United States Patent

Newman

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[54] TENSIONER FOR SAW CHAIN

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[51] **Int. Cl.** **B27b 17/14**

[58] **Field of Search** ..... 143/32 J, 32; 144/72, 73; 74/242.11, 242.8, 242.16

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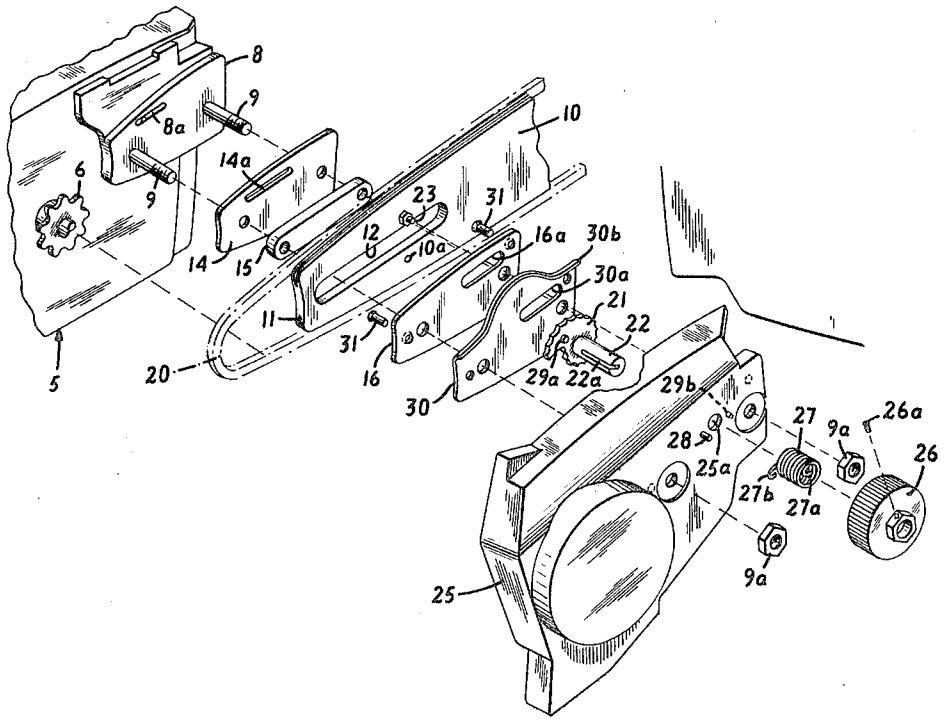
[57] **ABSTRACT**

A chain saw is provided with means for tensioning the cutting chain to compensate for wear and thermal expansion during operation. The chain guide bar is slidably mounted on the chain saw frame so as to be movable longitudinally toward and away from the chain-driving sprocket. A spring-operated cam rotatably mounted on the frame engages a pin on the guide bar to move it in a direction away from the driving sprocket and thereby tighten the chain. The cam has a generally spiral cam contour with equally spaced cusps and intervening concavities.

