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# United States Patent [19]

**Hagen et al.**

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[54] **GRAFTING MACHINE**

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[73] Assignee: **Vinifera, Inc.**, Petaluma, Calif.

[21] Appl. No.: **09/071,548**

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[51] **Int. Cl.**[7] .......... **A01G 1/06**

[52] **U.S. Cl.** .......... **47/6**

[58] **Field of Search** .......... 47/6, 7, 1.01 R; 83/352, 862, 871, 915.3, 869; 451/419; 144/91; 30/279.2, 279.4, 303, 304, 299, 369, 484, 487, 493, 121, 373, 173

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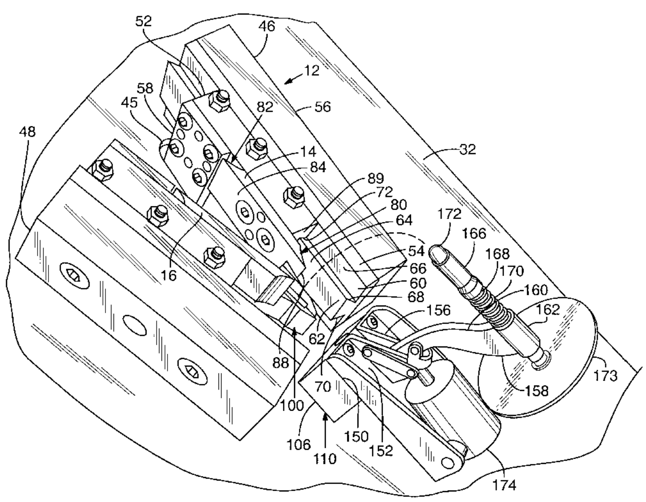
[57] **ABSTRACT**

A grafting system for cutting the end of a plant material includes a frame for holding the plant material and a blade assembly mounted to the frame. The blade assembly includes a blade that is movable at an angle oblique to the longitudinal axis of the plant material into cutting engagement with the plant material. The system also includes an actuating system for moving the blade into cutting engagement with the plant material.

**9 Claims, 6 Drawing Sheets**



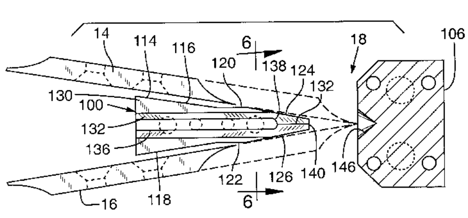



FIG. 1

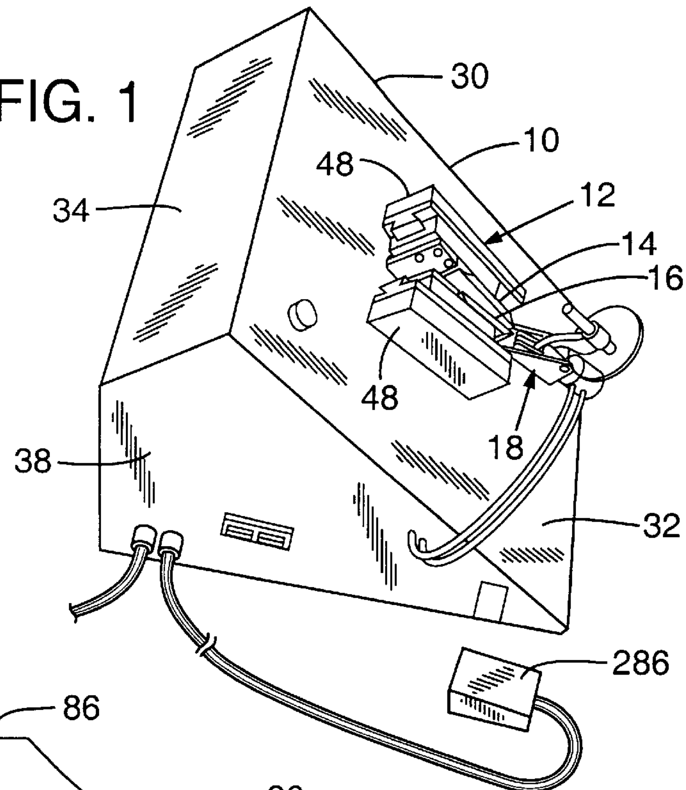



FIG. 9

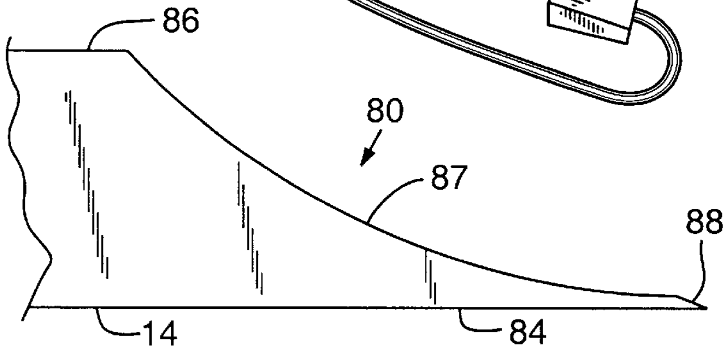
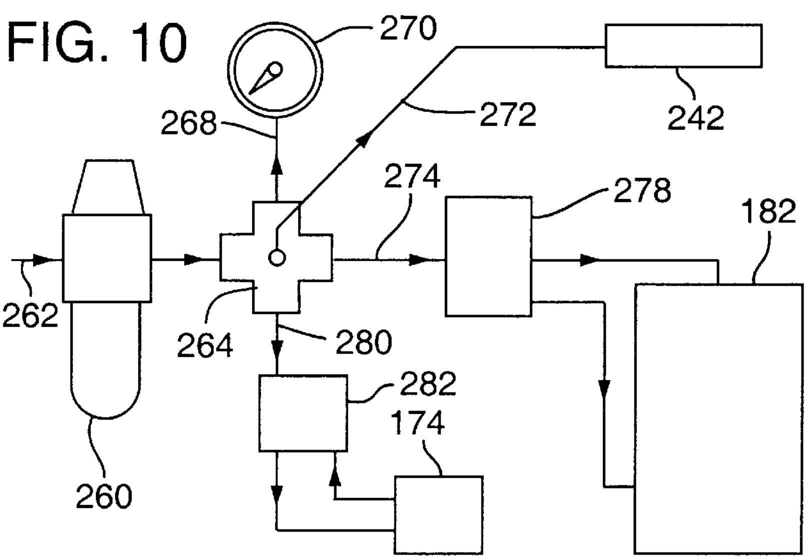
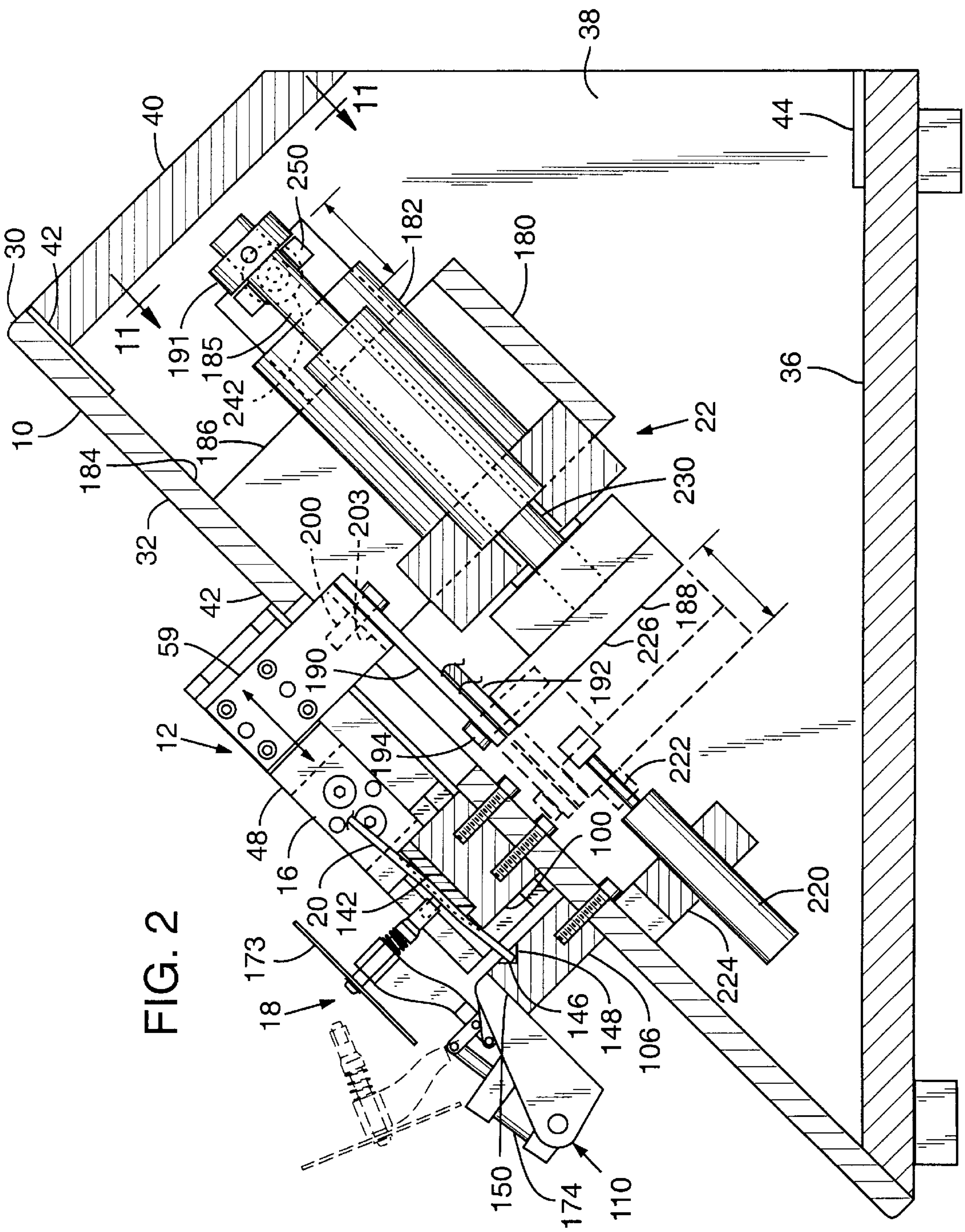



