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(54) BELT TENSIONING APPARATUS

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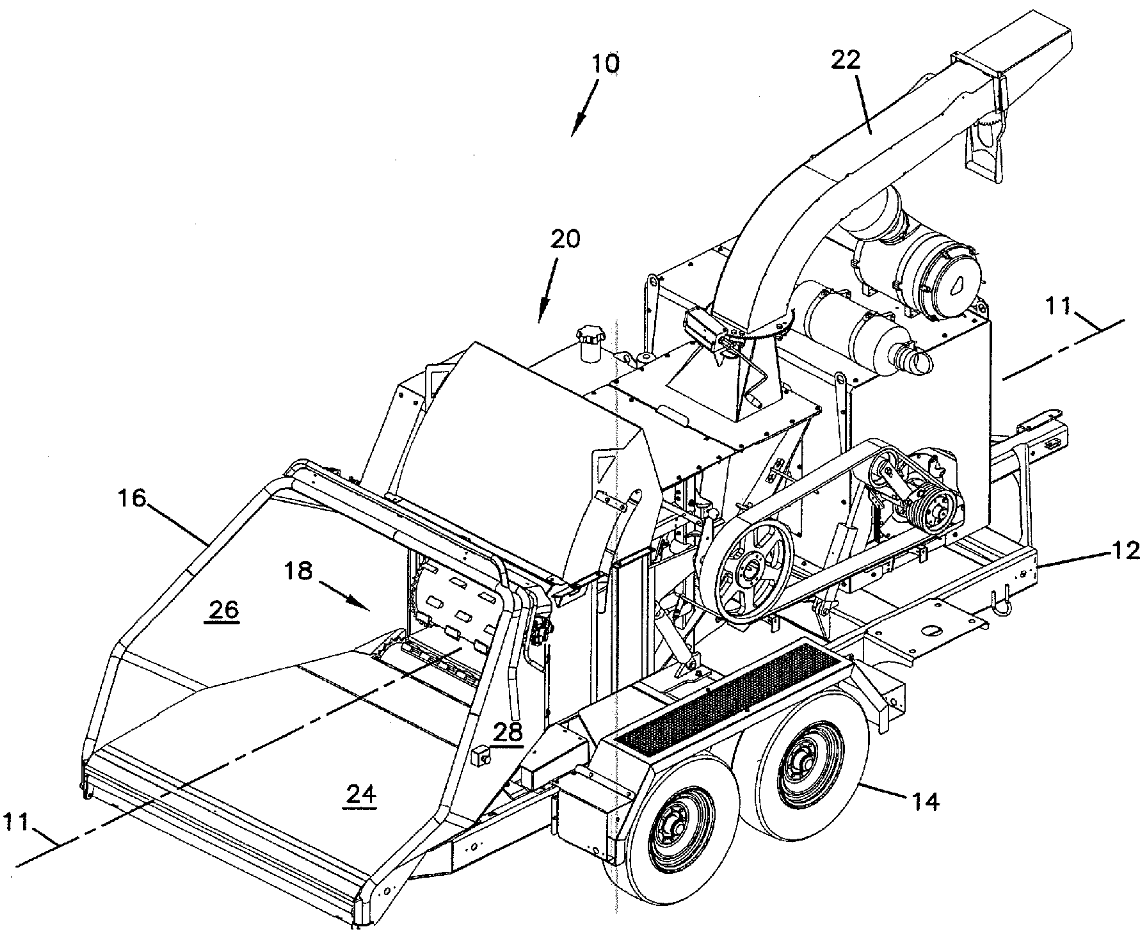
(57) **ABSTRACT**

A belt tensioning system configured to more effectively maintain the proper tension in a belt that can be engaged and disengaged. Proper tension in the belt is maintained even if the belt stretches or contracts by including a spring biased member between a tension wheel and a pivot frame. The spring member is preloaded such that when the belt stretches the tension wheel is biased against the belt by the force of the spring. Also, by selectively engaging the tension system one can avoid overloading the engine without the need to incorporate a clutch.



