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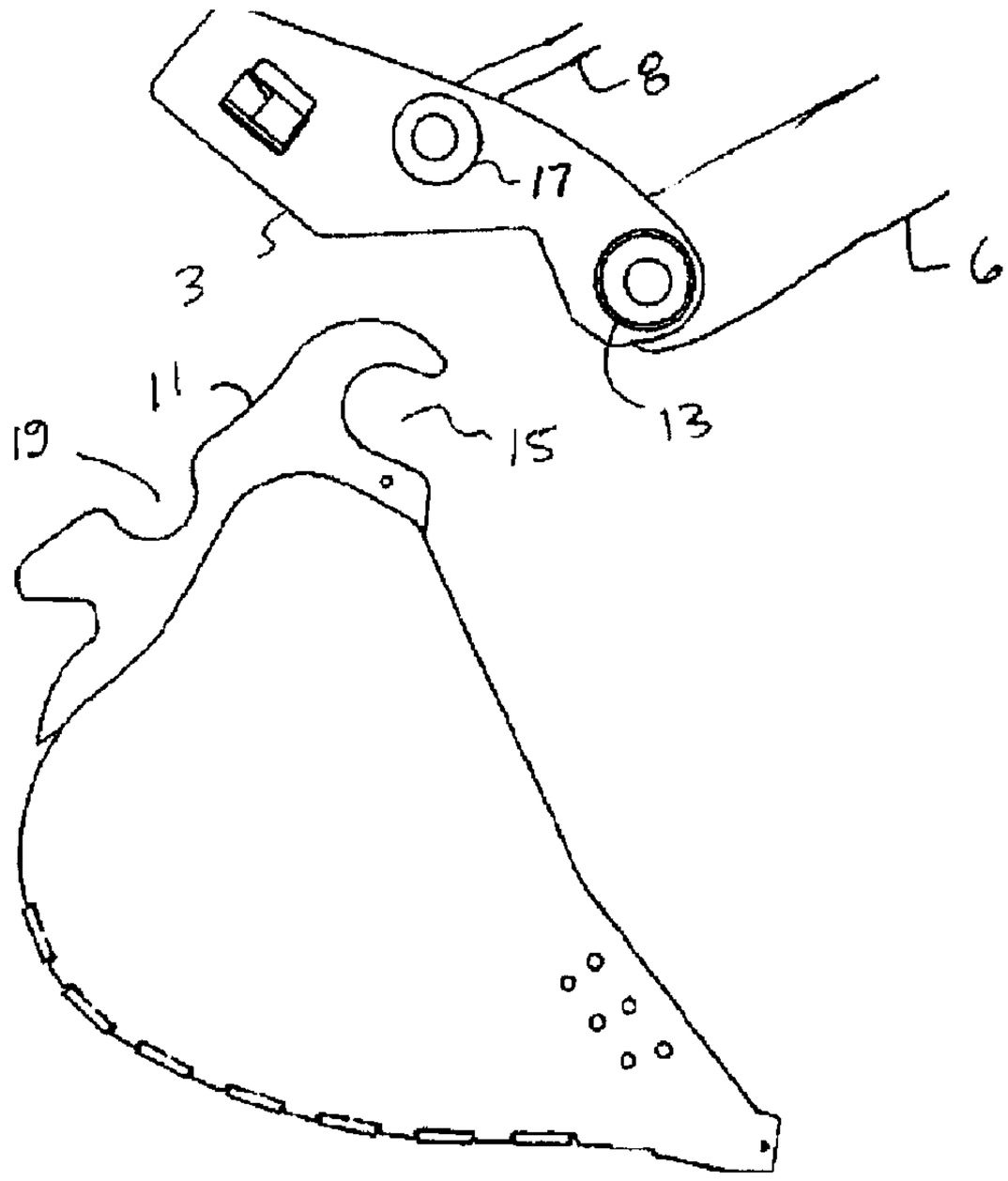


ABSTRACT

QUICK COUPLING MECHANISM FOR TOOL ATTACHMENT

This invention is in the field of machines such as hoe excavators and in particular a mechanism for coupling and uncoupling a tool to such machines, for example for coupling an excavator bucket to an excavator hoe arm.

BACKGROUND

In many types of machines different tools are coupled to and then uncoupled from the machine to accomplish different tasks. For example, a hoe excavator with a hoe arm may have a variety of buckets of various widths and shapes that are suitable for particular different tasks. Depending on the task, the desired bucket is coupled to the end of the hoe arm of the excavator, and when that task is finished the bucket will be uncoupled and a different bucket will be coupled to the arm to accomplish the next task. In addition to various buckets, other tools such as pneumatic hammers, post hole augers, and the like are often attached to the excavator arm to increase the variety of tasks that the machine may accomplish.

Changing the bucket can be time consuming and so various quick coupling mechanisms have been developed to reduce the time and effort required to couple various tools to the

excavator arm. Often these tools are maneuvered in holes or like confined areas where people are working, and so it is necessary for such quick coupling mechanisms to secure the tool such that same cannot fall off accidentally, and further must secure the tool tightly to the end of the excavator arm such that undesirable loose movement of the tool with respect to the excavator arm is prevented and control is maintained.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a quick coupling apparatus for coupling a tool to a machine that overcomes problems in the prior art.

The present invention thus provides a quick coupling apparatus comprising a coupler member that is attached to the machine at the tool attachment point. For a boom excavator the coupler member is attached by a first pin through the end of the hoe arm, and then by a second parallel pin to the end of the hydraulic cylinder that extends and retracts to pivot the bucket about the end of the hoe arm. The coupler member is also configured to engage mounting brackets that extend out from the bucket. A first lug on the coupler member is manipulated into engagement with a first recess on the mounting bracket, and then the hydraulic cylinder is operated to pivot the coupler member about the pivot axis created by the first lug engaging the first recess such that a second lug on the coupler engages a second recess on the mounting bracket.

The coupler and mounting brackets are configured such that when the first and second lugs are in full engagement with the corresponding first and second recesses the bucket is properly oriented with respect to the hoe arm, and an actuator on the coupler member is operated to move a wedge mounted on the coupler member from an open position toward a closed position where the wedge is engaged in a groove on the mounting bracket. The wedge and groove are configured such that as the wedge moves into the groove the tapered side of the wedge bears against a corresponding tapered side of the groove. The wedge is forced into the groove and the force of the tapered wedge bearing against the correspondingly tapered groove draws the second lug into the second recess to substantially rigidly connect the coupler member and the mounting bracket. When the wedge has moved to the fully engaged closed position with respect to the groove, a latch member moves to a lathed position and engages a catch member to prevent the wedge from moving out of the groove. A latch bias element is operative to exert a latch bias force on the latch member toward the latched position. An indicator can be provided to indicate to the operator that the latch is in the latched position and the coupler is safely locked to the mounting bracket.

A wedge bias element is oriented to exert a wedge bias force on the wedge towards the groove such that the wedge bias force forces the wedge into the groove, and the actuator is configured to selectively exert or release a force opposite to the wedge bias force. A single acting hydraulic cylinder conveniently provides the actuator wherein directing pressurized fluid into the hydraulic cylinder exerts an actuator force overcoming the wedge bias force to maintain the wedge in the open position while engaging the first and

second lugs on the coupler member into engagement in the first and second recesses on the mounting bracket. The pressurized fluid is then released from the hydraulic cylinder and the bias force then moves the wedge into the groove.

The hydraulic cylinder also is configured to operate the latch. When it is desired to release the coupler member from the mounting bracket, pressurized fluid is directed into the hydraulic cylinder and as the actuator extends it first moves the latch member out of engagement with the catch member, so that extending the actuator further can then move the wedge out of the groove and into the open position where the coupler member and mounting bracket are released. A safety switch in the operator's position is provided for the control directing pressurized fluid into the hydraulic cylinder to prevent accidental activation of the hydraulic cylinder and accidental release of the tool.

In one embodiment the latch is provided by a safety pin and corresponding pin aperture. As the wedge moves into engagement with the groove the safety pin moves into alignment with a corresponding aperture on the coupler member and when the wedge has moved to the fully engaged closed position with respect to the groove, the safety pin and aperture are aligned and the safety pin is pushed into the aperture and prevents the wedge from moving out of the closed position. Thus the apparatus will maintain the wedge in the groove if there is a hydraulic fluid leak, spring failure, or the like.

