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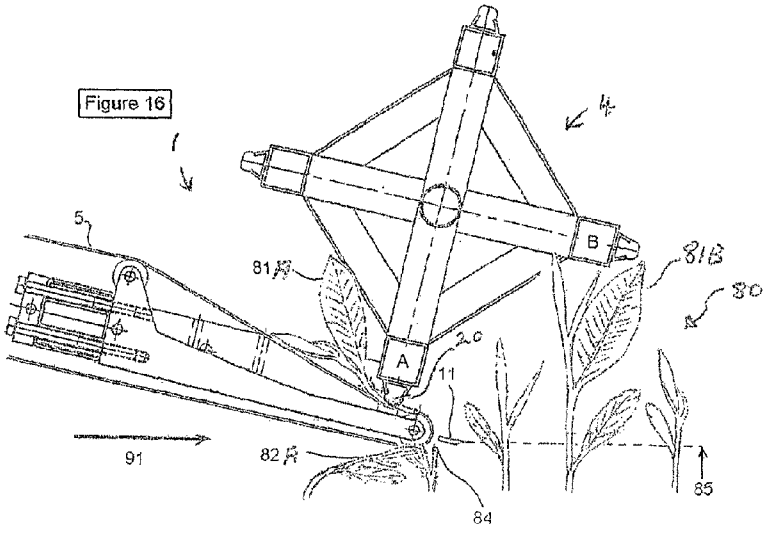

(57) Abstract: Apparatus for selectively harvesting plant material, particularly the leaves and bud of a plant having a stem, such as a tea plant, is provided. The apparatus includes a conveyor belt (5), plant engaging members (20) movable relative to the conveyor belt (5) to trap the plant matter between the conveyor belt (5) and the plant engaging members (20) at a first level, and a stem engaging member (11) arranged to contact a stem of the plant at a predetermined second level, lower than the first, wherein when the stem of trapped plant material extending above the predetermined second level is broken by the stem engaging member (11) to harvest the trapped plant material. In one embodiment, the stem engaging member is a breaker bar (11). In an alternative embodiment, the stem engaging member is a cable, wire or cord maintained in tension at the predetermined second level.

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IMPROVEMENTS TO SELECTIVE TEA PLUCKING

FIELD OF THE INVENTION

This invention relates to plant harvesting apparatus, and more particularly to apparatus for harvesting selected plant matter of a tea crop.

BACKGROUND TO THE INVENTION

The invention will be described herein with specific reference to the harvesting of tea, however, it will be apparent that the invention may also be used for harvesting of other plant crops and that the scope of the invention therefore should not be restricted to harvesting of tea only.

Machines have been devised to mechanically harvest leaf by mechanically cutting all the tea stems at a set height regardless of the stage of development. This practice reduces the overall tea bush productivity, although it is less labour intensive. It is desirable to provide a machine for selectively harvesting only those shoots that are of optimum size and stage of development to ensure maximum tea quality and maximum tea bush productivity, while requiring less labour than hand picking.

Willames Tea Pty Ltd has previously developed a method and apparatus for selectively harvesting only fresh young tea shoots largely comprising of two leaves and a bud. This invention is described in and International patent application no. PCT/AU2006/001764 published as WO 2007/059570 A1.

It is desirable to provide an improved harvester for harvesting plant material, particularly harvesting only mature tea shoots comprising two leaves and bud of a tea plant, without damaging the immature tea shoots above the breakpoint level. The breakpoint level is the height at which the mature tea shoots are harvested. This allows the immature tea shoots to mature, typically in six to eight days from harvesting, such that they are ready for subsequent harvesting at their developed stage.

It is also desirable to avoid damaging or plucking of the upper layer of maintenance foliage or dark green foliage located above or below the breakpoint level. Maintenance foliage assists the development of young tea shoots by providing nutrients.

It is also desirable to avoid a harsh plucking action that may lift any lateral stems or branches whilst plucking the selected tea shoots. Damage caused by

the harvesting apparatus by engaging branches could cause damage to maintenance foliage and stem material of a tea plant.

It is also desirable, when plucking succulent young leaves of the selected tea shoot avoid any surface damage to immature tea shoots and maintenance foliage. Furthermore, whilst avoiding damage, it is also desirable that the harvesting apparatus grips tea shoots comprising two leaves and a bud as well as its supporting stem and veins across a maximum area of the tea bushes.

SUMMARY OF THE INVENTION

An aspect of the present invention provides apparatus for selectively harvesting plant material, particularly the leaves and bud of a plant having a stem, the apparatus including a first plant engaging means, a second plant engaging means movable relative to the first plant engaging means to trap the plant matter between the first and second plant engaging means at a first level, and a stem engaging means arranged to contact a stem of the plant at a predetermined second level, lower than the first, wherein when the stem of trapped plant material extending above the predetermined second level is broken by the stem engaging means to harvest the trapped plant material.

In a preferred embodiment, the first plant engaging means has a leading edge, and the second plant engaging means is disposed relative to the leading edge such that entrapment of plant matter between the first and second plant engaging means occurs at a distance from the leading edge whereby only selected plant matter of sufficient height may be harvested.

Preferably, the stem engaging means has a front end disposed forwardly of the leading edge of the plant engaging means adapted to break or cut the stem of trapped plant material.

The arrangement is preferably such that only plant material engaged by the front end of the stem engaging means that is of sufficient height to be trapped between the first and second plant engaging means is broken by the front end of the stem engaging means, and plant material that is of insufficient height to be trapped between the first and second plant engaging means of the plant matter is pushed by the front end of the stem engaging means and bends underneath the apparatus.

In one embodiment, the stem engaging means includes a cable, wire or cord maintained in tension at the second or breakpoint level. In an alternative embodiment, the stem engaging means preferably includes a breaker bar including a substantially sharp edge at its front end.

Preferably, the first plant engaging means is a belt conveyer and the second plant engaging means includes at least one rotor member, the directions of rotation of said belt conveyor and the at least one rotor member being opposed whereby plant matter is drawn between and trapped between the conveyor belt and rotor member.

In a particularly preferred embodiment, the second plant engaging means includes a plurality of rotor members of a rotor assembly.

Preferably, the speed of rotation of the belt conveyor is substantially identical to the speed of rotation of the rotor assembly. The belt conveyor and the rotor assembly are preferably driven by a synchronised drive, such as pulley drive or a gearbox drive.

The belt conveyor preferably includes a front roller, a rear roller and a conveyor belt extending around the front and rear rollers. Preferably, at least one tracking strip is provided on the conveyor belt for engagement with guide means on the front roller and rear roller of the belt conveyor.

Preferably, the conveyor belt has a resilient surface. The or each rotor member preferably has a plant engaging portion of resilient material. The resilient surface of the conveyor belt may be made of silicon rubber or the like. The plant engaging portion of the or each rotor member may be a plucking rubber mounted on a rotor arm. The resilient surface of the conveyor belt and the resilient plant engaging portion of the rotor member assist in minimising damage to the plucked tea shoots, leaves and buds.

The apparatus preferably includes leaf guards mounted at the sides of the belt conveyor arranged to overlap an upper suface and/or a lower surface of the conveyor belt .This helps to avoid leaf material being trapped within the rollers and inside the conveyor belt.

The apparatus may includes a cover extending from the leading edge of the first plant engaging means or conveyor belt to a rear end of the stem engaging means or breaker bar. This helps to prevent any extraneous material

being trapped between the rear of the stem engaging means and the conveyor belt.

Preferably, the harvested plant matter is conveyed to a collection chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a detailed side view of a harvester according to an embodiment of the present invention.

Figure 2 shows a further detailed side view of a harvester according to an embodiment of the present invention.

Figure 3 shows (A) a side view and (B) a plan view of a plucking rotor according to a preferred embodiment of the invention.

Figure 4 shows a cross-section of a plucking rotor bar according to a preferred embodiment of the invention.

Figure 5 shows a side view of a tea harvester according to another embodiment of the present invention.

Figure 6 shows a detailed side view of a tea harvester according to another embodiment of the present invention.

Figure 7 shows (A) a side view and (B) a front view of an intermediate pulley assembly according to a further embodiment of the present invention.

Figure 8 shows a plan view of a breaker bar assembly according to a preferred embodiment of the present invention.

Figure 9 shows a detailed plan view of a breaker bar assembly according to another embodiment of the present invention.

Figure 10 shows a further detailed plan view of a breaker bar assembly according to another embodiment of the present invention.

Figure 11 shows a further detailed plan view of a breaker bar assembly according to a preferred embodiment of the present invention.

Figure 12 shows a cross-sectioned view of a conveyor belt and a conveyor support roller according to a preferred embodiment of the present invention.

Figure 13 shows a canopy surface level and plants of varying maturity.

Figure 14 to 17 show a side view of a harvester progressing through a canopy of plants of varying maturity, selectively harvesting plant matter of the plants, according to an embodiment of the present invention.

Figure 18 shows a side view of a harvester according to an alternative embodiment of the invention with a breaker cable assembly replacing the breaker bar.

Figure 19 shows an enlarged view of the front end of the harvester and breaker cable assembly of Figure 18.

Figure 20 shows a schematic view of the harvesting of tea plants by the harvester with breaker cable of Figure 18.

Figure 21 shows a plan view of the adjustment mechanism for the breaker cable.

Figures 22, 23 and 24 show side, front and plan views of a mounting bracket for the breaker cable.

Please note that the figures are for illustration purposes only to describe the invention. The figures are not to scale.

DESCRIPTION OF PREFERRED EMBODIMENTS

As mentioned above, it is desirable to provide a tea harvester which can selectively harvest maximum area of tea shoots without damaging immature tea shoots and maintenance foliage.

APPARATUS

Referring to figures 1 to 4 and 8, a tea harvester 1 includes a conveyor belt assembly 2, a second plant engaging means being rotor assembly 4, and a stem engaging means being a breaker bar assembly 3 The conveyor belt assembly 2 includes a conveyor belt 5 made of resilient material constituting a first plant engaging means, front belt support rollers 6 located at a leading edge of the conveyor belt assembly 2, rear belt support rollers 7, a conveyor cross tube support 8, a support member 9 and retaining bolts 10. The conveyor belt 5 is mounted on the front belt support rollers 6 and rear belt support rollers 7, which are supported by support member 9 attached to the conveyor cross tube support 8. The support member 9 is attached to the conveyor cross tube support 8 by means of retaining bolts 10. The breaker bar assembly 3 includes a breaker bar 11 constituting stem-engaging means and having a substantially sharp edge located at the front end of the breaker bar 11, a pedestal support 12, a breaker bar support 13, a breaker bar cross tube support 14 and mounting spacers 15 and attachment bolts 16.

