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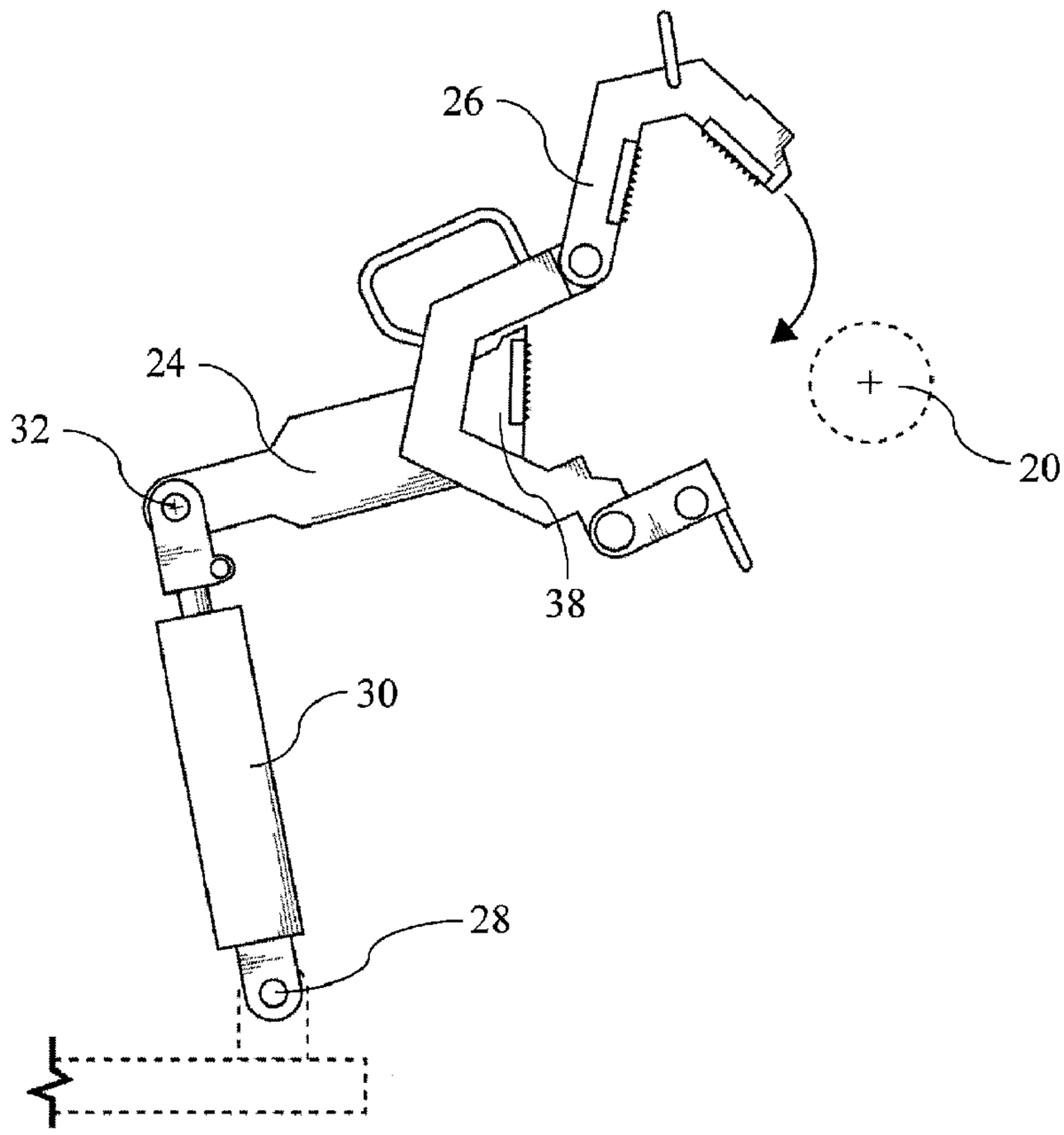
(54) Title: WRENCH FOR BREAKING INTERNAL CONNECTIONS



(57) Abrégé/Abstract:
There is provided a makeup/breakout tool, having a chassis, first and second workpiece clamps mounted to the chassis, a wrench having a wrench head, and a wrench actuator. At least the first workpiece clamp is movable along a length of the chassis, each of

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(57) Abrégé(suite)/Abstract(continued):
the first and second workpiece clamps has a workpiece engagement area sized to receive a workpiece, the workpiece engagement areas being axially aligned, and at least one of the first and second workpiece clamps has a clamp actuator for applying torque to the workpiece. The wrench is pivotally mounted to the first workpiece clamp, and has a range of pivotal movement that allows the wrench head to move into and out of axial alignment with the workpiece engagement areas of the first and second workpiece clamps. The wrench actuator actuates the wrench head to apply torque to the workpiece.

ABSTRACT OF THE DISCLOSURE

There is provided a makeup/breakout tool, having a chassis, first and second workpiece clamps mounted to the chassis, a wrench having a wrench head, and a wrench actuator. At least the first workpiece clamp is movable along a length of the chassis, each of the first and second workpiece clamps has a workpiece engagement area sized to receive a workpiece, the workpiece engagement areas being axially aligned, and at least one of the first and second workpiece clamps has a clamp actuator for applying torque to the workpiece. The wrench is pivotally mounted to the first workpiece clamp, and has a range of pivotal movement that allows the wrench head to move into and out of axial alignment with the workpiece engagement areas of the first and second workpiece clamps. The wrench actuator actuates the wrench head to apply torque to the workpiece.

WRENCH FOR BREAKING INTERNAL CONNECTIONS

TECHNICAL FIELD

[0001] This relates to a wrench that is used to make up or break internal connections on a downhole motor.

BACKGROUND

[0002] When servicing a downhole motor, a makeup/breakout tool is used to separate the various components, which are generally assembled by threaded connections. The makeup/breakout tool typically uses hydraulic cylinders that engage the workpiece before turning the assembly to make or break the connection. Makeup/breakout tools are typically too large to grasp internal components, and a wrench is applied manually to make or break these connections. US Patent No. 3,844,547 teaches a wrench that can be used as a supplementary wrench for a larger breakout wrench.

SUMMARY

[0003] According to an aspect, there is provided a makeup/breakout tool, comprising a chassis, first and second workpiece clamps mounted to the chassis, wherein at least the first workpiece clamp is movable along a length of the chassis, each of the first and second workpiece clamps has a workpiece engagement area sized to receive a workpiece, the workpiece engagement areas being axially aligned, and at least one of the first and second workpiece clamps comprises a clamp actuator for applying torque to the workpiece, a wrench having a wrench head, the wrench being pivotally mounted to the first workpiece clamp, the wrench having a range of pivotal movement that allows the wrench head to move into and out of axial alignment with the workpiece engagement areas of the first and second workpiece clamps, and a wrench actuator that actuates the wrench head to apply torque to the workpiece.

[0004] According to another aspect, the wrench may be mounted to the first workpiece clamp by the wrench actuator, and the wrench actuator comprises a telescopic actuator.

[0005] According to another aspect, the telescopic actuator may be hydraulic.

[0006] According to another aspect, the wrench actuator may be connected to the first

workpiece clamp by a first pivotal connection and to the wrench by a second pivotal connection.

[0007] According to another aspect, the first workpiece clamp may comprise a carriage that moves the first workpiece clamp along the chassis, and the wrench body may be mounted to the carriage.

[0008] According to another aspect, the wrench head may have an adjustable inner diameter.

[0009] According to another aspect, the wrench head may be self-adjusting.

[0010] According to another aspect, the wrench head may be reversible.

[0011] According to another aspect, the first clamp may have a minimum engagement diameter, and the wrench head may have a minimum engagement diameter that is less than the first minimum engagement diameter of the first clamp.

