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(71) Applicant: **KABUSHIKI KAISHA KOMATSU SEISAKUSHO**
3-6, Akasaka 2-chome
Minato-ku Tokyo 107(JP)

Applicant: **KOMATSU MEC CORPORATION**
3-6, Akasaka 2-chome
Minato-ku, Tokyo 107(JP)

(72) Inventor: **MISUDA, Kenji Head Factory of Komatsu Mec Corp.**
9, Minamidai 1-chome Kawagoe-shi
Saitama-ken 350(JP)
Inventor: **BANDO, Norihito Head Factory of Komatsu Mec Corp.**
9, Minamidai 1-chome Kawagoe-shi
Saitama-ken 350(JP)

(74) Representative: **Patentanwälte TER MEER - MÜLLER - STEINMEISTER & PARTNER**
Mauerkircherstrasse 45
D-8000 München 80(DE)

(54) OPERATION MACHINE LINK MECHANISM.

(57) This invention relates to an operation machine link mechanism which keeps a conventional Z bar linkage function, moves up and down a bucket under a horizontal state without operating a tilt cylinder and is mounted to a loading vehicle such as a loader shovel. When a distance from a pivotal point (A) between a bucket (3) and a lift arm (1) to a pivotal point (B) between a lift arm (1) and a bell crank (5) is (X) and a distance from the pivotal point (B) to a pivotal point (O) between the lift arm (1) and a car body (9) is (Y), the link mechanism is set to $Y/X = \alpha$ and first and second triangles (ΔABC, ΔOBE) defined by the lift arm (1) and the bell crank (5) on the car body side and on the bucket side, respectively, have mutually similar relationship with a third triangle (ΔADC) defined by a tilt rod (6) and the bucket (3) and a fourth triangle (ΔOFE) defined by the tilt cylinder and the car body (9).

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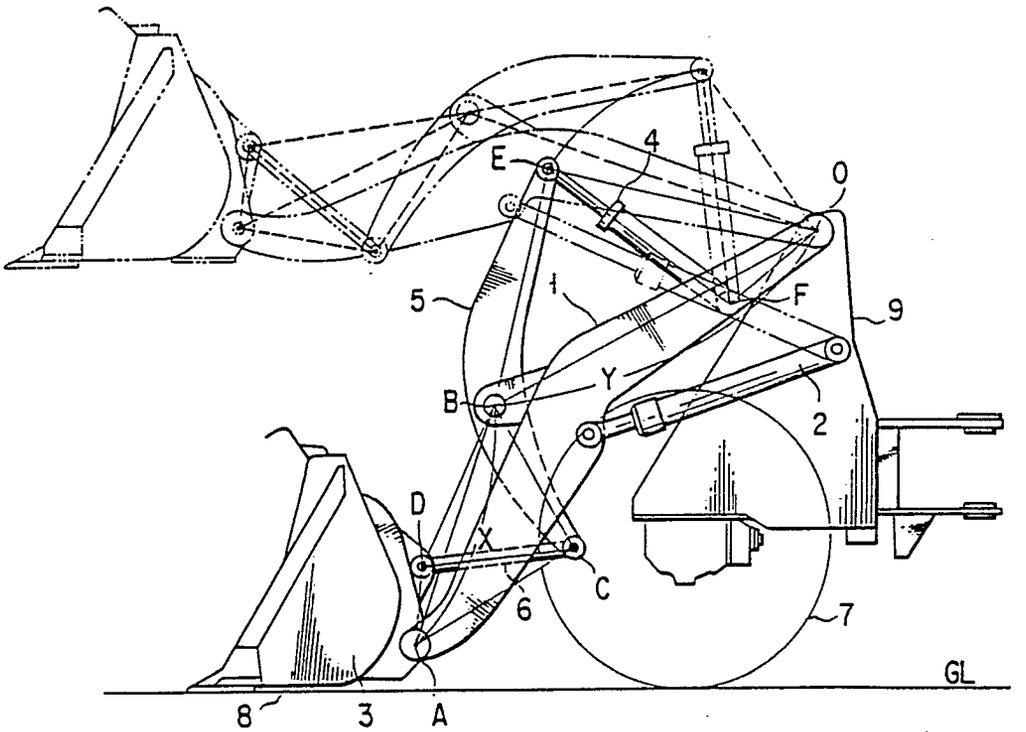
FIG. 2
第 2 図



SPECIFICATION

LINKAGE MECHANISM OF A WORK IMPLEMENT

Field of the Invention

The present invention relates to a linkage mechanism of a work implement that is available in a loading vehicle such as a shovel-loader or the like, and more particularly to a linkage mechanism of a work implement in which improvements are made in an attitude of a bucket connected in a forwardly and backwardly tiltable manner to a tip end of a lift arm whose base end is pivotably supported from a vehicle body and which can rotate up and down about the aforementioned pivotable support point.