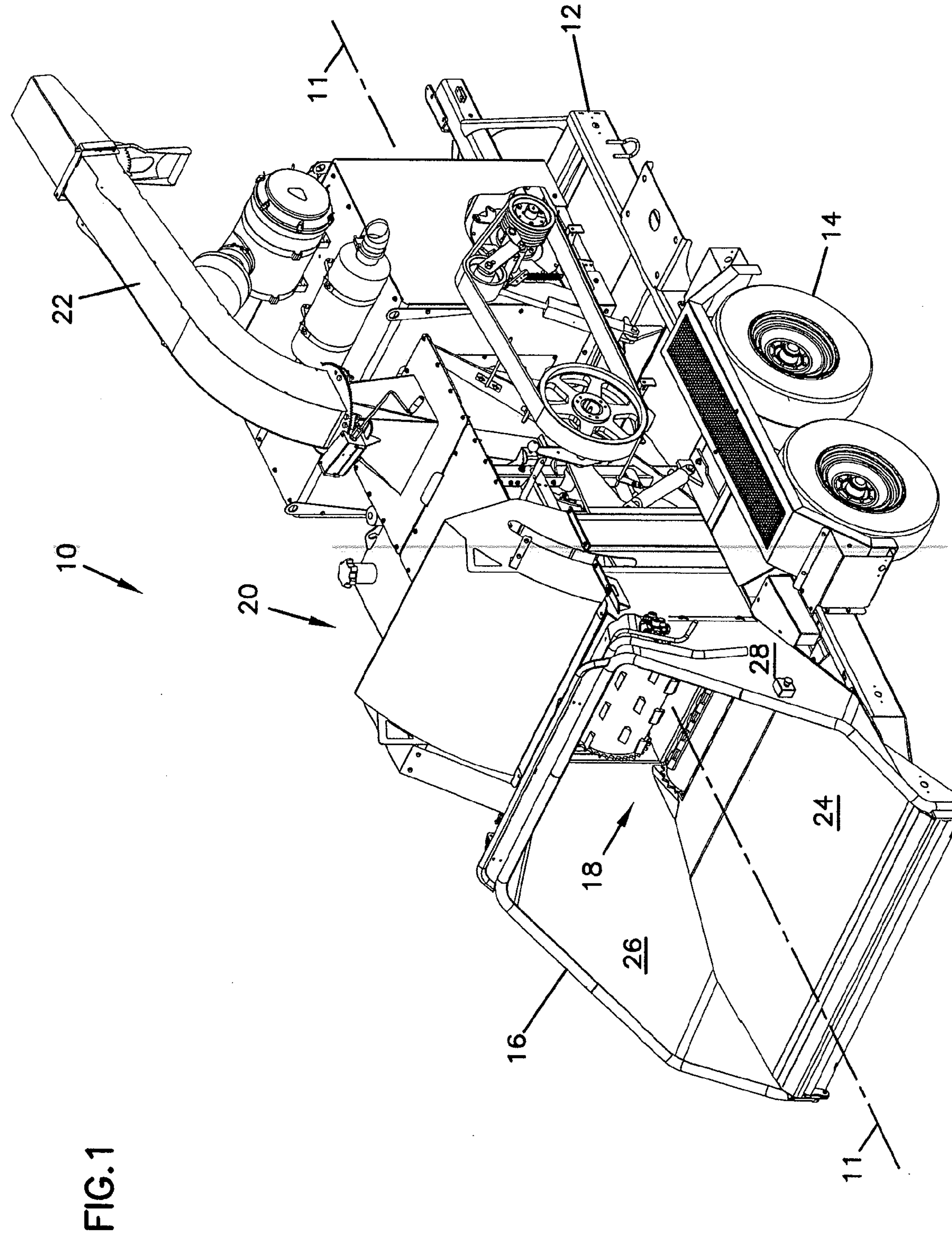


FIG.1

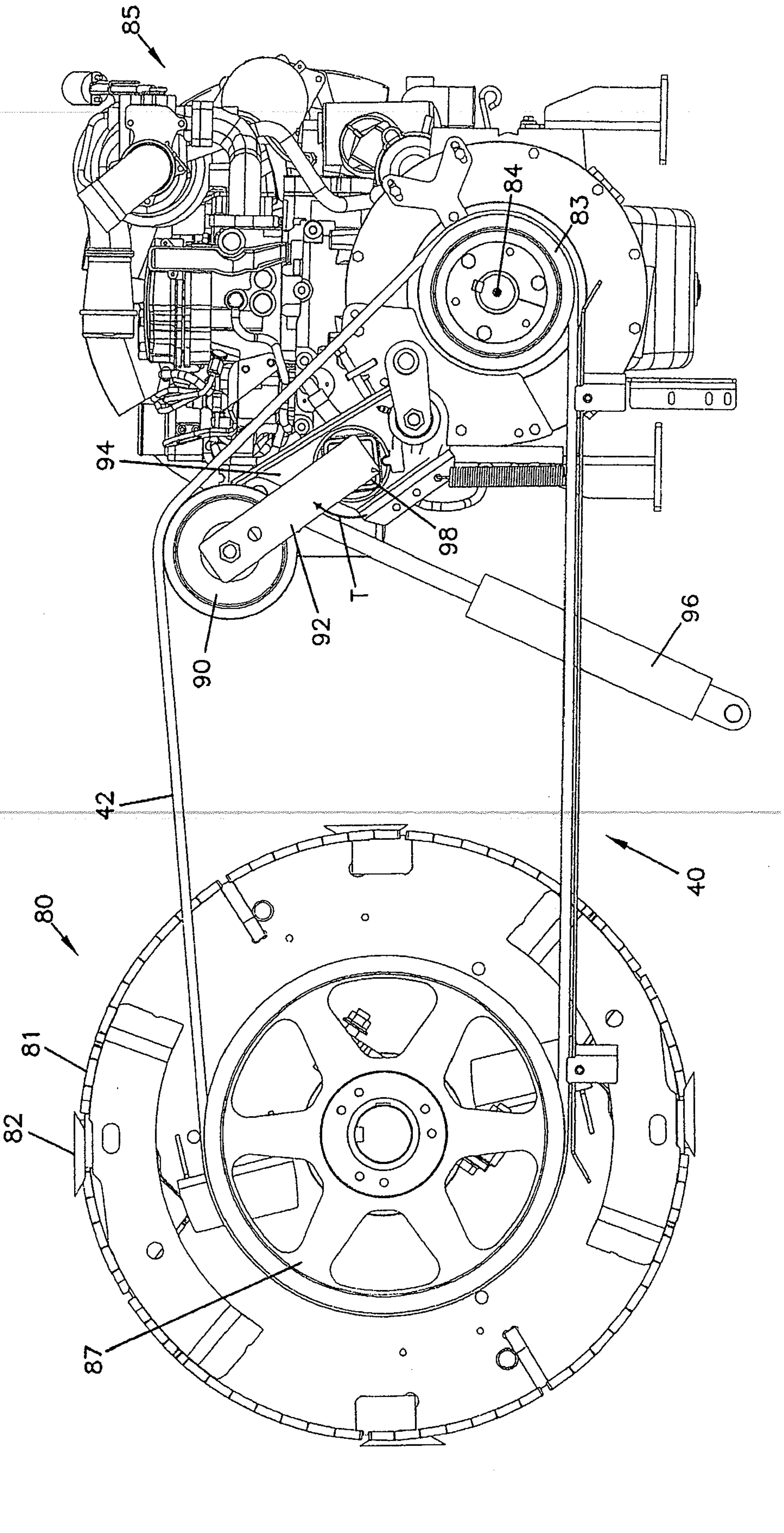


FIG.2

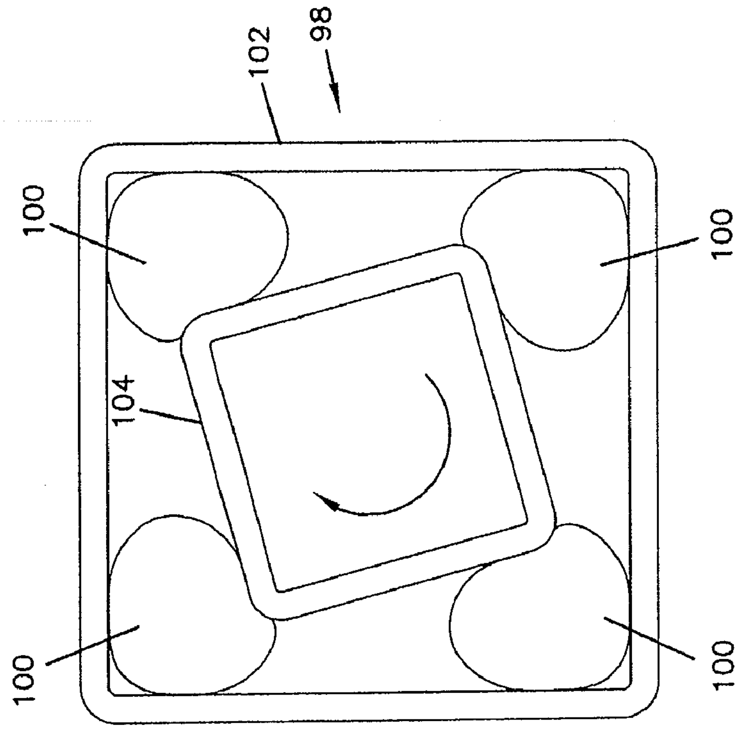


FIG.3B

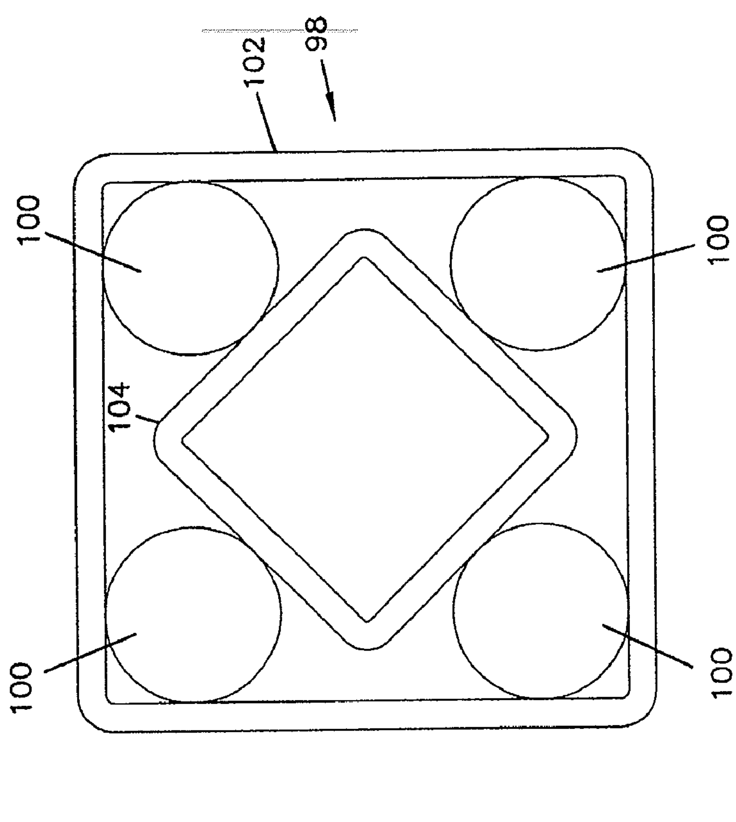


FIG.3A

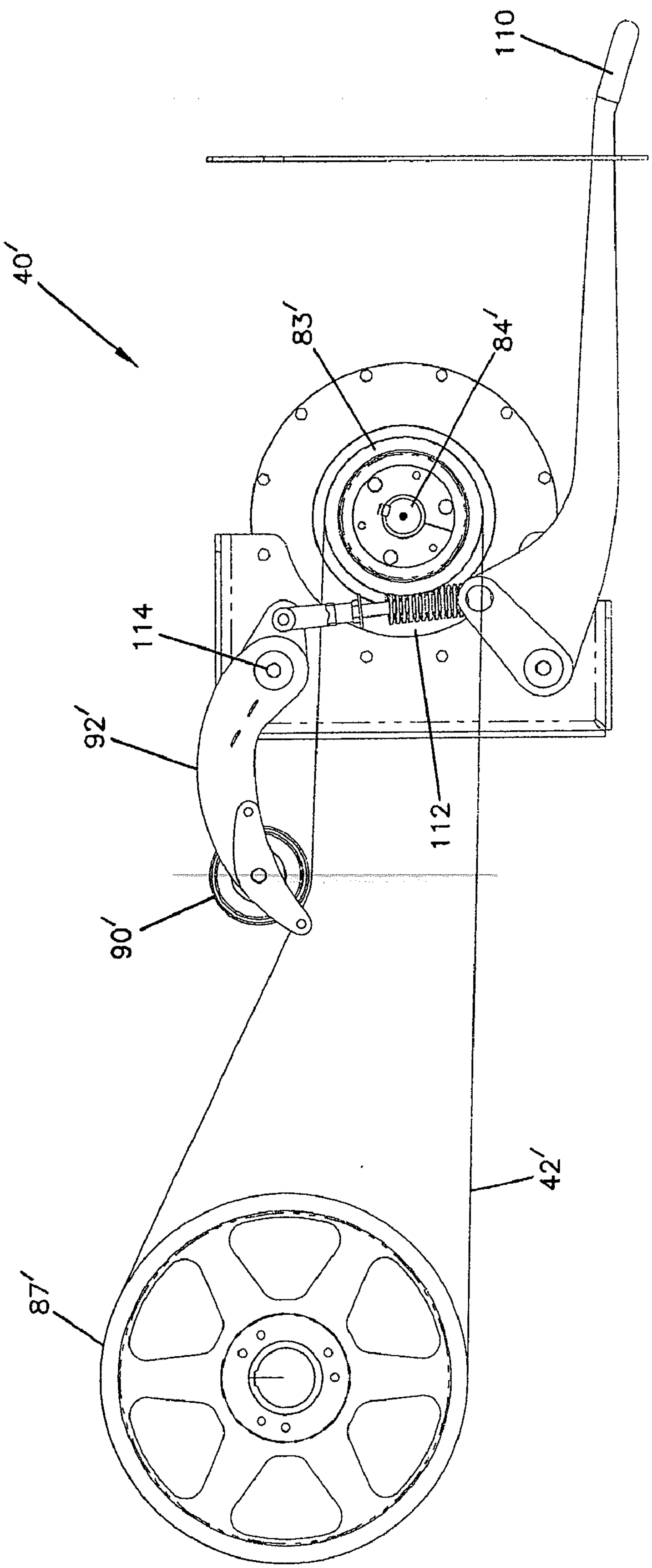


FIG. 4

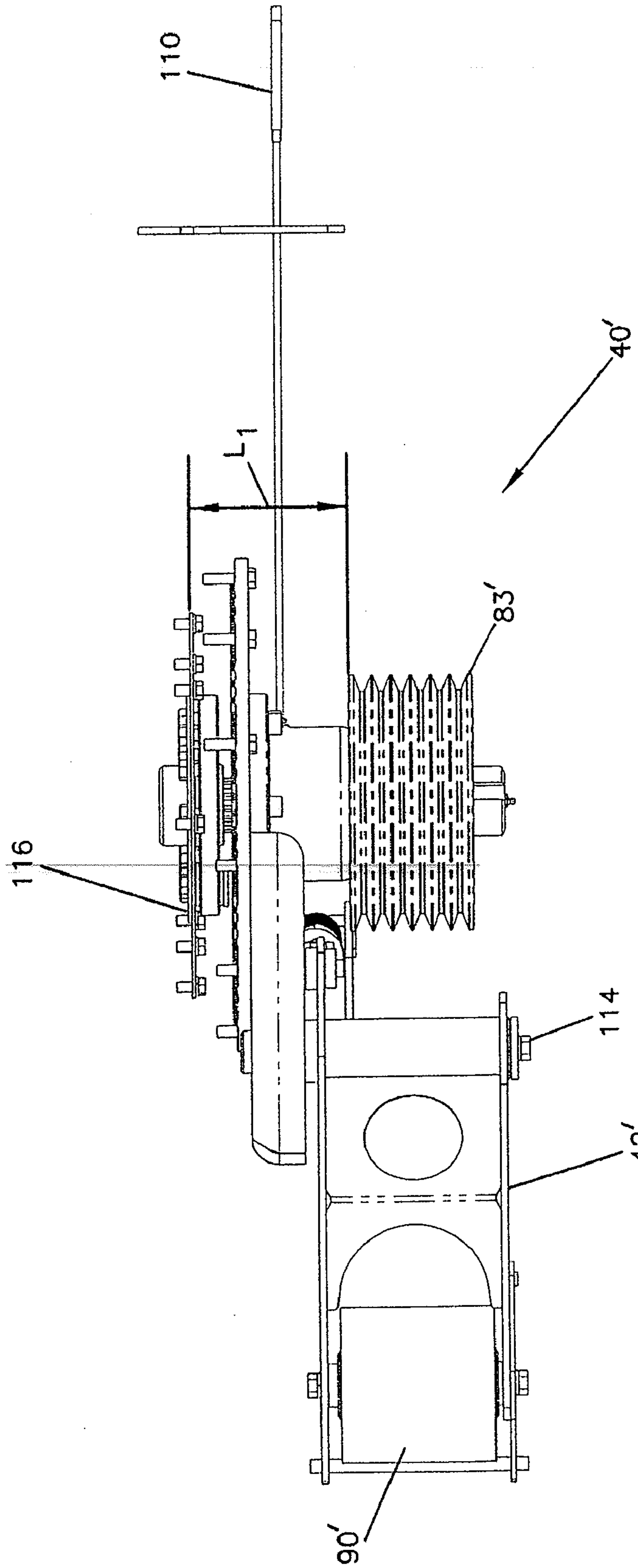


FIG. 5

BELT TENSIONING APPARATUS

[0001] This application is being filed on 1 May 2008, as a PCT International patent application in the name of Vermeer Manufacturing Company, a U.S. national corporation, applicant for the designation of all countries except the US, and John T. Bouwers and Justin J. Humpal, citizens of the U.S., applicants for the designation of the US only, and claims priority to U.S. Provisional Patent Application Ser. No. 60/928,861, filed May 10, 2007, which is herein incorporated by reference in its entirety.

FIELD OF THE INVENTION

[0002] The present invention relates generally to a belt tensioning apparatus.

BACKGROUND OF THE INVENTION

[0003] Belt tension systems are found in many different types of machinery including, for example, chippers and grinders. Chippers are used to reduce branches, trees, brush, and other bulk wood products into small chips. A chipper typically includes a feed system for controlling the feed rate of wood products into the chipper, a chipping mechanism, a drive system for powering the feed system and the chipping mechanism, and a discharge chute.

[0004] The chipping mechanism is commonly a large drum that includes blades thereon which is driven by a belt. The belt rotates the drum, enabling the drum to grind, flail, cut, or otherwise reduce the material fed into the chipper into small chips. The proper tension in the belt between the motor and the drum can be difficult to maintain as the belts tend to stretch and contract over time or even during use. Accordingly, there is a need in the art for an improved belt tension system.

