United States Patent [19]

Avramidis

[11] **3,742,776**

[45] **July 3, 1973**

[54] **SILENT CHAIN WITH IMPROVED ROCKER JOINT**

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[73] Assignee: **FMC Corporation,** San Jose, Calif.

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[21] Appl. No.: **190,872**

[52] **U.S. Cl.** ..... **74/251 S,** 74/253 S

[51] **Int. Cl.** **F16g 13/02**

[58] **Field of Search** ..... 74/253 S, 254, 251 S, 74/250 S

[56] **References Cited**

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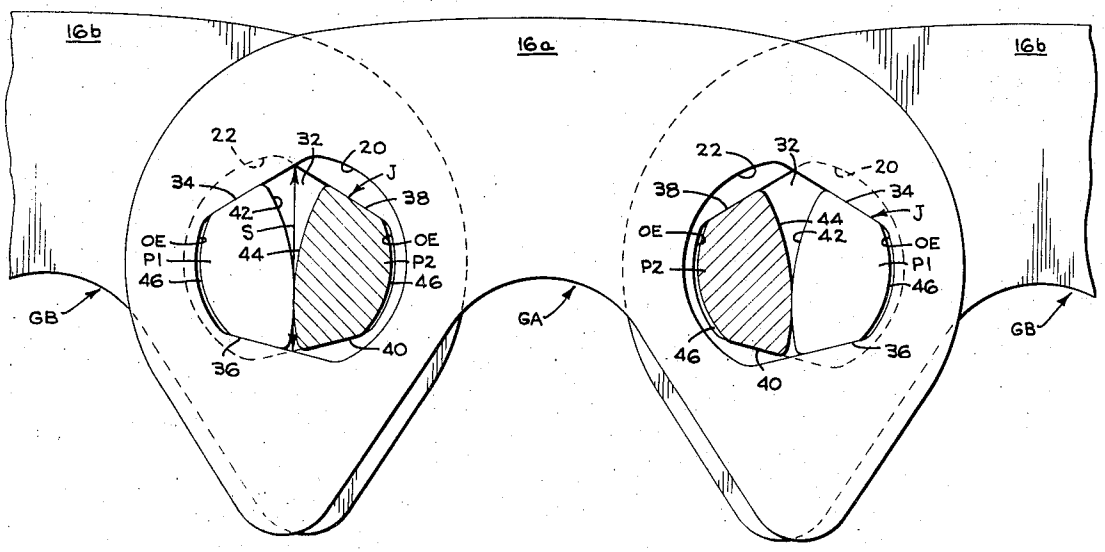
[57] **ABSTRACT**

A silent chain of the rocker type has groups of links joined together at joints by pins extending through openings at the ends of the links. At each joint one pin is wedged in the openings in one group of links and another pin, in rocking engagement with the first pin, is wedged in the openings in the adjacent group of links. The openings and the pins have complementary substantially straight wedging surfaces converging as they extend outwardly from the center of the openings. The aligned openings of two adjacent groups of links define a channel at each joint which is substantially filled by the two pins at that joint.