The rotor assembly 4 includes rotor members of a rotor frame 17 mounted on an end shaft 18, a drive shaft 25 (seen in figure 3B), rotor braces 24, an internal plucking brace 19 and plucking rubbers 20 made of resilient material. The plucking rubbers 20 of the rotor frame 17 form second plant engaging means and are attached to the rotor members of the rotor frame 17 by means of a connecting means 21, clamp bolts 22, washers 26 and clamp nuts 27 (seen in figure 4). The conveyor belt assembly 2, the breaker bar assembly 3 and the rotor assembly 4 are attached to a frame 23 of the tea harvester 1.

Referring to figure 5, in an embodiment of the present invention, direction of rotation 41 of rotor assembly 4 is opposite to the direction of movement 42 of the conveyor belt 5. For example, as seen in figure 5, if the rotor assembly 4 rotates in a counter-clockwise direction, then the conveyor belt 5 moves in a substantially clockwise direction. Alternatively, if the rotor assembly 4 rotates in a clockwise direction, then the conveyor belt 5 moves in a substantially counter-clockwise direction. In operation, referring to Figures 1 and 13 to 17, as the tea harvester advances, the rotor assembly rotates in a clockwise direction and the conveyor belt moves in a counter clockwise direction.

In a preferred embodiment of the present invention, as seen in figure 5 and 6, a rotor pulley 43 is attached to the rotor assembly 4, a conveyor pulley 46 is attached to the conveyor assembly 2, and an intermediate rotor pulley 44 and an intermediate conveyor pulley 45 are attached to a drive shaft 49. A rotor pulley belt 47 is cross-mounted on the rotor pulley 43 and intermediate rotor pulley 44, whereas conveyor pulley belt 48 is mounted on conveyor pulley 46 and intermediate conveyor pulley 45, in order to rotate the rotor assembly 4 in a direction 41 opposite to the direction of movement 42 of conveyor belt. Furthermore, the ratio of pulleys 43, 44, 45 and 46 is such that velocity of the top surface of the plucking rubber 20 is substantially identical to the velocity of the conveyor belt 5. It is envisioned that, in an another embodiment, the direction of rotation of the rotor assembly 4 in relation to that of the conveyor belt 5, and the velocity of the plucking rubber 20 in relation to that of the conveyor belt 5 is achieved by means of motor and gear box drive instead of pulley drive.

Referring to figure 7, an intermediate drive assembly 50 includes intermediate rotor pulley 44, intermediate conveyor pulley 45, pulley drive shaft

49, bearings 51, belt tension adjustment assembly 52 including tension adjustment bolts 55, and a support frame 53. The intermediate drive assembly 50 is to the tea harvester frame 23 by means of mounting clamp assembly 54 and assembly bolts 55.

Referring to figures 9 and 10, in another embodiment of the present invention, the conveyor belt assembly 2 includes helical belt support rollers 6B and helical rear belt support rollers 7B. Helical rollers assist in transferring and excluding extraneous plant material which could otherwise be entrapped if conveyor belt end guards are not fitted.

In another preferred embodiment, referring to figures 11 and 12, the belt support rollers 6 includes a sloping side recess 61 to accommodate a tracking strip 62 attached to the conveyor belt 5 at bonding region 63. The arrangement is provided tracking for the conveyor belt 5, thereby preventing lateral movement of the conveyor belt 5 relative to the belt support rollers 6.

Referring to figure 12, in a preferred embodiment, the belt support roller 6 includes an end profile 67 to mount a bearing 64. The bearing 64 is held in place by a retaining washer 65 and a bolt 66. Therefore, belt support roller 6 is supported on the support member 9 through bearing 64.

METHOD OF OPERATION

Figure 13 shows a general area of tea shoots 80 of tea plants at the canopy surface or plucking table of tea bushes. Generally, the plucking height 85 is set at the plucking table. The tea harvester 1 of the present invention selectively harvests mature tea shoots 81A and 81B including two leaves and a bud extending above the plucking height 85 by breaking or cutting their stems 84 at the plucking height 85, without damaging immature tea shoots 82A and 82B or the maintenance foliage 83 of the tea plant.

In use, as seen in figure 14, the tea harvester 1 is set at a level such that the breaker bar 11 is at the plucking height 85. Subsequently, as seen in figure 15 to 17, the tea harvester 1 is moved forward in a direction 91 towards the tea shoots 80, whilst the rotor assembly 4 rotates in unison with the movement of the conveyor belt 5 as described above.

Referring to figure 15, the rotor assembly 4 captures tea shoot 81A including two leaves and a bud, whilst the breaker bar 11 engages against the

immature tea shoot 82A and pushes the immature tea shoot 82A over because of the flexibility and resilience of the stem of the immature tea shoot 82A Remaining tea shoots are unaffected by the tea harvester 1 at this stage.

Referring to figure 16, the rotor assembly 4 is further rotated and the tea harvester 1 is moved forward simultaneously. The tea shoot 81A including two leaves and a bud is entrapped between the plucking rubber 20 and the conveyor belt 5. The entrapment causes tension of the stem 84 of tea shoot 81A over the breaker bar 11. This tension and the forward travel of the tea harvester 1 causes the stem 84 of the tea shoot 81A to be cut or broken by the sharp front end of the breaker bar 11 so that the tea shoot 81A is cleanly plucked at the plucking height 85. The immature tea shoot 82A is deflected under the harvester, and remaining tea shoots are unaffected by the tea harvester 1 at this stage.

Referring to figure 17, the rotor assembly 4 is further rotated and the tea harvester 1 is moved forward simultaneously. The tea shoot 81A including two leaves and a bud has been selectively harvested at the plucking height 85 and is transported in a direction 93 along the conveyor belt 5 into a collection means. On further movement of the tea harvester 1, as seen in figure 17, the immature tea shoot 82A passes under the inclined conveyor belt 5 and by means of its natural resilient flexible stem is returned to its undamaged original vertical position. Also, the lower part of the stem 84 originally attached to the plucked tea shoot 81A returns to its original vertical position on the tea bush. Advantageously, the maintenance foliage 83 is not harvested or damaged even though it is above the plucking height 85 because it is attached to the stem 84 at a level lower than the plucking height 85. The breaker bar engages with the subsequent immature shoot 82B to gently bend the immature tea shoot 82 B on the resilient flexible stem attaching the immature tea shoot 82 B to the tea bush. At the same time, the subsequent tea shoot 81B including two leaves and a bud is engaged with the rotor assembly 4.

The process is repeated continuously along the breadth of the tea plantation 80, selectively harvesting tea shoots 81 including two leaves and a bud at the plucking height 85, without damaging immature tea shoots 82 and the maintenance foliage 83. The tea harvester 1 of the invention is able to selectively

pluck tea shoots 81 from a tea plantation 80 at a rate of substantially 4 kilometres per hour.

PREFERRED FEATURES

Timing. The speed of (a) conveyor belt 5 and (b) plucking rubber 20 is timed to engage at 90 degree intervals to enable proper engagement and entrapment of tea shoots 81 including two leaves and a bud between the rotor frame 17 and to be held on surface of conveyor belt 5 for fine selective leaf plucking. Therefore, the rotor assembly 4 includes four plucking rubbers 20 and an open space between consecutive plucking rubbers 20. In another embodiment, the rotor assembly 4 could include more or less than four plucking rubbers 20. Furthermore the diameter of rotor frame 17 or pitch circle diameter at which plucking rubbers 20 operate may be varied to suit a particular tea plantation.

As described with reference to figures 5 to 7, the rotor assembly 4 and the conveyor belt 5 are rotated in opposite direction at substantially uniform speeds, in order to avoid friction between the upper surface and lower surface of the tea shoot 81 which is gripped to cause its plucking, such that the tea shoot 81 is plucked at plucking height 85. Furthermore, the forward speed of the tea harvester 1 is coordinated with the timed plucking in order to allow entry of a single shoot into the plucking rotor and to pluck the tea bush surface canopy at closely spaced intervals to pluck all the harvestable shoots.

Breaker Bar. The breaker bar 11 having a substantially sharp outer edge located ahead of the conveyor belt 5 enables the plucking to be clean and efficient. In other words, the breaker bar 11 enables selectively harvesting of tea shoots 81 including two leaves and a bud at the plucking height 85, without damaging immature tea shoots 82 and the maintenance foliage 83. Preferably, the breaker bar 11 is located in front of the conveyor belt 5 substantially at the centre line of the front belt support roller 6. The selective plucking action of the tea harvester 1 exerts minimal pulling of the stem of the tea shoot 81, since a tea shoot 81 which is long enough to be entrapped between the rotor assembly 4 and the conveyor belt 5, is pulled over the substantially sharp breaker bar 11 and simultaneously moved away from the breaker bar 11 along the conveyor belt 5. Therefore, pulling the stem of tea shoot 81 around the substantially sharp breaker

bar's 11 edge causes the tea shoot 81 to break quickly, allowing a pristine harvested shoot to travel up the conveyor belt 5 into the collection area.

Furthermore, any immature tea shoot 82 or extraneous maintenance foliage 83 that is not entrapped between the plucking rubber 20 and the conveyor belt 5 is simply pushed over and passed under the breaker bar 11, without being harvested and importantly without damage. The breaker bar 11 is mounted from the rear and under the conveyor belt 5 to prevent obstruction from the clean entry and plucking of the selected tea shoot 81.

In a preferred embodiment, a cover is fitted extending from the back end of the breaker bar 11 to the leading edge of the conveyor belt 5, in order to prevent extraneous plant material being entrapped in the gap between the back of the breaker bar 11 and the conveyor belt 5.

