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(54) Dampening system for tool handles

(57) A tool 10 having a frame 16, 24, a drive system 18 connected to the frame, handles 22 movably connected to the frame, and a vibration dampening system connected between the frame and the handles. The improvement comprises the dampening system comprising at least one load transmission element 80 connected to a first one of the handles 22 and a first block 82 of resilient material located between the load transmission element 80 and a portion 24 of of the frame 16.

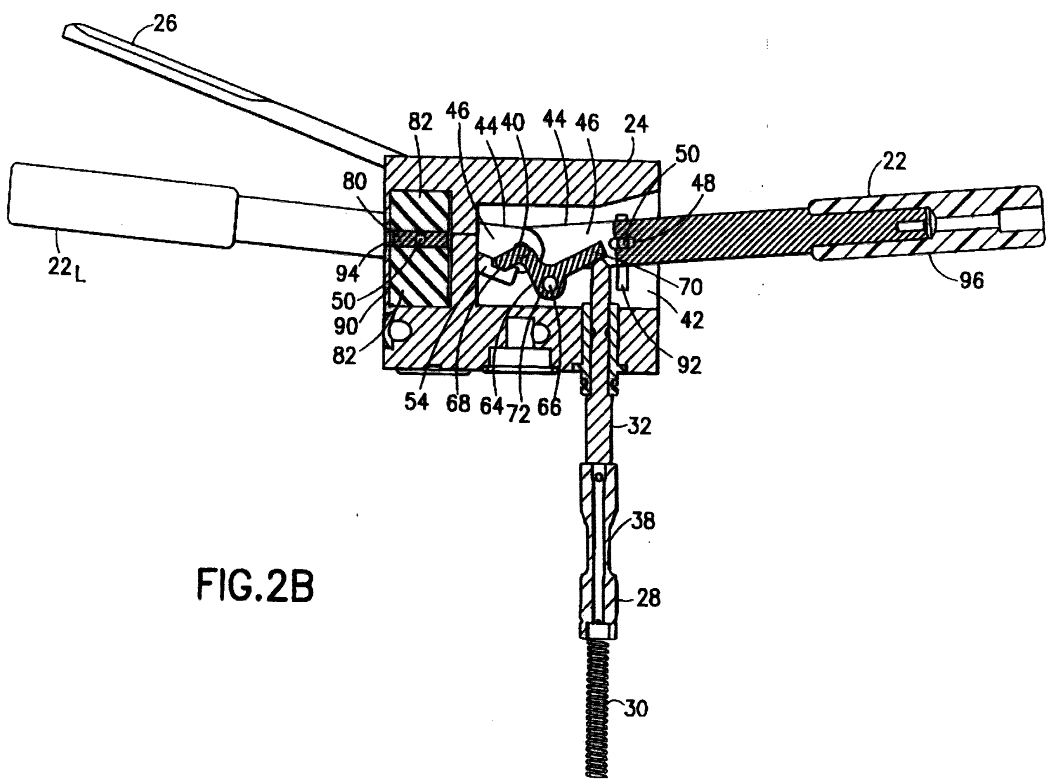

FIG.2B

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to power tools and, more particularly, to a handle vibration dampening system.

[0002] The Racine division of FCI USA, Inc. manufactures and sells hydraulically operated tools including railroad ballast tampers or tie tampers and hydraulic breakers. U.S. Patent 5,749,421 discloses different types of handles for a power tool including a pair of pivotal handles biased by springs and a one piece plastic member forming two handles. Handle vibration from using a conventional hydraulic tie tamper, concrete breaker, or spike driver tools, caused by a hydraulically driven oscillating member, creates excessive stresses in the hands and arms of the operator. Vibration can be felt while pushing the tool down and pulling the tool up. Most conventional designs use springs to absorb the vibration. It is desired to provide a vibration dampening system which reduces stresses on a user's hands and arms while pushing the tool down and pulling the tool up.

SUMMARY OF THE INVENTION

[0003] In accordance with one embodiment of the present invention, a tool is provided having a frame, a drive system connected to the frame, handles movably connected to the frame, and a vibration dampening system connected between the frame and the handles. The improvement comprises the dampening system comprising at least one load transmission element connected to a first one of the handles and a first resilient block of material located between the load transmission element and a portion of the frame.

[0004] In accordance with another embodiment of the present invention, a tool is provided having a frame, a drive system connected to the frame, handles movably connected to the frame, and a vibration dampening system connected between the frame and the handles. The improvement comprises the dampening system comprising at least one first load transmission element having a first pin extending through a first slot in a first one of the handles and through a first passage in the frame. The pin is movable along lengths of the first slot and first passage as the handle moves relative to the frame.

