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(54) **A method for damping oscillations and a crane provided with an oscillation damper**

Ein Verfahren zur Dämpfung von Schwingungen und ein Kran versehen mit einem Oszillationsdämpfer

Une méthode d'amortissement des oscillations et une grue munie d'un amortisseur d'oscillations

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EP 2 455 321 B1

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Description

[0001] The present invention relates to a method and a device for providing oscillation damping in a hydraulically operated crane. In particular, the invention relates to a crane having a loading tool attached to a slewable boom.

[0002] Such cranes are generally occurring, for example, in the forestry business for the loading of timber. It is in that connection, a generally familiar fact that it is difficult for the operator to bring the loading tool quickly and securely into an exact position for engagement with the cargo to be lifted.

[0003] DE 42 16 241 A1 discloses a damping device for damping pendling movements of a hydraulic crane. It includes a double acting hydraulic setting device connected to a hydraulic circuit for slewing the crane. There is a damping device arranged in a by-pass conduit which has a throttling portion in series with a hydraulic piston-cylinder arrangement movable between two end positions. The disclosed device however does not solve the above mentioned problem.

[0004] This problem is obviated or at least brought down to a minimum by means of the present invention, as defined in method claim 1 and in apparatus claim 4.

[0005] In the method according to the invention, the hydraulic regulation of the boom embraces an operator-independent pressure detection provided for a rotator link belonging to the working tool and intended for the counteraction of undesired oscillations of the loading tool.

[0006] The pressure detection is advantageously effected on a hydraulic slew device arranged for the slewable boom and produces pressure information that is fed into a break means that, in the rotator link between the loading tool and the outer end of the boom, damps the oscillatory motion of the loading tool.

[0007] Preferably, the oscillation damping is effected by the break means acting against at least one joint of the rotator link.

[0008] By a device according to the invention, a rotator link belonging to the loading tool has a hydraulically actuated brake mechanism, the regulation of which is operator-independently pressure sensed for the counteraction of undesired oscillations of the loading tool.

[0009] Preferably, the brake mechanism is formed with a hydraulically actuated brake, which, via a line, is coupled to a hydraulic slew device arranged for the slewable boom for the receipt of pressure information.

[0010] The rotator link is preferably double jointed and at least one of the joints thereof is formed with the hydraulically actuated brake mechanism.

[0011] The brake mechanism advantageously embraces a piston/cylinder device where the cylinder is coupled to one joint of the rotator link, the one joined to the loading tool. The piston rod projecting into the cylinder is coupled to the other joint of the rotator link, the one joined to the boom of the crane.

[0012] The pressure detection is preferably effected

on a hydraulic slew device - arranged for the turning of the slewable boom - for the receipt of pressure information from the same.

[0013] This pressure information from the hydraulic slew device arranged for the slewing of the boom is conveyed to the chamber in the cylinder of the break means via an axially extending channel in the piston rod projecting into the cylinder.

[0014] The pressure information is extracted from the hydraulic slew device, drive motor, of the boom in the hydraulic chamber of which pressure variations are produced upon the slewing of the boom. A pressure detecting system is coupled to the hydraulic chamber of the drive motor for the transfer of the pressure information to the piston/cylinder device of the break means in the rotator link of the loading tool.

[0015] Advantageously, the pressure-sensing system embraces a shuttle valve connected to the hydraulic chamber of the drive motor in order to, via a pressure-indicating line, forward the occurring pressure present during the slewing of the boom to the cylinder in the break means of the loading tool. The shuttle valve allows braking upon both acceleration and retardation of the slew motion of the boom.

[0016] The invention furthermore relates to a crane that comprises a device for damping oscillations in accordance with what has been mentioned above.

[0017] The invention will be explained more in detail below in connection with an embodiment that shown in the appended drawings and depicted in connection with a known crane for forestry use, wherein

Fig. 1 shows a view from the side of the crane and Fig. 2 shows the principle for the oscillation damping according to the invention.

