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(71) Applicant (for all designated States except US):
HUSQVARNA AB [SE/SE]; S-561 82 Huskvarna (SE).

(72) Inventor; and

(75) Inventor/Applicant (for US only): MAEDA, Kazuyuki
[JP/JP]; Kawagoe Park Familiar room #1006 2-19-1, Naka-
hara-cyou, Kawagoe, Saitama 350-0042 (JP).

(74) Agent: ROMEDAHL, Anna; c/o Husqvarna AB, Intellect-
tual Property Dept, EM-LPH, S-561 82 Huskvarna (SE).

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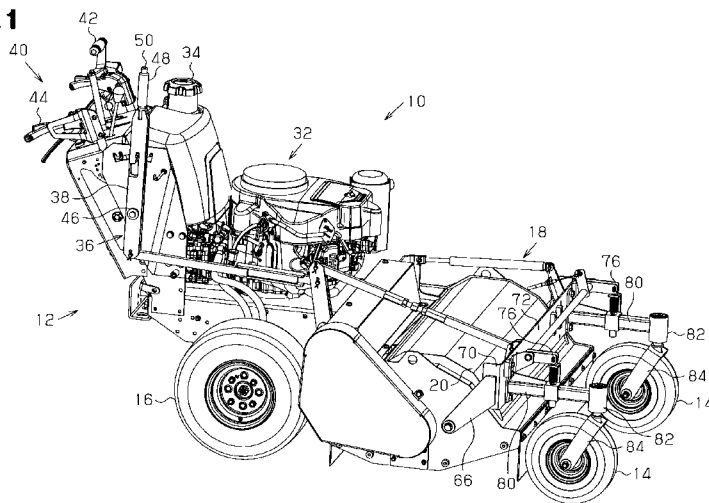
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(54) Title: A FLAIL MOWING MACHINE AND A LINKAGE FOR SUCH A MACHINE

Fig.1



(57) Abstract: Disclosed is a flail mowing machine that includes a lifting/moving system. The lifting/moving system includes a front tire and a rear tire, a cutter deck, a shaft accommodated within the cutter deck, at least one cutter equipped around the shaft, and a linkage mechanism for lifting/moving the cutter deck. The linkage mechanism includes a first link functioning as a grip located near by an operational portion, a second link, a bracket provided on the cutter deck, and an attachment member provided with the front tire. In addition, each link is arranged with each other in such a way that the second link is connected/interlocked to the attachment member via the bracket.



DESCRIPTION

A flail mowing machine and a linkage for such a machine

5 TECHNICAL FIELD

[0001]

The present invention relates to a machine for mowing vegetation, and more particularly, to mowing machines of the type known as flail mowers.

10

BACKGROUND ART

[0002]

15 Flail mowing machines are often used for mowing vegetation, especially grass and weeds, over surfaces having irregularities or obstacles. Unlike mowing machines that employ blades that rotate in a plane parallel to the ground surface at the end of a vertically rotating shaft, flail mowing machines employ a horizontally rotating shaft. In particular, the horizontally rotating shaft includes a plurality of cutters attached to its surface, which strike vegetation as the shaft rotates at high
20 speed and severs the vegetation to thereby mow it.

[0003]

25 The disadvantage of a vertically rotating shaft arrangement is that horizontally rotating blades are more likely to strongly impact the ground or other obstacles on irregular surfaces. With a horizontally rotating shaft, it is easier to move the shaft in correspondence with variations in the ground surface. Moreover, if the cutters do strike the ground or other obstacle, the cutters are flexibly attached to the shaft surface so that they are able to swing or pivot, and thus less likely to be damaged. In addition, if they are damaged or become dull, there are many cutters relative to a mowing machine employing horizontally rotating blades, and thus there
30 is less adverse impact upon mowing performance.

[0004]

35 Nevertheless, it is still desirable to adjust mowing height with flail mowing machines to account for irregular surfaces, obstacles, or variations in vegetation density and height on the ground surface. In the prior art, this has required the operator to temporarily pause mowing with the flow mailing machine to make

mowing height adjustments. Conventionally, this is has been performed by adjusting wheel/tire height or by turning a crank through many revolutions to move support structure for the shaft. A desire exists for mowing height adjustments to be made more conveniently and rapidly so that mowing operations need not be paused or possibly only paused for a brief moment during mowing.

SUMMARY OF INVENTION

[0005]

In one aspect of the invention, a flail mowing machine is provided that includes a lifting/moving system. The lifting/moving system includes a front tire and a rear tire, a cutter deck, a shaft accommodated within the cutter deck, at least one cutter equipped around the shaft, and a linkage mechanism for lifting/moving the cutter deck. The linkage mechanism includes a first link functioning as a grip located near by an operational portion, a second link, a bracket provided on the cutter deck, and an attachment member provided with the front tire. In addition, each link is arranged with each other in such a way that the second link is connected/interlocked to the attachment member via the bracket.

[0006]

In a second aspect, the linkage mechanism additionally includes a third link having opposite ends, wherein one end of the third link is connected to the first link and the other end of the third link is connected to the second link. The link mechanism is activated by operation of the group, and the cutter deck is moved by the operation. Preferably, the grip is located in or at a lateral side of the operational portion. Furthermore, the second link has a length that is selectively adjustable. In yet another aspect the, second link is bent.

[0007]

In still another aspect, a linkage mechanism is provided for a flail mowing machine having a cutter deck in which the flail mowing machine includes front and rear tires. The linkage mechanism is for lifting/moving the cutter deck. The linkage mechanism includes a first link having opposite ends with one end graspable by a user as a grip. The linkage mechanism additionally includes a second link connected to the opposite end of the first link, a bracket mountable to the cutter deck, and an attachment member connectable to the front tire. Each link is arranged with each other in such a way that the second link is connected/interlocked to the

attachment member via the bracket when the bracket is mounted to the deck and the attachment member is connected to the front tire.

[0008]

5 In yet another aspect, the linkage mechanism further includes a third link having opposite ends. The second link is connected to the first link via the third link. In addition, one end of the third link is connected to the first link and the other end of the third link connected to the second link.