DESCRIPTION OF THE DRAWINGS

While the invention is claimed in the concluding portions hereof, preferred embodiments are provided in the accompanying detailed description which may be best understood in conjunction with the accompanying diagrams where like parts in each of the several diagrams are labeled with like numbers, and where:

Fig. 1 is a perspective view of an embodiment of the quick coupling apparatus of the present invention connected to an excavator bucket;

Figs. 2 -5 are side views showing the steps for installing the apparatus of Fig. 1 to the bucket;

Fig. 6 is a perspective cut away view of the apparatus of Fig. 1 showing the latching and wedge moving mechanism;

Figs. 7 - 9 are side views of the embodiment of Fig. 6 showing the wedge moving from the open position of Fig. 7 to a closed and latched position of Fig. 9;

Fig. 10 is a perspective cut away view of an alternate embodiment of the quick coupling apparatus of the present invention showing the latching and wedge moving mechanism;

Figs. 11 - 13 are side views of the embodiment of Fig. 6 showing the wedge moving from the open position of Fig. 11 to a closed and latched position of Fig. 13;

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

Figs. 1 - 5 illustrate the operation of an embodiment of a quick coupling apparatus 1 of the present invention. The apparatus 1 comprises a coupler member 3 that is attached to a tool manipulating machine at the tool attachment point. The illustrated apparatus 1 is adapted for attachment to the end of the hoe arm of an excavator. The attachment is conventional, and the hoe arm is not illustrated. The coupler member 3 is attached by a first pin through first pin aperture 5 and through a corresponding aperture on the end of the hoe arm 6, and then by a second parallel pin through second pin aperture 7 and through a corresponding aperture on the end of the hydraulic boom cylinder 8 that extends and retracts to pivot the bucket 9 about the end of the hoe arm.

The coupler member 3 is configured to engage mounting brackets 11 that extend out from the bucket 9. A first set of lugs 13 on the coupler member 3 are manipulated from the unattached position of Fig. 2 into engagement with a corresponding first set of recesses 15 on the mounting brackets 11 as illustrated in Fig. 3, and then the hydraulic boom cylinder is operated to pivot the coupler member 3 about the pivot axis PA1 created by the first lugs 13 engaging the first recesses 15 such that a second set of lugs 17 on the coupler 3 engage a second set of recesses 19 on the mounting bracket 3 as illustrated in Fig. 4.

The coupler 3 and mounting brackets 11 are configured such that when the first and

second sets of lugs 13, 17 are in full engagement with the corresponding first and second sets of recesses 15, 19 the bucket 9 is properly oriented with respect to the hoe arm, as illustrated in Fig. 1. An actuator on the coupler member 3 is then operated to move a wedge 21 mounted on the coupler member 3 from an open position as shown in Fig. 4 toward a closed position where the wedge 21 is engaged in grooves 23 on the mounting brackets 11. The wedge 21 and grooves 23 are configured such that as the wedge 21 moves into the grooves 23 the tapered sides 25 of the wedge 21 bear against corresponding tapered sides 27 of the grooves 23. The wedge 21 is forced into the grooves 23 and the force of the tapered wedge 21 bearing against the correspondingly tapered grooves 19 draws the second lugs 17 into the second recesses 19 to substantially rigidly connect the coupler member 3 and the mounting bracket 11. When the wedge 21 has moved to the fully engaged closed position with respect to the grooves 23 as shown in Fig. 5, a latch member, described below, moves to a latched position and engages a catch member to prevent the wedge 21 from moving out of the groove 19.

Figs. 6 - 9 illustrate the interior mechanism of the apparatus 1. A wedge bias element, illustrated as a pair of springs 31, is oriented to exert a wedge bias force WF on the wedge 21 towards the groove such that the wedge bias force WF forces the wedge 21 into the groove, and an actuator, illustrated as a hydraulic actuator cylinder 33, is configured to selectively exert or release an actuator force AF in a direction opposite to the wedge bias force WF. Directing pressurized fluid into the hydraulic actuator cylinder 33 exerts an actuator force AF greater than the wedge bias force WF such that the wedge is maintained in the open position, illustrated in Fig. 7, while engaging the first and second

lugs 13, 17 on the coupler member 3 into engagement in the first and second recesses 15, 19 on the mounting bracket 3 as shown in Figs. 2, 3, and 4. The pressurized fluid is then released from the hydraulic actuator cylinder 33, removing the actuator force AF and the bias force WF then moves the wedge 21 to the position of Fig. 8 and thus into the groove 23 as shown in Fig. 5.

To reduce the risk that the wedge 21 might be dislodged from the groove 23, thus allowing the bucket to fall off the hoe arm, a latch member moves to a latched position and engages a catch member to prevent the wedge 21 from moving out of the position of Fig. 8. In the illustrated embodiment the latch member is a safety pin 35 pivotally attached at a top end thereof to a pin arm 37. A spring 39 is operative to exert a downward latch bias force LF on the safety pin 35 toward the latched position. The pin arm 37 pivots about an arm pivot axis APA, and the end of the hydraulic actuator cylinder 33 bears against the lower portion 38 of the pin arm 37. Thus the configuration of the pin arm 37 is such that when pressurized fluid is present in the hydraulic actuator cylinder 33, the actuator force AF overcomes the latch bias force LF and maintains the safety pin 35 in the up and unlatched position of Figs. 7 and 8.

When the pressurized hydraulic fluid is released from the hydraulic actuator cylinder 33, the actuator force AF is removed and the wedge 21 moves into engagement with the groove, the bottom end of the safety pin 35 moves into alignment with a corresponding pin aperture 41 on the coupler member 3 that acts as the catch for the latch. When the wedge 21 has moved to the fully engaged closed position illustrated in Fig. 8 the safety

pin 35 and pin aperture 41 are aligned and in response to the latch bias force LF the safety pin 35 moves into the pin aperture 41 as illustrated in Fig. 9, and prevents the wedge 21 from moving out of engagement with the groove.

The hydraulic actuator cylinder 33 thus is configured to operate the latch and also move the wedge from the closed position of Fig. 9 to the open position of Fig. 7. When it is desired to release the coupler member 3 from the mounting brackets 11, pressurized fluid is directed into the hydraulic actuator cylinder 33 and as the cylinder 33 extends it first moves the safety pin 35 up out of the pin aperture 41, so that extending the cylinder 33 further can then move the wedge 21 out of the groove and into the open position of Fig. 7 where the coupler member and mounting bracket are released from each other.

In order to prevent accidental activation of the hydraulic actuator cylinder 33 and accidental release of the bucket, a safety switch is provided at the operator's position for the control directing pressurized fluid into the hydraulic cylinder. For example the hydraulic control may be armed by an arming switch, such that unless the arming switch is placed (or even held) in the armed position, the control cannot direct pressurized hydraulic fluid into the hydraulic actuator cylinder 33. For improved safety, the an audible alarm may be activated when the arming switch is in the armed position, thus alerting the operator that the bucket connection is not secure. Further to reduce the risk of accidental disengagement, an indicator can be provided to visually indicate to the operator that the latch, the safety pin 35 in the embodiment of Figs. 6-9, is in the latched position and the coupler 3 is safely locked to the mounting brackets 11. The indicator

could be a flag attached to the coupler, an indicator light at the operator's position, or the like.

Figs. 10 - 13 illustrate the interior mechanism of an alternate embodiment of the quick coupling apparatus 110. A wedge bias element, illustrated as a pair of springs 131, is oriented to exert a wedge bias force WF on the wedge 121 rearward towards the groove such that the wedge bias force WF forces the wedge 121 into the groove. A hydraulic actuator cylinder 133, is configured to selectively exert or release an actuator force AF in a direction opposite to the wedge bias force WF. Directing pressurized fluid into the hydraulic actuator cylinder 133 exerts an actuator force AF greater than the wedge bias force WF such that the wedge is maintained in the open position, illustrated in Fig. 11. The pressurized fluid is then released from the hydraulic actuator cylinder 133, removing the actuator force AF and the bias force WF then moves the wedge 121 to the closed position of Fig. 12.

In the illustrated apparatus 110 of Figs. 10 - 13 the latch member is a latch arm 135 fixed to a rocker plate 134, to which the hydraulic actuator cylinder 133 is also fixed. The latch arm 135 and hydraulic actuator cylinder 133, via the rocker plate 134, are pivotally attached to the coupler member 103 about a latch pivot axis LPA. Bolts 130 through springs 131 are operative to exert a moment M on the rocker plate 134, and thus on the hydraulic actuator cylinder 133 and the latch arm 135, about the latch pivot axis LPA such that the hook 145 at the end of the latch arm 135 is urged upward toward the latched position of Fig. 13 where the hook 145 lies behind the wedge 121 and prevents the wedge

from moving out of the closed position. With no pressure in the hydraulic actuator cylinder 133, the moment M also rotates the front end of the cylinder rod 147 of the hydraulic actuator cylinder 133, which is fixed to the latch arm 135, upward to the position illustrated in Fig. 13 where the end of the rod 147 is pushed out of the recess 149 that is shaped to correspond to the end of the rod 147.

When pressurized fluid is directed into the hydraulic actuator cylinder 133, the rod 147 moves outward and is forced downward into the recess 149, which also moves the latch arm 135 downward such that the hook 145 no longer prevents the wedge from moving out of the closed position of Fig. 13 to the open position of Fig. 12, and then the actuator force AF exerted by the hydraulic actuator cylinder 135 can push the wedge 121 to the open position of Fig. 11.

Thus again the hydraulic actuator cylinder 133 thus is configured to operate the latch and also move the wedge from the closed position of Fig. 13 to the open position of Fig. 11. When it is desired to release the coupler member 103 from the mounting brackets, pressurized fluid is directed into the hydraulic actuator cylinder 133 and as the rod 147 extends it first moves down into the recess 149, thereby moving the latch arm 135 down and the hook away from the wedge 121 so that extending the rod 147 further can then move the wedge 121 out of the groove and into the open position of Fig. 11 where the coupler member and mounting bracket are released from each other.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous changes and modifications will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all such suitable changes or modifications in structure or operation which may be resorted to are intended to fall within the scope of the claimed invention.

