Sept. 8, 1953 H. E. WARREN 2,651,336

CHAIN SAW

Filed July 11, 1947

3 Sheets-Sheet 1

Fig. 2.

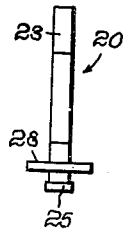


Fig. 3.

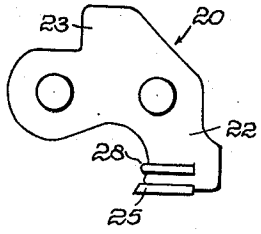


Fig. 4

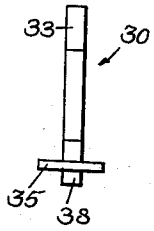


Fig. 5

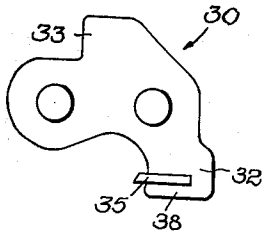


Fig. 1.

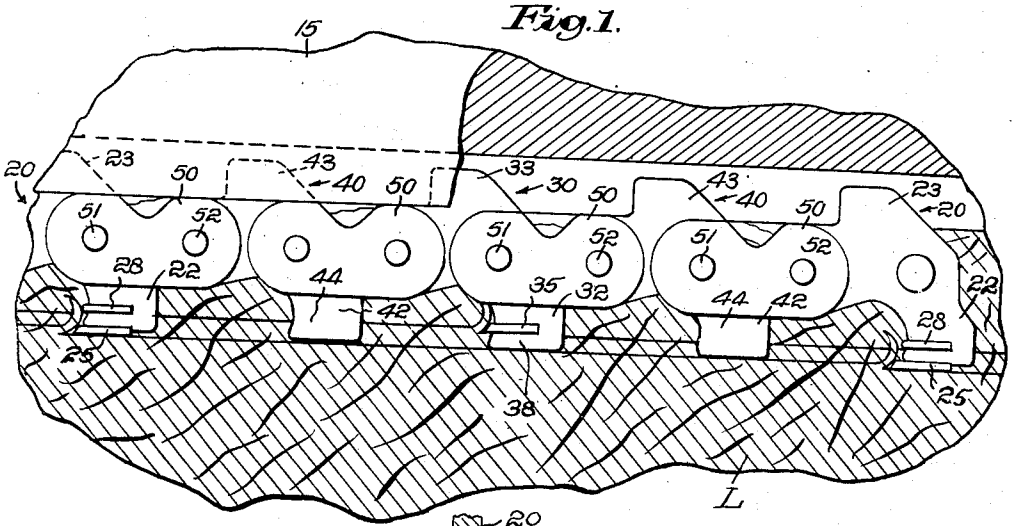
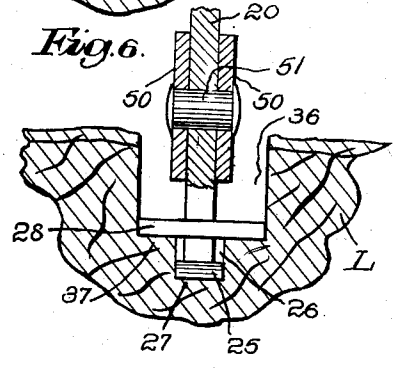


Fig. 6.



INVENTOR
HENRY E. WARREN.
BY
Emery, Booth, Townsend, Miller & Wisher
ATTORNEYS

Sept. 8, 1953

H. E. WARREN

2,651,336

CHAIN SAW

Filed July 11, 1947

3 Sheets-Sheet 2

Fig. 10.

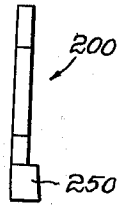


Fig. 11

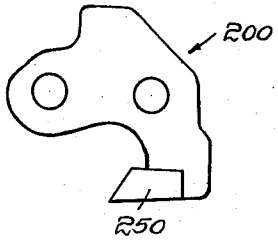


Fig. 9.