[0009]

10 In still another aspect, the linkage mechanism is activated by an operation of the grip, and the cutter deck is moved by the operation. The flail mowing machine includes an operational portion, which the user stands behind for controlling operation of the flail mowing machine. The end of the first link that is graspable by a user as a grip is proximate the operational portion and located at a lateral side of the operational portion. Moreover, the second link preferably has a length that is
15 selectively adjustable in length. In yet another aspect, the second link includes a bend.

[0010]

The foregoing aspects provide several advantages. In this regard, it permits a user to conveniently adjust mowing height without interruption. Further, fine
20 adjustment of mowing height is provided via a selectively adjustable link. In addition, it provides a simplified arrangement. Other aspects and advantages of the present invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the
25 invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

30 The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

[0012]

Fig. 1 is an overall schematic perspective view of a preferred embodiment of a flail mowing machine in accordance with the present invention;

35 [0013]

Fig. 2a is an explanatory, partial side view of the flail mowing machine of Fig. 1, with the handle of the linkage mechanism positioned vertically;
[0014]

5 Fig. 2b is an explanatory, partial side view of the flail mowing machine of Fig. 1, with the handle of the linkage mechanism pushed as forward as possible towards the front tires of the flail mowing machine;
[0015]

10 Fig. 2c is an explanatory, partial side view of the flail mowing machine of Fig. 1, with the handle of the linkage mechanism pulled as far reward as possible towards the rear tires of the flail mowing machine;
[0016]

15 Fig. 3a is an explanatory, partial side view of an alternative preferred embodiment of the flail mowing machine of Fig. 1 having a linkage mechanism with a bent link, with the handle of the linkage mechanism positioned vertically;
[0017]

Fig. 3b is an explanatory, partial side view of the flail mowing machine of Fig. 3a, with the handle of the linkage mechanism pushed as forward as possible towards the front tires of the flail mowing machine;
[0018]

20 Fig. 3c is an explanatory, partial side view of the flail mowing machine of Fig. 3a, with the handle of the linkage mechanism pulled as far reward as possible towards the rear tires of the flail mowing machine;
[0019]

25 Fig. 4a is an explanatory, partial side view of another alternative preferred embodiment of the flail mowing machine of Fig. 1 with a linkage mechanism having fewer links and with the handle of the linkage mechanism positioned vertically;
[0020]

30 Fig. 4b is an explanatory, partial side view of the flail mowing machine of Fig. 4a, with the handle of the linkage mechanism pulled as far rearward as possible towards the rear tires of the flail mowing machine;
[0021]

35 Fig. 4c is an explanatory, partial side view of the flail mowing machine of Fig. 4a, with the handle of the linkage mechanism pushed as far forward as possible towards the front tires of the flail mowing machine; and
[0022]

Fig. 5 is a perspective view showing the shaft of the flail mowing machine of Fig. 1, with the cutters attached thereto.

5 DESCRIPTION OF EMBODIMENTS

[0023]

Fig. 1 illustrates a preferred embodiment of a flail mowing machine 10 in accordance with the present invention. In particular, the flail mowing machine 10 includes a lifting/moving system 12. The lifting/moving system 12 includes front wheels or tires 14 and rear wheels or tires 16 supporting the flail mowing machine 10 above the ground and for rolling the machine 10 thereacross. Reference numeral 10 is used to indicate the flail mowing machine generally, while reference number 12 is used to indicate the lift/moving system 12 of the machine.

15 [0024]

The lifting/moving system 12 further includes a cutter deck 18 to which the front wheels 14 connect. The cutter deck 18 has an upper surface 20. The lifting/moving system 12 includes a shaft 22 (see Fig. 5) disposed below the upper surface 20 of the cutter deck 18. Hence, the shaft 22 is not visible in Fig. 1 as it is accommodated within the cutter deck 18.

[0025]

Fig. 5 illustrates a view of the shaft 22 removed from the flail mowing machine 10. Disposed at spaced apart locations along and around the shaft 22 are cutters 24. Each cutter 24 corresponds to a Y-shape with the base of the Y-shape mounted to the shaft 22. In particular, the base of each Y-shape is received in a bracket 26 on the outer circumferential surface 28 of the shaft 22. More particularly, each bracket 26 includes two legs and the base of each Y-shaped cutter 24 being received therebetween. A bolt 30 passes through both legs of each bracket 26 and the base of the Y-shape of the cutter 24 is received therebetween to fasten the cutter 24 to the shaft 22. In this regard, each cutter 24 is pivotable about its respective bolt 30.

[0026]

The flail mowing machine 10 includes an internal combustion engine 32. The engine 32 uses a liquid fuel stored in an onboard tank to power the engine 32. Fuel is introduced into the onboard tank by removing a fuel cap 34 and pouring the

fuel into the opening that the fuel cap 34 covers.

[0027]

Power from the engine 32 is used to rotate the shaft 22 at high speed, i.e., several thousand revolutions per minute (rpm), typically around 3,000 rpm.

5 Centrifugal force caused by the high speed rotation causes the cutters 24 to extend perpendicularly from the surface 28 of the shaft 22, i.e., the cutters 24 swing outward from the bolts 30 when the shaft rotates. Power from the engine 32 is also used to rotate the rear wheels 16 to drive the flail mowing machine over the ground. In this regard, the rear wheels 16 are positioned below the engine 32. When the flail
10 mowing machine 10 is passed over a ground surface overgrown with vegetation and the engine 32 is rotating the shaft 22, the cutters 24 strike the vegetation and sever the vegetation closer to the ground, thereby mowing the vegetation.

[0028]

The lifting/moving system includes a linkage mechanism 36 for
15 lifting/moving the cutter deck 18, i.e., raising and lowering the cutter deck 18. The cutter deck is lifted/moved upward and downward to adjust the height at which vegetation is mown and to avoid obstacles, such as rocks or irregularities in the ground surface.

