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- (73) Patent holder
 LS Mtron Co., Ltd.
127 LS-ro (Hogye-dong) Dongan-gu, Anyang-si, Gyeonggi-do
- (72) Inventors
Dae-Hyun Lee
 Life Sciences Department (Natural Sciences Campus, Sungkyunkwan University, Cheoncheon-dong) 2066 Seobu-ro, Jangan-gu, Suwon-si, Gyeonggi-do 61106
Jung-Woong Choi
 #801 Bldg. 108 (Seo Suwon Xii Apartment, Ipbuk-dong) 50 Ipbuk-ro, Gwonseon-gu, Suwon-si, Gyeonggi-do
Yong-Ju Kim
 #1102 Bldg. 2102 (Lotte Castle Gold Apartment, Guwol-dong) 803 Hogupo-ro, Namdong-gu, Incheon Metropolitan City
- (74) Agents
Young-Cheol Kim, Soon-Young Kim

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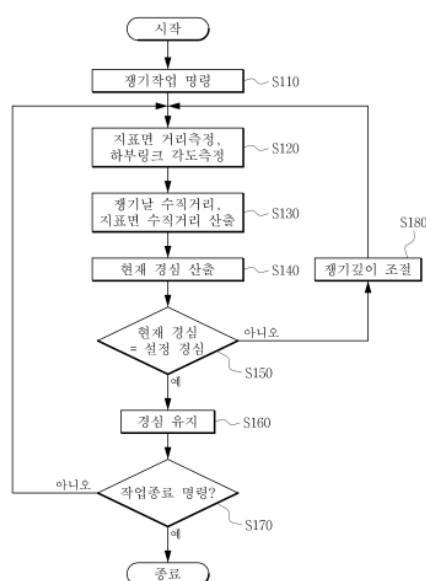
Examiner: Gyeong-Jin Yang

(54) Name of patent: **Tractor Plow Depth Control Apparatus and Method****(57) Abstract**

The present invention relates to a tractor plow depth control apparatus and method.

The tractor plow depth control apparatus according to the present invention comprises: a distance sensor, installed on a plow frame connection part connected to a lower connection part provided at the front end of a lower link, that measures under the control of a control

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Representative drawing – Fig. 3

	Start		
	Plowing work command	S110	
	Ground surface distance measurement, lower link angle measurement	S120	
	Plow blade vertical distance, ground surface vertical distance calculation	S130	S180
	Current plow depth calculation	S140	Plow depth adjustment
	Current plow depth = Set plow depth	No	
	Yes	S150	
	Maintain plow depth	S160	
No	End work command?		
	Yes	S170	
	End		

unit and transmits to the control unit the ground surface distance corresponding to the distance from the ground surface; an angle sensor that measures under the control of the control unit and transmits to the control unit the lower link angle corresponding to the driving angle of the lower link; the control unit that, according to a plow depth control program during plowing work, performs plow depth control to maintain a constant plow depth, receives input of the ground surface distance from the distance sensor and the lower link angle from the angle sensor, calculates the current plow depth, and controls a flow control valve to maintain a constant plow depth; a storage unit that stores and provides to the control unit the plow depth control program and that stores various data for plow depth control processing under control of the control unit; a display unit that displays various driving state information according to the plow depth control under the control of the control unit; a flow control valve under the control of the control unit that applies hydraulic pressure to an actuator for driving the lift rod, drives the lift rod up and down, and adjusts the depth of the plow by raising and lowering the plow frame using the lift rod; and an operation unit that applies commands and data input through manual operation to the control unit.

According to the present invention, when performing plowing work with a plow connected to a tractor, the plowing work is performed by automatically adjusting to maintain a constant plow depth by measuring the plow depth during plowing operations, thereby being able to create favorable soil conditions for cultivating crops.

