment of the present invention with reference to Figs 1 to 4, and Figs. 5 and 7 showing schematic configurations of hydraulic excavators accordingly. In the embodiment, an offset type excavator into which a special attachment is installed is taken as an example to which the present invention is applied.

[0030] Fig. 1 schematically shows an excavator according to the embodiment and a contact area thereof.

[0031] A configuration of the excavator itself is the same as THE RELATED ART. Therefore, the same parts as Fig. 7 are given the same reference numerals and a duplicated explanation thereof will be omitted.

[0032] As an area where a contact between a bucket 9 and a cabin 14 is generated when an arm top pin 8 intrudes, a special contact area (hereinafter, simply referred to as the contact area) B is set in front of the cabin. In principle, a function of preventing the contact in the above contact area B is executed so that attachment actions are limited. Specifically, actions of boom raising, arm pulling and left offset of the attachment are stopped as mentioned above.

[0033] In the above excavator, in a corner part (a corner part on the front and lower side) formed by an area front surface B1 serving as a front limitation of the contact area B and an area lower surface B2 serving as a lower limit of the contact area B, an exception area C of a right triangle seen from the side taking the area front surface B1 as a vertical side and the area lower surface B2 as the base is set over the entire width of the contact area B. When the arm top pin 8 is in the above exception area C, the contact prevention function is cancelled (the attachment actions are permitted as described later).

[0034] A detailed description will be given to the above exception area C with reference to Fig. 2.

[0035] A first point P1 serving as a front limitation and a lower limit of the area C is an x-coordinate position (position in the front and back direction) where the arm top pin 8 is stopped by the contact prevention function at the time of grounding and horizontally drawing (horizontally moving to the rear side) the bucket 9 in the case where there is not the exception area C.

[0036] A second point P2 serving as the front limitation and an upper limit of the area C, the second point P2 located above the first point P1, is a y-coordinate position determined by adding an increasing amount (an anticipated maximum value) V of a y-coordinate position from a land surface to be grounded to the arm top pin 8 due to large bucket size or use of a special attachment

device called quick hitch to a y-coordinate position at the time of stopping the arm top pin 8 at the first point P1.

[0037] A third point P3 is an x-coordinate position determined by adding a distance W from a tooth top of the bucket to a target point set behind the first point P1 (a front surface of a dozer 15 in the present embodiment) to an x-coordinate position at the time of stopping the arm top pin 8 at the first point P1.

[0038] The distance W is the same as a distance β from the tooth top of the bucket to the front surface of the dozer 15 shown in Fig. 7. The third point P3 is set so as to make the above distance β zero.

[0039] It should be noted that the target point for determining the third point P3 is set as an arbitrary point behind the first point P1, and may be set slightly ahead of the front surface of the dozer, or behind a position of the dozer (in front of a front end of the lower traveling body) in the case where there is not the dozer 15.

[0040] It is desirable to add an accidental error amount due to an accidental error in manufacturing or assembling the machine to both the second and third points P2 and P3.

[0041] A right triangle area connecting the above first to third points P1, P2 and P3 is the exception area C.

[0042] In the above excavator, by control means shown in Fig. 3, a straight line L is calculated from coordinates of both the second and third points P2 and P3, a current position of the arm top pin 8 is detected, and it is determined whether the position is above (within the contact area B and outside the exception area C) or below (within the exception area C) the straight line L. Only in the case where the position is below the straight line L, the attachment actions are permitted.

[0043] The control means is formed by a controller 16 for outputting arithmetic and command signals, boom angle, arm angle and offset angle sensors 17, 18 and 19 serving as position detecting means for detecting the position of the arm top pin 8, a cancel switch 20 for cancelling the contact prevention function by an operation of an operator, stop proportional valves 21, 22 and 23 for stopping or decelerating the actions of boom raising, arm pulling and left offset on the basis of the command signals from the controller 16, and an alarm (such as a buzzer and an indicator) 24 for giving an alert to and notifying the operator when the arm top pin 8 is within the exception area C set by the control means.

[0044] A description will be given to an effect of the above control means by a flowchart of Fig. 4.

