



(11) Publication number : **0 597 816 A2**

(12)

EUROPEAN PATENT APPLICATION

(21) Application number : **93850214.3**

(51) Int. Cl.⁵ : **B27B 33/14**

(22) Date of filing : **11.11.93**

(30) Priority : **13.11.92 US 975872**

(43) Date of publication of application :
18.05.94 Bulletin 94/20

(84) Designated Contracting States :
DE FR GB

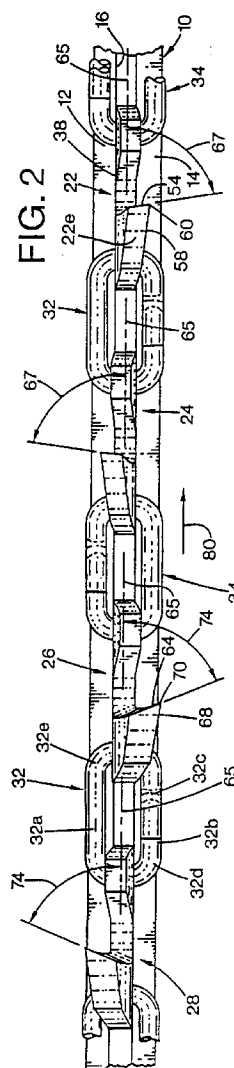
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(54) **Saw chain with wire form connectors.**

(57) Saw chain (20) having generally upright plate-formed cutter links (22,24,26,28) connected by horizontally disposed wire-formed connector links (32,34). The cutter links cut a kerf wider than the connector links to protect the connector links. Bores (40,42) in the cutter links are larger than the cross-section size of the connector links permitting a limited degree of vertical movement between the cutter and connector links.



This invention relates generally to saw chain, and more particularly to saw chain in which upright plate-formed links are interconnected by wire-formed connector links.

Cutting chain technology originally was dominated by large, powerful chain saws which required heavy metal links and large connecting rivets for pivotally connecting the links. More recently, improvements and advances in cutting chain technology and power head construction have resulted in the ability to use much smaller chains and power heads expanding the use of chain saws into a variety of new uses and new users.

A form of a very light weight cutting chain for use with small power heads is shown in U.S. patent 4,827,821 entitled "Saw Chain" which issued May 9, 1989, and is assigned to the assignee of the present invention. This patent discloses the use of plate-like cutter links interconnected by wire-formed connector links. However, a disadvantage has arisen with the construction disclosed. The substantially horizontal connector links extend laterally outwardly to opposite sides of the center line of the chain, a distance greater than the cutting width of upright links in the chain. It is thus required that the horizontal connector links have sharpened cutting edges at their facing edges. It has been found that since the connector links are formed in enclosed loops, the forces imposed upon the sharpened edges of the connector links when they engage the wood have tendency to peel the wire-formed connector links apart, which can result in damage to the chain, requiring replacement of the chain.

A general object of the present invention is to provide a novel saw chain having wire-formed connector links which is inexpensively and easily made, and which overcomes the disadvantages of prior devices.

Another object is to provide such a cutting chain which has good cutting characteristics while allowing the wire-formed connector links to be protected against damaging work-engaging loads.

A further object of the present invention is to provide a novel saw chain in which the interconnection between the upright links and substantially horizontal wire-formed links is such as to allow a limited degree of rotational shifting of the vertical link, or vertical shifting between the horizontal and vertical links to reduce vibration in the chain.

Another object of the invention is to provide a novel saw chain having multiple plate-formed upright cutter links, which are formed from substantially similar planar blanks, with certain of the cutter links having upper ends bent over a first distance from the center plane of the blank, and a second set of links having upper cutter portions bent over a greater distance from the plane of the blank. The second set of links may have a coined area for kerf wall fiber shearing. These cutter links may all be top sharpened in a com-

mon manner to produce links in the chain with different cutting width characteristics.

Brief Description of the Drawings

Fig. 1 is a side elevation view of a short length of a cutting chain constructed according to an embodiment of the invention, showing the chain positioned on a guide bar;

Fig. 2 is a top plan view of the chain illustrated in Fig. 1;

Fig. 3 is an enlarged cross-sectional view taken generally along the line 3-3 in Fig. 1;

Fig. 4 is an enlarged cross-sectional view taken generally along the line 4-4 in Fig. 1;

Fig. 4A is an enlarged cross-sectional view, similar to Fig. 4, illustrating an alternate embodiment of a cutter link in the chain;

Fig. 5 is an enlarged side elevational view of a planar metal blank from which the cutter link is formed;

Fig. 6 is an end view of the blank of Fig. 5; and Figs. 7, 8 and 8A are cross sectional views taken along the line 7-7 in Fig. 5 showing three different cutter configurations as produced from the blank of Fig. 5.

