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| Patent Right | Date | February 24, 2021 | Court | Intellectual Property High Court, Third Division |
| | Case number | 2020 (Gyo-Ke) 10049 | | |
| - A case in which the court rescinded a JPO decision which invalidated the patent for an invention titled "Work machine" due to violation of the enablement requirement | | | | |

Case type: Rescission of Trial Decision of Invalidation
Result: Granted
References: Article 36, paragraph (4), item (i) of the Patent Act
Related rights, etc.: Patent No. 5976246

Summary of the Judgment

1. This case is a lawsuit seeking rescission of a JPO decision which invalidated the patent for an invention titled "Work machine" due to violation of the enablement requirement, and the issue is whether or not the enablement requirement is satisfied.
2. In this judgment, the court ruled as outlined below, and rescinded the JPO decision, holding that the determination in the JPO decision to the effect that the statement of the detailed explanation of the invention in the description violated the enablement requirement (Article 36, paragraph (4), item (i) of the Patent Act) was erroneous.
(1) The JPO decision determined that it would not be possible to understand the theoretical explanation behind the claimed configuration ("the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases"; hereinafter referred to as "Constituent Feature G") even based on the claim, the description, and the drawings, and so the description fails to satisfy the enablement requirement. However, a person ordinarily skilled in the art would have been able to understand the theoretical explanation behind Constituent Feature G based on the claim, the description, and the drawings as well as the common general technical knowledge of mechanics, and hence the abovementioned determination of the JPO decision is erroneous.
(2) The JPO decision determined that, in order for enablement of Constituent Feature G to be satisfied, it is necessary to explain that Constituent Feature G can be achieved at least when the work machine is on the tilt at the time of the tilling work, and if it can be achieved only under conditions that are not described in the description in question, etc., such as in a position where the work machine is raised and adjusted using the tractor's hydraulic mechanism, it cannot be said that enablement of Constituent Feature G is satisfied. However, in light of the purpose of the invention and other factors that are found based on the statement of the description, such as the problem to be solved by the invention and the effect of the

invention, if Constituent Feature G can be achieved when the work machine is tilted forward and is in a "state where the entire work machine is raised above ground," it is found that enablement of Constituent Feature G is satisfied, and according to evidence, it is found that Constituent Feature G can be achieved in a "state where the entire work machine is raised above ground"; and hence the abovementioned determination of the JPO decision is erroneous.

(3) The JPO decision determined that, in order for enablement of Constituent Feature G to be satisfied, the force required for flipping up the apron needs to decrease to an extent that can be clearly perceived by the apron operator when the work machine is in the position taken at the time of the tilling work, but the force does not decrease to such extent when the work machine is in the position taken at the time of the tilling work, and concluded that enablement of Constituent Feature G is not satisfied. However, as enablement of Constituent Feature G can be satisfied if Constituent Feature G can be achieved in a "state where the entire work machine is raised above ground," the abovementioned determination of the JPO decision cannot be accepted in terms of its premise. In addition, given the meaning of the invention in question, in order to say that Constituent Feature G is achieved, the force required for flipping up the apron needs to gradually decrease to an extent that can be perceived by a general operator as the apron angle increases, and according to evidence, it is found to have been proved that the force gradually decreases to an extent that can be perceived by a general operator, so enablement of Constituent Feature G is found to be satisfied, and hence the abovementioned determination of the JPO decision is erroneous.

(4) The JPO decision determined that it would require a person ordinarily skilled in the art to carry out undue trial and error in working the invention, but the plaintiff is found to have proved by simulation enablement of Constituent Feature G, and there are no circumstances suggesting that undue trial and error was required for obtaining that result, so it is not found that undue trial and error was required for a person ordinarily skilled in the art to achieve the configuration of Constituent Feature G, and hence the abovementioned determination of the JPO decision is erroneous.

(5) The JPO decision determined that it cannot be said that the invention could have been worked also given that the plaintiff's explanations in the trial for invalidation were inconsistent and changed several times, but in light of the progress of proceedings of the trial for invalidation, it cannot be found that the plaintiff provided a theoretical explanation or explained the technical meaning of the invention erroneously or that the plaintiff's explanations changed several times based on the matters pointed out by the JPO decision, and hence the abovementioned determination of the JPO decision is erroneous.

Judgment rendered on February 24, 2021
2020 (Gyo-Ke) 10049 Case of seeking rescission of the JPO decision
Date of conclusion of oral argument: December 17, 2020

Judgment

Appellant: Kobashi Industries Co., Ltd.

Appellee: Matsuyama Plow Mfg. Co., Ltd.

Main text

1. The decision made by the JPO on March 23, 2020 for the case of Invalidation Trial No. 2018-800039 shall be rescinded.
2. The Defendant shall bear the court costs.

Facts and reasons

No. 1 Claims

Same as the main text.

No. 2 Outline of the case

1. Outline of procedures at the JPO, etc.

(1) The Plaintiff is the patentee of the patent for an invention titled "Work machine" (Patent No. 5976246; the patent concerning Patent Application No. 2016-46843, which was filed on March 10, 2016, as a new patent application resulting from division of Patent Application No. 2015-174637 filed on September 4, 2015 (original application); date of registration of establishment: July 29, 2016; number of claims: 1; hereinafter referred to as the "Patent").

(2) The Defendant filed a request for a trial for invalidation of the Patent (the patent for the invention claimed in Claim 1) with the JPO on April 13, 2018, and the JPO examined the case concerning the abovementioned request as Invalidation Trial No. 2018-800039 (hereinafter referred to as the "Trial for Invalidation"). The Plaintiff filed a request for correction on August 30, 2019 (hereinafter referred to as the "Correction") (Exhibits Ko 87-1 and 87-2).

On March 23, 2020, the JPO rendered a decision concluding that "the claim of Patent No.5976246 shall be allowed to be corrected according to the corrected claim attached to the written request for correction; the patent for the invention claimed in Claim 1 of Patent

No.5976246 shall be invalidated; and the respondent shall bear the costs of the trial" (hereinafter referred to as the "JPO Decision"), and a certified copy of the decision was served upon the Plaintiff on April 1, 2020.

(3) On April 21, 2020, the Plaintiff filed this lawsuit to seek rescission of the JPO Decision.

2. Statement of the claim

The statement of Claim 1 in the claim after the Correction is as follows (the division of the claim into constituent features A through J was adopted in the JPO Decision (page 8 of the JPO Decision); the invention claimed in Claim 1 after the Correction is hereinafter referred to as the "the Invention").

[A] A work machine which is attached to the rear part of a traveling machine body and which tills a farm field by advancing along with the forward traveling of said traveling machine body while rotating a tilling rotor, wherein:

[B] said work machine comprises a frame connected to said traveling machine body and

[C] further comprises an apron, which is provided behind said frame and capable of being lowered or flipped up in a pivotal movement around a first fulcrum fixed to said frame and whose center of gravity is positioned behind said first fulcrum,

[D] and an assist mechanism that includes a gas spring, which is provided between a second fulcrum fixed to said frame and a third fulcrum fixed to said apron and which applies a force in the direction of flipping up said apron by applying a force that changes the distance between said second fulcrum and said third fulcrum;

[J] said gas spring has a cylinder, a piston inserted inside said cylinder, and a piston rod extended from said piston;

[E] said assist mechanism further has a first cylindrical member and a second cylindrical member which are movable on the same axis that passes through said second and third fulcra and in which said gas spring is located,

[F] one end of said first cylindrical member on said frame's side has said second fulcrum connected thereto, the other end of said first cylindrical member on said apron's side has the tip of said piston rod connected thereto, and one end of said second cylindrical member on said frame's side has the tip of said cylinder connected thereto;

[G] as a first projecting part provided in a protruding manner on the circumference of said second cylindrical member contacts a second projecting part that pivots around said third fulcrum and that is provided on said apron via a pedestal and changes in the direction of reducing the distance between said third fulcrum and said second fulcrum, the force required for flipping up said apron gradually decreases within a predetermined angle range in which the apron angle increases; and

[H] said gas spring is configured to contract at the point where said apron is lowered,

[I] as characteristics of the work machine.

3. Summary of the reasons for the JPO Decision

(1) In the Trial for Invalidation, the Plaintiff alleged the following reasons for invalidation (page 9 of the JPO Decision).

A. Invalidation Reason 1

The Invention is the invention relating to Object of Observation Ko 1 ("Niplo Grand Rotary SKS2000 (serial number: 1007)" manufactured by the Defendant), which was public knowledge or publicly known to be worked prior to the filing of the Patent, so it falls under Article 29, paragraph (1), items (i) and (ii) of the Patent Act and cannot be patented.

Even if the Invention was not the invention relating to Object of Observation Ko 1 per se, it is still an invention which a person ordinarily skilled in the art would have easily been able to make based on that invention, so it cannot be patented, pursuant to the provisions of Article 29, paragraph (2) of the Patent Act.

B. Invalidation Reason 2

The Invention is an invention which a person ordinarily skilled in the art would have easily been able to make based on the invention described in Exhibit Ko 14, so it cannot be patented, pursuant to the provisions of Article 29, paragraph (2) of the Patent Act.

C. Invalidation Reason 3

The Invention is the same as the invention described in the description, claims or drawings originally attached to the written application of Exhibit Ko 18, which is another patent application that was filed prior to the filing date of the Patent and that was published after the filing of the application for the Patent; further, the inventor of the invention in the application for the Patent is not the same as the inventor of the invention in that other patent application, and the applicant at the time of filing the application for the Patent is also not the same as the applicant of that other patent application . Therefore, the Invention cannot be patented, pursuant to the provisions of Article 29-2 of the Patent Act.

D. Invalidation Reason 4

The statement of the detailed explanation of the invention in the description attached to the written application of the patent application for the Patent (hereinafter referred to as "the Description"; the contents thereof are as described in the attached patent gazette) fails to be clear and sufficient to enable a person ordinarily skilled in the art to work the Invention, so it fails to satisfy the requirement prescribed in Article 36, paragraph (4), item (i) of the Patent Act.

(2) The reasons for the JPO Decision are as described in the attached written trial decision

(copy), and the summary of the determination on each reason for invalidation is as follows.

A. Regarding Invalidation Reason 1

The Invention is neither an invention which was public knowledge or publicly known to be worked prior to the filing of the original application for the Patent nor is one which a person ordinarily skilled in the art would have easily been able to make based on such invention (page 93 of the JPO Decision).

B. Regarding Invalidation Reason 2

The Invention is not an invention which a person ordinarily skilled in the art would have easily been able to make based on the invention described in Exhibit Ko 14 or the matters described in Exhibits Ko 23 through 30 (page 95 of the JPO Decision).

C. Regarding Invalidation Reason 3

As the Invention is not the same as the invention described in the description, claims or drawings originally attached to the written application of Exhibit Ko 18, which is another patent application that was filed prior to the filing date of the Patent and that was published after the filing of the application for the Patent, the Invention is not the invention described in Exhibit Ko 18, which is the description of a prior application (page 100 of the JPO Decision).

D. Regarding Invalidation Reason 4

As the statement of the detailed explanation of the invention in the Description fails to be clear and sufficient to enable a person ordinarily skilled in the art to achieve the configuration that "the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases" (Constituent Feature G), the statement violates the provisions of Article 36, paragraph (4), item (i) of the Patent Act (page 88 of the JPO Decision).

4. Grounds for rescission of the Plaintiff's claim

Error in the determination concerning Article 36, paragraph (4), item (i) of the Patent Act (regarding Invalidation Reason 4)

(omitted)

No. 5 Summary of the court decision

1. Whether the decision made by the JPO is erroneous

Regarding Invalidation Reason 4 alleged in the Trial for Invalidation, the JPO Decision determined that the statement of the detailed explanation of the invention in the Description fails to be clear and sufficient to enable a person ordinarily skilled in the art to achieve the configuration of Constituent Feature G of the Invention that "the force

required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases," and so it violates the provisions of Article 36, paragraph (4), item (i) of the Patent Act (line 1 on page 83 to line 28 on page 88 of the JPO Decision). However, this court determines that the abovementioned determination of the JPO Decision is erroneous. The determinations indicated by the JPO Decision as reasons based on which the Description fails to satisfy the enablement requirement are described in detail below.

2. Regarding the theoretical explanation behind Constituent Feature G

(1) Determination in the JPO Decision

A. The JPO Decision made a determination on the enablement requirement regarding paragraph [0028] of the Description and [Figure 7] as follows.

"However, according to the abovementioned statement, if the apron starts to be raised under 'the positional relationship of the respective fulcra in the abovementioned working example,' 'an increase in the moving distance of the fulcrum 152 against a predetermined rotation angle' as explained by the respondent inevitably occurs, and because of the increase in the moving distance, 'a reverse characteristic (the force 1 applied by the assist mechanism increases as the apron angle increases) is exhibited' as a result due to the 'principle of leverage.' However, 'the positional relationship of the respective fulcra in the abovementioned working example' under which the abovementioned reverse characteristic is to be exhibited is not described in the description of the Patent, so a person ordinarily skilled in the art would not be able to understand what kind of positional relationship of the respective fulcra would cause the abovementioned reverse characteristic to be exhibited.

Moreover, in the explanation, the relationship between the fact that 'there will be an increase in the moving distance of the fulcrum 152 against a predetermined rotation angle' and the 'principle of leverage' as well as the fact that 'a reverse characteristic (the force 1 applied by the assist mechanism increases as the apron angle increases) is exhibited' is also unclear." (lines 2 to 14 under the figure on page 84 of the JPO Decision)

B. In addition, the JPO Decision made a determination on the enablement requirement regarding the principle of leverage as follows.

"In contrast, regarding the 'principle of leverage,' the respondent alleges as follows:

'the logic that the "assist force" gradually increases as the apron angle increases in the Invention is that "the force of the gas spring itself (F) becomes smaller ($F_1>F_2$) as the apron angle increases, but the difference of the force is small, whereas the percentage by which the value of $\sin\theta$ increases ($\sin\theta_1<\sin\theta_2$) as the apron angle increases is larger," so at the point of action of the "principle of leverage" (the position of the center of gravity

of the apron), the force applied in the direction of raising the apron (assist force) becomes larger ($F_1\sin\theta_1 < F_2\sin\theta_2$) as the apron angle increases' (No. 4, 3. (4) A. and C. above).

However, the abovementioned formulae and their explanation were not described in the Description, etc. in the first place, and it cannot be found that a person ordinarily skilled in the art who comes in contact with the term 'principle of leverage' would gain an understanding as described in the abovementioned formulae and explanation.

In particular, the abovementioned formulae merely indicate the conditions required for the assist force to become larger as the apron angle increases, and a person ordinarily skilled in the art would not be able to easily understand how to set abovementioned F and $\theta$ under those conditions.

Under the output characteristics of a common gas spring or the apron angle used in ordinary work, 'the percentage by which the value of $\sin\theta$ increases ($\sin\theta_1 < \sin\theta_2$) as the apron angle increases' does not necessarily become 'larger' than the percentage by which 'the force of the gas spring itself (F) becomes smaller ($F_1 > F_2$) as the apron angle increases.' On such basis, a sufficient explanation has not been provided as to whether the decreasing tendency as expressed by 'the force of the gas spring itself (F) becomes smaller ($F_1 > F_2$) as the apron angle increases' and the increasing tendency as expressed by 'the percentage by which the value of $\sin\theta$ increases ($\sin\theta_1 < \sin\theta_2$) as the apron angle increases is larger' can be obtained according to conditions such as the arrangement of the respective fulcra and the output characteristics of the gas spring, and regarding how the decreasing tendency of the force of the gas spring itself (F) and the increasing tendency of the value of $\sin\theta$ balance with each other to cause the assist force to become 'larger ($F_1\sin\theta_1 < F_2\sin\theta_2$) as the apron angle increases.'

Therefore, it is found that the abovementioned formulae and their explanation are not described in the Description, etc., and even if a person ordinarily skilled in the art were to work the Invention based on the abovementioned formulae and explanation, it would require the person to carry out undue trial and error.

Accordingly, even if the abovementioned formulae and their explanation are taken into consideration, it cannot be said that the Description, etc. describe the Invention to an extent that the Invention can be enabled." (line 15 under the figure on page 84 to line 32 on page 85 of the JPO Decision)

(2) Whether the determination is erroneous

A. The import of the determination of the JPO Decision in (1) above is found to be that a person ordinarily skilled in the art would not be able to understand the theoretical explanation behind the configuration of Constituent Feature G that "the force required for flipping up the apron gradually decreases within a predetermined angle range in which

the apron angle increases," even based on Claim 1, the Description, and the drawings attached to the written application of the patent application for the Patent after the Correction, and so the Description fails to satisfy the enablement requirement.