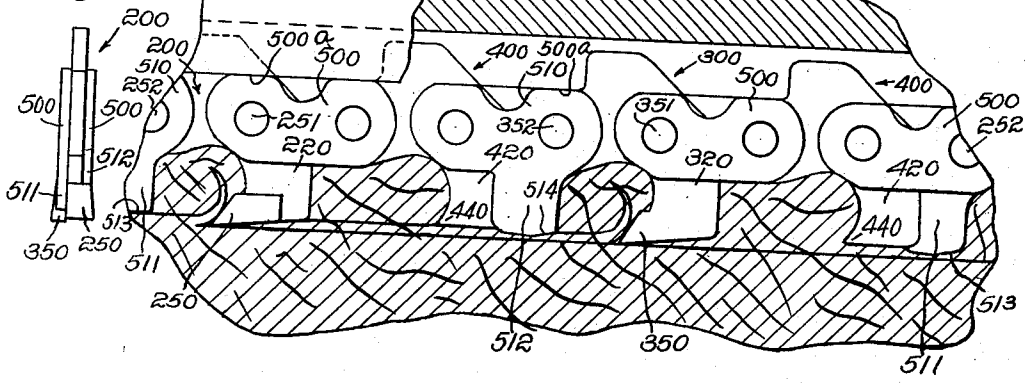


Fig. 8.

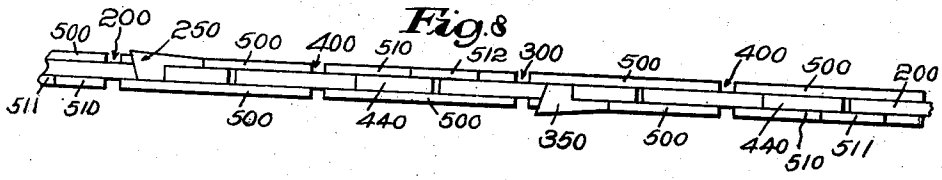
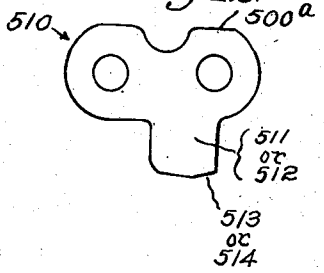


Fig. 12.



INVENTOR
HENRY E. WARREN.

BY
Emery, Booth, Townsend, Miller & Weidner
ATTORNEYS

Sept. 8, 1953

H. E. WARREN

CHAIN SAW

2,651,336

Filed July 11, 1947

3 Sheets-Sheet 3

Fig. 13.

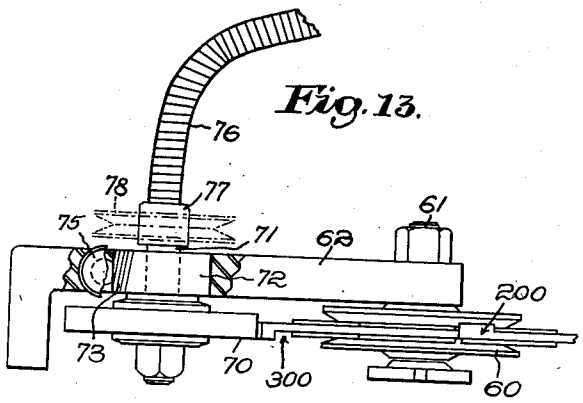


Fig. 14.

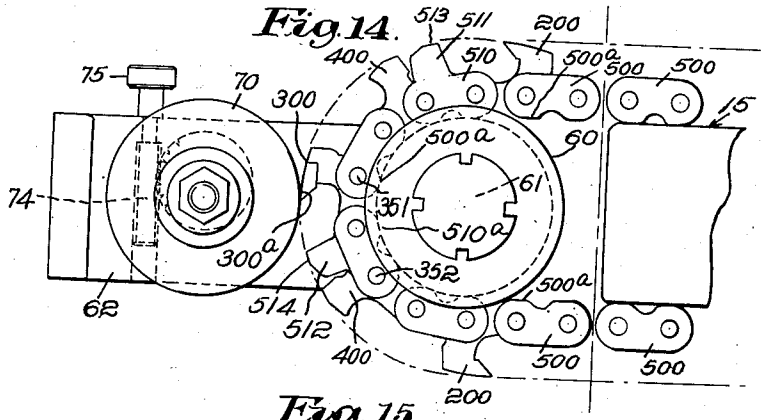
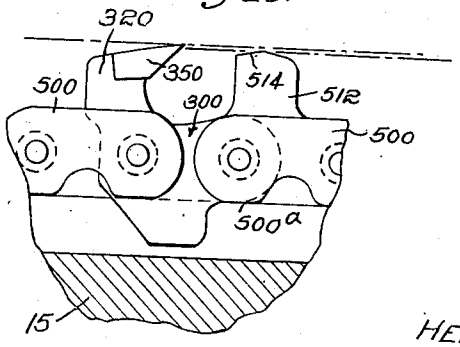


Fig. 15.