[0012] According to an aspect, there is provided a method of making and breaking internal connection on a downhole tool, the method comprising providing a makeup/breakout tool comprising a chassis, first and second workpiece clamps mounted to the chassis, wherein at least the first workpiece clamp is movable along a length of the chassis, each of the first and second workpiece clamps has a workpiece engagement area sized to receive a workpiece, the workpiece engagement areas being axially aligned, and at least one of the first and second workpiece clamps comprises a clamp actuator for applying torque to the workpiece, a wrench having a wrench head, the wrench being pivotally mounted to the first workpiece clamp, the wrench having a range of pivotal movement that allows the wrench head to move into and out of axial alignment with the workpiece engagement areas of the first and second workpiece clamps, and a wrench actuator that actuates the wrench head to apply torque to the workpiece, placing a the downhole tool into the workpiece engagement area of the first and second workpiece clamps, using the clamp actuator of at least one of the first and second workpiece clamps, manipulating a first threaded connection of the downhole tool having a diameter greater than a minimum engagement diameter, pivoting the wrench head into axial alignment

with the workpiece engagement areas of the first and second clamps, and using the wrench actuator, manipulating a second threaded connection of the downhole tool having a diameter less than a minimum engagement diameter of the at least one of the first and second workpiece clamps.

[0013] According to another aspect, the wrench may be mounted to the first workpiece clamp by the wrench actuator, and the wrench actuator may comprise a telescopic actuator.

[0014] According to another aspect, the telescopic actuator may be hydraulic.

[0015] According to another aspect, the wrench actuator may be connected to the first workpiece clamp by a first pivotal connection and to the wrench by a second pivotal connection.

[0016] According to another aspect, the first workpiece clamp may comprise a carriage that moves the first workpiece clamp along the chassis, and the wrench body may be mounted to the carriage.

[0017] According to another aspect, the wrench head may have an adjustable inner diameter.

[0018] According to another aspect, the wrench head may be self-adjusting.

[0019] According to another aspect, the wrench head may be reversible.

[0020] According to another aspect, the first clamp may have a minimum engagement diameter, and the wrench head may have a minimum engagement diameter that is less than the first minimum engagement diameter of the first clamp.

[0021] In other aspects, the features described above may be combined together in any reasonable combination as will be recognized by those skilled in the art.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] These and other features will become more apparent from the following description in which reference is made to the appended drawings, the drawings are for the purpose of illustration only and are not intended to be in any way limiting, wherein:

FIG. 1 is a front elevation view of a wrench for breaking internal connections reaching for and closing around a workpiece.

FIG. 2 is a front elevation view of the wrench for breaking internal connections of FIG. 1 closed around a workpiece and lifting to rotate the workpiece in a clockwise direction.

FIG. 3 is a front elevation view of the wrench for breaking internal connections of FIG. 1 closed around a workpiece that has been rotated in a clockwise direction.

FIG. 4 is a front elevation view of the wrench for breaking internal connections of FIG. 1 closed around a workpiece and lowering to rotate the workpiece in a counter clockwise direction.

FIG. 5 is a front elevation view of the wrench for breaking internal connections of FIG. 1 closed around a workpiece that has been rotated in a counter clockwise direction.

FIG. 6 is a front elevation view of the wrench for breaking internal connections of FIG. 1 that has been folded away from a workpiece.

FIG. 7 is a side elevation view of the wrench for breaking internal connections of FIG. 1 in context with a makeup/breakout tool, where the wrench has been folded away from a workpiece.

FIG. 8 is a front elevation view of the wrench for breaking internal connections of FIG. 1 in context with a makeup/breakout tool, where the wrench is folded toward the workpiece.

FIG. 9 is a side elevation view of a makeup/breakout tool having a wrench for breaking internal connections as shown in FIG. 1.

FIG. 10 is a front elevation view of the wrench for breaking internal connections having an alternate connection mechanism.

DETAILED DESCRIPTION

[0023] A makeup/breakout tool, generally identified by reference numeral 10, will now

be described with reference to FIG. 1 through 10.

[0024] Referring to FIG. 9, a generic makeup/breakout tool 10 is shown with a chassis 12, and first and second workpiece clamps 14 and 16 mounted to chassis 12. As shown, workpiece clamp 14 is movable along the length of chassis 12, although both clamps 14 and 16 may be movable. Referring to FIG. 8, each of the workpiece clamps 14 and 16 has a workpiece engagement area 18. The workpiece engagement areas 18 are sized to receive a workpiece 20, and the workpiece engagement areas 18 of each of workpiece clamps 14 and 16 are axially aligned. At least one of workpiece clamps 14 and 16 has a clamp actuator 22 for applying torque to workpiece 20. As will be understood, the depicted makeup/breakout tool 10 is intended to refer to a generic design, and that the actual design of any particular makeup/breakout tool 10 that may be used will vary from what is depicted.

[0025] Referring to FIG. 8, makeup/breakout tool 10 has a wrench 24 with a wrench head 26. Wrench 24 is designed to be mounted to move with one of the clamps 14 or 16, such as workpiece clamp 14 in the depicted embodiment. Wrench head 26 may be of a standard size for a particular application, or may have an adjustable inner diameter for engaging different sizes of workpiece, such as by adjusting a length-adjustable member, adding or removing inserts, or replacing some or all of wrench head 26. Regardless of if wrench head 26 has a standard size, or has an adjustable inner diameter, the inner diameter of wrench head 26 will typically be selected such that wrench head 26 has an engagement diameter size that is less than the minimum engagement diameter of first workpiece clamp 14. This allows wrench head 26 to engage workpieces that are small than those that can be engaged by the first workpiece clamp 14. Where wrench head 26 has an adjustable inner diameter, wrench head 26 may be designed to be self-adjusting when closed around a workpiece 20. In the depicted example, wrench head 26 is adjustable by providing a sliding gripper 38 that is pushed toward the workpiece as actuator 30 applies a force to wrench head 26. This adjusts wrench head 26 to the necessary size, and also ensures a strong grip when applying torque. Referring to FIG. 10, wrench 24 may be sized using a slot and pin connection 40 to adjust sliding gripper 38. Slot and pin connection 40 may cooperate with a die (not shown) sized to hold the jaws of wrench head 26 at a specific size. Wrench 24 may also be biased in order to apply an initial

gripping force to workpiece 20. A spring (not shown) may be used to bias wrench 24. The spring may, for example, be a spring and pin installed into wrench head 26 that biases sliding gripper 38 into a gripping position. For an adjustable wrench head 26, the maximum engagement diameter size will preferably be around the minimum engagement diameter of first workpiece clamp 14 with only a small amount of overlap in order to reduce the design requirements on wrench 26. Wrench head 26 may also be reversible, allowing wrench head 26 to be turned in both directions.

[0026] Referring to FIG. 8, wrench 24 is actuated by wrench actuator 30 that causes wrench head 26 to apply torque to workpiece 20. Wrench actuator 30, may, for example, be a telescoping actuator, which may be a hydraulic actuator. Wrench actuator 30 may, for example, also be mechanically powered or use other actuation systems known in the art to be appropriate for the application. As shown, wrench 24 is mounted to first workpiece clamp 14 by wrench actuator 30. However, it will be understood that wrench 24 may be mounted to first workpiece clamp 14 using a variety of methods known in the art, and wrench actuator 30 may be in an alternate position, such as near wrench head 26. Wrench 24 may be equipped with a torque sensor that may be used to provide a digital readout or printout to allow for measurement of the torque applied to connections by wrench 24.