B. However, a person ordinarily skilled in the art is found to have been able to understand the theoretical explanation behind the configuration of Constituent Feature G that "the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases," based on Claim 1, the Description, and the drawings attached to the written application of the patent application for the Patent after the Correction as well as the common general technical knowledge of mechanics, and hence the abovementioned determination of the JPO Decision is erroneous. The reasons are as described in (3) below.

(3) Reasons

A. Structure of the work machine claimed in the Invention

According to Claim 1, the Description, and the drawings attached to the written application of the patent application for the Patent after the Correction, the structure of the work machine claimed in the Invention is found to be as follows.

(A) Overall structure of the work machine

The Invention relates to a "work machine" "which is attached to the rear part of a traveling machine body and which tills a farm field by advancing along with the forward traveling of said traveling machine body while rotating a tilling rotor" (Constituent Feature A), which comprises "a frame connected to said traveling machine body" (Constituent Feature B) and further comprises an "apron" "which is provided behind said frame" (Constituent Feature C) and "an assist mechanism that includes a gas spring" "fixed to said frame" (Constituent Feature D), while the "working example" of the Description (paragraphs [0016] to [0021]), along with [Figure 1] to [Figure 3], which indicate the overall structure of the work machine, describes the specific structure of the "work machine 100," which comprises a frame (a main frame 110 and a shield cover 120), a tilling rotor 102, an apron103, and an apron flip-up assist mechanism 141.

(B) Structure of the "assist mechanism including a gas spring"

The "assist mechanism" comprised in the work machine of the Invention is provided between a "second fulcrum" "fixed to said frame" and a "third fulcrum" "fixed to said apron," and "applies a force in the direction of flipping up said apron by applying a force that changes the distance between said second fulcrum and said third fulcrum" (Constituent Feature D), while paragraph [0021] of the Description, along with [Figure 2] and [Figure 3], which show side views of the work machine, describes the specific structure in which an assist mechanism 141 is provided between a "fulcrum 151" (second

fulcrum) and a "fulcrum 152" (third fulcrum).

(C) Structure of the "apron"

The "apron" comprised in the work machine of the Invention is "capable of being lowered or flipped up in a pivotal movement around a first fulcrum fixed to said frame" and "whose (the apron's) center of gravity is positioned behind said first fulcrum" (Constituent Feature C), while paragraph [0020] of the Description, along with [Figure 2] and [Figure 3], which show side views of the work machine, describes the specific structure of making an apron130 capable of pivoting around a "fulcrum 140" (first fulcrum).

B. Theoretical explanation behind Constituent Feature G

Taking into consideration the common general technical knowledge of mechanics and in light of the structure of the work machine claimed in the Invention referred to in A. above, the theoretical explanation for deriving the configuration of Constituent Feature G that "the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases," is found to be as follows (Regarding (A) through (C) below, see the figure on page 5 of Attached Figure 1 (Exhibit Ko 60 (Trial Exhibit Otsu 14))).

(A) Force required for flipping up the apron

While the apron operator (worker), when raising the apron, grasps the lower end of the apron by hand and raises the apron with force, the "force required for flipping up the apron" in Constituent Feature G is literally found to mean the upward perpendicular force applied at the position of the apron to be grasped by hand ($F_s$).

Then, when examining the force to be applied to the apron when raising the apron, not only the "force required for flipping up the apron" ($F_s$), but also the gravity that acts vertically on the center of gravity of the apron (W) and the assist force that acts on the third fulcrum in the direction of the second fulcrum ($F_g$) are applied.

(B) Moment around the first fulcrum

a. However, as the apron has a structure to pivot around the first fulcrum, the force applied to the apron acts as the moment around the first fulcrum.

b. Supposing that the angle of a straight line connecting the first fulcrum and the position for raising the apron (the position where the apron operator grasps it to raise the apron) against the vertical direction is $\beta$, the angle of a straight line connecting the first fulcrum and the center of gravity of the apron against the vertical direction is $\alpha$, and the angle of a straight line connecting the first fulcrum and the third fulcrum against a straight line connecting the second fulcrum and the third fulcrum is $\theta_a$, and with regard to the force that acts in the direction perpendicular to the radius of a circle centered on the first fulcrum,

the force that acts on the position for raising the apron is $F_u$, the force that acts on the third fulcrum is $F_a$, and the force that acts on the center of gravity of the apron is $F_w$, then the force that acts on each of these points in the direction perpendicular to the radius of a circle centered on the first fulcrum can be expressed as follows:

$F_u=F_s \cdot \sin\beta \quad F_a=F_g \cdot \sin\theta_a \quad F_w=W \cdot \sin\alpha$

Here, $F_u$ and $F_a$ are upward forces and $F_w$ is a downward force.

c. In addition, supposing that the distance from the first fulcrum to the position for raising the apron is R, the distance from the first fulcrum to the third fulcrum is $R_a$, and the distance from the first fulcrum to the center of gravity of the apron is $R_w$, and with regard to the moment around the first fulcrum (the product of the distance from the first fulcrum and the force), the moment at the position for raising the apron is $T_u$, the moment at the third fulcrum is $T_a$, and the moment at the center of gravity of the apron is $T_w$, then the moment around the first fulcrum (the product of the distance from the first fulcrum and the force) at each of these points can be expressed as follows:

$T_u=R \cdot F_u \quad T_a=R_a \cdot F_a \quad T_w=R_w \cdot F_w$

Here, $T_u$ and $T_a$ are upward moments and $T_w$ is a downward moment.

d. When raising the apron, the upward moment around the first fulcrum becomes larger than the downward moment, so the formula $T_u+T_a>T_w$ holds. If the terms referred to in c. above are applied to this formula, the following can be derived:

$R \cdot F_u+R_a \cdot F_a>R_w \cdot F_w$

If the terms referred to in b. above are further applied to this, the following can be derived:

$R \cdot F_s \cdot \sin\beta+R_a \cdot F_g \cdot \sin\theta_a>R_w \cdot W \cdot \sin\alpha$

This can be rearranged to express the "force required for flipping up the apron" ($F_s$) as follows:

$$F_s > \frac{(R_w \cdot W \cdot \sin\alpha - R_a \cdot F_g \cdot \sin\theta_a)}{R \cdot \sin\beta}$$

(C) Apron angle

Supposing that the angle of the apron against a straight line passing through the first fulcrum is $\theta$, and assuming $\theta=0°$ when the apron is in the lowest lowered state, if the angle of a straight line connecting the first fulcrum and the position for raising the apron against the vertical direction in such state is $\beta_0$, and the angle of a straight line connecting the first fulcrum and the center of gravity of the apron against the vertical direction is $\alpha_0$, the formulae $\beta=\theta+\beta_0$ and $\alpha=\theta+\alpha_0$ hold. If these are applied to the last formula referred to in (B) d. above, the following can be derived:

$$Fs > \frac{(Rw \cdot W \cdot sin(\theta + \alpha 0) - Ra \cdot Fg \cdot sin\theta a)}{R \cdot sin(\theta + \beta 0)}$$

(D) Configuration that the "force required for flipping up the apron" "gradually decreases within a predetermined angle range in which the apron angle increases"

a. The "force required for flipping up the apron" ($F_s$) can be expressed by the formula shown in (C) above, and apron angle θ increases as the apron is raised (angle $\theta_a$ also increases as the apron is raised, but its percentage of increase differs from that of apron angle θ), so the configuration of Constituent Feature G that "the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases" is found to be a configuration where, in the formula shown in (C) above, $F_s$ gradually decreases within a predetermined angle range in which θ increases.

b. Among the terms in the formula shown in (C) above, the gravity that acts vertically on the center of gravity of the apron W ((A) above), the distance from the first fulcrum to the center of gravity of the apron $R_w$ ((B) c. above), the distance from the first fulcrum to the position for raising the apron R ((B) c. above), the distance from the first fulcrum to the third fulcrum Ra ((B) c. above), the angle of a straight line connecting the first fulcrum and the position for raising the apron against the vertical direction when the apron is in the lowest lowered state (when θ=0°) $\beta_0$ ((C) above), and the angle of a straight line connecting the first fulcrum and the center of gravity of the apron against the vertical direction $\alpha_0$ ((C) above) can be determined based on the weight, size, shape, etc. of the apron. In addition, with regard to the angle of a line connecting the first fulcrum and the third fulcrum against a line connecting the third fulcrum and the second fulcrum $\theta_a$ (it increases as the apron is raised, but its percentage of increase differs from that of apron angle θ), the angle when the apron is lowered to its lowest state (when θ=0°) $\theta_{a0}$ can also be determined based on the weight, size, shape, etc. of the apron. Moreover, the assist force that acts on the third fulcrum ($F_g$) ((A) above) is, according to Constituent Feature D of the Invention, a force that acts in the direction of flipping up the apron as a result of changing the distance between the second fulcrum and the third fulcrum with the use of the gas spring, and it can be set by selecting a gas spring having appropriate characteristics in terms of repulsion and extension.

As above, it is found that, by appropriately setting the terms in the formula shown in (C) above, other than θ, and achieving a configuration where $F_s$ gradually decreases within a predetermined angle range in which θ increases, the configuration of Constituent Feature G that "the force required for flipping up the apron gradually decreases within a

predetermined angle range in which the apron angle increases" would be achieved.

C. Recognition of the theoretical explanation

Taking into consideration the common general technical knowledge of mechanics and in light of the structure of the work machine claimed in the Invention, as mentioned in B. above, the configuration of Constituent Feature G that "the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases" is found to be a configuration where, in the formula shown in B. (C) above [page 27 of this judgment], $F_s$ gradually decreases within a predetermined angle range in which $\theta$ increases.

Indeed, the facts that the "force required for flipping up the apron" ($F_s$) can be expressed by the formula shown in B. (C) above and that the configuration of Constituent Feature G that "the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases" is a configuration where, in the formula shown in B. (C) above, $F_s$ gradually decreases within a predetermined angle range in which $\theta$ increases, are not directly described in Claim 1 of the Patent or the Description.

However, in the Trial for Invalidation, the Defendant showed Attached Figure 3 on page 26 of the summary of the statements in oral proceedings dated September 25, 2018 (Exhibit Ko 71), conducted the mechanical verification on pages 42 to 49 of the summary of the statements in oral proceedings (2) dated February 7, 2019 (Exhibit Ko 76), and showed in line 6 on page 48 thereof that the following formula ("formula (12)") holds when the upward moment and the downward moment are equal:

$R \cdot F_s \cdot \sin\beta = R_w \cdot W \cdot \sin\alpha - R_a \cdot F_g \cdot \sin A$ (formula (12))

(In formula (12) above, R, $F_s$, $R_w$, $R_a$, $F_g$, angle $\alpha$, and angle $\beta$ are the same as those mentioned in B. above, and angle A in formula (12) is the same as angle $\theta_a$ mentioned in B. (B) b. above [page 26 of this judgment]. Based on formula (12) above, the relationship of the moments when the upward moment is larger than the downward moment can be expressed as $R \cdot F_s \cdot \sin\beta + R_a \cdot F_g \cdot \sin\theta_a > R_w \cdot W \cdot \sin\alpha$, which is the same as the formula "$R \cdot F_s \cdot \sin\beta + R_a \cdot F_g \cdot \sin\theta_a > R_w \cdot W \cdot \sin\alpha$" shown in B. (B) d. above [page 27 of this judgment].) Then, on page 11 of the summary of the statements in oral proceedings (4) dated March 1, 2019 (Exhibit Ko 82), the Defendant showed that the abovementioned formula ("formula (12)") can be transformed into the following formula.

$F_s = (R_w \cdot W \cdot \sin\alpha - R_a \cdot F_g \cdot \sin A) / (R \cdot \sin\beta)$

(In the abovementioned formula, R, $F_s$, $R_w$, $R_a$, $F_g$, angle $\alpha$, and angle $\beta$ are the same as those mentioned in B. above, and angle A in the abovementioned formula is the same as angle $\theta_a$ mentioned in B. (B) b. above [page 26 of this judgment]. Except for the difference

between an equality sign and an inequality sign, the abovementioned formula is the same as the formula rearranged to express $F_s$ in B. (B) d. above [page 27 of this judgment].)

On page 6 of Exhibit Ko 60 (Trial Exhibit Otsu14), which is a written statement dated March 22, 2019 prepared by the Plaintiff's workers, the Plaintiff indicated that it will adopt the abovementioned formula, which was presented by the Defendant as the calculation method for the "force required for flipping up the apron" ($F_s$) in Constituent Feature G, and simulated the relationship between the "force required for flipping up the apron" ($F_s$) and the apron angle θ. The Plaintiff also conducted a simulation based on a similar concept in Exhibit Ko 64 (Trial Exhibit Otsu 18), which is a written statement dated August 22, 2019 prepared by the Plaintiff's workers. Meanwhile, the formula written on page 6 of Exhibit Ko 60 (Trial Exhibit Otsu 14) is as follows, and although $F_g$ is expressed as $F_G$, the contents of the formula are the same as those of the abovementioned formula, which the Defendant showed on page 11 of the summary of the statements in oral proceedings (4) (Exhibit Ko 82).

$$\therefore\ Fs = (Tw - Ta) \diagup (R \cdot \sin\beta)$$
$$= ((Rw \cdot W \cdot \sin\alpha) - (Ra \cdot FG \cdot \sin\theta a)) \diagup (R \cdot \sin\beta)$$

As angles α, β, and $\theta_a$ change along with apron angle θ as mentioned in B. (C) and (D) above [page 27 of this judgment] (however, whereas angles α and β increase as much as apron angle θ increases, the percentage of increase of angle $\theta_a$ differs from that of apron angle θ), this formula shows the relationship between the "force required for flipping up the apron" ($F_s$) and the apron angle, and the parties did not dispute this point.

In this way, in the Trial for Invalidation, the specific contents of the theoretical explanation for the configuration of Constituent Feature G that "the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases" were presented by the Defendant on the basis of the structure of the work machine claimed in the Invention and common general technical knowledge of mechanics, and based on this, the Plaintiff simulated a specific example that achieves Constituent Feature G and specifically showed that Constituent Feature G can be achieved, as mentioned in 5. below [page 47 of this judgment].

On such basis, it can be found that a person ordinarily skilled in the art would have been able to recognize the theoretical explanation for the configuration of Constituent Feature G that "the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases" by taking into

consideration the common general technical knowledge of mechanics and referring to the structure of the work machine claimed in the Invention which can been identified from the statement of Claim 1 and the Description after the Correction.

D. Statement of paragraph [0028] of the Description

(A) The statement of paragraph [0028] of the Description is as follows.

"[0028]

［Relationship between the assist operation force and the apron angle］

Figure 7 shows a graph indicating the relationship between the assist operation force and the apron angle (the results of actual measurement using a tilling work machine manufactured and sold by the applicant). It can be understood that, when the assist mechanism does not function, a fairly constant load starts to be applied as the apron angle (the apron angle is defined as the angle at which the apron pivots starting from the lowest lowered state, which is regarded as 0°) exceeds approximately 10°. On the other hand, when the assist mechanism functions, the load starts to decrease almost linearly at the apron angle of nearly 0°. Then the load becomes zero at the apron angle of about 60°. In other words, from the worker's perspective, the apron gradually becomes lighter. Such tendency of the load is observed due to the positional relationship of the respective fulcra in the abovementioned working example. In the gas spring 250 explained above, the force in the compressed state is larger than the force in the extended state; however, as the fulcrum 152 approaches the fulcrum 151, there will be an increase in the moving distance of the fulcrum 152 against a predetermined rotation angle, so a reverse characteristic (the force 1 applied by the assist mechanism increases as the apron angle increases) is exhibited due to the 'principle of leverage.'"