[0005] Accelerating chipper drums and other cutting tools from a stopped position to maximum speed can be a challenge because the drums and other cutting/grinding tools are relatively large and heavy. If the belt is fully engaged between the output shaft and the drum during start up, the engine can be overloaded. To avoid overloading the engine in the start up process, typically a clutch is used to interface between the engine and the wheel that drives the belt. The clutch typically mounts adjacent the output shaft of the engine which is typically perpendicular to the length of the chipper or grinder frame. Accordingly, the inclusion of the clutch constrains how narrow the machine can be constructed. Also, since the clutch mechanism is lighter than the engine, the inclusion of the clutch typically undesirably shifts the center of gravity of the machine off to one side of the frame. A belt tension arrangement that could eliminate the need for a clutch is desirable.

SUMMARY OF THE INVENTION

[0006] The present disclosure relates to a belt tensioning system that is configured to more effectively maintain the proper tension in the belt that is driven by the motor to drive a cutting/grinding tool. The system of the present disclosure is configured so that the tension in the belt can be maintained even if the belt stretches or contracts. The present disclosure also relates to a belt tension system and method of starting the drum rotating that eliminates the need for a clutch.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1** is a perspective view of a chipper according to the principles of the present invention with portions of the engine and drum housing removed;

[0008] FIG. **2** is a side view of the drum, engine, and belt tension system of FIG. **1**.

[0009] FIG. **3***a* is a cross-sectional view of a portion of torsion bar in an unloaded position;

[0010] FIG. **3***b* is a cross-sectional view of a portion of torsion bar in a loaded position;

[0011] FIG. **4** is a side view of an alternative embodiment of the belt tension system of FIG. **1**; and

[0012] FIG. **5** is a top view of the embodiment of the belt tension system of FIG. **4**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0013] Referring to FIG. **1** the tensioning assembly **40** is shown on a chipper. In the depicted embodiment the chipper **10** is mounted to a frame **12** (chassis) that rests on wheels **14**, which enable the chipper **10** to be conveniently moved. The depicted chipper **10** includes a feed chute **16**, which is also commonly referred to as a feed table. The feed chute **16** can be any structure located at the rear of the chipper **10** that facilitates the loading of materials to be chipped into the chipper **10**. (The material to be chipped can be any material that the user desires to reduce to chips. The material is most commonly brush and tree parts, therefore, for convenience the material to be chipped will be referred to herein interchangeably as wood, trees, or brush.) In the depicted embodiment the feed chute includes a flat table portion **24** and two side walls **26**, **28**. It should be appreciated that many other configurations of the feed chute **16** are possible. Feed chutes are described in greater detail in a related application filed on May 10, 2007 titled WOOD CHIPPER INFEED CHUTE, which is incorporated herein by reference (No. 60/928,937).

[0014] The chipper **10** in the depicted embodiment includes an feed system **18** that grabs and pulls brush from the feed chute **16** into the body portion **20** of the chipper **10** which houses cutters **80** (see FIG. **2**) that cut the brush into small chips. The cutter **80** shown has blades **82** mounted on a drum **81**. However, it should be appreciated that the cutter can be any structure that is capable of breaking the material to be chipped into chips. Once the material is broken into small chips, the chips are then projected out of the chipper **10** through a discharge chute **22**. Feed rollers are described in greater detail in a related application filed on May 10, 2007 titled SYSTEM FOR CONTROLLING THE POSITION OF A FEED ROLLER, which is incorporated herein by reference (No. 60/928,926). The cutter drums are described in greater detail in a related application filed on May 10, 2007 titled CHIPPER DRUM WITH INTEGRAL BLOWER which is incorporated herein by reference (No. 60/928,928). In the depicted embodiment the longitudinal axis **11** of the chipper **10** is parallel to the general direction that material to be chipped flows through the chipper **10**.

[0015] Referring to FIG. **2**, a belt tension assembly **40** is shown. In the depicted embodiment the belt tension assembly **40** includes a belt **42** that extends around a first wheel **87** that is fixed to an end of the drum **81** such that by rotating the wheel **87** the drum **81** rotates. The belt **42** also extends around second wheel **83** attached to the output shaft **84** of the engine **85**. A tensioning wheel **90** presses against the inside of the belt to apply tension to the belt **42** to enable it to frictionally engage the first wheel **87** and the second wheel **83**.

[0016] The tension wheel **90** is mounted to an arm **92**. The arm **92** is connected to a frame **94** that pivots relative to engine **85**. The frame **94** pivots when the cylinder **96** is extended and retracted. To apply tension to the belt **42** the cylinder **96** is extended. To release the tension in the belt **42**, the cylinder **96** is retracted. In the depicted embodiment, the arm **92** is connected to the frame by a torsion spring member **98**. The torsion spring member **98** biases the tension wheel **90** outwardly (upwardly towards the belt) which applies tension to the belt **42**. In use the cylinder **96** is extended to engage the belt **42** and preload the torsion spring member **98**. In the depicted embodiment, the preloading occurs when the frame **94** is pivoted clockwise and the arm **92** is pivoted counterclockwise as a result of the extension of the cylinder **96**. If the belt **42** stretches during operation, the cylinder **96** need not be extended further to compensate because the torsion spring member **98** will bias the tension wheel **90** against the belt **42**. The torsion spring member **98** keeps a relatively constant tension force on the belt **42** to dampen the motion of the belt **42**.