[0005] In accordance with another embodiment of the present invention, a tool is provided having a frame, a drive system connected to the frame, handles movably connected to the frame, and a vibration dampening system connected between the frame and the handles. The improvement comprises the dampening system comprising a first load transmission element movably connected to a first one of the handles. The load transmission element is located in a chamber of the frame. Two blocks of resilient material are located on opposite sides of the load transmission element between the load transmission element and the frame. The blocks are resiliently deformed as the load transmission element moves in the chamber due to movement of the first handle relative to the frame.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The foregoing aspects and other features of the present invention are explained in the following description, taken in connection with the accompanying drawings, wherein:

Fig. 1 is an elevational view of a power tool incorporating features of the present invention;
Fig. 2A is a top plan view of the handle section of the tool shown in Fig. 1;
Fig. 2B is a cross-sectional view of the handle section shown in Fig. 2A taken along line 2B-2B with the handles located at a home or rest position;
Fig. 2C is a cross-sectional view of the handle section shown in Fig. 2A taken along line 2C-2C;
Fig. 3 is a cross-sectional view as in Fig. 2B with the handles located at a down position; and
Fig. 4 is a cross-sectional view as in Fig. 2B with the handles located at an up position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0007] Referring to Fig. 1, there is shown an elevational view of a tool 10 incorporating features of the present invention. Although the present invention will be described with reference to the single embodiment shown in the drawings, it should be understood that the present invention can be embodied in many alternate forms of embodiments. In addition, any suitable size, shape or type of elements or materials could be used.

[0008] The tool 10 in this embodiment is a hydraulic tie tamper also known as a railroad ballast tamper. In an alternate embodiment the tool could be a breaker or any other suitable type of tool including a pneumatically operated tool. The tool 10 generally comprises a frame 16, a drive section 18 located inside the frame, and a tool bit 20. The drive section 18 is connected to a hydraulic pump 12 by hoses 14. The tool 10 includes two handles 22. The handles 22 are pivotally connected to a top section 24 of the frame 16. The tool 10 also includes a user actuatable trigger or lever 26.

[0009] Referring also to Figs. 2A and 2B, the drive section 18 shown in Fig. 1 includes a trigger spool 28, which is biased by a spring 30 in an upward direction, and a trigger push rod 32. The spool 28 is longitudinally movably located in a manifold 34 (see Fig. 1) of the frame 16 having the hose couplings 36. The spool 28 is longitudinally movable by moving the rod 32 or by biasing of the spring 30 between up and down positions. The spool 28 has a channel 38 which, depending on whether the spool 28 is in its up or down position will either cause the drive section 18 to move the tool bit 20 (ON position) or allow the tool bit to remain stationary (OFF position). In the ON position the channel 38 directs the hydraulic fluid from the pump 12 to the rest of the drive system. In the OFF position the channel 38 merely directs the hydraulic fluid back to the pump 12 without going through the rest of the drive system. In alternate embodiments any suitable type or configuration of drive system or actuator could be used. In this embodiment the actuator rod 32 is located off-center relative to a pivotable connection of the handles 22 to the top section 24.

[0010] The two handles 22 are movably mounted to the top section 24 between an up position (Fig. 4) and a down position (Fig. 3). In this embodiment the handles 22 are pivotably attached to the top section 24 by two pivot pins 40 (only one of which is shown). The pins 40 extend inward into the center channel 42 from opposite sides of the channel 42. The handles 22 have inward ends 44 with center open spaces 46. The inward ends 44 have general fork shapes with two arms on opposite sides of their respective spaces 46; each arm of each handle being pivotably mounted to one of the pins 40. The handles 22 also each comprise a groove 48. Pins 50 from a spring damper system located in the top section 24 extends into the grooves 48.

[0011] The trigger 26 is pivotably connected to the left handle or trigger handle 22L as disclosed in U.S. Patent Application No.09/604.133 filed on the same date as the present application, which is hereby incorporated by reference in its entirety. A link 64 is pivotably connected to the top section 24 by a pivot pin 66. The link 64 includes a first end 68, an opposite second end 70, and a middle section 72. The middle section 72 is pivotably attached to the top section 24 by the pivot pin 66. The first end 68 contacts the end 54 of the trigger 26. The second end 70 contacts the top end of the actuator rod 32. Portions of the link 64 extends into the spaces 46 at the inward ends 44 of the handles 22. The spring 30 biases the spool 28 and the actuator rod 32 in an upward direction such that the rod 32 is biased against the second end 70 of the link 64 to bias the first end 68 of the link against the end 54 of the trigger 26. This biases the trigger 26 in an unactuated position relative to the left handle 22L as shown in Fig. 2B. In alternate embodiments any suitable trigger mechanism or trigger linkage could be provided.