16 Claims, 4 Drawing Figures



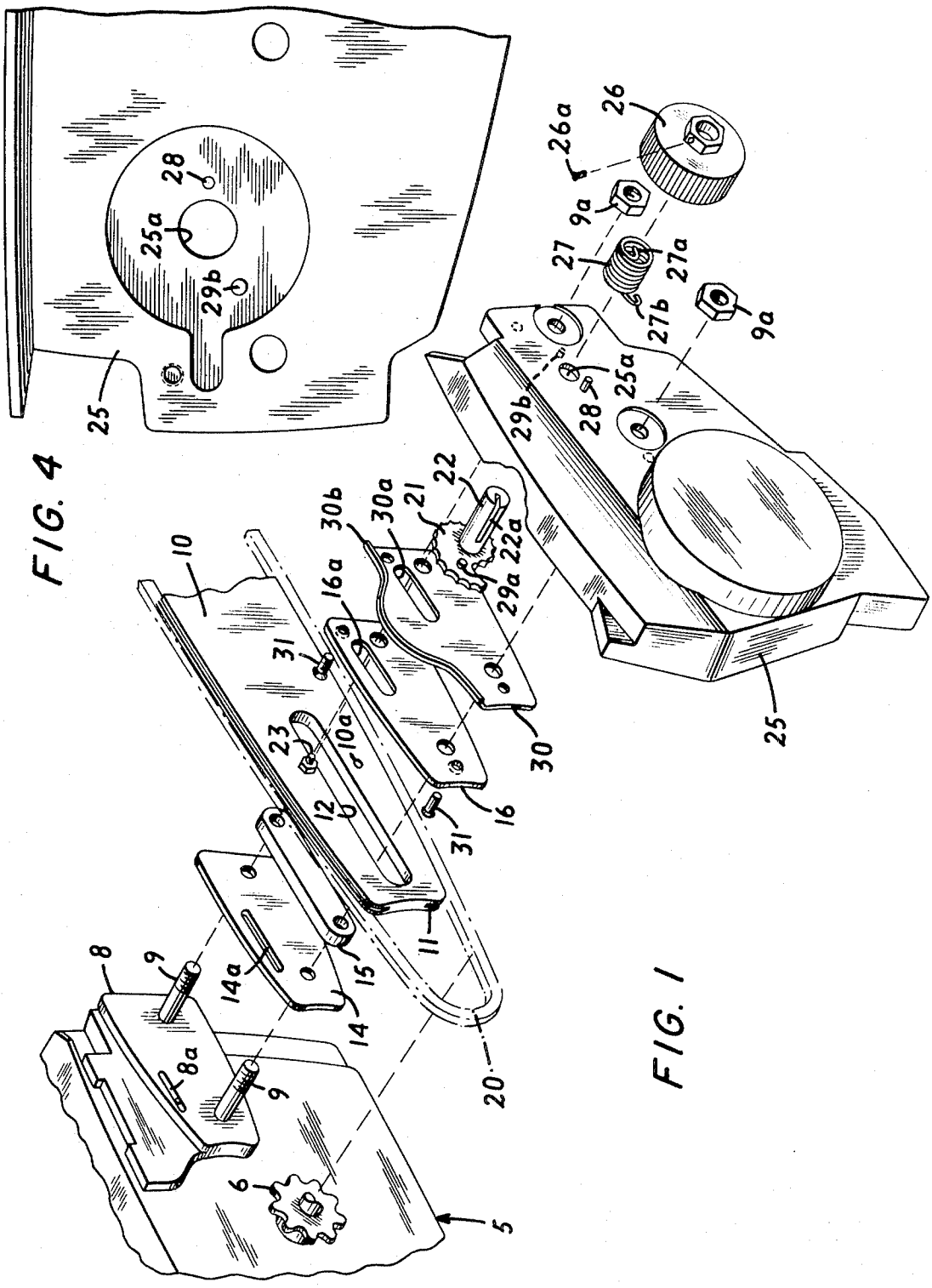

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FIG. 4

FIG. 1

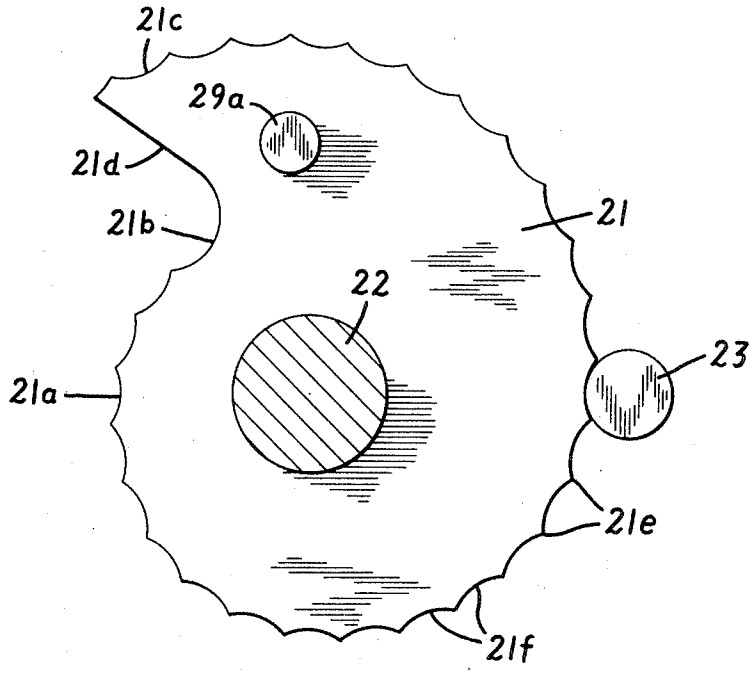
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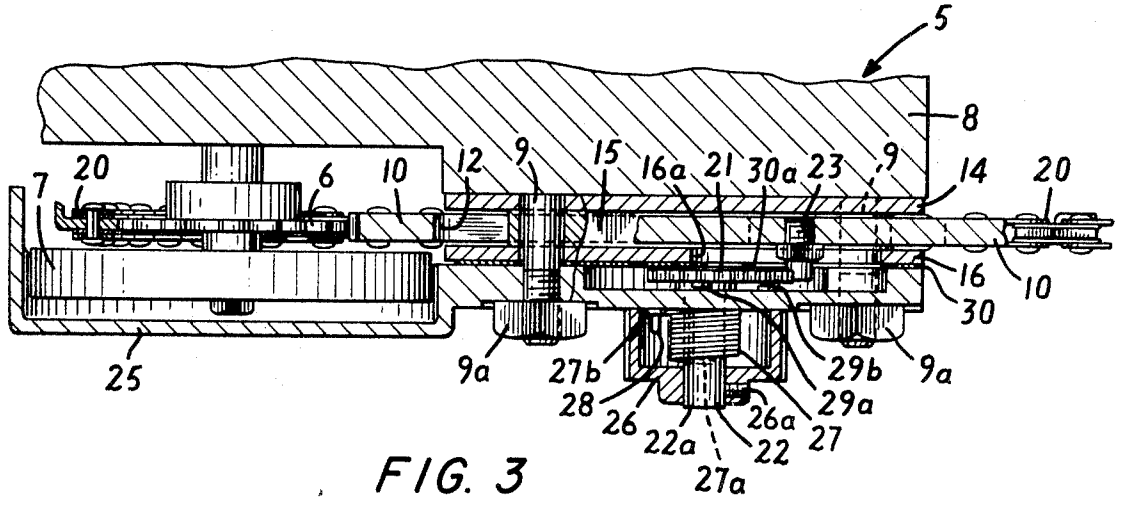
FIG. 2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9a
27b
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26
22a
27a
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26a
29a
27
29b
9a

FIG. 3

TENSIONER FOR SAW CHAIN

The present invention relates to chain-tensioning means and in particular to means for maintaining the cutting chain of a chain saw under proper tension.

In a chain saw, the cutting chain customarily runs around the periphery of a guide bar which is secured at one end to the frame or chassis of a handheld engine and may be provided at the other end with a nose sprocket or roller to reduce friction. The chain is driven by a sprocket which is located in line with the inboard end of the guide bar and is driven by the engine. The chain is provided with inwardly projecting lugs or tangs which engage teeth of the driving sprocket and are received in a peripheral groove of the guide bar.

In order for the chain saw to operate efficiently and safely, the cutting chain must be under proper tension. If it is too loose it may jump off of the guide bar with the possibility of causing serious injury to the operator. If the chain is too tight there may be excessive friction between the chain and guide bar particularly at the nose of the guide bar with the result of overheating and loss of efficiency in operation. If a critical value of tension is exceeded, the chain will break.