(B) Taking into consideration the common general technical knowledge of mechanics and in light of the structure of the work machine claimed in the Invention, as can be found from the statement of Claim 1 and the Description after the Correction, it is found that the statement of paragraph [0028] of the Description can be understood as follows.

a. Specifically, the statement of paragraph [0028] of the Description discusses the force that assists the force to raise the apron and the apron angle, and given that, in the work machine of the Invention, the apron makes a rotary movement around the first fulcrum (140), and the assist force to be applied by the gas spring is applied to the third fulcrum (152), as a result of which the force that assists the force to raise the apron is obtained, the "principle of leverage" described in paragraph [0028] of the Description can be understood to be an explanation of the relationship for obtaining the force that assists the raising of the apron with the use of the force of the gas spring, by using the first fulcrum (140) of the work machine claimed in the Invention as the "fulcrum," the third fulcrum

(152) to which the force of the gas spring is applied as the "point of effort," and the position of the center of gravity of the apron as the "point of action."
b. In addition, given that paragraph [0028] first states, "in the gas spring 250 explained above, the force in the compressed state is larger than the force in the extended state," and then states "a reverse characteristic (the force 1 applied by the assist mechanism increases as the apron angle increases)," it can be understood that the "reverse characteristic" refers to the fact that, although the force of the gas spring itself applied to the "point of effort" in the "principle of leverage" gradually decreases as the apron angle increases because the gas spring comes to be in an extended state, the assist force that can be obtained at the "point of action" in the "principle of leverage" will gradually increase as the apron angle increases.
c. Furthermore, the statement "as the fulcrum 152 approaches the fulcrum 151, there will be an increase in the moving distance of the fulcrum 152 against a predetermined rotation angle" in paragraph [0028] indicates the reason that the "reverse characteristic" referred to in b. above is exhibited by the "principle of leverage." According to the principle of leverage, even where the same force acts on the point of action, if the distance between the point of effort and the fulcrum becomes larger, less force will be required to be applied to the point of effort. In the work machine claimed in the Invention, the distance between the first fulcrum (140) (the "fulcrum" of the principle of leverage) and the third fulcrum (152) (the "point of effort" of the principle of leverage) does not change structurally. As the apron is raised and the apron angle increases, it is the distance between the first fulcrum (140) and a straight line passing through the third fulcrum (152) and the second fulcrum (151) that becomes larger, and the force by the gas spring acts along this straight line.

Then, the exhibition of the "reverse characteristic" due to the "principle of leverage" can be understood to mean that, as the apron is raised and the apron angle increases, the force of the gas spring itself becomes smaller, but the distance between a straight line, passing through the third fulcrum (152) and the second fulcrum (151), and the first fulcrum (140) (the "fulcrum" of the principle of leverage) becomes larger, and as a result, the moment which is expressed as the product of the force and the distance (the force that acts as the assist force) becomes larger.
d. This can be illustrated as Attached Figure 3 (the drawing on page 26 of Exhibit Ko 71, which is the summary of the statements in oral proceedings dated September 25, 2018 submitted by the Defendant). Supposing that the distance between the first fulcrum (140) and the third fulcrum (152) is L, the force applied by the gas spring to the third fulcrum in the direction toward the second fulcrum when the apron is in a lowered state (the upper

figure in Attached Figure 3) is $F_1$, and the angle of a straight line connecting the first fulcrum and the third fulcrum against a straight line connecting the third fulcrum and the second fulcrum at that time is $\theta_1$, then the force that acts on the third fulcrum in the direction of forming a right angle with the radius of a circle centered on the first fulcrum is $F_1 \cdot \sin\theta_1$ and the distance between the first fulcrum and the third fulcrum is L; thus the moment that acts on the third fulcrum (the moment around the first fulcrum that acts on the third fulcrum to move the apron upward) is $F_1 \cdot \sin\theta_1 \cdot L$, which is a product of the force and the distance.

On the other hand, the force applied by the gas spring to the third fulcrum in the direction toward the second fulcrum when the apron is in a raised state (the lower figure of Attached Figure 3) is $F_2$, and if the angle of a straight line connecting the first fulcrum and the third fulcrum against a straight line connecting the third fulcrum and the second fulcrum at that time is $\theta_2$, then the force that acts on the third fulcrum in the direction of forming a right angle with the radius of a circle centered on the first fulcrum is $F_2 \cdot \sin\theta_2$ and the distance between the first fulcrum and the third fulcrum is L; thus the moment that acts on the third fulcrum (the moment around the first fulcrum that acts on the third fulcrum to move the apron upward) is $F_2 \cdot \sin\theta_2 \cdot L$, which is a product of the force and the distance.

As mentioned above, the moment that acts on the third fulcrum when the apron is in a lowered state (the upper figure of Attached Figure 3) is $F_1 \cdot \sin\theta_1 \cdot L$, and the moment that acts on the third fulcrum when the apron is in a raised state (the lower figure of Attached Figure 3) is $F_2 \cdot \sin\theta_2 \cdot L$. Meanwhile, as mentioned in c. above, the exhibition of the "reverse characteristic" due to the "principle of leverage" can be understood to mean that, as the apron is raised and the apron angle increases, the force of the gas spring itself becomes smaller, but the distance between a straight line, passing through the third fulcrum (152) and the second fulcrum (151), and the first fulcrum (140) (the "fulcrum" of the principle of leverage) becomes larger, and as a result, the moment which is expressed as the product of the force and the distance (the force that acts as the assist force) becomes larger. Therefore, this can be summarized according to such "principle of leverage" as follows: the moment that acts on the third fulcrum when the apron is in a lowered state (the upper figure of Attached Figure 3) is $F_1 \cdot L\sin\theta_1$, that is, a product of $F_1$, which is the force of the gas spring itself, and $L\sin\theta_1$, the distance between a straight line, passing through the third fulcrum (152) and the second fulcrum (151), and the first fulcrum (140), whereas the moment that acts on the third fulcrum when the apron is in a raised state (the lower figure of Attached Figure 3) is $F_2 \cdot L\sin\theta_2$, that is, a product of $F_2$, which is the force of the gas spring itself, and $L\sin\theta_2$, which is the distance between a

straight line, passing through the third fulcrum (152) and the second fulcrum (151), and the first fulcrum (140).

When the apron is in a raised state (the lower figure of Attached Figure 3), the upward moment becomes larger and the force required by the worker to raise the apron becomes smaller, as compared to when the apron is in a lowered state (the upper figure of Attached Figure 3); therefore, the formula $F_2 \cdot L\sin\theta_2 > F_1 \cdot L\sin\theta_1$ holds.

In the gas spring, the force in the compressed state is larger than the force in the extended state (paragraph [0028]), so the relationship $F_2 < F_1$ holds. On the other hand, as the relationship $\theta_2 > \theta_1$ holds, the relationship $\sin\theta_2 > \sin\theta_1$ also holds. If, as the apron is raised, the percentage of decrease from $F_1$ to $F_2$ becomes larger than the percentage of increase from $\sin\theta_1$ to $\sin\theta_2$, the formula $F_2 \cdot L\sin\theta_2 > F_1 \cdot L\sin\theta_1$ holds. In this way, despite the fact that the force of the gas spring itself applied to the "point of effort" in the "principle of leverage" gradually decreases as the apron angle increases because the gas spring comes to be in an extended state, the assist force that can be obtained at the "point of action" in the "principle of leverage" will gradually increase as the apron angle increases, and it is found that this is referred to as a "reverse characteristic" in paragraph [0028].

(C) As described in B. (D) above [page 27 of this judgment], the theoretical explanation behind the configuration of Constituent Feature G that "the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases" is a configuration where, in the formula shown in B. (C) above [page 27 of this judgment], $F_s$ gradually decreases within a predetermined angle range in which $\theta$ increases. In addition, as described in C. above [page 29 of this judgment], it can be found that a person ordinarily skilled in the art would have been able to recognize the abovementioned theoretical explanation by taking into consideration the common general technical knowledge of mechanics and referring to the structure which can been identified from the statement of Claim 1 and the Description after the Correction. Furthermore, considering that, in the Trial for Invalidation, the Defendant showed Attached Figure 3 and showed that the formula $F_2 \cdot L\sin\theta_2 > F_1 \cdot L\sin\theta_1$ holds on pages 25 to 26 of the summary of the statements in oral proceedings (September 25, 2018, Exhibit Ko 71), and that the Plaintiff also does not dispute the fact that this formula holds, it is found that a person ordinarily skilled in the art would have been able to recognize that the meaning of paragraph [0028] was as described in (B) a. through d. above.

Meanwhile, the apron angle referred to in B. (C) above [page 27 of this judgment] assumes the angle of the apron against a straight line passing through the first fulcrum to be $\theta$, and assumes $\theta = 0°$ when the apron is in the lowest lowered state. Thus, it differs

from angles $\theta_1$ and $\theta_2$ shown in Attached Figure 3. However, as apron angle $\theta$ referred to in B. (C) above [page 27 of this judgment] becomes larger as the apron is raised, and angle $\theta_2$ in a state where the apron is raised is larger than angle $\theta_1$ in a state where the apron is lowered, they are the same in that they become larger as the apron is raised. Moreover, when appropriately setting the terms in the formula shown in B. (C) above [page 27 of this judgment], other than $\theta$, and achieving a configuration where $F_s$ gradually decreases within a predetermined angle range in which $\theta$ increases (B. (D) above [page 27 of this judgment]), given that paragraph [0028] states that "in the gas spring 250 explained above, the force in the compressed state is larger than the force in the extended state," it is necessary to set the terms in such a manner that the assist force of the gas spring itself ($F_g$) that acts on the third fulcrum becomes weaker as the apron angle increases, and paragraph [0028] is found to explain that the force required for the operator to flip up the apron $F_s$ decreases in spite of that.

(D) The Defendant alleges that the statement of paragraph [0028] of the Description and [Figure 7] relate to the Plaintiff's product called "FTE240," which has a different configuration from the Invention, and that even if enablement of Constituent Feature G is satisfied in "FTE240," Constituent Feature G cannot be achieved in the Invention. However, while it is found that the statement of paragraph [0028] of the Description can be understood as described in (B) and (C) above with regard to the Invention, this logic should be applicable also to tilling machines other than a specific product, and in fact, Constituent Feature G of the Invention can be achieved as described in 5. below. Therefore, the Defendant's abovementioned allegation cannot be accepted.

3. Regarding the position of the work machine when achieving Constituent Feature G

(1) Determination of the JPO Decision

The JPO Decision determined as follows regarding the position of the work machine.

"However, with regard to the position of the abovementioned work machine, the Description, etc. do not describe that the position of the work machine should be tilted forward, such as the 'position where the work machine is raised and adjusted using the tractor's hydraulic mechanism' or the 'standing position' in a case where 'when scraping off soil adhered to the front surface part (the side facing the tilling rotor) of the apron or to the tilling rotor or when replacing tilling claws provided on the tilling rotor, the apron is maintained in a flipped-up state' (paragraph [0002] of the Description, etc.). In addition, as the Description, etc. state that 'it is possible to prevent the worker from flipping up the apron accidentally from the state where the apron is lowered in the tilling state; once the apron is flipped up to a certain angle with a reasonable degree of force (but smaller than the force required when there is no assist mechanism), it can be flipped up with a lighter

force thereafter' (paragraph [0037]) and 'the gas spring is configured to contract at the point where the apron is lowered, so the surface of the piston rod of the gas spring will no longer be soiled at the time of tilling, which accounts for the longest hours of use, and the life of the gas spring will be greatly improved' (paragraph [0041]), it is clear that 'the tilling state' and 'at the time of tilling' refer to the time of the tilling work. Therefore, it is necessary to at least explain that it is possible to have the assist mechanism act so as to achieve the configuration of the Invention that 'the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases' when the work machine is on the tilt at the time of the tilling work, as mentioned above.

Accordingly, if it can be achieved only under conditions that are not described in the Description, etc., such as the "position where the work machine is raised and adjusted using the tractor's hydraulic mechanism" or the "standing position" as asserted by the respondent, it cannot be said that enablement of the Invention is satisfied." (line 18 on page 86 to line 2 on page 87 of the JPO Decision)

(2) Whether the determination is erroneous and the reasons thereof

A. However, the determination of the JPO Decision referred to in (1) above is erroneous. The reasons are as described in B. below.

B. (A) Regarding the tilt of the work machine when achieving Constituent Feature G, Claim 1 after the Correction has not added any limitations, but according to [Problem to be solved by the invention], paragraph [0006], paragraph [0007], [Effect of the invention], and paragraph [0013] of the Description, the Invention is construed to provide a work machine that solves the problem that had existed with regard to assist mechanisms for flipping up the apron, is capable of performing stable assist operation, and also prevents deterioration of the gas spring, and paragraph [0002] states as follows: "This type of rotary work machine has a frame connected to a traveling machine body and an apron, which is provided behind the frame and capable of being lowered or flipped up in a pivotal movement around a fulcrum fixed to the frame (the first fulcrum). When scraping off soil adhered to the front surface part (the side facing the tilling rotor) of the apron or to the tilling rotor or when replacing tilling claws provided on the tilling rotor, the apron is maintained in a flipped-up state." The time when the assist operation for flipping up the apron will be required is the time when conducting work such as scraping off soil adhered to the tilling rotor or replacing tilling claws provided on the tilling rotor, and such work, in light of their purpose, characteristics, procedures, and so on, is found to be normally conducted not in a "state where the tilling claws are inserted into the farm field," but in a state where the work machine is tilted forward and is in a "state where the entire work

machine (including the blades) is raised above ground." Meanwhile, the inclination of the forward tilt of the work machine against the horizontal axis when such work is conducted is found to be in a range of 17.41° to 34.8°, which is a range combining the 18.0° to 34.8° range found based on Exhibit Ko 59 (Trial Exhibit Otsu 13) and the 17.41° to 33.97° range found based on Exhibits Ko 90 through 92. In light of the purpose of the invention and other factors described above, if Constituent Feature G can be achieved when the work machine is tilted forward and is in a "state where the entire work machine is raised above ground" (a state where the inclination of the forward tilt of the work machine against the horizontal axis is in a range of 17.41° to 34.8° as found above), it can be found that enablement of Constituent Feature G is satisfied. There is no ground in having to show that Constituent Feature G can be achieved also when the work machine is in a position other than the above, in order to say that enablement of Constituent Feature G is satisfied.

Incidentally, in the "first position" (a state in which input shaft is tilted forward by 33° from the horizontal axis) and the "second position" (a state in which the input shaft is tilted forward by 18° from the horizontal axis) in Exhibit Ko 60 (Trial Exhibit Otsu 14), and in the "highest position"(the position at which the work machine is raised the highest by using the tractor's hydraulic mechanism; a state in which the input shaft is tilted forward by 30.5° from the horizontal axis) in Exhibit Ko 64 (Trial Exhibit Otsu 18), the inclination of the work machine's tilt forward against the horizontal axis falls within the abovementioned range of 17.41° to 34.8°, and they are found to be the abovementioned "state where the entire work machine is raised above ground." Moreover, as described in 4. (2) B. (A) below (page 43 of this judgment), it is found according to Exhibit Ko 60 (Trial Exhibit Otsu 14) that, in the "first work machine," the force required for flipping up the apron gradually decreased to an extent that could be perceived by a general worker, in the "first position" and the "second position," and it is found according to Exhibit Ko 64 (Trial Exhibit Otsu 18) that, in the "first work machine," the force required for flipping up the apron gradually decreased to an extent that could be perceived by a general worker, in the "highest position"; therefore, it is found that enablement of Constituent Feature G is satisfied.

(B) The Defendant alleges that "the tilling state" in the statement "it is possible to prevent the worker from flipping up the apron accidentally from the state where the apron is lowered in the tilling state; once the apron is flipped up to a certain angle with a reasonable degree of force ..., it can be flipped up with a lighter force thereafter" in paragraph [0037] of the Description can only be understood to mean "at the time of the tilling work" (the "tilling position" in [Figure 2]); in addition, the only position of the work machine

described in the Description is the "tilling position" in [Figure 2] and the Plaintiff consented to this "tilling position" in conducting verification. Therefore, the Defendant alleges that if Constituent Feature G of the Invention can be achieved only under conditions that are not described in the Description, such as the "position where the work machine is raised and adjusted using the tractor's hydraulic mechanism" or the "standing position," it cannot be said that enablement of Constituent Feature G of the Invention is satisfied.

However, the statement of paragraph [0037] only explains a working example, and when also taking into account the point indicated in (A) above, in the tilling state, not only is it normally unnecessary to flip up the apron, but it is even necessary to prevent the apron from being flipped up unexpectedly for the sake of safety, etc., and hence there is room to construe that the mention of "the tilling state" in the paragraph was made in relation to the fact that the machine prevents the worker from flipping up the apron accidentally during the tilling work, and there is no ground for conversely limiting the contents of the Invention based on the statement of paragraph [0037] by interpreting it as meaning that the assist mechanism needs to appropriately function also in the tilling state. In addition, as there is also room to construe that [Figure 2] is a figure that explains the shape and configuration of the tilling machine, and not a figure that explains the assist mechanism, it cannot be concluded that the figure indicates the fact that the assist mechanism functions also in the tilling state. Therefore, the Defendant's abovementioned allegation cannot be accepted.