Conveyor belt self tracking. The diameter of the front belt support rollers 6 is relatively small in order to allow correct tea canopy clearance as well as to reduce weight of tea harvester 1. The small diameter of front belt support rollers 6 may create a problem of tracking the conveyor belt or preventing its lateral movement when in motion. To rectify this problem, a tracking strip 62 is attached to the conveyor belt 5 and a corresponding recess 61 is provided on the front belt support roller 6 and the drive roller to provide belt tracking, as seen in figure 12. Belt tracking arrangement ensures reliability of the conveyor belt 5 and its unison motion with rotor assembly 4, and eliminates the need for tracking adjustment.

Conveyor belt surface. Tea harvesting is carried out every operational day regardless of weather conditions. In a preferred embodiment the conveyor belt 5 includes a silicon rubber surface to match the frictional gripping surface of the plucking rubber 20. The materials provide adhesion and grip on upper and lower surface of tea shoot 81 in wet conditions, therefore, allowing the tea harvester 1 to be operated during wet rainy seasons.

Plucking Rubber. The plucking rubber 20 over continued operation wears out due to frictional contact with tea shoots 80 and conveyor belt 5. The plucking rubber 20 is attached to the rotor frame 17 through an extruded aluminium connecting means 21. The plucking rubbers 20, at the rotational rotor assembly 4 speed, provide carry-through kinetic energy to intermittently pluck all of the tea shoots 81 across the width of the tea harvester 1.

Leaf Guards. To avoid entrapment of tea leaves or branches within the front belt support rollers 6, rear belt support rollers 7, or inside the conveyor assembly 2, in a preferred embodiment, there are provided overlapping leaf guards. The leaf guards cover both sides of the conveyor belt assembly 2. The leaf guards protrude over the upper and/or lower surfaces of the conveyor belt assembly 2 and surround the belt edges. Thereby, entrapment of leaves and/or extraneous plant material in the conveyor belt assembly is prevented.

An alternative embodiment of a tea harvester in accordance with the invention is described with reference to Figures 18 to 24 in which the stem engaging means is a breaker cable instead of a breaker bar.

Figure 18 shows a tea harvester 100 which has a chassis 101 attached to a nose assembly 105 and is fitted with a small diameter nose roller 107 and a support roller 108 to support a belt 103 and provide tension across a semi-circle at the belt 103 between the nose roller 107 and the support roller 108.

A rotor assembly 110 is comprised of a central tube 111, mounting collars 112, a disc 113, retention strips 114 and plucking engagement rubbers 115. Importantly a breaker cable 118 is located at the front of the nose assembly 121 to induce a high-stress on the stem of the selected tea plant causing it to break (plucked) and be harvested as shown in Figure 20.

Figure 19 shows the engagement of a plucking rubber 115 depressing the belt 113 between the point of support of the nose roller 107 and an intermediate roller 130 providing deflection and continuity of contact on the belt surface between points 131 and 132 just before the plucking rubber moves away from contact with the belt 103.

Figure 19 also shows retaining screws 134 fitted through a slotted support plate 135 that provides axis adjustment in forward and backward directions 136 and 137 moving the contact engagement of the plucking rubber 115 and belt 103 at 131 forward or back. This provides the length of material to be selectively harvested.

Figure 20 shows the requirements for proper selective harvesting. The zone 216 above a predetermined first level 201 is the area in which mature tea plants 210 each having a shoot 211 and two leaves 213 ready for harvesting are engaged by the plucking rollers of the selective harvester. Tea plants marked

217 are young developing shoots that are not engaged by the plucking rollers because they are required to be left for continued growth and later harvest.

The invention provides for breaking the shoots of selected plants 210 at break points 218 by the breaker cable 118 at the predetermined second level 201 without breaking the immature shoots 217 at 219.

Figure 20 shows an entrapped tea shoot pulled over the contact point of the breaker cable 118 causing the succulent stem to snap and be plucked. The high tension required on the breaker cable 118 is provided by a roller 119 and adjuster 120 shown in Figures 19 and 21.

Figure 21 shows a plan view of the breaker cable 118, roller 119 and adjuster 120. An important aspect is the height location of the breaker wire 118 relative to the nose roller. This is provided by a mounting bracket 121 shown in Figures 22, 23 and 24, fitted with a vertical shaft 122 having a continuous thread with adjustment nuts 123 and 124 on either side of the roller or pulley 119.

CLAIMS:

1. Apparatus for selectively harvesting plant material, particularly the leaves and bud of a plant having a stem, the apparatus including a first plant engaging means, a second plant engaging means movable relative to the first plant engaging means to trap the plant matter between the first and second plant engaging means at a first level, and a stem engaging means arranged to contact a stem of the plant at a predetermined second level, lower than the first, wherein when the stem of trapped plant material extending above the predetermined second level is broken by the stem engaging means to harvest the trapped plant material.

2. Apparatus according to claim 1, wherein the first plant engaging means has a leading edge, and the second plant engaging means is disposed relative to the leading edge such that entrapment of plant matter between the first and second plant engaging means occurs at a distance from the leading edge whereby only selected plant matter of sufficient height may be harvested.

3. Apparatus according to any one of the preceding claims wherein the stem engaging means has a front end disposed forwardly of the leading edge of the plant engaging means adapted to break or cut the stem of trapped plant material.

4. Apparatus according to claim 4 wherein only plant material engaged by the front end of the stem engaging means that is of sufficient height to be trapped between the first and second plant engaging means is broken by the front end of the stem engaging means, and plant material that is of insufficient height to be trapped between the first and second plant engaging means of the plant matter is pushed by the front end of the stem engaging means and bends underneath the apparatus..

5. Apparatus according to claim 4 or claim 5 wherein the stem engaging means includes a breaker bar having a substantially sharp edge at its front end.

6. Apparatus according to claim 3 or claim 4 wherein the stem engaging means includes a cable, wire or cord.

7. Apparatus according to claim 6 wherein the cable, wire or cord is maintained in tension.

8. Apparatus according to claim 7 wherein the cable wire or cord is maintained in tension by a roller and adjuster assembly.

9. Apparatus according to any one of the preceding claims wherein the first plant engaging means is a belt conveyer and the second plant engaging means includes at least one rotor member, the directions of rotation of said belt conveyor and the at least one rotor member being opposed whereby plant matter is drawn between and trapped between the conveyor belt and rotor member.

10. Apparatus according to claim 9 wherein the second plant engaging means includes a plurality of rotor members of a rotor assembly.

11. Apparatus according to claim 10 wherein the speed of rotation of the belt conveyor is substantially identical to the speed of rotation of the rotor assembly.

12. Apparatus according to claim 11 wherein the belt conveyor and the rotor assembly are driven by a synchronised drive, such as pulley drive or a gearbox drive.

13. Apparatus according to any one of claims 9 to 12 wherein the belt conveyor includes a front roller, a rear roller and a conveyor belt extending around the front and rear rollers.

14. Apparatus according to claim 13 wherein at least one tracking strip is provided on the conveyor belt for engagement with guide means on the front roller and rear roller of the belt conveyor.

15. Apparatus according to claim 13 or claim 14, wherein said conveyor belt has a resilient surface and the or each rotor member has a plant engaging portion of resilient material.

16. Apparatus according to claim 15 wherein the resilient surface of the conveyor belt is made of silicon rubber.

17. Apparatus according to claim 15 or claim 16 wherein the plant engaging portion of the or each rotor member is a plucking rubber mounted on a rotor arm.

18. Apparatus according to any one of claims 9 to 17 further including leaf guards mounted at the sides of the belt conveyor arranged to overlap an upper surface and/or a lower surface of the conveyor belt.

19. Apparatus according to claim 2 or any one of claims 3 to 18 dependent on claim 2, including a cover extending from the leading edge of the first plant engaging means to a rear end of the stem engaging means.

20. Apparatus according to any one of the preceding claims wherein harvested plant matter is conveyed to a collection chamber.

WILLIAMES TEA PTY LTD

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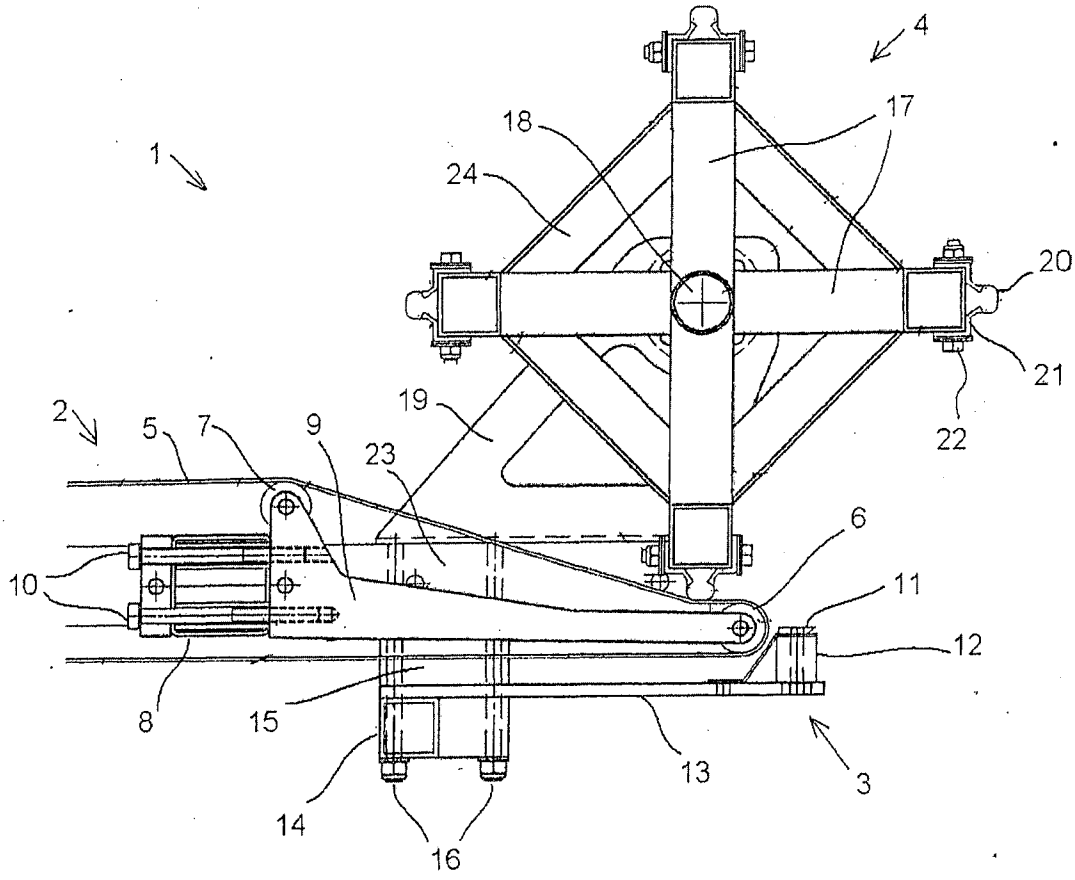