[0029]

20 The linkage mechanism 36 includes a first link 38 that functions as a grip for operation by a user. Specifically, the flail mowing machine 10 includes an operational portion 40 behind the engine 32. After the engine 32 is started, a user stands at the operational portion 40 to operate and control the flail mowing machine 10, such as by moving levers 42 and 44 to engage the engine transmission
25 and rotate one or more of the rear wheels 16 to drive the flail mowing machine over the ground. The operational portion 40 provides for selectively driving the rear wheels separately or together to facilitate turning of the flail mowing machine 10.

[0030]

The first link 38 of the linkage mechanism 36 is mounted to the flail mowing
30 machine 10 proximate the operational portion 40, i.e., near by the operational portion 40. The first link 38 has a length significantly greater than its width. The first link 38 is mounted to the right side of the flail mowing machine 10 with the length of the first link 38 approximately vertical. The first link 38 is mounted to the side of the flail mowing machine 10 by a first pivot pin 46 that permits the first link 38 to be
35 pivoted toward and away from the right front wheel or tire 14. The upper end of the

first link 38 includes a handle 48, which a user may grasp when standing at the operational portion 40. To lift/move the cutter deck 18, the user depresses a button 50 at the top of the handle 48 with the user's thumb. This deactivates a latch, permitting the first link 38 to be rotated toward and away from the front right wheel 14 about the first pivot pin 46, a few degrees to either side of vertical. When the cutter deck 18 is lifted/moved to a height satisfactory to the user, the user releases the button 50, and this activates the latch prohibiting further movement of the first link 38 to thereby lock the cutter deck 18 at its current position relative to the ground until the button 50 is pressed again.

[0031]

The first pivot pin 46 is offset from the longitudinal center of the first link 38. Specifically, the first pivot pin 46 is nearer the lower end of the first link 38 than the upper end. More particularly, the first pivot pin 46 is disposed at approximately two-thirds to three-quarters of the length of the first link 38 towards the bottom of the first link 38. This provides a greater amount of leverage for a user in moving the first link 38 toward and away from the right front wheel or tire 14 to facilitate lifting/moving the cutter deck 18.

[0032]

With reference to Fig. 2a, the lower end 52 of the first link 38 connects to a second link 54 via a third link 56. In other preferred embodiments such as illustrated in Figs. 3a-3c and 4a-4c, the first link 38 connects directly to the second link 54. Returning to the current embodiment, both the second link 54 and the third link 56 connect to a fourth link 58.

[0033]

In particular, a second pivot pin 60 connects the lower end of the fourth link 58 to the frame supporting the engine 32. One end of the second link 54 pivotably connects to the opposite end 62 of the fourth link 58. One end of the third link 56 pivotably connects to the lower end of the first link 38. The other end of the third link 56 pivotably connects to the fourth link 58 at a location 64 below the upper end 62 of the fourth link 58, but nearer to the upper end 62 than the middle of the fourth link 58.

[0034]

The fourth link 58 is shorter than the first link 38 and is mounted approximately vertical like the first link 38. However, the fourth link 58 moves opposite in direction corresponding to that of the handle 48 of the first link 38. As

can be seen in Fig. 2b, the first link 38 has been pivoted to move the handle 48 thereof as far as possible toward the front right tire 14. This causes the upper end 62 of the fourth link 58 to pivot away from the front right tire 14. The converse is shown in Fig. 2c. That is, the first link 38 has been pivoted to move the handle 48 as far away as possible from the front right tire 14. This causes the top 62 of the fourth link 58 to pivot as far as possible towards the front right tire 14.

[0035]

The linkage mechanism 36 further includes a bracket 66 provided on the cutter deck 18, i.e., connected to the cutter deck 18 on the right side thereof. In particular, the bracket has a lower end 68 attached to the cutter deck 18. From there, the bracket slopes upward and forward. For balance, another bracket 66 is preferably provided on the left side of the cutter deck 18, mirroring the first bracket 66.

[0036]

The linkage mechanism 36 additionally includes an attachment member 70 provided with the right front tire 14, i.e., connected to the right front tire 14. In particular, the attachment member 70 attaches to the bracket 66. That is, the bracket 66 on the right side and the bracket 66 on the left side of the cutter deck 18. In this regard, the attachment member 70 extends across the front of the cutter deck 18 and attaches to both front tires 14. In particular, the attachment member 70 includes a cross-bar 72 to which the other end of the second link 54 connects. L-shaped links 76 extend from the attachment member 70 and connect to a beam 80 corresponding to each front tire 14. In particular, the cross-bar 72 extends across the front of the cutter deck 18 with an L-shaped link 76 connected to each end thereof and a beam 80 corresponding to each front tire 14. The distal end of each beam 80 provides a pivotable support 82 for a fork rotatably supporting each front tire 14. The pivotable support 82 permits the front tires 14 to be turned in any direction along the ground to facilitate maneuvering of the flail mowing machine thereacross.

[0037]

Fig. 2b illustrates the situation when a user has pushed the handle 48 of the first link 38 as far forward as possible towards the front tires 14. In particular, the first link 38 pivots about the first pivot pin 46. This causes the lower end 52 of the first link 38 to swing or pivot away from the front tires 14. The result is to pull the third link 56 away from the front tires 14, and thereby the top end 62 of the fourth

link 58 as well. As the end of the second link 54 nearest the rear tires 16 is connected to the top end of the fourth link 58, the second link 54 is likewise pulled or drawn away from the front tires 14.

[0038]

5 Pulling or drawing the second link 54 away from the front tires 14 rotates via the attachment member 70, the top of the bracket 66 rearward toward the rear tires 16. As the lower end 68 of the bracket 66 is attached to the cutter deck 18, the forward end of the cutter deck 18 is rotated and pushed downward towards the ground. Thus, the second link 54 is connected/interlocked to the attachment
10 member 70 via the bracket 66 and vice-versa. Accordingly, pushing the handle 48 forward as far as possible towards the front tires 14 as shown in Fig. 2b causes the cutter deck 18 to be moved as close as possible to the ground for closely mowing vegetation.

[0039]

15 Fig. 2c illustrates the situation when a user has pulled the handle 48 of the first link 38 as far as possible away from the front tires 14. In particular, the first link 38 pivots about the first pivot pin 46. This causes the lower end 52 of the first link 38 to swing or pivot toward the front tires 14. The result is to push the third link 56 toward the front tires 14, and thereby the top end 62 of the fourth link 58 as well. As
20 the end of the second link 54 nearest the rear tires 16 is connected to the top end of the fourth link 58, the second link 54 is likewise pushed toward the front tires 14.