6 Claims, 7 Drawing Figures



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SHEET 1 OF 4

FIG_1

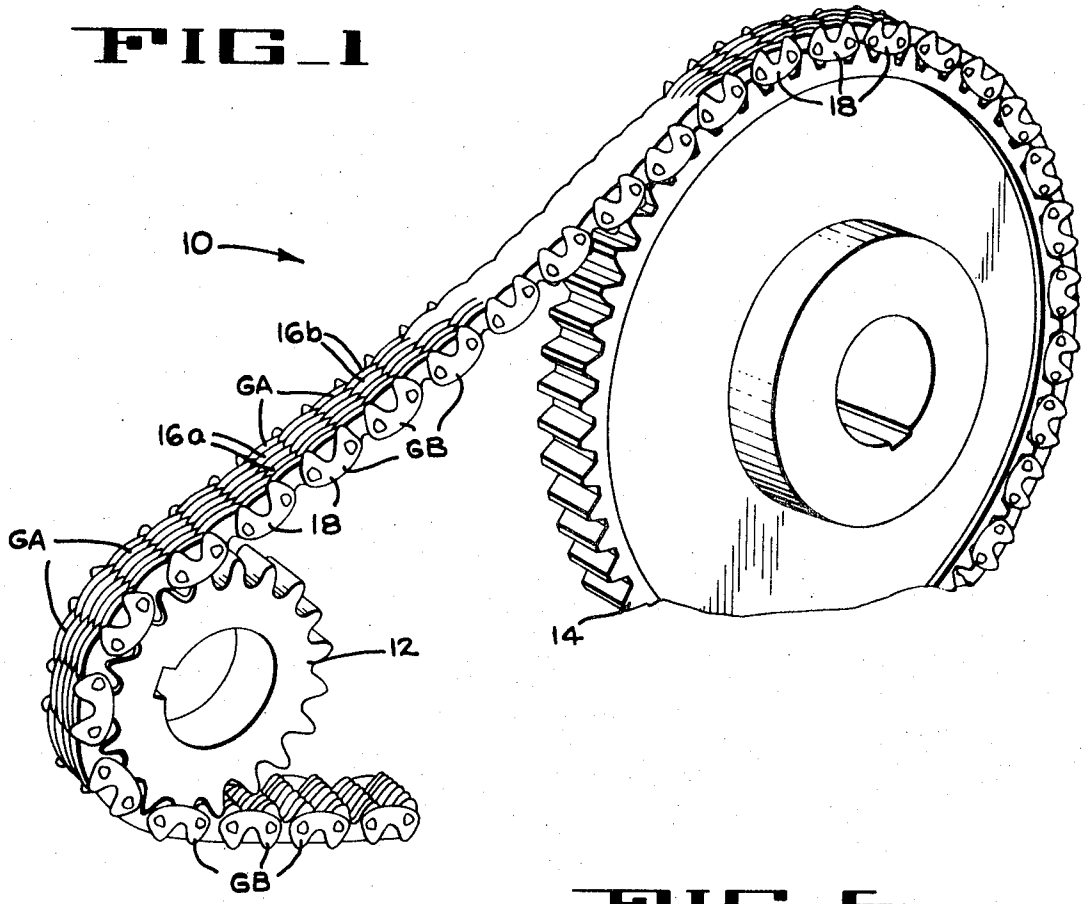


FIG_5

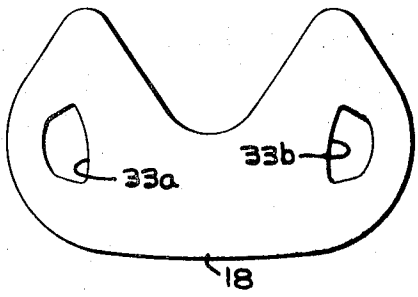
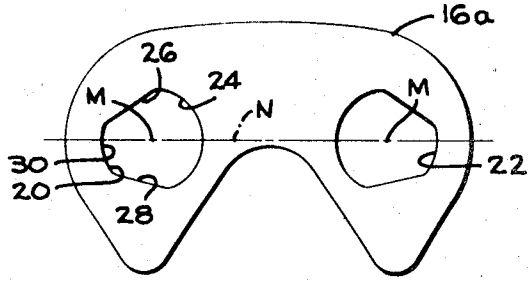