Background of the Invention

In Fig. 1 is shown a side view of a work implement in a heretofore known shovel-loader. In this figure, a lift arm d pivotably supported at a pivotal support section i of the lift arm on the side of a vehicle body a in an upwardly and downwardly rotatable manner, rotates upwards when a lift cylinder e extends, and a bucket c pivotably supported in a forwardly and backwardly tiltable manner at a bucket pivotable support section j at the tip end of the lift arm d, is tilted backwardly via a bellcrank f and a tilt rod h when a tilt cylinder

is extended. Reference character b designates a tire. The state of the backet shown at c in this figure is a state upon excavation of earth and sand, and a bucket bottom surface k is nearly parallel to a ground surface GL (horizontal). And, a vehible body connecting pivotable support section of the tilt cylinder g is designated by reference character ℓ, a connecting pivotable support section on the side of the bellcrank f by character m, a connecting pivotable support section to the lift arm d of the bellcrank f by character n, a connecting pivotable support section between the bellcrank f and the tilt rod h by character p, a connecting pivotable support section between the tilt rod h and the bucket c by character q, a connecting pivotable support section on the side of the vehicle body of the lift cylinder e by character r, and a connecting pivotable support section on the side of the lift and d thereof by character s.

Thus, after excavation has been finished, a loading work starts, and when the lift cylinder e and the tilt cylinder g are extended in a desired manner, the bucket becomes the state shown at c_1. If the centers of the above-described respective pivotable support sections when the bucket has moved from c to c_1 are represented by movements of reference characters for simplicity of explanation, they are indicated by $s \rightarrow s_1$, $j \rightarrow j_1$,

$\underline{m} \rightarrow \underline{m}_1$, $\underline{n} \rightarrow \underline{n}_1$, $\underline{p} \rightarrow \underline{p}_1$, $\underline{q} \rightarrow \underline{q}_1$ and $\underline{k} \rightarrow \underline{k}_1$.

Then, if the lift and $\underline{d}$ is further rotated upwards by operating the lift cylinder $\underline{e}$ and the bucket pivotable support section $\underline{j}$ is raised up to the highest position $\underline{j}_2$, the bucket comes to a position $\underline{c}_2$, and the respective pivotable support sections would come respectively to the positions designated by the same characters but having a suffix 2 (for instance, $\underline{m} \rightarrow \underline{m}_2$). Under this condition, if the tilt cylinder $\underline{g}$ is contracted in order to forwardly tilt the bucket, the respective pivotable support sections would come respectively to the positions designated by the same characters but having a suffix 3 (for instance, $\underline{m}_2 \rightarrow \underline{m}_3$, but the positions of the sections $\underline{n}_2$, $\underline{s}_2$ and $\underline{j}_2$ would not change), and the bucket takes the state shown at $\underline{c}_3$.

This linkage mechanism in the prior art shown in Fig. 1 is a linkage generally called "Z-bar linkage", in which when the bucket takes the state shown at $\underline{c}$ in Fig. 1, if the tilt cylinder $\underline{g}$ is extended, the bucket bottom surface $\underline{k}$ would rotate in the direction shown by an arrow $\underline{K}$, and at this time a hydraulic pressure in the bottom side pressure receiving chamber $\underline{g}b$ of the tilt cylinder $\underline{g}$ acts, and therefore, this linkage is that generally used in a loading vehicle which necessitates a large excavation force.

Though this linkage is designed so as to maintain a backwardly tilted state (designed for reducing tilt angle variations under a tilted state) so that loaded articles may not spill out even if the lift arm is rotated up and donw with the bucket held backwardly tilted (the state shown at $\underline{c}_1$ in Fig. 1) because it is mainly used for loading of earth and sand, it does not have a structure for eliminating tilt angle variations under a horizontal state of the bucket.

More particularly, one example of the operation when the bucket is held in parallel to the ground surface (held horizontal) as shown at c in Fig. 1 and the lift arm d is rotated upwards with the length of the tilt cylinder g at that time (the distance between ℓ and m in that figure) maintained, is shown by a dash-line R in Fig. 4, in which at a certain instance at tilt angle θ with respect to the ground of the bucket bottom surface k changes by about 20°.

Consequently, in order to maintain a horizontal state of the bucket, upon rotating the lift arm the operation of extending and/or contracting the tilt cylinder is necessitated, and thus there was a disadvantage that the operation is troublesome and also a maneuverability was poor.

Summary of the Invention

The present invention has been worked out in view of the above-described circumstance of the art, and one object of the invention is to provide a linkage mechanism of a work implement which preserves the functions of the Z-bar linkage in the prior art, and yet which can vertically move a bucket while maintaining it at a horizontal state without operating a tilt cylinder.