[0012] Referring also to Fig. 2C the spring damper system or handle vibration dampening system for each handle generally comprises a load transmission element 80 and blocks 82 of resilient material. The top section 24, in the embodiment shown, comprises two frame members 84, 86 which are connected to each other by fasteners 88 (see Fig. 2A). In addition to the center channel 42, the frame members 84, 86 form four chambers 90; two chambers on opposite sides of each handle 22 (see Figs 2A and 2C). Elongate passages or slots 92 extend between the center channel 42 and the chambers 90. The load transfer elements 80 each generally comprise one of the pins 50 and two pads or plates 94. The plates 94 are connected to opposite ends of the pins 50. In a preferred embodiment the plates 94 are free floating on the pins 50. The pins 50 extend through holes in the plates. The plates 94 can move vertically up and down with the pins, but can rotate relative to the pins. Each pin 50 extends through a slot 48 of one of the handles 22, through an associated pair of the slots 92, and into an associated pair of the chambers 90. Each plate 94 is located in one of the chambers 90. In this embodiment each chamber 90 has two of the blocks 82 located therein; one block 82U on the top side of the respective plate 94 and one block 82L on the bottom side of the respective plate. In this embodiment the bottom side blocks are larger than the top side blocks. However, in alternate embodiments any suitable size of blocks could be provided, and more or less than two blocks could be provided in each chamber 90. In addition, the chambers 90 could be located above and/or below the center channel 42, and/or more or less than two chambers could be provided for each handle.

[0013] The blocks 82 are preferably comprised of microcellular polyurethane. However, in alternate embodiments, any suitable type of resiliently deformable polymer material could be used. Fig. 2B shows the handles 22 at a home or rest position. The plates 94 are each sandwiched between two of the blocks 82 which are sandwiched between the frame members 84, 86. Thus, the load transmission elements 80 are normally held by the blocks at the position shown in Figs. 2B and 2C. Because the pins 50 extend through the slots 48 in the handles 22, the system is able to position and maintain the handles at their home positions shown until forces applied between the handles and the frame causes the handles to move relative to the frame; with one or more of the blocks 82 resiliently deforming. The blocks 82 can absorb high amplitude vibrations between the frame and the handles as the tool bit 20 reciprocally moves. Thus, stress to the user's hands and arms can be reduced.

[0014] As shown in Fig. 3, when the operator pushes down on both handles, the free floating pads 94 compress the lower blocks 82L of microcellular polyurethane. As the microcellular polyurethane compresses, it stores the energy imposed by the operator. Also as the microcellular polyurethane compresses, it's cross-sectional area normal to the compressive force expands engaging the previously spaced vertical walls inside the chambers 90. The contact between the microcellular polyurethane and the walls create friction which creates heat and, thus, removes energy from the microcellular polyurethane. This energy loss is the dampening of the downward force. The larger the compressive force, the greater the dampening. Once the force is removed from the handles, the microcellular polyurethane releases it's partially depleted energy returning the handles to the rest position.

[0015] The microcellular polyurethane also has one other benefit: the spring properties of the material are nonlinear. This property can be important especially if the operator imposes a large downward force on the tool. In normal operation of this design, the microcellular polyurethane acts as a linear coiled compression spring. If the operator, or the kickback of the tool, imposes a large force on the handles, the movement of the handles causes the microcellular polyurethane to compress past the linear mark and the reaction force curve, created by the spring, becomes exponential. The result of this nonlinearity is that the operator will never feel metal-to-metal contact with the housing; the handles will always absorb the vibration.

[0016] The handles can play an important rule in this design. Both handles are connected to the housing by rotating joints. The two handles are completely independent of each other. The design will work even if the handles are connected off-center relative to each other. They simply need to be able to rotate with respect to the housing. A vibration absorption material 96 is placed over the outside of the handles to absorb the low amplitude, high frequency vibrations.

[0017] When the handles 22 move from their rest position shown in Fig. 2B to their down position shown in Fig. 3, the pins 50 are able to vertically slide in the slots 92 and also horizontally move relative with the slots 48. Referring also to Fig. 4, the handles 22 are shown in their up position. This occurs such as when the user is pulling the tool upward and the tool bit 20 is stuck. The plates 94 compress the upper blocks 82U of microcellular polyurethane. Similar to compression of the lower blocks, as the upper blocks are compressed, they store energy. As the microcellular polyurethane compresses, it's cross-sectional area normal to the compressive force expands engaging the housing wall. The contact between the microcellular polyurethane and the wall creates friction, which creates heat and, thus, removes energy from the Urethane. This energy loss is the dampening of the upward force. The larger the compressive force, the greater the dampening. Once the force is removed from the handles, the microcellular polyurethane releases it's partially depleted energy returning the handles to the rest position.

[0018] In a preferred embodiment the tool 10 comprises a tamper bit vibration system as described in U.S. patent application No. 09/290,024 filed April 9, 1999 which is hereby incorporated by reference in its entirety. The upper blocks 82 are provided to dampen forces to the user's hands and arms that might occur when using the tamper bit vibration system and pulling up on the handles. However, in an alternate embodiment, the upper blocks 82U or the lower blocks 82L could alternatively be replaced by conventional coil springs. In an alternate embodiment, features of the present invention could merely be used on a single handle, such as a "D" or "U" shaped handle pivotably connected to the frame.

