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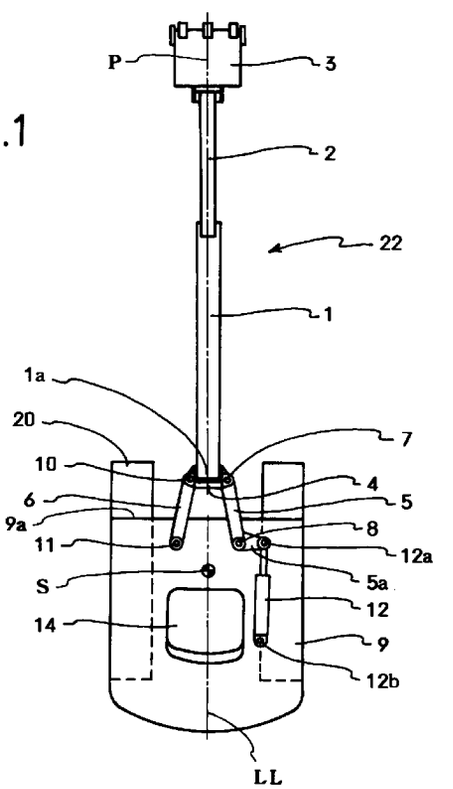
(54) Power shovel

(57) In the power shovel of the present invention, an operator can easily watch movement of a bucket even if an excavator is shifted. The power shovel comprises: a vehicle section (20); a rotary section (9) being provided on the vehicle section (20); and an excavator (22) having a bucket (3) and a boom (1); a boom bracket (4) connecting a rear end of the boom (1) to the rotary section (9); a first link (5) being pivotably connected to one end of the boom bracket (4) and one side of the rotary section (9); a second link (6) being pivotably connected to the other end of the boom bracket (4) and the other side of the rotary section (9); and a cylinder unit (12) whose one end is pivotably connected to the first link (5) or the second link (6) and whose the other end is pivotably connected to the rotary section (9). With this structure, the cylinder unit (12) is capable of shifting the excavator (22) sideward.

FIG.1



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Description

The present invention relates to a power shovel, more precisely relates to a power shovel comprising: a vehicle section; a rotary section being provided on the vehicle section and being capable of rotating in a rotational plane, which is parallel to a plane in which the vehicle section runs; and an excavator being provided to the rotary section and having a bucket , an arm and a boom.

A conventional power shovel, which comprises the vehicle section, the rotary section, and the excavator, is shown in Fig. 5. In Fig. 5, a vertical pin 31 is vertically provided to the rotary section 30. The vertical pin 31 is arranged perpendicular to a plane in which the power shovel (the vehicle section) runs. A boom bracket 32 is pivotably attached to the vertical pin 31. A boom foot (a rear end) of the boom 33 is pivotably connected to the boom bracket 32, so the boom 33 is capable of vertically turning or swinging. In this conventional boom-swing type power shovel, the excavator 35 can be turned rightwardly and leftwardly around the vertical pin 31 by a swing cylinder unit 34, whose one end is pivotably connected to the boom bracket 32 and whose the other end is pivotably connected to the rotary section 30, and the boom bracket 32. The vertical pin 31 is provided to a front end of the rotary section 30. The vertical pin 31 is separated a proper distance away from a rotary axis "X" of the rotary section 30. By extending and shortening the swing cylinder unit 34, the excavator 35 is turned rightwardly and leftwardly. In the conventional power shovel shown in Fig. 5, the excavator 35 is capable of leftwardly turning from a standard position (shown by solid lines) to a position "A" (shown by two-dot chain lines); maximum turning angle "$\theta 1$" is about 90 ° . On the other hand, the excavator 35 is capable of rightwardly turning from the standard position to a position "B"; maximum turning angle "$\theta 2$" is about 50° .

The boom-swing type power shovel is used to excavate ditches, which are located outer side of a width of the power shovel (or the vehicle section). Ditches are usually excavated parallel to a running direction of the power shovel. Namely, a center line of the excavator 35 is kept parallel to the running direction of the power shovel while excavating ditches.

A distance between the power shovel (the vehicle section) and a ditch is defined by the turning angle of the boom bracket 32 and the distance between the vertical pin 31 the rotary axis "X". The distance between the vertical pin 31 the rotary axis "X" is usually designed according to the size of the power shovel. In the case of turning the boom bracket 90° , the distance between the ditch and the power shovel is maximum.

A method of excavating a ditch will be explained with reference to Fig. 6. In Fig. 6, the boom bracket 32 and the excavator 35 are leftwardly turned 90 ° (maximum), with respect to the rotary section 30; the rotary section 30 is rightwardly turned 90 ° with respect to the vehicle section 36. In this state, the excavator 35 is parallel to the vehicle section 36, so the ditch can be excavated in the running direction of the vehicle section 36.

In the conventional power shovel, an operator sits in an operator's seat 37, and he heads toward the front end of the rotary section 30, so he must twist his neck to watch the excavator 35, especially the bucket 38. If the operator works for a long time with twisting his neck, he must be tired much. The forced posture and the exhaustion cause misoperation, accident, etc.. So a power shovel which is capable of easily and safely operating has been required.