Figure 1

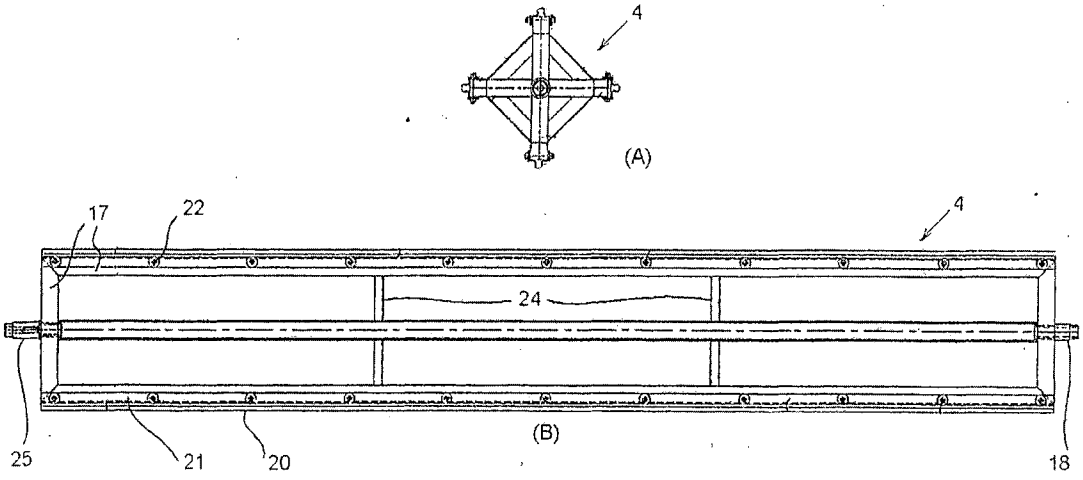


Figure 3

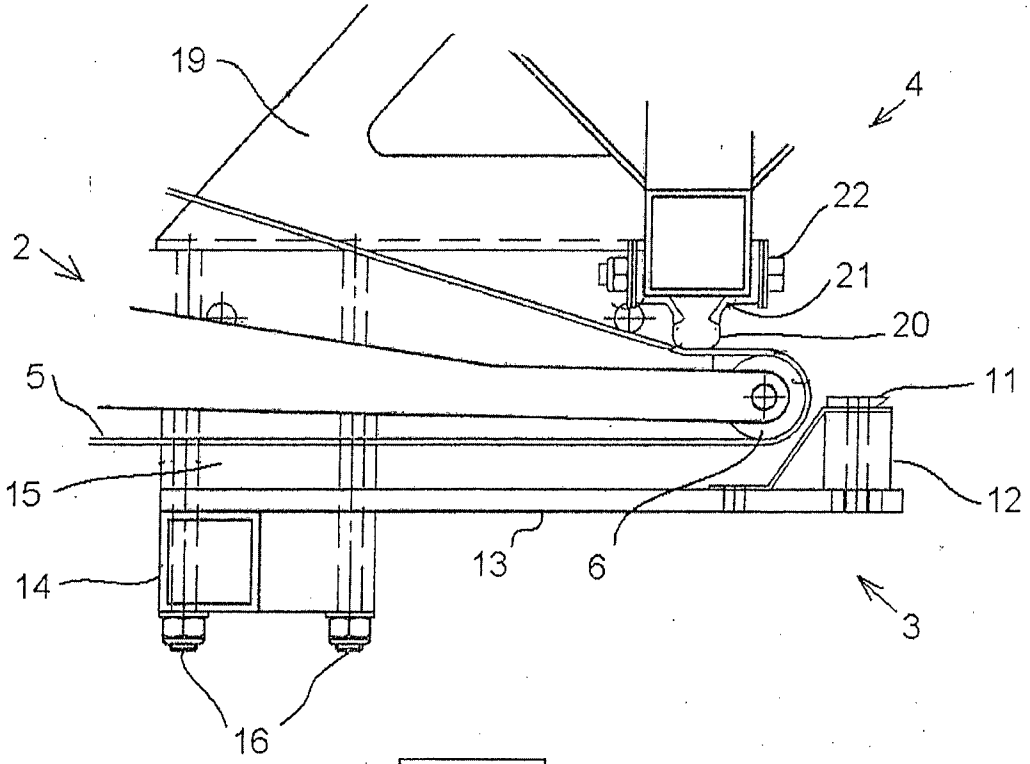


Figure 2

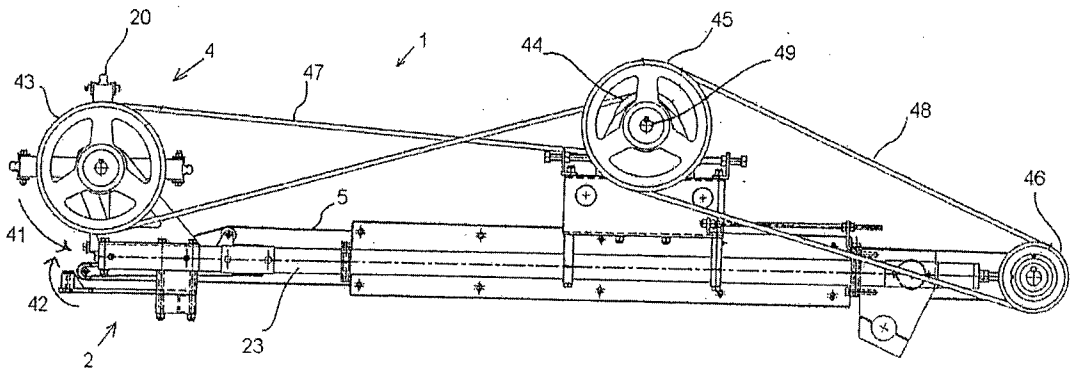


Figure 5

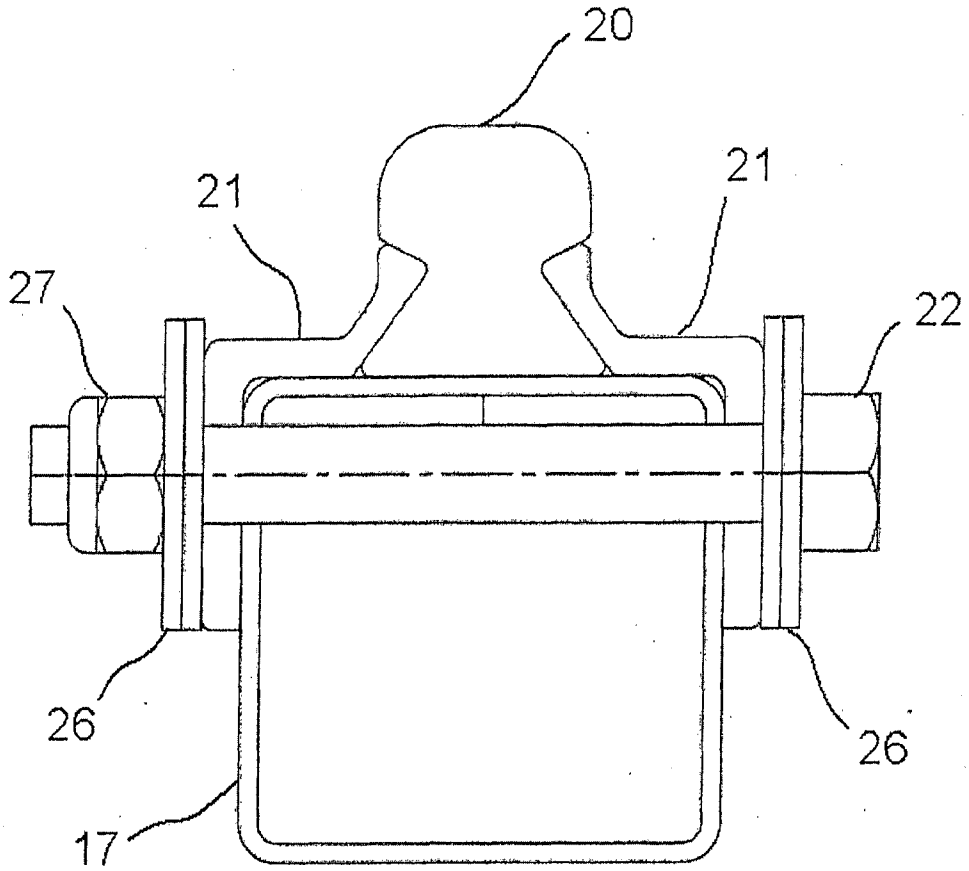
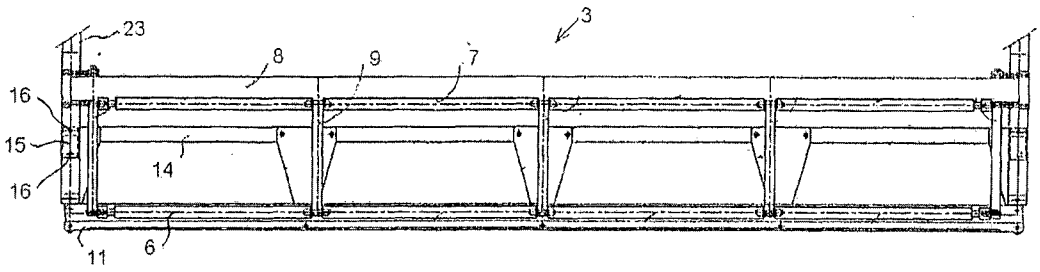