Specification**Claims****Claim 1**

A tractor plow depth control apparatus characterized wherein the tractor plow depth control apparatus comprises:

a distance sensor installed on a plow frame connection part connected to a lower connection part provided at the front end of a lower link, that measures under the control of a control unit and transmits to the control unit the ground surface distance corresponding to the distance from the ground surface;

an angle sensor that measures under the control of the control unit and transmits to the control unit the lower link angle corresponding to the driving angle of the lower link;

the control unit that, according to a plow depth control program during plowing work, performs plow depth control to maintain a constant plow depth, receives input of the ground surface distance from the distance sensor and the lower link angle from the angle sensor, calculates the current plow depth, and controls a flow control valve to maintain a constant plow depth;

a storage unit that stores and provides to the control unit the plow depth control program and that stores various data for plow depth control processing under control of the control unit;

a display unit that displays various driving state information according to the plow depth control under the control of the control unit;

a flow control valve under the control of the control unit that applies hydraulic pressure to an actuator for driving the lift rod, drives the lift rod up and down, and adjusts the depth of the plow by raising and lowering the plow frame using the lift rod;

and an operation unit that applies commands and data input through manual operation to the control unit,

wherein the control unit calculates the plow blade vertical distance by multiplying the plow blade depth corresponding to the distance from the plow frame to the plow blade front end by the cosine of the lower link angle, calculates the ground surface vertical distance by multiplying the ground surface distance by the cosine of the lower link angle, and then calculates the current plow depth by calculating the difference between the plow blade vertical distance and the ground surface vertical distance.

Claim 2

Deleted

Claim 3

The tractor plow depth control apparatus in Claim 1 characterized wherein

if the calculated current plow depth matches the set plow depth, the control unit controls the flow control valve to maintain as-is the hydraulic pressure applied to the actuator, thereby maintaining as-is the position of the lift rod using the actuator to maintain as-is the position of the plow frame, so as to maintain as-is the current plow depth.

Claim 4

The tractor plow depth control apparatus in Claim 3 characterized wherein

if the calculated current plow depth does not match the set plow depth, the control unit controls the flow control valve to adjust the hydraulic pressure applied to the actuator, thereby raising and lowering the lift rod using the actuator to adjust the plow frame up and down using the lift rod, so as to adjust the depth of the plow blade to reach the set plow depth.

Claim 5

A tractor plow depth control method characterized wherein the tractor plow depth control method includes:

a step wherein the control unit measures the ground surface distance corresponding to the distance from the ground surface using a distance sensor installed on a plow frame connection part connected to a lower connection part provided at the front end of a lower link and measures the lower link angle corresponding to the driving angle of the lower link using an angle sensor;

a step wherein the control unit calculates the plow blade vertical distance by multiplying the plow blade depth corresponding to the distance from the plow frame to the plow blade by the cosine of the lower link angle, and calculates the ground surface vertical distance by multiplying the ground surface distance by the cosine of the lower link angle;

a step wherein the control unit calculates the current plow depth by calculating the plow depth as the difference between the plow blade vertical distance and the ground surface vertical distance; and

a step wherein the control unit controls the driving of the plow frame based on whether the calculated current plow depth matches the set plow depth.

Claim 6

The tractor plow depth control method in Claim 5 wherein

the step of controlling the driving of the plow frame includes:

a step wherein the control unit checks whether the calculated current plow depth matches the set plow depth;

a step wherein, if the calculated current plow depth does not match the set plow depth, the control unit controls the flow control valve to adjust the hydraulic pressure applied to the actuator, thereby raising and lowering the lift rod using the actuator to adjust the plow frame up and down using the lift rod, so as to adjust the depth of the plow blade to reach the set plow depth; and

a step wherein, if the calculated current plow depth matches the set plow depth, the control unit controls the flow control valve to maintain as-is the hydraulic pressure applied to the actuator, thereby maintaining as-is the position of the lift rod using the actuator to maintain as-is the position of the plow frame, so as to maintain as-is the current plow depth.

Description of the invention

Field of the art

- [0001] The present invention relates to the control of tractor plow depth, and more particularly, to a tractor plow depth control apparatus and method to perform plowing work by automatically adjusting to maintain a constant plow depth by measuring the plow depth during plowing operations when performing plowing work with a plow connected to a tractor.

Background art

- [0002] Plowing work in agricultural operations is the task of turning over the soil to plant crops, and it is generally performed using a tractor.
- [0003] When performing plowing work using a tractor in this manner, the plowing work is performed by connecting a plow to the tractor and towing it with the plow inserted below the ground.
- [0004] To create favorable soil conditions for cultivating crops during plowing work, it is very important to perform plowing work at a constant depth. However, a difficult problem in most plowing work using a tractor is that the plowing depth is determined by the operator's subjective judgment according to the undulations of the ground surface, making it very difficult to maintain a constant plow depth during plowing work.