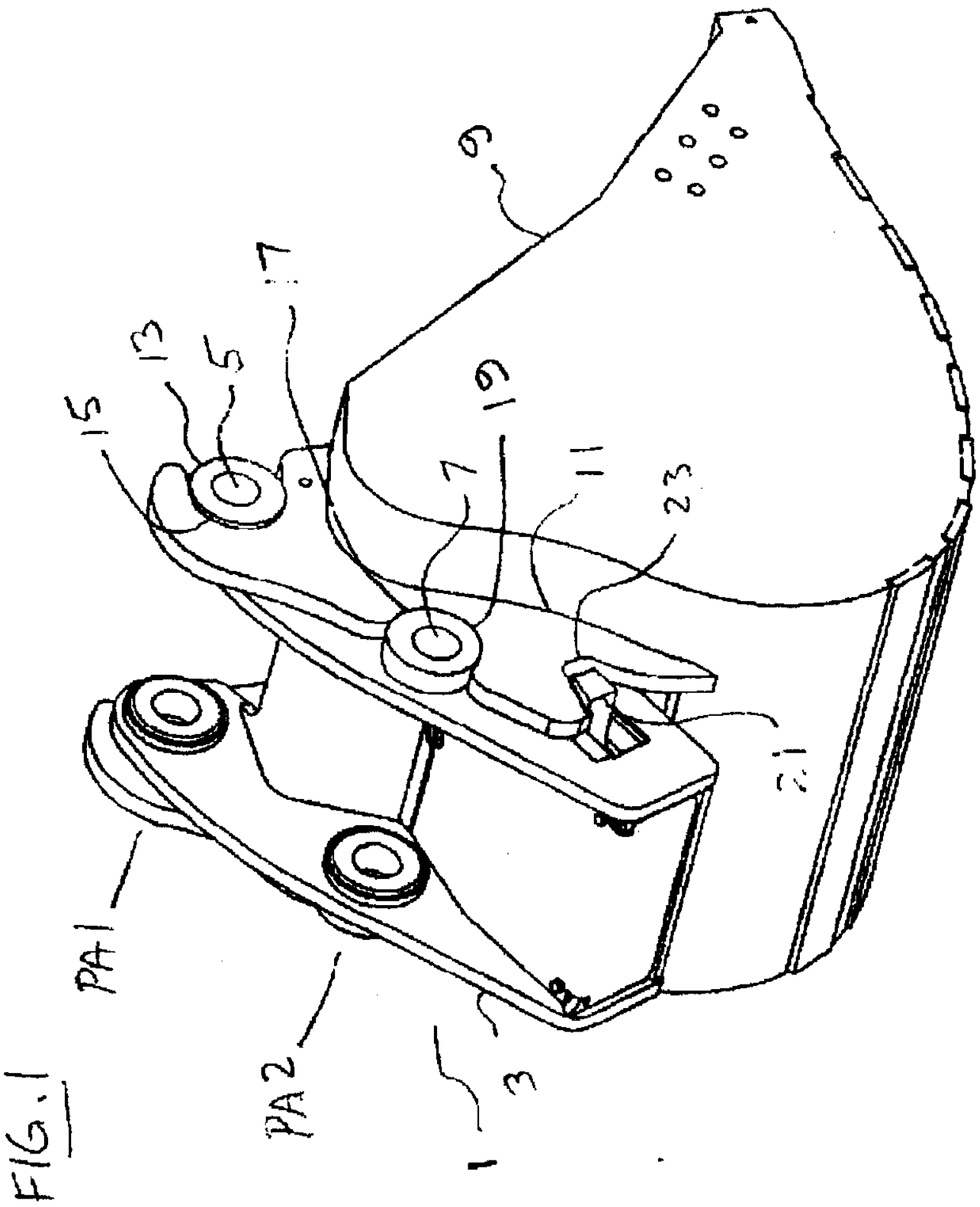


FIG. 1

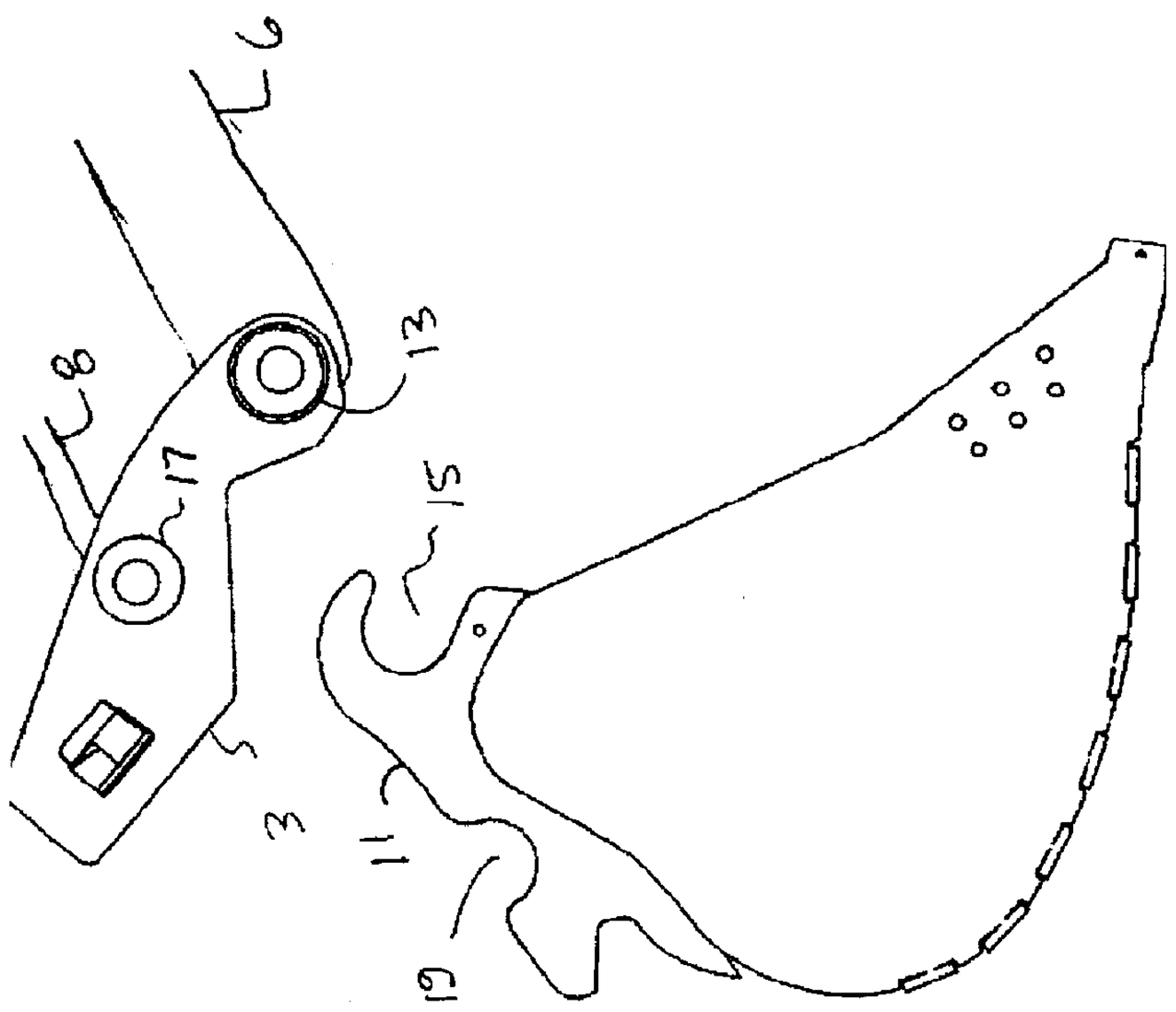


FIG. 2