While Exhibit Ko 13, which is a report dated January 31, 2018 prepared by the Defendant's workers, described that the force required for flipping up the apron would be measured in the tilling position, ahead of conducting measurement (verification) of the force required for flipping up the apron by using Object of JPO Observation Ko 1 in the Trial for Invalidation, the Plaintiff described in the summary of the statements in oral proceedings dated October 9, 2018 (Exhibit Ko 73) that "we have no particular objection to conducting measurement to confirm that 'the force required for flipping up said apron gradually decreases within a predetermined angle range in which the apron angle increases' by the method described in the report (Exhibit Ko 13)" (page 3 of Exhibit Ko 73), and as a result, the measurement (verification) of the force required for flipping up the apron was conducted in the tilling position. However, the abovementioned response of the Plaintiff only related to the method for measuring (verifying) the force required for flipping up the apron by using Object of JPO Observation Ko 1, and is not found to be of a nature that would have served as a ground for limiting the Plaintiff's subsequent allegations in the Trial for Invalidation, and no facts suggest that the Plaintiff's allegations

were actually limited thereafter. If so, even if the Plaintiff made the abovementioned response, it cannot be found that the Plaintiff's allegation to the effect that enablement of Constituent Feature G is satisfied in a "state where the entire work machine is raised above ground," which is not the tilling position, violates the principle of good faith or doctrine of estoppel.

4. Extent of decrease of the force for flipping up the apron

(1) Determination of the JPO Decision

The JPO Decision made a determination on the extent of decrease of the force for flipping up the apron as follows.

"In addition, the respondent submitted Exhibit Otsu 18 and asserts that, as a result of calculating the changes in the 'force required for flipping up the apron' in the 'tilling position' (the input shaft of the work machine is tilted forward by 3.0°) and plotting the result in a graph, 'it can be seen that the force required gradually decreases even if the apron is flipped up from the tilling state' (middle of the graph in 1. (13) B. above).

However, with regard to the fact that 'the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases,' paragraph [0037] of the description of the Patent states 'once the apron is flipped up to a certain angle with a reasonable degree of force (but smaller than the force required when there is no assist mechanism), it can be flipped up with a lighter force thereafter.' This suggests that, in the Invention, the condition that the 'force required for flipping up the apron' 'gradually decreases' can be construed to mean a decrease to an extent that the apron operator can clearly perceive the gradual decrease of the outlined force (for example, the decrease shown in the graph of Figure 7 of the Patent), but it cannot be found from the inclination in the graph shown in Exhibit Otsu 18 that the outlined force has decreased to an extent that the apron operator can clearly perceive it.

Accordingly, if the outlined force decreases merely to an extent that the apron operator cannot clearly perceive it in the position taken at the time of the tilling work, it cannot be regarded that Constituent Feature G has been achieved, and hence it cannot be said that enablement of the Invention is satisfied." (lines 3 to 21 on page 87 of the JPO Decision)

(2) Whether the determination is erroneous and the reasons thereof

A. However, the determination of the JPO Decision referred to in (1) above is erroneous. The reasons are as described in B. below.

B. (A) The determination of the JPO Decision in (1) above is premised on the fact that Constituent Feature G must be achieved in the position taken at the time of the tilling work. However, as described in 3. (2) B. (A) above [page 39 of this judgment], if Constituent Feature G can be achieved in a "state where the entire work machine is raised

above ground," it is found that enablement of Constituent Feature G is satisfied, so the abovementioned determination of the JPO Decision cannot be accepted in terms of such premise. As described in 3. (2) B. (A) above [page 39 of this judgment], the "first position" and the "second position" in Exhibit Ko 60 (Trial Exhibit Otsu 14) and the "highest position" in Exhibit Ko 64 (Trial Exhibit Otsu 18) are found to be in a "state where the entire work machine is raised above ground"; thus, it is found that, if the configuration that "the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases" can be achieved in these positions, enablement of Constituent Feature G is satisfied.

(B) Moreover, it is found that, in order to say that enablement of the configuration of Constituent Feature G that "the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases" is satisfied, the force required for flipping up the apron needs to gradually decrease to an extent that can be perceived by a general operator as the apron angle increases. The reasons are as described below.

Specifically, according to the wording "the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases" in Constituent Feature G, in order to say that Constituent Feature G is achieved, the force required for flipping up the apron needs to gradually decrease as the apron angle increases. In addition, the Description states "however, as the apron is fairly heavy and its center of gravity is positioned behind the fulcrum (the first fulcrum), the work of flipping up the apron is heavy labor for the worker" [Background art], paragraph [0003], which points out, as background art, that the work of flipping up the apron is heavy labor for the worker because the apron is heavy. While prior art documents described apron flip-up assist mechanisms that support the flipping-up force for facilitating the work of flipping up the apron in order to solve such problem in background art (paragraph [0004]), the problems involved in such prior art are pointed out as the problems to be solved by the Invention ([Problem to be solved by the invention] and paragraphs [0006] and [0007]). This is followed by statement of the contents of the Invention ([Means for solving problem] and paragraphs [0008] through [0012]), and the effect of the invention is described as follows: "According to the work machine of the present invention, it is possible to provide a work machine that is capable of performing stable assist operation and that also prevents deterioration of the gas spring. In addition, it will be possible to prevent the apron from flipping up abruptly when the apron is in a lowered state." (paragraph [0013]) According to such statements in the Description, the challenge for the Invention is found to be to solve the problem that the work of flipping up the apron is

heavy labor for the worker because the apron is heavy and to solve the problems in prior art regarding apron flip-up assist mechanisms to be provided for facilitating the work of flipping up the apron. By solving such problems, the Invention is found to enable stable assist operation of the apron flip-up assist mechanism, facilitate the work of flipping up the apron, and ultimately solve the problem that the work of flipping up the apron is heavy labor for the worker because the apron is heavy. While the "force required for flipping up the apron" in Constituent Feature G is the force required for the worker to flip up the apron, given the meaning of the Invention as mentioned above, in order to say that the configuration of Constituent Feature G that "the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases" is achieved, it should be said that the work of flipping up the apron needs to become easy for the worker, and it is found necessary that the force required for flipping up the apron gradually decreases to an extent that can be perceived by a general operator as the apron angle increases. While [Figure 7] indicates that the force required for flipping up the apron gradually decreased from 250 N to 0 N as the apron angle changed approximately from 0° to 60°, as mentioned in (D) below, there is no ground to construe that the extent of decrease of the force required for flipping up the apron is limited to the specific numerical values indicated in [Figure 7], but it can rather be said that [Figure 7] is intended to support the fact that the force required for flipping up the apron gradually decreases to an extent that can be perceived by a general operator in the Invention.

(C) However, according to the graph on page 7 of Exhibit Ko 60 (Trial Exhibit Otsu 14) (Attached Figure 4), in the "first work machine," the force required for flipping up the apron is found to have gradually decreased from 250 N to 0 N while the apron angle changed from 0° to 60° in the case of the "first position" (the blue line in that graph), and the force required for flipping up the apron is found to have gradually decreased from about 230 N to about 75 N, i.e., to below one-third in percentage, while the apron angle changed from 0° to 60° in the case of the "second position" (the yellow line in that graph). In addition, according to the graph on page 6 of Exhibit Ko 64 (Trial Exhibit Otsu 18) (Attached Figure 5), in the "first work machine," the force required for flipping up the apron is found to have gradually decreased from about 230 N to 20 N, i.e., to below one-eleventh in percentage, while the apron angle changed from 0° to 60° in the case of the "highest position" (the blue line in the graph). In these cases, the force required for flipping up the apron has gradually decreased during the process in which the apron was raised above, and the percentage of decrease was considerably large in all cases, so the decrease in the force required for flipping up the apron is found to have been a decrease to an extent that could be perceived by a general worker. Then, it is found that, in these

cases, the force required for flipping up the apron gradually decreased to an extent that could be perceived by a general worker as the apron angle increased, and it is found to have been proved that Constituent Feature G can be achieved. Accordingly, it is found that enablement of Constituent Feature G is satisfied.

(D) With regard to the extent to which "said force required for flipping up the apron" "gradually decreases within a predetermined angle range in which the apron angle increases" in Constituent Feature G, the Defendant alleges that, because paragraph [0037] of the Description states "once the apron is flipped up to a certain angle with a reasonable degree of force..., it can be flipped up with a lighter force thereafter," and the graph in [Figure 7] indicates that the assist operation force decreases from about 250 N to about 0 N, the "reasonable degree of force" referred to in paragraph [0037] means about 250 N, and the "lighter force" means a force that moves toward about zero.

Nevertheless, as the size and the weight of the work machine is not restricted in the Invention, various sizes and weights are assumed for the work machine claimed in the Invention, and this is supported by the fact that paragraph [0030] mentions a "large tilling work machine, puddling machine, or the like, which has a heavy apron" as a "variant example." In light of this, it cannot be construed that the force required for flipping up the apron in the Invention is restricted to any specific numerical values. Moreover, paragraph [0037] of the Description explains a working example of the Invention, and [Figure 7] is merely a figure indicating the effect of the flip-up assist mechanism of a work machine according to a working example of the Invention; there is no statement in the Description indicating that the extent to which "said force required for flipping up the apron" "gradually decreases within a predetermined angle range in which the apron angle increases" in Constituent Feature G is limited to the specific numerical values indicated in [Figure 7], and there is no ground to make such construction. Therefore, the Defendant's abovementioned allegation cannot be accepted.

5. Whether undue trial and error is required for achieving the configuration of the invention

(1) Determination of the JPO Decision

As described in 2. (1) B. above [page 22 of this judgment], the JPO Decision determined that, even if a person ordinarily skilled in the art were to work the Invention based on the formulae and explanation asserted by the Plaintiff, it would require the person to carry out undue trial and error.

(2) Whether the determination is erroneous and the reasons thereof

A. However, the determination of the JPO Decision referred to in (1) above is erroneous. The reasons are as described in B. below.

B. (A) As described in 2. (3) B. (D) above [page 27 of this judgment], while it is found that, by appropriately setting the terms in the formula shown in 2. (3) B. (C) above [page 27 of this judgment], other than θ, and achieving a configuration where $F_s$ gradually decreases within a predetermined angle range in which θ increases, the configuration of Constituent Feature G that "the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases" would be achieved, given that there are multiple terms in the formula shown in 2. (3) B. (C) above [page 27 of this judgment], other than θ, it would be necessary to examine whether undue trial and error would be required for working the Invention through finding an appropriate combination of numerical values for such terms and producing the work machine claimed in the Invention.

Regarding this point, the Plaintiff simulated the change curves of the "force required for flipping up the apron" and the "apron angle" in the Constituent Feature G based on the basic positional relationship of the respective fulcra shown in [Figure 2], and obtained the results as shown in the graph on page 7 of Exhibit Ko 60 (Trial Exhibit Otsu 14) (Attached Figure 4). According to that graph, in the "first work machine" in which the positional relationship of the work machine described in [Figure 2] is adopted as the basis, and the position of the third fulcrum 152 is pivotally moved downward by 25°around the first fulcrum 140, the force required for flipping up the apron is found to have gradually decreased from 250 N to 0 N while the apron angle changed from 0° to 60° in the case of the "first position" (a state in which the work machine is tilted forward by 33° from the horizontal axis) (the blue line in that graph), and the force required for flipping up the apron is found to have gradually decreased from about 230 N to about 75 N while the apron angle changed from 0° to 60° in the case of the "second position" (a state in which the work machine is tilted forward by 18° from the horizontal axis) (the yellow line in that graph). In addition, according to the graph on page 6 of Exhibit Ko 64 (Trial Exhibit Otsu 18) (Attached Figure 5), in the "first work machine," the force required for flipping up the apron is found to have gradually decreased from about 230 N to about 20 N while the apron angle changed from 0° to 60° in the case of the "highest position" (the position at which the work machine is raised the highest by using the tractor's hydraulic mechanism; a state in which the input shaft is tilted forward by 30.5° from the horizontal axis). As described in 4. (2) B. (A) above [page 43 of this judgment], in these cases, the force required for flipping up the apron is found to have gradually decreased to an extent that could be perceived by a general worker. Then, it is found to have been proved by these simulations that Constituent Feature G can be achieved.

While these simulations are presumed to have been conducted by using a computer,

it cannot be found that the implementation of these simulations was particularly difficult, and there are no circumstances suggesting that undue trial and error was required for obtaining the abovementioned results.

Accordingly, it is found that undue trial and error is not required for a person ordinarily skilled in the art to work the configuration of Constituent Feature G that "the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases" through finding an appropriate combination of numerical values for the terms in the formula shown in 2. (3) B. (C) above [page 27 of this judgment], other than $\theta$, and producing the work machine claimed in the Invention.

(B) a. The Defendant indicated that paragraph [0028] of the Description states "such tendency of the load is observed due to the positional relationship of the respective fulcra in the abovementioned working example," which clarifies that the graph in [Figure 7] was obtained based on the positions of the fulcra of the work machine shown in [Figure 2]. On such basis, the Defendant alleges that, because the "first work machine" (the structure indicated in blue in Attached Figure 2), for which the Plaintiff has allegedly obtained the change curves showing that the "force required for flipping up the apron" "gradually decreases within a predetermined angle range in which the apron angle increases" by mechanical simulations, has the third fulcrum (152) in a different position from that of the work machine shown in [Figure 2], and because the "first work machine" is not shown in the Description or the drawings attached to the written application of the patent application for the Patent, the Plaintiff's allegation to the effect that enablement of Constituent Feature G of the Invention is satisfied, based on the graph on page 7 of Exhibit Ko 60 (Trial Exhibit Otsu 14) and the graph on page 6 of Exhibit Ko 64 (Trial Exhibit Otsu 18), which have been obtained by using the "first work machine," is erroneous.

However, while the work machine shown in [Figure 2] is one example of the work machine for explaining the configuration of the Invention (paragraph [0016]), given that, with regard to the positions of the fulcra, the claim of the Invention only specifies that the positions of the second and third fulcra must be such that the assist mechanism is movable on the same axis that passes through the two fulcra (Constituent Feature E), as long as this specification is met, the positions of the second and third fulcra in the work machine of the Invention do not need to be the same as the specific positions indicated in [Figure 2]. As the drawings attached to the written application of a patent application are not required to show accurate dimensions, etc. like engineering drawings, but are only required to be expressed with the degree of accuracy that makes the technical details of the invention understandable, and [Figure 2] is also shown for explaining the configuration of the Invention and is not found to specifically show rigorous shapes and

dimensions, etc. like an engineering drawing. Accordingly, as long as it is indicated that enablement of the configuration of Constituent Feature G that "the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases" is satisfied in the "first work machine," which has the same overall configuration as the work machine shown in [Figure 2] except for the position of the third fulcrum (152), and which also satisfies Constituent Feature E, it is found that enablement of Constituent Feature G in the Invention is satisfied. Paragraph [0028] of the Description states "such tendency of the load is observed due to the positional relationship of the respective fulcra in the abovementioned working example," but in consideration of the fact that the configuration of the Invention has been specified by the claim, the abovementioned statement of paragraph [0028] is not found to require the positions of the second and third fulcra in the work machine of the Invention to be the same as their specific positions shown in [Figure 2]. Therefore, the Defendant's abovementioned allegation cannot be accepted.

b. The Defendant alleges that, because the gas spring used in the calculation for the "first work machine" (Exhibit Ko 65 (Trial Exhibit Otsu 19)) is an "all-gas-type" with a diameter of $\varphi$16 mm, and not the "free piston type" described in [Figure 5] and [Figure 6], it is clear that the graph shown in [Figure 7] cannot be obtained by using a piston of the "free piston type" described in [Figure 5] and [Figure 6].

However, with regard to the gas spring to be used for the assist mechanism in the Invention, Claim 1 after the Correction only states a "gas spring," and it does not specify whether it should be an "all-gas-type" or a "free piston type." In addition, paragraph [0029] of the Description states "while the abovementioned working example uses a gas spring having a free piston, it is also possible to use a conventional gas spring that does not use a free piston," indicating that the gas spring of the Invention is not limited to a "free piston type." If so, because it has been shown that Constituent Feature G can be achieved by the "first work machine," as described in (A) above, by using a gas spring of an "all-gas-type" (Exhibit Ko 65 (Trial Exhibit Otsu 19)) for the calculation (pages 1 to 2 of Exhibit Ko 60 (Trial Exhibit Otsu14), page 1 of Exhibit Ko 64 (Trial Exhibit Otsu 18), and Exhibit Ko 65 (Trial Exhibit Otsu 19)), it is found that enablement of Constituent Feature G is satisfied. Moreover, it is presumed that a gas spring of an "all-gas-type" (Exhibit Ko 65 (Trial Exhibit Otsu 19)), in light of its structure, could have been achieved at the time of the filing of the original application for the Patent, and there is no specific evidence to support that it could not have been achieved at the time of the filing of the original application for the Patent. Therefore, the Defendant's abovementioned allegation cannot be accepted.

c. The Defendant alleges that it is clear that Constituent Feature G cannot be achieved because even the Plaintiff that has developed the work machine claimed in the Invention by itself cannot reproduce the "work machine at the time," which had existed on the day on which the data of the graph shown in [Figure 7] was obtained.