[0018] The oscillation damping according to the present invention, which is operator-independent, automatic and self-locking, will be exemplified in an application of a crane 1 known *per se*, as shown in Fig. 1. This crane 1 has a boom 2 that comprises different, hydraulically driven regulating parts irrelevant to the present invention. The boom 2 is fixedly anchored on a support, for example on a lorry/truck chassis (not shown), by means of a hydraulically driven slew device 6. At the free end 5 of the boom 2, there is suspended a loading tool in the form of a grip 3. The boom 2 is slewable in the horizontal plane around the vertical axis 7 of the slew device 6. This slewing is operated by means of the hydraulically driven slew device 6.

[0019] In the operation of the boom 2, the slew device 6 is thus brought to slew the same for adjustment into a position where the cargo to be lifted is placed. A certain technique is required of the operator conducting the crane in order to get the grip 3 into the correct position. Even if it is known to form the rotator 4 with a brake mechanism having oscillation dampers, the grip 3 will still obtain an undesired oscillation.

[0020] In order to obviate or at least quickly bring down this undesired oscillation to a minimum, the present invention embraces an operator-independent pressure detection in the hydraulically driven slew device 6. In that connection, a pressure indication or pressure information is obtained that is fed to an oscillation damping rotator link 14 belonging to the rotator 4.

[0021] The principle for the invention will be described in more detail in the following, reference being made to Fig. 2. This figure illustrates the invention in connection with a slew device 6 known *per se* and a rotator link 14 known *per se*. Therefore, it should be entirely clear to the reader that the invention is applicable also in other embodiments of slew devices and oscillation dampers for cranes.

[0022] Thus, the crane is equipped with a hydraulic slew device 6 that can slew the crane boom both clockwise and counter clockwise. The hydraulics of the slew device 6 may be made as any hydraulic drive motor having hydraulic pressure chambers, but in the embodiment described herein, it embraces four actuator cylinders 11A, 11B, 12A, 12B, the pistons of which drive a gear-wheel D for the slewing of the boom to the right or the left depending on the position of an operator-actuated actuator valve V. The actuator valve V has three positions: L, 0 and R for the connection of the slew device 6 to a hydraulic source S. In the intermediate position 0, the slew device 6 is locked while the positions L and R feed the cylinders 11A, 11B, 12A, 12B of the slew device 6 from the hydraulic source S for the slewing of the boom to the left and to the right, respectively.

[0023] The rotator link 14 known *per se* embraces a brake mechanism 16, 18. Furthermore, in this embodiment, the rotator link 14 is double jointed 5, 19, where at least one of the joints is actuable by a brake function. In the embodiment shown here, the brake mechanism 16, 18 of the rotator link 14 embraces a piston/cylinder device interconnected between the two joints 5, 19. The piston rod 16 is then joined to the joint 5 directed perpendicular to the plane of the drawing while the cylinder 18 is coupled to the joint 19 extending in the plane of the drawing.

[0024] For the provision of the operator-independent function counteracting undesired oscillations, the piston rod 16 according to the invention is provided with a channel 17, which mouths in a chamber 20 formed by the cylinder 18. The channel 17 is connected to a shuttle valve 10 via the line 9. By the two entrances thereof, the shuttle valve 10 is joined to the slew device 6 for the output of the pressure that prevails in the hydraulics thereof in the slewing of the boom of the crane. The shuttle valve 10 supplies said hydraulic pressure to the rotator link 14 and the piston/cylinder device 16, 18 arranged therein. The shuttle valve 10 allows braking upon both acceleration and retardation of the slew motion of the boom.