An object of the present invention is to provide a power shovel, in which an operator on a rotary section can fully watch an excavator, especially a bucket, without twisting his neck when the excavator is sidewardly shifted.

To achieve the object, the power shovel of the present invention comprises:

a vehicle section;
a rotary section being provided on the vehicle section, the rotary section being capable of rotating in a rotational plane, which is parallel to a plane in which the vehicle section runs;
an excavator being provided to the rotary section, the excavator having a bucket, an arm and a boom;
a boom bracket connecting a rear end of the boom of the excavator to the rotary section;
a first link whose one end is pivotably connected to one end of the boom bracket and whose the other end is pivotably connected to one side of the rotary section, the first link being capable of moving in a plane parallel to the rotational plane;
a second link whose one end is pivotably connected to the other end of the boom bracket and whose the other end is pivotably connected to the other side of the rotary section, the second link being capable of moving in a plane parallel to the rotational plane; and
a cylinder unit whose one end is pivotably connected to the first link or the second link and whose the other end is pivotably connected to the rotary section, the cylinder unit being capable of shifting the excavator sideward.

In the power shovel of the present invention, the excavator is sidewardly shifted by the boom bracket, the first link and the second link, so an operator, who is sitting on the rotary section, easily and fully watch the excavator, especially the bucket, without twisting his body or neck when the excavator is shifted sidewardly. So the operator can execute operation safely.

In the power shovel of the present invention, a distance between the one end of the first link and the one end of the second link, which are pivotably connected to the boom bracket, may be shorter than a distance between the other end of the first link and the other end

of the second link, which are pivotably connected to the rotary section. With this structure, the excavator can be stably provided to the rotary section, and the excavator can properly excavate ditches on both sides of the power shovel.

An embodiment of the present invention will now be described by way of an example and with reference to the accompanying drawings, in which:

Fig. 1 is a plan view of a power shovel of an embodiment of the present invention;
Fig. 2 is a side view of the power shovel shown in Fig. 1;
Fig. 3 is a plan view of the power shovel whose excavator is shifted leftward;
Fig. 4 is a plan view of the power shovel whose excavator is shifted rightward;
Fig. 5 is a plan view of a conventional power shovel; and
Fig. 6 is a plan view of the conventional power shovel, which is in a state of excavating a ditch.

A preferred embodiment of the present invention will now be described in detail with reference to the accompanying drawings.

Fig. 1 is a plan view of a power shovel of an embodiment of the present invention; Fig. 2 is a side view of the power shovel; Fig. 3 is a plan view of the power shovel whose excavator is shifted leftward; and Fig. 4 is a plan view of the power shovel whose excavator is shifted rightward.

A vehicle section 20 is a lower part of the power shovel. The vehicle section 20 has a pair of crawlers. A rotary section 9 is an upper part of the power shovel. The rotary section 9 is provided on the vehicle section 20. The rotary section 9 is capable of rotating about a rotary axis "S", which is vertically fixed to the vehicle section 20. Thus, the rotary section 9 rotates in a rotational plane, which is parallel to a plane in which the vehicle section 20 runs. The vehicle section 20 (the crawlers) is driven by a known mechanism, and the rotary section 9 is rotated by a known mechanism, too. So details of the mechanisms will be omitted. An excavator 22 is provided to the rotary section 9. The excavator 22 includes a boom 1, an arm 2 and a bucket 3. The boom 1, the arm 2 and the bucket 3 are driven by hydraulic cylinder units 22a (see Fig. 2).

A boom bracket 4 is provided to the rotary section 9. The boom bracket 4 pivotably connects a rear end 1a of the boom 1 of the excavator 22 to the rotary section 9. The boom 1 is pivotably connected to a shaft 4a, which is horizontally provided to the boom bracket 4, so that the boom 1 can be upwardly and downwardly turned round the shaft 4a.

A first link 5 is horizontally arranged. One end of the first link 5 is pivotably connected to one end (the right end in Fig. 1) of the boom bracket 4 by a first link pin 7; the other end of the first link 5 is pivotably connected to the rotary section 9, on one side (the right side in Fig. 1) of a center line "LL" of the rotary section 9, by a second link pin 8. Thus, the first link 5 can be moved in a plane parallel to said rotational plane of the rotary section 9.

A second link 6 is horizontally arranged. One end of the second link 6 is pivotably connected to the other end (the left end in Fig. 1) of the boom bracket 4 by a third link pin 10; the other end of the second link 6 is pivotably connected to the rotary section 9, on the other side (the left side in Fig. 1) of the center line "LL", by a fourth link pin 11. Thus, the second link 6 can be moved in a plane parallel to said rotational plane of the rotary section 9.

In the present embodiment, the other end of the first link pin 5 (or the second link pin 8) and the other end of the second link 6 (or the fourth link pin 11) are symmetrically arranged with respect to the center line "LL" of the rotary section 9 (see Fig. 1). The first link 5 and the second link 6 have the same length. A distance between the one end of the first link 5 (or the first link pin 7) and the one end of the second link 6 (or the third link pin 10) is shorter than a distance between the other end of the first link 5 (or the second link pin 8) and the other end of the second link 6 (or the fourth link pin 11). With this structure, the excavator 22 can be stably provided to the rotary section 9, and the excavator 22 can properly excavate ditches on both sides of the vehicle section 20.