[0045] At the beginning of control, the position of the arm top pin 8 (both the x-coordinate and y-coordinate positions) is calculated from detected values detected by the angle sensors 17 to 19 (Step S1). It is determined whether or not the calculated position of the arm top pin is within the contact area B (Step S2).

[0046] In the case of YES here, it is determined whether or not the x-coordinate position of the arm top pin 8 is between the first and third points P1 and P3 of Fig. 2 in Step S3. In the case of NO, that is, in the case where the

x-coordinate position is outside the exception area C and within the contact area B, stop signals are outputted to the boom raising, arm pulling and left offset stop proportional valves 21 to 23 as the original contact prevention function so that the actions are stopped (Step S4).

[0047] Meanwhile, in the case of YES in Step S3, it is determined that the x-coordinate position of the arm top pin 8 is between the points P1 and P3 (within the exception area C). Therefore, in Step S5, the x-coordinate position of the arm top pin 8 is substituted in a preliminarily determined line equation so as to calculate a y-coordinate point on the straight line L corresponding to the x-coordinate position of the arm top pin 8.

[0048] In the following Step S6, it is determined whether or not the y-coordinate position of the arm top pin 8 is larger than (above) the calculated y-coordinate point on the straight line L. In the case of NO (the y-coordinate position is below the straight line L, that is, within the exception area C), it is determined that the attachment actions should be permitted. Therefore, in Step S7, the command signals for permitting the actions of boom raising, arm pulling and left offset are outputted to the proportional valves 21 to 23.

[0049] In such a case, since possibility of generating the contact between the bucket 9 and the cabin 14 is increased with making the actions completely free, command signals for decelerating the actions are outputted in the embodiment.

[0050] In Step S8, an action command signal to the alarm 24 is outputted so that the alert is given to the operator, and then the flow returns to Step S1.

[0051] It should be noted that in the case of YES (the arm top pin 8 is above the straight line L) in Step S6, the attachment actions are stopped in Step S4. In the case of NO (the arm top pin 8 is outside the contact area B) in Step S2, the flow returns to Step S1.

[0052] As mentioned above, when the arm top pin 8 is within the exception area C, the contact prevention function is cancelled. Therefore, it is possible to displace a front limitation position of the arm top pin 8 in a state that the bucket is grounded to the rear side (the machine side).

[0053] Consequently, since the grounded bucket 9 can be brought in the vicinity of the lower traveling body 1 and the tooth top of the bucket can reach the dozer 15 in the present embodiment, it is possible to sufficiently ensure the near-by work described above including a dustpan work. In other words, the exception area C is set so as to obtain such a situation.

[0054] Furthermore, the exception area C is set to the corner part on the front and lower side of the contact area B where the bucket 9 is grounded at the most distant position from the cabin 14. Therefore, the contact between the bucket 9 and the cabin 14 is highly unlikely generated.

[0055] The exception area is set as the right triangle seen from the side. Therefore, in comparison to the case where the exception area is set as square, the possibility

of the contact is further reduced while ensuring the near-by work.

[0056] From the points mentioned above, it is possible to enlarge a working range of the near-by work described above while preventing the contact between the bucket 9 and the cabin 14 as much as possible.

[0057] When the arm top pin 8 is in the exception area C, the attachment actions are decelerated. Therefore, when the contact between the bucket 9 and the cabin 14 seems to be generated by any chance, dangerous actions are stopped without delay so as to avoid the contact.

[0058] Further, since the operator is notified that the arm top pin 8 is within the exception area C by the alert so as to take measures on the alert, it is possible to enhance safety.

[0059] The present invention is generally applied to the offset type excavator exemplified in the embodiment. However, even in an excavator in which the working attachment 3 does not perform the offset action, the contact with the cabin 14 may be generated in the case where a wide special attachment is installed in the bucket 9. Therefore, it is also possible to apply the present invention to such an excavator.

[0060] Although the invention has been described with reference to the preferred embodiments in the attached figures, it is noted that equivalents may be employed and substitutions made herein without departing from the scope of the invention as recited in the claims.