[0040]

Pushing the second link 54 toward the front tires 14 rotates via the attachment member 70, the top of the bracket 66 forward toward the front tires 14.
25 As the lower end 68 of the bracket 66 is attached to the cutter deck 18, the forward end of the cutter deck 18 is rotated and lifted upward away from the ground. Thus, the second link 54 is connected/interlocked to the attachment member 70 via the bracket 66 and vice-versa. That is, the front tires 14 are rotated and pushed downward by the attachment member 70, while front of the cutter deck 18 is rotated
30 and lifted. Accordingly, pulling the handle 48 rearward as far as possible from the front tires 14 as shown in Fig. 2c causes the cutter deck 18 to be moved as far as possible away from the ground so that the vegetation is not as closely mown.

[0041]

The second link 54 is preferably selectively adjustable in length. In
35 particular, a turnbuckle is provided 86 having a nut that may be turned in one

direction to increase the length of the second link 54. The nut is turned the other way to decrease the length of the second link 54. This provides for more fine adjustment of the mowing height.

[0042]

5 The foregoing embodiment as described achieves several advantages over prior art arrangements. First, it permits the user to conveniently adjust the mowing height without interruption. Prior art arrangements required a user to stop the mowing machine and turn a crank for several revolutions to adjust mowing height, which was both time consuming and inconvenient. Specifically, the user was
10 required to stop travel of the machine, leave the operational portion 40 and turn the crank for several turns until the desired mowing height was reached. In contrast, with the current arrangement, the user may adjust the mowing height while standing at the operational portion 40 by simply depressing the button 50 at the top of the handle 48 and pushing or pulling on the handle and then releasing the button.
15 Accordingly, mowing height can be adjusted rapidly, without requiring the user to depart from behind the operational portion 40. In addition, fine adjustment of mowing height is provided via the turnbuckle 86 in the second link 54 for the adjusting length thereof.

[0043]

20 Figs. 3a-3c illustrate an alternative embodiment having a different linkage mechanism 88. The different linkage mechanism 88 is identical to the previously described linkage arrangement with one major exception. Namely, the third and fourth links 56 and 58 have been eliminated. Instead, a bent second link 90 is provided. One end of the bent second link 90 attaches to the lower end 52 of the
25 first link 38. The other end of the bent second link 90 connects to the attachment member 70. The remaining components are the same as in the previously described embodiment and the same reference numerals as in the previously described embodiment are used to denote components that are identical in both embodiments.

[0044]

30 Fig. 3b shows what happens in the alternative embodiment when a user pushes the handle 48 as far as possible toward the front tires 14. This causes the lower end 52 of the first link 38 to pivot away from the front tires 14. When the lower end 52 of the first link 38 pivots away from the front tires 14, this draws the bent
35 second link 90 away from the front tires 14 as well. The result is an upward acting force on the attachment member 70 and correspondingly on the upper end of the

bracket 66 as well. The top of the bracket 66 is pivoted up and rearward toward the rear tires 16, i.e., pivoted counter-clockwise. As the lower end 68 of the bracket 66 is attached to the cutter deck 18, the forward end of the cutter deck 18 is rotated and pushed downward towards the ground. In this regard, the bent second link 90 is connected/interlocked to the attachment member 70 via the bracket 66 and vice-versa. Accordingly, pushing the handle 48 forward as far as possible towards the front tires 14 as shown in Fig. 3b causes the cutter deck 18 to be moved as close as possible to the ground for closely mowing vegetation.

[0045]

Fig. 3c shows what happens in the alternative embodiment when a user pulls the handle 48 as far as possible away from the front tires 14. In particular, the first link 38 pivots about the first pivot pin 46. This causes the lower end 52 of the first link 38 to swing or pivot toward the front tires 14. The result is to push the bent second link 90 toward the front tires 14, and thereby push the attachment member 70 forward. This rotates via the attachment member 70, the top of the bracket 66 forward toward the front tires 12. As the lower end 68 of the bracket 66 is attached to the cutter deck 18, the forward end of the cutter deck 18 is rotated and lifted upward away from the ground. Thus, the bent second link 90 is connected/interlocked to the attachment member 70 via the bracket 66 and vice-versa. That is, the front tires 14 are rotated and pushed downward by the attachment member 70, while the front of the cutter deck 18 is rotated and lifted. Accordingly, pulling the handle 48 rearward as far as possible from the front tires 14 as shown in Fig. 3c causes the cutter deck 18 to be moved as far as possible away from the ground so that the vegetation is not as closely mown.

[0046]

The bent second link 90 is adjustable in length. Specifically, it includes a turnbuckle 86 as described in the previous embodiment. Thus, the length of the bent second link 90 may be adjusted by turning a nut on the turnbuckle. This is useful for fine adjustment of the height of the cutter deck 18 or for adjustments for removing slack in the linkage mechanism 88 or for other adjustments for improving performance.

[0047]

An advantage of the different linkage mechanism 88 is that it requires less components, i.e., links have been eliminated relative to the previously described embodiment. The disadvantage though, is that there is less support in that there is

one less connection between the linkage mechanism 88 and the flail mowing machine 10. In addition, there may be some flexing or bending in the bent link 90, which may cause some slack in the linkage mechanism 88 when adjusting the height of the cutter deck 18.

5 [0048]

Figs. 4a-4c illustrate another alternative embodiment having a different linkage mechanism 88. The different linkage mechanism 88 is identical to the first previously described linkage arrangement with a couple of major differences. Components that are the same as in the first previously described embodiment are designated with the same reference numerals as used earlier for the first previously described embodiment.

10

[0049]

With respect to the major differences between this alternative embodiment and the first previously described embodiment, the third and fourth links 56 and 58 have been eliminated. Instead, a substantially straight second link 94 is provided in this alternative embodiment. In addition, the straight second link 94 does not attach to the lower end 52 of the first link 38. Instead, it attaches to a location 96 thereabove to the first link 38. In this alternative embodiment, the lower end 52 of the first link attaches to the flail mowing machine 10 as a pivot point for the first link 38. The other end of the straight second link 94 connects to the attachment member 70.