FIG_4



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ATTORNEYS

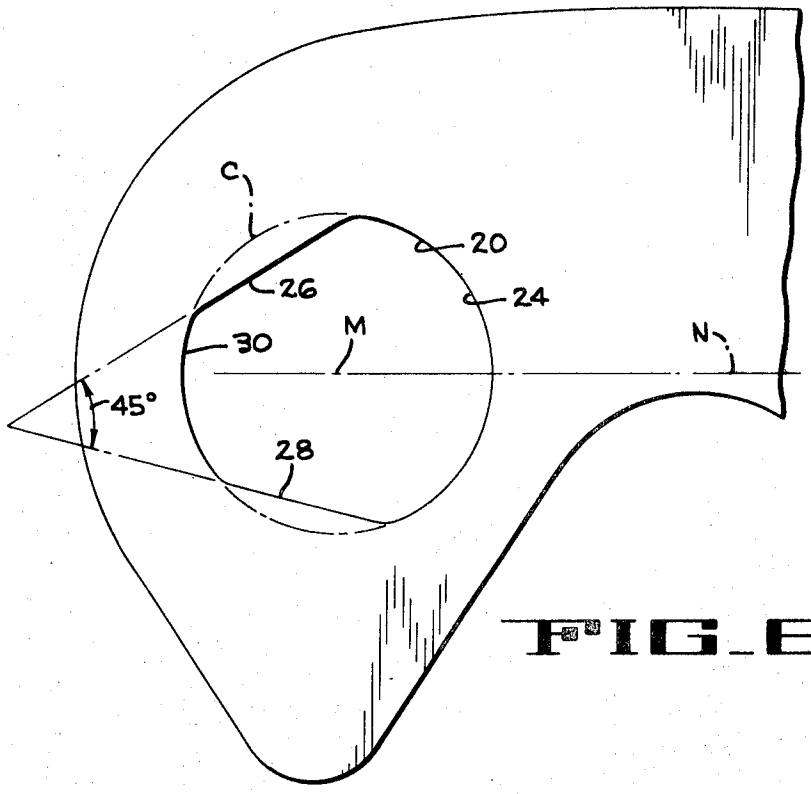
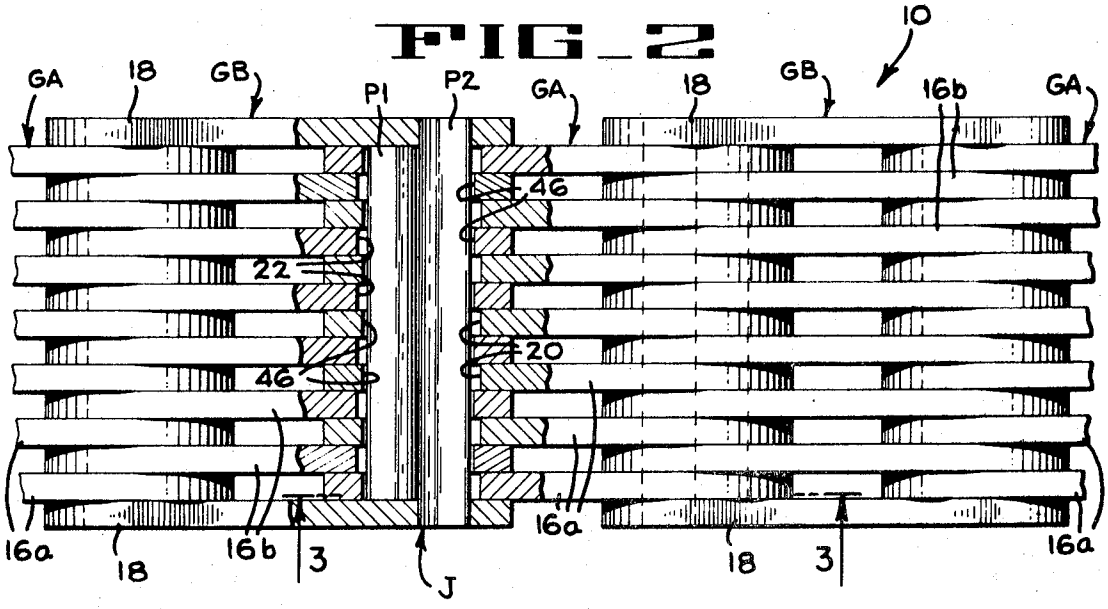