[0061] In a corner part on the front and lower side of a contact area between a bucket and a cabin formed by an area front surface serving as a front limitation of the contact area and an area lower surface serving as a lower limit of the contact area, an exception area of a right triangle seen from the side taking the area front surface as a vertical side and the area lower surface as the base is set under a fixed condition. When an arm top pin is within the above exception area, a contact prevention function is cancelled and actions of boom raising, arm pulling and left offset are permitted in a decelerating state.

Claims

1. An excavator, comprising:

- a lower traveling body;
- an upper rotating body mounted on said lower traveling body, the upper rotating body being provided with a cabin;
- a working attachment installed in a front section of said upper rotating body, the working attachment being provided with a boom to be raised and lowered, an arm attached to a front end of the boom pivotally around a boom top pin, and a bucket attached to a front end of the arm pivotally around an arm top pin;
- position detecting means for detecting a position of the arm top pin; and

control means for executing a contact prevention function of limiting actions of said working attachment when the arm top pin intrudes a contact area preliminarily set in front of the cabin, wherein

said control means is to set, in a corner part formed by an area front surface serving as a front limitation of the contact area and an area lower surface serving as a lower limit of the contact area, an exception area of a right triangle seen from the side taking the area front surface as a vertical side and the area lower surface as the base under the following condition, and to cancel the contact prevention function when the arm top pin is within the exception area, the condition for setting the exception area:

in the case where there is not the exception area mentioned above, an x-coordinate position where the arm top pin is stopped by the contact prevention function at the time of grounding and horizontally moving the bucket to the rear side is made as a first point, an y-coordinate position determined by adding a maximum value for an increasing amount of a distance from a land surface to be grounded to the arm top pin in accordance with bucket size or the like to an y-coordinate position at the time of stopping the arm top pin at the first point is made as a second point, an x-coordinate position determined by adding a distance from a tooth top of the bucket to a target point set behind the first point to an x-coordinate position at the time of stopping the arm top pin at the first point is made as a third point, and a right triangle area connecting the points mentioned above is made as an exception area.

2. The excavator according to claim 1, wherein said working attachment is capable of performing an offset action towards the cabin side.

3. The excavator according to claim 1, wherein a dozer is provided in a front section of said lower traveling body, and taking a front surface of the dozer as a target point, an x-coordinate position determined by adding a distance from the tooth top of the bucket to the dozer to the x-coordinate position at the time of stopping the arm top pin at the first point is made as the third point so as to set the exception area.

4. The excavator according to claim 1, wherein when the arm top pin is within the exception area, the actions of the working attachment are decelerated.