15

20

[0050]

As will be appreciated from the following description, in this alternative embodiment with a straight second link 94, the cutter deck 18 moves in opposite correspondence with the handle 48 compared to the previously described embodiments. In that regard, Fig. 4b illustrates the situation when a user has pulled the handle 48 of the first link 38 as far away as possible from the front tires 14. In particular, the first link 38 pivots about its lower end 52. The result is to pull or draw the straight second link 94 away from the front tires 14. Since the straight second link 94 is connected to the attachment member 70, this rotates via the attachment member 70 the top of the bracket 66 rearward toward the rear tires 16. As the lower end 68 of the bracket 66 is attached to the cutter deck 18, the forward end of the cutter deck 18 is rotated and pushed downward towards the ground. Thus, the straight second link 94 is connected/interlocked to the attachment member 70 via the bracket 66 and vice-versa. Accordingly, pulling the handle 48 reward as far as

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possible towards the rear tires 16 as shown in Fig. 4b causes the cutter deck 18 to be moved as close as possible to the ground for closely mowing vegetation.

[0051]

Fig. 4c illustrates the situation when a user has pushed the handle 48 of the first link 38 as far as possible toward the front tires 14. In particular, the first link 38 pivots about its lower end 52. The result is to push the straight second link 94 toward the front tires 14. Pushing the straight second link 94 toward the front tires 14 rotates via the attachment member 70, the top of the bracket 66 forward toward the front tires 14.

[0052]

As the lower end 68 of the bracket 66 is attached to the cutter deck 18, the forward end of the cutter deck 18 is rotated and lifted upward away from the ground. Thus, the second link 54 is connected/interlocked to the attachment member 70 via the bracket 66 and vice-versa. That is, the front tires 14 are rotated and pushed downward by the attachment member 70, while front of the cutter deck 18 is rotated and lifted. Accordingly, pushing the handle 48 forward as far as possible toward the front tires 14 as shown in Fig. 4c causes the cutter deck 18 to be moved as far as possible away from the ground so that the vegetation is not as closely mown.

[0053]

An advantage of this alternative embodiment is that the linkage mechanism 92 is simplified. Specifically, there are two fewer links. Relative to the other alternative embodiment, the present alternative embodiment provides a straight second link 94 through which force may be more efficiently applied because there is less bending. The disadvantage of a straight second link 94 is that clearance is more limited between the straight second link 94 and the flail mowing machine 10. In particular, when the handle 48 is pushed forward towards the front tires 14 as in Fig. 4c, the straight second link 94 is also moved downward. Notwithstanding, the straight second link 94 is provided with a turnbuckle 86 as in the other embodiments for adjusting the length thereof and clearance.

[0054]

As can be appreciated from the foregoing description, in the described embodiments the front of the cutter deck 18 is moved up and down to adjust mowing height relative to the rear of the cutter deck 18 (portion closest to the rear tires). That is the cutter deck 18 both moves and rotates. Since the cutters 24 rotate around a shaft 22 as shown in Fig. 5, the vegetation is mown smoothly and the

cutters 24 do not strike the ground. Moreover, the arrangement is convenient as the handle 48 is positioned proximate or near the operational portion 40 and a user may adjust mowing height without being required to depart from behind the operational portion 40.

5 [0055]

Various changes and modifications can be made to the described embodiments without departing from the spirit and scope of the invention as will be recognized by a person of ordinary skill in the art. For example, instead of using a turnbuckle 86 to provide for selective adjustment of the second links 54, 90 and 94
10 in the embodiments, a slidable telescoping arrangement could be used with locking pins or clamps to adjust the length of a second link. Further, it is not necessary to have a second link that is selectively adjustable in length. Instead a second link could be provided of a predetermined length that is suitable for use with the flail mowing machine. This would provide an advantage in simplification of the second
15 link and provided for greater rigidity and strength of the second link.

[0056]

Other modifications to the linkage mechanisms 36, 88 and 92 could be made. For example, in the first described embodiment, the end of the third link 56 could align and also connect to the upper end of the fourth link 58. Since changes
20 can be made as described, the present examples and embodiments are to be considered as illustrative and not restrictive and the invention is not to be limited to the details given herein, but may be modified within the scope and equivalence of the appended claims.

CLAIMS

1. A flail mowing machine comprising:
a lifting/moving system, the lifting/moving system including:
5 a front tire and a rear tire,
a cutter deck,
a shaft accommodated within the cutter deck,
at least one cutter equipped around the shaft,
a linkage mechanism for lifting/moving the cutter deck,
10 the linkage mechanism comprising;
a first link functioning as a grip located near by an operational portion,
a second link,
a bracket provided on the cutter deck,
an attachment member provided with the front tire,
15 each link is arranged with each other in such a way that the second link is
connected/interlocked to the attachment member via the bracket.
2. The flail mowing machine according to claim 1, wherein the linkage
mechanism further comprises a third link having opposite ends, wherein one end of
20 the third link is connected to the first link and the other end of the third link is
connected to the second link.
3. The flail mowing machine according to claim 1, wherein the link
mechanism is activated by an operation of the grip, and the cutter deck is moved by
25 the operation.
4. The flail mowing machine according to claim 1, wherein the grip is
located in a lateral side of the operational portion.
- 30 5. The flail mowing machine according to claim 1, wherein the second link
has a length that is selectively adjustable.
- 35 6. The flail mowing machine according to claim 1, wherein the second link

extends from the first link to the attachment member and the second link is straight.

7. A flail mowing machine comprising:

a lifting/moving system, the lifting/moving system including:

5 at least front and rear tires,

a cutter deck having an upper surface,

a shaft disposed under the upper surface of the cutter deck,

at least one cutter disposed upon the shaft,

a linkage mechanism for lifting/moving the cutter deck,

10 the linkage mechanism comprising;

a first link having opposite ends with one end graspable by a user as a grip,

a second link connected to the opposite end of the first link,

a bracket attached to the cutter deck,

an attachment member connected to the front tire,

15 each link is arranged with each other in such a way that the second link is

connected/interlocked to the attachment member via the bracket.