The tension of a saw chain does not remain constant. By reason of wear in the chain elements, a chain progressively lengthens during use thereby resulting in a decrease of tension if no compensation is made for the increased length. The change of length and hence of tension is more rapid during the initial period of use of a new chain. Changes in tension also occur by reason of changes in temperature. In the operation of a chain saw the temperature of the chain increases more rapidly than that of the guide bar so that the tension of the chain is decreased. When the chain and guide bar cool overnight or during periods of nonuse, the chain becomes tighter. Hence, in order to maintain proper operating tension of the chain, it is necessary to provide some kind of adjustment.

Heretofore, adjustment has been effected manually when the chain saw is not operating. The guide bar is customarily secured to the frame or chassis of the engine by two bolts which must be loosened in order to move the guide bar in a lengthwise direction relative to the sprocket in order to change the tension of the chain. The guide bar is customarily moved by means of a runner on the guide bar engaging a screw rotatably mounted on the chassis adjacent the inboard end of the guide bar. The bolts holding the guide bar are then again tightened to secure the guide bar in the position to which it has been adjusted. In order to make any adjustment the chain saw must, of course, be stopped. The tensioning of a chain to the proper value is dependent on the skill of the operator who customarily determines the tightness of the chain by "feel."

It is an object of the present invention to provide improved means for adjusting the tension of the cutting chain of a chain saw. In accordance with the invention the guide bar, instead of being bolted tightly on the frame or chassis of the engine, is mounted so as to be readily slidable in a lengthwise direction while being held against lateral movement either vertically or horizontally. Cam means is provided for moving the guide bar longitudinally away from the sprocket so as to tension the chain to the correct value. In a preferred embodiment of the invention the tensioning cam is spring operated so as to increase the chain tension automatically in the event the chain becomes too slack. The cam is preferably rotary with a generally spiral cam contour. Moreover, the contour of the cam is preferably provided with alternating high and low portions, for example spaced cusps and intervening concavities. This configuration of the cam has been found to avoid excessive tension on the chain and also prevents rearward movement of the guide bar when abnormal pressure is applied to the end of the guide bar, for example in boring.

The objects and advantages of the invention will be more fully understood from the following description of a preferred embodiment shown by way of example in the accompanying drawings in which:

FIG. 1 is a somewhat schematic exploded view showing chain-tensioning means in accordance with the invention together with associated portions of a chain saw;

FIG. 2 is an enlarged side view of a cam and associated abutment for adjusting chain tension;

FIG. 3 is a horizontal section of chain-tensioning means in accordance with the invention, and

FIG. 4 is a partial inside view of a cover shown in FIG. 1.

In the drawings there are shown portions of a chain saw comprising an engine with a frame or chassis 5. The engine is ordinarily a small two-cycle internal combustion engine although an electric motor may be used if desired. The chain saw is provided in known manner with suitable handles and controls for starting, regulating and manipulating the chain saw. At one side of the engine chassis there is provided a chain-driving sprocket 6 which is driven by the engine preferably through a centrifugal clutch 7 (FIG. 3) so that the sprocket is driven only when the engine speed exceeds a predetermined value and is not driven at idling speed. Forwardly of the sprocket 6 and in proper alignment therewith the engine chassis is provided with a fixed block or bracket 8 for mounting a guide bar. Two stud bolts 9 project outwardly from the mounting bracket 8. The bolts 9 are spaced apart from one another on a line extending forwardly from the sprocket. A guide bar 10 is slidably mounted on the chassis in alignment with the sprocket 6 so as to be movable in a longitudinal direction toward and away from the sprocket while being held firmly against lateral movement or deflection either horizontally or vertically. The guide bar is provided with a peripheral groove or slot 11 to receive the inwardly projecting tangs of the cutting chain and may be provided at its outer end with a roller nose or sprocket (not shown) in known manner. Near the inner end of the guide bar there is a longitudinally extending slot 12.