Summary of the invention

Problem to be solved

- [0005] The present invention has been proposed to solve the conventional problem as described above, and its purpose is to provide a tractor plow depth control apparatus and method to perform plowing work by automatically adjusting to maintain a constant plow depth by measuring the plow depth during plowing operations when performing plowing work with a plow connected to a tractor.

Means for solving the problem

- [0006] The tractor plow depth control apparatus according to the present invention to achieve the above-described purpose comprises: a distance sensor installed on a plow frame connection part connected to a lower connection part provided at the front end of a lower link, that measures under the control of a control unit and transmits to the control unit the ground surface distance corresponding to the distance from the ground surface; an angle sensor that measures under the control of the control unit and transmits to the control unit the lower link angle corresponding to the driving angle of the lower link; the control unit that, according to a plow depth control program during plowing work, performs plow depth control to maintain a constant plow depth, receives input of the ground surface distance from the distance sensor and the lower link angle from the angle sensor, calculates the current plow depth, and controls a flow control valve to maintain a constant plow depth; a storage unit that stores and provides to the control unit the plow depth control program and that stores various data for plow depth control processing under control of the control unit; a display unit that displays

various driving state information according to the plow depth control under the control of the control unit; a flow control valve under the control of the control unit that applies hydraulic pressure to an actuator for driving the lift rod, drives the lift rod up and down, and adjusts the depth of the plow by raising and lowering the plow frame using the lift rod; and an operation unit that applies commands and data input through manual operation to the control unit.

- [0007] According to the tractor plow depth control apparatus of the present invention, the control unit calculates the plow blade vertical distance by multiplying the plow blade depth corresponding to the distance from the plow frame to the plow blade front end by the cosine of the lower link angle, calculates the ground surface vertical distance by multiplying the ground surface distance by the cosine of the lower link angle, and then calculates the current plow depth by calculating the difference between the plow blade vertical distance and the ground surface vertical distance.
- [0008] Also, according to the tractor plow depth control apparatus of the present invention, if the calculated current plow depth matches the set plow depth, the control unit controls the flow control valve to maintain as-is the hydraulic pressure applied to the actuator, thereby maintaining as-is the position of the lift rod using the actuator to maintain as-is the position of the plow frame, so as to maintain as-is the current plow depth.
- [0009] Further, according to the tractor plow depth control apparatus of the present invention, if the calculated current plow depth does not match the set plow depth, the control unit controls the flow control valve so as to adjust the hydraulic pressure applied to the actuator, thereby raising and lowering the lift rod using the actuator so as to adjust the plow frame up and down using the lift rod, so as to adjust the depth of the plow blade so as to reach the set plow depth.
- [0010] Meanwhile, the tractor plow depth control method according to the present invention to achieve the above-described purpose includes: a step wherein the control unit measures the ground surface distance corresponding to the distance from the ground surface using a distance sensor installed on a plow frame connection part connected to a lower connection part provided at the front end of a lower link and measures the lower link angle corresponding to the driving angle of the lower link using an angle sensor; a step wherein the control unit calculates the plow blade vertical distance by multiplying the plow blade depth corresponding to the distance from the plow frame to the plow blade by the cosine of the lower link angle, and calculates the ground surface vertical distance by multiplying the ground surface distance by the cosine of the lower link angle; a step wherein the control unit calculates the current plow depth by calculating the plow depth as the difference between the plow blade vertical distance and the ground surface vertical distance; and a step wherein the control unit controls the driving of the plow frame based on whether the calculated current plow depth matches the set plow depth.
- [0011] According to the tractor plow depth control method of the present invention, the step of controlling the driving of the plow frame includes: a step wherein the control unit checks whether the calculated current plow depth matches the set plow depth; a step wherein, if the calculated current plow depth does not match the set plow depth, the control unit controls the flow control valve to adjust the hydraulic pressure applied to the actuator, thereby raising and lowering the lift rod using the actuator to adjust the plow frame up and down using the lift rod, so as to adjust the depth of the plow blade to reach the set plow depth; and a step wherein, if the calculated current plow depth matches the set plow depth, the control unit controls the flow control valve to maintain as-is the hydraulic pressure applied to the actuator, thereby maintaining as-is the position of the lift rod using the actuator to maintain as-is the position of the plow frame, so as to maintain as-is the current plow depth.