[0025] When slewing of the boom of the crane is desired, the actuator valve V, which is spring-loaded so as

to normally assume the middle position 0, is brought into one of the outer positions, for example into L, for the slewing of the boom to the left. In that connection, the cylinder 11 B is pressurized from the hydraulic source S, while the cylinder 12B is pressure-relieved. On the cylinder 11 B as well as on the cylinder 12A, a pressure is then obtained (a pressure change, pressure increase, pressure pulse) that, via the shuttle valve 10 and the line 9, is supplied to the piston/cylinder device 16, 18 of the rotator link 14. By the pressure change arisen thereby in the chamber 20 of the cylinder 18, in the embodiment shown herein, the piston/cylinder device 16, 18 is pressed apart against the respective joint 5 and 19, so that brake action is provided on these joints and thereby the desired oscillation damping. The same conditions occur when operating the slew device 6 in the right direction.

[0026] By the fact that the pressure detection is carried out automatically in the slew device 6 and is forwarded to the rotator link 14 via the shuttle valve 10, there is obtained an operator-independent damping oscillation function for the boom of the crane and the working tools thereof.

[0027] Even if the invention and the function thereof here has been exemplified in connection with a known embodiment of the slew device 6 and a known embodiment of the rotator link 14, a person skilled in the art appreciates that the invention also is applicable in other embodiments. Accordingly, the slew device may equally well be hydraulic components of another embodiment where pressure detection may take place, and the rotator link may be designed differently with pressure action by, for example, drum brakes or disc brakes.

[0028] Therefore, the present invention must not be considered limited to the above-mentioned designs, but its principle, as defined in the subsequent claims, is applicable in different embodiments.

Claims

1. Method for damping oscillations in a hydraulically operated crane (1) having a loading tool (3) attached to a slewable boom (2), where the boom (2), by means of hydraulic regulation and a hydraulic motor, is swung into different working positions, and where the loading tool (3) is fastened to a rotator link (14) attached to the outer end of the boom (2), which rotator link (14) is provided with a brake mechanism (16, 18), **characterized in that** the hydraulic regulation is performed by operator-independently detecting the pressure upon the slewing of the boom (2) for the counteraction of undesired oscillations of the loading tool (3), by and hydraulically coupling the hydraulic motor to the brake mechanism (16, 18) via a shuttle valve (10).

2. Method according to claim 1, **characterized in that**

the pressure detection is effected on a hydraulic slew device (6) arranged for the slewable boom (2) and produces pressure information that is fed to a brake mechanism (16, 18) that, in the rotator link (14) between the loading tool (3) and the outer end (5) of the boom (2), damps the oscillatory motion of the loading tool (3).

3. Method according to claim 2, **characterized in that** the oscillation damping is effected by the brake mechanism (16, 18) acting against at least one joint (5, 19) of the rotator link (14).

4. Device for damping oscillations in a hydraulically operated crane (1) embracing a rotator link (14) attached to a slewable boom (2) and arranged for attaching a loading tool (3), which rotator link (14) is provided with a brake mechanism (16, 18), and where the slewing of the boom (2) is driven by means of a hydraulic slew device (6) comprising a hydraulic motor for the adjustment thereof into different working positions, **characterized in that** the brake mechanism is hydraulically actuated (16, 18), and has regulation means including operator-independently pressure sensing means for the counteraction of undesired oscillations of the loading tool (3), and the hydraulic motor being hydraulically coupled to the brake mechanism (16, 18) via a shuttle valve (10).

5. Device according to claim 4, **characterized in that** the rotator link (14) is double jointed, where at least one of the joints (5, 19) is equipped with the hydraulically actuated brake mechanism (16, 18).

6. Device according to any one of claims 4-5, **characterized in that** the brake mechanism (16, 18) embraces a piston/cylinder device where the cylinder (18) is coupled to one joint (19) of the rotator link (14), the one joined to the loading tool (3), and the piston rod (16) projecting into the cylinder (18) is coupled to the other joint (5) of the rotator link (14), the one joined to the boom (2) of the crane.

7. Device according to claim 6, **characterized in that** the chamber (20) of the cylinder (18) is in hydraulic pressure communication with the hydraulic slew device (6) arranged for the slewing of the slewable boom (2) for the receipt of pressure information from the same.