Detailed Description of the Preferred Embodiment

Referring to the drawings, and first more specifically to Fig. 1, at 10 as indicated generally a chain saw guide bar having a pair of opposed side rails 12, 14 between which is formed a chain-receiving groove 16.

Mounted on the bar is a section of an elongate saw chain 20 constructed according to an embodiment of the invention. Although only a short length of the chain is illustrated, it will be recognized that the chain is formed in a continuous loop which extends about the periphery of the guide bar and about a drive sprocket on a power head to which the bar and chain are connected for driving the chain about the bar.

The chain includes a plurality of links, some of which are upright plate-formed cutter links and others of which are substantially horizontally disposed wire-formed connector links. The upright plate-formed cutter links are noted at 22, 24, 26, 28, and are referred to also as cutter drive links. The cutter links are interconnected by a plurality of substantially horizontal wire-formed connector links 32, 34, as will be explained in greater detail below.

Cutter links 22, 24, are substantially similar, except that their upper cutter portions are bent to opposite sides to be mirror images of each other. Cutter links 26, 28 also are substantially similar to each, the only difference being that their upper cutter portions are bent to opposite sides so that they are mirror images. Therefore for each style of cutter link in the

chain, only one will be described in detail, recognizing that generally similar construction applies.

Each cutter link is formed from a substantially planar steel plate blank as illustrated for cutter link 22 in Figs. 5 and 6. The blank includes a depending tang portion 22a, an intermediate portion 22b, an upwardly projecting cutter portion 22c, and an upwardly projecting depth gauge portion 22d spaced from cutter portion 22c by an open gullet region 38. As is seen in Figs. 5 and 6, cutter portion 22c extends above the elevation of depth gauge portion 22d. A pair of circular bores, or apertures, 40, 42 are defined adjacent opposite ends of the intermediate portion 22b.

The cutter portion 22c has opposite side face surfaces 22f, 22g and a front face surface 22h which defines one side of gullet region 38.

To form cutter 22, cutter portion 22c is bent over at an angle 44 to one side of the center plane 46 of the drive tang and intermediate portions of the cutter as seen in Figs. 3 and 7. In the illustrated embodiment the material from which the cutter is manufactured may be on the order of .042 inch thick. The cutter portion 22c may be bent outwardly at an angle 44 of about 10° from the center plane 46 of remainder portions of the blank.

Referring to Figs. 4 and 8, a similar blank is used to form cutters 26, however the upper cutter portion 26c is bent over at a greater angle 50 from the center plane 52 of remainder portions of the cutter than angle 44 which was formed in cutter 22. Angle 50 in the illustrated cutter may be on the order of 30°.

Cutter portion 26c of cutter link 26 also has opposed side face surfaces 26f, 26g, and a front face surface 26h.

Referring to Figs. 4A and 8A, a cutter link which may be used in place of cutter links 26 and 28 is illustrated. It includes a depending tang portion 90a, an intermediate portion 90b, and upwardly projecting cutter portion 90c. It would also have an upwardly projecting depth gauge portion spaced from the cutter portion by an open gullet region as illustrated for the other cutters, but which are not shown here for simplicity. Similarly, it would have a pair of circular bores 40, 42 adjacent opposite ends of intermediate portion 90b. The cutter portion 90c has opposite side face surfaces 90f, 90g and a front face surface 90h defining one side of the open gullet region.

In this embodiment, the cutter portion 90c is bent over at an angle somewhat greater than angle 50 to which the upper portion of cutter 26 is bent. The extreme upper region of portion 90c then is coined at opposite sides to produce an inward face 90j substantially parallel to the center plane 98 of remainder portions of the cutter and an outer face 90k which is formed at a slight angle 94 from a line 96 paralleling plane 98 of remainder portions of the cutter. This coined outer surface 90k will produce a leading side cutting edge which provides a kerf wall fiber shearing

edge in the chain.