FIG. 10

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200
203
42
59
190
192
226
188
12
194
222
48
100
16
20
142
220
173
146
148
106
224
18
150
174
110

FIG. 2

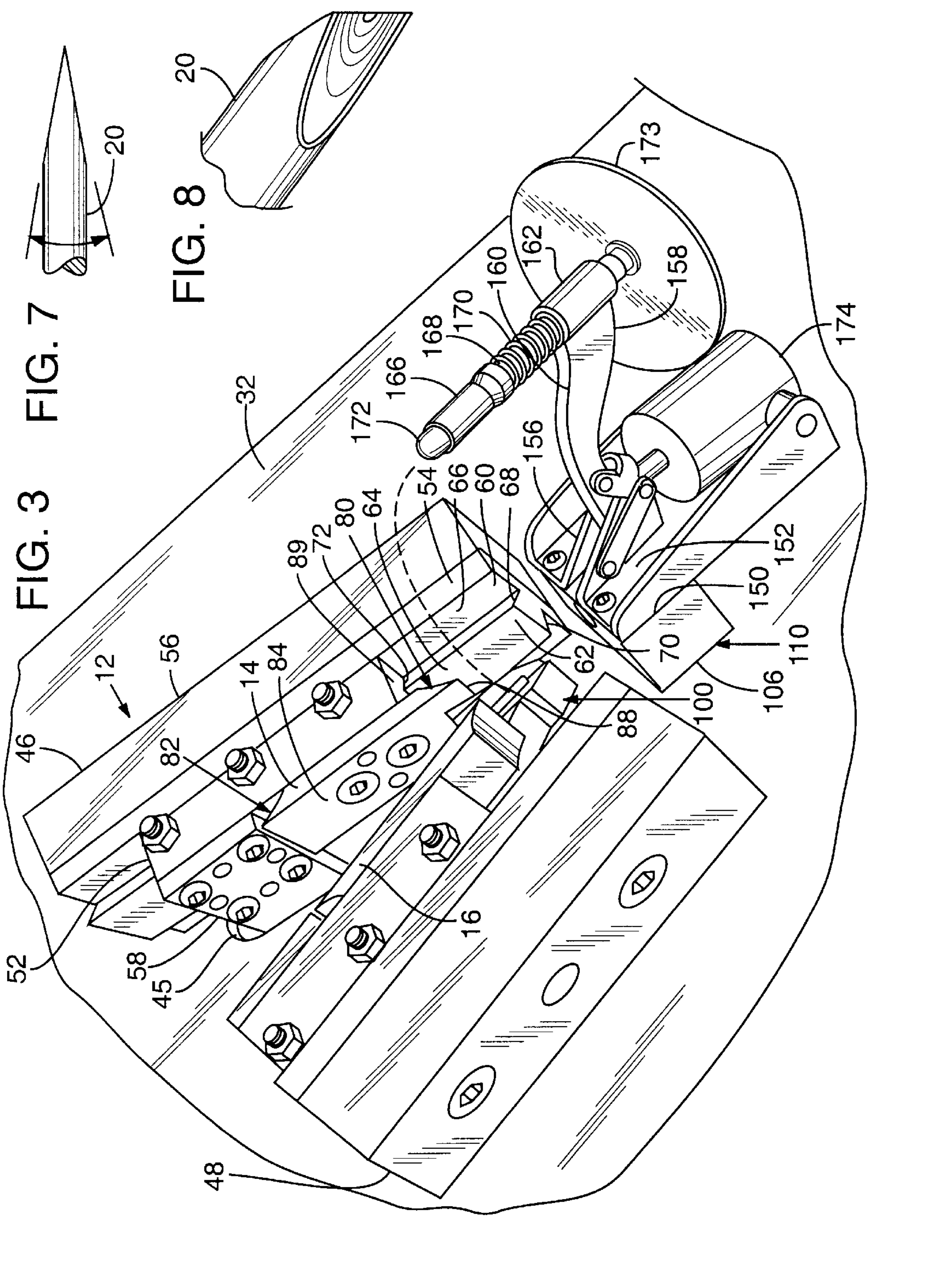



FIG. 3

FIG. 7

FIG. 8

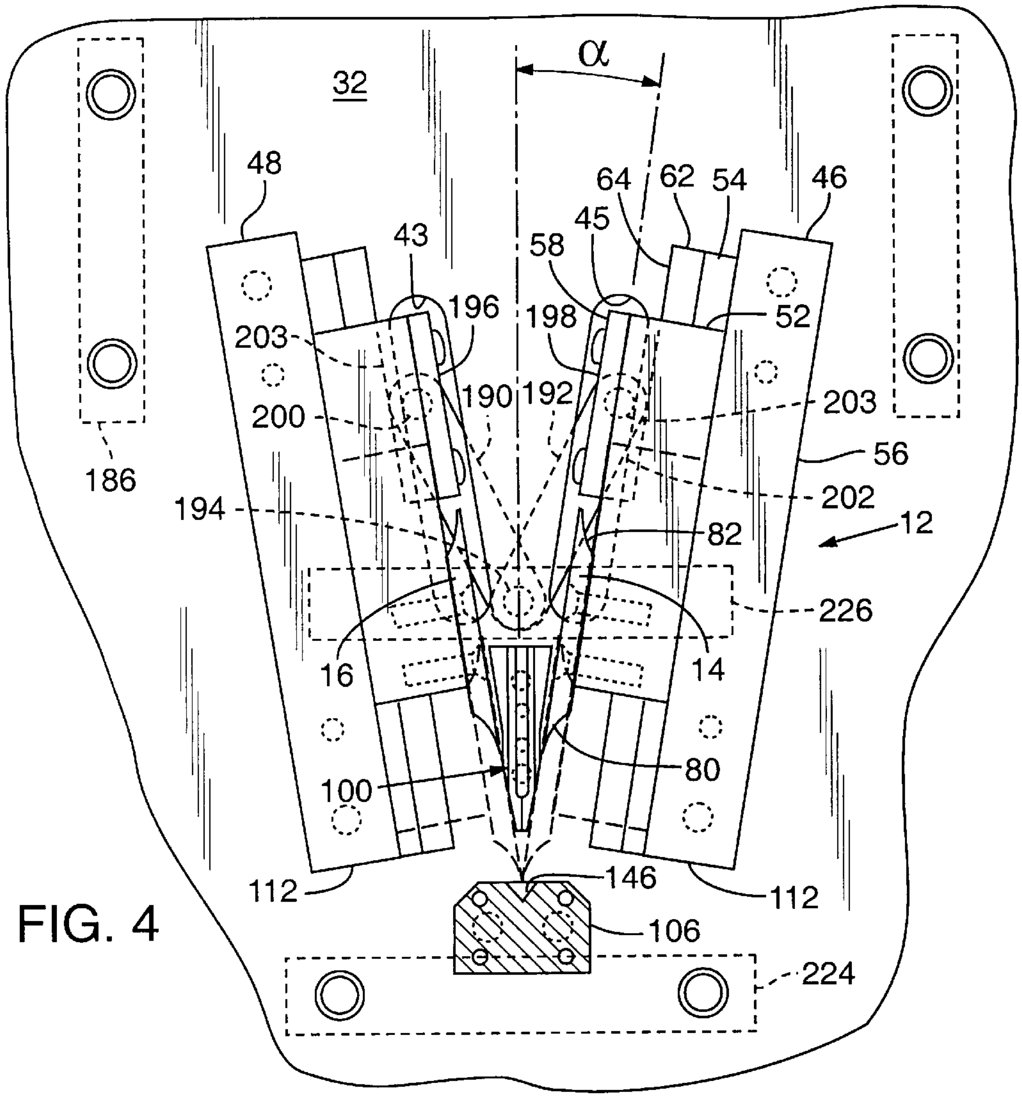

α
32
48
43
64
62
54
46
45
58
196