8. Device according to claim 6, **characterized in that** the piston rod (16) projecting into the cylinder (18) has an axially extending channel (17), which mouths in the chamber (20) of the cylinder (18) and the free end of which is coupled to the hydraulic slew device (6) of the slewable boom (2) for the receipt of pressure information from the same.

9. Device according to any one of claims 4-8, **characterized in that** the hydraulic slew device (6) for the slewable boom (2) is a hydraulic drive motor, from the chambers (11A, 11B, 12A, 12B) of which a pressure-sensing system (9, 10) is arranged to feed the pressure information to the piston/cylinder device of the brake mechanism (16, 18).

10. Device according to claim 9, **characterized in that** the pressure-sensing system (9, 10) embraces a shuttle valve (10) arranged to connect the side of the chambers (11A, 11B, 12A, 12B) of the drive motor that has the pressure occurring during the slewing of the boom (2) to a pressure-indicating line (9) connected to the chamber (20) of the cylinder (18) in the brake mechanism (16, 18) of the rotator link (14).

11. Crane comprising a device for damping oscillations according to any one of claims 4-10.

Patentansprüche

1. Verfahren zum Dämpfen von Oszillationen in einem hydraulisch betriebenen Kran (1), der ein Ladewerkzeug (3) aufweist, das an einem schwenkbaren Ausleger (2) angebracht ist, wobei der Ausleger (2) mittels Hydraulikregulierung und einem Hydraulikmotor in unterschiedliche Arbeitspositionen geschwenkt wird und wobei das Ladewerkzeug (3) an einem Drehgelenk (14) befestigt ist, das an dem äußeren Ende des Auslegers (2) angebracht ist, wobei das Drehgelenk (14) mit einem Bremsmechanismus (16, 18) bereitgestellt ist, **dadurch gekennzeichnet, dass** die Hydraulikregulierung durch anwenderunabhängiges Erkennen des Drucks beim Schwenken des Auslegers (2) zum Entgegenwirken von unerwünschten Oszillationen des Ladewerkzeugs (3) durchgeführt wird, und durch hydraulisches Koppeln des Hydraulikmotors mit dem Bremsmechanismus (16, 18) über ein Wechselventil (10).

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die Druckerennung an einer hydraulischen Schwenkvorrichtung (6) ausgeführt wird, die für den schwenkbaren Ausleger (2) angebracht ist und Druckinformationen erzeugt, die an einen Bremsmechanismus (16, 18) geleitet werden, der in dem Drehgelenk (14) zwischen dem Ladewerkzeug (3) und dem äußeren Ende (5) des Auslegers (2) die Oszillationsbewegung des Ladewerkzeugs (3) dämpft.

3. Verfahren nach Anspruch 2, **dadurch gekennzeichnet, dass** die Oszillationsdämpfung von dem Bremsmechanismus (16, 18) ausgeführt wird, der mindestens einer Verbindung (5, 19) des Drehge-

lenks (14) entgegenwirkt.