[0019] It should be understood that the foregoing description is only illustrative of the invention. Various alternatives and modifications can be devised by those skilled in the art without departing from the invention. Accordingly, the present invention is intended to embrace all such alternatives, modifications and variances which fall within the scope of the appended claims.

Claims

1. A tool (10) having a frame (16, 24), a drive system (18) connected to the frame, handles (22) movably connected to the frame, and a vibration dampening system connected between the frame and the handles, **characterized in that**

   the dampening system comprises at least one load transmission element (80) connected to a first one (22) of the handles and a first block (82) of resilient material located between the load transmission element (80) and a portion (24) of the frame (16).

2. A tool as in Claim 1 wherein the load transmission element (80) comprises a connecting pin (50) which extends through an elongated slot (92) in the first handle (22).

3. A tool as in Claim 2 wherein the elongated slot (92) extends along a longitudinal axis of the first handle (22).

4. A tool as in Claim 2 wherein the frame comprises two chambers (90) on opposite sides of the first handle (22) and two elongate passages (92) into the chambers (90), and wherein the connecting pin (50) extends through the two passages (92).

5. A tool as in Claim 1 wherein the dampening system further comprises a second block (82) of resilient material on an opposite side of the load transmission element (80) from the first block (82).

6. A tool as in Claim 1 wherein a second one of the load transmission elements (80) is connected to a second one of the handles (22) and a second block (82) of resilient material is located between the second load transmission element (80) and a portion of the frame (16).

7. A tool as in Claim 1 wherein the first handle (22) is pivotably connected to the frame (16), wherein the load transmission element (80) is vertically movable with the first handle relative to the frame, and wherein the load transmission element is horizontally movable relative to the first handle.

8. A tool (10) having a frame (16, 24), a drive system (18) connected to the frame, handles (22) movably connected to the frame, and a vibration dampening system connected between the frame and the han-

dles, **characterized in that** :

the dampening system comprises at least one first load transmission element (80) having a first pin (50) extending through a first slot (48) in a first one of the handles and through a first passage (92) in the frame, the pin (50) being movable along lengths of the first slot (48) and first passage (92) as the handle (22) moves relative to the frame (16).

9. A tool as in Claim 8 wherein the pin (50) extends through a second passage (92) in the frame on an opposite side of the first handle (22) from the first passage (92).

10. A tool as in Claim 8 wherein the first slot (48) has a general elongated shape generally along a longitudinal axis of the first handle (22).

11. A tool as in Claim 8 wherein the first passage (92) has a general elongated shape and extends generally vertically along a portion (24) of the frame (16).

12. A tool as in Claim 8 wherein the dampening system further comprises a second load transmission element (80) having a second pin (50) movably extending through a second slot (48) in a second one of the handles (22) and movably through a third passage (92) in the frame adjacent the second handle (22).

13. A tool (10) having a frame (16, 24), a drive system (18) connected to the frame, handles (22) movably connected to the frame, and a vibration dampening system connected between the frame and the handles, **characterized in that** :

the dampening system comprises a first load transmission element (80) movably connected to a first one of the handles, the load transmission element being located in a chamber (90) of the frame, and two blocks (82) of resilient material located on opposite sides of the load transmission element (80) between the load transmission element and the frame, wherein the blocks are resiliently deformed as the load transmission element (80) moves in the chamber (90) due to movement of the first handle (22) relative to the frame (16, 24).

14. A tool as in Claim 13 wherein the connecting pin (50) extends through an elongated slot (48) in the first handle (22).

15. A tool as in Claim 14 wherein the elongated slot (48) extends along a longitudinal axis of the first handle (22).

16. A tool as in Claim 13 wherein the blocks (82) **characterized in that** comprise microcellular polyurethane material.