8. The flail mowing machine according to claim 7, wherein the linkage

mechanism further comprises a third link having opposite ends, in which the second

20 link is connected to the first link via the third link with one end of the third link being

connected to the first link and the other end of the third link connected to the second

link.

9. The flail mowing machine according to claim 7, wherein the link

25 mechanism is activated by an operation of the grip, and the cutter deck is moved by

the operation.

10. The flail mowing machine according to claim 7, further comprising an

operational portion, wherein the one end is proximate the operational portion and

30 the one end is located at a lateral side of the operational portion.

11. The flail mowing machine according to claim 7, wherein the second

link has a length that is selectively adjustable.

35 12. The flail mowing machine according to claim 7, wherein the second

link includes a bend.

13. A linkage mechanism for a flail mowing machine having a cutter deck for lifting/moving the cutter deck and including front and rear tires, the linkage

5 mechanism comprising:

a first link having opposite ends with one end graspable by a user as a grip,

a second link connected to the opposite end of the first link,

a bracket mountable to the cutter deck,

an attachment member connectable to the front tire,

10 each link is arranged with each other in such a way that the second link is connected/interlocked to the attachment member via the bracket when the bracket is mounted to the deck and the attachment member is connected to the front tire.

14 The linkage mechanism according to claim 13, the linkage mechanism

15 further comprising a third link having opposite ends, in which the second link is

connected to the first link via the third link with one end of the third link being

connected to the first link and the other end of the third link connected to the second link.

20 15. The linkage mechanism according to claim 13, wherein the linkage mechanism is activated by an operation of the grip, and the cutter deck is moved by the operation.

25 16. The linkage mechanism according to claim 13, wherein the flail mowing machine includes an operational portion, and the one end is proximate the operational portion and the one end is located at a lateral side of the operational portion.

30 17. The linkage mechanism according to claim 13, wherein the second link has a length that is selectively adjustable in length.

18. The linkage mechanism according to claim 13, wherein the second link is bent.

35 19. The linkage mechanism according to claim 13, wherein the second link

extends from the first link to the attachment member and the second link is straight.

Fig. 2a

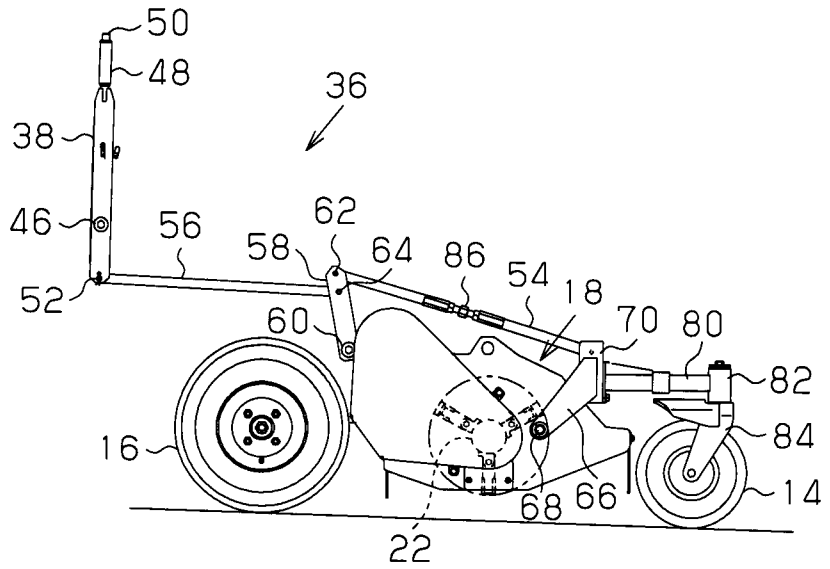


Fig. 2b

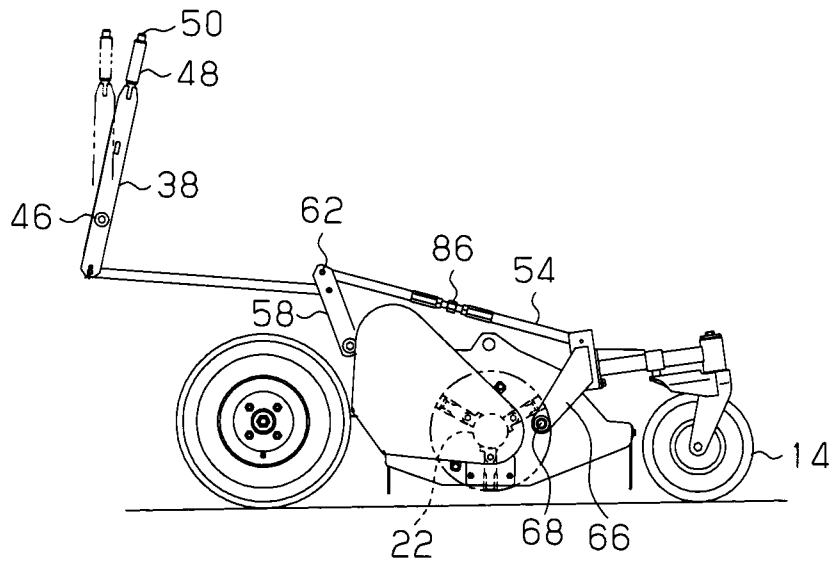
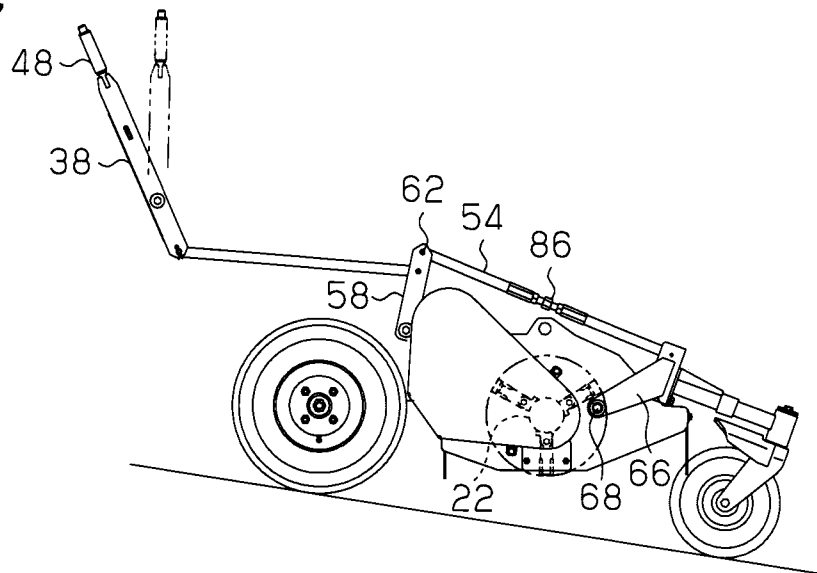