Means for mounting the guide bar on the chassis are shown by way of example in the drawings as comprising the mounting base or bracket 8 with projecting stud bolts 9, an inner guide plate or shim 14, a guide block 15 and an outer guide plate or shim 16. The guide block 15 and each of the shims 14 and 16 have spaced bolt holes to receive the stud bolts 9. The guide block 15 has a thickness slightly greater than the thickness of the guide bar 10, a width slightly less than the width of the slot 12 in the guide bar and a length sufficiently shorter than the length of the slot 12 to permit the desired range of longitudinal movement of the guide bar. The inner and outer shims 14 and 16 have a length somewhat greater than the length of the guide block 15 and a shape corresponding approximately to the shape of the adjacent portion of the guide bar. When the parts are assembled as shown in FIG. 3 and nuts 9*a* on the stud bolts 9 are tightened, the inner shim 14 is clamped tightly against the mounting base or bracket 8, the mounting block 15 is received in the slot 12 of the guide bar 10 and the inner and outer shims 14 and 16 are clamped tightly against opposite faces of the guide block 15. By reason of the guide block being slightly thicker than the guide bar 10, the inner and outer shims 14 and 16 are not clamped tightly against opposite faces of the guide bar but provide sufficient clearance to permit longitudinal movement of the guide bar (without loosing the nuts 9*a*) while confining it in a lateral direction so as to prevent any substantial lateral movement or deflection of the guide bar. In like manner, the width of the guide block 15 is sufficiently less than the width of the slot 12 in the guide bar to provide sufficient clearance to permit free longitudinal movement of the guide bar while preventing any substantial up or down movement. The mounting base 8 and inner shim 14 are shown as being provided with mating slots 8*a* and 14*a* through which lubricant is supplied to the inner end portion of the guide bar 10 from a suitable lubricant supply, for example an oil tank and pump connected through a suitable duct to the slot 8*a*. This provides lubrication for the chain running on the guide bar and also lubricates the inner end portion of the guide bar to facilitate longitudinal movement of the guide bar. The slots 8*a* and 14*a* are inclined at a small angle, for example about 6° to the centerline connecting the bolts 9.

An endless cutting chain 20 runs around the guide bar 10 and the sprocket 6. The chain is provided in usual manner with links having cutting teeth and depth gages and has in-

wardly projecting lugs or tangs which engage the teeth of the sprocket **6** and are received in the peripheral slot **11** of the guide bar. If, as is preferable, the guide bar is provided with a nose sprocket, the inwardly projecting tangs of the saw chain likewise engage the nose sprocket teeth in known manner. It will be seen that since the cutting chain extends around both the driving sprocket **6** and the guide bar **10**, movement of the guide bar in a longitudinal direction away from the driving sprocket **6** applies tension to the chain.

In accordance with the present invention, cam means is provided for moving the guide bar relative to the sprocket to tension the cutting chain. The tension-regulating cam means is shown by way of example in the drawings as a generally spiral cam **21** fixed on a rotatable shaft **22** and engaging a stud or pin **23** projecting laterally from the guide bar **10** adjacent one side of the slot **12** and projecting through a longitudinally extending slot **16***a* in the outer shim **16**. The cam shaft **22** is rotatably supported in a hole **25***a* of a cover **25** which is shaped to enclose the inner end portion of the guide bar including the chain-tensioning means and also the chain-driving sprocket **6** and associated centrifugal clutch **7**. A hollow knob **26** fixed on a projecting outer end portion of the cam shaft **22** encloses a spiral spring **27**, one end **27***a* of which is turned inwardly so as to engage in a longitudinally extending radial slot **22***a* in the shaft **22** while the opposite end **27***b* is anchored by engagement with a pin **28** projecting outwardly of the cover **25** near the shaft hole **25***a*. The spring **27** acts on the shaft **22** to bias it in a clockwise direction as seen in FIG. **1**. The cam shaft **22** and hence the cam **21** are rotatable in a counterclockwise direction against the tension of the spring **27** by the knob **26**, rotation being limited by engagement of a pin **29***a* on the cam with a pin **29***b* projecting inwardly on the inner face of the cover **25** adjacent the shaft hole **25***a*.