198
52
203
200
190
192
203
56
186
202
194
82
12
226
16
14
80
100
146
112
112
106
224

FIG. 4

FIG. 5

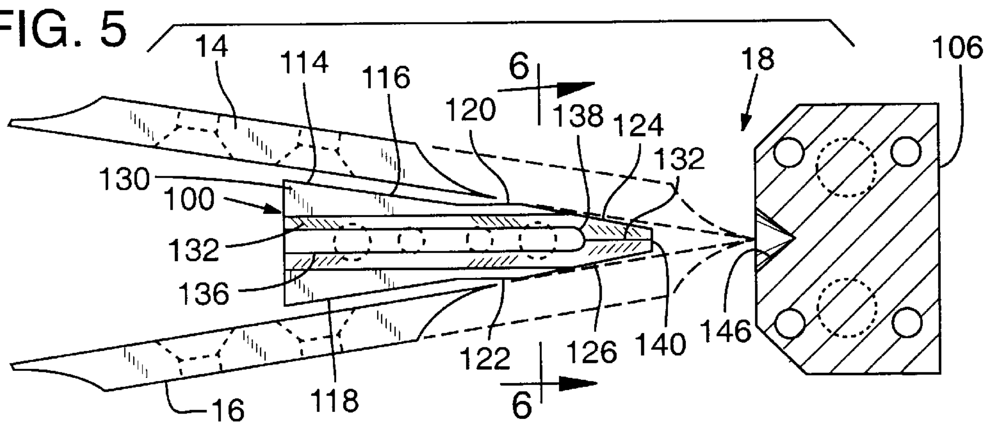

14
114
116
6
120
138
124
18
106
132
130
100
132
136
122
126
140
146
118
16
6

FIG. 6

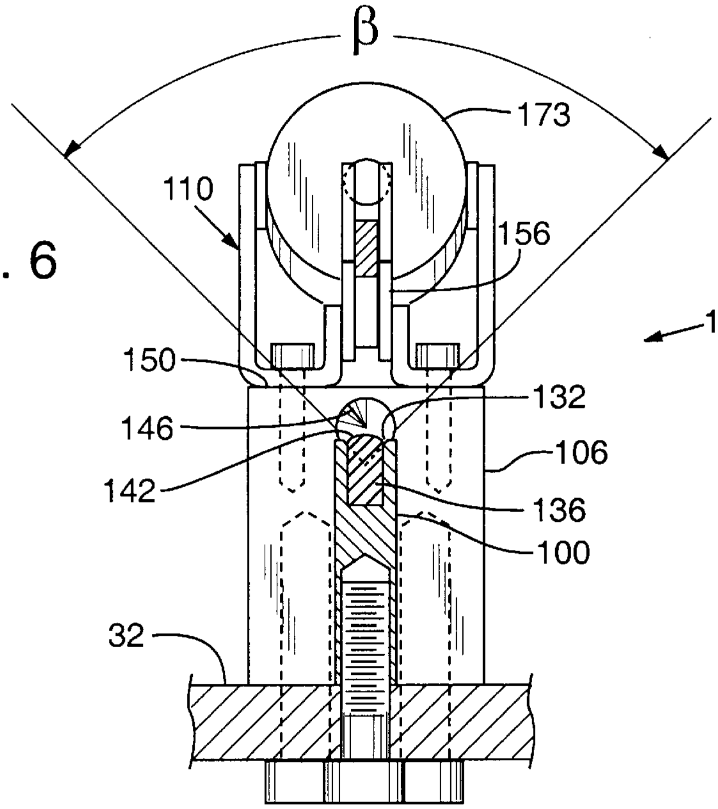
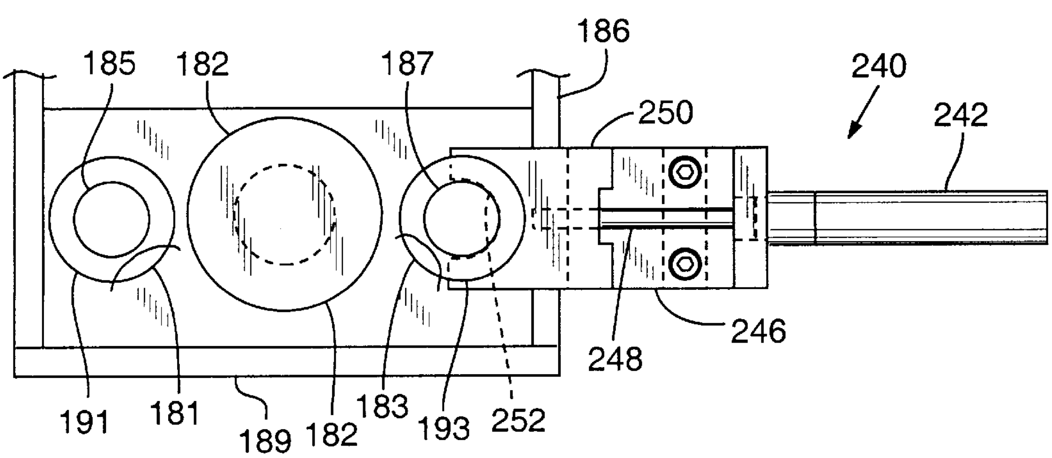