Fig. 2c



3/5

Fig. 3a

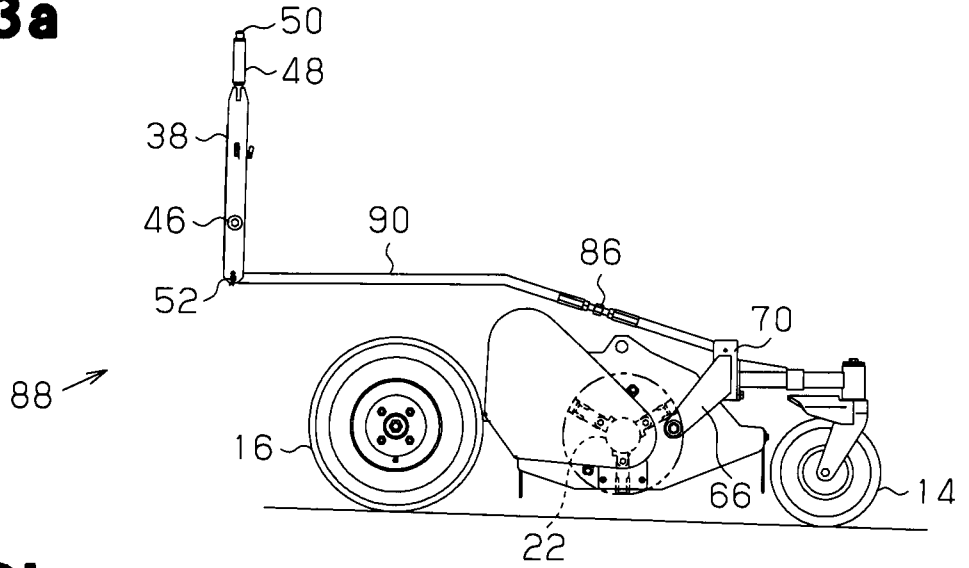


Fig. 3b

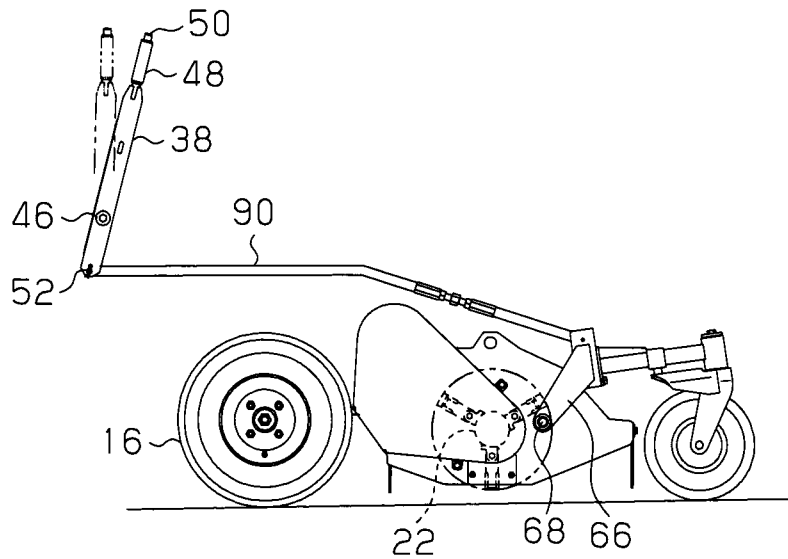
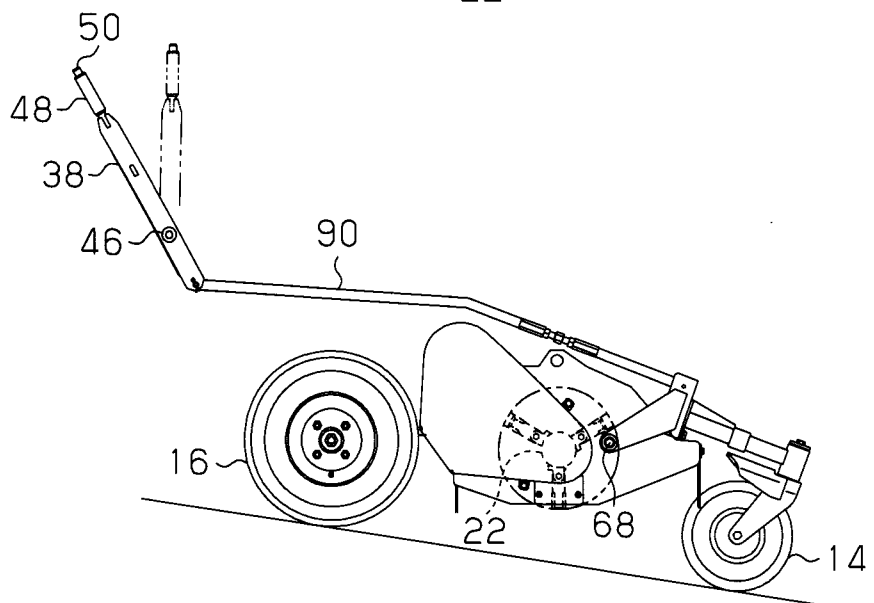