A cam cover **30** is preferably interposed between the outer shim **16** and the cam and is provided with an elongated slot **30***a* to accommodate the pin **23** on the guide bar **10** and with a contoured rim portion **30***b* which projects outwardly over the cam. The cam cover **30** and outer cover **25** are provided with bolt holes to receive the stud bolts **9**, the entire assembly comprising the inner shim **14**, the guide block **15**, the outer shim **16**, the cam cover **30** and the outer cover **25** being secured by the nuts **9***a* on the stud bolts **9** with the guide bar **10** received between the inner and outer shims, the cam **21** being accommodated between the cam cover **30** and the outer cover **25** and the cam shaft **22** extending outwardly through the hole **25***a* provided in the cover **25**. To facilitate assembly of the parts, the outer shim **16** and cam cover **30** are removably secured to the outer cover **25** by two screws **31** which extend through holes in the outer shim and cam cover and screw into blind tapped holes in the outer cover.

As seen more clearly in the enlarged view of FIG. **2**, the cam **21** has a cam contour **21***a* which is generally spiral so that an inner end portion **21***b* is closer to the axis of the shaft **22** than is the outer end portion **21***c*. As seen in FIG. **2** the resulting step **21***d* is somewhat undercut so that the inner end portion **21***b* partially underlies the outer end portion **21***c*. The contoured periphery **21***a* of the cam **21** is preferably not smooth but comprises a plurality of alternate high and low increments which are shown by way of example in the drawings as spaced cusps **21***e* and intervening concavities **21***f*. The concavities **21***f* are preferably at least approximately arcuate with a curvature that is slightly less than the curvature of the pin **23** (the radius of curvature of the concavities **21***f* being slightly greater than the radius of the pin **23**).

In assembling the parts shown in FIG. **1**, the pin **23** is fixed on the guide bar **10**, for example by being screwed into a tapped hole by means of a hexagonal or other noncircular section provided on the pin. The cam shaft **22** with the cam **21** fixed on the inner end thereof is inserted through the hole **25***a* from the inside of the cover and the spring **27** and knob **26** are assembled on the outer end of the cam shaft and the knob **26** is secured on the shaft, for example by a set screw **26***a*. The inner shim **14**, guide block **15**, guide bar **10**, outer shim **16**, cam cover **30** and outer cover **25** are then assembled on the stud bolts **9** in that order, the chain **20** being positioned around the guide bar **10** and over the drive sprocket **20** before the cover **25** is positioned on the bolts **9**. After the cover is placed on the bolts **9** but before it is slipped in far enough for the cam **21** to engage the pin **23** of the guide bar, the knob **26** is turned in a counterclockwise direction against the tension of the spring **27** until the pin **29***a* on the cam engages the pin **29***b* on the inner face of the cover. These pins are so positioned as to present the inner end **21***b* of the cam to the pin **23** on the guide bar **10**. The cover **25** is then slid all the way in and the nuts **9***a* are screwed onto the bolts **9** and tightened. Upon release of the knob **26**—after the cover **25** has been pushed home—the spring **27** tends to turn the cam **21** in a clockwise direction. The cam will turn until the cam periphery firmly engages the pin **23**. With the chain saw in a static condition the cam **21** acted on by the spring **27** may not exert sufficient force on the pin **23** to overcome static friction and move the guide bar **10** longitudinally away from the drive sprocket to tension the chain. However, as soon as the chain saw is started, friction is reduced by the natural vibration of the chain saw whereupon—if the chain is not already at proper tension—the cam **21** will rotate further in a clockwise direction until proper tension on the chain is achieved. The contour of the cam **21** and the force of the spring **27** are selected so that the chain **20** is under proper tension when equilibrium is reached between the force of the spring **27** and the tension of the chain.

During operation of the saw, the chain **20** tends to become longer by reason of the wear and setting of the chain parts and also because of thermal expansion of the chain upon increase of temperature occurring during cutting operations. If no correction were made, the increase in chain length would result in a decrease of chain tension. However, with the tensioning device herein illustrated and described, the cam **21** turns farther in a clockwise direction whenever slack occurs in the chain so as to maintain the chain under proper tension.