Figure 4



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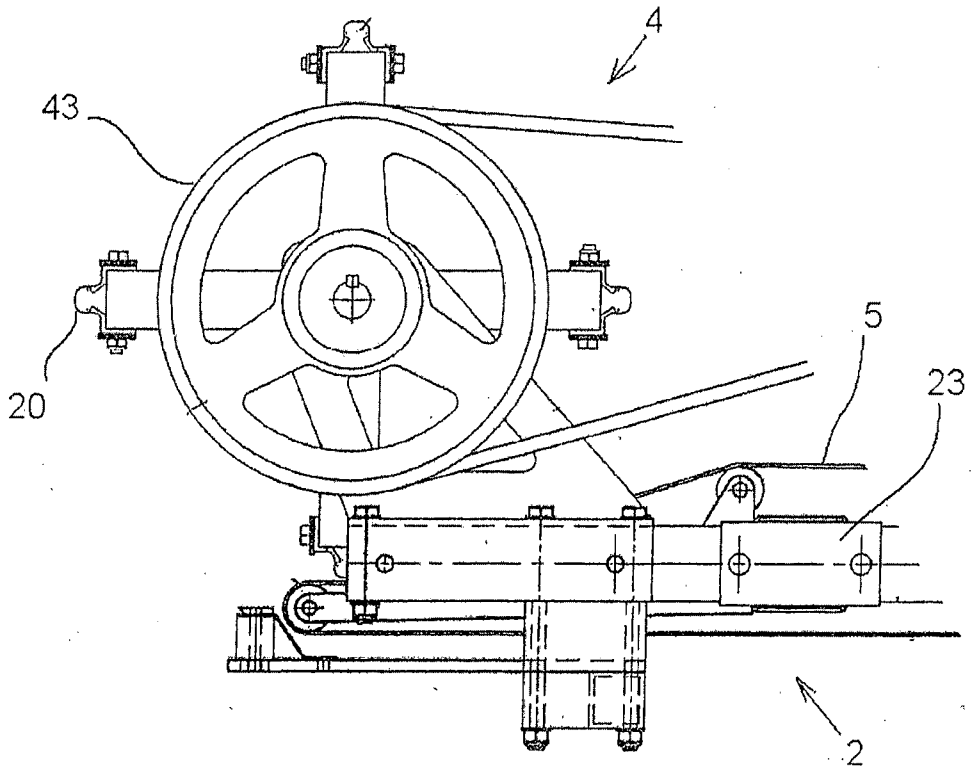

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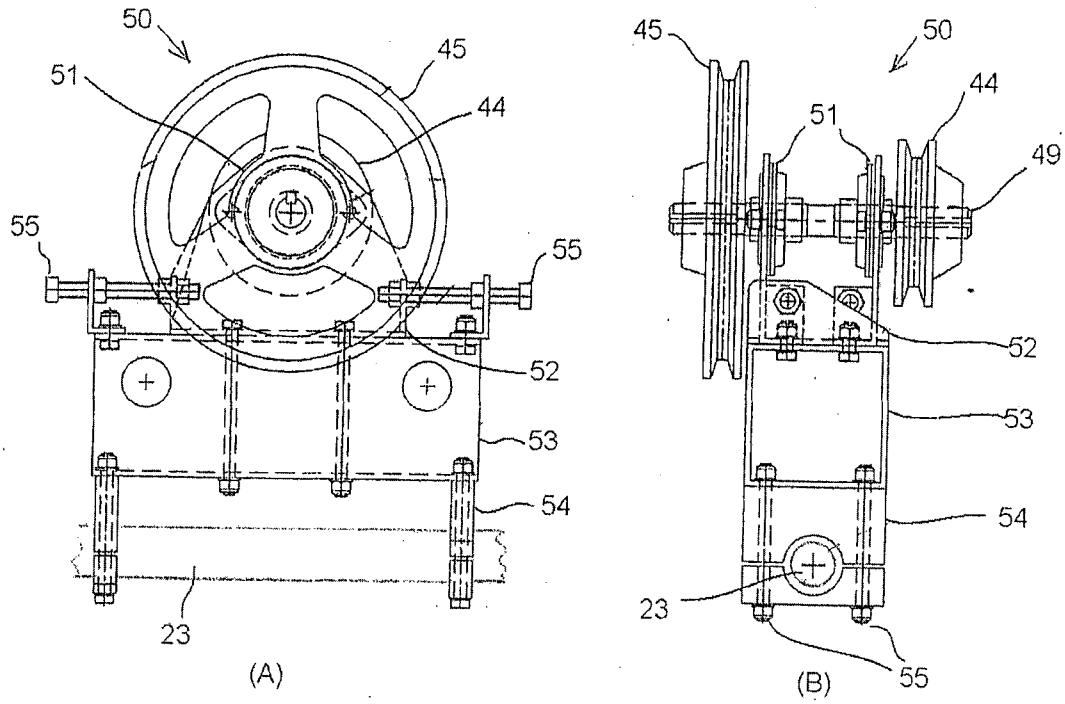