C
20
26
24
30
M
N
45°
28

FIG_6

FIG_2


10
GA
18
GB
P1
P2
GA
18
GB
16b
GA
46
22
20
46
16a
18
16b
3
J
16a
18
3
16a

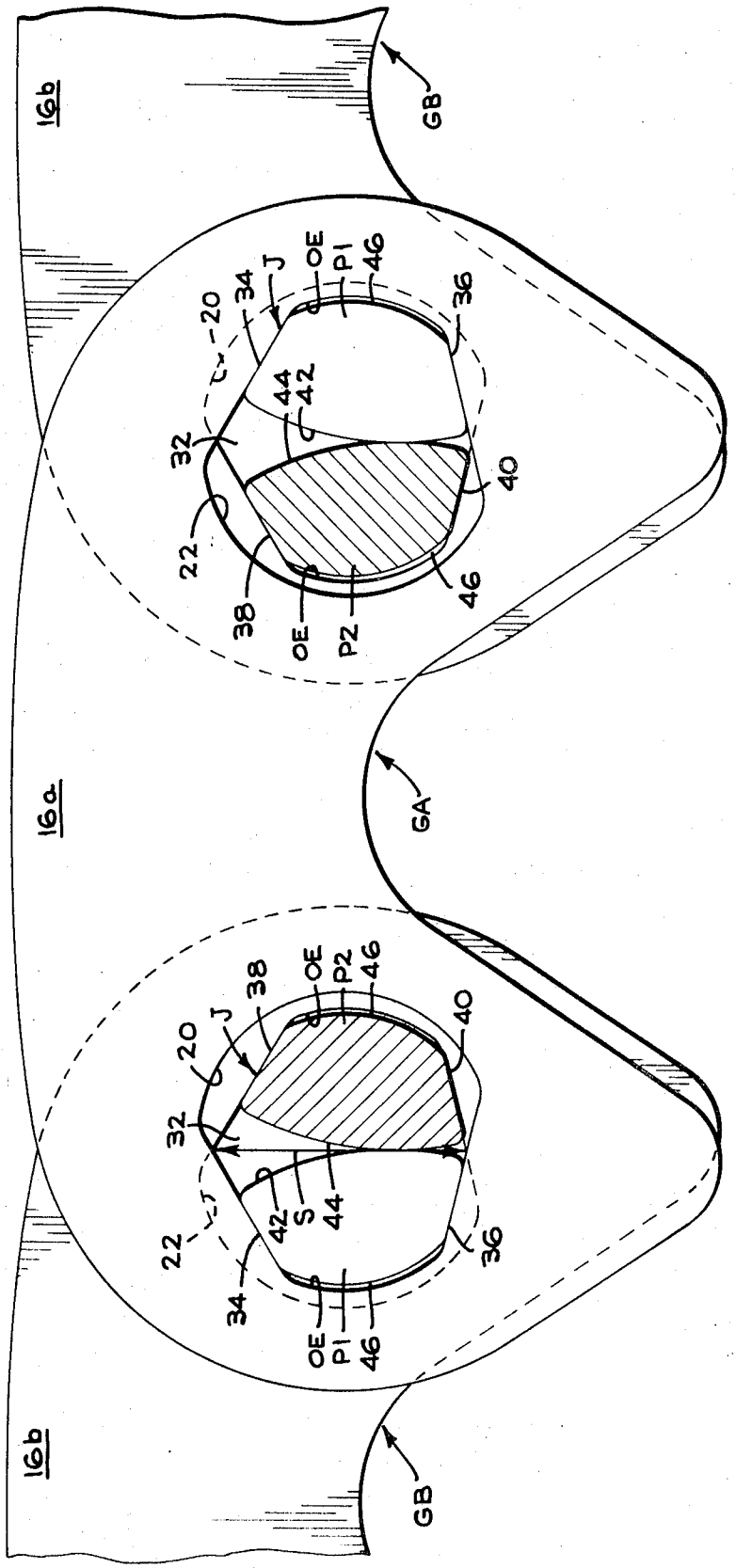

16b
GB
20
34
J
OE
P1
46
36
44
42
32
40
22
38
OE
P2
46
16a
GA
38
OE
P2
46
J
20
40
32
42
S
44
22
36
34
OE
P1
46
16b
GB

FIG_3

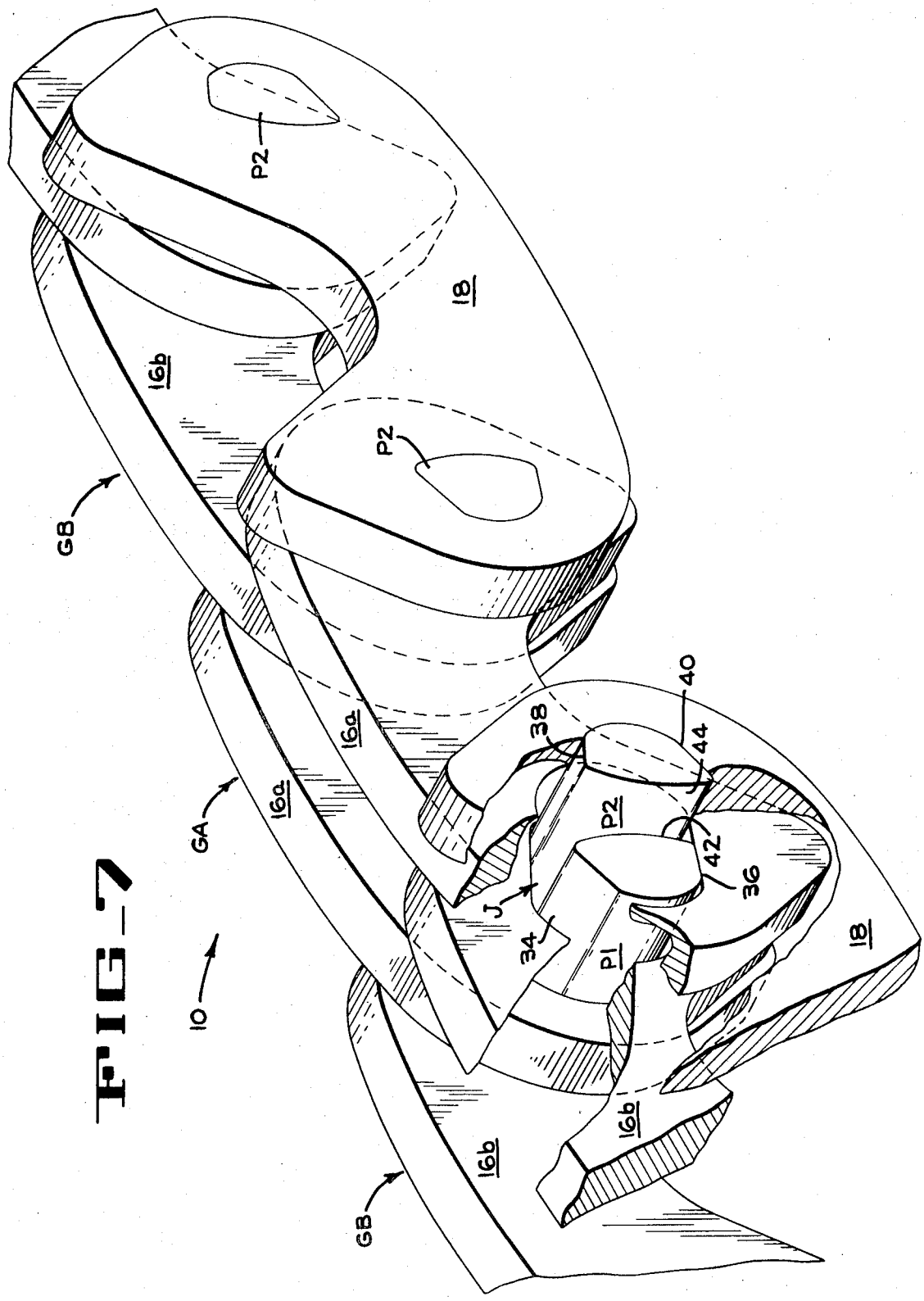


FIG_7

SILENT CHAIN WITH IMPROVED ROCKER JOINT

BACKGROUND OF THE INVENTION

1. Field of the Invention

This application relates to silent chains of the rocker joint type and more particularly to an improved chain of superior strength to reduce the elongation thereof when under tension.

2. Description of the Prior Art

Silent chains, as distinguished from roller type chains, have teeth which engage the teeth of the sprocket on which the chain is received. A typical rocker joint type of silent chain has adjacent sets of links joined by a pair of pins. One of the pins is secured in openings in one of the groups of links and the other pin is secured in openings in the other group of links. Both pins pass through the openings in both sets of links, and both pins have arcuate faces for rocking engagement to render the chain flexible. Typical silent chains of the rocker joint type are shown in the patents of Howe U.S. Pat. No. 1,188,657; Morse U.S. Pat. No. 1,634,334; Belcher U.S. Pat. No. 1,644,656; Rothman U.S. Pat. No. 1,822,749; and Terepin U.S. Pat. No. 3,213,699.