In order to achieve the above-mentioned object, according to one feature of the present invention, there is provided a linkage mechanism of a work implement in a loading vehicle such as a shovel-loader or the like, including a lift arm having one end pivotably supported from a vehicle body and the other end extended forwards and adapted to be rotated up and down in the vertical direction about the pivotable support point on one side, a forwardly and backwardly tiltable bucket having a lower portion of its rear surface pivotably supported from the front end portion of the above-mentioned lift arm, a bellcrank having its nearly middle portion in the lengthwise direction pivotably supported from the above-mentioned lift arm, a tilt rod pivotably connected between the lower side end portion of the aforementioned bellcrank and an upper portion of the rear surface of the above-mentioned bucket, and a tilt cylinder pivotably connected between the aforementioned vehicle body and the

other end portion of the above-mentioned bellcrank to be operated for tilting the above-mentioned bucket; characterized in that in the case where the distance from the pivotable support point between the aforementioned bucket and the above-described lift arm to the pivotable support point between the aforementioned lift arm and the above-described bellcrank is represented by $\underline{X}$, and the distance from the pivotable support point between the aforementioned lift arm and the above-mentioned bellcrank to the pivotable support point between the aforementioned lift arm and the above-described vehicle body is represented by Y, a ratio between these distances X and Y is set at $\propto$ ($Y/X = \alpha$), and that a triangle formed by connecting the pivotable support point of the aforementioned lift arm from the vehicle body, the pivotable support point of the aforementioned bellcrank from the lift arm and the pivotable support point of the aforementioned tilt cylinder from the bellcrank and a triangle formed by connecting the pivotable support point of the aforementioned bellcrank from the lift arm, the pivotable support point of the aforementioned lift from the bucket and the pivotable support point of the aforementioned tilt rod from the bellcrank, as well as a triangle formed by connecting the pivotable support point of the aforementioned lift arm from the vehicle

body, the pivotable support point of the aforementioned tilt cylinder from the bellcrank and the pivotable support point of the aforementioned tilt cylinder from the vehicle body, and a triangle formed by connecting the pivotable support point of the aforementioned lift arm from the vehicle body, the pivotable support point of the aforementioned tilt rod from the bellcrank and the pivotable support point of the aforementioned tilt rod from the bucket, are respectively in a mutually similar figure relation.

The advantages of the present invention as featured above are as follows.

That is, since upon rotation of the lift arm, vertical movement at a horizontal attitude of the bucket becomes possible without extension nor contraction of the tilt cylinder while preserving the characteristic of the Z-bar linkage such that a hydraulic pressure in a bottom side pressure receiving chamber of a tilt cylinder is utilized upon excavation and that shock upon removal of earth with the boom held at a high position can be reduced, improvements in a versatility and a maneuvability can be realized.

The above-mentioned and other objects, features and advantages of the present invention will become apparent for those skilled in the art from the following

description in which a preferred embodiment conformable to a principle of the present invention is disclosed as a practical example and the explanation taken in conjunction with the accompanying drawings.

Brief Description of the Drawings

Fig. 1 is a schematic side view for explaining operations relating to a work implement in a shovel-loader in the prior art;

Fig. 2 is a schematic side view showing one preferred embodiment of the present invention;

Fig. 3 is a diagrammatic view for explaining operations of the preferred embodiment illustrated in Fig. 2;

Fig. 4 is a diagram comparatively showing bucket tilt angle with respect to the ground in the preferred embodiment of the present invention and in the example of the prior art.

Detailed Description of the Preferred Embodiment

In the following, one preferred embodiment of the present invention will be explained with reference to Figs. 2 to 4 in the accompanying drawings.

Fig. 2 shows a side view of a work implement in a shovel-loader according to the present invention. In this figure, a lift arm 1 pivotably supported at a lift arm pivotable support portion 0 on the vehicle body side

(in the following explanation and in Figs. 3 and 4, for the purpose of simplicity, for a pivotable support portion and for its center is used a same reference symbol like in Fig. 2) in a vertically rotatable manner, would rotate upwards when a lift cylinder 2 extends, and a bucket 3 pivotably supported at a bucket pivotably support portion A at the tip end of the lift arm 1 in a forwardly and backwardly tiltable manner would be tilted backwards via a bellcrank 5 and a tilt rod 6 when a tilt cylinder 4 extends.