[0027] In order to allow wrench 24 to properly engage workpiece 20, and to be moved out of the way when not in use, wrench 24 preferably has a number of positions that can be achieved, for example, by providing movable or adjustable connections. As shown, wrench 24 is pivotally mounted to the first workpiece clamp 14 by a pivotal mounting 28 connected to wrench actuator 30, which is in turn connected to wrench 24 by a second pivotal connection 32. As shown in FIG. 4 and 5, pivotal connections 28 and 32 allow wrench 24 to engage and apply torque to workpiece 20. Referring to FIG. 6, pivotal connections 28 and 32 also allow wrench 24 to move out of the way by moving outward from the tool. In other designs, referring to FIG. 7, wrench 24 may also be designed to move in other directions as well. This may be by providing connection 32 as a universal joint, or permitting wrench head 24 to pivot about the hydraulic cylinder of wrench actuator 30 as shown.

[0028] Wrench 24 preferably has a range of pivotal movement that allows wrench head 26 to move into and out of axial alignment with workplace engagement areas 18 of first and second workpiece clamps 14 and 16. Referring to FIG. 9, first workpiece clamp 14 may have a carriage 34 that moves first workpiece clamp 14 along chassis 12. Wrench 24 may be mounted in a variety of locations depending on the application, such as on the side of first workpiece clamp 14, or mounted to carriage 34.

[0029] Referring to FIG. 1, in order to engage a workpiece 20, wrench 24 is first aligned and then engaged with workpiece 20. As shown, wrench head 26 has a two-part hinged connection that allows workpiece 20 to be grasped by wrench head 26. However, it will be understood by those skilled in the art that wrench head 26 may take a variety of forms and connect to workpiece 20 in a variety of ways. In order to position wrench head 26, wrench 24 may be pivoted about pivotal mounting 28, as well as pivotal connection 32. These connections may allow for pivotal movement within a single plane, or may allow for pivotal movement in a variety of directions, depending on the application. Referring to FIG. 2 and FIG. 3, once wrench head 26 is secured around workpiece 20, wrench actuator 30 is activated to apply torque to workpiece 20, which will manipulate a threaded connection (not shown) of workpiece 20. As shown, wrench actuator 30 is a telescopic hydraulic actuator that raises the end 36 of wrench 24 that is opposite wrench head 26 to apply a clockwise rotation to workpiece 20. Wrench head 26 may have a gripping portion 38 as shown that tightens against workpiece 20 as wrench 24 is turned. Gripping portion 38 may serve to make wrench head 26 self-adjusting. Referring to FIG. 4 and FIG. 5, in order to turn workpiece 20 in the opposite direction, wrench head 26 may be reversed, such that gripping portion 38 tightens as wrench 24 is turned in the opposite direction. As shown, wrench actuator 30 lowers the end 36 of wrench 24 and workpiece 20 is turned in a counter-clockwise direction.

[0030] Referring to FIG. 6, wrench 24 may be rotated out of alignment with the workpiece engagement areas 18 of the first and second workpiece clamps 14 and 16, allowing wrench 24 to be stored in a position that does not interfere with the work being done when wrench 24 is not needed. For example, workpiece clamps 14 and 16 may engage and manipulate threaded connections of workpiece 20 that have a diameter that is greater than the

minimum engagement diameters of the workpiece clamps 14 and 16. Wrench 24 may only be needed when the workpiece to be manipulated has a diameter that is less than the minimum engagement diameter of the first and second workpiece clamps 14 and 16. This may allow for cooperation between the two tools to make and break threaded connections having a variety of sizes. Referring to FIG. 7, wrench 24 may be capable of rotation in a variety of directions for storage. Wrench 24 may be rotated through a plane that is parallel to the face of workpiece clamp 14 to move out of the way, as is shown in FIG. 8. Wrench 24 may also be rotated in a plane that is perpendicular, as shown in FIG. 7. It will be understood that wrench 24 may also be capable of movement in other directions. For example, wrench 24 may rotate to be stored alongside workpiece clamp 14.

[0031] In this patent document, the word "comprising" is used in its non-limiting sense to mean that items following the word are included, but items not specifically mentioned are not excluded. A reference to an element by the indefinite article "a" does not exclude the possibility that more than one of the elements is present, unless the context clearly requires that there be one and only one of the elements.

[0032] The scope of the following claims should not be limited by the preferred embodiments set forth in the examples above and in the drawings, but should be given the broadest interpretation consistent with the description as a whole.

What is Claimed is:

1. A makeup/breakout tool, comprising:

a chassis;

first and second workpiece clamps mounted to the chassis, wherein:

at least the first workpiece clamp is movable along a length of the chassis;

each of the first and second workpiece clamps has a workpiece engagement area sized to receive a workpiece, the workpiece engagement areas being axially aligned; and

at least one of the first and second workpiece clamps comprises a clamp actuator for applying torque to the workpiece;

a wrench having a wrench head, the wrench being pivotally mounted to the first workpiece clamp, the wrench having a range of pivotal movement that allows the wrench head to move into and out of axial alignment with the workpiece engagement areas of the first and second workpiece clamps; and

a wrench actuator that actuates the wrench head to apply torque to the workpiece.

2. The makeup/breakout tool of claim 1, wherein the wrench is mounted to the first workpiece clamp by the wrench actuator, and the wrench actuator comprises a telescopic actuator.

3. The makeup/breakout tool of claim 1, wherein the telescopic actuator is hydraulic.

4. The makeup/breakout tool of claim 2, wherein the wrench actuator is connected to the first workpiece clamp by a first pivotal connection and to the wrench by a second pivotal connection.

5. The makeup/breakout tool of claim 1, wherein the first workpiece clamp comprises a carriage that moves the first workpiece clamp along the chassis, and wherein the wrench body is mounted to the carriage.

6. The makeup/breakout tool of claim 1, wherein the wrench head has an adjustable

inner diameter.

7. The makeup/breakout tool of claim 6, wherein the wrench head is self-adjusting.

8. The makeup/breakout tool of claim 7, wherein the wrench head is reversible.

9. The makeup/breakout tool of claim 1, wherein the first clamp has a minimum engagement diameter, and the wrench head has a minimum engagement diameter that is less than the first minimum engagement diameter of the first clamp.

10. A method of making and breaking internal connection on a downhole tool, the method comprising:

providing a makeup/breakout tool comprising:

a chassis;

first and second workpiece clamps mounted to the chassis, wherein:

at least the first workpiece clamp is movable along a length of the chassis;

each of the first and second workpiece clamps has a workpiece engagement area sized to receive a workpiece, the workpiece engagement areas being axially aligned; and

at least one of the first and second workpiece clamps comprises a clamp actuator for applying torque to the workpiece;

a wrench having a wrench head, the wrench being pivotally mounted to the first workpiece clamp, the wrench having a range of pivotal movement that allows the wrench head to move into and out of axial alignment with the workpiece engagement areas of the first and second workpiece clamps; and

a wrench actuator that actuates the wrench head to apply torque to the workpiece;

placing a the downhole tool into the workpiece engagement area of the first and second workpiece clamps;

using the clamp actuator of at least one of the first and second workpiece clamps, manipulating a first threaded connection of the downhole tool having a diameter greater than

a minimum engagement diameter;

pivoting the wrench head into axial alignment with the workpiece engagement areas of the first and second clamps; and

using the wrench actuator, manipulating a second threaded connection of the downhole tool having a diameter less than a minimum engagement diameter of the at least one of the first and second workpiece clamps.

11. The makeup/breakout tool of claim 1, wherein the wrench is mounted to the first workpiece clamp by the wrench actuator, and the wrench actuator comprises a telescopic actuator.

12. The makeup/breakout tool of claim 1, wherein the telescopic actuator is hydraulic.

13. The makeup/breakout tool of claim 2, wherein the wrench actuator is connected to the first workpiece clamp by a first pivotal connection and to the wrench by a second pivotal connection.

14. The makeup/breakout tool of claim 1, wherein the first workpiece clamp comprises a carriage that moves the first workpiece clamp along the chassis, and wherein the wrench body is mounted to the carriage.