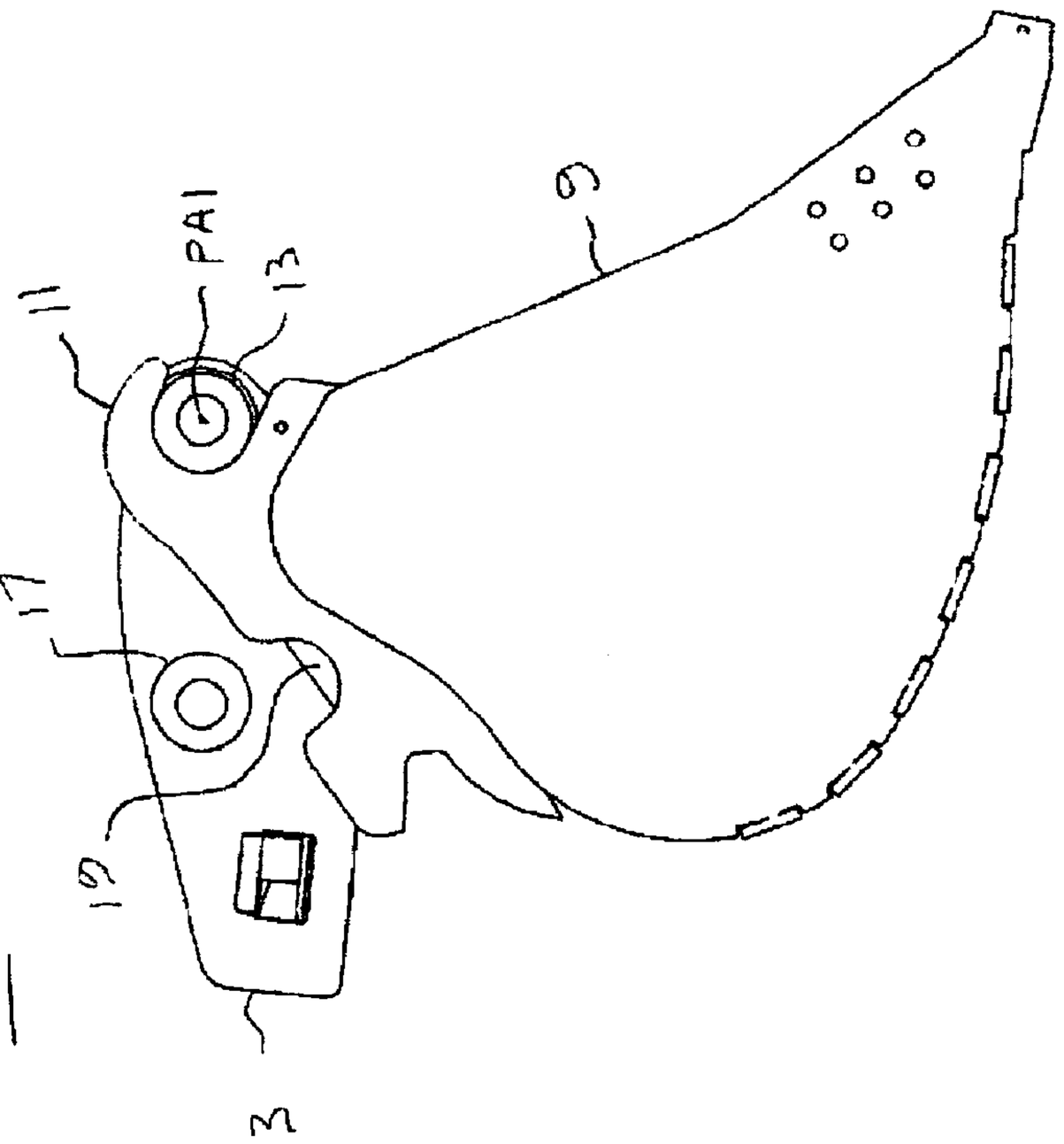


FIG. 3

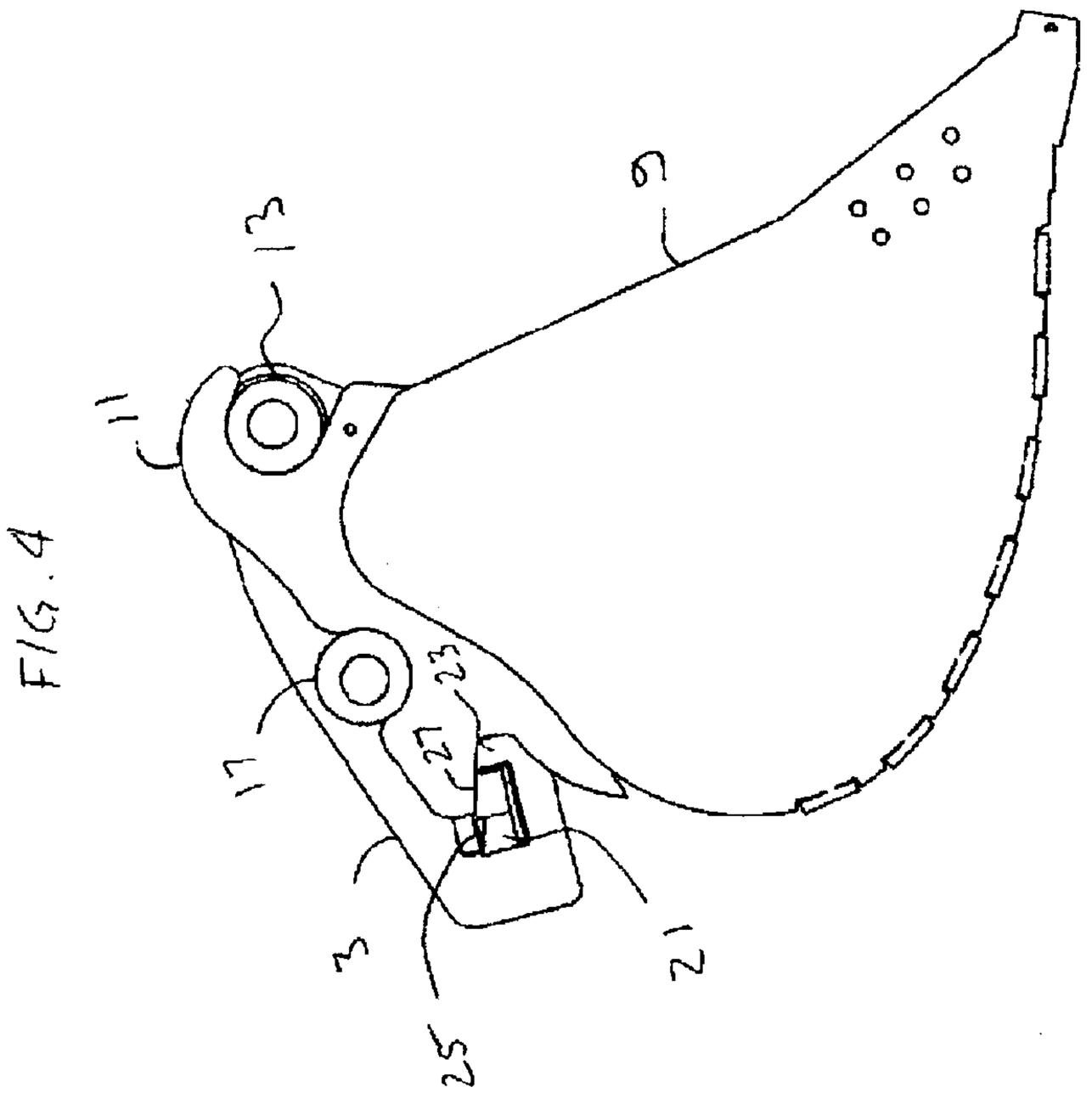
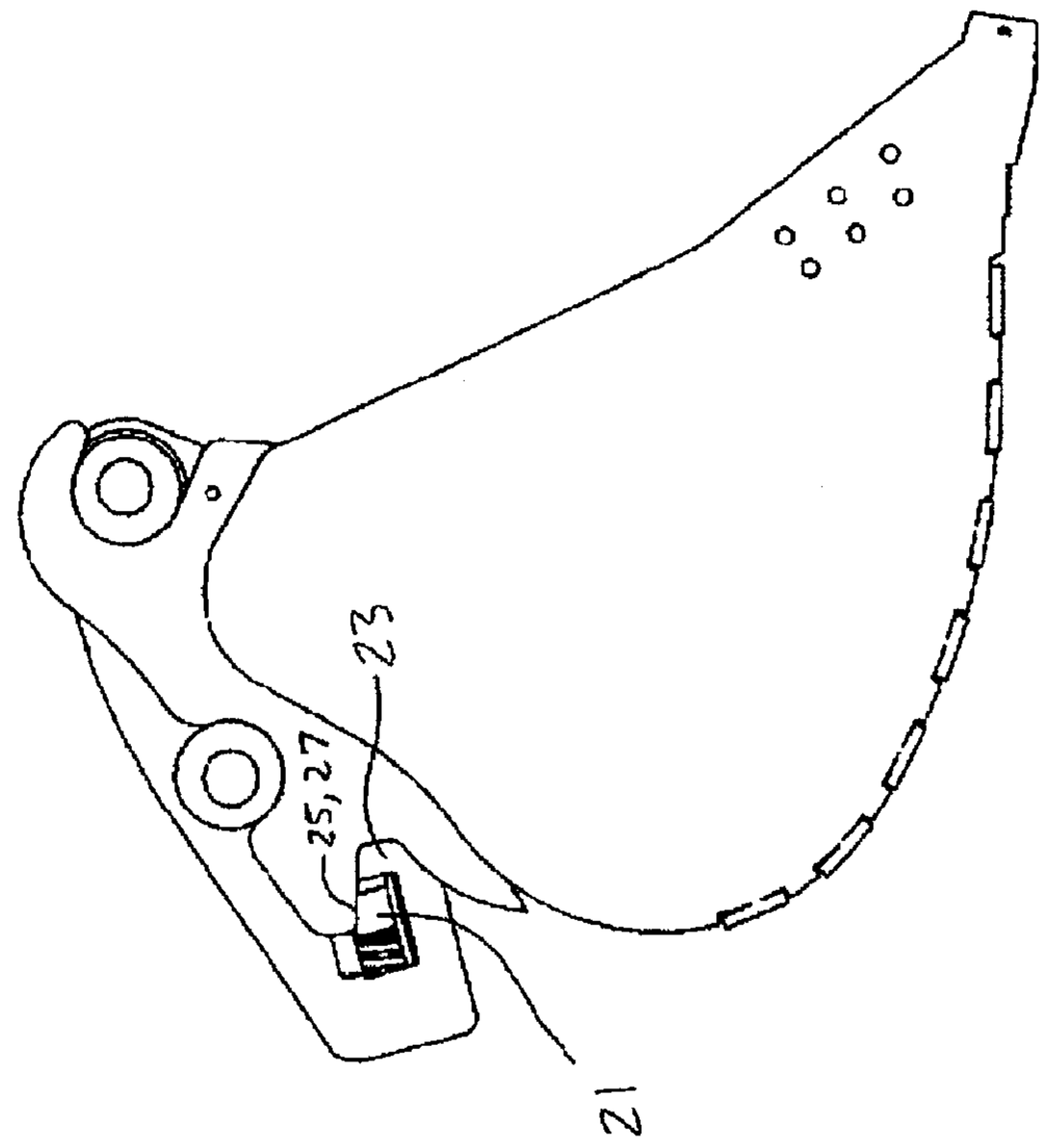