5. The excavator according to claim 1, wherein when the arm top pin is within the exception area, an alarm is operated.

FIG. 1

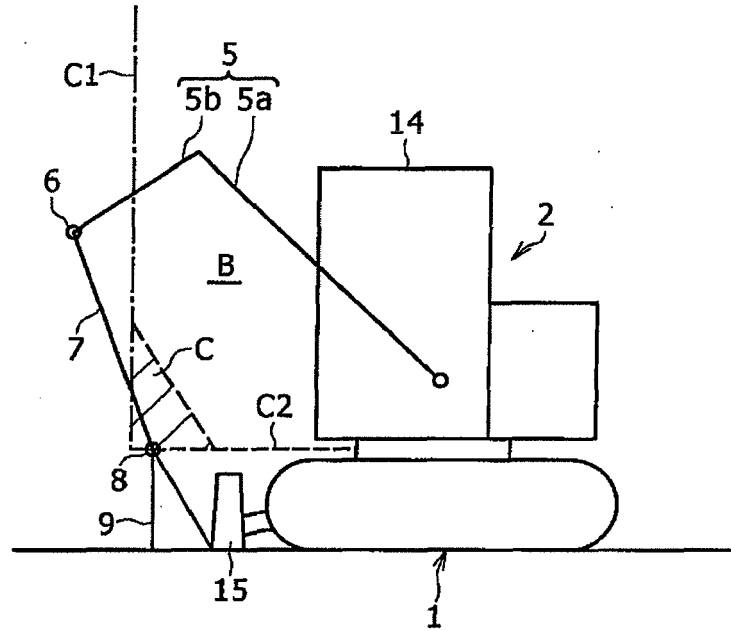


FIG. 2