However, whether or not enablement of a patented invention is satisfied should not be determined by whether or not the example shown in the working example can be specifically reproduced as-is, so whether or not a person ordinarily skilled in the art could have worked the Invention based on the statement of the Description at the time of the filing of the original application for the Patent should not be determined by whether or not the actual "work machine at the time," with which the data of the graph shown in [Figure 7] was obtained, can be reproduced. As described in (A) above, according to Exhibit Ko 60 (Trial Exhibit Otsu 14) and Exhibit Ko 64 (Trial Exhibit Otsu 18), it is found that enablement of Constituent Feature G is satisfied. Therefore, the Defendant's abovementioned allegation cannot be accepted.

6. Whether there were changes in the Plaintiff's allegations

(1) Determination of the JPO Decision

The JPO Decision made a determination on the explanations given in the summary of the statements in oral proceedings dated October 9, 2018 prepared by the Plaintiff (Exhibit Ko 73) and the summary of the statements in oral proceedings (2) dated February 7, 2019 prepared by the Plaintiff (Exhibit Ko 78) as follows (the "summary of the respondent's statements (1)" below is the summary of the statements in oral proceedings dated October 9, 2018 prepared by the Plaintiff (Exhibit Ko 73), and the "summary of the respondent's statements (2)" below is the summary of the statements in oral proceedings (2) dated February 7, 2019 prepared by the Plaintiff (Exhibit Ko 78)).

"Invalidation Reason 4 is explained as described in (3) above also in the summary of the respondent's statements (1).

Moreover, to add to that explanation, the summary of the respondent's statements (2) explains as follows: '(1) the case where the force of the gas spring itself becomes larger ($F_1<F_2$) as the apron angle increases' 'is premised on the characteristic of the gas spring that "the force in the compressed state is larger than the force in the extended state," and also premised on the fact that the gas spring is attached to the work machine in the direction where it comes into a compressed state when the apron is in the lowered state, and comes into an extended state when the apron is in a flipped-up state; therefore, for example, if the direction of attaching the gas spring to the work machine is reversed so that the gas spring comes into an extended state when the apron is in the lowered state, and comes into a compressed state when the apron is in a flipped-up state, the force of the

gas spring itself becomes larger (F1<F2) as the apron angle increases'; 'in this way, by appropriately selecting factors such as the combination of the diameter sizes of the piston rod and the cylinders, as well as the numerical values of the stroke length and the entire length of the gas spring, it is easy to set the change rate of the gas spring high and use a gas spring with a large difference in the reaction force between the time of extension and the time of compression'; and therefore, even if the positions of the fulcra, etc. in Object of Observation Ko 1, Exhibit Ko 14, and Exhibit Ko 18 do not differ from those in the Invention, it is possible to achieve the relationship $F_1<F_2$ by reversing the direction of attaching the gas spring or using a gas spring with a different extending direction.'

However, it is clear that these explanations (particularly the underline parts above) are inconsistent with the matters including the following: the 'gas spring' of the Invention 'is configured to contract at the point where said apron is lowered'; 'the force of the gas spring itself (F) becomes smaller ($F_1>F_2$) as the apron angle increases, but the difference of the force is small' (i.e., the change rate of the gas spring is small) as mentioned in (3) above; and 'the force applied in the direction of raising the apron (assist force) becomes larger ($F_1\sin\theta_1<F_2\sin\theta_2$) as the apron angle increases.' A person who fully understands the technical meaning of the Invention would never error in explaining those matters.

Regarding this point, the respondent's written petition (2) further provided an explanation by replacing the allegations, but after all, the allegations were arranged by primarily returning them to the allegation referred to in (3) above. Therefore, also considering that the abovementioned allegation in the summary of the respondent's statements (2) was inconsistent with other allegations and the explanation has changed several times, it cannot be said that a person ordinarily skilled in the art was able to carry out the Invention in a manner that achieves the abovementioned matters at the time of the filing of the application for the Patent." (line 23 on page 87 to line 21 on page 88 of the JPO Decision)

(2) Whether the determination is erroneous and the reasons thereof

A. However, the determination of the JPO Decision referred to in (1) above is erroneous. The reasons are as described in B. below.

B. (A) The progress of proceedings of the Trial for Invalidation is found to be as follows.

a. JPO administrative judges issued the written notice of the matters to be examined dated December 25, 2018 (Exhibit Ko 75).

The written notice of the matters to be examined dated December 25, 2018 (Exhibit Ko 75) stated as follows in "3. Provisional view of the panel" and "(5) Regarding Invalidation Reason 4" (the written statement of oral proceedings dated September 25, 2018 below is Exhibit Ko 71, and the summary of the statements in oral proceedings dated

October 9, 2018 below is Exhibit Ko 73).

"The demandant alleges that the detailed explanation of the invention fails to describe the feature that 'the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases' to an extent that it enables a person ordinarily skilled in the art to achieve the feature, and generally asserts in the written request for trial (pages 30 to 32) that the configuration of the gas spring used in the Invention is unclear and the fulcra, the point of effort, the point of action, etc. of the 'principle of leverage' described in paragraph [0028] of the Description is unclear. In addition, in the written statement of oral proceedings dated September 25, 2018, the demandant explains the characteristics of the gas spring and the positional relationship of the respective fulcra by using the [Reference explanatory drawing] on page 26 of that statement. In response, in the summary of the statements in oral proceedings dated October 9, 2018, the respondent explains the mechanism based on that 'principle of leverage' by using that [Reference explanatory drawing].

If that 'principle of leverage,' which is a logic that the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases, is as shown in that [Reference explanatory drawing], it is unclear what kinds of features would differ between the Invention and the machines of Object of Observation Ko 1, Exhibit Ko 14, and Exhibit Ko 18, in which the positions of the fulcra, etc. do not particularly differ from those of the Invention." (line 30 on page 4 to line 10 of page 5 of Exhibit Ko 75)

Furthermore, the written notice of the matters to be examined dated December 25, 2018 (Exhibit Ko 75) described as follows in "5. In response to the respondent," "(5)."

"With regard to 3. (5) above, if there are any features, other than the 'principle of leverage' that cause the outlined force to decrease or that affect the outlined force in the Invention, please explain in detail." (lines 6 to 8 on page 6 of Exhibit Ko 75)

b. In response to the request for explanation in the written notice of the matters to be examined dated December 25, 2018 (Exhibit Ko 75) mentioned in a. above, the Plaintiff described as shown in Attachment 6 (line 14 on page 6 to line 14 on page 10 of Exhibit Ko 78) in the summary of the statements in oral proceedings (2) dated February 7, 2019 (Exhibit Ko 78).

(B) According to Attachment 6 (line 14 on page 6 to line 14 on page 10 of the summary of the statements in oral proceedings (2) dated February 7, 2019 (Exhibit Ko 78)), the Plaintiff is found to have indicated in the statement therein that, even in a work machine having a positional relationship of fulcra similar to those in the Invention, it is possible to appropriately design a structure in which the assist force gradually decreases, a structure

in which the assist force remains fairly constant, and also a structure in which the assist force gradually increases as in the Invention, as the apron angle increases, by changing factors such as the increase or decrease of the force of the gas spring itself as the apron angle increases, the percentage of a decrease in the force of the gas spring itself as the apron angle increases, and the percentage of an increase of $\sin\theta_2$ above $\sin\theta_1$ ($\sin\theta_1$ and $\sin\theta_2$ are the same as $\sin\theta_1$ and $\sin\theta_2$ in Attached Figure 3). In addition, the parts of the statements of the summary of the statements in oral proceedings (2) dated February 7, 2019 (Exhibit Ko 78), which are pointed out by the JPO Decision to be inconsistent with the explanation of the Invention (the indicated parts described in (1) above) are found to be parts stating that even in a work machine having a positional relationship of fulcra similar to those in the Invention, it is possible to also design a configuration that differs from that in which the assist force increases as the apron angle increases as in Constituent Feature G of the Invention. Therefore, even if the summary of the statements in oral proceedings (2) dated February 7, 2019 (Exhibit Ko 78) described matters pointed out by the JPO Decision (the indicated parts described in (1) above), it is not found that the Plaintiff provided a theoretical explanation or explained the technical meaning of the Invention erroneously or that the Plaintiff's explanations on the Invention changed several times based on the matters pointed out by the JPO decision, and hence it is not found that the Invention could not have been worked.

7. Satisfaction of the enablement requirement

In light of the above, the statement of the detailed explanation of the invention in the Description is found to be clear and sufficient to enable a person ordinarily skilled in the art to achieve the configuration of Constituent Feature G of the Invention that "the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases," and the determination of the JPO Decision which indicated that it fails to satisfy the enablement requirement and violates the provisions of Article 36, paragraph (4), item (i) of the Patent Act, because the statement of the detailed explanation of the invention in the Description fails to be clear and sufficient to enable a person ordinarily skilled in the art to achieve Constituent Feature G, is erroneous.

Although the Defendant has made various allegations, none of them affect the abovementioned conclusion.

8. Conclusion

For the reasons stated above, the JPO Decision contains illegality to be rescinded, and the grounds for rescission of the Plaintiff's allegations are well-founded.

Accordingly, the Plaintiff's claim is accepted and the judgment is rendered as indicated in the main text.

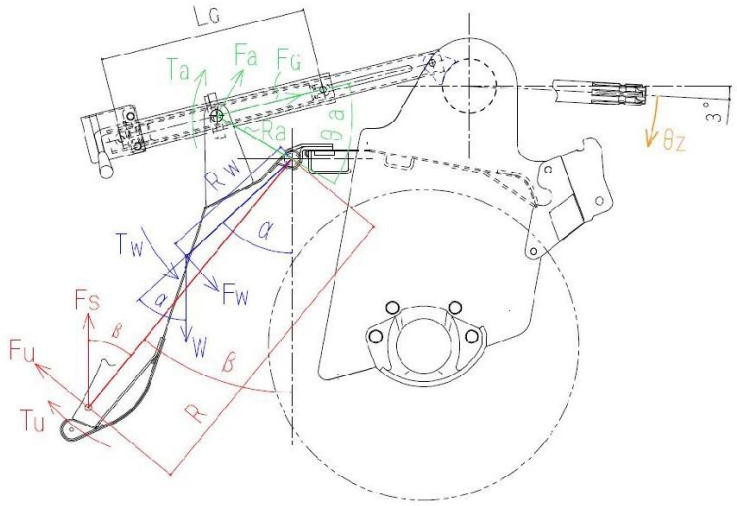
Intellectual Property High Court, Third Division
Presiding Judge: TSURUOKA Toshihiko
Judge: UEDA Takuya
Judge: NAKADAIRA Ken

Attached Figure 1

(Drawing on page 5 of Exhibit Ko 60 (Trial Exhibit Otsu 14), which is a written statement dated March 22, 2019 prepared by the Plaintiff's workers)

Calculation method

Changes in the force required are calculated respectively for the first work machine and the second work machine by the same calculation method as the demandant.