Final forming of a cutter is produced by top grinding the upper surfaces of the cutter portions using a known top grinding procedure. The depth gauge may or may not be ground. As is known for top sharpened chain, the chain is sharpened after assembly and in so doing all the cutter portions are ground to substantially the same height. This is illustrated in Figs. 3, 4, 4A, 7, 8 and 8A where cutter 22 is ground along a horizontal line to form top surface 22e, cutter 26 is ground along a horizontal line to form top surface 26e, and cutter 90 is ground to form top surface 90e.

Referring to Figs. 2 and 3, the convergence of top surface of 22e and front surface 22h define therebetween a top plate cutting edge 54. The convergence of front face 22h and side face 22f define a generally upright side cutting edge 56. The convergence of top surface 22e and side surface 22f define therebetween a top plate edge 58. The convergence of these three edges 54, 56, 58 define an outwardly projecting cutting point 60.

The top plate cutting edge 54 is disposed at a substantial angle 67 relative to center line 65 of the chain. Angle 67 between center line 65 of the chain and the top plate cutting edge 54 is in a range of approximately 82° to 88°.

Since cutters 26, 28 are formed by the same method as is used for cutters 22, 24, cutter 26 has a top plate cutting edge 64, a side plate cutting edge 66, and a top plate edge 68. A cutting point 70 is defined at the convergence of edges 64, 66, 68.

The angle 74 between the top cutting edge 64 of cutters 26, 28 and center line 65 of the chain is in a range of 60° to 75°, which is less than the angle 67 for top plate cutting edge 54 for cutter links 22, 24.

As is seen in the illustrations, and more particularly in Figs. 3, 4, 7 and 8, the cutter points 60 of cutters 22, 24 extend a distance 78 laterally of the center plane 46 of remainder portions of the link. Cutter points 70 of cutters 26, 28 extend a distance 79 from the center plane 52 of remainder portions of the link which is greater than distance 78. In the illustrated embodiment distance 78 is about .040 inch and 79 is about .100 inch. This provides a kerf-cutting width of about .200 inch.

Referring to connector links 32, 34 each of these is formed from a length of round wire. Referring to a connector link 32, it includes an elongate central portion 32a, a pair of opposed end portions, 32b, 32c, and a pair of bight portions 32d, 32e. As is best seen in Fig. 1, end portion 32c is bent up to overlie and protect underlying end portion 32b. Further, ends 32f, 32g of the wire have been blunted so that there is little likelihood that they will catch in material to be cut which could impose unwanted stress on the connecting link, as occurs in prior art devices having sharpened ends to produce cutting. These two end portions may be secured together, as by welding for added

strength.

Bight portions 32d, 32e extend through bores 42, 40, respectively, in successive links in the chain.

The side-to-side, or lateral, dimension 82 of a connector link is less than the lateral, side-to-side, dimension of cutting points 70 on cutter links 26, 28. In the illustrated embodiment dimension 82 is about .145 inch. Thus, point 70 projects a distance 81 beyond the outside of connector link 34, which in the illustrated embodiment is about .0275 inch.

The bores 40, 42 through which connector links 32, 34 extend are substantially larger in diameter than the diameter of the wire from which the connector links are constructed. In an embodiment which has worked well, bores 40, 42 have diameters of approximately .060 inch and the wire forming the connector links has a diameter of approximately .045 inch.

In operative condition the upright cutter links are positioned with their depending drive tang portions received in groove 16 in the guide bar. The connector links lie substantially horizontally with their undersides resting on the tops of guide rails 12, 14 of the guide bar.

In operation the chain is driven in the direction of arrow 80 about bar 10. In so doing, the cutter links cut a kerf through material, such as wood, which is at least as wide as the lateral, or side-to-side, distance between points 70 on cutter links 26, 28, at opposite sides of the chain. The connector links, 32, 34 have a lesser side-to-side, or lateral, dimension than the kerf width and thus do not have substantial contact with material being cut. If they should, the fact that the ends of the wire from which the connector links are formed is blunted and the forwardly directed end of the wire connector is overlaid by a rearwardly directed end portion, there is little chance that snagging will occur which would tend to separate the loop. Thus, the connector links are not subjected to substantial forces that would tend to separate the links as in prior chain.

During running of the chain it is drawn taut on the bar. Since the bores in the cutter links and the wire of the connector links are circular, the bight portion of the connector link generally moves to the portion of the bore most remote from the center of the cutter link.