FIG. 4

FIG. 5



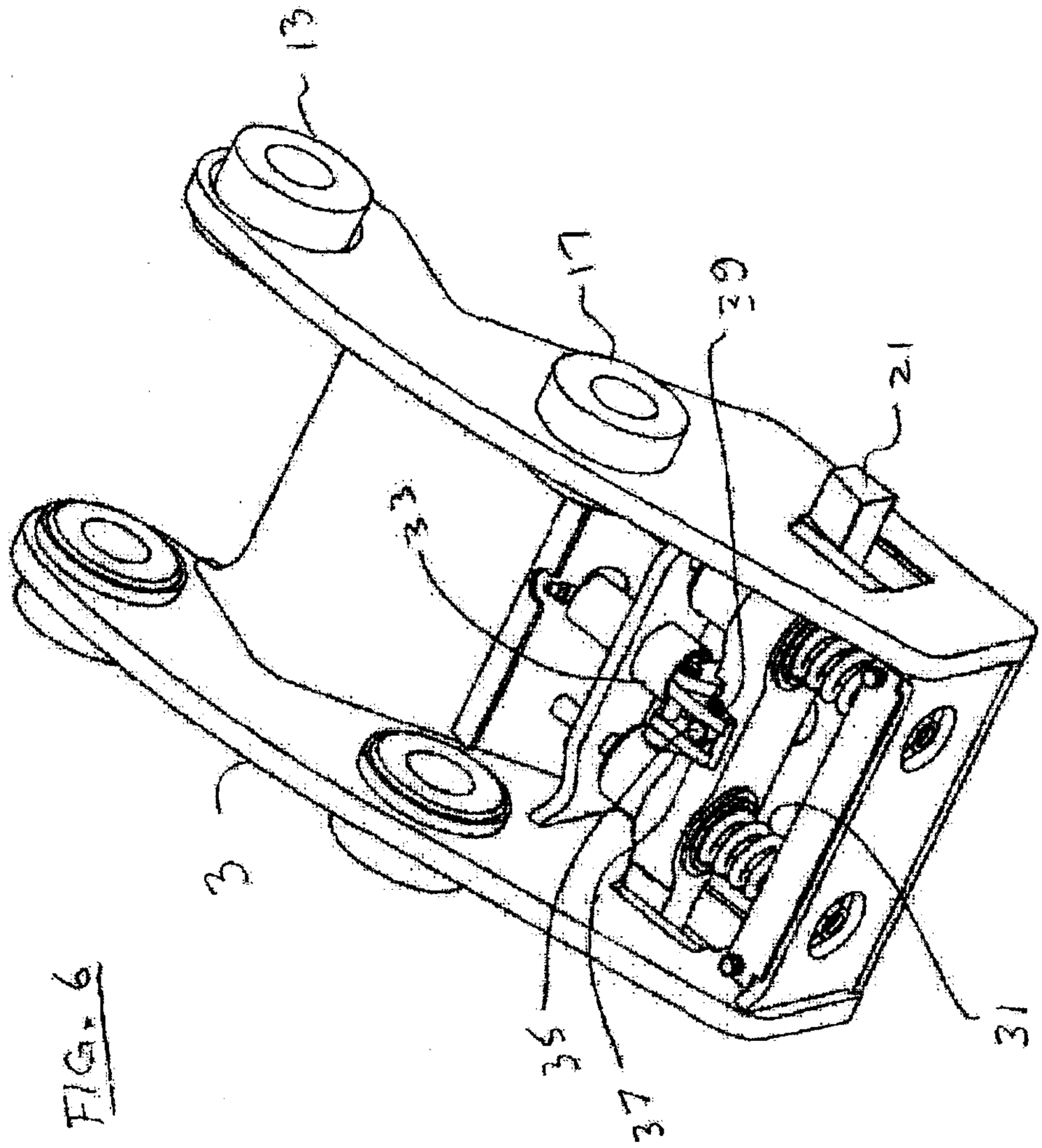


FIG. 6

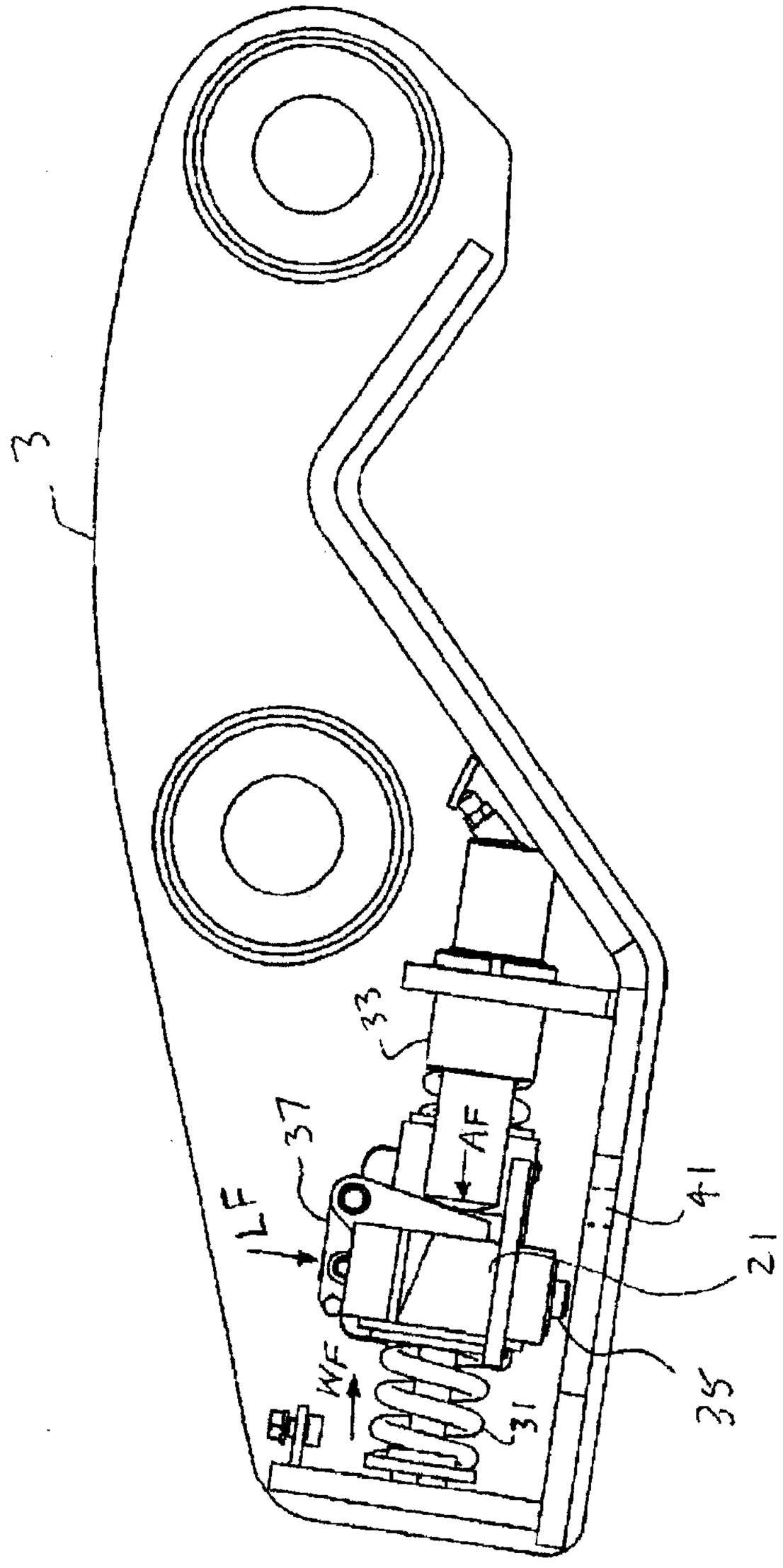


FIG. 7