Figure 7

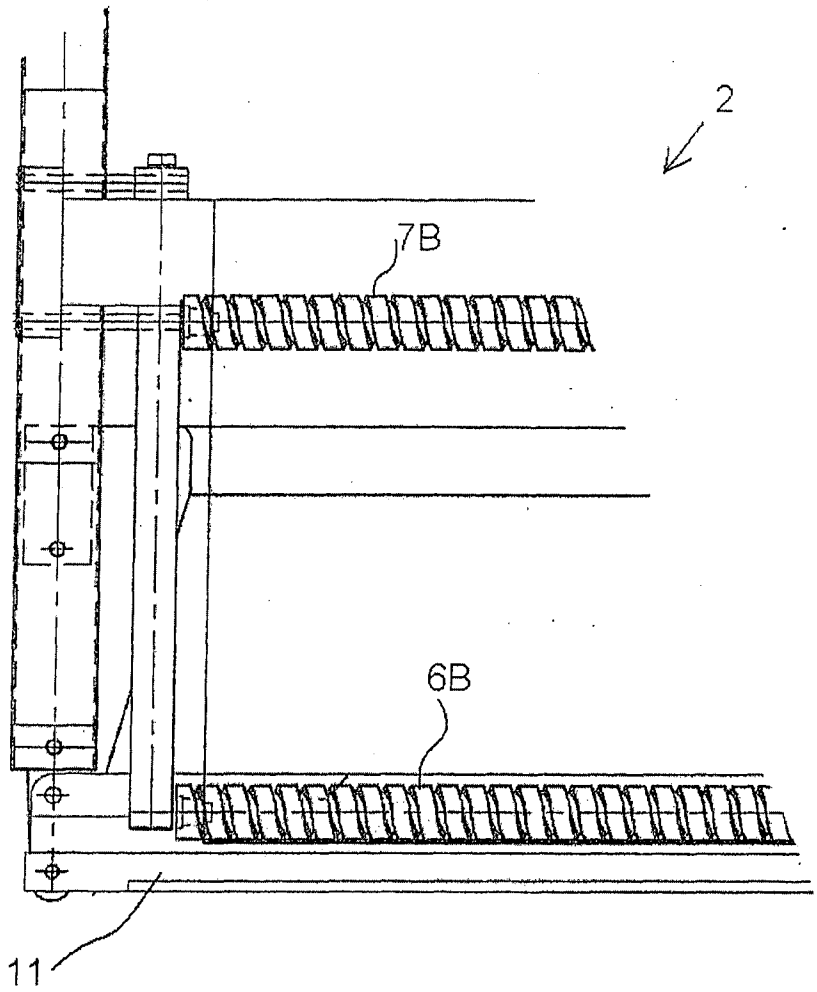


Figure 9

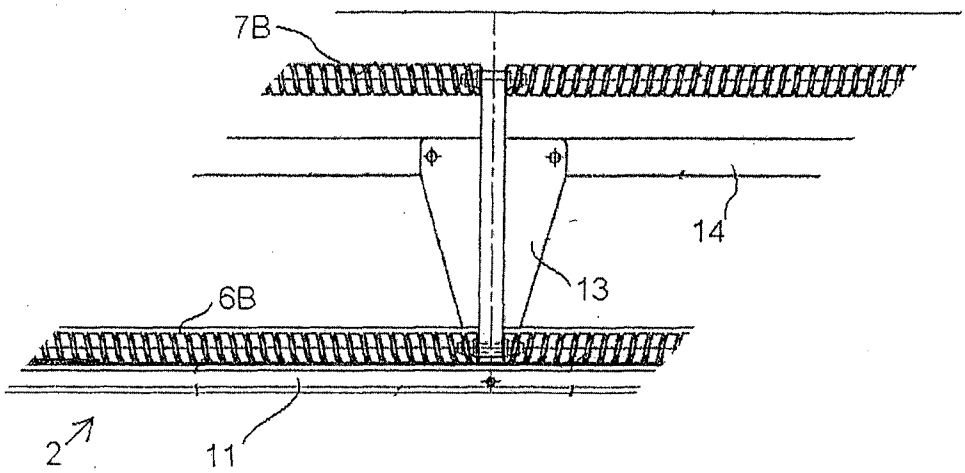


Figure 10

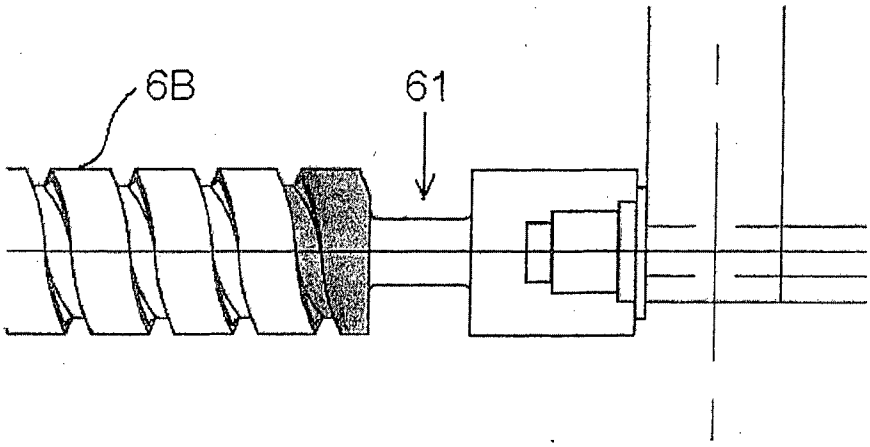


Figure 11

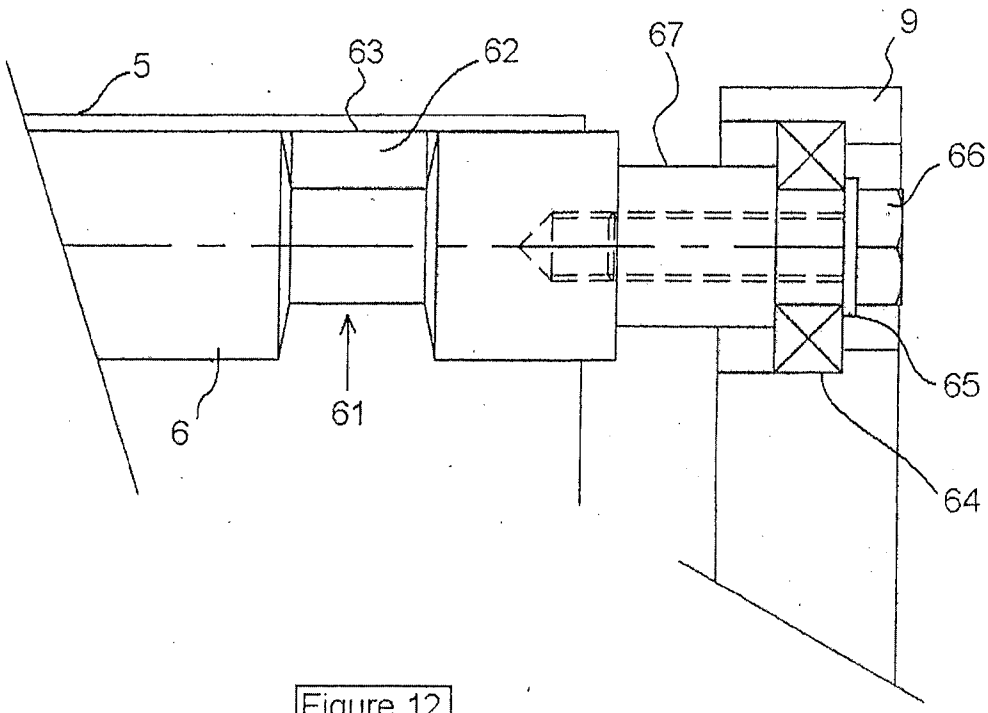
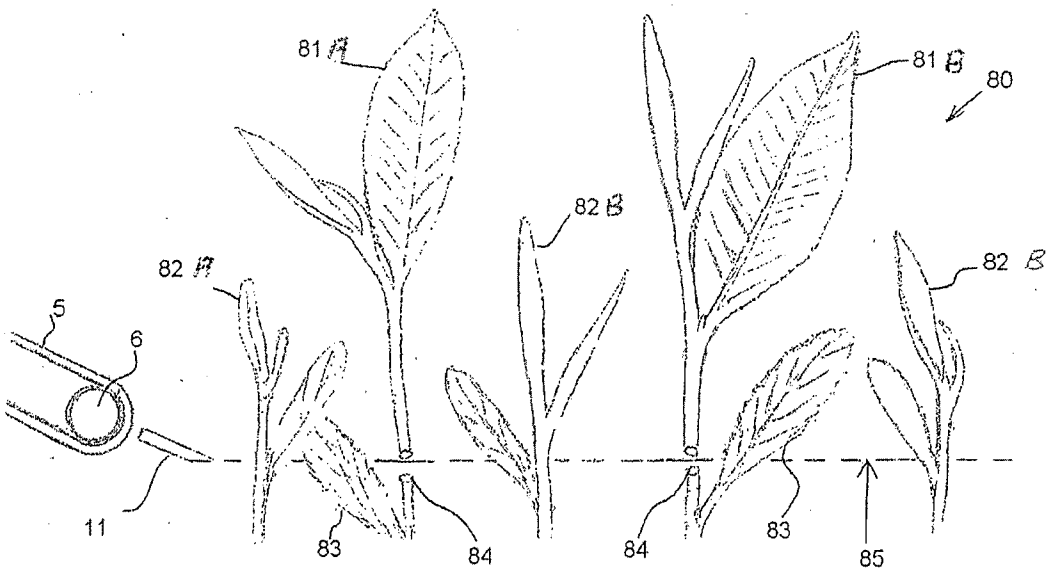


Figure 12


81 A
81 B
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82 B
82 A
82 B
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Figure 13

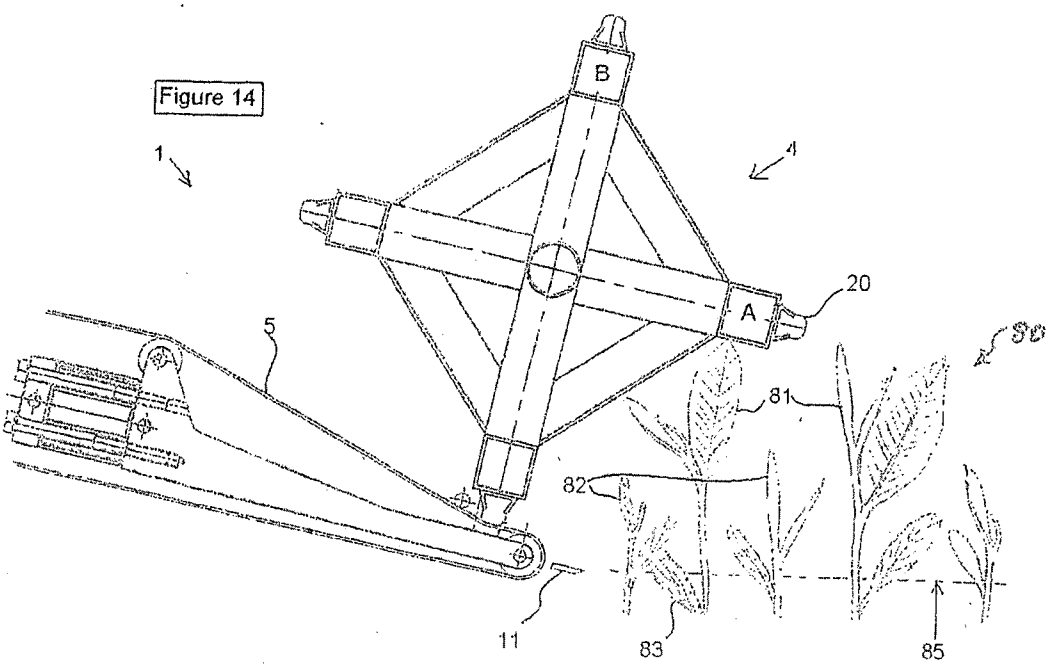
Figure 14
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Figure 15