This tends to center the bight of the connector link relative to the top and bottom of the bore (i.e., as illustrated in solid outline in Fig. 1, the bight portions of the connector links are substantially centered vertically in bores 40, 42 in the cutter links). However, due to the difference in sizes of the bores and wire some vertical movement can occur between the wire connector link and its associated cutter link. This allows a cutter to rock rearwardly as indicated by the dashed outline configuration for cutter 24 in Fig. 1. The difference in vertical dimensions between the bore and connector is substantial enough that the angle 84

through which the cutter may rock may be in the range of from 2° to 10°.

It has previously been recognized that allowing a cutter to rock rearwardly to reduce the depth gage setting during a cutting action is instrumental in helping to reduce vibration in the chain.

Explaining further, when the cutter link enters the cut it is in the position illustrated in solid outline. On engaging the workpiece, such as a piece of wood, if the resistance to cut is too great, the chain link may rock rearwardly as indicated in dashed outline to reduce the depth gage setting and reduce the bite being taken by the cutter, thus to reduce forces imparted to the cutting system which produce vibration. Upon release of the cutter from engagement with the wood, the tension in the chain will draw it back to the centered cutting position shown in solid outline.

The built-in looseness of the chain parts provided by difference in size of the diameter of the wire in the connector links and the bores in the cutter links helps to reduce kinking that often occurs in saw chain. Also, it allows the chain to shorten, or accordion lengthwise, as it moves off the driving sprocket toward the guide bar groove. This reduces the possibility that the chain will be thrown from the bar during operation.

It should be recognized that the embodiment described herein is for illustrative purposes only, and the chain could be either increased or decreased in size and the relationships of sizes of parts may vary.

While a preferred embodiment of the invention has been described herein, it should be apparent to those skilled in the art that variations and modifications are possible without departing from the spirit of the invention.

Claims

1. A saw chain comprising

a plurality of generally upright plate-formed links aligned along the central axis of the chain having bores extending therethrough adjacent opposite ends thereof, certain of said links being cutter links having cutter portions directed laterally of the central axis of the chain to produce a kerf-cutting sequence of a preselected width measured laterally of the chain, and

a plurality of elongate wire-formed connector links, each being disposed substantially horizontally in said chain, extending between a pair of adjacent links, and having bent over portions forming bights at opposite ends thereof extending through said bores in said links to pivotally connect adjacent links, said connector links having side-to-side dimensions as measured laterally of the chain less than said preselected width.

2. The saw chain of claim 1, wherein a connector link comprises a length of wire formed in an elongate loop.
3. The saw chain of claim 2, wherein opposite end portions of said length of wire overlap and are secured together.
4. The saw chain of claim 2, wherein the ends of said length of wire are blunted to inhibit catching in a workpiece to be cut by the saw chain.
5. The saw chain of claim 1, which comprises a first cutter link having a cutter portion extending across the center line of the chain and a second cutter link having a cutter portion projecting laterally outwardly to one side of the chain to said preselected width measurement on said one side of the chain.
6. The saw chain of claim 5, wherein said first and second cutter links each have cutting edges directed forwardly in the direction of travel of the chain and the cutting edge of the first cutter link is formed at a greater angle relative to the center line of the chain than is the cutting edge of the second cutter link.
7. The saw chain of claim 6, wherein said cutter links have depending tang portions and said first and second cutter links each have a central region intermediate said tang portion and said cutter portion, the cutter portion of said first cutter link is bent laterally from the plane of the central portion at a first angle and the cutter portion of said second cutter link is bent laterally from the plane of the central portion at a second angle greater than said first angle.
8. The saw chain of claim 1, wherein a connector link is comprised of wire having a preselected diameter and the bore in a cutter link through which said connector extends has a vertical dimension greater than said preselected diameter to allow the cutter link to shift vertically relative to said connector.
9. The saw chain of claim 8, which comprises means for releasably positioning a connector link substantially centrally between the top and bottom of its associated cutter link bore when the chain is drawn tight.
10. The saw chain of claim 1, wherein the bores at opposite ends of a cutter link are of larger diameter than the diameter of the connector links extending therethrough to allow opposite ends of the cutter link to shift vertically relative to its associ-

ated connector links.