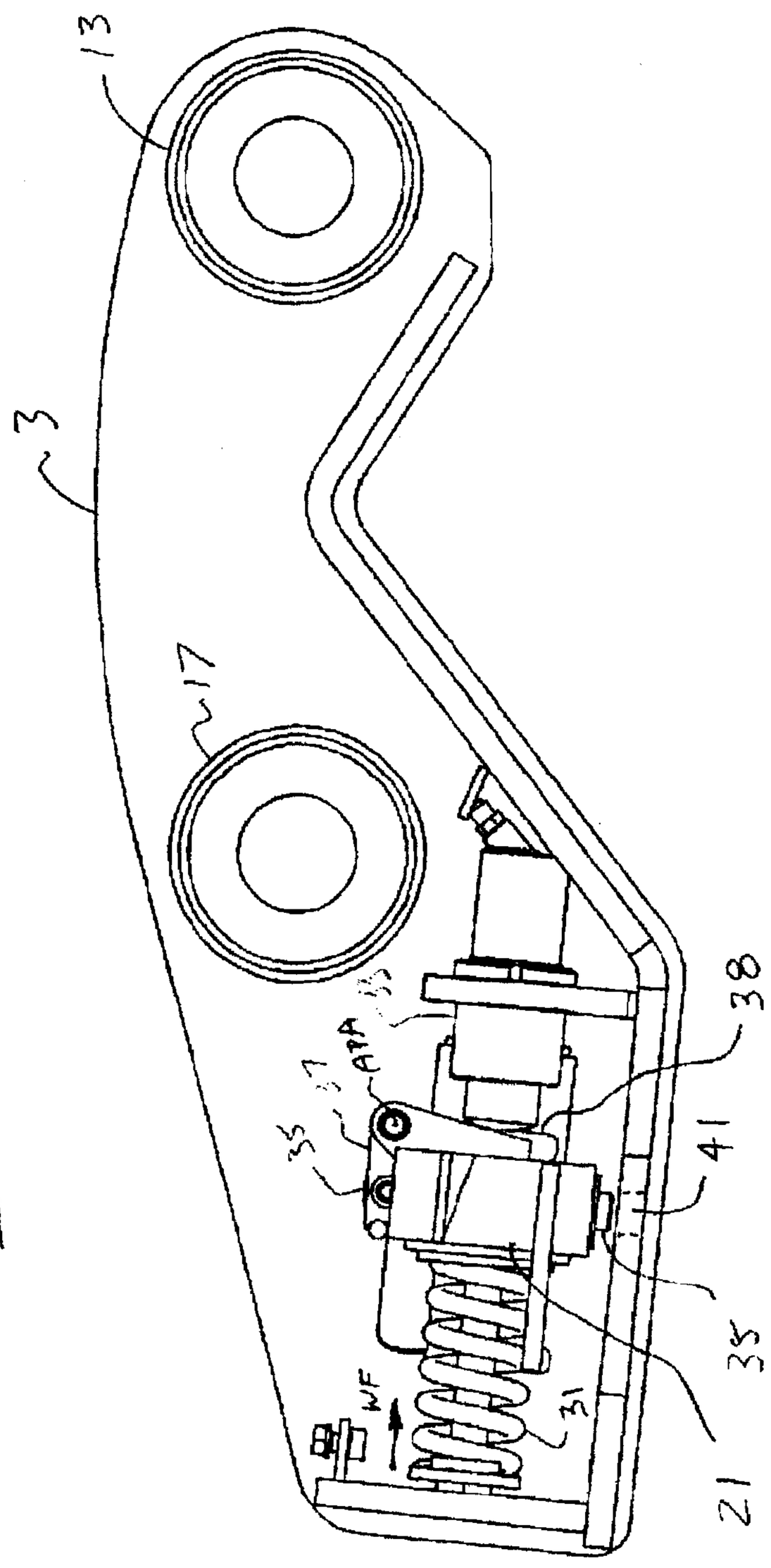


FIG. 8

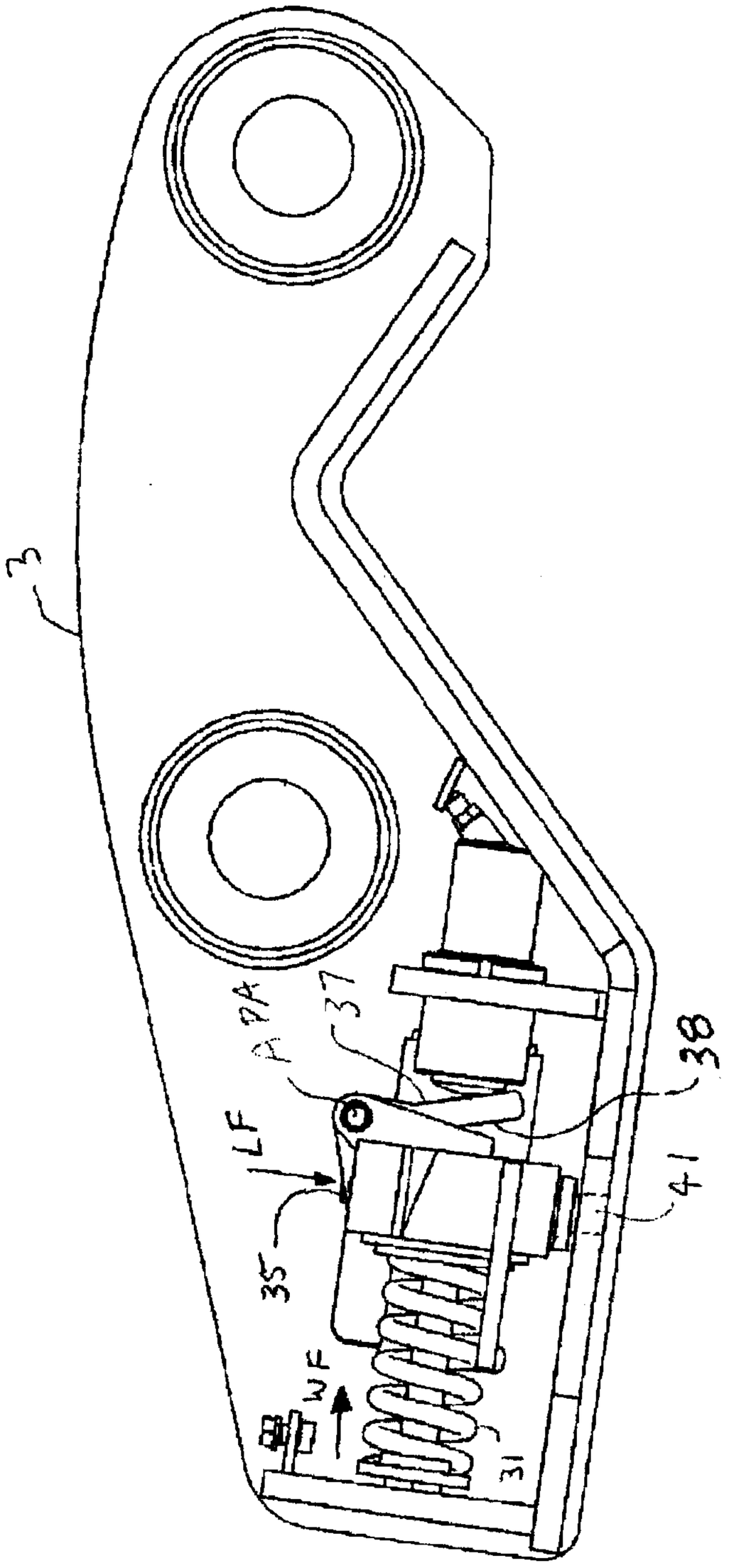


FIG. 9

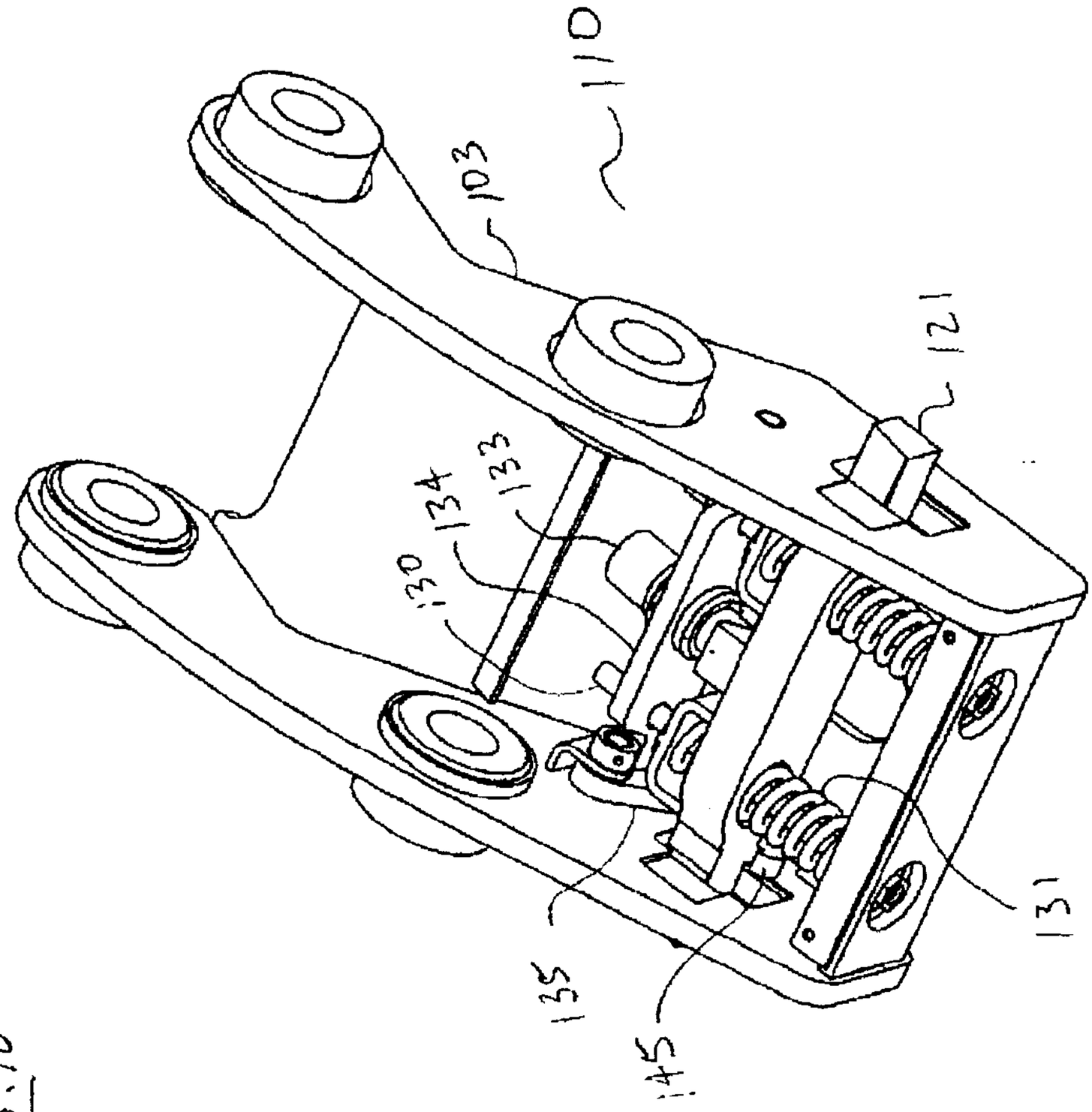