15. The makeup/breakout tool of claim 1, wherein the wrench head has an adjustable inner diameter.

16. The makeup/breakout tool of claim 6, wherein the wrench head is self-adjusting.

17. The makeup/breakout tool of claim 7, wherein the wrench head is reversible.

18. The makeup/breakout tool of claim 1, wherein the first clamp has a minimum engagement diameter, and the wrench head has a minimum engagement diameter that is less than the first minimum engagement diameter of the first clamp.

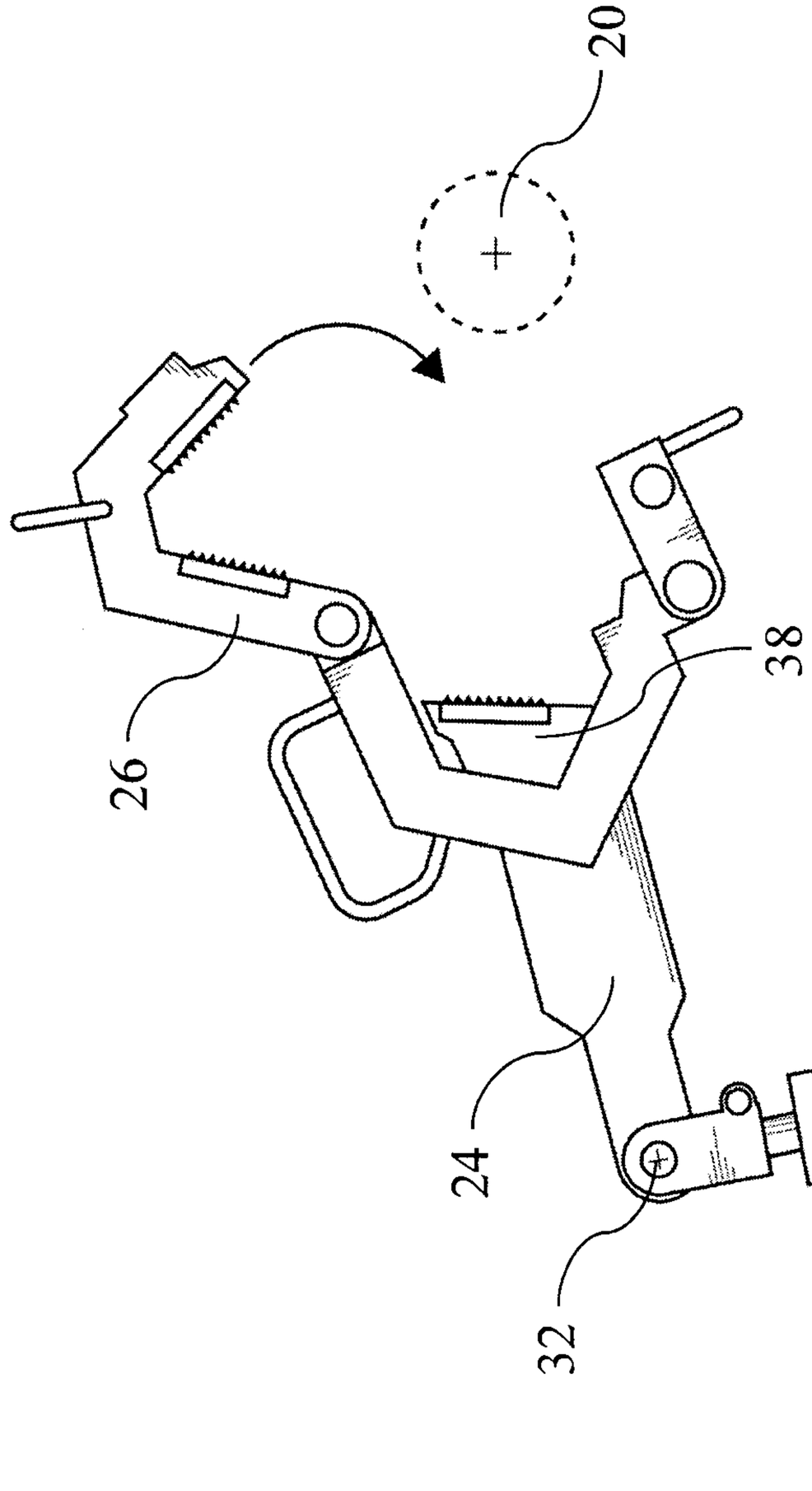


FIG. 1

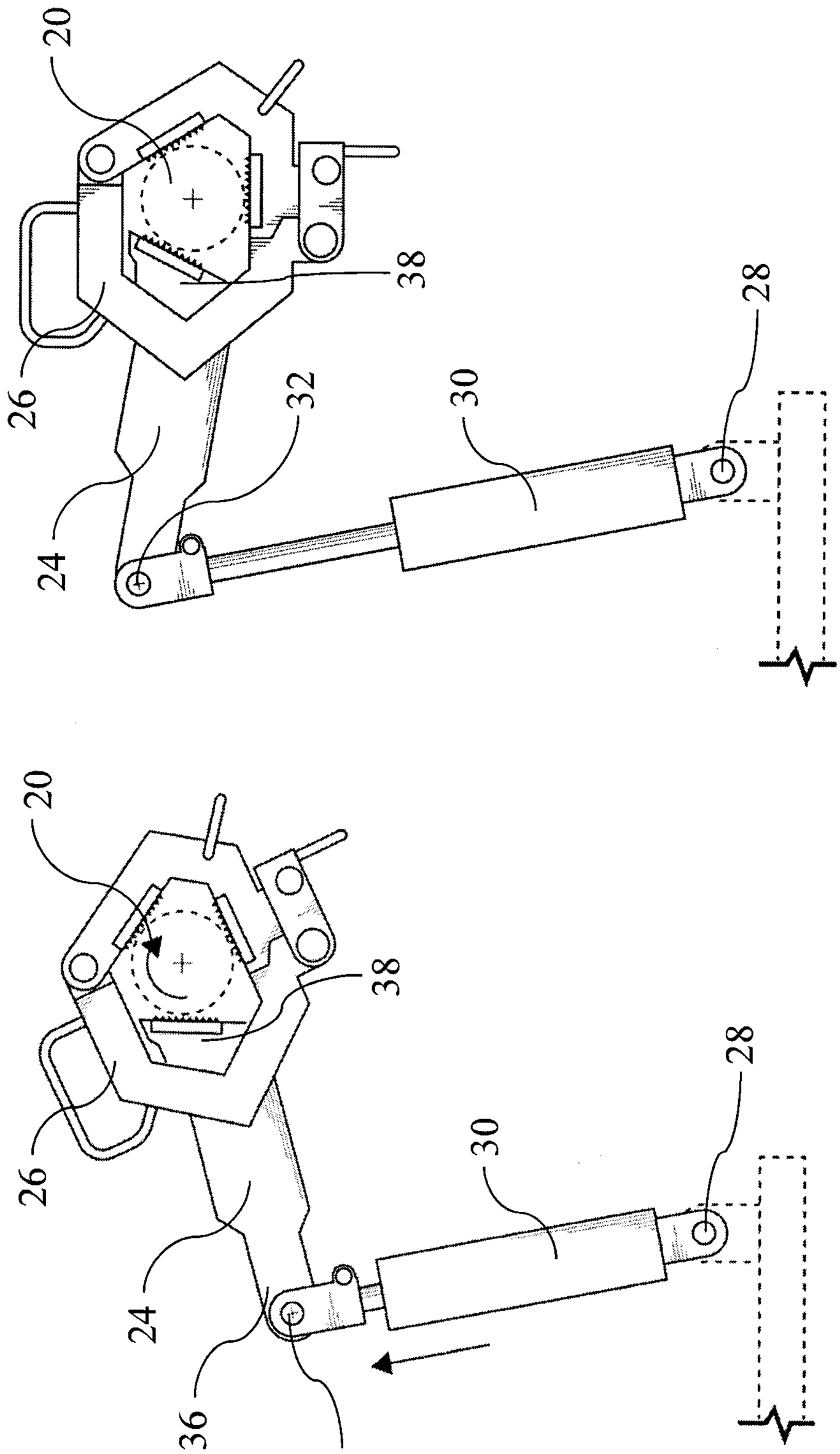


FIG. 3

FIG. 2

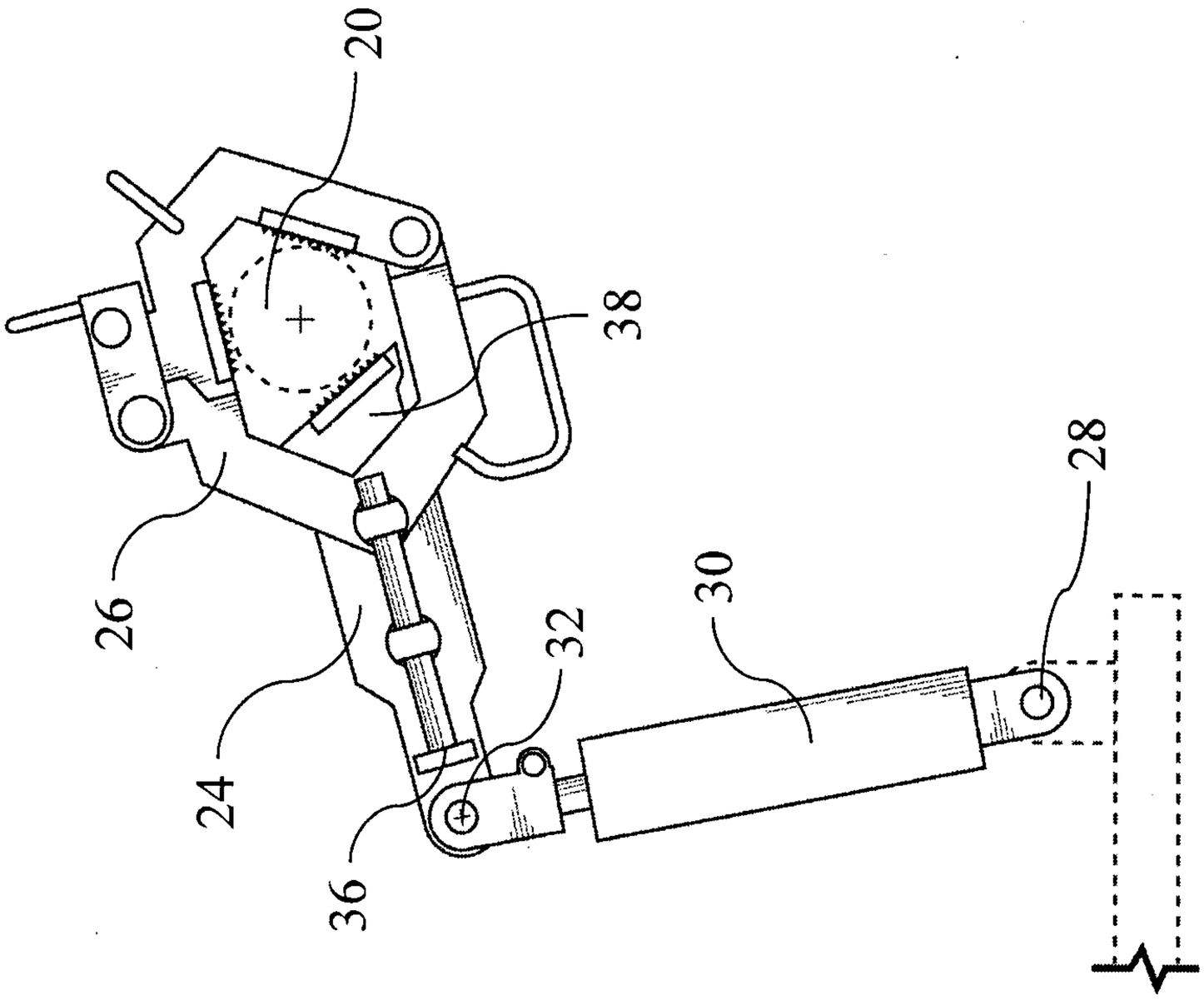