11. A saw chain formed for mounting on a chain saw guide bar having a groove therein, the chain comprising
 - a plurality of generally upright plate-formed links aligned along the central axis of the chain having depending tang portions to be received in the bar groove and bores extending therethrough adjacent opposite ends thereof above the tang portions, certain of said links being cutter links having cutter portions directed laterally of the central axis of the chain to produce a kerf-cutting sequence of a preselected width as measured laterally of the chain, and
 - a plurality of wire-formed connector links disposed substantially horizontally in said chain and having bent over portions forming bights at opposite ends thereof extending through said bores in said links to pivotally connect adjacent links, said connector links having side-to-side dimensions as measured laterally of the chain less than said preselected width.
12. A saw chain comprising a plurality of plate-formed cutter links pivotally interconnected in succession in said chain with a first cutter link having a top cutting edge which extends laterally a first distance from the center line of said chain and a second cutter link having a top cutting edge which extends laterally to said one side of the center line of said chain a distance greater than said first distance, said cutter links each being formed from similar blanks having a substantially planar intermediate portion and upwardly extending cutter portions which are bent laterally outwardly from said intermediate portion to said respective first and second distances.
13. The saw chain of claim 12, wherein the blank from which a cutter link is formed has an upwardly and forwardly sloped forward edge and the cutting edge is defined by the intersection of a top surface ground in a plane substantially perpendicular to the plane of the intermediate portion and said forward edge.