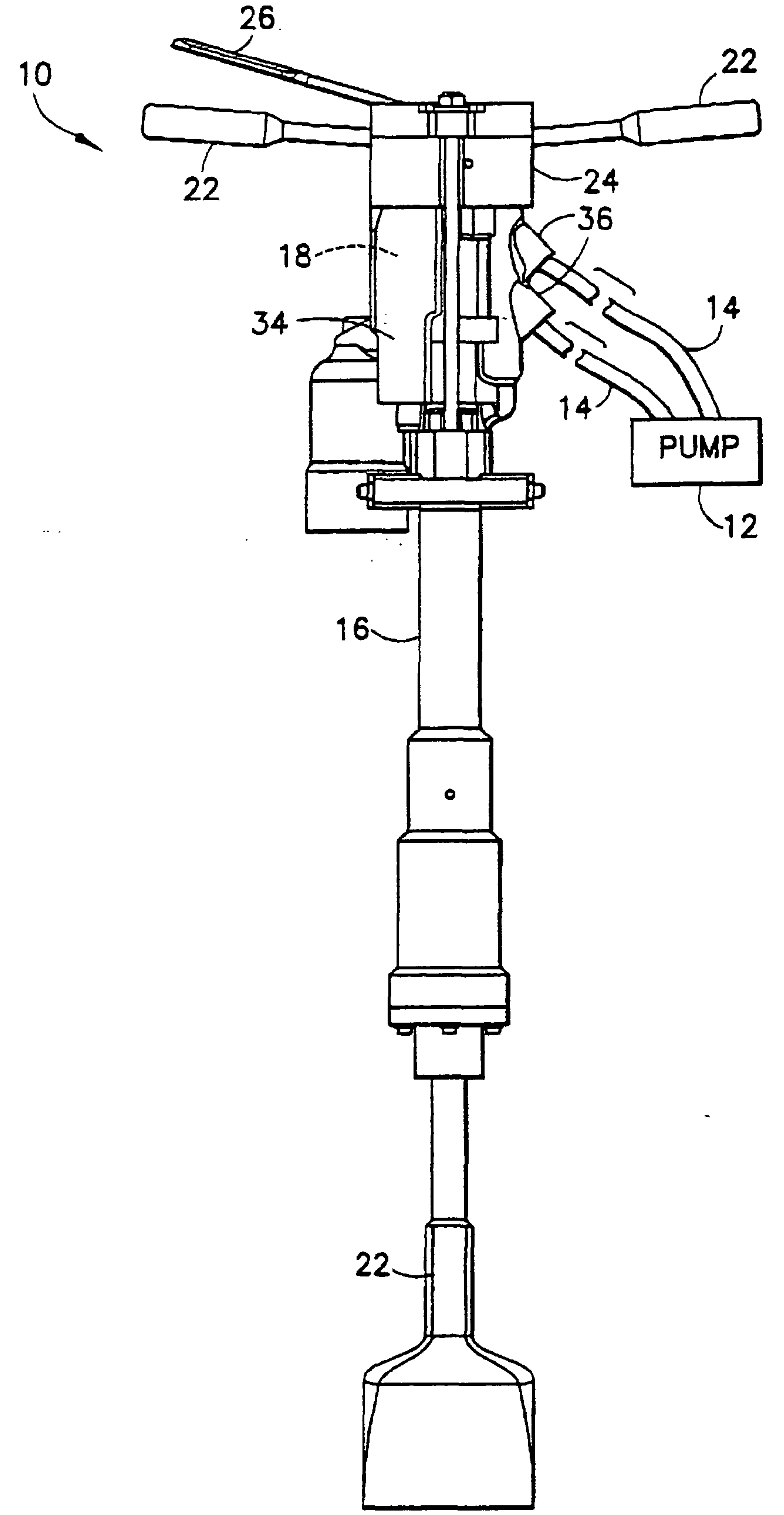

FIG.1

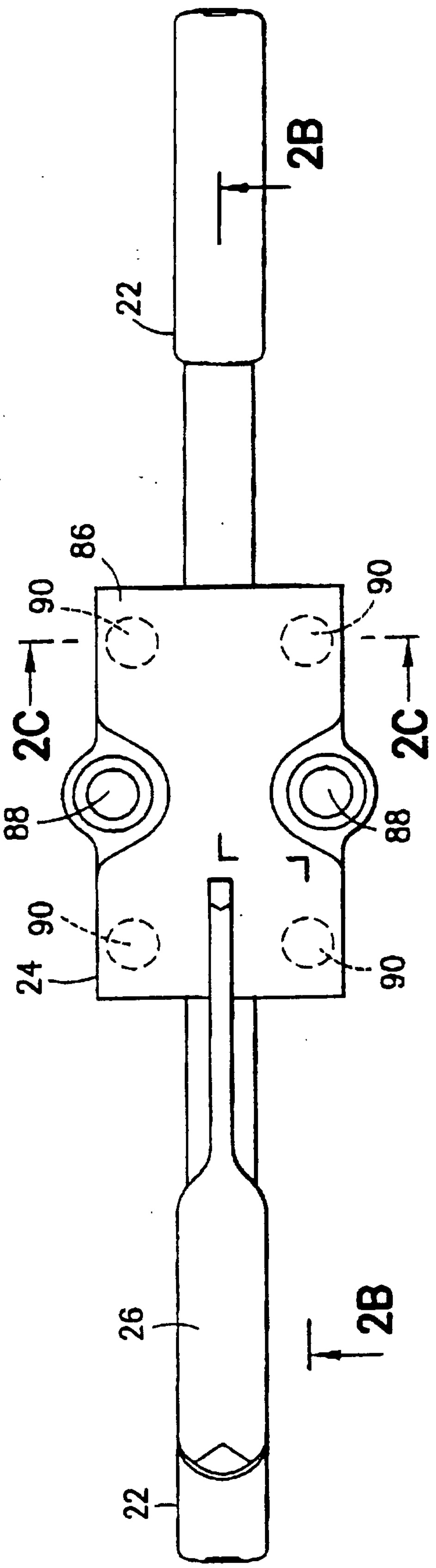

FIG.2A