Note that, the positions of the second link pin 8 and the fourth link pin 11 in the rotary section 9 are not limited. The first link 5 and the second link 6 may have mutually different length. In the case of shifting the excavator 22 toward one side (the right side or the left side only), the second link pin 8 and the fourth link pin 11 may be dissymmetrically arranged with respect to the center line "LL", and the first link 5 and the second link 6 may have mutually different length.

A swing cylinder unit 12 is provided to the rotary section 9. One end of the cylinder unit 12 (a front end 12a of a cylinder rod) is pivotably connected to an extended section 5a, which is extended from the first link 5; the other end of the cylinder unit 12 (a rear end 12b of the cylinder unit 12) is pivotably connected to the rotary section 9. The swing cylinder unit 12 drives a link mechanism, which includes the boom bracket 4, the first link 5 and the second link 6, so as to shift the excavator 22 rightwardly and leftwardly. In the case of connecting the swing cylinder unit 12 to the second link 6, the excavator 22 can be shifted as well. The link mechanism may be driven by a plurality of cylinder units. Further, other means, e.g., a motor, may be employed instead of the cylinder unit 12. Note that, in the case of the hydraulic power shovel like the present embodiment, the hydraulic cylinder unit is preferably employed as the cylinder unit 12.

In said link mechanism, the boom bracket 4 and the rotary section 9 are connected by the first link 5 and the second link 6, so the link mechanism is a four-joint link mechanism. In the present embodiment, the four-joint mechanism is not a parallel link mechanism. But the

four-joint mechanism of the present embodiment is made symmetry with respect to the center line "LL" (see Fig. 1), so the boom bracket 4 is parallel to the rotary section 9 when the boom bracket 4 is located close to the rotary axis "S" of the rotary section 9 (see Fig.1); the rotary bracket 4 is slightly leftwardly turned round the link pin 10 when the boom bracket 4 is moved to the right side of the center line "LL" of the rotary section 9 (see Fig.4); the rotary bracket 4 is slightly rightwardly turned round the link pin 7 when the boom bracket 4 is moved to the left side of the center line "LL" of the rotary section 9 (see Fig.3).

In the present embodiment, the boom bracket 4 is connected with the rotary section 9 by the first link 5 and the second link 6, which are pivotably connected by the link pins 7, 8, 10 and 11. Further, the front end 12a of the swing cylinder unit 12 is pivotably connected to the first link 5. Namely, comparing with the conventional power shovel (see Fig. 5), the power shovel of the present embodiment further has the first link 5, the second link 6 and the link pins 7, 8, 10 and 11. Unlike the conventional power shovel, the front end 12a of the swing cylinder unit 12 is pivotably connected to the first link 5 (or the second link 6).

In the present embodiment, the boom bracket 4, which is provided in front of the rotary section 9, is connected with the rotary section 9 by the first link 5 and the second link 6. When the boom bracket 4 is located close to the center axis "S" of the rotary section 9, the center line "LL" of the rotary section 9 is coincided with or made parallel to a center line "P" of the excavator 22 (see Fig. 1). The state shown in Fig. 1 is kept by the swing cylinder unit 12, which is connected to the first link 5. Note that, this state corresponds to the state of the conventional power shovel shown in Fig. 5 (shown by the solid lines), in which the excavator 33 is located at the center.

By extending and shortening the rod of the swing cylinder unit 12, the first link 5 rightwardly and leftwardly turned round the second link pin 8. Simultaneously, the boom bracket 4, which is pivotably connected to the one end of the first link 5, is rightwardly and leftwardly moved by the first link pin 7. The second link 6, which is pivotably connected to the boom bracket 4, is also turned with the movement of the boom bracket 4. By the first link 5 and the second link 6, the boom bracket 4 can be moved to the right side and the left side of the center line "LL" of the rotary section 9. The moving stroke of the boom bracket 4 depends on the length of the links 5 and 6, etc..

If said link mechanism of the present embodiment is a four-joint parallel link mechanism, the boom bracket 4 is moved parallel to a front edge 9a of the rotary section 9. In this case, the distance between the power shovel and a ditch to be excavated is equal to the moving distance of the boom bracket 4.

However, in the present embodiment, the link mechanism is not the parallel link as described above, the center line "P" of the excavator 22 is slightly turned leftward with respect to the center line "LL" of the rotary section 9 when the boom bracket 4 is moved rightward (see Fig. 4). On the other hand, the center line "P" of the excavator 22 is slightly turned rightward with respect to the center line "LL" of the rotary section 9 when the boom bracket 4 is moved leftward (see Fig. 3). The link mechanism is designed according to the moving stroke of the boom bracket 4, angle between the boom bracket 4 and the center line "LL" of the rotary section 9, the distance between the power shovel and the ditch to be excavated, etc.. Since the link mechanism is not the parallel link mechanism, the excavator 22 can be greatly shifted or offseted with respect to the rotary section 9, the operator in the seat 14 can fully watch the excavator 22, especially the bucket 3, without twisting his neck. Namely, positional interrelationship between the bucket 3 and the operator's seat 14 can be proper.