Fig. 3c



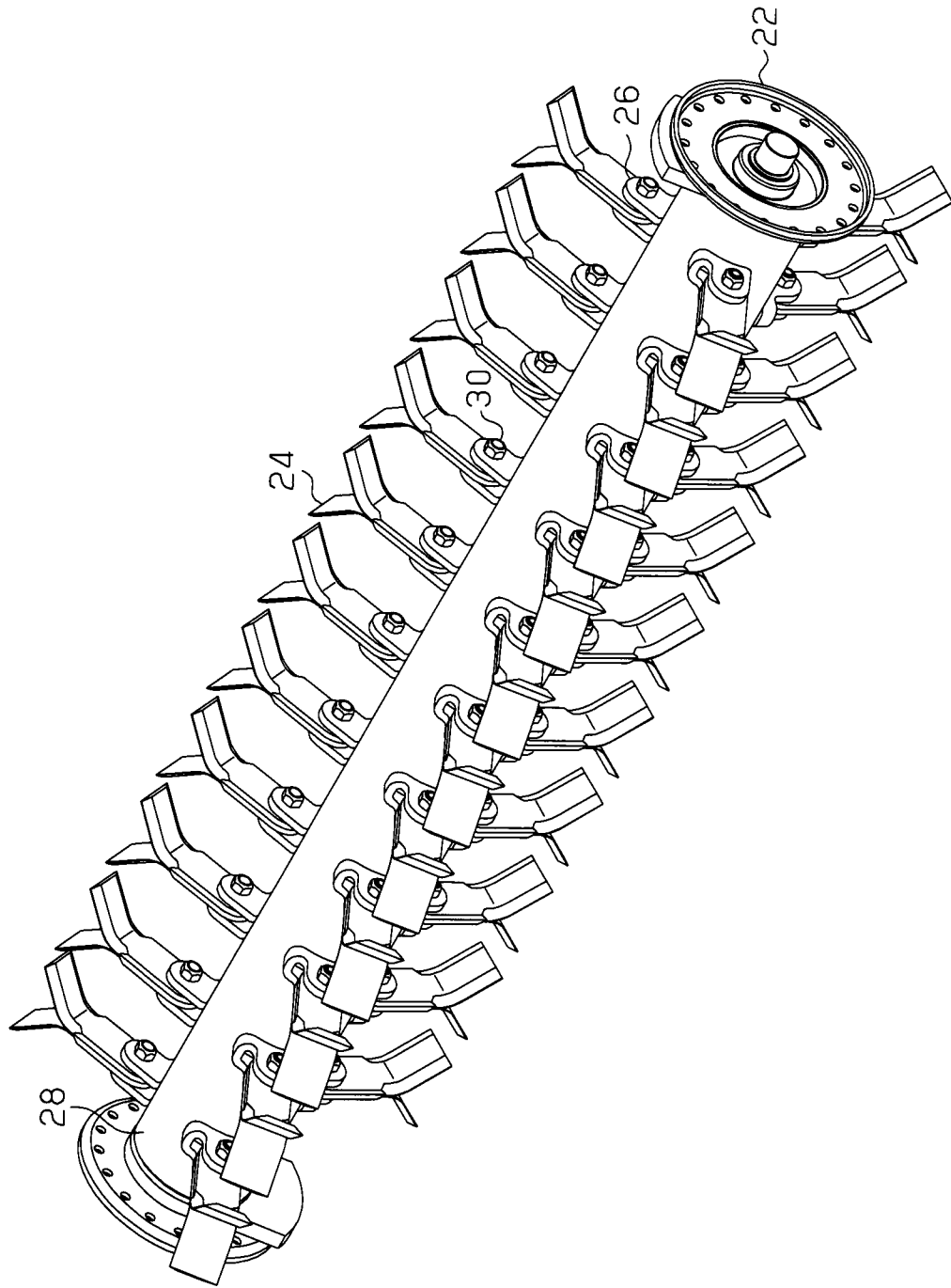


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2012/050417

A. CLASSIFICATION OF SUBJECT MATTER IPC: see extra sheet According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC: A01D Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched SE, DK, FI, NO classes as above Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, PAJ, WPI data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 20100186361 A1 (BRYANT CHRISTIAN STANTON CARVER ET AL), 29 July 2010 (2010-07-29); paragraph [0048]; figure 7 --	1-19
Y	DE 10012365 C2 (STELLA ENGINEERING GMBH), 27 September 2001 (2001-09-27); abstract; figures 1-3 --	1-19
X	US 6347593 B1 (MORAN RICHARD TADASHI ET AL), 19 February 2002 (2002-02-19); whole document --	1-19
A	EP 0144214 A2 (HONDA MOTOR CO LTD), 12 June 1985 (1985-06-12); abstract; figure 1 --	1-19
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 21-12-2012		Date of mailing of the international search report 21-12-2012
Name and mailing address of the ISA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86		Authorized officer Magnus Thorén Telephone No. + 46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2012/050417

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4106269 A (KNUDSON HENRY T), 15 August 1978 (1978-08-15); column 1, line 67 - column 2, line 6; figure 1 --	1-19
A	US 5123234 A (HARADA ERIYA ET AL), 23 June 1992 (1992-06-23); figures 1,2 --	1-19
A	US 4291522 A (KAWASAKI MASAMI ET AL), 29 September 1981 (1981-09-29); abstract; figure 7 --	1-19
A	WO 2010120197 A2 (TRIMAX HOLDINGS LTD ET AL), 21 October 2010 (2010-10-21); claims 1, 2 --	1-19
A	GB 1156223 A (TURNER ENGINEERING COMPANY COU), 25 June 1969 (1969-06-25); whole document --	1
A	GB 1148377 A (TURNER ENGINEERING COMPANY COU), 10 April 1969 (1969-04-10); whole document -- -----	1

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International Patent Classification (IPC)

A01D 34/54 (2006.01)

A01D 34/42 (2006.01)

A01D 34/535 (2006.01)

INTERNATIONAL SEARCH REPORT
Information on patent family members

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PCT/SE2012/050417

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GB	1148377	A	10/04/1969	NONE			