Reference numeral 7 designates a tire. Under the state of the bucket 3 shown by solid lines in Fig. 2, a bucket bottom surface 8 is parallel to the ground surface GL (horizontal). And a vertical body side connecting pivotable support portion of the tilt cylinder 4 is represented by reference character F, a bellcrank side connecting pivotable support portion thereof is represented by reference character E, a connecting pivotable support portion of the bellcrank 5 to the lift arm 1 is represetned by reference character B, a connecting pivotable support portion between the bellcrank 5 and the tilt rod 6 is represented by reference character C, and a connecting pivotable support portion between the tilt rod 6 and the bucket 3 is represented by reference character D.

In addition, in the case where the distance from a

pivotable coupling portion A between the lift arm 1 and the bucket 3 to a pivotable coupling portion B between the lift arm 1 and the bellcrank 5 is represented by reference character X and the distance from the pivotable coupling portion B between the lift arm 1 and the bellcrank 5 to a pivotable coupling portion O between a vehicle body 9 and the lift arm 1 is represented by reference character Y, the ratio between these distances X and Y is set to be equal to α ($Y/X = \alpha$), and so that the triangles formed on the side of the vehicle body 9 and on the side of the bucket 3 with respect to the pivotable coupling portion B between the bellcrank 5 and the lift arm 1 may become similar figures to each other, the following relations are established:

$\Delta ABC \backsim \Delta OBE$ (similar figure ratio α)

$\Delta ADC \backsim \Delta OFE$ (similar figure ratio α)

Next, explaining the operation, assuming now that the bucket 3 is placed with the bucket bottom surface 8 put on the ground surface GL as shown by solid lines in Fig. 2, then even if the lift arm 1 is rotated upwards without operating the tilt cylinder 4, the relations of $\Delta ABC \backsim \Delta OBE$ and $\Delta ADC \backsim \Delta OFE$ would be always established.

Accordingly, the bucket 3 would rotate while holding the above-mentioned attitude with respect to the line of the ground surface GL, and the bucket would be always held

horizontal.

Now this will be proved with reference to Fig. 3.

Under the condition where the bucket is disposed and held in parallel to the ground surface (horizontal),

$\Delta A_1B_1C_1 \backsim \Delta OB_1E_1$ (similar figure ratio α)

$\Delta A_1D_1C_1 \backsim \Delta OFE_1$ (similar figure ratio α).

Now, imagining the case where the lift arm has been rotated upwards (without operating the tilt cylinder), then the relations of:

$\angle A_2B_2C_2 = \angle OB_2E_2 = \alpha_2$

are always valid.

Therefore, $\Delta A_2B_2C_2 \backsim \Delta OB_2E_2$ ... ①

Hence, $\overline{A_2C_2} = \frac{1}{\alpha} \overline{OE_2}$ ... ②

On the other hand, $\overline{A_2D_2} = \overline{A_1D_1} = \frac{1}{\alpha} \overline{OF}$ ... ③

and $\overline{D_2C_2} = \overline{D_1C_1} = \frac{1}{\alpha} \overline{FE_1} = \frac{1}{\alpha} \overline{FE_2}$ ... ④

are always valid.

From ①, ② and ③, $\Delta A_2D_2C_2 \backsim \Delta OEF_2$ ... ⑤

From ① and ⑤, quadrilateral $A_2C_2B_2D_2 \backsim$ quadrilateral OE_2B_2F ... ⑥

Also, $\angle C_2B_2E_2 = \beta$ = constant ... ⑦

⑥ and ⑦ show that at any arbitrary lift arm position, two similar quadrilaterals are jointed at a point B with a constant angle β formed therebetween.

Accordingly, a relative angle between a pair of corresponding edges of the two similar quadrilaterals, for instance,

$\overline{AD}$ and $\overline{OF}$

is always constant (β) without depending upon the position of the lift arm.

$\overline{OF}$ is a segment fixed to the vehicle.

Therefore, $\overline{AD}$ has a constant angle with respect to the vehicle without depending upon a rotary angle of the lift arm. Accordingly, the bucket keeps its horizontal attitude even if the position of the lift arm changes.

Also, a bucket tilt angle θ with respect to the ground of the bucket bottom surface 11 when the lift arm 4 is rotated up and down in this preferred embodiment, is shown by a straight line L in Fig. 4. As will be obvious from this figure, while the angle in the linkage mechanism in the prior art changes by about 20° at the maximum as shown by a curve R, it is seen that in the linkage mechanism according to the present invention, a perfectly horizontal operation is effected as shown by the straight line L.