Effects of the invention

- [0012] According to the present invention, when performing plowing work with a plow connected to a tractor, the plowing work is performed by automatically adjusting to maintain a constant plow depth by measuring the plow depth during plowing operations, thereby creating favorable soil conditions for cultivating crops.

Brief description of drawings

- [0013] Fig. 1 is a diagram illustrating a tractor plow depth control apparatus according to the present invention.

Fig. 2 is a diagram illustrating a mechanism configuration for tractor plow driving according to the present invention.

Fig. 3 is a diagram describing the plow depth control processing by the tractor plow depth control apparatus according to the present invention.

Detailed description for implementation of the invention

- [0014] The embodiments of the present invention will be described in detail with reference to the accompanying drawings below. The present invention has been described with reference to the embodiments shown in the drawings, but this is for illustrative purposes only, and the technical spirit and core configuration and operation of the present invention are not limited thereto.
- [0015] The tractor plow depth control apparatus according to the present invention, as shown in Fig. 1, includes an angle sensor (40), a distance sensor (50), a control unit (70), a display unit (75), a storage unit (80), a flow control valve (85), and an operation unit (90).

- [0016] The distance sensor (50) is a laser sensor, installed on a connection part of a plow frame connected to a lower connection part provided at the front end of a lower link, measuring the distance from the ground surface by emitting laser light to the ground surface under the control of the control unit (70) and measuring the distance from the ground surface based on the laser light reflected from the ground surface, and transmitting the measured distance to the control unit (70). The angle sensor (40) is driven under the control of the control unit (70), measuring the angle of the lower link and transmitting the measured angle to the control unit (70).
- [0017] The control unit (70) controls the overall driving of the tractor, performing plow depth control processing to control so as to maintain a constant plow depth according to the plow depth control program during plowing work. And, the storage unit (80) stores the plow depth control program and provides it to the control unit (70), storing various data for plow depth control processing under the control of the control unit (70). Also, the display unit (75) displays various driving state information according to the plow depth control under the control of the control unit (70).
- [0018] The flow control valve (85), under the control of the control unit (70), applies hydraulic pressure to the actuator for driving the lift rod, driving the lift rod up and down to raise and lower the plow frame connected to the tractor, thereby allowing the adjustment of the plow depth during plowing work. The operation unit (90) applies commands and data input through manual operation by the tractor driver to the control unit (70).
- [0019] Also, the mechanism configuration for driving a plow on a tractor according to the present invention is as illustrated in Fig. 2.
- [0020] The plow frame (20) equipped with a plow blade (21) is connected to the lower link (13) through the lower connection part (15) and to the upper link (11) through the upper connection part (22), being mounted on the tractor (10). And, the lift rod (12), driven up and down by an actuator provided on the tractor, is coupled to the lower link (13), driving the lower link (13) up and down to raise and lower the plow frame (20) connected to the lower connection part (15).
- [0021] Also, the distance sensor (50) is installed on the connection part of the plow frame (20) connected to the lower connection part (15), measuring the distance from the ground surface (31) by emitting laser light to the ground surface (31) under the control of the control unit (70) and measuring the distance from the ground surface based on the laser light reflected from the ground surface, and transmitting the measured distance to the control unit (70). The angle sensor (40) is installed on the tractor coupling part for coupling the lower link (13) to the tractor (10), measuring the angle of the lower link (13) and transmitting the measured angle to the control unit (70). In addition, although Fig. 2 shows the angle sensor (40) installed on the tractor coupling part for coupling the lower link (13) to the tractor (10), it is not limited thereto and may also be installed on the driving mechanism for driving the lift rod.
- [0022] In Fig. 2, the ground surface vertical distance (33) is the vertical distance between the distance sensor (50) and the ground surface (31), the ground surface distance (34) is the distance between the distance sensor (50) and the ground surface (31) measured by the distance sensor (50), the plow blade vertical distance (35) is the vertical distance from the plow frame (20) to the plow blade (21), the plow blade depth (36) is the distance from the plow frame (20) to the front end of the plow blade (21), and the plow depth (37) is the vertical distance from the ground surface (31) to the plow blade (21), and the lower link angle (32) is the angle between the lower link (13) and the ground surface (31).
- [0023] The control unit (70) controls the flow control valve (85) so the flow control valve (85) applies hydraulic pressure to the actuator for driving the lift rod, driving the lift rod (12) up and down to drive the plow frame (20) connected to the tractor (10) up and down to perform plowing work. As the lift rod (12) moves up and down, the lower link (13) is driven up and down, changing the lower link angle (32), and as the lower link angle (32) changes, the position and inclination of the plow frame (20) change.
- [0024] And, the control unit (70) determines the plow depth (37) by the depth of the plow blade (21) located at the very front end of the plow frame (20), and can calculate the plow depth (37) as the difference between the plow blade vertical distance (35) and the ground surface vertical distance (33). The plow blade vertical distance (35) is calculated by multiplying the plow blade depth (36) by the cosine of the lower link angle (32), and the ground surface vertical distance (33) is calculated by multiplying the ground surface distance (34) by the cosine of the lower link angle (32). The plow depth (37), which corresponds to the depth from the ground surface (31) to the very front end of the plow blade (21) of the plow frame (20), has a set fixed value, and the plow blade depth (36), which is the distance from the plow frame (20) to the front end of the plow blade (21), has a set fixed value.
- [0025] In other words, the control unit (70) calculates the plow depth (37) as the difference between the plow blade vertical distance (35) and the ground surface vertical distance (33) as shown in Formula 1, where the plow blade vertical distance (35) is calculated as shown in Formula 2, and the ground surface vertical distance (33) is calculated as shown in Formula 3.
- [0026] [Formula 1]
- [0027] $\text{plow depth} = \text{plow blade vertical distance} - \text{ground surface vertical distance}$
- [0028] [Formula 2]
- [0029] $\text{plow blade vertical distance} = \text{plow blade depth} \times \cos(\text{lower link angle})$
- [0030] [Formula 3]