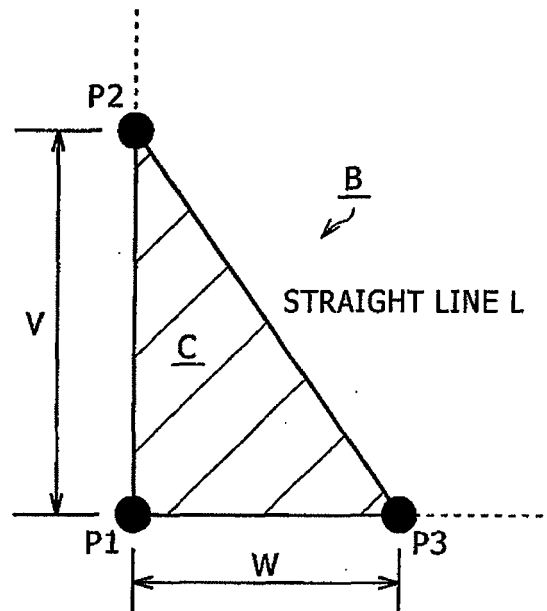


FIG. 3

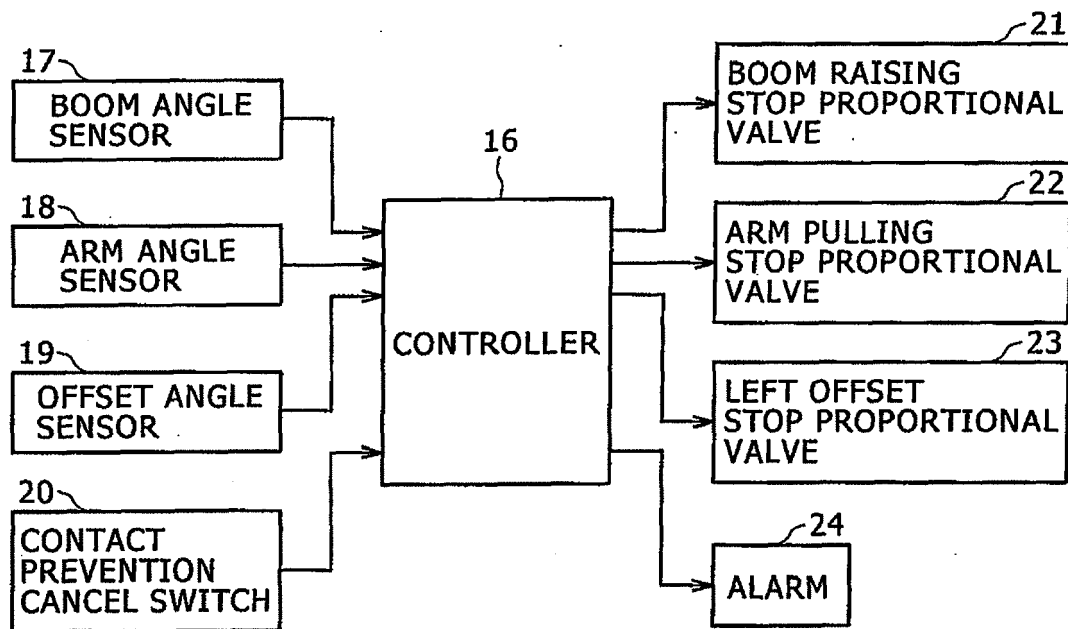


FIG. 4

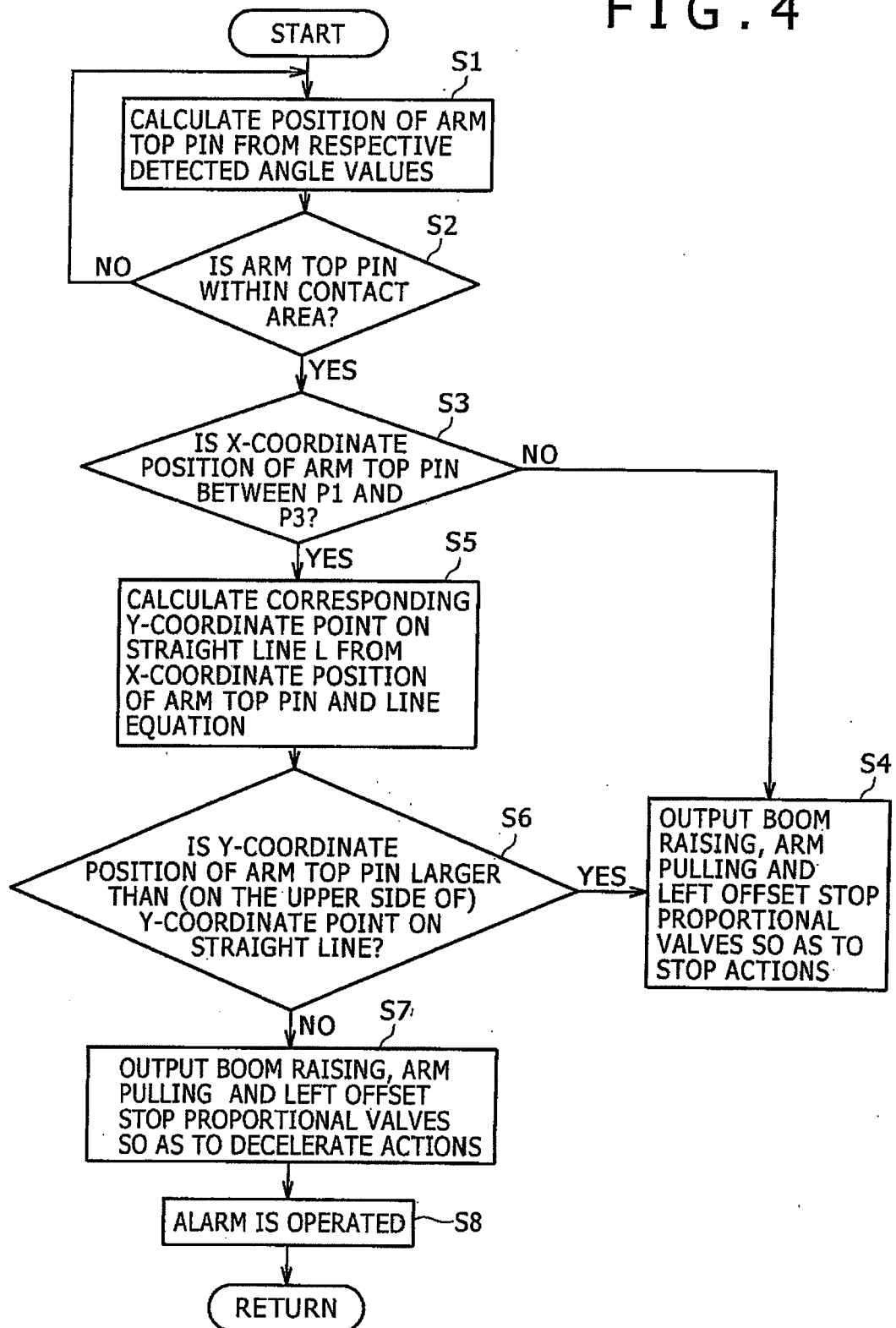


FIG. 5

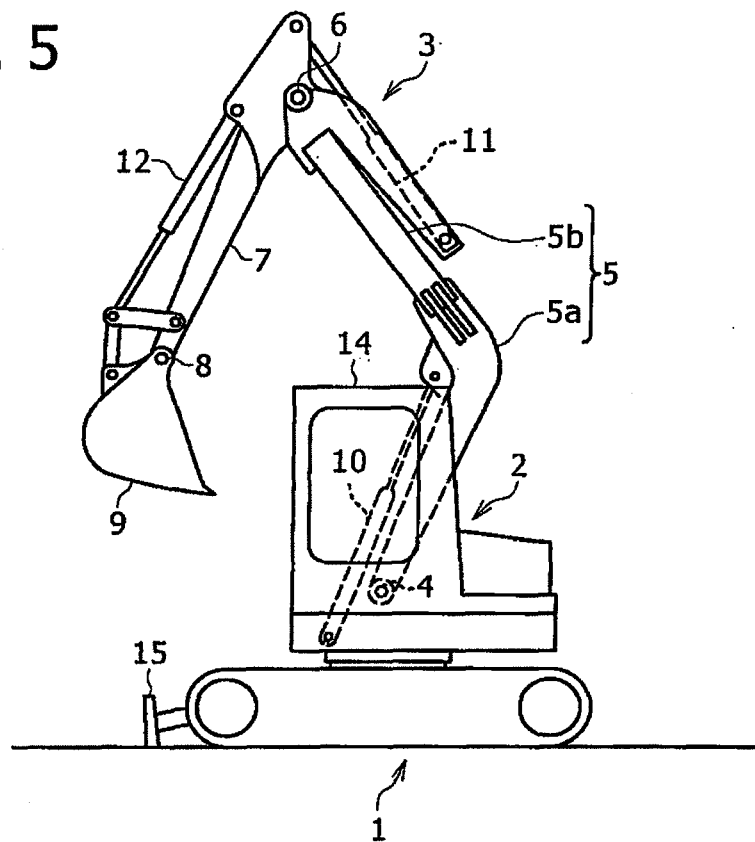