INVENTOR
HENRY E. WARREN

BY
Emery, Booth, Townsend, Miller & Weidner
ATTORNEYS

Patented Sept. 8, 1953

2,651,336

UNITED STATES PATENT OFFICE

2,651,336

CHAIN SAW

Henry E. Warren, Ashland, Mass., assignor to Lombard Governor Corporation, Ashland, Mass., a corporation of Massachusetts

Application July 11, 1947, Serial No. 760,237

3 Claims. (Cl. 143—135)

1

The present invention relates to power operated sawing machines of the chain type and to chain saws therefor. It aims to increase the cutting efficiency of chain saws through an improved correlation of successive cutting elements, and to reduce manufacturing and maintenance costs as a result of new and improved constructions and arrangements of the link components.

In the drawings illustrating by way of example certain embodiments of the invention:

Fig. 1 shows a length of a chain saw in active position sawing crosswise of a tree, log or timber of which a portion is seen in cross-section;

Figs. 2 and 3 are respectively front end and side elevations of one cutter link of the chain;

Figs. 4 and 5 are corresponding views of another cutter link;

Fig. 6 is a sectional view on a larger scale taken transversely of the saw and kerf, substantially as though looking from the left at Fig. 1;

Fig. 7 is a view similar to Fig. 1 illustrating another construction for the saw chain of the invention;

Fig. 8 is a bottom plan view of the chain length of Fig. 7;

Fig. 9 is a cross-sectional view of the chain as viewed from the left looking onto Fig. 7;

Figs. 10 and 11 are front and side elevations of one of the cutter links of the Fig. 7 chain embodiment;

Fig. 12 shows a connector link carrying a depth-gauging guard and raker element;

Figs. 13 and 14 are respectively a plan and a side elevation showing a grinder means incorporated with the chain saw and comprised in the present invention, said views further illustrating the correlation of the cutter chain elements and the grinding instrument; and

Fig. 15 shows on a larger scale the chain links acted upon by the grinder in Figs. 13 and 14 but horizontally extended as in operative cutting position.

In the chain saw art as heretofore practiced it has been customary to employ various different shapes and types of teeth and cutting elements acting in general to remove wood particles at the edges of the kerf so as to define the latter and then to rout or rake out interior sections of the kerf. The action of these cutting teeth has commonly been to tear away particles of wood in a somewhat irregular manner requiring a disproportionate power consumption as compared for example with the action of an efficient cross-cut saw. The present invention is generally characterized by the provision of a

2

single functional type of cutting tooth acting in the manner of a plane, chisel or plow and wherein the extent of cut by sucecssive cutting members or teeth is mutually regulated by a reciprocal guarding action.

Referring first to the embodiment of Figs. 1 to 6, in Fig. 1 a portion of the longitudinal guide plate of the sawing machine is indicated at **15**, the machine being represented in action crosswise of a tree, timber or log L. The chain saw as here shown comprises a multiplicity of central links designated generally at **20**, **30** and **40**. They are disposed in longitudinal alinement and are pivotally joined into a continuous chain by lateral pairs of connector links **50**. Each pair of such connectors **50**, one at each side of the central links **20**, **30**, and **40**, spans between the trailing and leading portions of successive central links, the connectors of each pair having their respective end portions pivotally connected to the central links as by riveting at **51**, **52**.

The central links desirably all have the same general configuration so that a common blank may be used for any one of them. Each comprises a body, a lower rear leg **22**, **32**, or **42** and in the illustrated example an upper body portion or lug **23**, **33**, or **43** for guided travel along the guide plate **15**. These blanks for the central link series are made of a strong and tough material such as spring tempered steel but which may be a relatively inexpensive stock as compared with that for the cutting elements or teeth proper in accordance with the present invention. These latter preferably are constituted as tool bits formed of a heat resistant material such as high speed tool steel, tungsten carbide steel, Stellite and others. These bits, one of which is seen in Figs. 2 and 3 and another in Figs. 4 and 5, are mounted in slots or recesses appropriately located on the link blanks and are held in position as by silver solder, copper welding or other suitable attachment.