[0017] Referring to FIGS. **3***a* and **3***b*, the torsion spring member (torsion bar) **98** in the depicted embodiment operates according to the rubber torsion spring principle. Four rubber inserts **100** are located in the corners of a square tube **102** and a smaller square tube **104** is located therein. From the neutral position shown in FIG. **3***a* the square tube **104** is designed to rotate in either the clockwise or counterclockwise direction as shown in FIG. **3***b*. When the square tube **104** rotates, the rubber inserts **100** deform. In the depicted embodiment the larger square tube **102** is mounted to the frame **94** which pivots, and the smaller square tube is mounted to the arm **92**.

[0018] The above arrangement provides a way for applying tension to a belt **42** while the belt **42** stretches or contracts, without having to adjust the extension of the cylinder **96**. The belt tension system **40** above also enables the belt **42** to be smoothly and continuously engaged and disengaged. In the depicted embodiment, there is no clutch positioned between the output shaft **84** and the wheel **83** that drives the belt **42**. To bring the drum **81** up to operating speed from a stopped position, the cylinder **90** can be selectively extended and retracted to cause the belt **42** to grab and release for short periods of time. This pulsing engagement of the belt **42** can be use to gradually increase the rotational speed of the cutter **80** to avoid overloading the engine **85**.

[0019] Referring to FIGS. **4** and **5** an alternative embodiment of the belt tension system is shown. Similar to the first embodiment, the belt tension assembly **40'** of the second embodiment includes a belt **42'** that extends around a first wheel **87'** that is fixed to an end of the drum (e.g., the drum **81** of the first embodiment) such that by rotating the wheel **87'** the drum rotates. The belt **42'** also extends around second wheel **83'** attached to the output shaft **84'** of the engine **85**. In the second embodiment the tensioning wheel **90'** presses against the outside rather than the inside of the belt **42'** to apply tension to the belt **42'**. Also, instead of using a cylinder **96** to apply the pressure a lever **110** is used to manually apply the tension to the belt **42'**.

[0020] In the depicted embodiment, the tension wheel **90'** is mounted to an arm **92'**. The arm **92'** is pivotally connected to a frame **94'** at pivot **114**. To apply tension to the belt **42'** the lever **110** is raised. To release the tension in the belt **42'**, the lever **110** is lowered. A coil spring **112** is used instead of the torsion spring member **98** of the first embodiment to maintain tension in the belt **42'** as the belt stretches. Though in the depicted embodiment the lever **110** is generally straight and arranged horizontally, it should be appreciated that it can be arranged in other orientations as well and can be of other geometric configurations. For example, the lever **110** could be L-shaped and/or arranged vertically. In the depicted embodiment the lever **110** is generally parallel the side of the frame **94'** and perpendicular to the output shaft **84'**. In some embodiment the lever **110** is positioned at an angle relative to the side of the frame **94'**. The lever **110** could be, for example, within +/−30 degrees from being parallel to the frame **94'** (i.e., 30 degrees from being perpendicular to the output shaft **84'**). It should be appreciated that features from the first embodiment can be combined with features from the second embodiment. For example, the spring **112** could be used with the cylinder **96** instead of with the lever **110**.

[0021] Referring to FIG. **5**, the distance L**1** from the inside edge of the second wheel **83** to the flywheel mounting plate **116** is relatively small. For example, the distance L**1** on a prior art type machine that includes a clutch and an engine horsepower of 185 is typically about 16 inches. Utilizing the principles described above, the distance L**1** for a chipper with an engine horsepower rating anywhere between 185 HP and 330 HP can be decreased to eight inches or less. In the depicted embodiment, the chipper includes a 215 HP engine and the distance L**1** is only about six inches. Both embodiments depicted show a bearing supported stub shaft as the drive coupler to the engine, however, it should be appreciated that many other configurations are also possible. For example, an engine drive direct coupled shaft that has both an inboard and an outboard bearing could also be used.

[0022] The above arrangement provides a way for applying tension to a belt **42'** while the belt **42'** stretches or contracts without having to readjust the position of the lever **110**. The belt tension system **40'** above also enables the belt **42'** to be smoothly and continuously engaged and disengaged. In the depicted embodiment, there is no clutch positioned between the output shaft **84'** and the wheel **83'** that drives the belt **42'**. To bring the drum up to operating speed from a stopped position, the lever **110** can be selectively raised and lowered to cause the belt **42'** to grab and release for short periods of time. This pulsing engagement of the belt **42'** can be use to gradually increase the rotational speed of the cutter to avoid overloading the engine. Alternatively, the lever **110** can be gradually raised causing the belt **42'** to transition from slipping to gripping over a longer period of time to allow the drum to gradually increase its speed.