$Ta = Ra \cdot Fa$

$Fa = FG \cdot \sin\theta a$

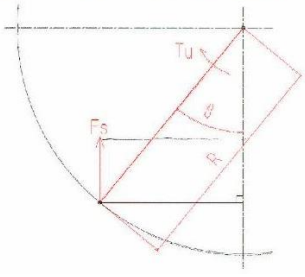
$Tw = Rw \cdot Fw$

$Fw = W \cdot \sin\alpha$

$Tu = Tw - Ta$

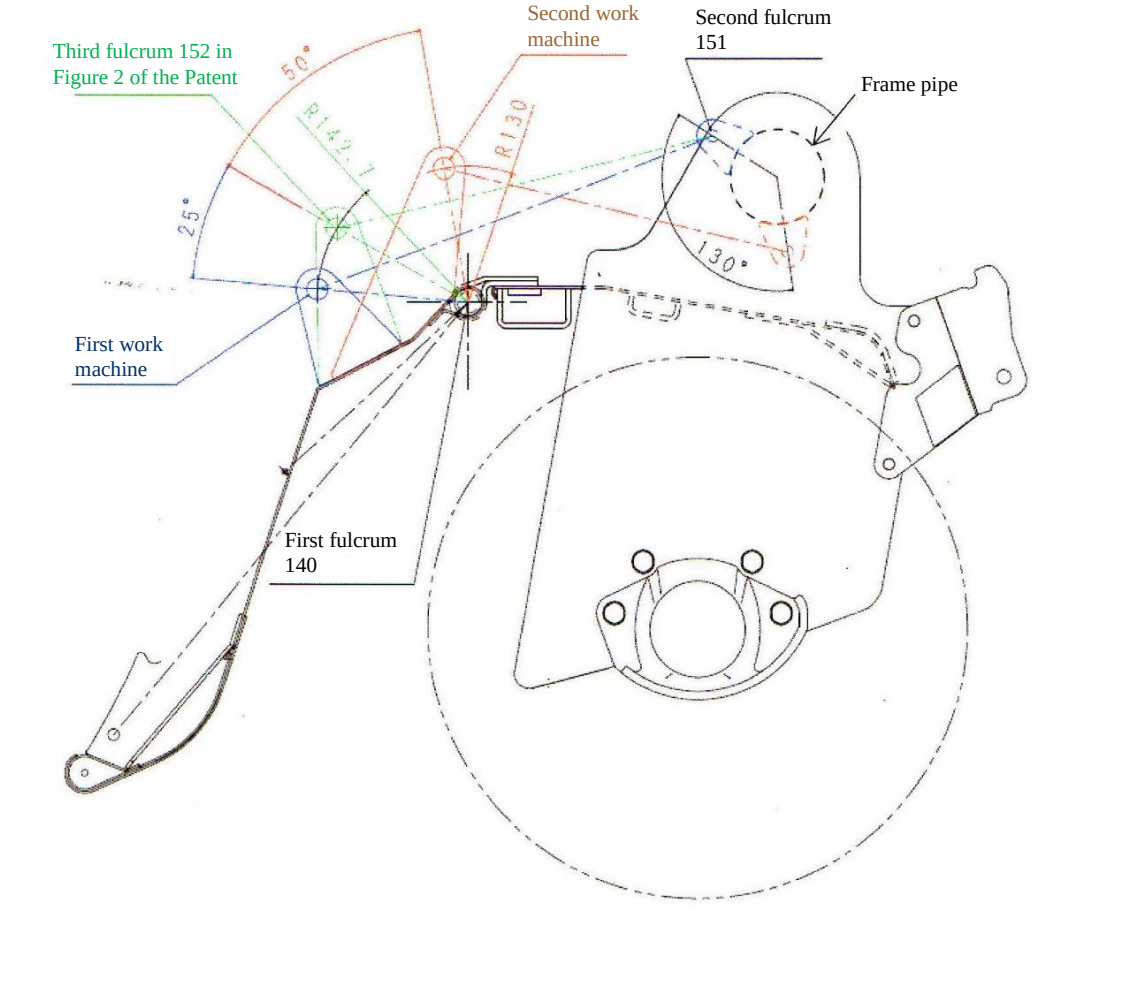
$Fs = Tu \,/\, (R \cdot \sin\beta)$

↑※ : $Tu = Fs \cdot R \cdot \sin\beta$



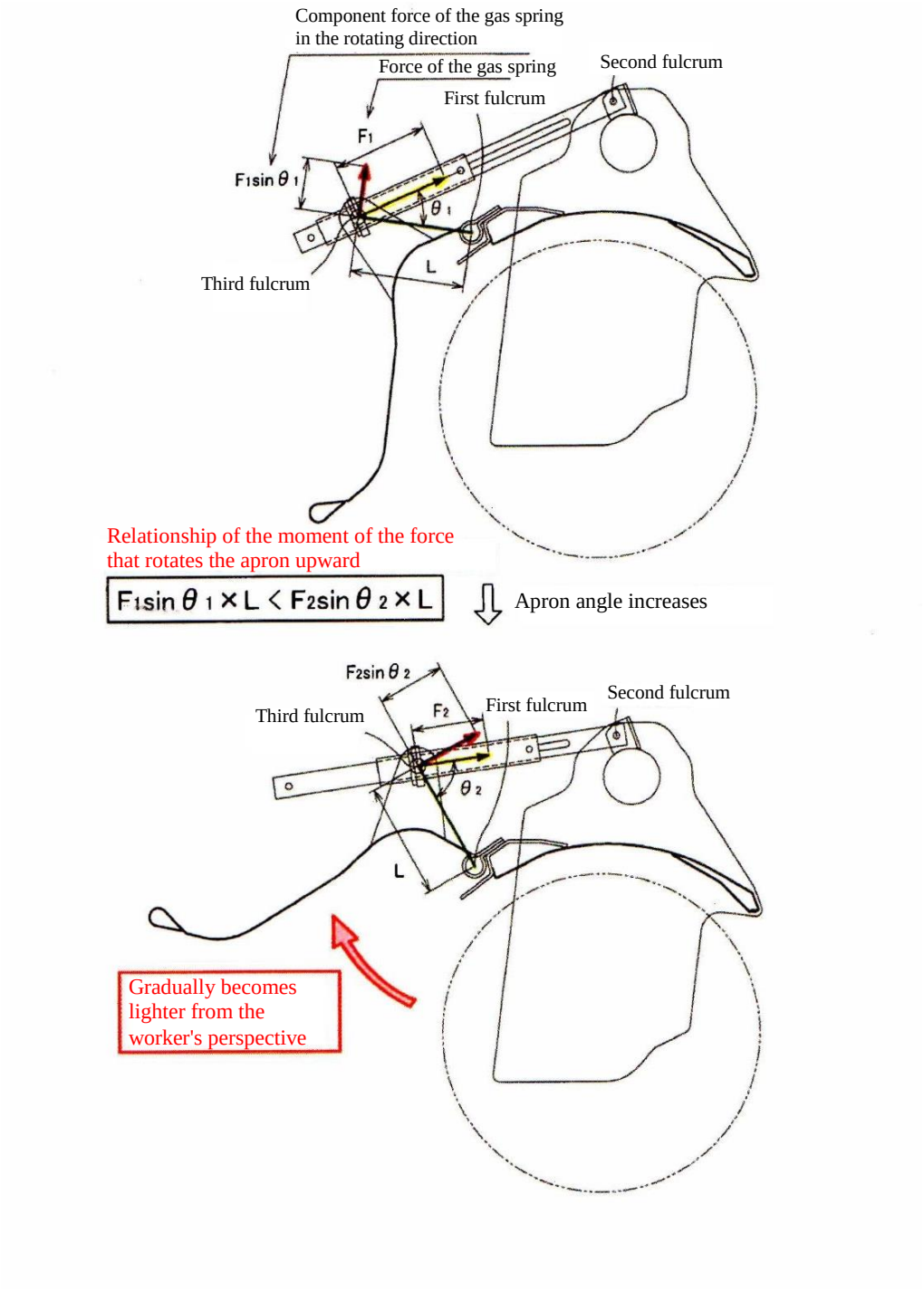
Attached Figure 2

(Drawing on page 3 of Exhibit Ko 60 (Trial Exhibit Otsu 14), which is a written statement dated March 22, 2019 prepared by the Plaintiff's workers)



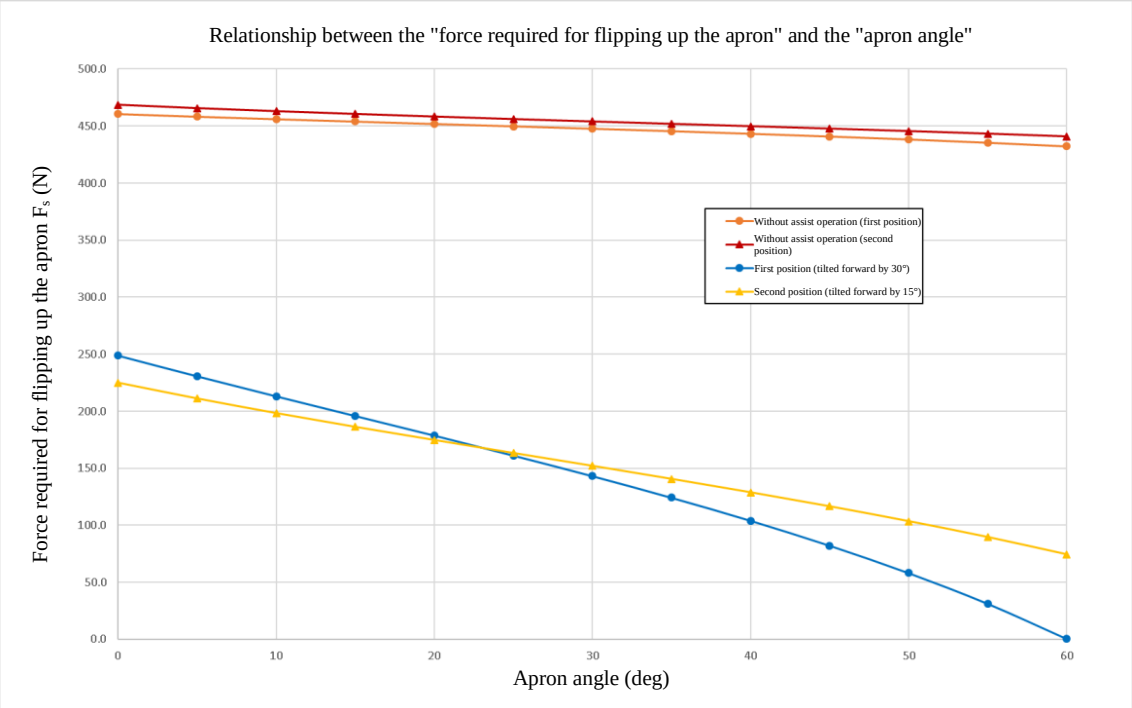
Attached Figure 3

(Drawing on page 26 of Exhibit Ko 71, which is the summary of the statements in oral proceedings dated September 25, 2018 submitted by the Defendant)



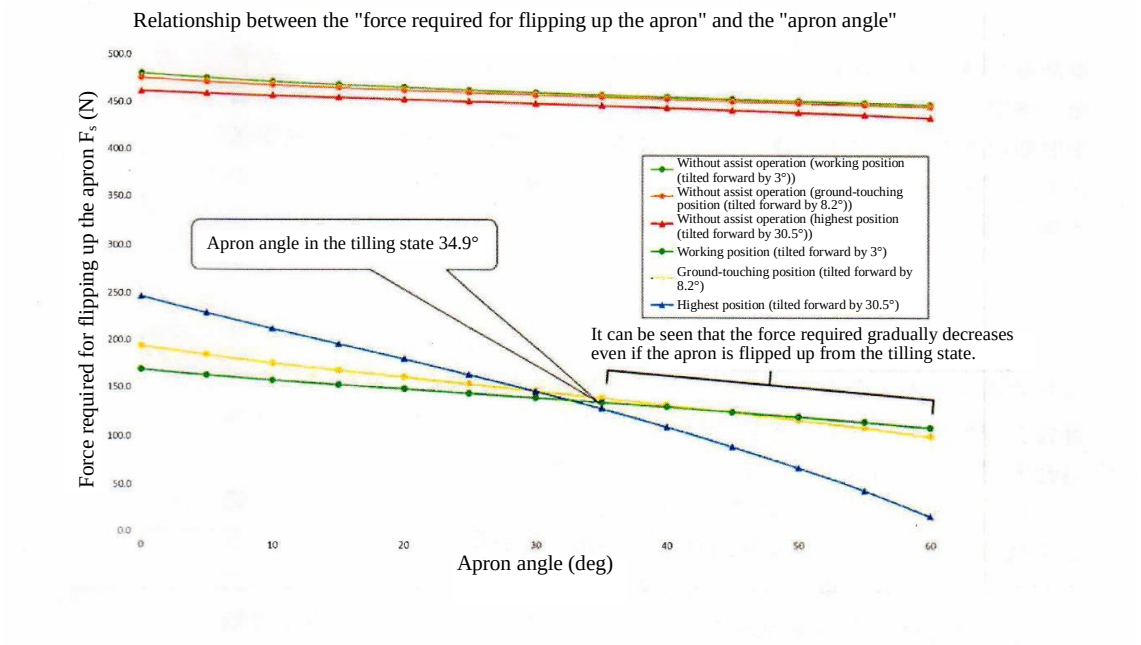
Attached Figure 4

(Graph on page 7 of Exhibit Ko 60 (Trial Exhibit Otsu 14), which is a written statement dated March 22, 2019 prepared by the Plaintiff's workers)



Attached Figure 5

(Graph on page 6 of Exhibit Ko 64 (Trial Exhibit Otsu18), which is a written statement dated August 22, 2019 prepared by the Plaintiff's workers)



Attachment 6

(Line 14 on page 6 to line 14 on page 10 of Exhibit Ko 78, which is the summary of the statements in oral proceedings (2) dated February 7, 2019 prepared by the Plaintiff)

**(6) Regarding "3 (5)" (Invalidation Reason 4: Regarding differences between the Invention and Object of Observation Ko 1, Exhibit Ko 14, and Exhibit Ko 18)**

As explained in lines 2 to 8 on page 21 of the respondent's summary of the statements in oral proceedings dated October 9, 2018 (hereinafter referred to as the "summary of the respondent's statements (1)"), the "principle of leverage" described in paragraph [0028] of the Description is the logic for obtaining the force that assists the raising of the apron with the use of the force of the gas spring (the force applied by the assist mechanism, i.e., the "assist force") by using the first fulcrum (fulcrum 140) as the "fulcrum," the third fulcrum to which the force of the gas spring is applied as the "point of effort," and the position of the center of gravity of the apron as the "point of action."

If the logic that the "force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases" is to be paraphrased based on the "principle of leverage," it will be the logic that the "assist force" obtained at the point of action of the "principle of leverage" (the position of the center of gravity of the apron) gradually increases as the apron angle increases.

In addition, the logic that the "assist force" gradually increases as the apron angle increases in the Invention is, as explained in lines 16 to 24 on page 21 of the summary of the respondent's statements (1), that **"the force of the gas spring itself (F) becomes smaller ($F_1>F_2$) as the apron angle increases, but the difference of the force is small, whereas the percentage by which the value of sinθ increases ($\sin\theta_1>\sin\theta_2$) as the apron angle increases is larger," so at the point of action of the "principle of leverage" (the position of the center of gravity of the apron), the force applied in the direction of raising the apron (assist force) becomes larger ($F_1\sin\theta_1<F_2\sin\theta_2$) as the apron angle increases**.

In this way, despite the fact that the force of the gas spring itself (F) applied to the "point of effort" in the "principle of leverage" gradually decreases as the apron angle increases, the assist force that can be obtained at the "point of action" in the "principle of leverage" will gradually increase as the apron angle increases, and this is expressed in the Description as follows: "a reverse characteristic (the force 1 applied by the assist mechanism increases as the apron angle increases) is exhibited due to the 'principle of leverage'." (paragraph [0028] of the Description)

Therefore, for example, [i] in the case where the force of the gas spring itself becomes larger ($F_1<F_2$) as the apron angle increases or [ii] in the case where the force of the gas

spring itself becomes smaller ($F_1>F_2$) as the apron angle increases, but the extent of the decrease is large, and exceeds the extent of the increase $\sin\theta_1<\sin\theta_2$, the relationship "$F_1\sin\theta_1>F_2\sin\theta_2$" holds, and as the "assist force" gradually decreases as the apron angle increases, the force required for flipping up the apron will gradually "increase" within a predetermined angle range in which the apron angle increases.

Specifically, in the case of [i], the logic in the Invention that "the force of the gas spring itself becomes smaller ($F_1>F_2$) as the apron angle increases" is premised on the characteristic of the gas spring that "the force in the compressed state is larger than the force in the extended state," and also premised on the fact that the gas spring is attached to the work machine in the direction where it comes into a compressed state when the apron is in the lowered state, and comes into an extended state when the apron is in a flipped-up state.

Therefore, for example, if the direction of attaching the gas spring to the work machine is reversed so that the gas spring comes into an extended state when the apron is in the lowered state, and comes into a compressed state when the apron is in a flipped-up state, the force of the gas spring itself becomes larger ($F_1<F_2$) as the apron angle increases.

Examining the case of [ii], if the gas spring is designed so that the extent of the decrease $F_1>F_2$ exceeds the extent of the increase $\sin\theta_1<\sin\theta_2$, the relationship "$F_1\sin\theta_1>F_2\sin\theta_2$" holds. In other words, factors such as the degree of the gas reaction force of the gas spring and the stroke range used for assisting the raising of the apron can be selected so that the difference in the gas reaction force between the time of extension and the time of compression will be large.

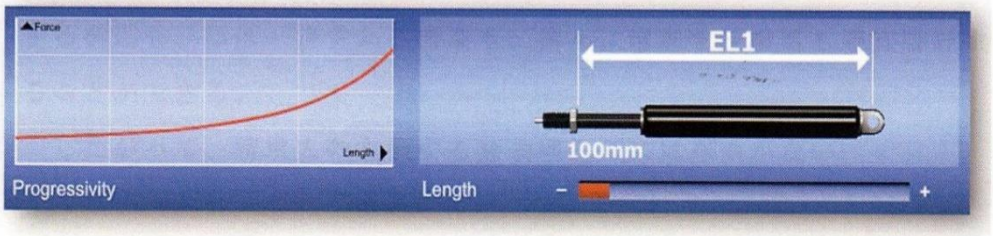
Regarding this point, the demandant alleges, based on Exhibit Otsu 3, that "the fact that a gas spring exhibits an approximately constant spring force in a wide range of strokes is common general technical knowledge for a person ordinarily skilled in the art" (lines 4 to 8 on page 25 of the summary of the demandant's statements (1)).

However, Exhibit Otsu 3 also describes that "[ii] the gas spring can be designed with a wide range of spring constant and gas reaction force" and "[vi] as the gas spring can be designed according to use, it can support a wide variety of uses" ("Characteristics" on page 1 of Exhibit Otsu 3).

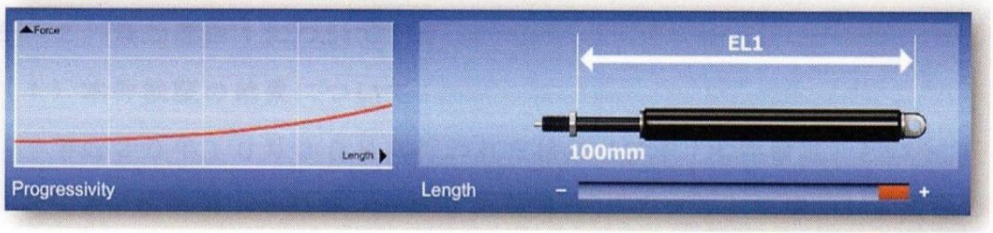
In addition, Exhibit Otsu 6 describes as follows: it is possible to calculate the extent to which the reaction force rises as a result of the gas filled inside the cylinder being compressed by the piston (change rate), and it is possible to design a gas spring with a change rate of approximately 35% or 100% according to the combination of the diameter sizes of the piston rod and the cylinders, as well as the numerical values of the stroke length and the entire length of the gas spring (page 2 of Exhibit Otsu 6); and it is possible

to calculate the gas spring reaction force at the time of compression ($F_2$) by multiplying the reference reaction force at the time of extension ($F_1$) by the numerical value of the change rate (if the change rate is 35%, "1.35"), and "if a gas spring with a high change rate is selected, the rise in the reaction force will be large." (page 3 of Exhibit Otsu 6)

When the change rate is approximately 100%




When the change rate is approximately 35%




Page 2 of Exhibit Otsu 6

In this way, by appropriately selecting factors such as the combination of the diameter sizes of the piston rod and the cylinders, as well as the numerical values of the stroke length and the entire length of the gas spring, it is easy to set the change rate of the gas spring high and use a gas spring with a large difference in the reaction force between the time of extension and the time of compression.

Therefore, even if the positions of the fulcra, etc. in Object of Observation Ko 1, Exhibit Ko 14, and Exhibit Ko 18 do not differ from those in the Invention, it is possible to achieve the relationship $F_1<F_2$ by reversing the direction of attaching the gas spring or using a gas spring with a different extending direction ([i]).

In addition, when the relationship $F_1>F_2$ holds, it is possible to achieve the relationship "$F_1\sin\theta_1>F_2\sin\theta_2$" by designing the gas spring so that the extent of the decrease $F_1>F_2$ exceeds the extent of the increase $\sin\theta_1<\sin\theta_2$ ([ii]).

Therefore, even if the positions of the fulcra, etc. in Object of Observation Ko 1, Exhibit Ko 14, and Exhibit Ko 18 do not differ from those in the Invention, it is possible to appropriately design a structure in which the "assist force" gradually decreases, a structure in which the assist force remains fairly constant, and also a structure in which

the assist force gradually increases, as the apron angle increases, depending on the other factors mentioned above.

Accordingly, Invalidation Reason 4 alleged by the demandant is groundless.