In accordance with the invention the teeth or cutting elements of the active links, whether separately made or otherwise, are formed in the manner of small chisels or plows, each having a similar character of action to shave or pare the wood at the cutting edge, removing the wood more in the form of elongated strips as contrasted with irregularly tearing the woody fibres into relatively small pieces or dust. The successive cutters are substantially spaced to provide room for the chip or strips removed, and if desired any convenient form of raker **44** may be provided at the spaces to assist in clearing the

kerf. As shown the rear legs **43** of the intermediate central links **40** are themselves constituted as such raker or clearer means **44**.

In the embodiment of Figs. 1 to 6 the successive cutting teeth operate at different vertical levels. The central links **20**, see particularly Figs. 2 and 3, carry the teeth, chisel bits or cutters **25** which operate at a lower depth. These are centrally disposed with respect to the kerf and are comparatively narrow so as to form a lowermost center slot as indicated at **26** in Fig. 6.

On certain others of the central links, namely the links **30**, see Figs. 4 and 5, the chisel bits **35** operate at a relatively higher level. These cutters **35** are relatively wider than the lower cutters **25** and also are symmetrically arranged with respect to the center line of the kerf. Thus they balance forces against their opposite side edges. The upper-level cutters **35** act to define the total width of the kerf **36** and to form the bottom wall thereof as at the level indicated by the numeral **37** in Fig. 6. The bottom wall of the center slot **26** at the level defined by the lower chisel cutter tooth **25** is designated **27** in Fig. 6.

Further in accordance with the invention the cutting depth for each of the vertically spaced chisel teeth or cutters **25** and **35** is determined by a guard preferably carried by the same link and which rides on a surface formed by the cutter of the other level. As seen in Figs. 1, 2, 3 and 6, the links **20** have at a level above the chisel tooth **25** a non-cutting guard **28** comprising a flat plate which may be mounted on the link **20** in a similar manner as the sharp edged cutters **35** on the links **30** and at a level corresponding to the latter. These guards **28** having a width not greater and preferably slightly less than the kerf **36** are adapted to ride on the bottom **37** of the latter. They limit the depth of the center slot **26** cut by the tooth **25** upon the same link **20**.

In a reciprocal and correlated fashion excessive penetration by the higher-level teeth **35** of the links **30** is guarded against by an underlying non-cutting guard **38** shown as a portion of the rear leg **32** of the particular link **30**. This guard portion **38** by riding on the bottom **27** of the center slot **26** limits the depth of the bottom wall **37** of the kerf **36**.

Thus the vertically spaced teeth or cutters **25** and **35** of the links **20** and **30** are reciprocally guarded so that neither can penetrate more than a limited distance beyond the other. In this manner the work of cutting and forming the kerf is divided between the two levels of teeth and neither one is free to dig into the wood beyond the calculated extent. This depth of penetration is determined by the height relationship between each tooth **25** or **35** and its own guard **28** or **38** respectively, as measured with respect to the other positioned tooth and its guard. The resultant chain as herein disclosed has in practice afforded a highly effective cutting action, requiring less power than the conventional form. Some of the central links, herein the links **40**, shown by way of example as alternating between the cutter links **20** and **30**, have no cutters but being formed of similar blanks as the others do have rear pendent legs **42**. These may serve as clearers or rakers and may afford a supplemental guarding action in which connection they may also be supplied with guards or gauges similar to the members **28** of the cutter links **20** if so desired.

Turning now to the further embodiment of the invention as illustrated in Figs. 7 to 12, the chain saw as there shown is organized and arranged in a generally similar manner as in the preceding embodiment. The cutting is in the nature of a planing, paring or plowing action by cutters or tool bits working at different portions of the total kerf. Here however the positional distinction as to the cutter elements is had by relatively offsetting them laterally rather than vertically of the kerf. The central cutter-carrying links accordingly are here differentiated as right-hand and left-hand.