14. The saw chain of claim 13, wherein the cutter portions of said first and second cutter links have side plate surfaces on the sides of said cutter portions opposite the center line of the chain, the intersection of the cutting edges and side plate surfaces of the cutters define a cutting point for the respective cutter, and the included angle adjacent the cutting point on the second cutter link is smaller than the included angle adjacent the cutting point on the first cutter link.

15. A saw chain comprising

a plurality of generally upright plate-formed links, each having apertures extending therethrough adjacent opposite ends of the link with an aperture having a selected vertical dimension, and

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connectors extending through said apertures to connect each link to an adjacent link in the chain, a connector having a vertical dimension substantially less than the vertical dimension of its associated aperture to allow the link to shift vertically relative to said connector.

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16. The saw chain of claim 15, which comprises means for releasably positioning a connector substantially centrally between the top and bottom of its associated aperture when the chain is drawn tight.

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17. The saw chain of claim 15, wherein an aperture is a circular bore, the connector has a circular cross-section, and the diameter of the bore is substantially larger than the diameter of the connector extending therethrough.

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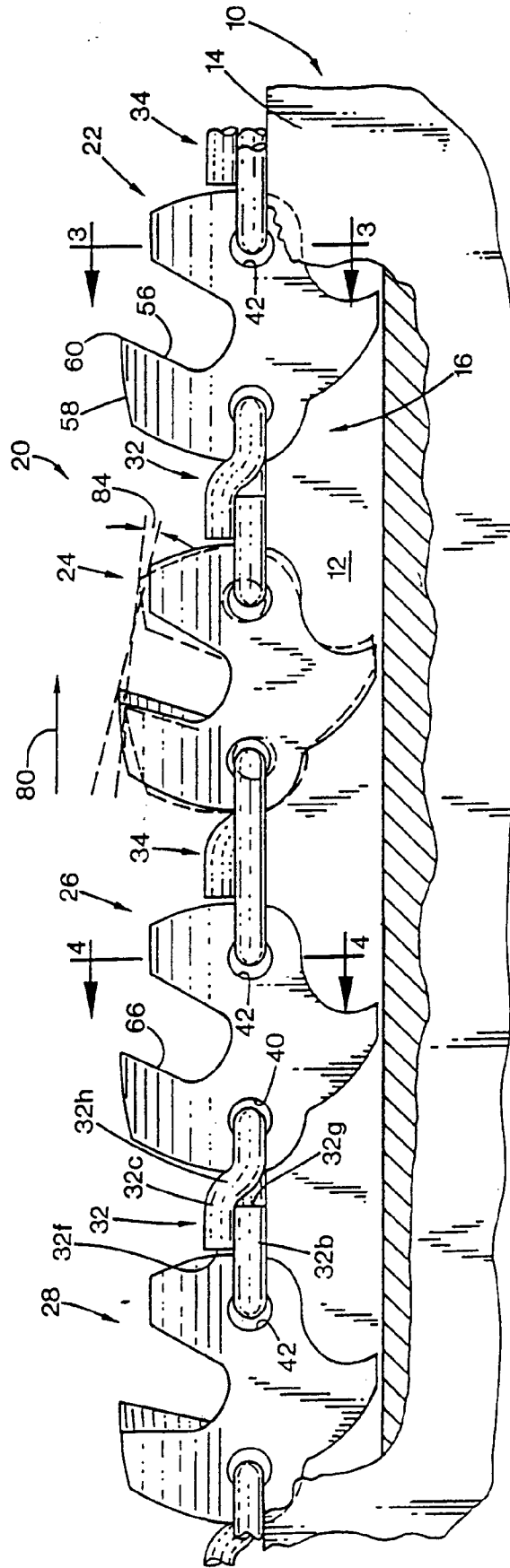
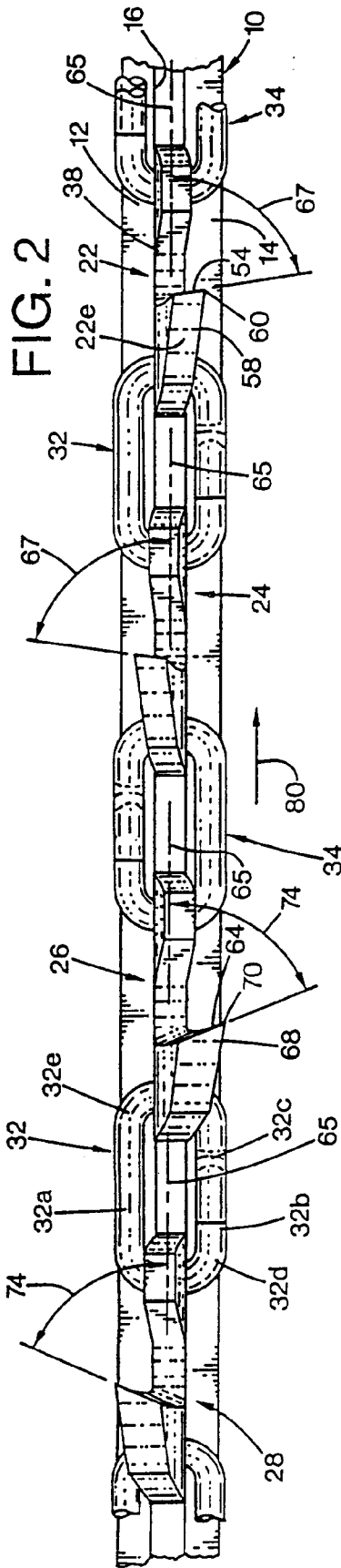