FIG. 10

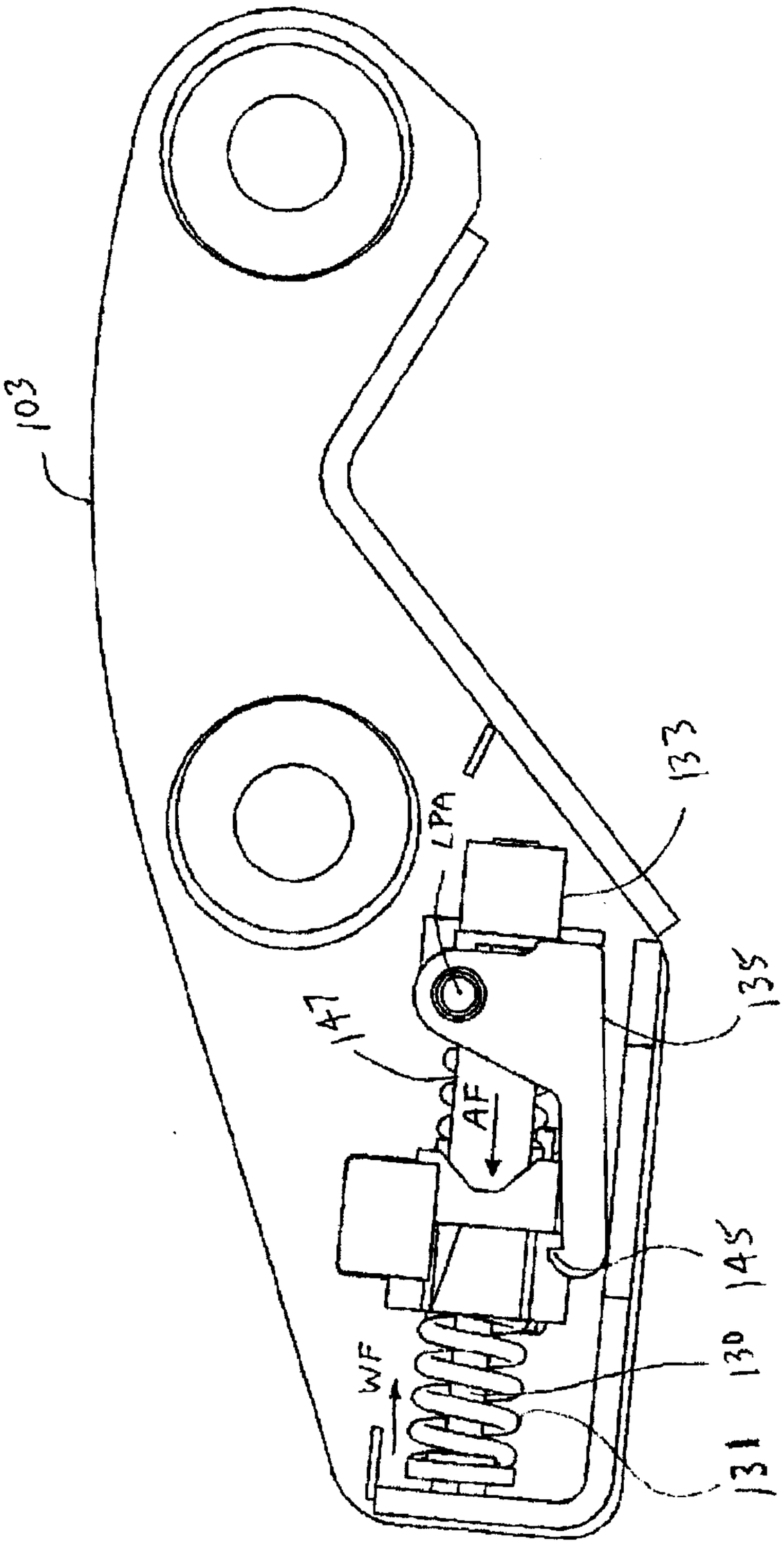


FIG. 11

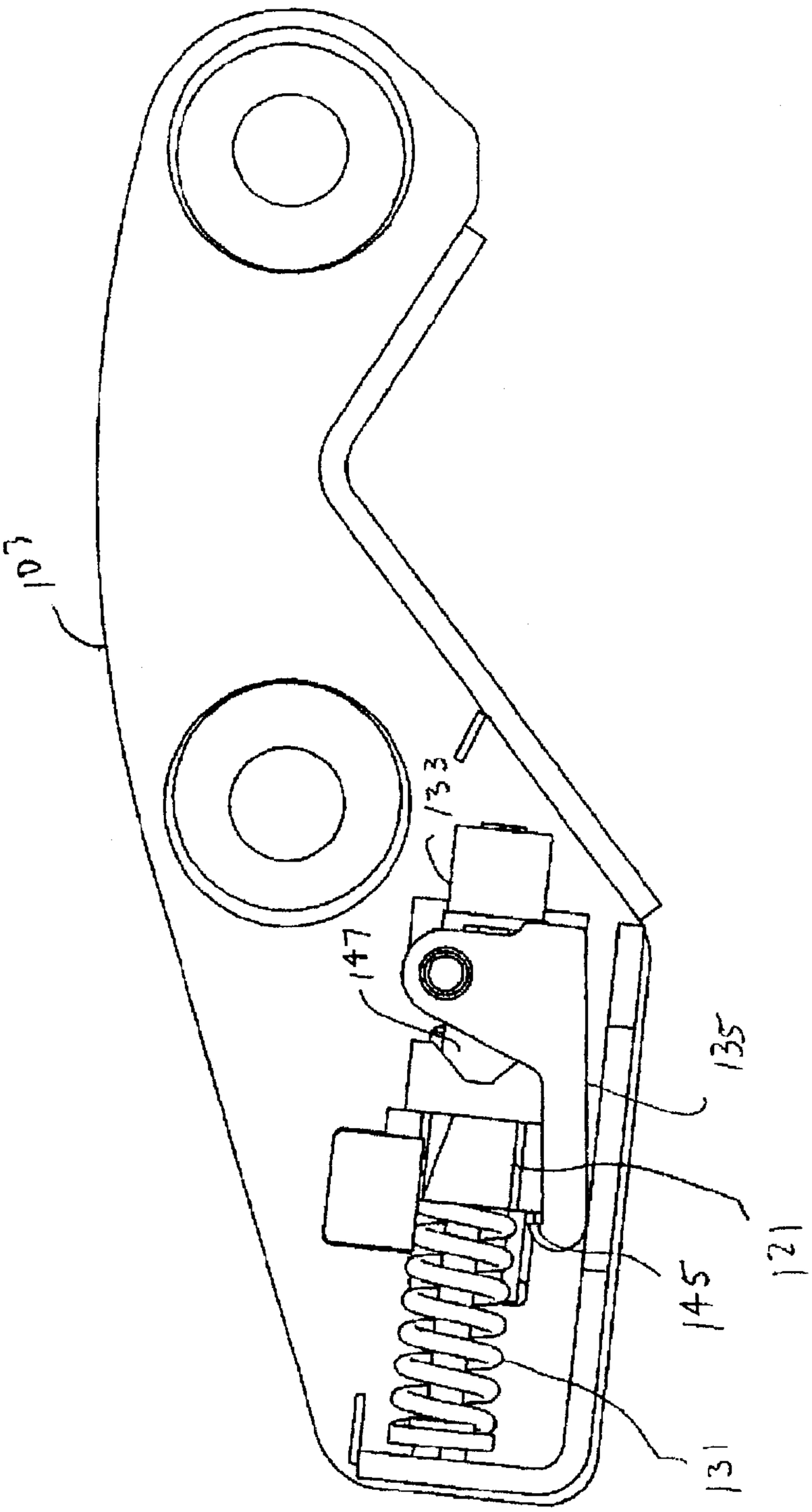


FIG. 12