- [0031] $\text{ground surface vertical distance} = \text{ground surface distance} \times \cos(\text{lower link angle})$
- [0032] The control unit (70) performs plow depth control processing to maintain a constant plow depth while performing plowing work according to commands input through the operation unit (90). During plowing work, the control unit (70) measures the ground surface distance (34) using the distance sensor (50) and the lower link angle (32) using the angle sensor (40), calculates the plow blade vertical distance (35) by multiplying the plow blade depth (36) by the cosine of the lower link angle (32) as in Formula 2, calculates the ground surface vertical distance (33) by multiplying the ground surface distance (34) by the cosine of the lower link angle (32) as in Formula 3, and then calculates the current plow depth by calculating the plow depth as the difference between the plow blade vertical distance (35) and the ground surface vertical distance (33) as in Formula 1.
- [0033] And, the control unit (70) checks whether the calculated current plow depth matches the set plow depth (37). If the calculated current plow depth matches the set plow depth (37), the control unit (70) controls the flow control valve (85) to maintain as-is the hydraulic pressure applied to the actuator, thereby maintaining as-is the position of the lift rod (12) using the actuator to maintain as-is the position of the plow frame (20) using the lift rod (12), so as to maintain as-is the current plow depth. Also, if the calculated current plow depth does not match the set plow depth (37), the control unit (70) controls the flow control valve (85) to adjust the hydraulic pressure applied to the actuator, thereby raising and lowering the lift rod (12) using the actuator to adjust the plow frame (20) up and down using the lift rod (12), so as to adjust the depth of the plow blade (21) to reach the set plow depth (37).
- [0034] The tractor plow depth control apparatus according to the present invention, having the functions as described above, performs the plow depth control processing as illustrated in Fig. 3.
- [0035] First, when a plowing work command is input through the operation unit (90) (S110), the control unit (70) measures the ground surface distance (34) through the distance sensor (50) and measures the lower link angle (32) through the angle sensor (40) (S120).
- [0036] And, the control unit (70) calculates the plow blade vertical distance (35) by multiplying the plow blade depth (36) by the cosine of the lower link angle (32) as in Formula 2, and calculates the ground surface vertical distance (33) by multiplying the ground surface distance (34) by the cosine of the lower link angle (32) as in Formula 3 (S130).
- [0037] Then, the control unit (70) calculates the current plow depth by calculating the plow depth as the difference between the plow blade vertical distance (35) and the ground surface vertical distance (33) as shown in Formula 1 (S140).
- [0038] And, the control unit (70) checks whether the calculated current plow depth matches the set plow depth (37) (S150).
- [0039] If the calculated current plow depth does not match the set plow depth (37) in S150, the control unit (70) controls the flow control valve (85) to adjust the hydraulic pressure applied to the actuator, thereby controlling to raise and lower the lift rod (12) using the actuator to adjust the plow frame (20) up and down using the lift rod (12), so as to adjust the depth of the plow blade (21) to reach the set plow depth (37) (S180), and then returns to S120 above to perform the process repeatedly.
- [0040] Also, if the calculated current plow depth matches the set plow depth (37) in S150, the control unit (70) controls the flow control valve (85) to maintain as-is the hydraulic pressure applied to the actuator, thereby maintaining as-is the position of the lift rod (12) using the actuator to maintain as-is the position of the plow frame (20) using the lift rod (12), so as to maintain as-is the current plow depth (S160).
- [0041] And, the control unit (70) checks whether an end plowing work command has been input through the operation unit (90) (S170), and if an end plowing work command has not been input, returns to S120 above to repeat the process, and if an end plowing work command has been input, ends the work.
- [0042] As described above, the tractor plow depth control apparatus according to the present invention performs plowing work by automatically adjusting to maintain a constant plow depth by measuring the plow depth during plowing operations when performing plowing work with a plow connected to a tractor, thereby creating favorable soil conditions for cultivating crops.
- [0043] The present invention is not limited to the above description, and those skilled in the art to which the present invention pertains can make various modifications to the present invention without departing from the technical spirit of the present invention, and such modifications are within the technical scope of the present invention.