FIG. 6

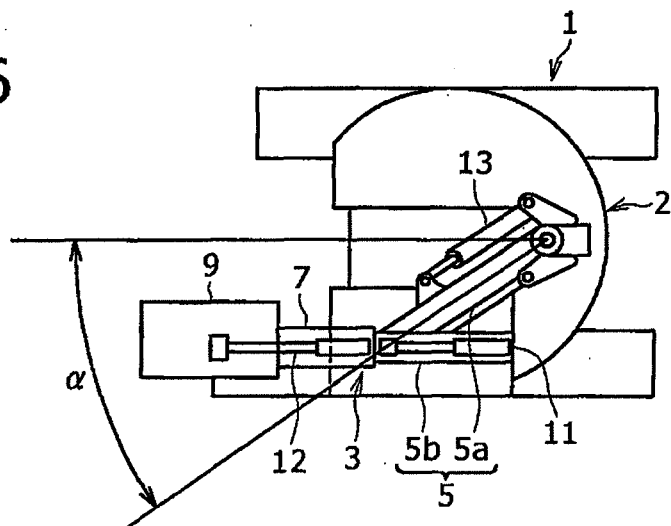
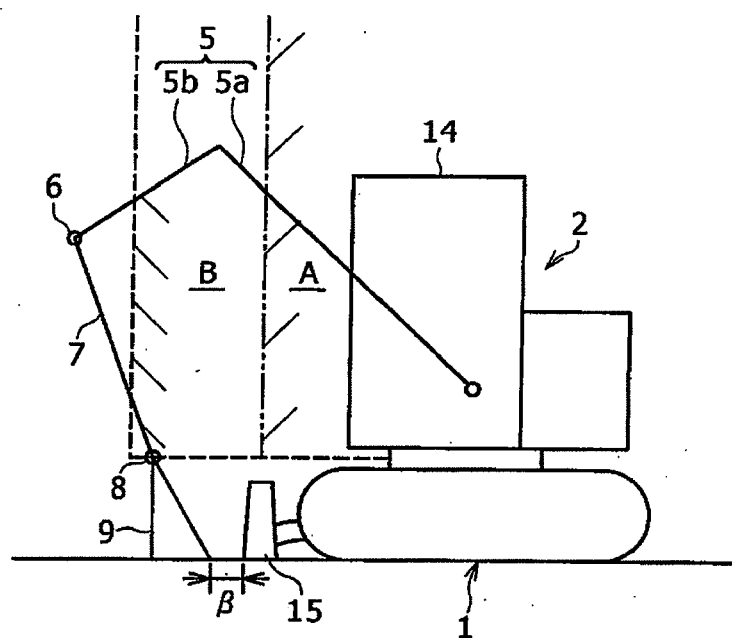


FIG. 7



REFERENCES CITED IN THE DESCRIPTION

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