Action of the power shovel of the present embodiment will be explained with reference to Figs. 1, 3 and 4.

In Fig. 1, the swing cylinder unit 12 is in an intermediate state, so the center line "P" of the excavator 22 is coincided with or parallel to the center line "LL" of the rotary section 9.

In Fig. 3, the rod of the swing cylinder unit 12 is extended, so the first link 5 is turned leftward. Since the link mechanism including the first link 5 and the second link 5 is not the parallel link mechanism, the boom bracket 4 is moved leftward and the excavator 22 is turned rightward by turning the first link 5 leftward. The rotary section 9 is turned leftward, so that a center line "R" of the vehicle section 20 is parallel to the center line "P" of the excavator 22.

When the rod of the swing cylinder unit 12 is extended, the first link 5 is turned round the second link pin 8. Since the boom bracket 4 is pivotably connected to the first link 5 by the first link pin 7, the boom bracket 4 is moved to the left side of the center line "LL" of the rotary section 9 with the movement of the first link 5. Further, the boom bracket 4 is pivotably connected to the second link pin 6 by the third link pin 10, and the second link 6 is pivotably connected to the rotary section 9 by the fourth link pin 11, so the boom bracket 4 is slightly turned rightward with respect to the center line "LL" (see Fig. 3). In this state, the center line "P" of the excavator 22 is parallel to the center line "R" of the vehicle section 9, namely the excavator 22 is made parallel to the running direction of the power shovel. The excavator 22 is properly leftwardly shifted or offseted with respect to the center line "LL" of the rotary section 9.

In Fig. 4, the rod of the swing cylinder unit 12 is shortened or retracted. The first link 5 is turned rightward, so that the boom bracket 4 is moved rightward, and the excavator 22 leftwardly turned with respect to the center line "LL" of the rotary section 9. The rotary section 9 is turned rightward, and the center line "P" of the excavator 22 is parallel to the center line "R" of the vehicle section 20, namely the excavator 22 is made

parallel to the running direction of the power shovel. The excavator 22 is properly rightwardly shifted or offseted with respect to the center line "LL" of the rotary section 9.

Successively, the power shovel of the present embodiment will be compared with the conventional power shovel.

In the conventional power shovel (see Fig. 5), the excavator 35 is rightwardly or leftwardly turned, with respect to the rotary section 30, 90° at the most; the rotary section 30 is turned in the opposite direction 90 ° at the most. So the excavator 30 can be parallel to the vehicle section, namely the excavator 35 is made parallel to the running direction of the power shovel, and a ditch can be excavated parallel to the running direction thereof. In this case, the operator watches the excavator 35 with twisting his body or neck toward the excavator 35 while operating the power shovel.

On the other hand, in the present embodiment (see Figs. 3 and 4), the center line "P" of the excavator 22 is slightly turned rightward of leftward with respect to the center line "LL" of the rotary section 9 when the boom bracket 4 is moved rightward or leftward with respect to the rotary section 9. The operator's seat is usually located in the vicinity of the center of the rotary section 9, so the operator feels as if the excavator 22 turns round the operator's seat 14. And the operator can fully watch the excavator 22, especially the bucket 3, from the operator's seat 14 without twisting his body or neck. Without twisting the body or the neck, the operator can work in an easy and comfortable posture. Further, the excavator 22 is slightly turned with respect to the center line "LL" of the rotary section 9, on which the operator sits, so the operator can fully watch the excavator 22. With this structure, the operator can easily and safely operate the power shovel without accident and misoperation.

Further, in the present embodiment, the non-parallel link mechanism is employed, so the excavator 22 is slightly turned rightward or leftward with respect to the center line "LL" of the rotary section 9 when the boom bracket 4 is moved righward and leftward with respect thereto. By this action, the excavator 22 can be greatly shifted or offseted sideward with respect to the rotary section 9. If the link mechanism including the first link 5 and the second link 6 is the parallel link, effective offset distance of the excavator 22 will be only "L1" (see Fig. 3); in the case of non-parallel link of the present embodiment, the excavator 22 can be greatly shifted with distance "L2" (see Fig. 2).

However, in the present invention, the link mechanism may be the parallel link mechanism; and the length of the first link 5 and the second link 6 may be mutually different if the excavator 22 can be properly shifted to one side. In both cases too, the operator can fully watch the excavator without twisting his body or neck, so safe and comfortable operation can be executed as well as the above described embodiment.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appendix claims rather than by the foregoing description and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

Claims

1. In a power shovel comprising: a vehicle section (20); a rotary section (9) being provided on said vehicle section (20), said rotary section (9) being capable of rotating in a rotational plane, which is parallel to a plane in which said vehicle section (20) runs; and an excavator (22) being provided to said rotary section (9), said excavator (22) having a bucket (3), an arm (2) and a boom (1),

   wherein the improvement comprises:

   a boom bracket (4) connecting a rear end of the boom (1) of said excavator (22) to said rotary section (9);
   a first link (5) whose one end is pivotably connected to one end of said boom bracket (4) and whose the other end is pivotably connected to one side of said rotary section (9), said first link (5) being capable of moving in a plane parallel to the rotational plane;
   a second link (6) whose one end is pivotably connected to the other end of said boom bracket (4) and whose the other end is pivotably connected to the other side of said rotary section (9), said second link (6) being capable of moving in a plane parallel to the rotational plane; and
   a cylinder unit (12) whose one end is pivotably connected to said first link (5) or said second link (6) and whose the other end is pivotably connected to said rotary section (9), said cylinder unit (12) being capable of shifting said excavator (22) sideward.