β
173
110
156
18
150
132
146
106
142
136
100
32

FIG. 11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182
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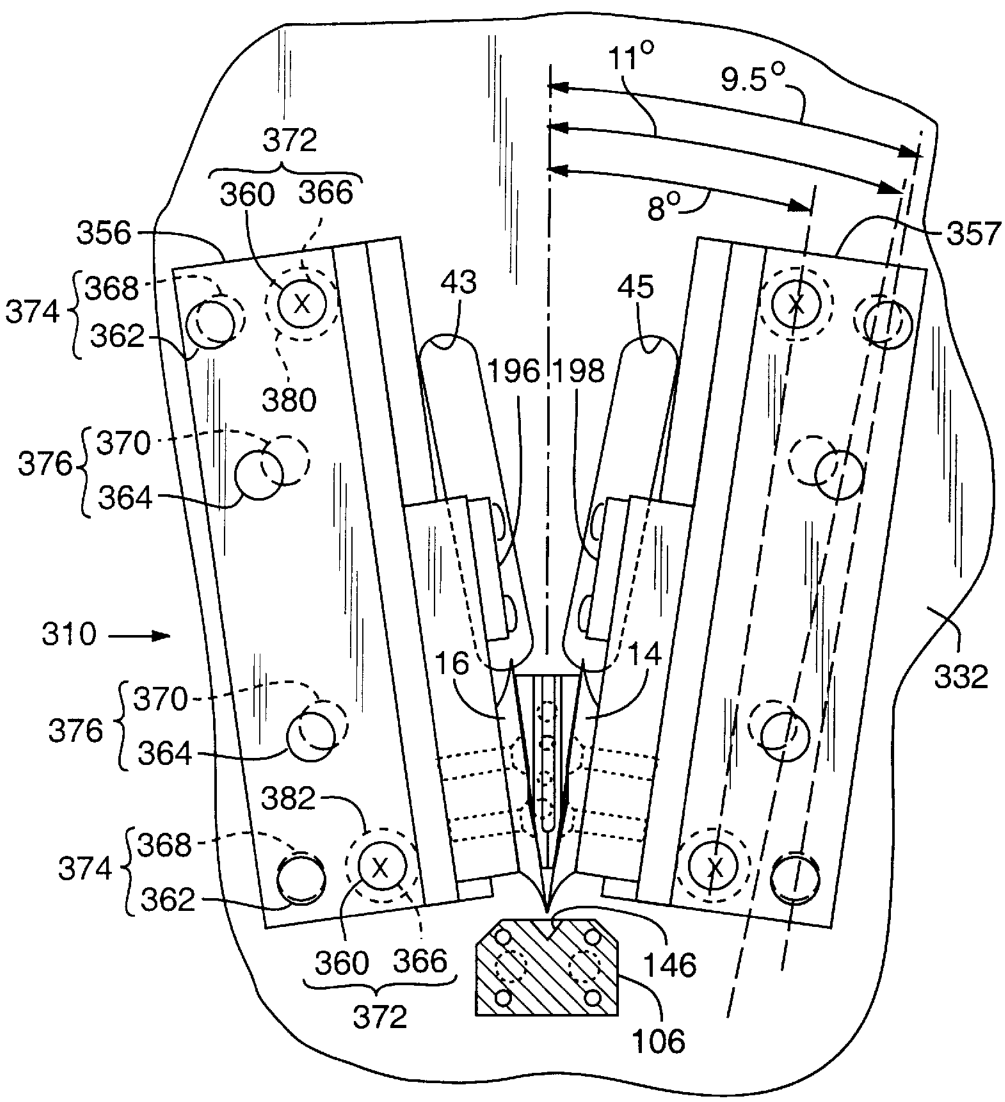
191
181
189
182
183
193
252

FIG. 12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8°
372
360
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362
380
43
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196
198
376
370
364
310
16
14
332
382
146
106

# GRAFTING MACHINE

## BACKGROUND OF THE INVENTION

The present invention relates to a system for preparing the mating ends of rootstock and scions for grafting and is particularly well suited for softwood grafting operations (sometimes referred to as "green grafting" or "herbaceous grafting").

Grafting typically involves the end-to-end connection of a scion to a rootstock of comparable diameter. Several types of graft unions are known, one of the most common being a tapered cut joint (or "cleft" graft) in which the scion end is trimmed to have a wedge or "V" shaped cross-section, and the stock end is slit longitudinally down its center to provide a mating slot to receive the trimmed scion end. Historically, the scion and stock ends were trimmed by hand, a relatively unsafe and inefficient procedure that produces grafts of inconsistent quality, dependent upon the skill of the manual laborer. In modern times, however, most stock ends are prepared using a mechanical cutter.

Green grafting involves the end-to-end connection of relatively immature, fragile scions to rootstock of comparable diameter. In this application, the step of trimming and joining the stock and scion ends is even more critical and requires greater precision than grafting procedures involving lignified plant material because less plant tissue is available to promote a successful graft. Green grafting typically involves scion and rootstock diameters between 2.5 and 10 mm, whereas dormant bench grafting typically involves diameters of 5 to 15 mm. Thus, there generally is less margin for error in cutting for green grafting. Also, the non-lignified soft plant tissue is more susceptible to drying out and more vulnerable to various diseases. As a result, efforts have been made to develop more effective ways of trimming scion and stock ends, especially those used in green grafting operations. Today, most bench grafts are done with machine cutters.

However, prior attempts to develop machines for trimming scion and stock ends have not been entirely satisfactory. See, for example, U.S. Pat. No. 3,680,255 to Grigorov, U.S. Pat. No. 3,969,843 to Whaler et al., and U.S. Pat. No. 4,769,944 to Fresne et al.

Many, if not all, of the prior machines trim the scion using blades that drop perpendicular to the longitudinal axis of the scion. Thus, the blades cut against the "grain" of the scion, which tends to smash the scion, tearing the tissue, rather than cleanly cutting through the scion. A less clean scion cut decreases the likelihood of a successful graft.

The scions cut by prior art machines are less likely to produce successful grafts than scions cut by hand. It is estimated that hand cutting produces about 15% more successful grafts than prior machines. Thus, to achieve the higher success rate, at least one company still continues to cut their scions for green grafting by hand.

Thus, there remains a need for an improved automatic grafting system which cuts the scion or stock more cleanly, completely, and precisely, without tearing the plant tissue, thereby producing a relatively high percentage of successful grafts. There also remains a need for a system that can be easily operated and maintained, and yet is safer for the operator.