Some of these rocker type silent chains will yield, or give, slightly under tension so that shock, or a sudden application of load, will not fracture the chain. For example, in the chain shown in Rothman U.S. Pat. No. 1,822,749, flexible, curved pins are used which flatten slightly under load and shock to provide elasticity to the chain. There are, however, applications where elasticity in the chain is not required or desired, as, for example, in uses where pitch changes because of wear or stretch must be minimal.

There are also applications where maximum strength, for any given chain size, is desirable.

SUMMARY OF THE INVENTION

The silent rocker joint type chain of the present invention is strong, inelastic, and especially resistant to wear. The chain, like the typical silent chain of the rocker joint type, has groups of aligned links which are joined to adjacent groups of like links by pairs of pins. As is conventional in this type of chain, the pins have facing arcuate surfaces for engagement as the groups of links pivot with respect to each other about the pins during flexing of the chain. In the preferred form of the present invention, however, the openings at the ends of the links of each group in which the pins are received to connect adjacent groups have upper and lower straight converging wedging surfaces. One of the pins at each joint is received in the aligned openings of one group of links. The pin has upper and lower straight converging wedging surfaces complementary to the wedging surfaces of the openings so that the pin is wedged tightly into the openings of the group when tension is applied to the chain. The other pin at that joint is received in the openings of the adjacent group of links, and the other pin of that joint is wedged between upper and lower straight converging wedging surfaces of the openings of the adjacent group of links. As in conventional silent chain of the rocker joint type, both pins passed through openings of both connected groups, but, in the present invention, the two pins substantially fill the channel defined by the aligned openings of the two groups of links.

For any given size chain, and any given size chain link, the larger the openings at the ends of the links, the weaker the link ends will be, and, under high fluctuating loads, the greater will be the elasticity of the chain and the greater will be the likelihood for link failure. Similarly, the smaller and thinner the pins, the greater the flexure of the pins under high fluctuating loads and the greater the elasticity of the chain as well as the greater the possibility of pins shearing. In the chain of the present invention, however, the opening is not so large as to weaken the link ends and the pins are not so small as to flex under load, because the pins are large enough (and the openings small enough) that the pins substantially fill the channel defined by the aligned openings of two adjacent groups. The pins have no notches, and the geometry of the pin allows the most efficient use of the space in which the pin is located. This results in smaller pin diameters which require smaller link openings to improve the strength of the link.

Each pin of the chain of the present invention is wedged tightly into a group of links when the chain is under tension to minimize wear, and hence elongation, of the chain from long and severe use. The pins may be designed to create a press fit in the openings. Preferably, a small clearance is left behind each pin so that each pin will seat tightly between the upper and lower wedging surfaces, and not against the outer edge of the opening.

It is therefore one object of the present invention to provide a silent chain of the rocker joint type in which there is minimum wear between the pins and the links.

It is another object of the present invention to provide an inelastic silent chain of the rocker joint type.

It is another object of the present invention to provide a rocker joint type chain of maximum strength for a given size.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a view in perspective of the chain of the present invention mounted on sprockets.

FIG. **2** is a plan view of the chain of FIG. **1** with portions being broken away.

FIG. **3** is a view taken on the line **3—3** of FIG. **2.**

FIG. **4** is a view in elevation of an inner link of the chain of FIG. **1.**

FIG. **5** is a view in elevation of an outer link of the chain of FIG. **1.**

FIG. **6** is an enlarged fragmentary view of one end of the link of FIG. **4.**

FIG. **7** is a fragmentary view in perspective of the chain of FIG. **1.**

There is shown in FIG. **1** the silent chain **10** of the rocker joint type of the present invention mounted on sprockets **12, 14.** The chain has a plurality of groups of links GA, GB (FIG. **2**) which are connected together by pairs of pins **P1, P2** at joints J.

As shown best in FIG. **2,** every other group of inks (groups GA) consist of inner links **16***a* while alternate groups of links (groups GB) consist of inner links **16***b* and outer links **18.** For illustrative purposes only, the group of links GA consist of a plurality of spaced lateral aligned inner links **16***a* which extend, at each end, into meshing relationship with the links of groups GB. The links of groups GB consist of a plurality of spaced laterally aligned inner links **16***b* bounded, at each side, by an outer link **18.** The links of all the groups GB extend

into intermeshing relationship at each end with the links of the groups GA. It will be understood that other arrangements of links could be utilized, insofar as the present invention is concerned. For example, the links of each group could be divided into sets of two or more contiguous links with each set spaced from adjacent sets to receive sets of links of adjacent groups of links in intermeshing relationship.