Industrial applicability

- [0044] The present invention can be usefully applied to tractors performing plowing work. According to the present invention, when performing plowing work with a plow connected to a tractor, the plowing work is performed by automatically adjusting to maintain a constant plow depth by measuring the plow depth during plowing operations, thereby being able to create favorable soil conditions for cultivating crops.

Description of the symbols

- [0045] 10; tractor 11; upper link

- 12; lift rod

13; lower link

15; lower connection part

20; plow frame

21; plow blade

22; upper connection part

40; angle sensor

50; distance sensor

70; control unit

75; display unit

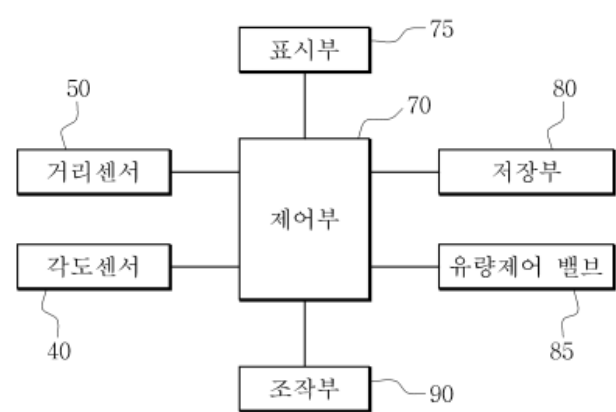
80; storage unit

85; flow control valve

90; operation unit

Drawings

Fig. 1



	display unit	75	
50		70	80
distance sensor	control unit		storage unit
angle sensor			flow control valve
40	operation unit	90	85