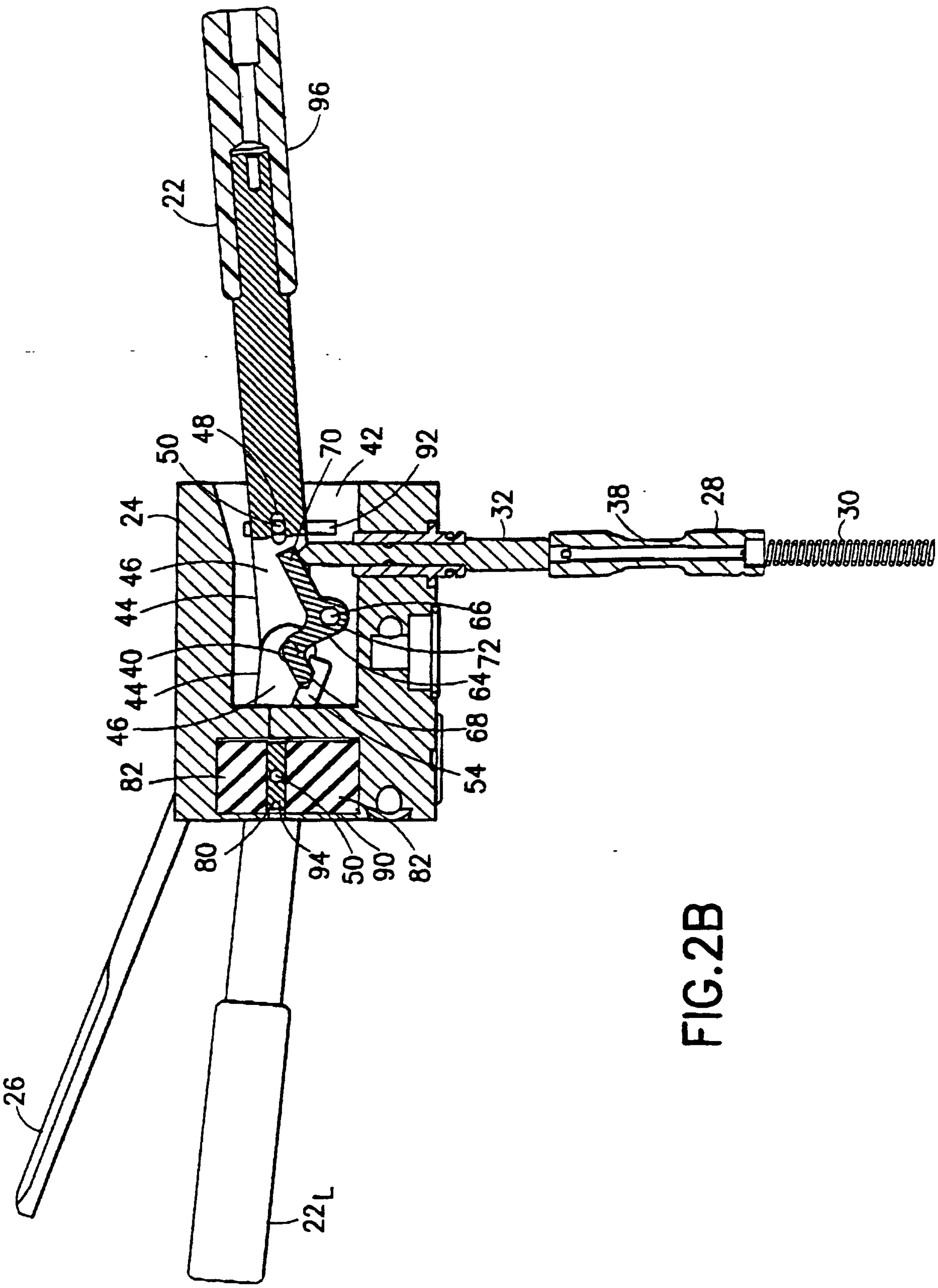
96
22
50
48
70
42
92
24
32
38
28
30
46
44
66
72
40
64
68
54
82
80
94
90
26
22L