FIG. 5

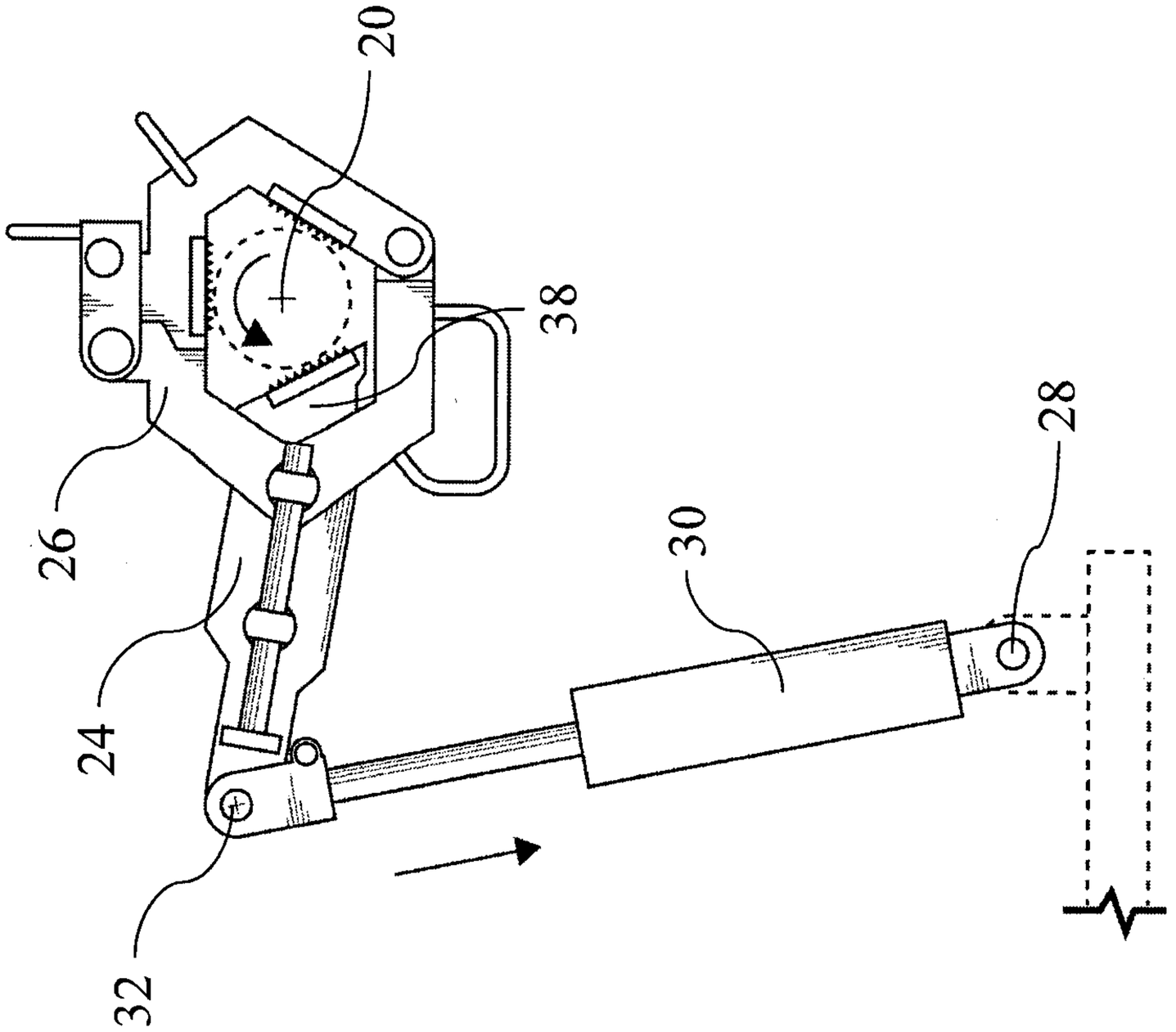


FIG. 4

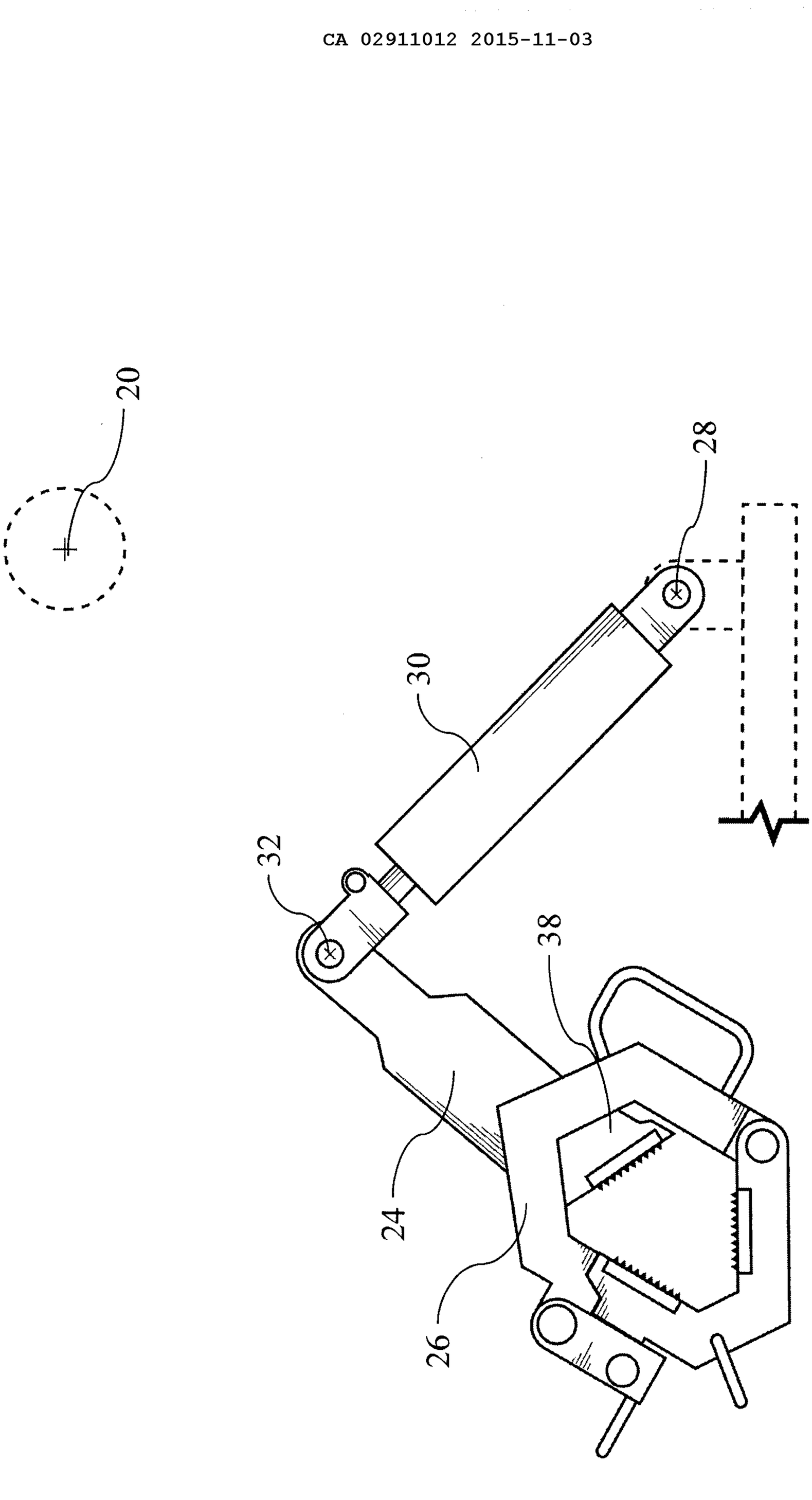


FIG. 6

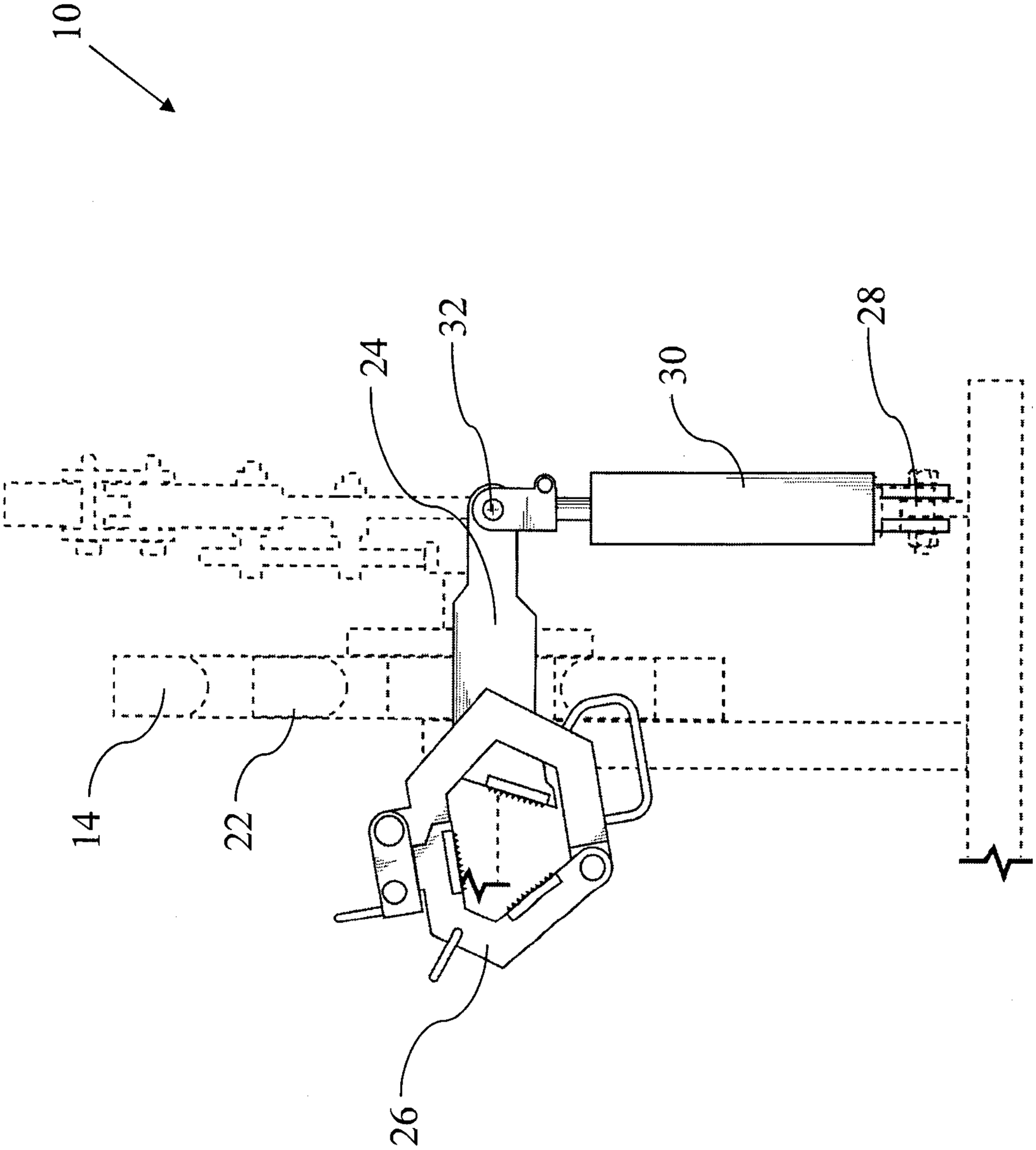


FIG. 7

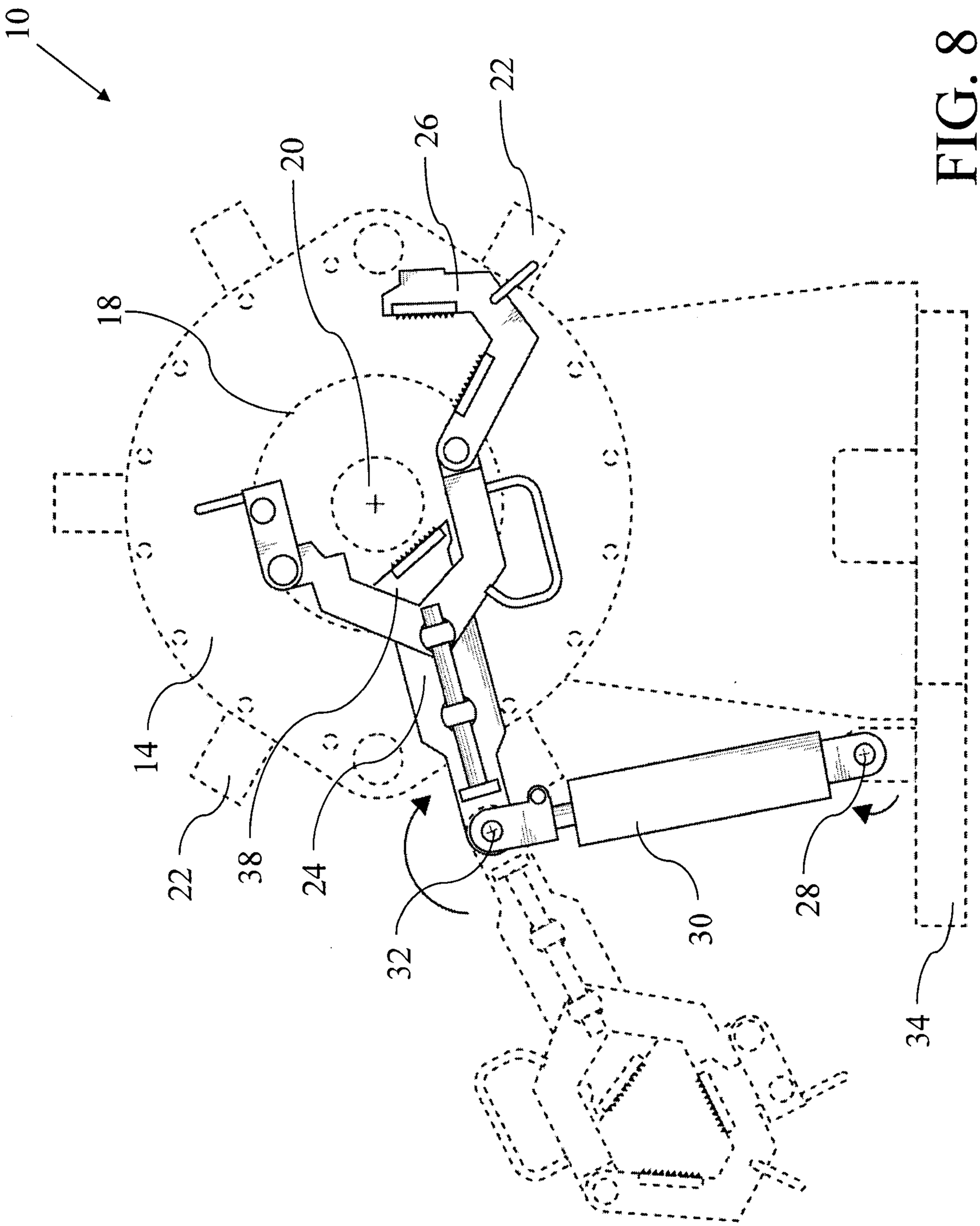