The alternate high and low increments of the cam contour represented by the cusps **21***e* and intervening concavities **21***f* serve the function of avoiding excess tension on the chain. The pin **23** ordinarily sits in one of the concavities as seen in FIG. **2** and the cam will not move until the chain has lengthened sufficiently to permit the pin **23** to ride over the intervening cusp **21***e*. The pin **23** thereupon drops down into the next concavity so as to decrease the tension slightly thereby providing the correct tension value and preventing overtensioning.

When the saw is used in a "boring" operation, the guide bar with the chain running thereon is pushed longitudinally into the timber being cut so that the nose of the guide bar penetrates the timber. This may give rise to a substantial longitudinal force on the guide bar tending to push it back toward the drive sprocket and thereby creating slack in the chain. The alternate cusps and concavities of the cam contour prevent retrogressive rotation of the cam by pressure applied by the pin **23** and thereby prevent slackening of the chain during boring operations.

In the preferred cam contour shown by way of example in FIG. **2**, successive cusps **21***e* are spaced apart from one another a uniform distance. Moreover, the radial distances between the bottoms of successive concavities **21***f* from the axis of the shaft **22** increase by equal increments from the inner end **21***b* of the cam contour to the outer end **21***c*. This means that the guide is moved equal amounts each time the pin **23** moves from one concavity to the next. By reason of this arrangement the included angle between successive cusps with the apex of the angle at the axis of the cam shaft **22** progressively decreases from the inner end to the outer end of the cam contour.

In order to increase the range of movement of the guide bar **10** provided by the tensioning mechanism, the guide bar is provided with an additional tapped hole **10***a* into which the pin **23** can be screwed. The hole **10***a* is on the opposite side of the slot **12** and is closer to the inner end of the guide bar by a

distance approximately equal to the throw of the cam 21. Hence, when the chain is lengthened to an extent where the outer end 21c of the cam contour has reached the pin 23, the guide bar 10 can be reversed side for side and the pin 23 moved to the other hole 10*a* in position to start again at the inner end 21*d* of the cam. Still additional holes can, if desired, be provided on the same or opposite side of the slot 12.

While biasing of the cam 21 by the spring 27 is desirable in order to provide automatic regulation of the chain tension while the saw is in operation, it will be understood that even without the spring 27, the mechanism shown and described would be useful in that it would permit convenient manual adjustment of tension by means of the knob 26. In this event it may be desirable to provide friction means, for example a friction washer, to assist in holding the cam in the position to which it is adjusted. If desired, the guide block 15 can be omitted in which event the slot 12 is proportioned to slide on the bolts 9 and adjustment of tension is effected by loosening the nuts 9*a* on bolts 9, turning the cam—by spring tension or manually—to provide the proper tension and then tightening the nuts. Moreover, it will be understood that while a rotary cam as described is considered preferable, a linearly movable cam may be used in like manner for movement of the guide bar in a longitudinal direction outwardly from the drive sprocket to adjust the tension of the chain without loosening the nuts on the bolts 9 by which the guide bar and associated parts are mounted on the chain saw chassis. While the chain-tensioning means of the present invention is particularly useful for maintaining saw chains at proper tension, it is also applicable to tensioning other endless chains, for example drive chains, running over a drive sprocket and a chain guide which is movable relative to the sprocket to tighten the chain.

What I claim and desire to secure by Letters Patent is:

1. In a chain saw having a frame and a chain-driving sprocket, the combination of a chain guide bar, means mounting said guide bar on said frame in alignment with said sprocket for movement in a longitudinal direction toward and away from said sprocket, an endless chain running on said guide bar and sprocket and driven by said sprocket, and means for automatically tensioning said chain to proper operating tension, said tensioning means comprising an abutment on said guide bar, a cam movably mounted on said frame and engaging said abutment, said cam having a cam contour for moving said abutment and hence said guide bar in a direction away from said sprocket to tension said chain upon movement of said cam in a forward direction, and spring means for moving said cam in a forward direction to tighten said chain, said cam contour having alternate high and low increments engageable with said abutment to arrest forward movement of said cam when the chain is under proper tension and to resist movement of said cam in a reverse direction.