Fig. 2

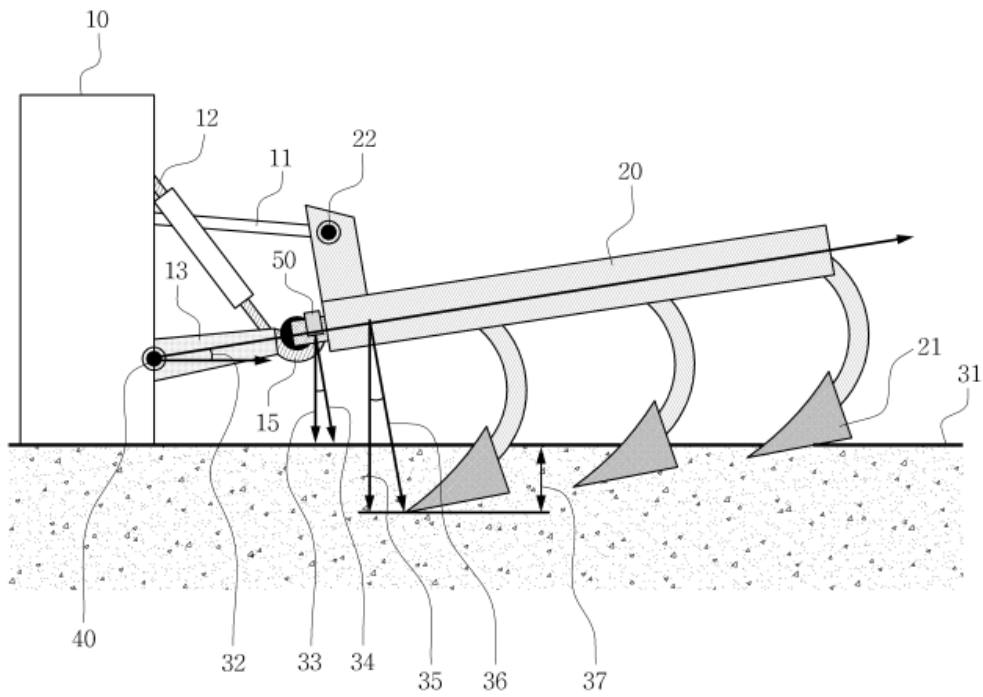
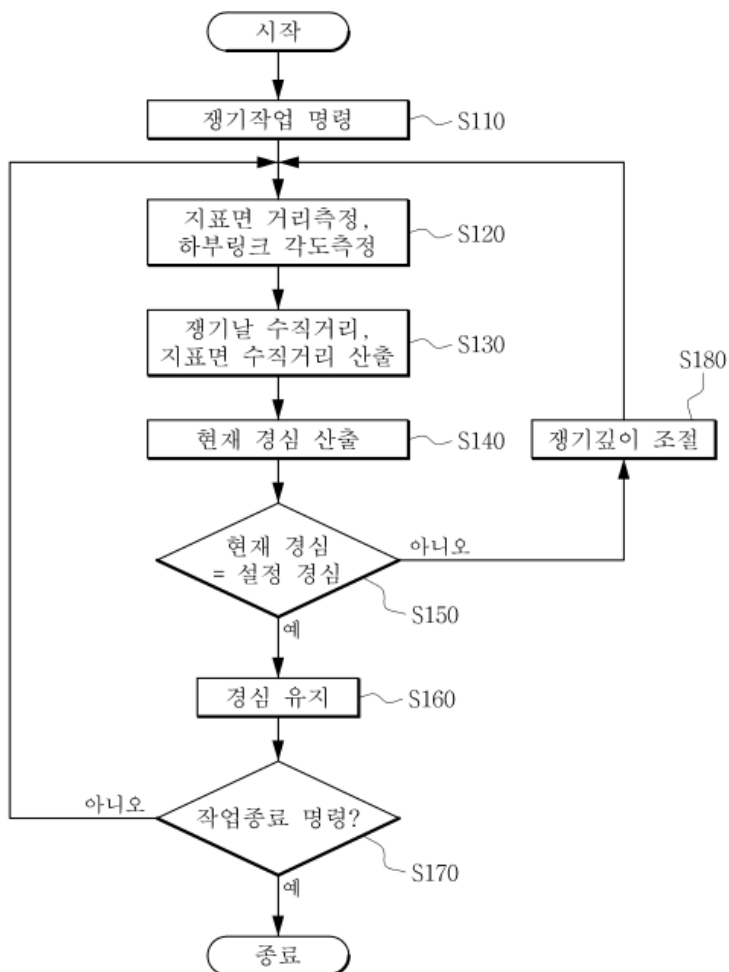


Fig. 3



	Start		
	Plowing work command	S110	
	Ground surface distance measurement, lower link angle measurement	S120	
	Plow blade vertical distance, ground surface vertical distance calculation	S130	S180
	Current plow depth calculation	S140	Plow depth adjustment
	Current plow depth = Set plow depth	No	
	Yes	S150	
	Maintain plow depth	S160	
No	End work command?		
	Yes	S170	
	End		