Claims

(1) A linkage mechanism of a work inplement in a loading vehicle such as a shovel-loader or the like, including a lift arm having one end pivotably supported from a vehicle body and the other end extended forwards and adapted to be rotated up and down in the vertical direction about the pivotable support point on one side, a forwardly and backwardly tiltable bucket having a lower portion of its rear surface pivotably supported from the front end portion of said lift arm, a bellcrank having its nearly middle portion in the lengthwise direction pivotably supported from said lift arm, a tilt arm pivotably connected between the lower side end portion of said bellcrank and an upper portion of the rear surface of said bucket, and a tilt cylinder pivotably connected between said vehicle body and the other end portion of said bellcrank to be operated for tilting said bucket; characterized in that in the case where the distance from the pivotable support point between said bucket and said lift arm to the pivotable support point between said lift arm and said bellcrank is represented by X, and the distance from the pivotable support point between said lift arm and said bellcrank to the pivotable support point between said lift arm and said vehicle body is represented by Y, a ratio between these distances X and

Y is set at α (Y/X = α), and that a first triangle formed by connecting the pivotable support of said lift arm from the vehicle body, the pivotable support point of said bellcrank from the lift arm and the pivotable support point of said tilt cylinder from the bellcrank and a second triangle formed by connecting the pivotable support point of said lift arm from the bucket and the pivotable support point of said tilt rod from the bell crank, as well as a third triangle formed by connecting the pivotable support point of said lift arm from the vehicle body, the pivotable support point of said tilt cylinder form the bellcrank and the pivotable support point of said tilt cylinder from the vehicle body, and a fourth triangle formed by connecting the pivotable support point of said lift arm from the vehicle body, the pivotable support point of said tilt rod from the bellcrank and the pivotable support point of said tilt rod from the bucket, are respectively in a mutually similar figure relation.

(2) A linkage mechanism of a work implement as claimed in claim (1), characterized in that the similar figure ratios of the respective pairs of said fixed and second triangles and said third and fourth triangles are α.