Referring particularly to Fig. 7 the central series of links comprises right-hand cutter links **200**, left-hand cutter links **300** and intermediate non-cutting or clearer links **400**, with pendent legs **220**, **320** and **420** respectively. As in the previous example these may all have a common size and shape of blank one of which is seen separately in Fig. 11. The central links **200**, **300**, **400** as before are pivotally interconnected by pairs of connector links **500** and **510** some of which in this instance additionally afford the guarding and guiding function to be described.

In this Fig. 7 embodiment the mutually cooperative cutter elements or teeth proper have the form of small plows, respectively disposed on the several links in a side relationship instead of the vertical relationship of the preceding example. While they may be formed integrally with the respective carrier links, preferably they are fashioned separately as tool bits, of a special high-grade steel as previously mentioned, inserted and secured on the rear legs of the blanks as already explained.

Figs. 10 and 11 show separately one of the cutter links, namely a right-hand link **200**. For the purposes of description the terms right and left are applied to the chain saw and the kerf as viewed from a position toward which the active run of the chain is travelling. In Fig. 7 the travel obviously is from right to left, and the positional designations are applied as if looking endwise onto Fig. 7 from the left portion of the sheet. Thus in Fig. 10 the plow or cutter tooth **250** is projected to the right of the link **200**. In Fig. 11 which is a right side elevational view of a cutter link **200** the tool bit or plow tooth **250** will be understood as laterally projective out from the sheet and toward the viewer. The same applies also to the cutter link **200** seen at the left portion of Fig. 7, the latter to be compared also with the bottom plan of Fig. 8 and the cross-sectional and end elevational view of Fig. 9.

It will be noted that the sharpened lower cutting edge of the plow or tooth **250** has a slight inclination in two directions, that is, upwardly from right to left as seen in Figs. 9 and 10 and also forwardly from the center line of the kerf toward the side at which the tooth projects, noting particularly Fig. 8 in the latter connection. The plow teeth or cutters **350** for the left-hand links **300** are similarly but oppositely constructed and arranged, laterally of the saw chain, as clearly seen at the lower right central portion of Fig. 8.

By reason of the plow-shape of the teeth **250** and **350** the ribbon-like chips are turned away from the respective teeth toward and into the space at the other side of the kerf where they are taken up and carried along. For this purpose intermediate central links **400** as in the previous instance have the rear legs **420** of their blanks

constituted as blunt or non-cutting clearers or rakers **440**.

In this Fig. 7 embodiment the horizontally offset cutter teeth **250** and **350** of the cutting links **200** and **300** are reciprocally guarded as to depth of penetration, by right- and left-hand means which also aid as rakers or clearers. Such means may be formed on the central links but preferably and as here shown is carried by certain of the connector links **510**, one of which is seen separately in Fig. 12. The means referred to comprises generally rectangular feet **511** and **512** pendent from the selected side connecting links **510** and having straight elongated bottom edges **513, 514**. As illustrated these depth guards are provided on one connector link **510** of alternate pairs, and alternately at the left and at the right. The other connective link pairs **500** may be similarly equipped or left plain as shown.

These rakers and depth gauges **511** and **512** are adapted to ride on the uncut lateral portion of the kerf on the side opposite to the particular cutting tooth **250** or **350** which they guard, herein that next following. Thus, starting at the left in Fig. 7, a left-hand raker-guard **511** guides on the track just previously made by a left-hand tooth **350** (passed beyond Fig. 7) and thereby limits the depth of cut to be made by the following right-hand tooth **250**. In similar reciprocal fashion the left-hand cutting teeth **350**, noting the central portion of Fig. 7, have the cutting depth gauged by the precedent right-hand guard **512** travelling on the right-hand track just cut by the right-hand tooth **250** immediately ahead of it.