2. A combination according to claim 1, in which said cam contour of said cam comprises a series of spaced cusps alternating with concave curves between said cusps.

3. A combination according to claim 2, in which said abutment comprises a round pin fixed on said guide bar and in which said concave curves of said cam contour have a radius of curvature slightly greater than that of said pin.

4. A combination according to claim 1, in which said guide bar is provided with a plurality of spaced holes at different distances from said sprocket and in which said abutment comprises a pin removably fixed selectively in one of said holes.

5. A combination according to claim 1, in which said cam is rotatably mounted and has a generally spiral contour, said spring means comprising a spiral spring acting on said cam to rotate it about its axis of rotation.

6. A combination according to claim 5, in which said cam contour comprises a series of spaced cusps and concave arcs between said cusps, the distance between said cusps and the axis of rotation of said cam progressively increasing from one terminus of said cam contour to the other, said cusps being substantially equally spaced along said cam contour and the included angles between said cusps with apices at said axis of rotation progressively decreasing with increase of the distance between said cusps and said axis.

7. A combination according to claim 1, comprising manually operable means for moving said cam in a reverse direction and thereby tensioning said spring means.

8. A combination according to claim 7, in which said cam is fixed on a rotatable shaft and in which said manually operable means comprises a knob fixed on said shaft.

9. A combination according to claim 1, in which said guide bar has a longitudinally extending slot in an end portion adjacent said sprocket and in which said mounting means comprise an elongated block received in said slot, said block having a width slightly less than the width of said slot, a length less than the length of said slot by an amount at least equal to the desired range of longitudinal movement of said guide bar and a thickness slightly greater than the thickness of said guide bar, guide plates on opposite sides of said block and said guide bar, said block spacing said plates apart a distance slightly greater than the thickness of said guide bar and means securing said plates and said block together, said block and plates firmly supporting said guide bar for free longitudinal movement by said cam.

10. In a chain saw having a frame and a chain-driving sprocket, the combination of a chain guide bar means mounting said guide bar on said frame in alignment with said sprocket for free movement in a longitudinal direction toward and away from said sprocket, an endless chain running on said guide bar and sprocket and driven by said sprocket, and means for tensioning said chain to proper operating tension, said tensioning means comprising an abutment on said guide bar, a cam movably mounted on said frame and engaging said abutment, said cam having a cam contour for moving said abutment and hence said guide bar in a direction away from said sprocket to tension said chain upon movement of said cam in a forward direction and means for progressively moving said cam in a forward direction to tighten said chain and compensate for progressive increase in length of said chain through wear and increase of temperature.

11. A combination according to claim 10, in which said cam contour comprises a plurality of spaced cusps with intervening concavities between said cusps.

12. A combination according to claim 10, in which said cam is rotatably mounted and said cam contour is generally spiral.

13. A combination according to claim 12, in which said cam is fixed on a rotatable shaft and means for rotating said cam comprises a manually operable knob fixed on said shaft.

14. In combination with an endless chain running over a driving sprocket and guide means which is movable toward and away from said driving sprocket to vary the tension of said chain, chain-tensioning means comprising a support, an abutment on said guide means, a cam movably mounted on said support and engaging said abutment, said cam having a cam contour for moving said abutment and hence said guide means in a direction to tension said chain upon movement of said cam in a forward direction, and spring means for moving said cam in a forward direction to tighten said chain, said cam contour having alternate high and low increments engageable with said abutment to arrest forward movement of said cam when the chain is under proper tension and to resist movement of said cam in a reverse direction.

15. Chain-tensioning means according to claim 14, in which said cam contour comprises a series of spaced cusps alternating with concavities between said cusps.

16. Chain-tensioning means according to claim 15, in which said cam is rotatable and said cam contour is generally spiral, said spring means acting on said cam to rotate it.

* * * * *