F I G. 1

第 1 図

PRIOR ART

従来例

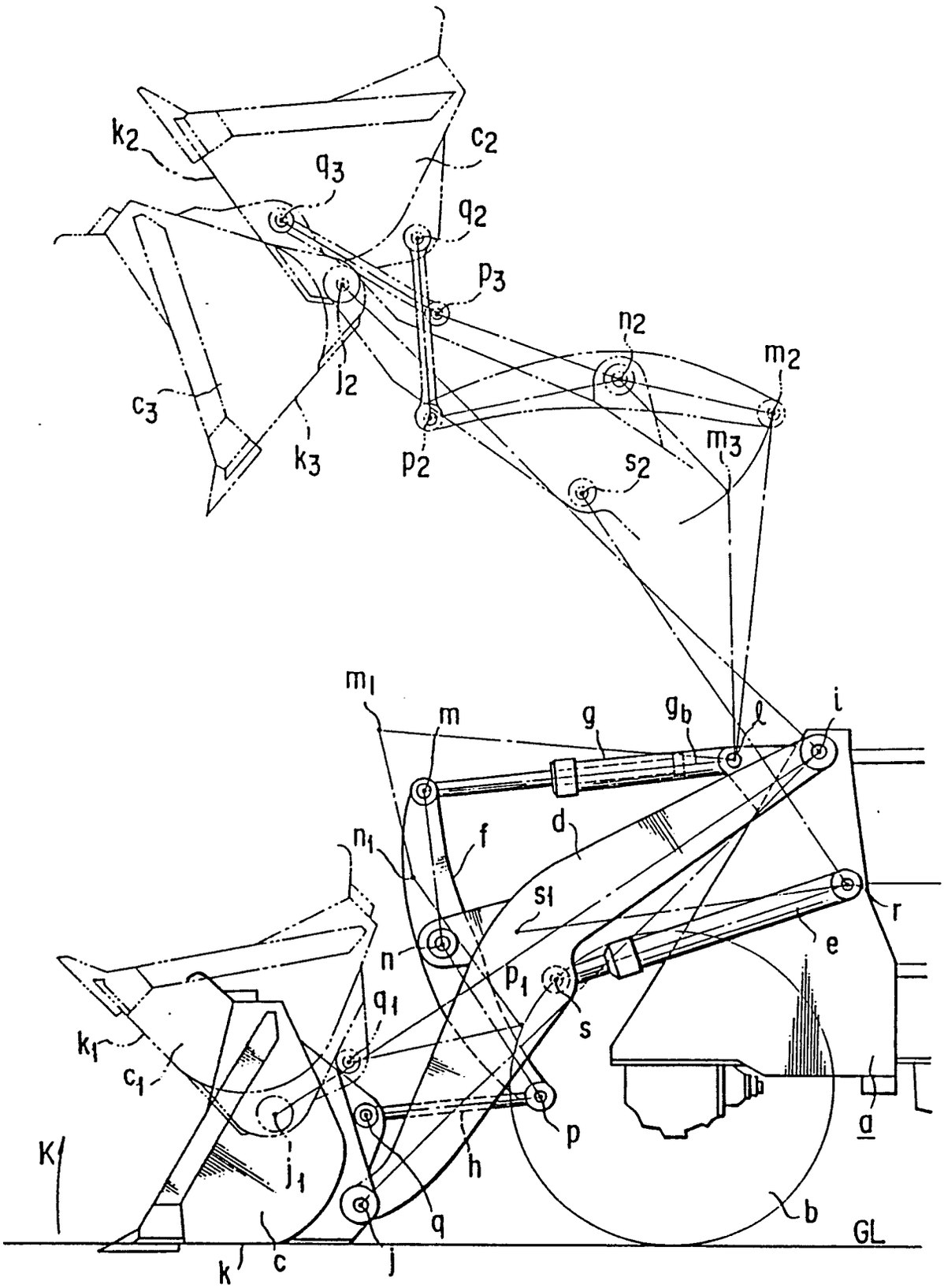


FIG. 2
第 2 図

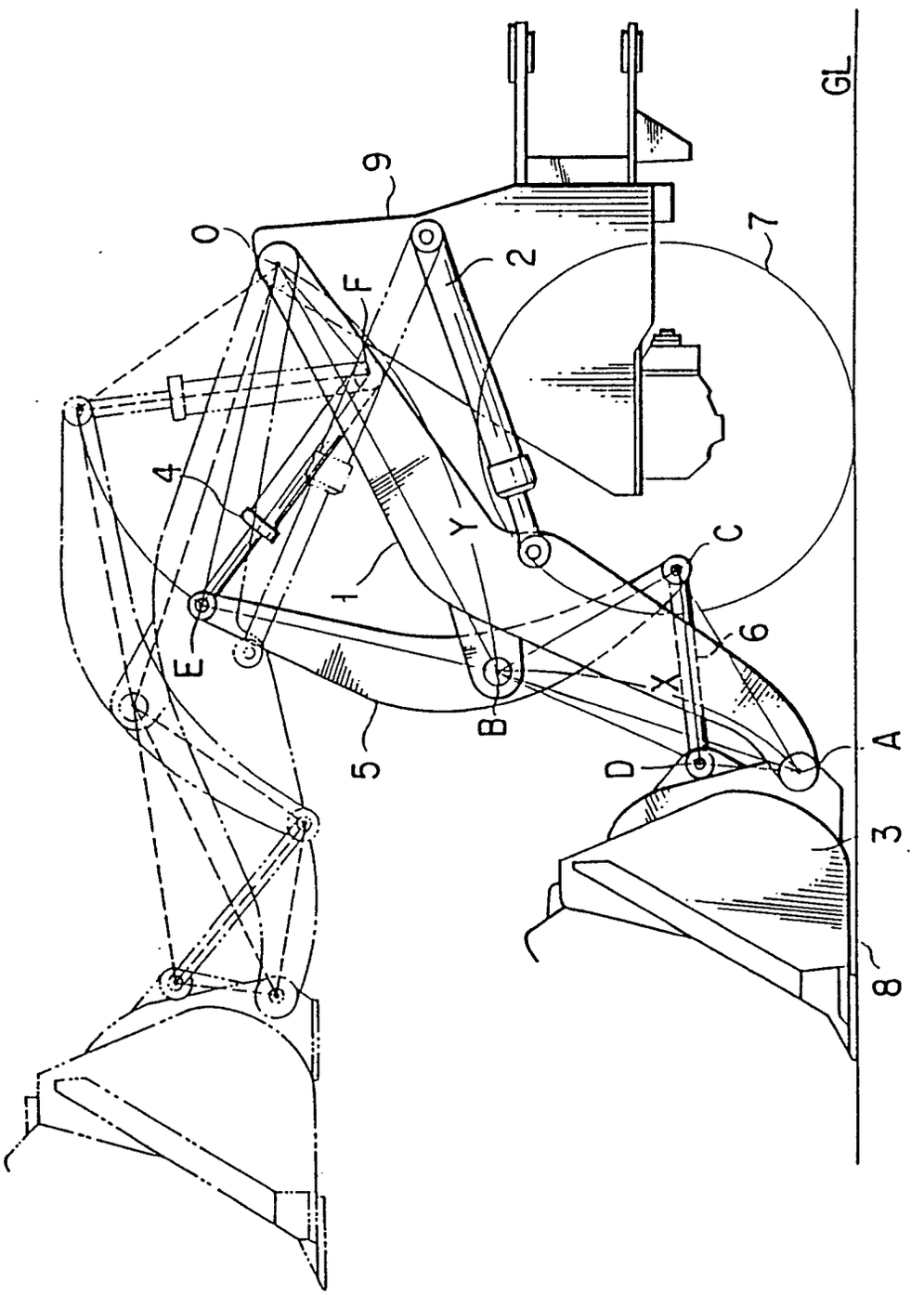