## SUMMARY OF THE INVENTION

It is an object of this invention, therefore, to provide an improved semi-automatic grafting system that produces a clean cut, which will increase the percentage of successful grafts.



A further object of the invention to provide a system that minimizes the amount of torn or disrupted plant tissue from cutting.

More specifically, according to the present invention, a semi-automatic grafting system provides a frame for holding plant material, a blade assembly mounted to the frame and having a blade. The blade is movable at an angle oblique to the longitudinal axis of the plant material and into cutting engagement with the plant material. The invention also has an actuating system for moving the blade assembly into cutting engagement with the plant material.

As another aspect of the invention, the system has a second blade and two blade mounting members. Each of the blades is movably mounted to one of the blade mounting members, and the blades are movable along paths that are substantially symmetric to one another about the longitudinal axis of the plant material. The paths end adjacent one another so that each blade moves through the plant material, cutting it substantially into a "V" shape.

Other objects and advantages of the present invention will be apparent from the following description and the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a grafting system in accordance with the present invention.

FIG. **2** is a cross-sectional view of the grafting system of FIG. **1**.

FIG. **3** is a detail view of a blade and hold-down assembly of the grafting system of FIG. **1**.

FIG. **4** is a front view of the grafting system of FIG. **1**.

FIG. **5** is a detail view of the blades, scion stand, and cutting block of the grafting system of FIG. **1**.

FIG. **6** is a cross-sectional view of the grafting system, taken along lines **6**—**6** of FIG. **5**.

FIG. **7** is a side view of an end of a scion cut by the grafting system of FIG. **1**.

FIG. **8** is a perspective view of the end of the scion of FIG. **7**.

FIG. **9** is a detail, end view of the blade of the grafting system of FIG. **1**.

FIG. **10** is a block diagram of the pneumatic actuating system for the grafting system of FIG. **1**.

FIG. **11** is a cross-sectional view taken along lines **11**—**11** of FIG. **2**.

FIG. **12** is a front view of a second embodiment of a grafting system in accordance with the present invention.

## DETAILED DESCRIPTION OF THE INVENTION

The present invention is a grafting system for trimming or cutting the ends of scions or rootstock and is suited particularly for use as part of a green grafting operation. Nevertheless, the principles of the present invention are applicable to other operations. The present invention works well on both actively growing green and actively growing lignified material, but will also work on smaller dormant cuttings.

As shown in FIG. **1**, the illustrated embodiment of the present invention includes a frame **10**, a blade assembly **12** having a right blade **14** and a left blade **16**, and a scion support assembly **18** for holding a plant material, such as a scion **20**, in place. The blades **14**, **16** are slidable at an angle oblique to the longitudinal axis of the scion **20** to bevel an end of the scion, as will be described in greater detail below. The illustrated embodiment also includes an actuator assembly **22**, as shown in FIG. **2**, for actuating the blades **14, 16** to cut the scion **20**.

As shown in FIGS. **1** and **2**, the frame **10** includes a housing **30** having a slanted front face plate **32**, a removable back cover **34**, a bottom plate **36**, a right side plate (not shown), and a left side plate **38**, which are assembled together to form a box-like enclosure. The housing **30** also includes hollow box beams **40** and reinforcing plates **42, 44** to which the removable back cover **34** attaches. The illustrated housing **30** is made of stainless steel, although other materials having sufficient rigidity and corrosion-resistance also will work, and is fastened together by bolts or other fastening methods. The housing **30** provides a support for the blade assembly **12** and houses the actuator assembly **22** therein.

The front face plate **32** slopes upwardly at an angle of about 45 degrees from horizontal. A 45 degree angle has been found to be comfortable for the operators of the system, but any angle could be used. Two slots **43, 45** are cut out of the face plate **32**, as best seen in FIG. **4**, for allowing a connecting plate to extend therethrough for connecting the blade slide assembly **12** to the actuator assembly **22**, as will be described below.

The blade slide assembly **12** is mounted to the upper surface of the front face plate **32**. The scion support assembly **18** also is mounted to the upper surface, between and partially beneath the blades **14, 16** of the blade slide assembly **12**, to hold the scion **20** (FIG. **2**) in a location that is crossed by the path of the moving blades.

The blade slide assembly **12** allows each blade **14, 16** to slide along a path positioned at an angle oblique to the longitudinal axis of the scion **20** and that crosses obliquely through the end of the scion **20**. The paths are substantially symmetric to one another about the longitudinal axis of the scion **20** and end adjacent one another so that when the blades **14, 16** move through the scion **20**, they cut the end of the scion **20** substantially into a "v" shape, as shown in FIGS. **7** and **8**. Although in the described embodiment, the oblique cut is achieved with a slidable blade assembly, a pivotable assembly could be used instead.

Cutting the scion **20** at an angle oblique to its longitudinal axis provides a clean cut, which does not tear or smash the scion **20** significantly. Thus, a scion **20** cut with the grafting system of the present invention is more likely to result in a successful graft than one cut with a machine in which the blade **14, 16** cuts through a scion at an angle perpendicular to the longitudinal axis.

A scion cut by the grafting system of the present invention is just as likely to "take," in other words result in a successful graft, as a scion trimmed by hand, and is more likely to "take" than a scion cut by a prior art machine, in which the blade cuts through the scion at an angle perpendicular to the longitudinal axis of the scion. More specifically, about 70–90% of scions cut by the present invention "take". The same percentage of hand-cut scions "take"; whereas only about 55–75% of scions cut by the prior art machines "take".

The present grafting machine is advantageous over hand grafting because it produces more consistent graft cuts, and requires less employee training and less employee skill than hand grafting. Also, the present grafting machine is safer than hand grafting, which results in less employee injuries, and thus reduces the employer's workmen's compensation payouts and medical bills.



The blade slide assembly **12** includes right and left assemblies **46, 48**. For ease of description, only the right assembly **46** will be described here with the understanding that the left assembly **48** is a mirror image of the right assembly **46**.

As seen best in FIG. **3**, the right blade slide assembly **46** includes the right blade **14**, a blade mount **52**, a slide **54**, a slide mount **56**, and a connecting plate **58**. In the illustrated embodiment, the slide mount **56**, which is a rectangular block of aluminum, is fastened to the front face plate **32** by bolting, although other fastening means can be used. The slide mount is tilted relative to the vertical, longitudinal centerline of the front face plate, as will be described in greater detail later.

The slide **54** has a base **60** with a central, longitudinal runner **62** protruding upwardly therefrom. The top surface **64** of the runner **62** is parallel with the top surface **66** of the base **60** but the sides **68, 70** of the runner angle inwardly from the top surface **64** of the runner to the top surface **66** of the base. The slide **54** is fastened to the slide mount **56** and is made of steel, which is nickel-plated for corrosion resistance.

The blade mount **52** provides a base for the blade **14** and allows the blade **14** to slide on the slide **54**. The blade mount **52** is a rectangular block of nickel-plated steel, and has a dovetail groove **72** defined therein. The shape of the groove **72** complements the shape of the runner **62** so that the two pieces mate in slidable relationship to one another. Slides and blade mounts of other shapes could be used, and even other apparatuses could be used for allowing the blade to slide relative to the plant material.

In the illustrated embodiment, as seen best in FIGS. **3** and **9**, the blade **14** is made of ¼ inch thick corrosion-resistant stainless steel, such as the type used in cutlery, and is approximately 1.25 inches wide. This width is approximately twice as wide as necessary to cut through the plant material to help reduce stress on the blades when the blades come together after cutting through the plant material, as will be described in greater detail below. Other thicknesses and widths could be used.