4. Vorrichtung zum Dämpfen von Oszillationen in einem hydraulisch betriebenen Kran (1), umfassend ein Drehgelenk (14), das an einem schwenkbaren Ausleger (2) angebracht ist und zum Anbringen eines Ladewerkzeugs (3) ausgelegt ist, wobei das Drehgelenk (14) mit einem Bremsmechanismus (16, 18) bereitgestellt ist und wobei das Schwenken des Auslegers (2) mittels einer hydraulischen Schwenkvorrichtung (6) angetrieben wird, die einen Hydraulikmotor für die Einstellung davon in unterschiedliche Arbeitspositionen umfasst, **dadurch gekennzeichnet, dass** der Bremsmechanismus (16, 18) hydraulisch betätigt wird und Regulierungsmittel, einschließlich anwenderunabhängiger Druckmessmittel, für das Entgegenwirken von unerwünschten Oszillationen des Ladewerkzeugs (3) aufweist, und der Hydraulikmotor mit dem Bremsmechanismus (16, 18) über ein Wechselventil (10) hydraulisch gekoppelt ist.
5. Vorrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** das Drehgelenk (14) ein Doppelgelenk ist, wobei mindestens eines der Gelenke (5, 19) mit dem hydraulisch betätigten Bremsmechanismus (16, 18) ausgestattet ist.
6. Vorrichtung nach einem der Ansprüche 4 bis 5, **dadurch gekennzeichnet, dass** der Bremsmechanismus (16, 18) eine Kolben-/Zylindervorrichtung umfasst, wobei der Zylinder (18) mit einem Gelenk (19) des Drehgelenks (14) gekoppelt ist, das nämlich mit dem Ladewerkzeug (3) verbunden ist, und die Kolbenstange (16), die in den Zylinder (18) ragt, mit dem anderen Gelenk (5) des Drehgelenks (14) verbunden ist, das nämlich mit dem Ausleger (2) des Krans verbunden ist.
7. Vorrichtung nach Anspruch 6, **dadurch gekennzeichnet, dass** die Kammer (20) des Zylinders (18) in hydraulischer Druckverbindung mit der hydraulischen Schwenkvorrichtung (6) steht, die zum Schwenken des schwenkbaren Auslegers (2) zum Empfang von Druckinformationen daraus angeordnet ist.
8. Vorrichtung nach Anspruch 6, **dadurch gekennzeichnet, dass** die Kolbenstange (16), die in den Zylinder (18) ragt, einen sich axial erstreckenden Kanal (17) aufweist, der in der Kammer (20) des Zylinders (18) mündet, und wobei das freie Ende davon mit der hydraulischen Schwenkvorrichtung (6) des Schwenkauslegers (2) zum Empfang von Druckinformationen davon gekoppelt ist.
9. Vorrichtung nach einem der Ansprüche 4 bis 8, **dadurch gekennzeichnet, dass** die hydraulische

Schwenkvorrichtung (6) für den schwenkbaren Ausleger (2) ein hydraulischer Antriebsmotor ist, an dessen Kammern (11A, 11B, 12A, 12B) ein Druckmesssystem (9, 10) angeordnet ist, um die Druckinformationen der Kolben-/Zylindervorrichtung an den Bremsmechanismus (16, 18) zu leiten.

10. Vorrichtung nach Anspruch 9, **dadurch gekennzeichnet, dass** das Druckmesssystem (9, 10) ein Wechselventil (10) aufweist, das zum Verbinden der Seite der Kammern (11A, 11B, 12A, 12B) des Antriebsmotors, an welcher der Druck beim Schwenken des Auslegers (2) auftritt, mit einer Druckanlegeleitung (9) angeordnet ist, die mit der Kammer (20) des Zylinders (18) in dem Bremsmechanismus (16, 18) des Drehgelenks (14) verbunden ist.

11. Kran, umfassend eine Vorrichtung zum Dämpfen von Oszillationen nach einem der Ansprüche 4 bis 10.

Revendications

1. Procédé d'amortissement d'oscillations dans une grue à commande hydraulique (1) comprenant un outil de chargement (3) attaché à une flèche pivotante (2), la flèche (2), par le biais d'une régulation hydraulique et d'un moteur hydraulique, étant pivotée dans différentes positions de travail, et l'outil de chargement (3) étant fixé à une bielle de rotateur (14) attachée à l'extrémité externe de la flèche (2), laquelle bielle de rotateur (14) est pourvue d'un mécanisme de freinage (16, 18), **caractérisé en ce que** la régulation hydraulique est effectuée par une détection de la pression indépendamment de l'opérateur lors du pivotement de la flèche (2) en vue de contrer des oscillations indésirables de l'outil de chargement (3), et par l'accouplement hydraulique du moteur hydraulique au mécanisme de freinage (16, 18) par le biais d'une soupape à deux voies (10).
2. Procédé selon la revendication 1, **caractérisé en ce que** la détection de la pression est effectuée sur un dispositif de pivotement hydraulique (6) prévu pour la flèche pivotante (2) et produit des informations de pression qui sont envoyées à un mécanisme de freinage (16, 18), qui, dans la bielle de rotateur (14) entre l'outil de chargement (3) et l'extrémité externe (5) de la flèche (2), amortit le mouvement d'oscillation de l'outil de chargement (3).
3. Procédé selon la revendication 2, **caractérisé en ce que** l'amortissement des oscillations est effectué par le mécanisme de freinage (16, 18) agissant à l'encontre d'au moins une articulation (5, 19) de la bielle de rotateur (14).