FIG. 3
第 3 図

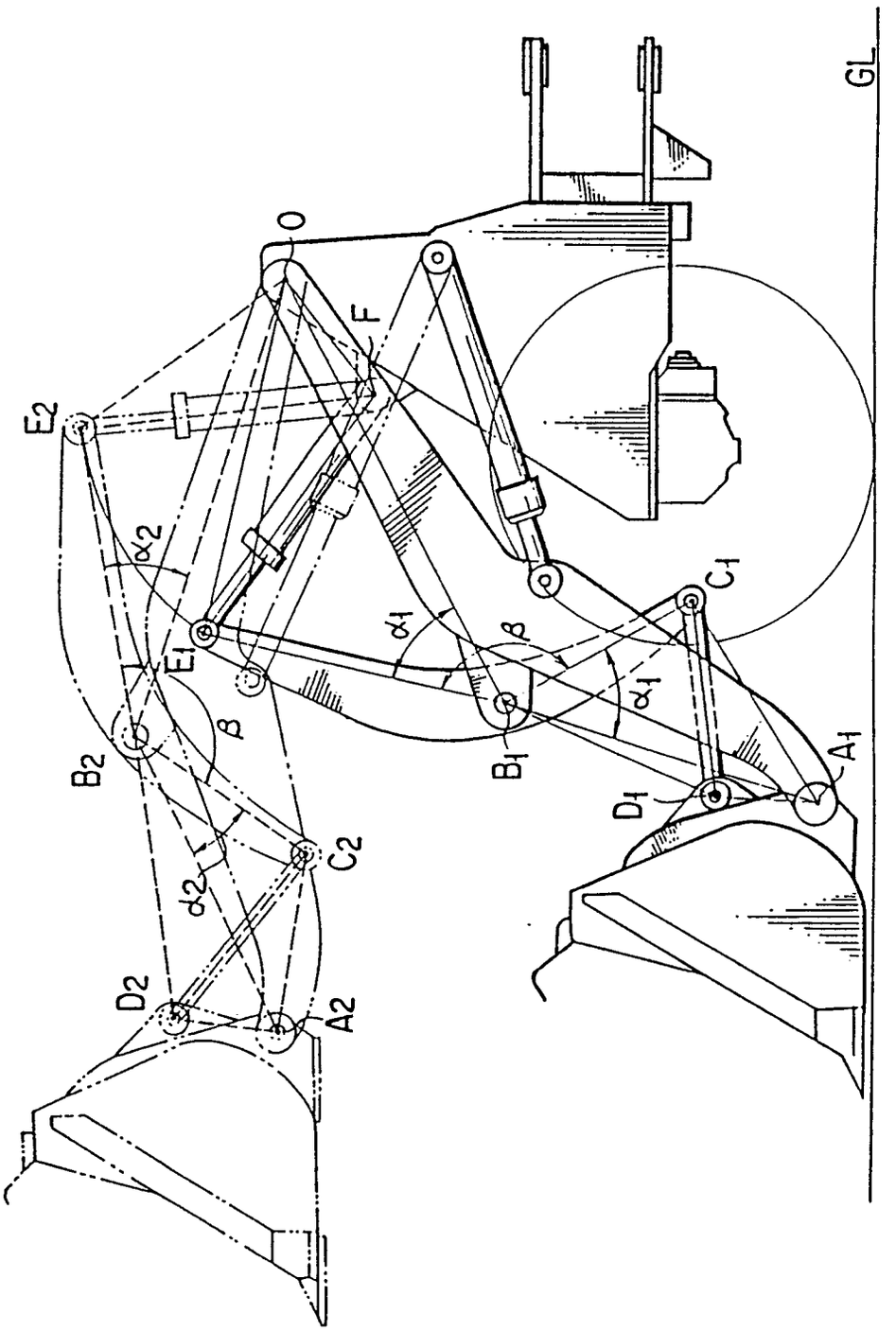
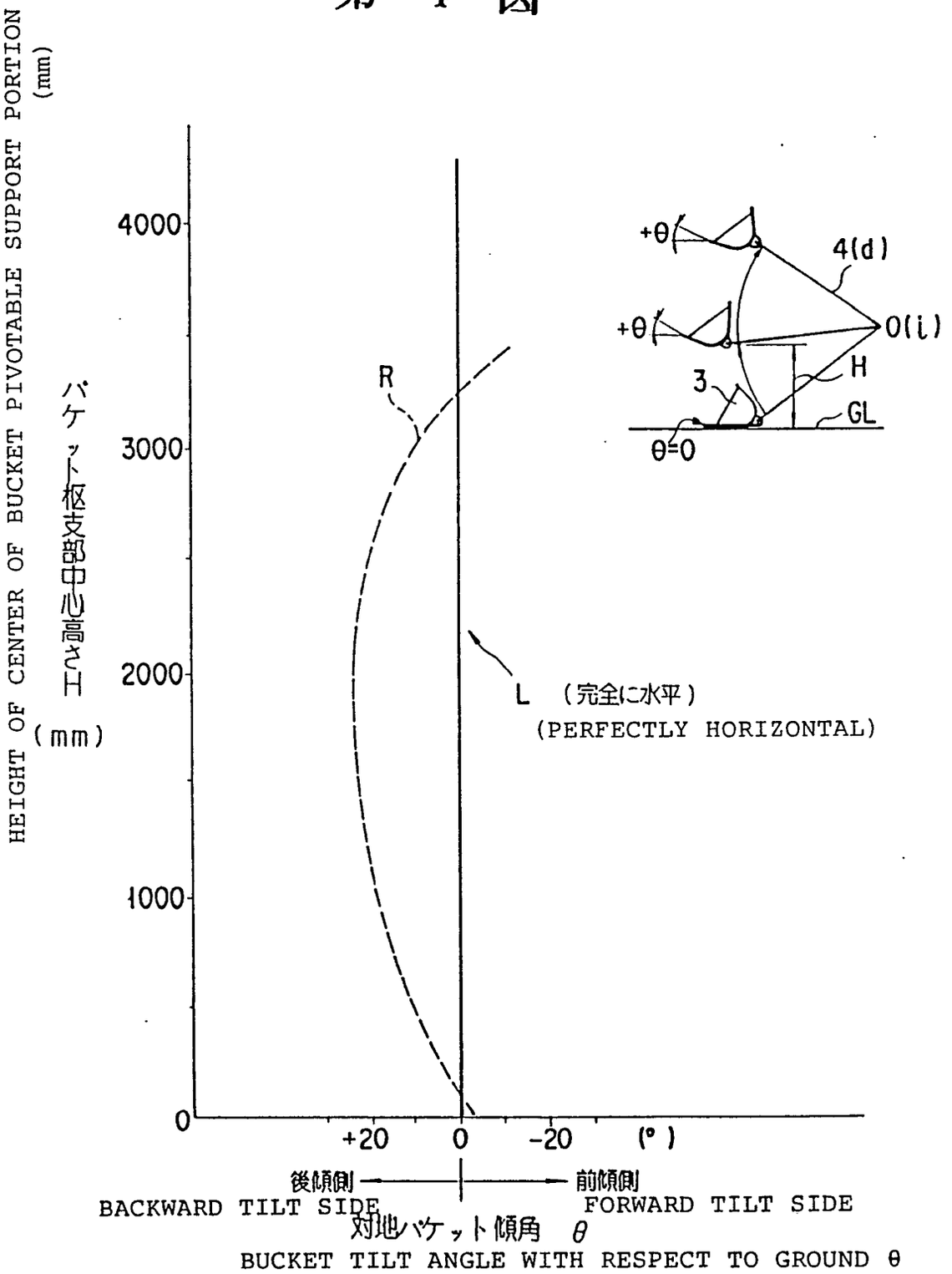