The blade **14** has first and second cutting edges **80, 82** (FIG. **3**). The second cutting edge **82** is not necessary but allows the blade **14** to be reversed, thereby providing a useful life twice as long as a blade with a single cutting edge. Both the first and second cutting edges are cut from the back side **86** of the blade **14** and are formed by a hollow grind **87**, as illustrated best in FIG. **9**. The illustrated hollow grind extends about 0.5 inches inwardly from the edge of the blade and is formed using a round grinding wheel; however, other sizes of hollow grinds and other methods for achieving hollow grinds could be used. A hollow grind provides good cutting action and a cleaner cut than a beveled blade not having a hollow grind. Nevertheless, a beveled blade could be used.

After the hollow grind is formed, the tip **88** of the blade **14** is sharpened at approximately a 10–12 degree angle. However, the top surface **84** of the blade **14** is entirely flat; that is, the top surface is not sharpened at all.

The blade **14** is mounted to the lower end of the blade mount **52** so that the entire hollow grind **87** on the lower cutting edge, plus a small portion of the non-sharpened and non-ground portion of the blade **14**, protrudes past the bottom **89** of the blade mount **52**. The blade is fixed to the blade mount **52** by fasteners in locations symmetric about the transverse center line of the blade **14**, so that the blade can be removed and flipped once the exposed cutting edge **80** has worn down.

The blade **14** and blade mount **52** are slidable on the slide **54** from a retracted position, as shown in FIGS. **3–5**, into cutting engagement with the scion **20**, and into an engaged position, as indicated in dashed lines in FIGS. **4** and **5**. In the engaged position, the tips **88** of the left and right blades **16**, **14** contact each other, although this is not necessary.

Although in the illustrated embodiment the blades slide in a straight path between the retracted and engaged positions, the grafting system could be designed such that the blades travel in an arcuate path.

In the illustrated embodiment, the blade **14**, along with the blade mount **52**, slide **54**, and slide mount **56**, are positioned at an angle, α (FIG. **4**), which is about 9.5 degrees from the longitudinal, upright centerline of the front face plate **32**. Angles in the range between 7 and 11 degrees are preferable; although angles between 5 and 15 degrees will work well also. Even angles between 3 and 20 degrees could be used.

Also, the optimal angle for α is somewhat dependent on the diameter of the scion being cut. The smaller the diameter of the scion—the shallower (closer to the longitudinal axis) the angle should be.

The connecting plate **58** is mounted to the blade mount **52** above the blade, for instance by bolting. As shown in FIG. **3**, the connecting plate **58** is a rectangular block, that extends from the blade mount **52**, through the slot **45** in the front face plate **32**, and into the housing **30** to connect with the actuator assembly **22**, as will be described later. The illustrated connecting plate is made of nickel-plated steel with a wear-resistant coating, although other materials and coatings could be used.

As shown in FIGS. **4–6**, the scion support assembly **18** includes a scion support member **100** for helping to hold the scion **20** in place before, during, and after cutting. The scion support assembly **18** (FIG. **2**) also includes a stand member **106**, which serves to locate and support the bottom of the scion **20** before and during cutting, and to support a hold down clamp assembly **110**. The clamp assembly **110** is movable to clamp the scion **20** against the scion support member **100** before and during cutting and to release the scion when desired, for instance, after cutting.

The scion support member **100** is mounted to the front face plate **32** between the lower ends **112** (FIG. **4**) of the right and left assemblies **46**, **48**. As seen best in FIG. **5**, the top portion **114** of the support member **100** is wedge-shaped, with each of the upper sides **116**, **118** tapering downwardly and inwardly at a 9.5 degree angle to extend in parallel relationship to the respective paths of blades **14**, **16**. The scion support sides have respective middle side portions **120**, **122** that do not taper inwardly and hence are parallel to one another, and respective bottom side portions **124**, **126** that taper inwardly at a 9.5 degree angle from vertical (again in parallel relationship to the converging paths of blades **14**, **16**). The converging top surfaces of blades **14**, **16** extend in parallel contact with the respective bottom side portions **124**, **126** of the support member **100** but do not contact the upper side portions **116**, **118** or middle side portions **120**, **122**.

Referring to FIG. **5**, the top surface **130** of the support member **100** has a central, longitudinal, "v"-shaped channel **132** for supporting the scion **20**. The channel **132** extends the length of the support member **100** and is beveled at an angle, β (FIG. **6**), of about 82 degrees. A rectangular groove **136** is cut into the bottom of the "v"-shaped channel **132**. In the illustrated embodiment, the groove **136** is about 0.3 inches deep and terminates at a radiused end **138** short of the bottom **140** of the support member **100**. The illustrated support member **100** is made of Delrin™ of about 1.5 inch thickness, although other materials or thicknesses can be used.

A rectangular piece of resilient material **142** (FIG. **6**) is squeezed into the groove **136** in the scion support member **100** to give the scion **20** a cushioned surface on which to rest. In the illustrated embodiment, rubber is used as the resilient material, although other materials also will work.

The stand member **106** is mounted to the front face plate **32** beneath the left and right assemblies **46**, **48** and the scion support member **100**. The stand member **106** is made of aluminum of a thickness of about 1.875 inches, although other materials and thicknesses would work. The top surface of the stand member **106** has a recess **146**, ⅜ inch in diameter and countersunk into a "v" shape. The center of the recess **146** almost is aligned with the center of the channel **132** in the scion support member **100** so that when the scion **20** is placed in the channel **132** of the scion support member **100**, as shown in FIG. **2**, the bottom end **148** of the scion **20** rests in the recess. The alignment should be close enough to allow the scion **20** to rest in the support member **100** with the bottom end **148** resting in the recess **146** of the stand member **106**.

As shown in FIG. **3**, the scion hold down clamp assembly **110** is mounted to the front surface **150** of the stand member **106** and is movable for holding the scion **20** in the scion support member **100**. The clamp assembly **110** has a clamp base **152**, which is mounted to the stand member **106** and has a yoke **156**, and a clamp member **158**. However, other types of clamp assemblies could be used.

The clamp member **158** has an arm **160** pivotably held by the yoke **156** on the clamp member **158** and a sleeve **162** attached to the end of the arm, into which fits a cylindrical rod **166**. The rod **166** has a plunger **168** slidably mounted therein, and a spring **170** extends between the plunger **168** and the sleeve **162** to force the plunger outwardly but to allow the plunger to retreat when the plunger is pressed against the scion **20**, as indicated in FIG. **2**. The end of the plunger **168** has a plunger button **172**, which preferably is made of a material soft enough not to damage the scion **20** when it is pressed thereagainst.

A hold down actuator **174** is mounted to both the base **152** and the arm **160** to pivot the clamp member **158** through about 90 degrees between a rest position, as shown in FIG. **3**, and a hold down position, as shown in FIG. **2**, in which the button **172** is pressed against the scion **20** to hold the scion **20** in the scion support member **100**. In the illustrated embodiment, the hold down actuator **174** is an air cylinder.

The clamp assembly **110** also has a translucent, circular shield **173** mounted near the sleeve **162**. When the clamp member **158** is in the hold down position, the shield **173** covers the area of the scion support member **100** for helping prevent any plant material from flying away from the front face plate **32** and injuring an operator during the cutting process.