The effectiveness of the depth guarding action will be apparent from the following consideration. No single cutter or tooth **250** or **350** can dig below the active cutting level as shown in Fig. 7 unless permitted to tilt in a counterclockwise direction about the rear rivet or pivotal connective point **251** or **351** of the respective carrier link **200** or **300**. Such tilting must involve a down movement of the leading portion of the same carrier link **200** or **300**, in the region of the fore pivotal connective point **252** or **352**. Such down movement in turn is prevented by the contact of the guard surface **513** or **514** of the corresponding guard **511** or **512** upon the uncut wood at the opposite half of the kerf to that of the particular guarded tooth **250** or **350**. In other words, the left-hand guards **511** coacting with the left portion of the kerf are directly and positively associated with the fore portions of the carrier links **200** having the right-hand cutting teeth **250** and limit the cut depth thereof. Similarly, the right-hand guards **512** engaging downwardly upon the right portion of the kerf are effectively carried at the fore portion of the carrier links **300** having the left-hand teeth **350** and accordingly control the cut depth of the latter.

Thus in the Fig. 7 embodiment a reciprocal and correlated guarding action is had for the horizontally differentiated teeth **250** and **350** in a substantially similar manner as for the vertically spaced cutting teeth **25** and **35** of the previous embodiment. In both instances the cutters of one positional type are depth-guarded by a guard directly associated with the same link as the particular cutter but which rides upon the horizontal surface of the kerf formed by a cutter of the other or another positional type, thereby affording a reciprocal correlation for the cutting depth as between the different positional types of cutters. It will be observed with reference to both illustrative embodiments that in the saw chain of the invention the work of cutting the kerf is divided between two series of teeth, the two series being in vertical relationship in one instance and having a horizontal relationship in the other example. Each series of teeth is reciprocally guarded so that those of neither series can penetrate more than a limited distance beyond those of the other series. At the same time substantially complete lateral balance is accorded, with a minimum tendency of objectionable drag or deviation at the sides of the kerf, the cutting elements being in each case symmetrically arranged with respect to the center line of the kerf. By reason of this lateral symmetry there is balancing of forces against the opposite side portions of the chain.

A further important aspect of the invention lies in the fact that the construction and arrangement of the various links of the saw chain and their relation to each other is such that the working surfaces of the cutting teeth and of the conjoint raker-guard elements are adapted to receive automatic grinding while the saw is in operation in the normal manner, such grinding herein being effected for example at the location where the chain bends around the arcuate guide means or idler pulley at the outer ends of the supporting frame or blade of the chain saw. In Figs. 13 to 15 a grinder means and the manner of cooperation with the saw chain are illustrated in connection with the horizontally spaced tooth construction such as that of Figs. 7 to 12.

Referring now more particularly to Figs. 13 and 14, the arcuate guide means for the chain shown by way of example as an idler pulley is indicated at **60**, it being understood as running upon a pulley shaft **61** carried on the saw frame **15**. The frame is longitudinally extended integrally or by means of a bracket **62** receiving support from the pulley shaft and adapted to mount a rotary abrasive element, disc or grinder **70**. As illustrated the grinder **70** has its shaft **71** eccentrically journalled in a circular bearer **72** rotatably supported on the bracket **62**. Means is provided for rotatively adjusting the bearer **72**, the latter as shown being formed with circumferential teeth as at **73** engaged by a worm **74** rotatable by knob **75**. By turning the latter the bearer **72** may be rotated in one or the opposite direction so as to adjust the axis of the grinder **70** to and from the chain position thereby to regulate the depth of grind. The grinder **70** may be driven through a flexible shaft **76** driven from the saw power plant, motor or any convenient driven part of the saw assembly. The drive shaft **76** desirably has a detachable coupling with the grinder shaft **71** as at **77**. If desired an auxiliary pulley **78** may be provided for independent operation of the grinder.

In Fig. 14, looking at the opposite side of the saw to that viewed in Fig. 7, the idler pulley **60** turns counterclockwise, and the lower run of the chain moves from left to right toward active cutting position with reference to the work. A left-hand cutter link **300** (using the same hand designation as for Fig. 7) is at the grinding location, at the region where in passing around the pulley **60** it crosses the line of centers of the pulley and of the grinder. It will be seen that the cutting surface **300***a* of the cutter tooth or bit **350** of this link **300** has the relief angle thereof presented in correct grinding relation to the grinder **70**, such that the latter tends to generate a circle of appropriate radius at the tooth surface. It

also will be observed that the guard surface **514** of the corresponding guard **512** immediately in advance of this cutter link **300** also moves along the same arcuate path of travel past the grinder **70** as the chain saw runs around the pulley or arcuate guide **60**. Both said surfaces accordingly receive the same degree and manner of grind, both being similarly determined by the arcuate path of travel of these parts around the pulley or arcuate guide axis **61** and in cooperative relation to the circle of grind presented or generated by the grinder **70**. During operation the latter is axially fixed and the location and path of grinding action is as described whether the grinder **70** is itself driven at the desired speed as through the means illustrated by way of example in Fig. 13, or is left at rest while the chain saw runs past it in grinding relation.