FIG. 3

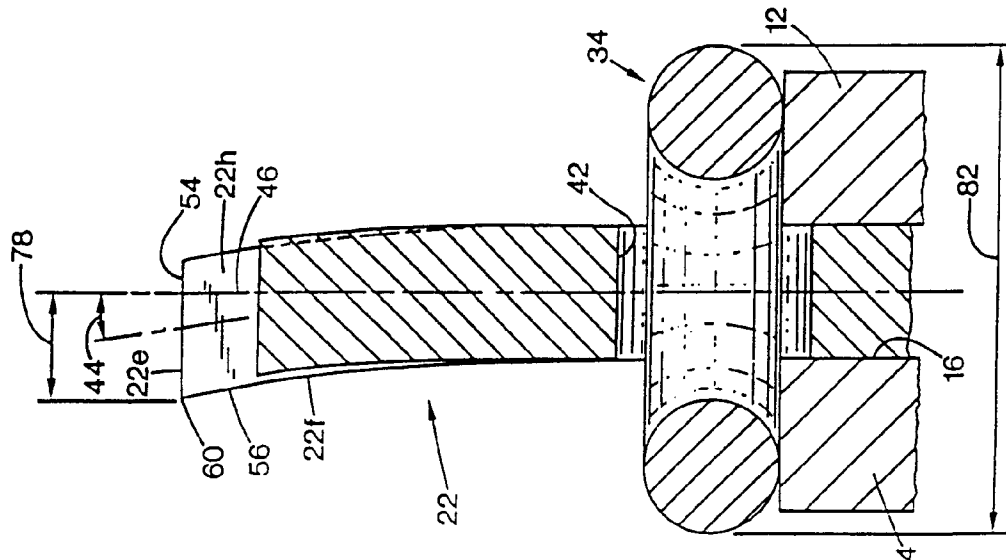


FIG. 4

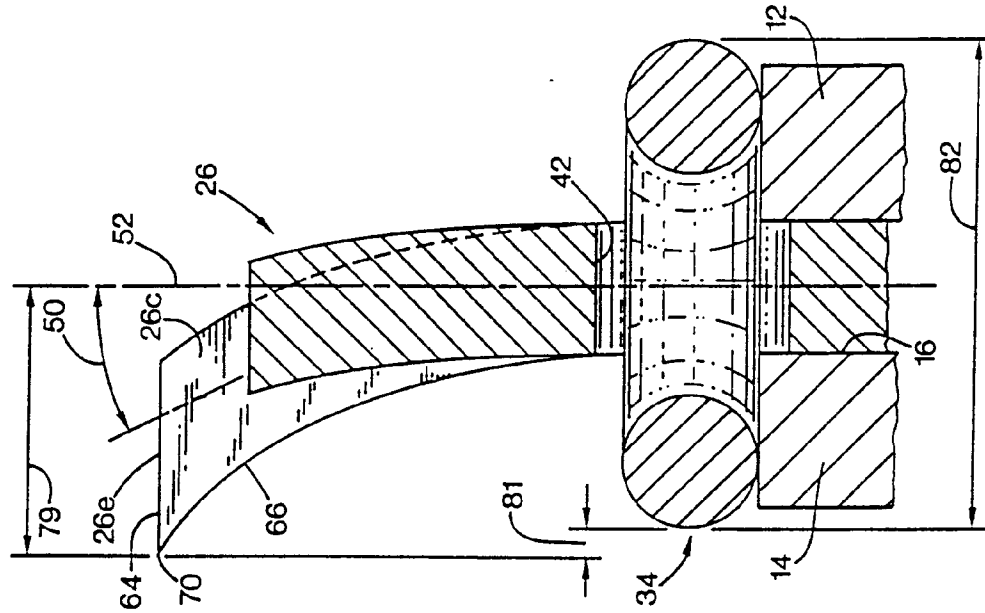


FIG. 4A

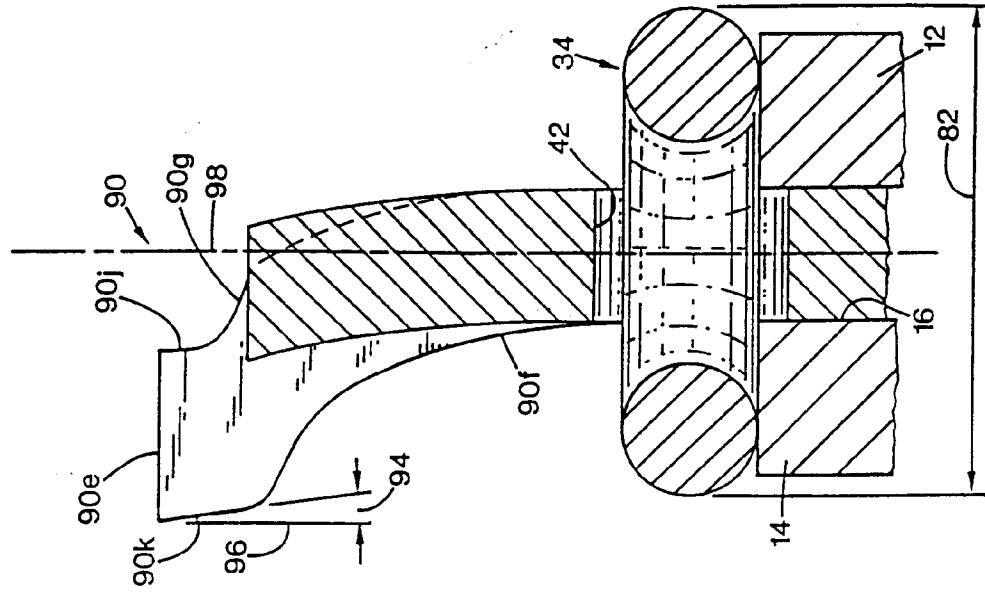


FIG. 5

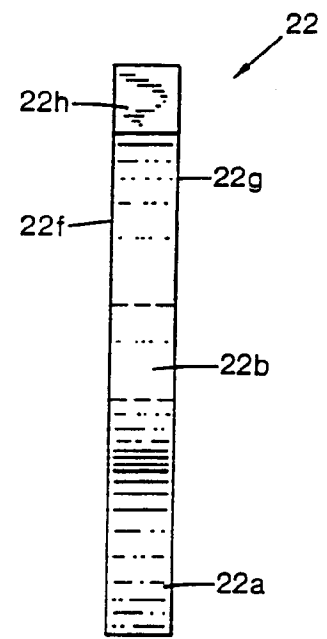