4. Dispositif d'amortissement d'oscillations dans une grue à commande hydraulique (1) comprenant une bielle de rotateur (14) attachée à une flèche pivotante (2) et prévue pour la fixation d'un outil de chargement (3), laquelle bielle de rotateur (14) est pourvue d'un mécanisme de freinage (16, 18), et le pivotement de la flèche (2) étant entraîné au moyen d'un dispositif de pivotement hydraulique (6) comprenant un moteur hydraulique en vue de son ajustement dans différentes positions de travail, **caractérisé en ce que** le mécanisme de freinage (16, 18) est actionné par commande hydraulique, et présente des moyens de régulation incluant un moyen de détection de la pression indépendamment de l'opérateur pour contrer des oscillations indésirables de l'outil de chargement (3), et le moteur hydraulique étant accouplé hydrauliquement au mécanisme de freinage (16, 18) par le biais d'une soupape à deux voies (10).
5. Dispositif selon la revendication 4, **caractérisé en ce que** la bielle de rotateur (14) présente une double articulation, au moins l'une des articulations (5, 19) étant équipée du mécanisme de freinage (16, 18) à commande hydraulique.
6. Dispositif selon l'une quelconque des revendications 4 à 5, **caractérisé en ce que** le mécanisme de freinage (16, 18) comprend un dispositif de piston/cylindre, le cylindre (18) étant accouplé à une articulation (19) de la bielle de rotateur (14), celle qui est reliée à l'outil de chargement (3), et la tige de piston (16) faisant saillie à l'intérieur du cylindre (18) étant accouplée à l'autre articulation (5) de la bielle de rotateur (14), celle qui est reliée à la flèche (2) de la grue.
7. Dispositif selon la revendication 6, **caractérisé en ce que** la chambre (20) du cylindre (18) est en communication de pression hydraulique avec le dispositif de pivotement hydraulique (6) prévu pour le pivotement de la flèche pivotante (2) en vue de recevoir des informations de pression provenant de celui-ci.
8. Dispositif selon la revendication 6, **caractérisé en ce que** la tige de piston (16) faisant saillie à l'intérieur du cylindre (18) présente un canal (17) s'étendant axialement, lequel débouche dans la chambre (20) du cylindre (18) et dont l'extrémité libre est accouplée au dispositif de pivotement hydraulique (6) de la flèche pivotante (2) en vue de la réception d'informations de pression provenant de celui-ci.
9. Dispositif selon l'une quelconque des revendications 4 à 8, **caractérisé en ce que** le dispositif de pivotement hydraulique (6) pour la flèche pivotante (2) est un moteur d'entraînement hydraulique, depuis les chambres (11A, 11B, 12A, 12B) duquel un système de détection de la pression (9, 10) est prévu pour fournir les informations de pression au dispositif de piston/cylindre du mécanisme de freinage (16, 18).
10. Dispositif selon la revendication 9, **caractérisé en ce que** le système de détection de la pression (9, 10) comprend une soupape à deux voies (10) prévue pour connecter le côté des chambres (11A, 11B, 12A, 12B) du moteur d'entraînement au niveau duquel se produit la pression lors du pivotement de la flèche (2) à une ligne d'indication de pression (9) connectée à la chambre (20) du cylindre (18) dans le mécanisme de freinage (16, 18) de la bielle de rotateur (14).
11. Grue comprenant un dispositif d'amortissement d'oscillations selon l'une quelconque des revendications 4 à 10.