It is apparent from the description in connection with the drawings that this common and uniform grinding action with respect both to the cutter teeth and to the corresponding guard surfaces is had by reason of their mutual construction and arrangement substantially as shown and described, and particularly the relation of the pivot points **351** and **352** with respect to the said surfaces to be ground and to the bearing surfaces **500***a* and **510***a* of the connector links **500** and **510**. These latter engage the track of the frame **15** and of the pulley **60** and accordingly determine the radial distance of the tooth and guard surfaces concerned from the pulley axis **61**.

In Fig. 15 a typical cutter tooth **350** and guard **512** therefor as considered in Figs. 13 and 14 are shown on a larger scale in the working position, as when extended rectilineally between the idler or arcuate guide **60** and the driving sprocket at the remote end of the frame **15**. As thus generally horizontally travelling along the kerf in cutting wood, the guard **512** and the tooth **350** of the cutter link **300** respectively have the rearward relief, and the difference in height indicated by the broken lines in Fig. 15, appropriate for the mutual depth-guarding and cutting functions. The depth or height difference indicated represents the depth of fresh cut to be made in the course of passage of the particular cutter along the kerf. As explained in connection with Figs. 7 to 12, each guard **511**, **512** rides upon the wood at the opposite half of the kerf from that of the corresponding cutter **250**, **350**, thereby correlating the cutting action of the horizontally spaced series of cutters.

It is important to note here that as the cutter teeth gradually wear down in use the provisions for automatic grinding as illustrated and described in connection with Figs. 13 to 15 are such that the same mutual depth relationship is maintained as between the cutters and the corresponding guards. The grinder **70** may be adjusted from time to time by manipulation of the knob **75** to accommodate it to the extent of wear

of the chain parts in actual operation. So far as I am aware the present invention for the first time adapts a chain for accurate grinding while running in a normal manner and makes provision for accomplishing that result.

It will be understood that while in the foregoing description with respect to Figs. 14 and 15 a left-hand cutter and tooth **300**, **350** has been referred together with the corresponding guard **512** the same grinding relation prevails also as to the cutter series **200** of opposite hands and to the guards **511** therefor.

My invention either as to means or method is not limited to the exemplary embodiments or steps herein illustrated or described, and I set forth its scope in my following claims:

I claim:

1. In a chain saw, an endless series of central links having pendent legs, connector links pivotally connecting the central links, the legs of some of the central links carrying single chisel-like bits providing cutter teeth formed to cut with a paring action along a substantially horizontal surface, the legs of the other central links each constituted as a raker, said toothed links alternating with said raker links in the central series, the cutter teeth of alternate toothed links being positionally differentiated in the vertical and in the horizontal direction transverse of the kerf so as to cut different bottom portions thereof, and a depth guard for each cutter-toothed link, such guard for the given tooth being directly associated therewith and being shaped, dimensioned and arranged as to both the vertical and horizontal directions so that such guard rides solely on that horizontal surface formed in the kerf by the precedent positionally differentiated cutter tooth.

2. A chain saw according to claim 1 in which the positionally differing cutter teeth are mutually offset vertically of the kerf and alternately are relatively wide and relatively narrow.

3. A chain saw according to claim 2 in which the depth guards for running on surfaces formed by the lower cutter teeth are carried on the same links with the higher cutter teeth, and vice versa, in the reciprocal and mutually coactive relation.

HENRY E. WARREN.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
896,357	Brown	Aug. 18, 1908
2,197,210	Forrest	Apr. 16, 1940
2,321,962	Zandecki	June 15, 1943
2,326,854	Hassler	Aug. 17, 1943
2,346,046	Ogden	Apr. 4, 1944
2,391,286	Wolf	Dec. 18, 1945

FOREIGN PATENTS

Number	Country	Date
581,061	Germany	July 20, 1933