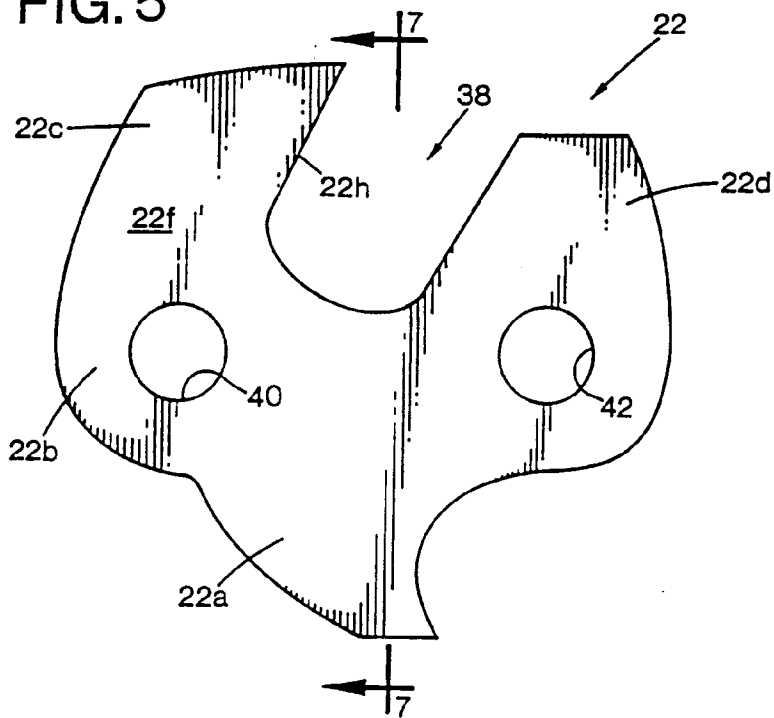


FIG. 6

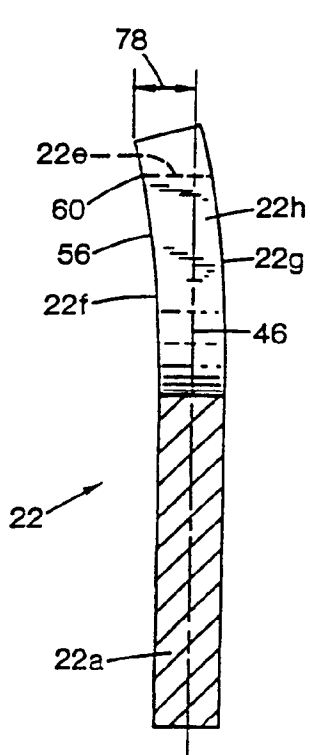


FIG. 7

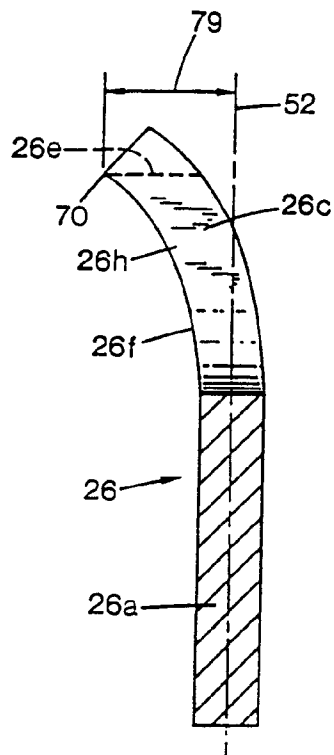


FIG. 8

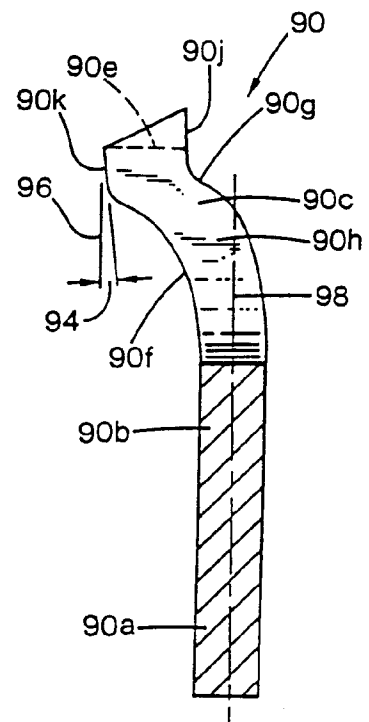


FIG. 8A