Other types of clamp assemblies could be used, or variations could be made to the illustrated clamp assembly. For instance, the arm **160** could be longer than that illustrated, and likewise the hold down actuator could have a longer stroke. In addition, the plunger button **172** could be triangular-shaped instead of round as it is illustrated. Such variations might lessen the chance that the scion would be bruised by the clamp assembly.

As shown in FIG. **2**, inside the housing **30** is the actuator assembly **22**, which includes a push slide assembly **180** for sliding the blades **14**, **16** between the retracted position and engaged position. The push slide assembly **180** includes a push slide air cylinder **182** fastened to the underside **184** of the front face plate **32** by a mounting bracket **186**. A rectangular push plate **188** is fixed to the lower end of the push slide cylinder **182**.

On each side of the push slide cylinder **182** is a guide pin **181, 183**, as shown in FIG. **11**. The guide pins **181, 183** are also connected to the push plate **188** and smoothly guide the push slide cylinder to stabilize the push slide assembly from twisting or binding. Each guide pin has a neck **185, 187** extending outwardly from a plate **189** through which the push slide cylinder **182** and guide pins slide. Near the outward end of each neck **185, 187** is a head **191, 193** of larger diameter than the neck. Such a system having a cylinder and guide pins is commonly available, for instance, from Bimba Manufacturing Company of Monee, Ill. (708-534-8544).

Left and right connecting bar linkages **190, 192** are attached by a single, push plate pivot pin **194** to the top of the push plate **188**, as shown in FIG. **2**, and in FIG. **4** in dashed lines. The top ends **196, 198** of each of the left and right connecting bar linkages **190, 192** are connected by a connecting plate pivot pins **200, 202** to extension plates **203** on the right and left connecting plates **58, 59**, respectively, which plates are fixed to the blade mounts **52**. Thus, the connecting bar linkages **190, 192** form a "V" shape.

The push slide cylinder **182** moves the push plate **188** between a retracted position, as shown in solid lines in FIG. **2**, and an extended position, as shown in dashed lines in FIG. **2**. As the push plate **188** moves between the retracted and extended positions, the connecting bar linkages **190, 192** pivot outwardly about the push plate pivot pin **194**, as the connecting plates **58, 59** are pulled downwardly along the slots **43, 45**. Because the connecting plates **58, 59** are mounted to the slide mounts **56**, which are mounted to the blades **14, 16**, this movement causes the blades to slide along the slide **54** from their retracted positions to their engaged positions.

Although in the illustrated embodiment the slides are pulled from their retracted to engaged positions, the slides could be pushed between these positions instead. Also, the slides could be operated independently and need not be linked together. However, pulling the linked blades is advantageous in achieving blades that strike the scion simultaneously, and thereby result in a better cut.

Also mounted to the underside **184** of the front face plate **32** is a shock absorber **220**. The illustrated shock absorber **220** is a hydraulic, preferably oil, cylinder with a retractable piston **222**, although other types of shock absorbers, such as air cylinders or soft foam, could be used. A shock absorber mounting bracket **224** holds the shock absorber **220** in a position so that the retractable piston **222** is spaced a few inches from the underside **226** of the push plate **188**. In the illustrated embodiment, the shock absorber **220** is positioned near the top of the push plate **188**, although being positioned anywhere along the push plate **188** would work. The piston **222** is spaced far enough from the push plate **188** so that the push plate strikes the piston **222** once the blades **14, 16** have cut almost entirely through the scion **20**.

When the push plate **188** hits the piston **222**, the piston retracts into the shock absorber **220**, as shown in dashed lines in FIG. **2**, slowing down the movement of the push plate **188**, along with all the components connected thereto, including the blades **14, 16**. Thus, the blade movements are slowed down to cushion the impact when the left and right blade tips **88** contact each other, thereby reducing the stress on the blades.

Once the push plate **188** reaches its extended position, the piston **230** (FIG. **2**) of the push slide cylinder **182** retracts to return the push plate **188** to the retracted position. Meanwhile, the shock absorber piston **222** moves to its extended position, as shown in solid lines in FIG. **2**, so that it is ready to cushion the next blade movement.

As shown in FIG. **11**, the push slide assembly **180** also includes a safety stop assembly **240** for ensuring that the blades **14, 16** do not move or slide unintentionally. The safety stop assembly **240** includes a spring extension air cylinder **242** mounted to the mounting bracket **186** for the push slide assembly **180** by a support bracket **246**. The spring-actuated retractable rod **248** of the spring extension air cylinder **242** has a stop block **250** mounted to its end. In the illustrated embodiment, the stop block **250** is rectangular with semi-circular groove **252** sized to complement the neck **187** of the guide pin **183**. The stop block **250** is also about the same height as the neck of the guide pin. Thus, when the stop block **250** is engaged with the neck **187**, and when the actuator assembly **22** is off, the head **193** of the guide pin **183** prevents the guide pin from moving out of its extended position. Because the guide pin **183** is interconnected with the push slide cylinder **182**, movement of the push slide cylinder **182** is prevented also.

FIG. **10** shows a schematic, pneumatic diagram for the actuator assembly **22**. Air enters a pressure regulator **260** through line **262** and then continues into a four-way valve **264**. From there, some air is directed through line **268** to a pressure gauge **270**, some through line **272** to the safety stop cylinder **242**, some through line **274** via solenoid valve **278** to the push slide cylinder **182**, and some via line **280** to solenoid valve **282** to the hold down actuator **174**.

To operate the grafting system, a user presses a foot pedal **286** (FIG. **1**), which actuates the hold down actuator **174** to pivot the clamp member **158** against a scion, which has been placed in the recess **146** of the stand member **106** and rests along the channel **132** in the scion support member **100**, as previously described. While the foot pedal is still pressed, the user then presses two buttons (not shown), one located on each side plate **38**, causing the air to travel through the actuator assembly **22**. Also, as air is delivered to the actuator assembly **22**, some of this air is channeled to the spring extension air cylinder **242** of the safety stop assembly **240**. When air reaches the spring extension air cylinder **242**, this causes the retractable rod **248** to retract, thereby moving the stop block **250** away from the guide pin. With the stop block retracted, the piston of the push slide cylinder **182** is actuated to move forward (to the left in FIG. 2). As the push slide actuator moves forward, and is guided along a straight path by the guide pins, the push plate **188** is moved forward also, toward its extended position. The movement of the push plate **188** pulls the connecting bar linkages **190, 192** forward, along with the connecting plates **58, 59** attached thereto. The pivot pins **200, 202** allow the upper ends of the connecting bar linkages **190, 192** to move outwardly.

As the connecting plates **58, 59** move forwardly, they pull the blade mounts **52** with them, which slides the blades **14, 16** from the retracted positions into the engaged positions. Specifically, the blade mounts **52** slide along the slides **54**, causing the blades **14, 16** to move from the retracted positions to the engaged positions. During the travel, the top surfaces **84** of the blades **14, 16** slide along the bottom side portions **124, 126** of the scion support member **100**. At some point along the bottom side portions **124, 126**, which point depends on the diameter of the scion, the blade tips **88** contact the scion **20** and begin to cut therethrough.

At about this point, the push plate **188** of the actuator assembly **22** hits the retractable piston **222** of the shock absorber **220**, which decreases the speed at which the blades **14**, **16** are traveling. The blades **14**, **16** continue to travel through the scion **20** to fully cut through the scion, each blade beveling a side of the end of the scion **20**, thereby trimming the end into a "v" shape, as shown in FIGS. **7** and **8**. Once the push plate **188** reaches its extended position, the piston **230** of the push slide cylinder **182** retracts, thereby reversing the process just described to return the blades **14**, **16** from the engaged positions to the retracted positions.