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(54) [Title of the invention] Work machine

(57) [Claims]
[Claim 1]
A work machine which is attached to the rear part of a traveling machine body and which tills a farm field by advancing along with the forward traveling of said traveling machine body while rotating a tilling rotor, wherein:
said work machine comprises a frame connected to said traveling machine body and
further comprises an apron, which is provided behind said frame and capable of being lowered or flipped up in a pivotal movement around a first fulcrum fixed to said frame and whose center of gravity is positioned behind said first fulcrum, and an assist mechanism that includes a gas spring, which is provided between a second fulcrum fixed to said frame and a third fulcrum fixed to said apron and which applies a force in the direction of flipping up said apron by applying a force that changes the distance between said second fulcrum and said third fulcrum;

said assist mechanism further has a first cylindrical member and a second cylindrical member which are movable on the same axis and in which said gas spring is located;
said first cylindrical member has said second fulcrum and one end of said gas spring connected thereto, and said second cylindrical member has the other end of said gas spring connected thereto;
as a first projecting part provided on said second cylindrical member contacts a second projecting part that pivots around said third fulcrum and changes in the direction of reducing the distance between said third fulcrum and said second fulcrum, the force required for flipping up said apron gradually decreases within a predetermined angle range in which the apron angle increases; and
said gas spring is configured to contract at the point where said apron is lowered, as characteristics of the work machine.
[Detailed explanation of the invention]
[Technical field]
[0001]
The present invention relates to a work machine. In particular, it relates to a work machine which is attached to the rear part of a traveling machine body and which tills a farm field by advancing along with the forward traveling of said traveling machine body while rotating a tilling rotor.
[Background art]
[0002]
This type of rotary work machine has a frame connected to a traveling machine body and an apron, which is provided behind the frame and capable of being lowered or flipped up in a pivotal movement around a fulcrum fixed to the frame (the first fulcrum). When scraping off soil adhered to the front surface part (the side facing the tilling rotor) of the apron or to the tilling rotor or when replacing tilling claws provided on the tilling rotor, the apron is maintained in a flipped-up state.
[0003]
However, as the apron is fairly heavy and its center of gravity is positioned behind the fulcrum (the first fulcrum), the work of flipping up the apron is heavy labor for the worker.
[0004]
As described in Patent Document 1, an apron flip-up assist mechanism (auxiliary mechanism) that supports the flipping-up force by employing the elastic force of a gas spring has been proposed. This assist mechanism (auxiliary mechanism) described in Patent Document 1 has a gas spring provided between a side cover, which is provided at a widthwise end part of the main body of the rotary work machine, and a widthwise end part of the apron, and the rod-side end of the gas spring is supported movably in the up and down direction along a guide hole provided on the side cover. In the case of the assist mechanisms (auxiliary mechanisms) described in Patent Documents 2 and 3, the assist mechanism (auxiliary mechanism) is provided above a shield cover covering over the tilling rotor.
[Prior art documents]
[Patent documents]
[0005]
[Patent Document 1] Unexamined Patent Application Publication No. 2008-278757
[Patent Document 2] Unexamined Patent Application Publication No. 2010-63367
[Patent Document 3] Unexamined Patent Application Publication No. 2014-97042
[Summary of the invention]
[Problem to be solved by the invention]
[0006]
However, as the assist mechanism (auxiliary mechanism) described in Patent Document 1 is provided at a widthwise end part of the apron, there is a risk that the gas spring would contact an obstacle, such as a ridge or a side wall, and become damaged during work.
[0007]
In addition, the assist mechanism (auxiliary mechanism) described in Patent Document 2 has a gas spring whose piston rod is exposed and the assist mechanism (auxiliary mechanism) described in Patent Document 3 uses a gas spring while keeping it horizontal. Therefore, both mechanisms have a risk of leakage of nitrogen gas from the gas spring, and their durability needs to be further increased.
[Means for solving problem]
[0008]
A work machine according to an embodiment of the present invention is a work machine which is attached to the rear part of a traveling machine body and which tills a farm field by advancing along with the forward traveling of the traveling machine body while rotating a tilling rotor, wherein: the work machine comprises a frame (a concept including a main frame and a shield cover; the same applies hereinafter) connected to said traveling machine body and further comprises an apron, which is provided behind the frame and capable of being lowered or flipped up in a pivotal movement around a first fulcrum fixed to the frame and whose center of gravity is positioned behind the fulcrum, and an assist mechanism that includes a gas spring, which is provided between a second fulcrum fixed to the frame and a third fulcrum fixed to the apron and which applies a force in the direction of flipping up the apron by applying a force that changes the distance between the second fulcrum and the third fulcrum; the gas spring has a cylinder, a piston inserted inside the cylinder, a piston rod extended from the piston, a rod guide for stabilizing the piston rod, and a free piston movable inside the cylinder in the space between the cylinder and the piston; oil is filled between the free piston

and the piston and between the piston and the rod guide in the inside of the cylinder; the assist mechanism further has a first cylindrical member and a second cylindrical member which are movable on the same axis; and the first cylindrical member has the second fulcrum and one end of the gas spring connected thereto, and the second cylindrical member has the third fulcrum and the other end of the gas spring connected thereto as characteristics of the work machine.
[0009]
In the work machine above, it is desirable that the assist mechanism further has a first cylindrical member and a second cylindrical member which are movable on the same axis, the first cylindrical member has the second fulcrum and one end of the gas spring connected thereto, and the second cylindrical member has the third fulcrum and the other end of the gas spring connected thereto. In addition, an opening facing downward may exist at one end on the apron side of the first cylindrical member or the second cylindrical member. Moreover, a resin collar may be interposed between the first cylindrical member and the second cylindrical member.
[0010]
In the work machine above, it is desirable to configure the gas spring to contract at the point where the apron is lowered.
[0011]
In the work machine above, it is desirable that the assist mechanism has a lock mechanism that prevents a force that changes the distance between the second fulcrum and the third fulcrum from being applied at the point where the apron is lowered. The lock mechanism may be configured so that it has a pivotable stop lever provided on the second cylindrical member, prevents the first cylindrical member from protruding from the second cylindrical member by the stop lever closing one end of the second cylindrical member, and allows the first cylindrical member to protrude from the second cylindrical member by the stop lever opening one end of the second cylindrical member. In addition, the lock mechanism may have a means for pivoting the stop lever in the direction of closing one end of the second cylindrical member and a means for temporarily fixing the stop lever at a position that opens one end of the second cylindrical member.
[0012]
In the work machine above, the assist mechanism may include multiple gas springs.
[Effect of the invention]
[0013]
According to the work machine of the present invention, it is possible to provide a work machine that is capable of performing stable assist operation and that also prevents deterioration of the gas spring. In addition, it will be possible to prevent the apron from flipping up abruptly when the apron is in a lowered state.
[Brief explanation of the drawings]
[0014]
[Figure 1] This is a rear view of a work machine according to a working example of the present invention.
[Figure 2] This is a side view of a work machine according to a working example of the present invention at the time of tilling.
[Figure 3] This is a side view of a work machine according to a working example of the present invention at the time when the apron is flipped up.
[Figure 4] This is a rear view of the flip-up assist mechanism of a work machine according to a working example of the present invention.
[Figure 5] This is a side view of the flip-up assist mechanism of a work machine according to a working example of the present invention at the time of tilling.
[Figure 6] This is a side view of the flip-up assist mechanism of a work machine according to a working example of the present invention at the time when the apron is flipped up.
[Figure 7] This is a figure showing the effect of the flip-up assist mechanism of a work machine according to a working example of the present invention.
[Embodiments of the invention]
[0015]
A working example of the work machine of the present invention is explained below with reference to drawings. However, the work machine of the present invention may be implemented in many different embodiments, and should not be construed to be limited to the statement of the example shown below. In the drawings referred to in the embodiments, the same parts or parts having similar functions are denoted by the same reference numerals, and their repetitive explanations are omitted. In addition, while the explanation uses the terms "above (upper part)" and "below (lower part)" for convenience of explanation, "above (upper part)" and "below (lower part)" respectively indicate the directions of the work machine in the working state. Similarly, while the explanation uses the terms "front (front side)" and "rear/behind (rear side)," "front (front side)" indicates the direction toward the traveling machine body that pulls the work machine relative to the work machine, and "rear/behind (rear side)" indicates the direction toward the work machine relative to the traveling machine body.
[0016]
<Working example>
The overall configuration of a work machine according to a working example of the present invention and the configuration of the flip-up assist mechanism (auxiliary mechanism) are explained using Figures 1 through 6. The work machine according to a working example of the present invention is a work machine that is connected to a rear part of a traveling machine body, such as a tractor for example, and tills or mixes soil by rotating work claws, like a tilling

work machine or a puddling machine. In the working example, the configuration of the present invention is explained using a tilling work machine as an example of the work machine, but the work machine claimed in the present invention may be a puddling machine or a work machine other than a tilling work machine or a puddling machine.
[0017]
[Configuration of work machine 100]
Figure 1 shows a rear view of a work machine according to a working example of the present invention. Figure 2 shows a side view of the work machine according to a working example of the present invention at the time of tilling. Figure 3 shows a side view of the work machine according to a working example of the present invention at the time when the apron is flipped up. The work machine 100 according to the working example is comprised of elements including a frame (including a main frame 110 and a shield cover 120), a tilling rotor 102, and an apron 130.
[0018]
The main frame 110 is connected to a traveling machine body, such as a tractor. The main frame 110 is cylindrical and has a power transmission shaft inside. Rotational power is obtained from the traveling machine body, such as a tractor, and the direction of its rotation axis is changed to left to right against the traveling direction. The power transmission shaft in the main frame 110 is connected to a chain case 105 at a side part of the work machine 100, and the power is transmitted to the rotary shaft 104 of the tilling rotor 102 by the chain transmission mechanism inside the chain case 105.
[0019]
The tilling rotor 102 is comprised of a rotary shaft 104 and multiple tilling claws 103 provided on the rotary shaft 104. As shown in Figure 1, the multiple tilling claws 103 are bent to the left or right against the traveling direction, and the area (width) of soil dug up by each tilling claw 103 partially overlaps with that dug up by the adjacent claws 103. The tilling rotor 102 rotates in a manner that scoops up soil from the front to the rear of the traveling direction. As a result, soil adheres to the inner side of the apron 130.
[0020]
The apron 130 is capable of being lowered or flipped up in a pivotal movement around a fulcrum 140 fixed to the shield cover 120. The center of gravity of the apron 130 is positioned behind the abovementioned fulcrum. Therefore, the apron 130 tends to descend by its own weight. A stainless leveling plate 131 is welded to the tip of the apron 130. The leveling plate 131 is configured to draw a loop from the inside of the apron 130 toward the outside. The leveling plate 131 flattens the farm field dug up by the tilling rotor 102. Movable extended leveling plates 132 are provided at both ends of the leveling plate 131. By opening up the extended leveling plates 132, the plates along with the leveling plate 131 can level a wide width of land. A compression rod 142 is provided between a pedestal provided on the main frame 110 and the apron 130. The compression rod 142 serves to press down the apron 130 and the leveling plate 131 against the farm field with a constant pressure when the apron 130 is in a lowered state. The degree of the force applied by the compression rod 142 can be adjusted by operation of the worker. Since soil adheres to the inside of the apron 130 in some cases, the inside of the apron is covered with a rubber sheet. The inside of the shield cover is also covered with a rubber sheet.
[0021]
In the working example, an apron flip-up assist mechanism (auxiliary mechanism) 141 is further provided in addition to the abovementioned configuration. The apron flip-up assist mechanism (auxiliary mechanism) 141 is provided between a fulcrum 151 at a pedestal 111 provided on the main frame 110 and a fulcrum 152 at a pedestal 134 provided on the apron 130, and it applies a force that changes the distance between the fulcrum 151 and the fulcrum 152. Specifically, it applies a force in the direction of flipping up the apron 130 by reducing the distance between the two fulcra. A lock mechanism 153 is provided in this apron flip-up assist mechanism 141. The lock mechanism 153 prevents a force in the direction of reducing the distance between the fulcrum 151 and the fulcrum 152 from being applied when the apron 130 is in a lowered state (Figure 2).
[0022]
[Configuration of the flip-up assist mechanism]
Figure 4 shows a rear view of the flip-up assist mechanism 141 of a work machine according to a working example of the present invention. Figure 5 shows a side view of the flip-up assist mechanism 141 of a work machine according to a working example of the present invention at the time of tilling. Figure 6 shows a side view of the flip-up assist mechanism 141 of a work machine according to a working example of the present invention at the time when the apron is flipped up. The flip-up assist mechanism 141 of a work machine according to a working example is comprised of elements including an inner cylindrical member 210, an outer cylindrical member 220, and a gas spring 250 positioned therein.
[0023]
[Configuration of the gas spring]
The gas spring 250 is comprised of a circular cylindrical cylinder 251 enclosing a space inside, a piston 256 inserted inside the cylinder 251, a piston rod 252 extended from the piston 256, and a free piston 257. A bracket 253 is provided at a tip of the piston rod 252 and a bracket 254 is provided at a tip of the cylinder 251. A rod guide 258 for stabilizing the piston rod 252 is provided near the other ends of the piston rod 252 and the cylinder 251. The free piston 257 is movable in the inside of the cylinder in the space between the cylinder 251 and the piston 256. An O-ring made of plastic resin is fitted between the free piston and the inner wall of the cylinder 251. A first chamber 261 between the free piston 257 and the tip of the cylinder (the chamber on the right of the free piston 257 in Figures 5 and 6) is filled

with nitrogen. As a result of changes in the volume of the nitrogen, the gas spring 250 expands and contracts like a spring, and when the distance between the brackets 253 and 254 is small, it applies a force in the direction to increase the distance. A second chamber 260 between the piston 256 inside the gas spring 250 and the free piston 257 (the chamber on the left of the free piston 257 in Figures 5 and 6) and a third chamber 280 between the piston 256 and the rod guide 258 (the chamber on the left of the piston 256 in Figures 5 and 6) are filled with oil. The oil prevents the nitrogen from leaking outside the gas spring 250. In the piston 256, an orifice (hole) 259 is formed along the extending direction of the gas spring 250. The oil filled in the second chamber 260 and the third chamber 280 moves back and forth through the chambers through the orifice 259 formed in the piston 256. Specifically, as the piston rod 252 extends toward the outside of the cylinder 251, the oil inside the third chamber 280 moves to the second chamber 260 through the orifice 259, and the distance between the piston 256 and the free piston 257 widens.

[0024]

[Configuration of the combination of the inner and outer cylindrical members]

The flip-up assist mechanism 141 combines the inner cylindrical member 210 and the outer cylindrical member 220 in order to convert the force in the extending direction, applied by the gas spring 250, to a force in the compressing direction. The inner cylindrical member 210 and the outer cylindrical member 220 are movable on the same axis. A resin-made cylindrical collar (resin collar), which is not shown, is provided between the two members to prevent abnormal noise from being generated by the sliding of the inner cylindrical member 210 and the outer cylindrical member 220 against each other. The bracket 254 of the gas spring 250 is connected to the outer cylindrical member 220 by a pin 271. The pin 271 moves back and forth within an elongated hole provided on the inner cylindrical member 210. The bracket 253 of the gas spring 250 is connected to the inner cylindrical member 210 by a pin 270. The fulcrum 151 is provided at one end of the inner cylindrical member, and the fulcrum 152 is provided at the outer cylindrical member. Accordingly, when a force is applied in the direction in which the gas spring 250 extends, the assist mechanism, in reverse, applies a force in the direction in which the distance between the fulcrum 151 and the fulcrum 152 is compressed. As a result of this, the assist mechanism makes the apron 130 pivot in the direction of flipping it up.

[0025]

Given the abovementioned configuration, the gas spring 250 inside the assist mechanism 141 will be arranged almost parallel to the horizontal axis (although there is a slight inclination), and will not be arranged perpendicularly. In the case of a general gas spring, it is desirable to arrange the piston rod below the cylinder from the viewpoint of preventing gas leakage and deterioration of the gas spring; however, according to the working example, gas leakage and deterioration of the gas spring can be suppressed even if the gas spring is almost parallel to the horizontal axis, because the abovementioned gas spring is used.

[0026]

[Configuration of the lock mechanism]

A lock mechanism 153 is provided in the apron flip-up assist mechanism 141. The lock mechanism 153 prevents a force in the direction of reducing the distance between the fulcrum 151 and the fulcrum 152 from being applied when the apron 130 is in a lowered state. As a result, at the time of tilling, the assist mechanism 141 works and prevents the apron from flipping up. As shown in Figure 4, the lock mechanism 153 is fixed to the outer cylindrical member 220, and is comprised of a lock bar 230 that pivots around the fulcrum 231, a lever 240 that extends from the lock bar 230, and a pivoting restriction plate 233 which restricts the pivoting of the lock bar 230.