FIG.2B

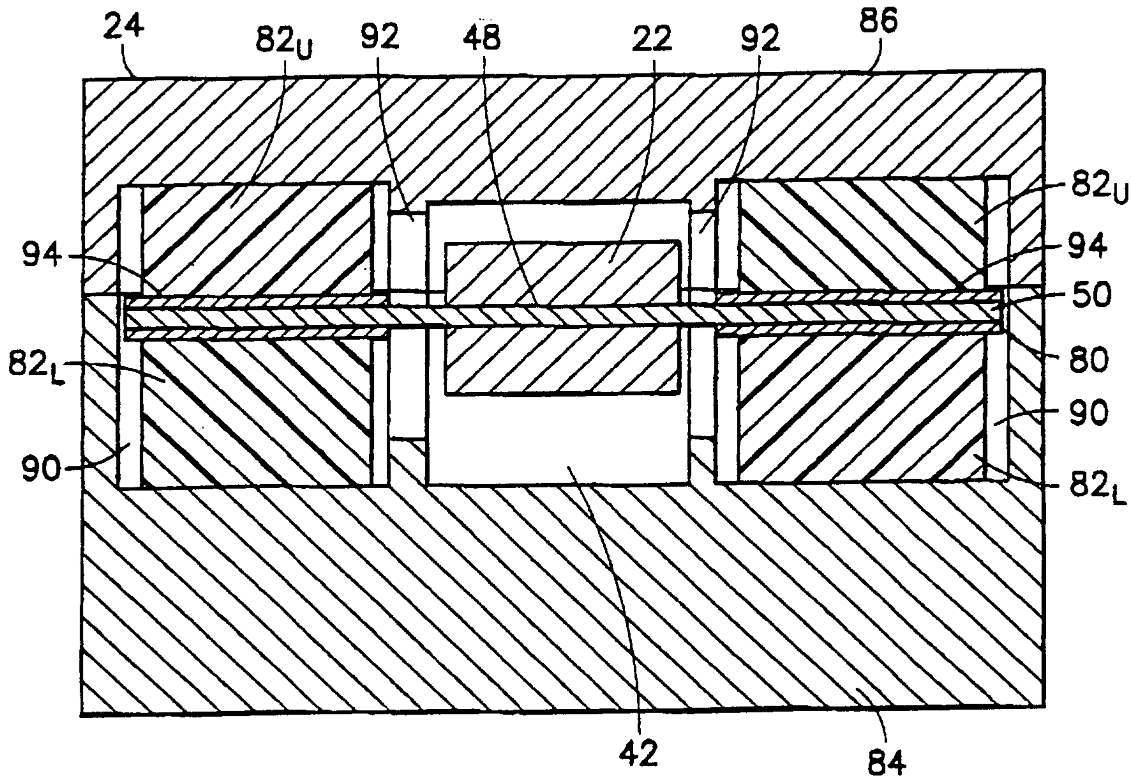

FIG.2C