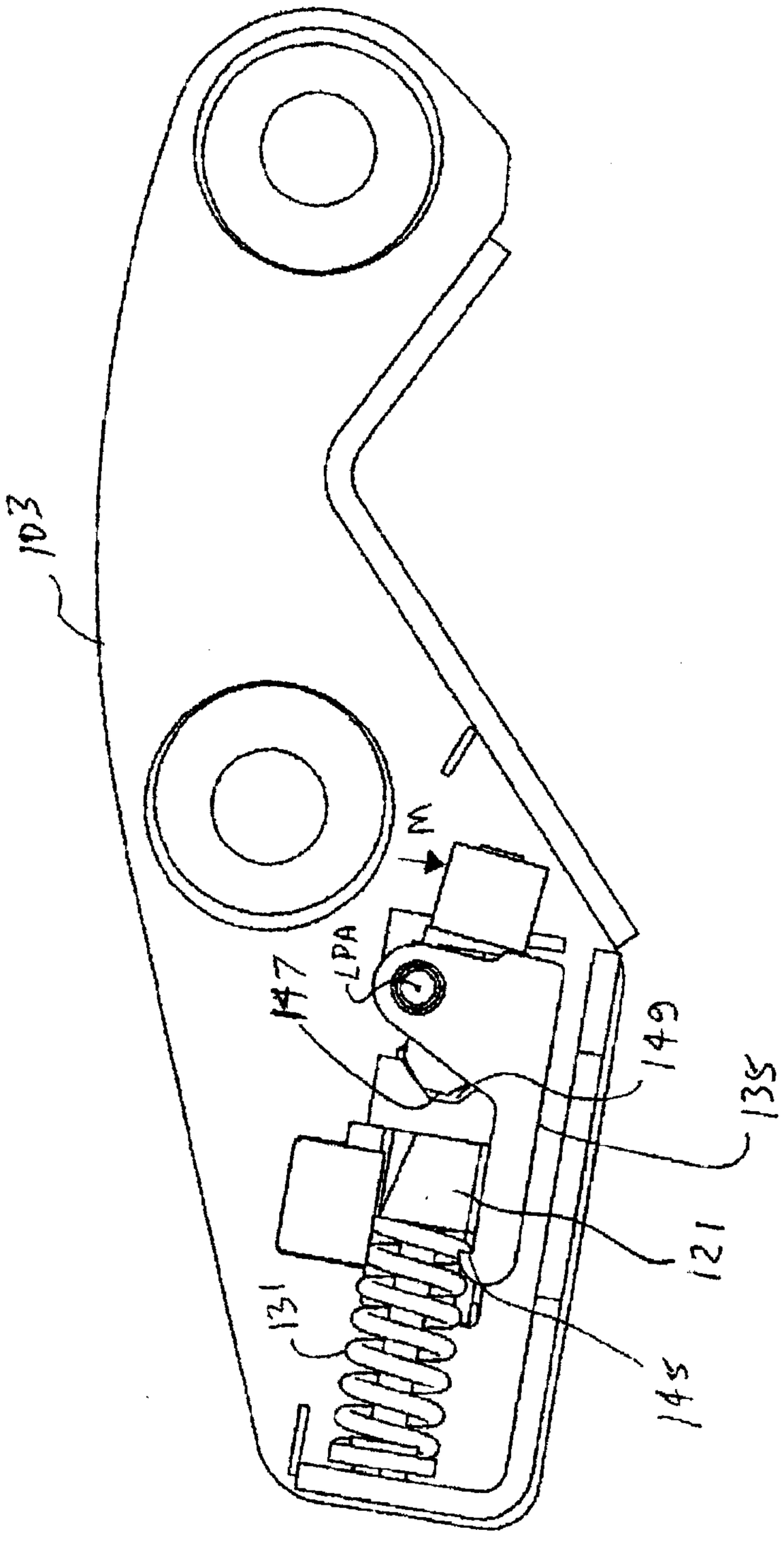
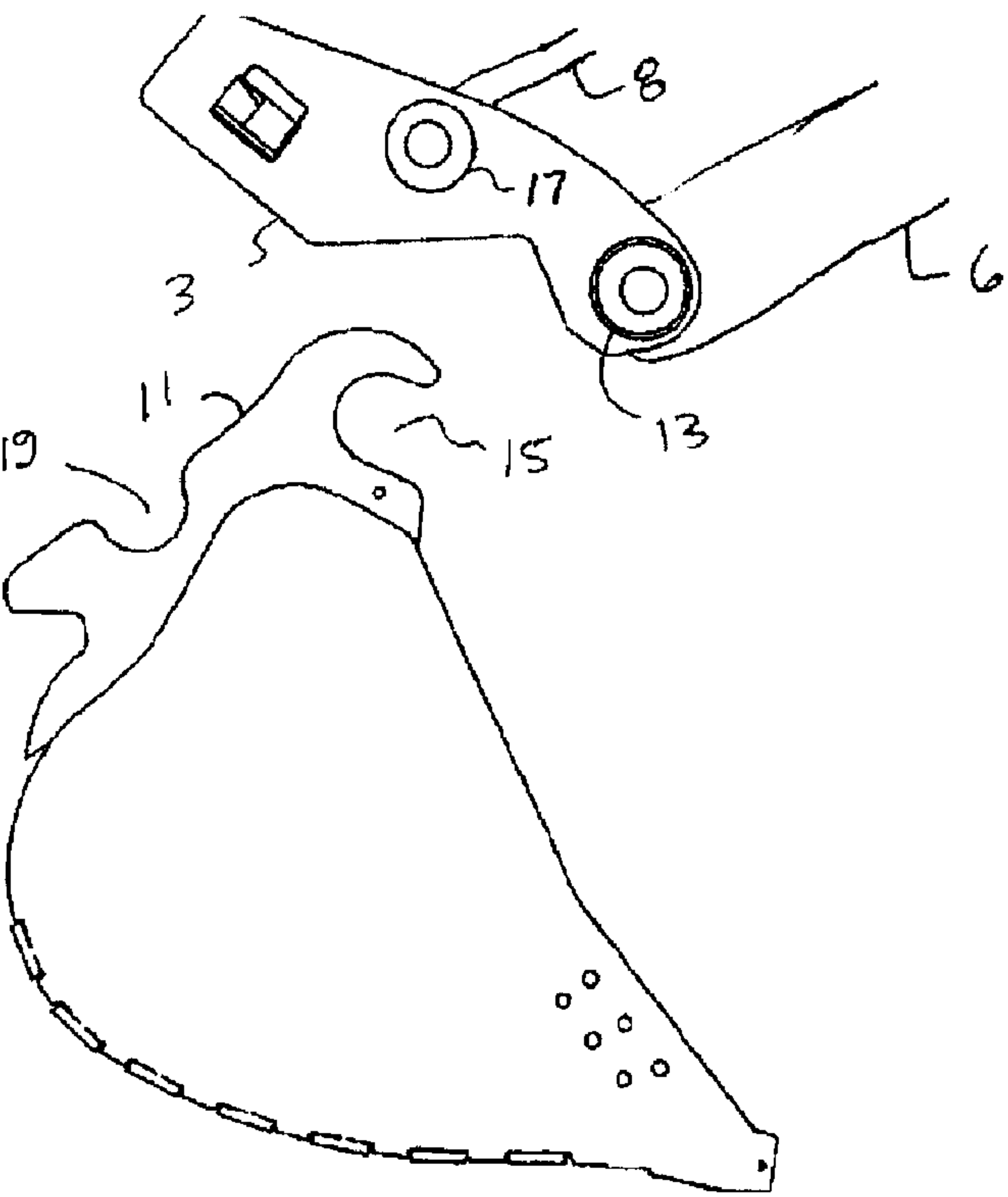


FIG. 13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