[0027]

When the lever 240 is tilted down, the lock bar 230 closes one end of the outer cylindrical member 220, thereby restricting the inner cylindrical member 210 from protruding. As a result, the assist mechanism does not apply a force in the direction in which the distance between the fulcrum 151 and the fulcrum 152 is compressed. When the lever 240 is tilted up, the lock bar 230 opens one end of the outer cylindrical member 220, allowing the inner cylindrical member 210 to protrude. As a result, the assist mechanism applies a force in the direction in which the distance between the fulcrum 151 and the fulcrum 152 is compressed. In this way, at the time of tilling, the operation of the assist mechanism can be locked by tilting down the lever 240.

[0028]

[Relationship between the assist operation force and the apron angle]

Figure 7 shows a graph indicating the relationship between the assist operation force and the apron angle (the results of actual measurement using a tilling work machine manufactured and sold by the applicant). It can be understood that, when the assist mechanism does not function, a fairly constant load starts to be applied as the apron angle (the apron angle is defined as the angle at which the apron pivots starting from the lowest lowered state, which is regarded as 0°) exceeds approximately 10°. On the other hand, when the assist mechanism functions, the load starts to decrease almost linearly at the apron angle of nearly 0°. Then the load becomes zero at the apron angle of about 60°. In other words, from the worker's perspective, the apron gradually becomes lighter. Such tendency of the load is observed due to the positional relationship of the respective fulcra in the abovementioned working example. In the gas spring 250 explained above, the force in the compressed state is larger than the force in the extended state; however, as the fulcrum 152 approaches the fulcrum 151, there will be an increase in the moving distance of the fulcrum 152 against a predetermined rotation angle, so a reverse characteristic (the force 1 applied by the assist mechanism increases as the apron angle increases) is exhibited due to the "principle of leverage."

[0029]

[Variant example 1]

While the abovementioned working example uses a gas spring having a free piston, it is also possible to use a conventional gas spring that does not use a free piston. In this case, it is desirable for the piston rod to be positioned below the cylinder in the normal state where the apron is lowered. This is because, even in a conventional gas spring that does not use a free piston, if the piston rod is positioned below the cylinder, the oil inside moves to the piston side and prevents leakage of nitrogen gas.

[0030]

[Variant example 2]

While the abovementioned working example shows an example using only one gas spring, multiple gas springs may also be used. By doing so, it will be possible to obtain sufficient assist force. In particular, it is desirable to use multiple gas springs in a large tilling work machine, puddling machine, or the like, which has a heavy apron. In this case, multiple assist mechanisms may be arranged at intervals in the width direction of the work machine.

[0031]

[Variant example 3]

While the abovementioned working example shows an example using only one gas spring in one assist mechanism, multiple gas springs may also be used in one assist mechanism. By doing so, it will be possible to obtain sufficient assist force. Further, the cylindrical member, instead of being a circular cylinder, may also be an elliptic cylinder having an elliptical cross section or a square cylinder having a rectangular cross section.

[0032]

[Variant example 4]

While in the abovementioned working example, the automatic locking mechanism is configured to only move the stop lever up and down, it may also be configured as a spring that biases the stop lever to pivot in the direction of closing one end of the second cylindrical member, or as a mechanism having a guide shape which temporarily fixes the stop lever to the position which opens one end of the second cylindrical member (for example, providing a step difference in the guide). By adopting such configuration, the biasing spring will automatically lock the apron at the position where it is lowered to its lowest state. In addition, by configuring the mechanism to have a guide shape which temporarily fixes the stop lever to the position which opens one end of the second cylindrical member, it will be possible to unlock the apron at the position where it is lowered to its lowest state, and flip up the apron in the unlocked state.

[0033]

[Operation and effect of the working example]

With the above configuration, the working example exhibits the following operation and effect.

[0034]

First, according to the working example of the present invention, because the assist mechanism is not provided at a widthwise end part of an apron, there is no risk that the gas spring would contact an obstacle, such as a ridge or a side wall, and become damaged during work. While the assist mechanism is provided between the second fulcrum fixed to the frame and the third fulcrum fixed to the apron, the frame is a structural member and already has sufficient strength, so the durability of the assist mechanism can be improved.

[0035]

Second, given the configuration of the working example of the present invention, the gas spring inevitably has to be arranged almost in parallel to the horizontal axis, and the risk of gas leakage tends to become high in a general gas spring (without a free piston). According to the working example of the present invention, the gas spring has a free piston inside, and the chamber between the free piston and the piston and the chamber between the piston and the rod guide are respectively filled with oil. As a result, the risk that gas, such as nitrogen, filled at the tip of the free piston would leak out from the gas spring will be reduced, deterioration of the gas spring will be prevented, and the life of the gas spring will be greatly improved. This also contributes to reducing the maintenance cost of the work machine.

[0036]

Third, according to the working example of the present invention, the piston rod of the gas spring is positioned below the cylinder when the apron is in a lowered state (i.e., the state at the time of tilling; this state is maintained for a much longer time than the time when the apron is in a flipped-up state). As a result, compared with the case where the piston rod of the gas spring is positioned above the cylinder, the risk that gas, such as nitrogen, would leak out from the gas spring will be reduced, deterioration of the gas spring will be prevented, and the life of the gas spring will be greatly improved. This also contributes to reducing the maintenance cost of the work machine.

[0037]

Fourth, according to the working example of the present invention, the force required for flipping up the apron is reduced by the force applied by the assist mechanism. Furthermore, as the assist mechanism is adjusted so that the force gradually decreases within a predetermined angle range, it is possible to prevent the worker from flipping up the apron accidentally from the state where the apron is lowered in the tilling state; once the apron is flipped up to a certain angle with a reasonable degree of force (but smaller than the force required when there is no assist mechanism), it can be flipped up with a lighter force thereafter. That is, the force required for flipping up the apron will be reduced, and the force required for the flipping up decreases as the rotation angle increases.

[0038]

Fifth, the working example of the present invention has a first cylindrical member and a second cylindrical member which are movable on the same axis, and adopts a double-cylinder configuration, which applies a force in the compressing direction to the first cylindrical member at the position where the second fulcrum and one end of the

abovementioned gas spring are connected thereto, and to the second cylindrical member at the position where the third fulcrum and the other end of the gas spring are connected thereto, when a force is applied in the direction in which the gas spring extends. As a result, the piston rod of the gas spring is covered with the cylindrical members, preventing the surface from becoming soiled, and the life of the gas spring will be greatly improved. This also contributes to reducing the maintenance cost of the work machine.

[0039]

Sixth, in the working example of the present invention, the inner cylindrical member and the outer cylindrical member will be in a state of doubly covering the piston rod of the gas spring at the time of tilling. In other words, the members protect the piston rod, which is found to deteriorate according to the surrounding environment.

[0040]

Seventh, in the working example of the present invention, an opening (small hole) facing downward is present at one end (on the apron side) of the inner cylindrical member. With this small opening, it is possible to discharge moisture accumulated in the inner cylindrical member.

[0041]

Eighth, in the working example of the present invention, the gas spring is configured to contract at the point where the apron is lowered, so the surface of the piston rod of the gas spring will no longer be soiled at the time of tilling, which accounts for the longest hours of use, and the life of the gas spring will be greatly improved. This also contributes to reducing the maintenance cost of the work machine.

[0042]

Ninth, in the working example of the present invention, the assist mechanism has a resin collar interposed between the outer cylindrical member and the inner cylindrical member. As a result, it is possible to prevent abnormal noise from being generated when the outer cylindrical member and the inner cylindrical member slide against each other.

[0043]

The present invention has been explained above with reference to drawings, but the present invention is not limited to the abovementioned embodiments, and can be appropriately modified to the extent that does not depart from the gist of the present invention.

[Explanations of letters or numerals]

[0044]

100: work machine; 210: inner cylindrical member; 220: outer cylindrical member; 250: gas spring; 251: cylinder; 252: piston rod; 256: piston; 257: free piston

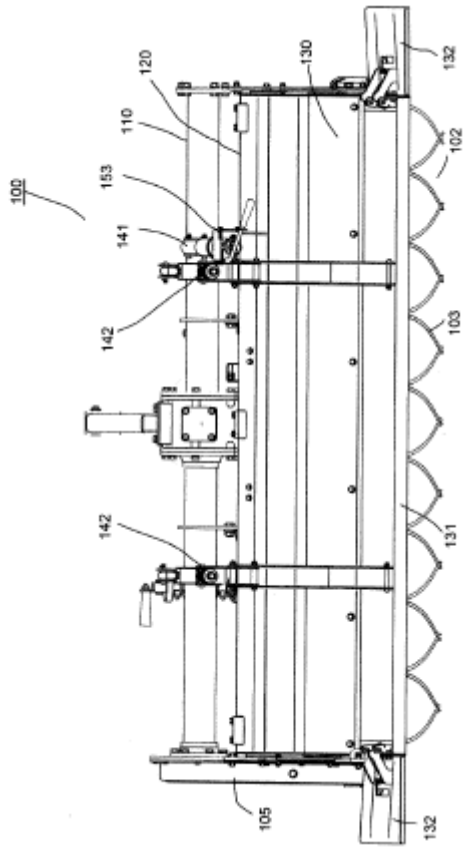
[Abstract]

[Problem to be solved] To provide a work machine that is capable of performing stable assist operation

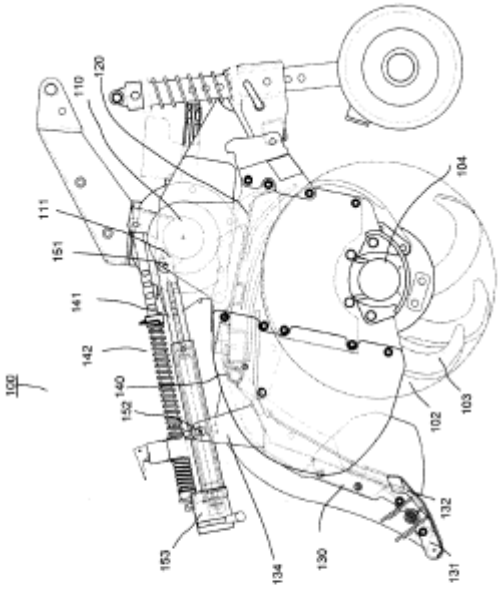
[Means for solving the problem] An assist mechanism which applies a force in the direction of flipping up an apron is disclosed, wherein: the assist mechanism has a first cylindrical member and a second cylindrical member; the first cylindrical member has the second fulcrum and one end of said gas spring connected thereto, and the second cylindrical member has the other end of said gas spring connected thereto; as a first projecting part provided on the second cylindrical member contacts a second projecting part that pivots around the third fulcrum and changes in the direction of reducing the distance between the third fulcrum and the second fulcrum, the force required for flipping up the apron gradually decreases within a predetermined angle range in which the apron angle increases; and the gas spring is configured to contract at the point where the apron is lowered.

[Chosen drawing] Figure 5

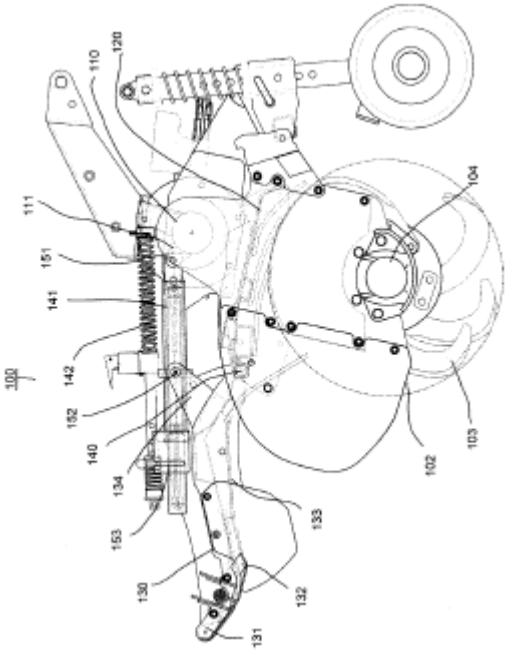
[Figure 1]



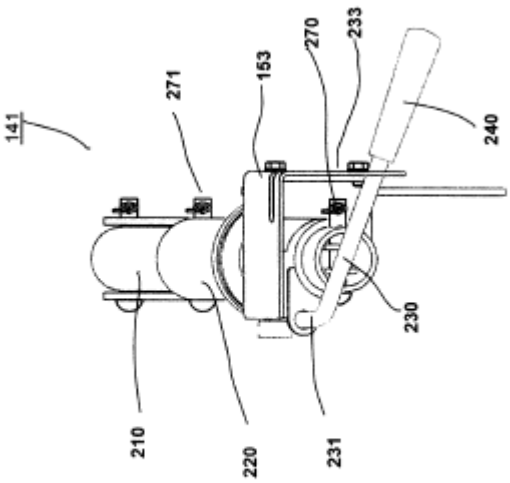

[Figure 2]



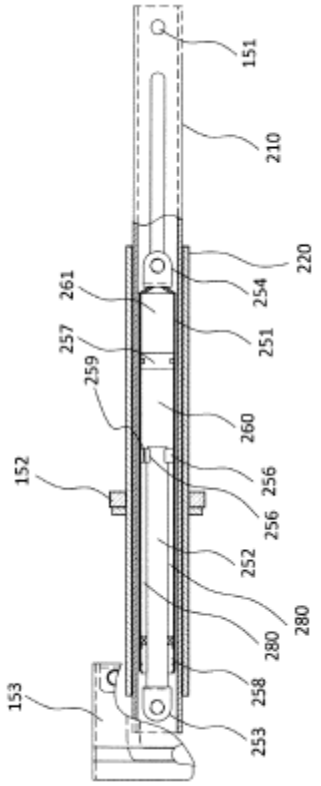

[Figure 3]



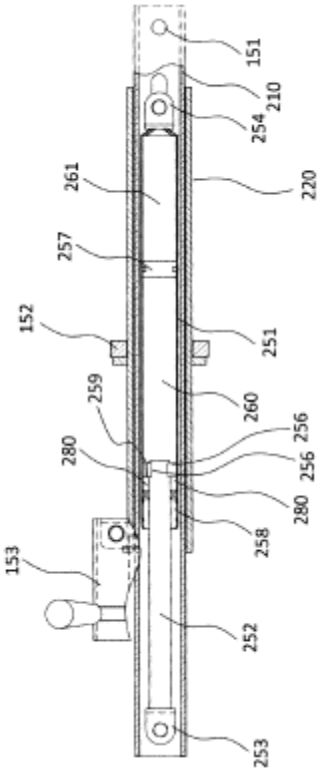

[Figure 4]



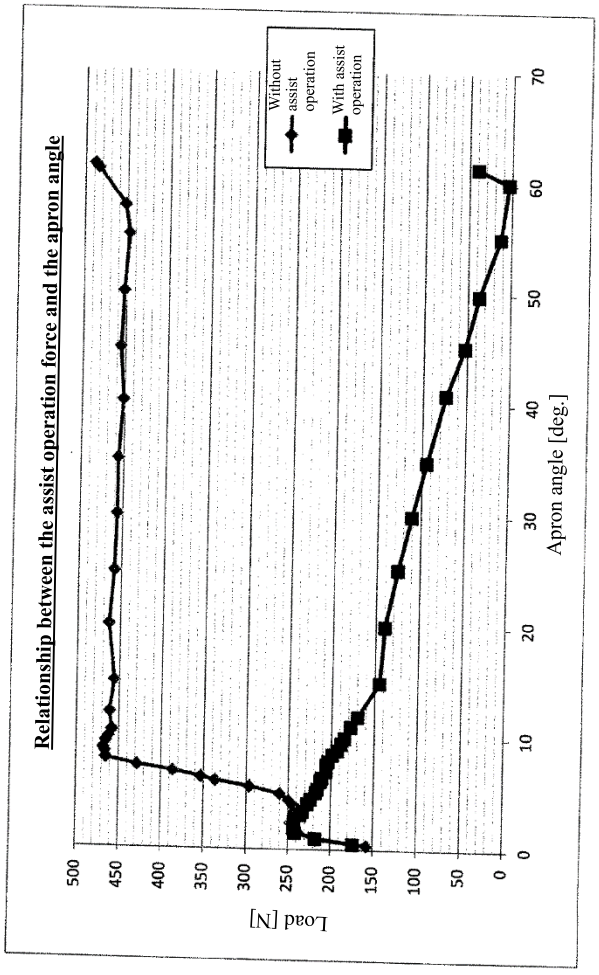
[Figure 5]




[Figure 6]



[Figure 7]


Relationship between the assist operation force and the apron angle
Without assist operation
With assist operation
Load [N]
500
450
400
350
300
250
200
150
100
50
0
0
10
20
30
40
50
60
70
Apron angle [deg.]

Continued from the front page

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