When the desired amount of cutting is complete, the air to the system in shut off. This causes the spring (not shown) in the spring extension air cylinder **242** of the stop block assembly **240** to move the stop block **250** against the guide pin to prevent the piston of the push slide cylinder **182**, and thus the blades, from accidentally moving forward. Alternatively, the stop block could be moved against the guide pin after the blade returns to its retracted position.

As shown in FIG. **12**, a second embodiment of the grafting system **300** has adjustable angles at which the blades travel and cut through the scion ("blade angles"). In this embodiment, the slide mounts **356** have an angle adjustment system **310**, which allows the slide mounts **356** to be mounted to the front face plate **332** at various predetermined angles. Because the location of the slide mounts **356** determines the locations of the components attached to the slide mounts (the slides **354**, the blade mounts **352**, the blades **314**, **316**, and the connecting plates **358**), mounting the slide mounts **356** at a different angle changes the angle of all the attached components, thus allowing adjustment of the blade angles.

The left and right slide mounts **356**, **357** of the second embodiment are symmetric about the longitudinal centerline of the front face plate **332**, and therefore only the left slide mount **356** and its associated elements are described.

The angle adjustment system **310** is achieved by providing each slide mount **356**, **357** with three sets of thru-holes **360**, **362**, **364** for mounting the slide mount to the front face plate **332**.

The front face plate **332** also has three sets of thru-holes **366**, **368**, **370**. Each set of face plate thru-holes **366**, **368**, **370** corresponds with one of the sets of thru-holes on the slide mount **360**, **362**, **364**. That is, each set of face plate thru-holes **366**, **368**, **370** can be aligned with one of the sets of slide mount thru-holes **360**, **362**, **364**, thereby forming sets of thru-hole pairs **372**, **374**, **376**.

Each set of thru-hole pairs **372**, **374**, **376** is associated with a different blade angle. For instance, in the illustrated embodiment, the first set of thru-hole pairs **372** is associated with an 8 degree blade angle; the second set of thru-hole pairs **374** is associated with a 9.5 degree blade angle; and the third set of thru-hole pairs **376** is associated with an 11 degree blade angle. These different blade angles are achieved by angling the first, second, and third sets of thru-holes on the slide mount **356** at 8, 9.5, and 11 degree angles, respectively, as shown in FIG. **12**, but angling all the sets of thru-holes on the face plate at an 8 degree angle. Alternatively, the thru-holes on the face plate **332** could be provided with different angles, and the thru-holes on the slide mount **356** could be provided with the same angle.

In the illustrated embodiment, the slide mount **356** is mounted in a first position by fastening the slide mount **356** to the front face plate **332** with two bolts **380**, **382**, each of which extend through one set of corresponding thru-holes in the first set of thru-hole pairs **372**. In the first position, the blade angle is 8 degrees. The blade angle can be adjusted by removing the bolts **380**, **382** and tilting the slide mount **356** into a second position (not shown), in which the second set of slide mount thru-holes **362** are aligned with the second set of face plate thru-holes **368**. In the second position, the blade angle is 9.5 degrees. Likewise, the blade angle can be adjusted into a third position (not shown), in which the third set of slide mount thru-holes **364** are aligned with the third set of face plate thru-holes **370**. In the third position, the blade angle is 11 degrees.

This description illustrates a few embodiments of the present invention and should not be construed to limit the scope of the invention in any way. Other modifications and variations could be made to the assembly described without departing from the invention as defined by the appended claims and their equivalents. For instance, other systems for adjusting the blade angles could be used.

What is claimed is:

**1**. A cutting assembly for cutting a plant material, the plant material having a longitudinal axis, the cutting assembly comprising:

a frame for holding the plant material;

a blade assembly mounted to the frame and having at least a first blade, the first blade being movable along an oblique path relative to the longitudinal axis of the plant material into cutting engagement with the plant material; and

an actuating system for moving the blade into cutting engagement with the plant material;

the blade assembly including a second blade and first and second blade mounting members, each of the first and second blades being movably mounted to one of the first and second blade mounting members, and wherein the blades are movable along paths that are substantially symmetric to one another about the longitudinal axis of the plant material and which paths end adjacent one another so that the plant material is cut into substantially a "V" shape.

**2**. A cutting assembly for cutting a plant material, the plant material having a longitudinal axis, the cutting assembly comprising:

a frame for holding the plant material;

a blade assembly mounted to the frame and having at least a first blade, the first blade being movable along an oblique path relative to the longitudinal axis of the plant material into cutting engagement with the plant material; and

an actuating system for moving the blade into cutting engagement with the plant material;

the blade assembly including a second blade, wherein the first blade is slidable along a first path and the second blade is slidable along a second path, the first and second paths substantially forming a "V" shape.

**3**. A cutting assembly for cutting a plant material, the plant material having a longitudinal axis, the cutting assembly comprising:

a frame for holding the plant material;

a blade assembly mounted to the frame and having at least a first blade, the first blade being movable along an oblique path relative to the longitudinal axis of the plant material into cutting engagement with the plant material;

an actuating system for moving the blade into cutting engagement with the plant material; and

an angle adjustment system operatively associated with the blade for permitting the angle at which the blade travels to be adjusted.

4. The assembly according to claim **3** in which the frame has at least first and second frame mounting holes and the blade assembly has at least first and second blade assembly mounting holes, the first frame mounting hole and the first blade assembly mounting hole alignable into a first position, in which the blade is movable at a first oblique angle, and the second frame mounting hole and the second blade assembly mounting hole alignable into a second position, in which the blade is movable at a second oblique angle, the first and second frame mounting holes and the first and second blade assembly mounting holes forming the angle adjustment system.

5. A machine for cutting an end of a scion, the machine comprising:

a frame having a surface for supporting the scion as the scion lays across the surface;

at least one blade movably mounted to the frame to move across the surface into cutting engagement with the scion to bevel the end of the scion; and

an actuating device to move the blade along an oblique path relative to a longitudinal axis of the scion and into cutting engagement with the scion; and

a second blade movable across the surface into cutting engagement with the scion to bevel the end of the scion.

6. The machine according to claim **5** further comprising at least one activation member operatively coupled with the blades for activating the blades to move in unison.

7. The machine according to claim **5** in which the blades are movable in paths symmetric about the longitudinal axis of the scion.

8. A machine for cutting a scion, the scion having a longitudinal axis, the machine comprising:

a frame;

a scion support member mounted to the frame for supporting the scion;

a hold down member adjacent the scion support member for holding the scion in the scion support member;

a blade slide assembly mounted to the frame, the blade slide assembly including:

first and second slide mounts;

first and second slides operatively arranged to be slidable relative to the first and second slide mounts; and

first and second blades, each of the first and second blades having a tapered cutting edge, the first and second blades being mounted to the first and second slides, respectively; the first slide and the first blade being slidable along an oblique path relative to the longitudinal axis of the scion so that the cutting edges of the blades cut through the scion in the oblique direction; the second slide and the second blade being slidable in a direction substantially symmetric about the longitudinal axis to the oblique direction of the first slide and the first blade, so that sliding the first and second blades through the scion cuts an end of the scion into a "V" shape; and

an actuating system for activating the slides and blades to cut the plant material.

9. The machine according to claim **8** in which the scion support member has an end beveled on one side in the oblique direction in which the first blade slides and on the other side in the oblique direction in which the second blade slides, and in which the first and second blades slide against the beveled sides.

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