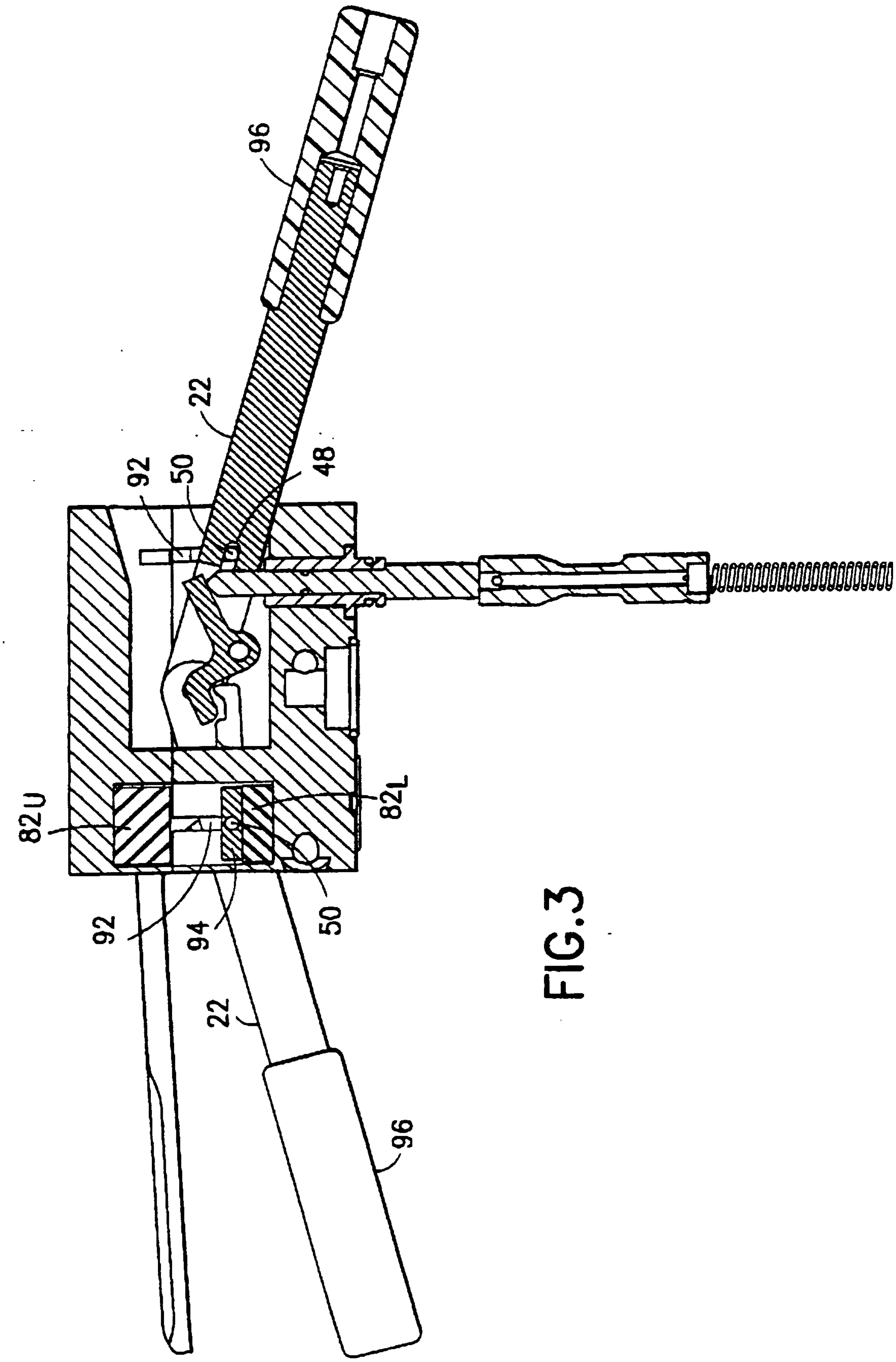

FIG.3

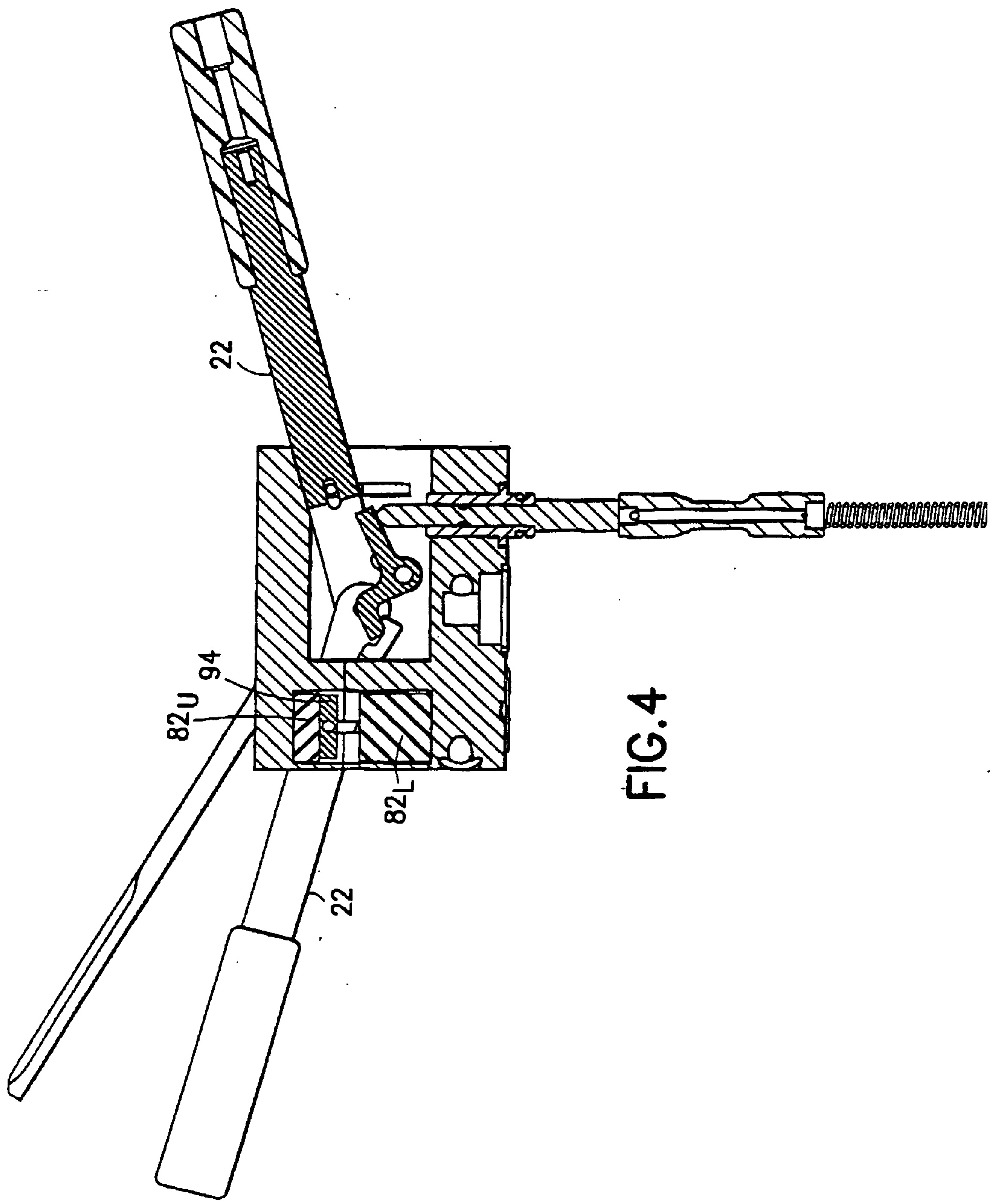

FIG.4