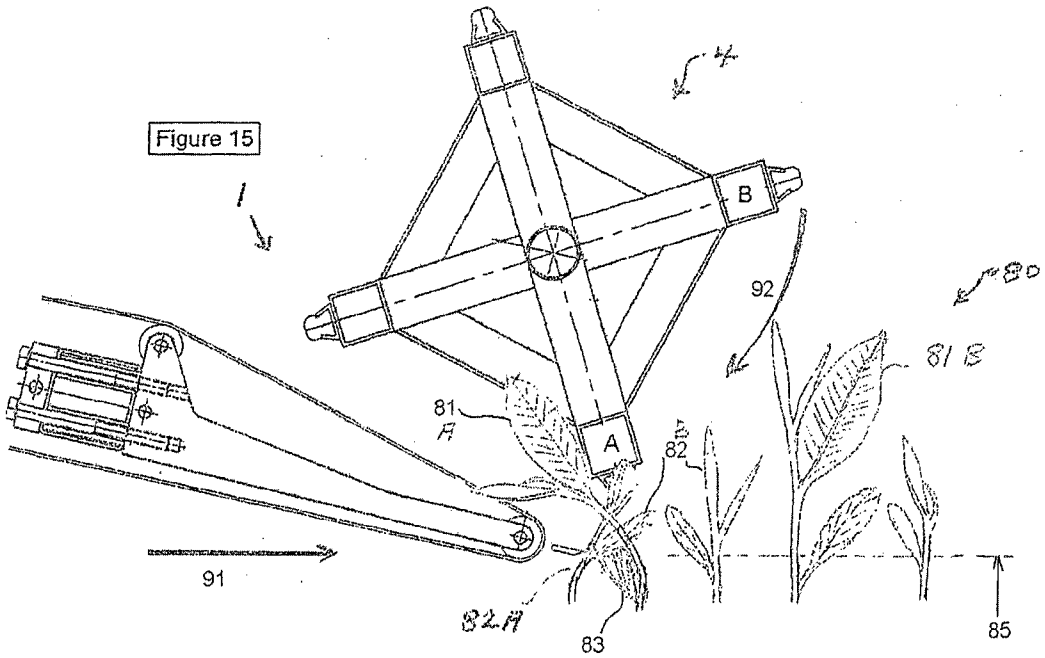


Figure 16

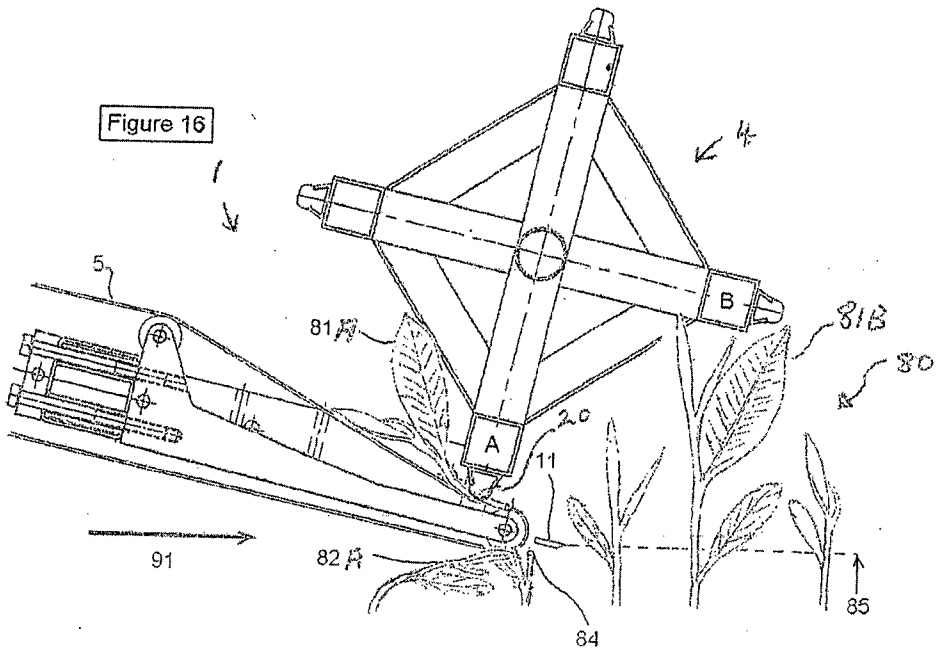
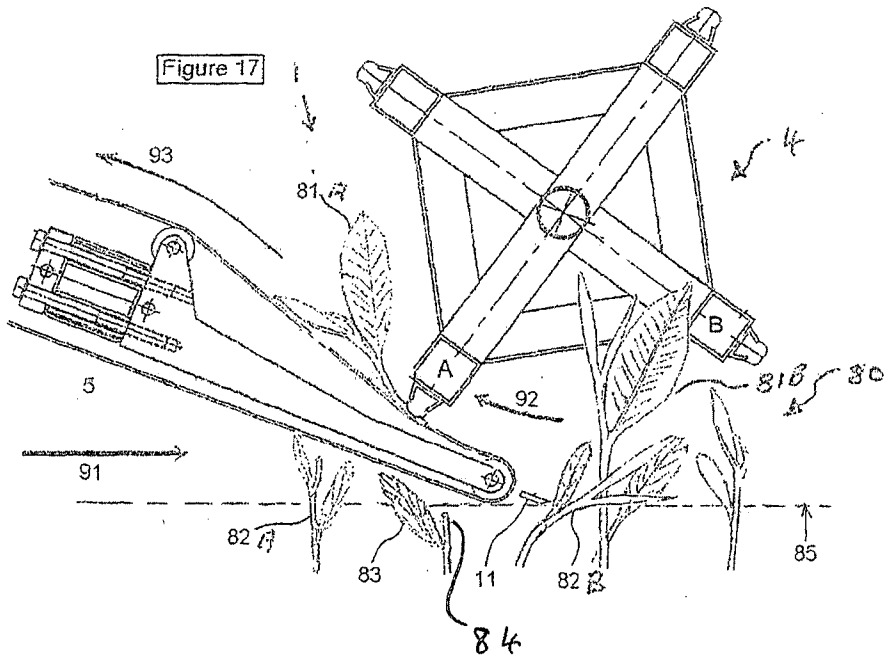