[0023] In both depicted embodiments the engine can be mounted along the longitudinal axis of the chipper **10** so that the weight on the wheels of the chipper on the left and right sides is balanced. In the depicted embodiments the weight on the wheels on either side is within (70-30) percent and more preferably within (60-40) percent. The absence of a clutch, which is typically mounted near the output shaft of the engine, enables the weight of the engine to be distributed closer to the center of the chipper.

[0024] It should be appreciated that the belt tension systems of the invention can be used in other types of machinery as well. The use of the belt tension system in a chipper is only one potential environment for the system. The above specification, examples and data provide a complete description of the manufacture and use of the composition of the invention. Since many embodiments of the invention can be made without departing from the spirit and scope of the invention, the invention resides in the claims hereinafter appended.

We claim:

1. A direct drive chipper comprising:

a chassis, the chassis including a longitudinal axis;

a chipper drum mounted to the chassis, the drum including a belt drive, wherein the drum drive includes an axis of rotation that is perpendicular to the longitudinal axis of the chassis;

an engine mounted to the chassis, the engine including an output shaft connected to a drive wheel, wherein the drive wheel includes a rotational axis that is perpendicular to the longitudinal axis of the chassis;

a tensioning assembly including:

an arm that pivots relative to the engine;

a tension wheel mounted to the arm, wherein the tension wheel includes a rotational axis that is perpendicular to the longitudinal axis of the chassis;

an actuator configured for biasing the tension wheel;

a resilient member connected to the arm to enable the rotational axis of the tension wheel to move without moving the actuator.

2. The chipper of claim **1**, wherein the chipper drum is cylindrical in shape and includes a plurality of cutting blades thereon, wherein the axis of the chipper drum is perpendicular to the longitudinal axis of the chassis.

3. The chipper of claim **2**, wherein the output shaft is perpendicular to the longitudinal axis of the chassis.

4. The chipper of claim **1**, wherein the drum drive, drive wheel, and tension wheel are aligned such that they engage a single belt.

5. The chipper of claim **4**, wherein the drum drive and drive wheel rotate from a stationary position relative to the chassis, and the tension wheel rotates from a movable position relative to the chassis.

6. The chipper of claim **1**, wherein the arm is mounted to a pivot frame via the resilient member and the actuator is connected between the pivot frame and the chassis.

7. The chipper of claim **6**, wherein the actuator is a hydraulic cylinder.

8. The chipper of claim **6**, wherein the resilient member is a torsion bar.

9. The chipper of claim **1**, wherein the arm is mounted to the chassis via a pivot and is connected to a lever arm via a resilient member such that moving the lever pivots the arm.

10. The chipper of claim **6**, wherein the resilient member is a coil spring.

11. The chipper of claim **1**, further comprising wheels positioned on the left and right sides of the chassis, wherein the weight of the chipper that is distributed on the wheels on the left side of the chassis and the wheels on the right side of the chassis is within 10 percent.

12. The chipper of claim **1**, further comprising a flywheel mounting plate, wherein the distance between the flywheel mounting plate and the drive wheel is less than eight inches and the engine has a horse power rating that is greater than or equal to 185 HP.

13. The chipper of claim **1**, wherein the actuator is positioned at a +/−30° angle relative to the chassis.

14. The chipper of claim **13**, wherein the actuator is positioned parallel to the chassis.

15. A belt tension system for a belt that is driven by an engine, the system comprising:

a frame member configured to pivot relative to an engine;

an arm including a tensioning wheel;

a torsion member connecting the arm to the frame; and

an actuator for moving the frame member, wherein the frame member and arm member are configured such that moving the frame member biases the tension wheel against the belt and loads the torsion member.

16. The system of claim **15**, wherein the actuator is a cylinder that extends and contracts.

17. The system of claim **15**, wherein the torsion member includes a square tube with a smaller square tube therein.

18. The system of claim **15**, wherein the tensioning wheel engages the inside surface of the belt.

19. A method of increasing the rotational speed of a chipper drum, the method comprising the step of:

pulsating the tension in a belt that connects an engine and a chipper drum.

20. The method of claim **19**, wherein the step of pulsating the tension in the belt includes the step of extending and retracting a cylinder that biases a tensioning wheel.

21. The method of claim **20**, wherein the step of extending the cylinder biases the tension wheel against the inside of the belt and loads a torsion bar located between the tension wheel and the hydraulic cylinder.

22. The method of claim **19**, wherein the step of pulsating the tension in the belt includes the step of manually moving a lever that biases a tensioning wheel.

23. The method of claim **20**, wherein the step of manually moving a lever biases the tension wheel against the outside of the belt and loads a coil spring located between the tension wheel and the lever.

* * * * *