FIG. 4

第 4 図


HEIGHT OF CENTER OF BUCKET PIVOTABLE SUPPORT PORTION (mm)
バケット支持中心高さ
(mm)
4000
3000
2000
1000
0
R
L (完全に水平)
(PERFECTLY HORIZONTAL)
+θ
4(d)
+θ
O(i)
H
3
GL
θ=0
+20
0
-20
(°)
後傾側
BACKWARD TILT SIDE
前傾側
FORWARD TILT SIDE
対地バケット傾角 θ
BUCKET TILT ANGLE WITH RESPECT TO GROUND θ

INTERNATIONAL SEARCH REPORT

International Application No PCT/JP89/00949

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl[4] E02F3/34

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System [1]	Classification Symbols
IPC	E02F3/30 - 3/40

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

Jitsuyo Shinan Koho	1952 - 1989
Kokai Jitsuyo Shinan Koho	1972 - 1989

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	JP, Y2, 51-9767 (Komatsu Ltd.) 16 March 1976 (16. 03. 76) (Family : none)	1
A	JP, Y2, 54-39643 (Endo Isamu) 29 November 1979 (29. 11. 79) Page 3, Fig. 2 (Family : none)	1
A	JP, U, 62-163557 (Kubota, Ltd.) 17 October 1987 (17. 10. 87) Fig. 1 (Family : none)	1

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
November 12, 1989 (12. 11. 89)	December 18, 1989 (18. 12. 89)
International Searching Authority	**Signature of Authorized Officer**
Japanese Patent Office	