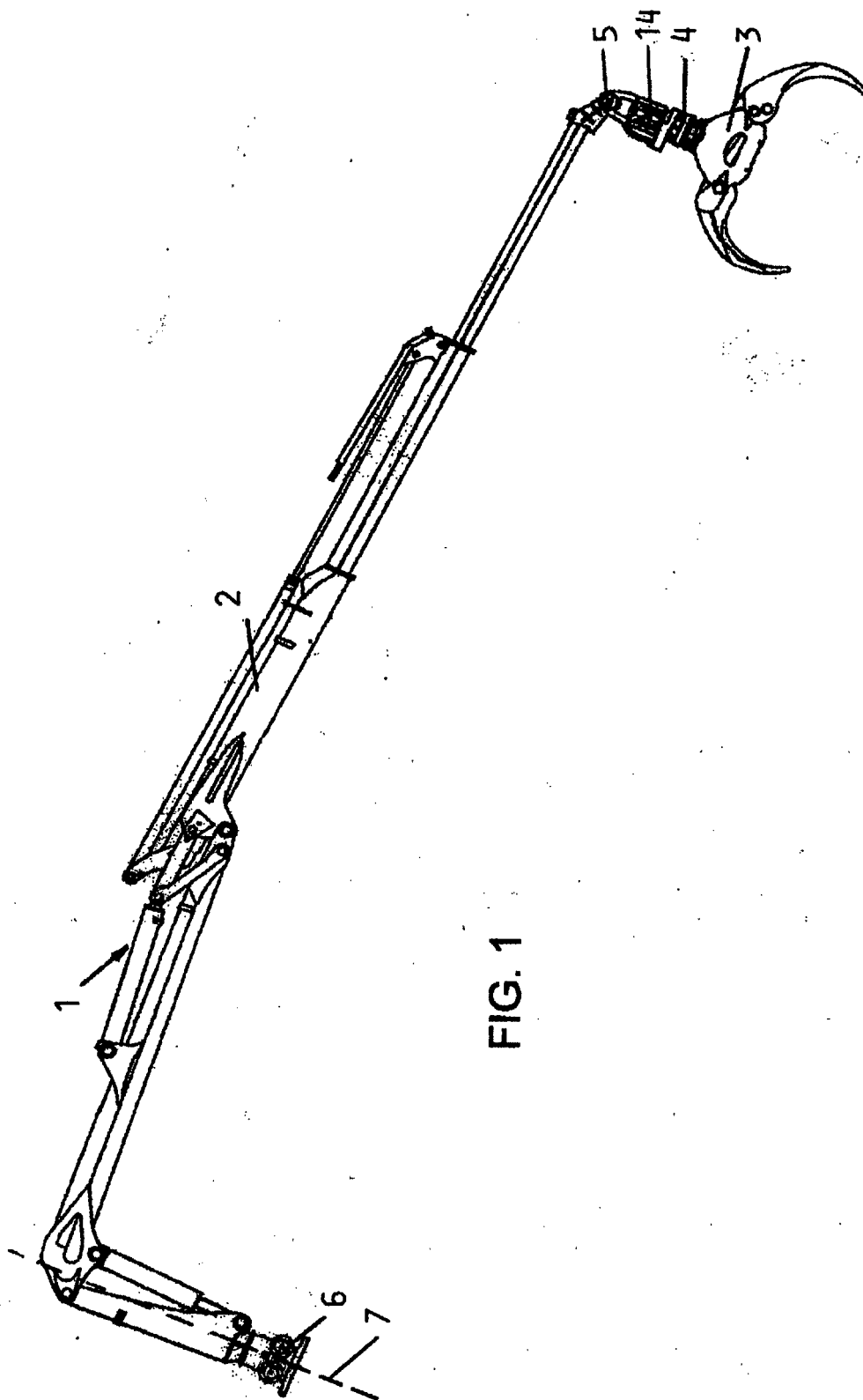
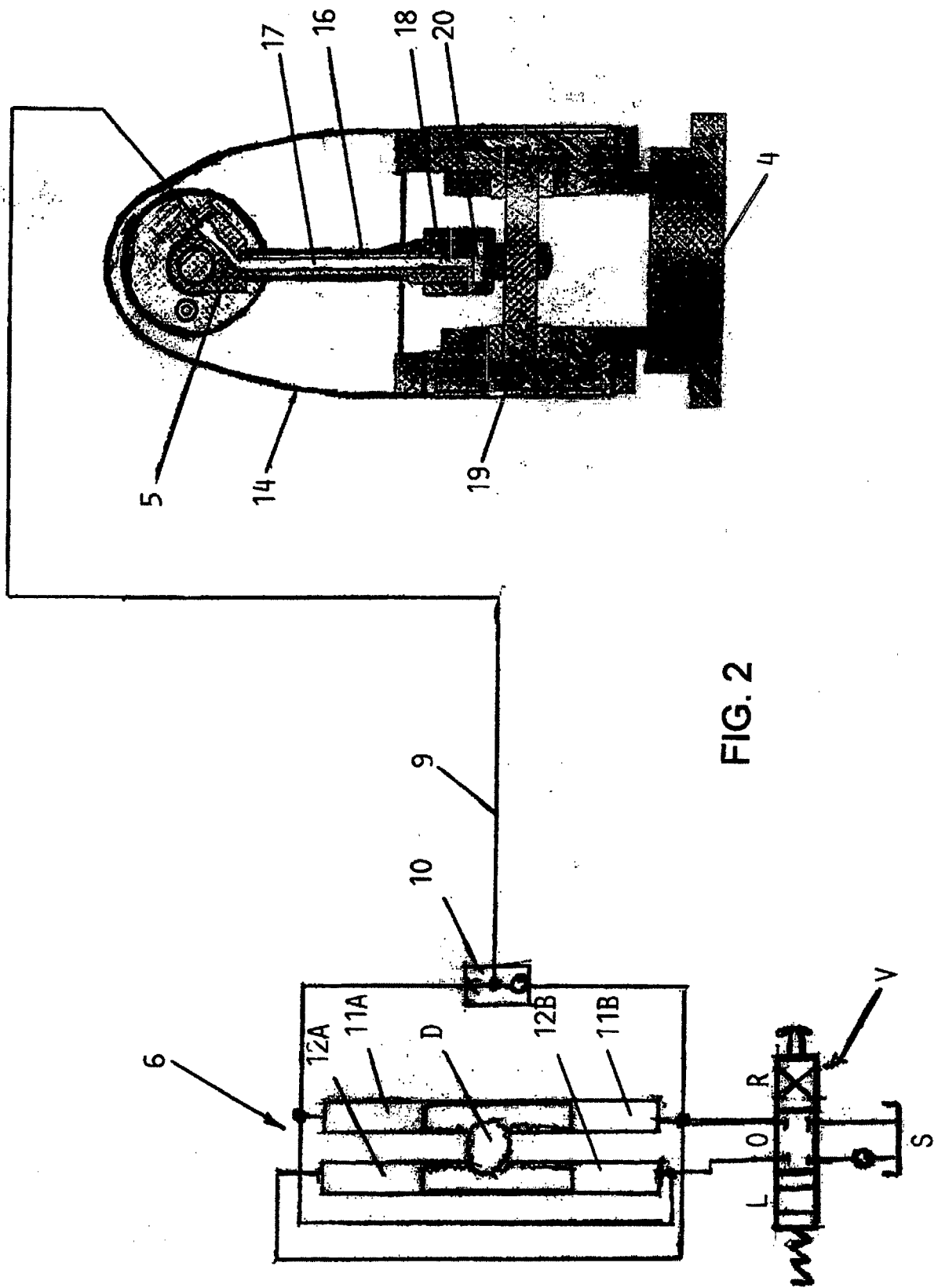


FIG. 1



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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