2. The power shovel according to claim 1,

   wherein a distance between the one end of said first link (5) and the one end of said second link (6), which are pivotably connected to said boom bracket (4), is shorter than a distance between the other end of said first link (5) and the other end of said second link (6), which are pivotably connected to said rotary section (9).

FIG.1

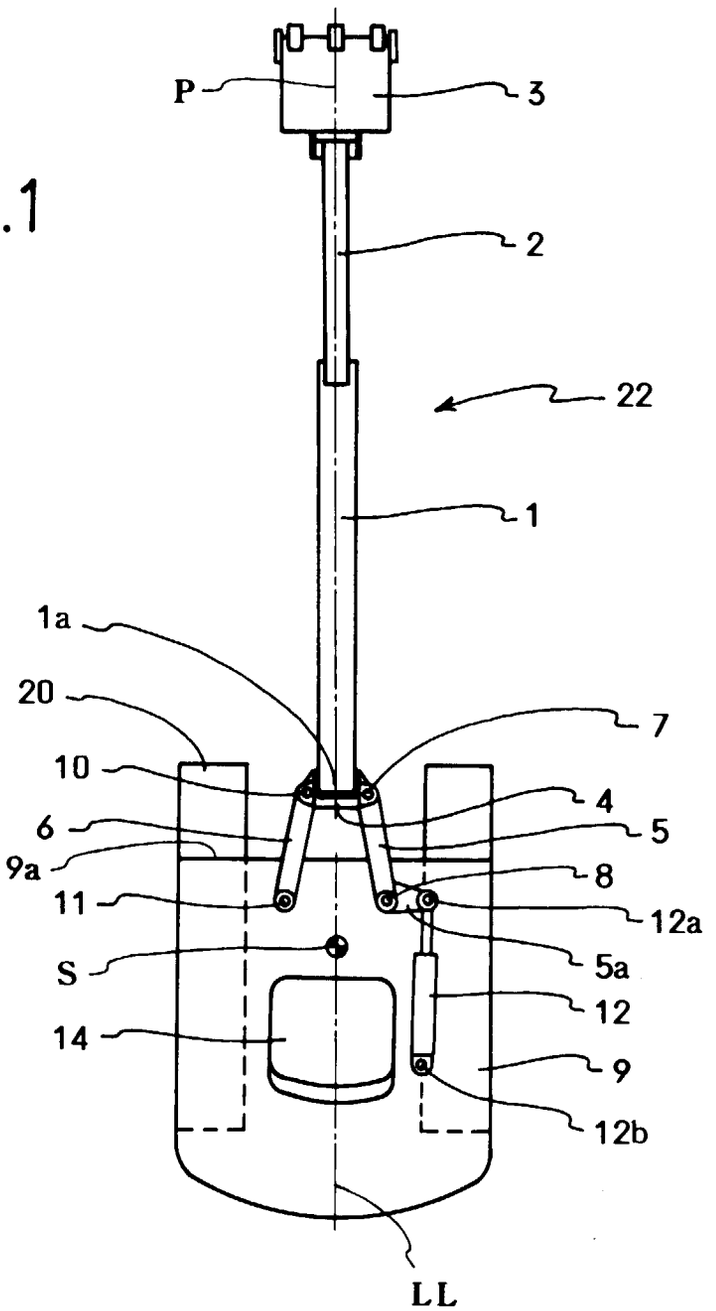


FIG. 2

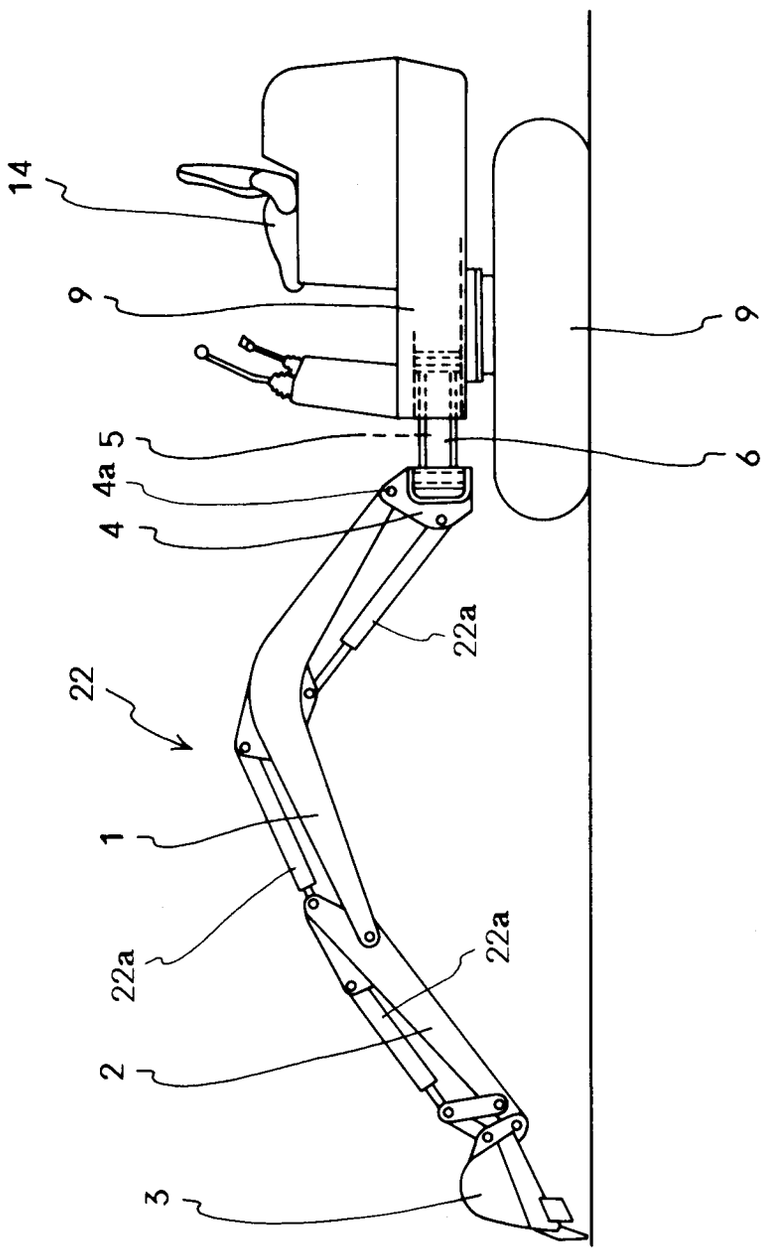


FIG.3

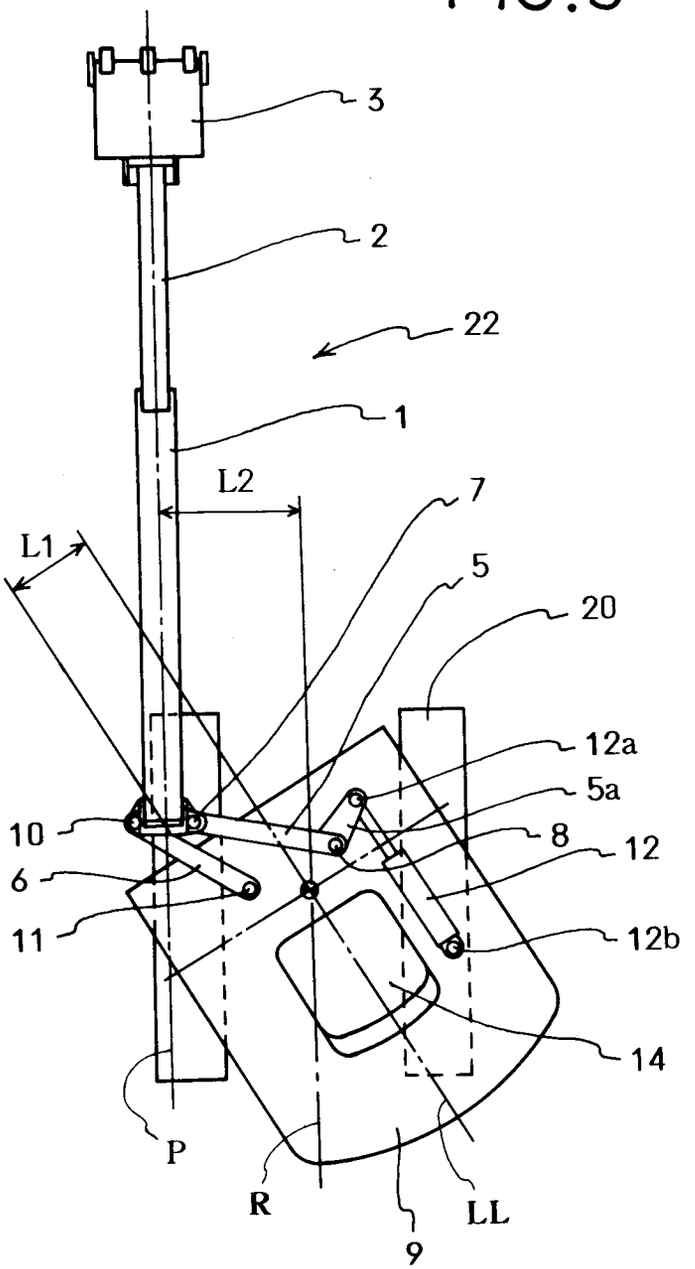


FIG.4

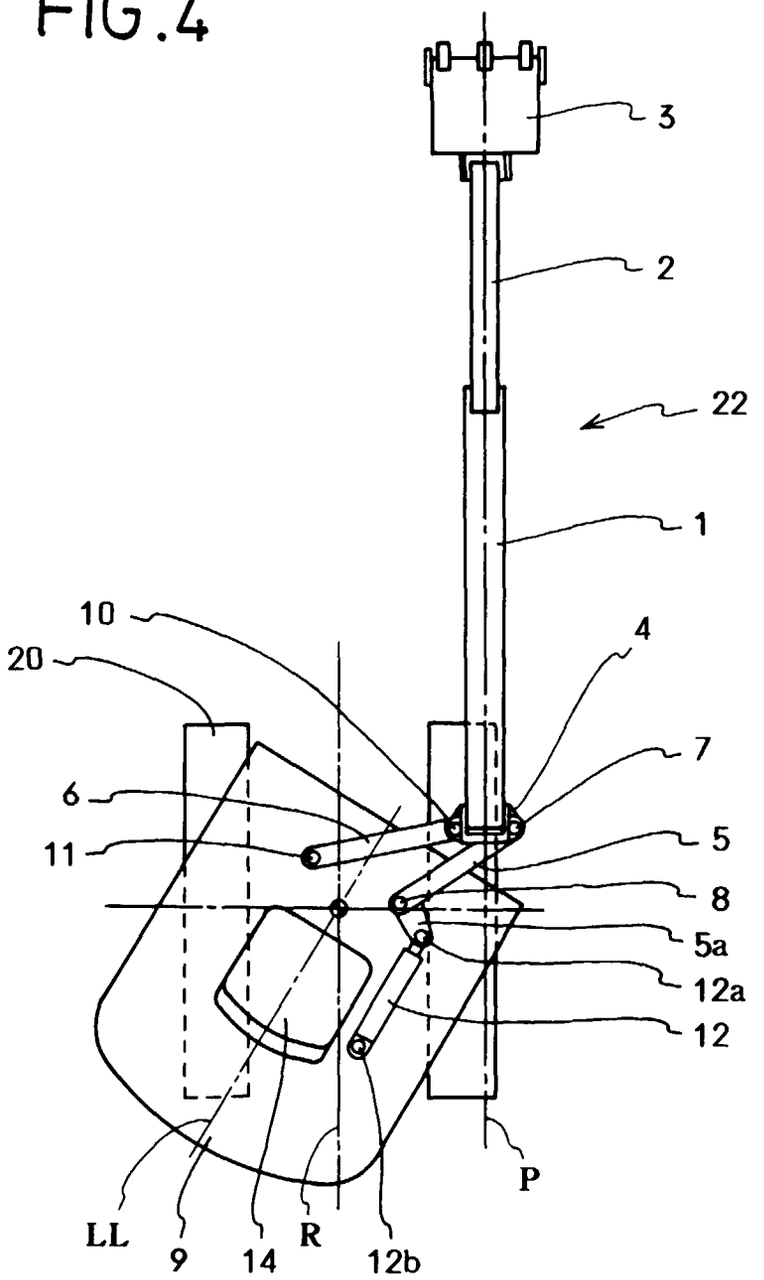


FIG.5

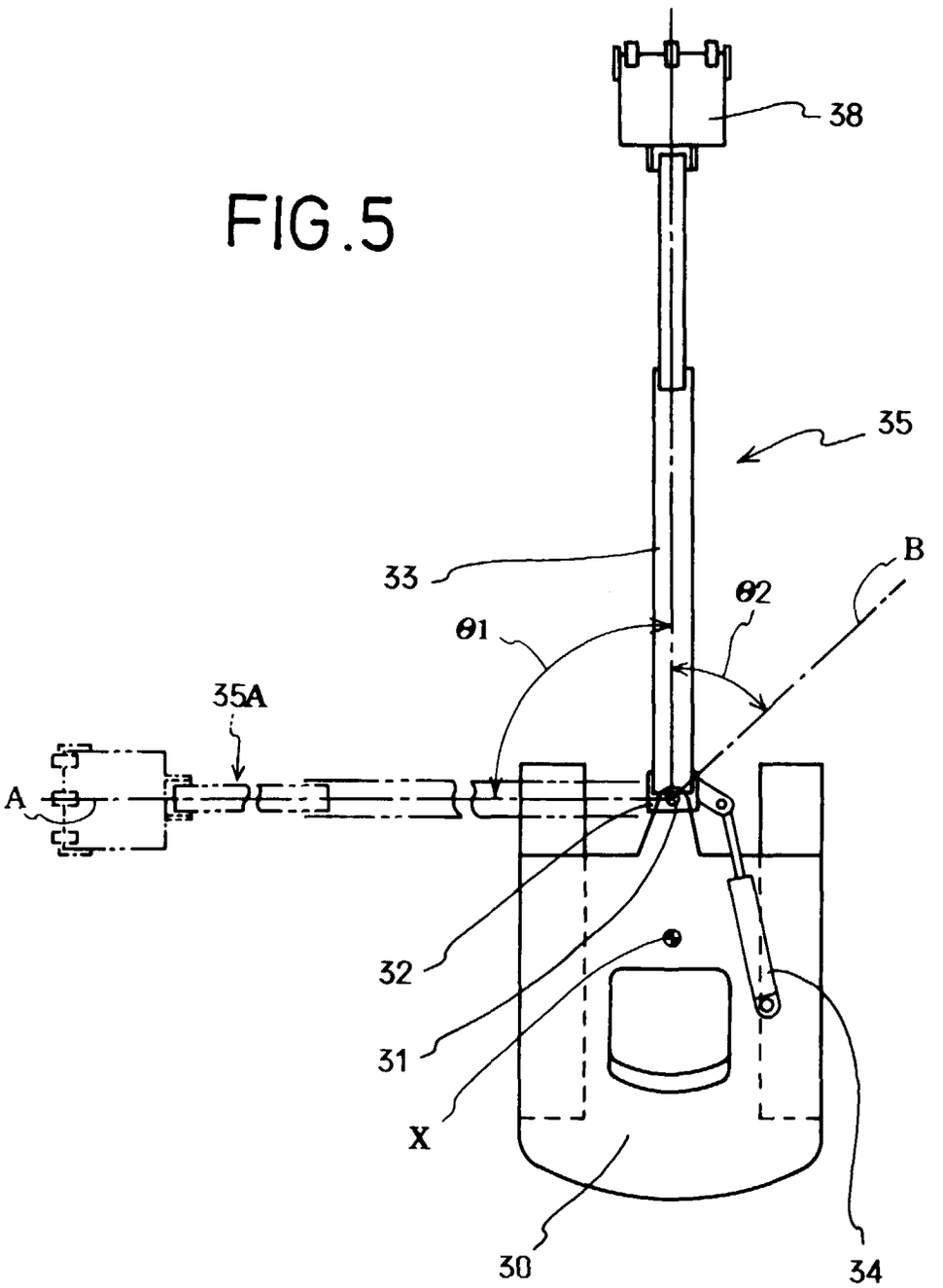
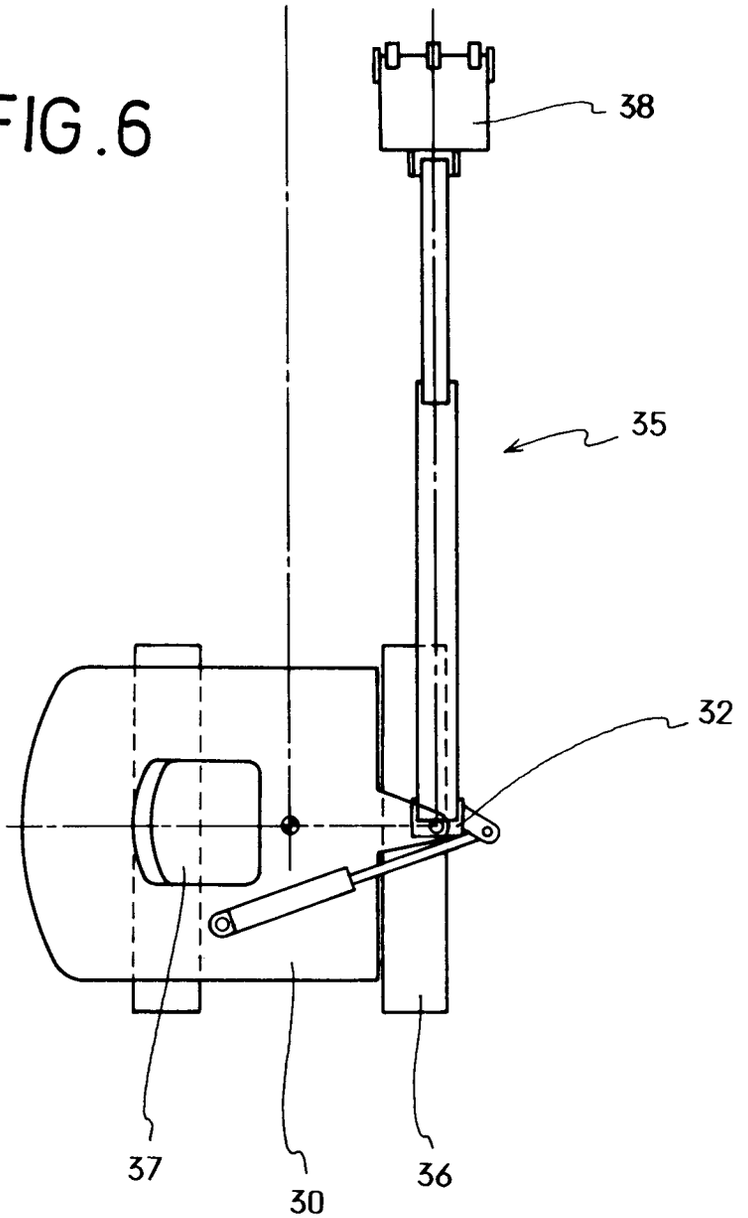


FIG.6



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EUROPEAN SEARCH REPORT

Application Number
EP 97 30 5346

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	GB 2 180 522 A (SCHAEFF KARL GMBH & CO) * figures 4,5 * * page 4, right-hand column *	1	E02F3/38
Y	DE 32 34 020 A (ORENSTEIN & KOPPEL AG) * page 6 - page 7 * * figures *	1,2	
Y	EP 0 176 829 A (MACMOTER SPA) * figures *	1,2	
A	EP 0 440 895 A (PORSCHE AG) * figures 1-4 *	1,2	
A	EP 0 131 939 A (SCHAEFF KARL GMBH & CO) * figures 1,3-5 *	1,2	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

E02F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 November 1997	Guthmuller, J

CATEGORY OF CITED DOCUMENTS

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