FIG. 8

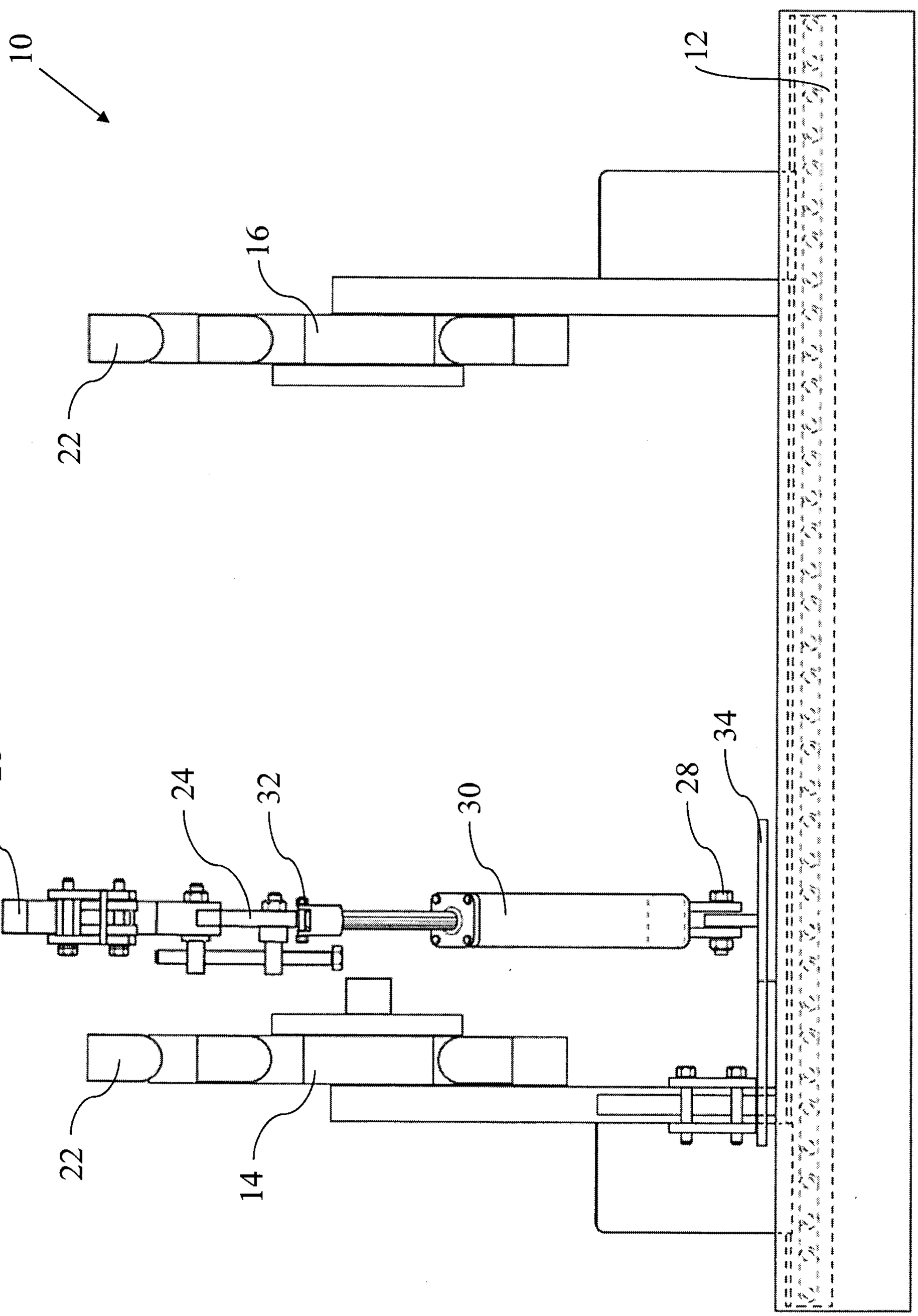


FIG. 9

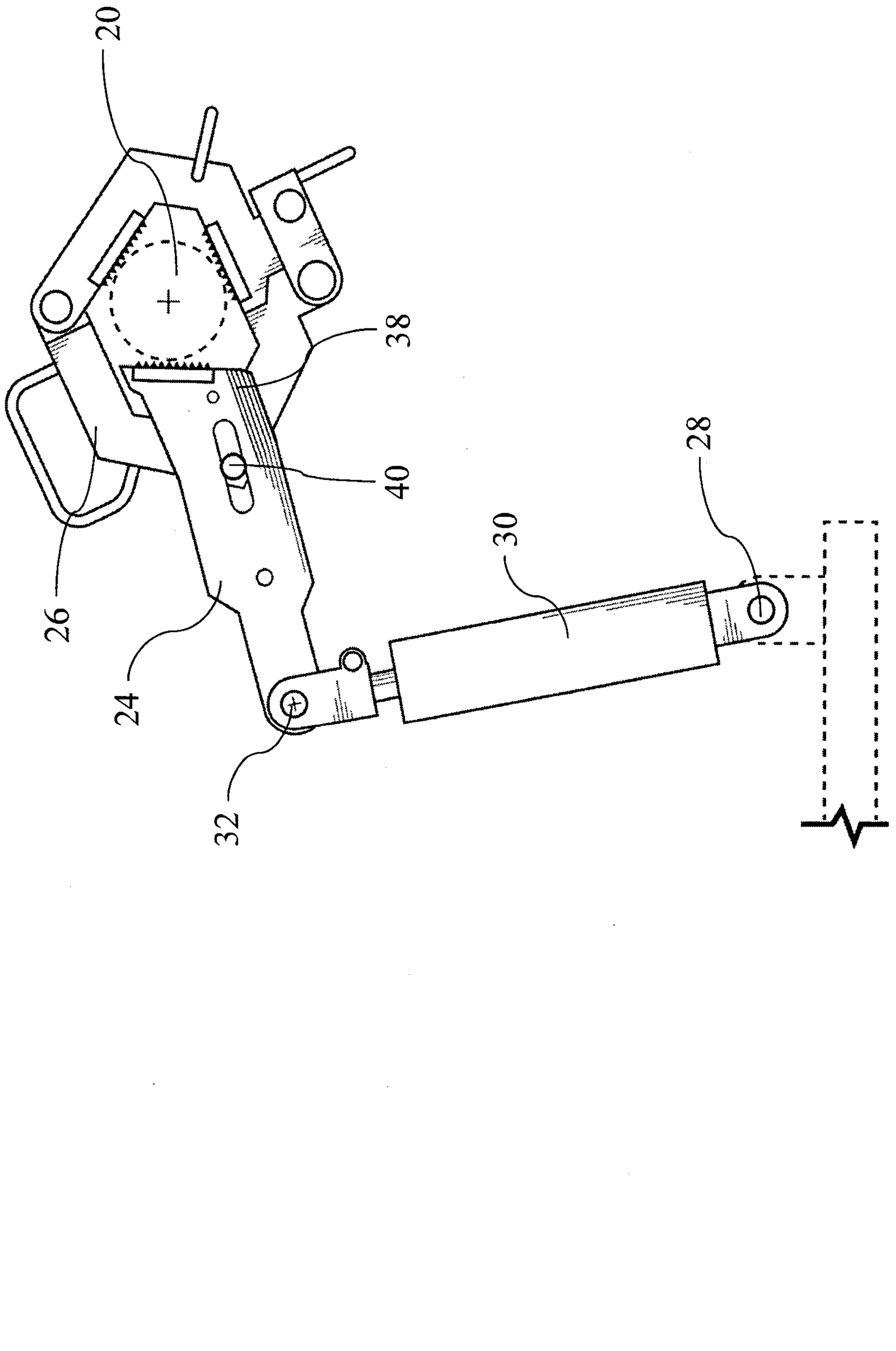
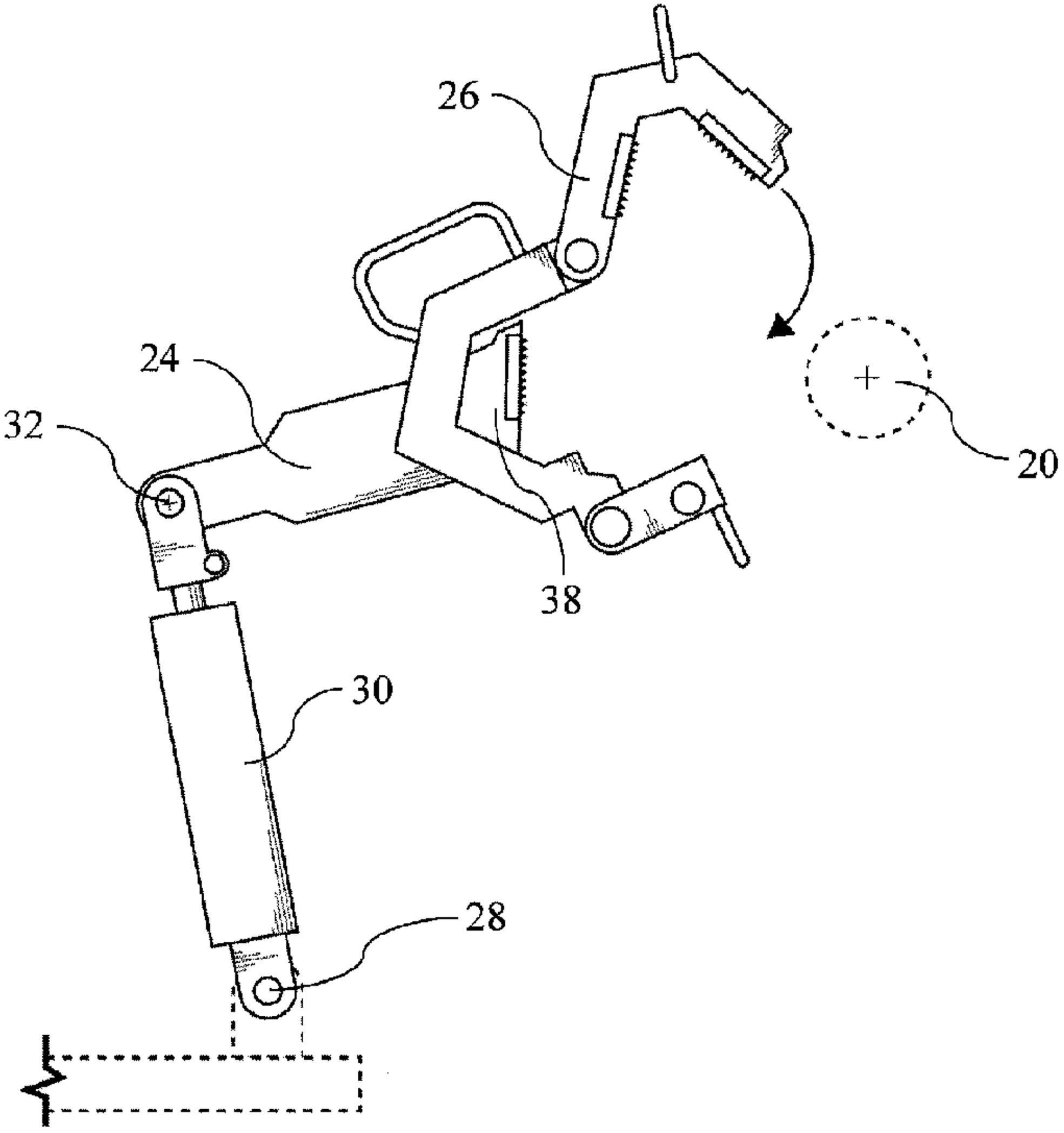


FIG. 10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