Figure 17



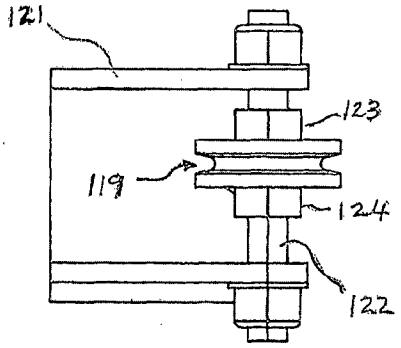


FIG. 22

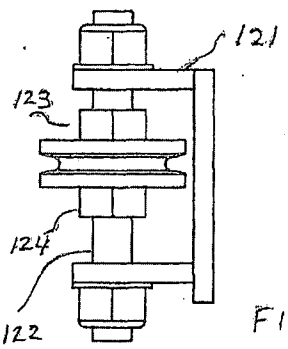


FIG. 23

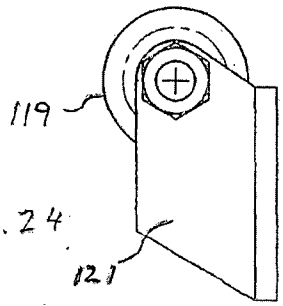


FIG. 24

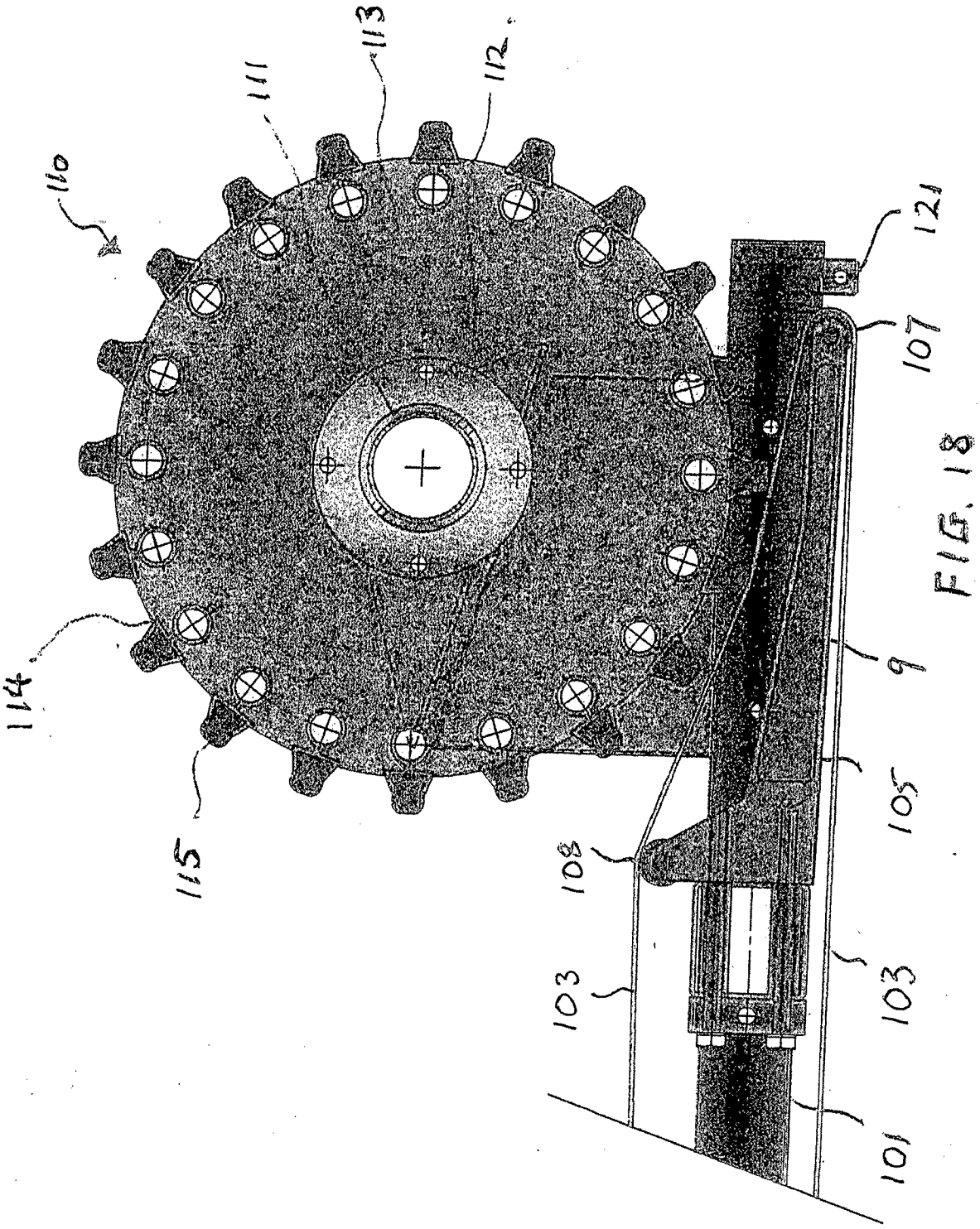


FIG. 18

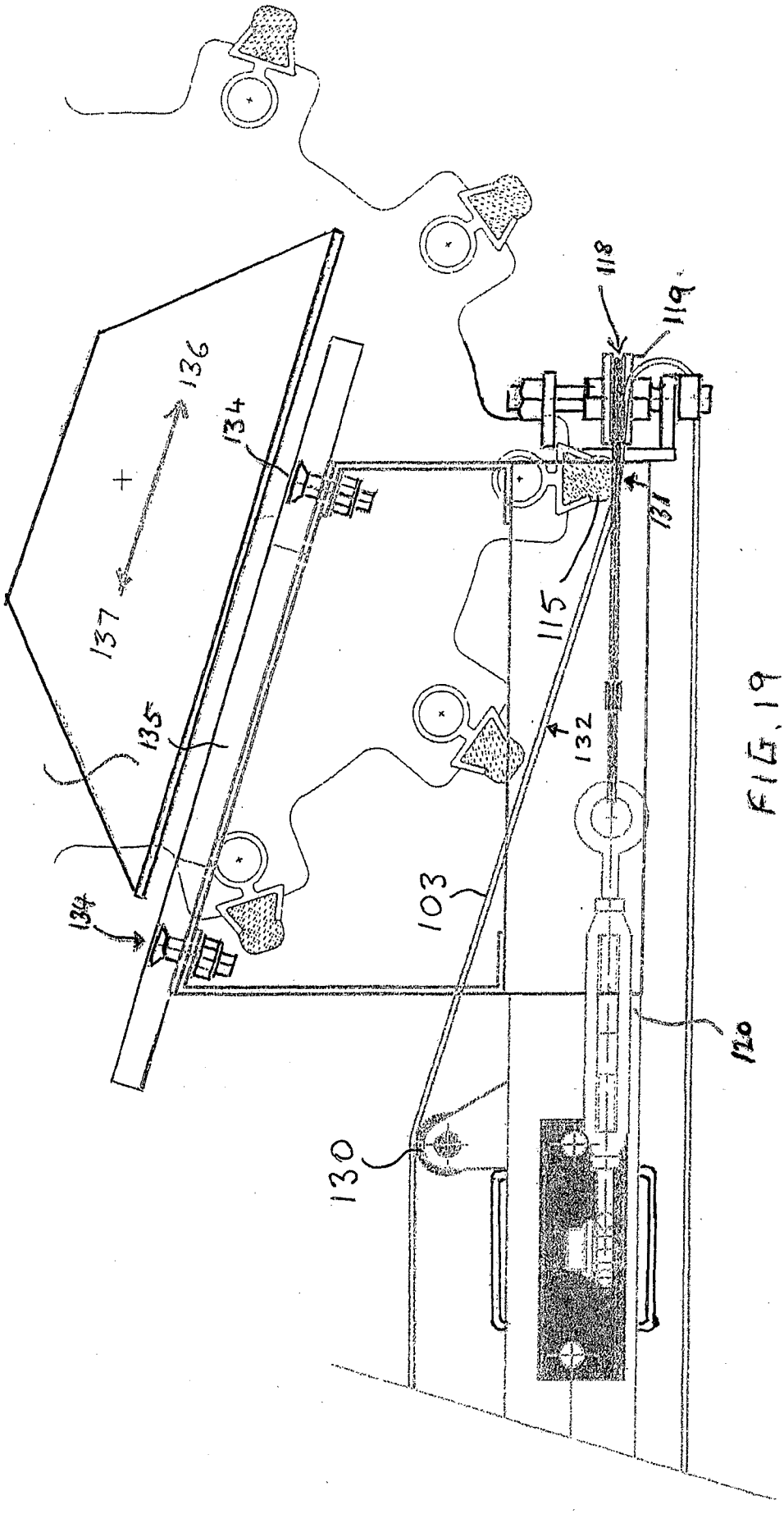


FIG. 19

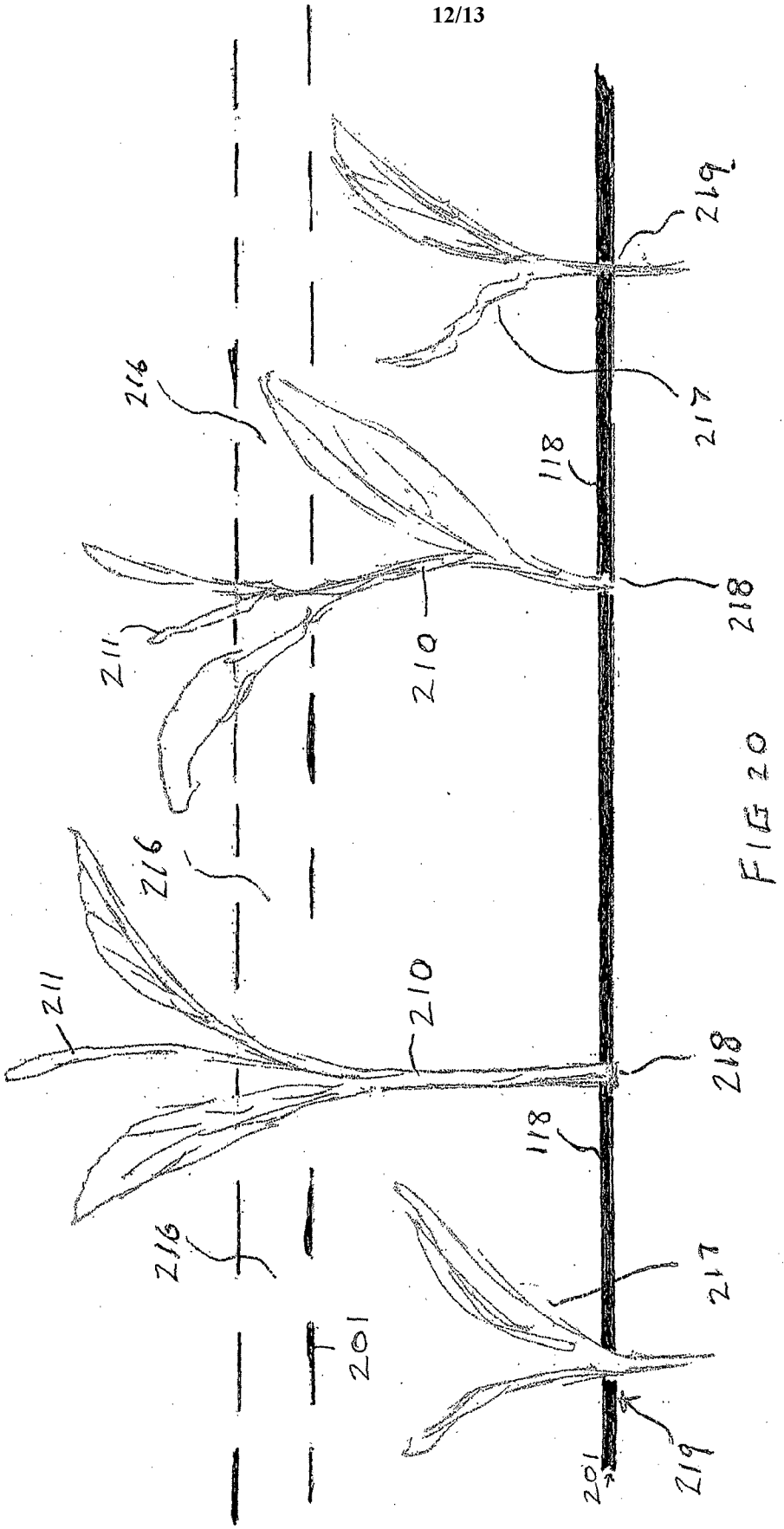

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FIG 20

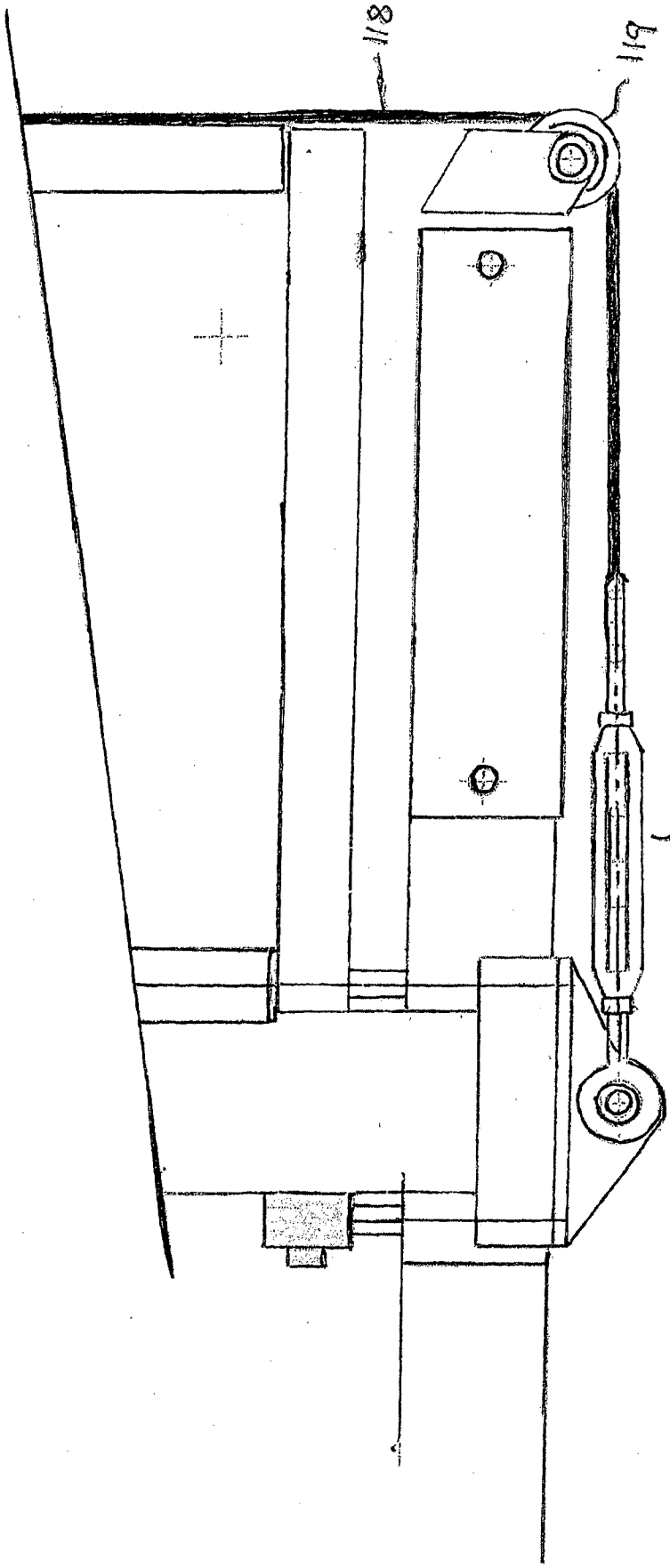

FIG. 21

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2013/000456

A. CLASSIFICATION OF SUBJECT MATTER

A01D 46/00 (2006.01) A01D 46/04 (2006.01)

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)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC: IPC, CPC A01D45, A01D46 and keywords (belt, conveyor, rotor, rotate, roll, spin, engage, trap, catch, guide, wedge, cut, break, shear, snip, tear, scissor, guillotin, sever, sharp, blade, cable, wire, cord, stem, shaft, height, level, distance, position, length, mark, depth, amount) and like terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

[X] Further documents are listed in the continuation of Box C [X] 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	Date of mailing of the international search report
24 July 2013	24 July 2013

Name and mailing address of the ISA/AU	**Authorised officer**
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INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/AU2013/000456**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 673306 A (LINDSAY et al.) 04 June 1952 Figures 1-6, page 1, lines 9-15, page 2, lines 48-121, page 3, lines 9-12	1-20
X	SU 704514 A1 (GRUZINSKIJ et al.) 25 December 1979 & English translation retrieved from ESPACE. English abstract, figure	1-20
X	JP 2010-259398 A (NISHIZAWA KK) 18 November 2010 & English translation retrieved from ESPACE. English abstract, figures 1-4, 11-14	1-20

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2013/000456**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
GB 673306 A	04 Jun 1952	None	
SU 704514 A1	25 Dec 1979	None	
JP 2010-259398 A	18 Nov 2010	None	

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.