As shown best in FIGS. **3** and **4**, each inner link (**16***a* and **16***b*) has an opening **20** at one end and an opening **22** at the opposite end. Since the openings are identical, except of opposite hand, only the opening **20** will be described. As shown best in FIG. **6**, the inner segment **24** of the opening (that is, the segment on the side toward the center of the link) lies on a circle C and extends for approximately 150° about the center M of the circle, which, for convenience of description, may be referred to as the center of the opening.

An imaginery line N extending between the center of opening **20** and the center of opening **22** will be considered a longitudinal axis of the link for convenience of description. The longitudinal direction will be considered parallel to axis N and lateral direction will be considered perpendicular thereto. Extending outwardly from the ends of the circular arc **24** are a straight wall section, or boundary, **26** on one side of axis N, and a straight wall section, or boundary, **28** on the opposite side of said boundary. These two wall sections, which extend, by way of example, in directions approximately 45° apart, converge (without meeting) as they extend toward the outer side of the link. It will be understood that this angle is given by way of illustration, since other angles could be used between the converging wall sections. The wall segments terminate at the ends of the outer segment **30** of the opening, which is a circular arc lying on circle C. Thus, the opening **20** has inner and outer circular segments lying on a circle C, and two wall segments on opposite sides of the axis N define straight chords of the circle C which converge (without meeting) toward the outer side of the opening.

As shown best in FIG. **3**, the openings **20** at one end of the links of group GA are aligned with the openings **22** of the links of group GB, and the openings **22** at the opposite end of the links of group GA are aligned with the openings **20** of the links of another group GB. At each end of each group of links in the chain, there is a channel **32** extending through all the links defined by the openings **20** in every other link and the openings **22** in alternate links. Stated another way, each channel **32** is defined by the openings **20** in one group of links (say group GA) and the openings **22** in the other, adjacent, group GB of links.

It will be noted, from FIG. **3**, that each channel has two straight oppositely sloping wall segments on one side of the longitudinal axes of the links, two straight oppositely sloping wall segments on the opposite side of the longitudinal axes of the links, and two circular side segments, intersecting said longitudinal axes. The wall segments on each side of the channel **32** converge (without meeting) as they extend away from the center of the channel. In other words, opposing wall segments of the channel are inclined to diminish the lateral span S of the channel toward the outer edges OE of the channel.

Each channel receives two pins, **P1** and **P2**. As shown best in FIGS. **2** and **7**, the pin **P1** extends through all the links of both groups of links GA and GB at the chain joint defined by the pins except the two outer links **18** of group GB. The pin **P2** extends through all the links of both groups of links GA and GB at the joint including the two outer links **18** of group GB. The outer links **18**, as shown in FIG. **5**, have reduced openings **33***a* and **33***b* which are similar but of opposite hand. The pins **P2** are tightly received in these openings. It will be noted that although the shape of link **18** is substantially similar to the shape of links **16***a* and **16***b*, the link is oriented upside down relative to the other links. As shown best in FIG. **1**, this is done so that the links **18** act as guide links to keep the chain on the sprockets. It will be understood that a differently shaped link, such as an oval link, could be used as a guide link.

As shown best in FIG. **3**, the pin **P1** has opposite straight walls, **34** and **36** respectively, which converge (without meeting) at an angle equal to the angle of convergence of the opposing wall segments of the opening **20**, and which are therefore complementary thereto. The pin **P1** is also complementary to the converging walls of opening **22**. The pins **P2** have similar walls, **38**, **40** which are complementary to the opposing straight converging walls of the openings **20** and **22**. The pins **P1** are secured, when the chain is under tension, by wedging action in openings **20** and **22** of all the links of group GA; the pins **P2** are secured, when the chain is under tension, by wedging action in openings **22** and **20** of all the links of group GB. The pins **P1** and **P2** all have arcuate surfaces **42, 44** for rocking engagement when the chain flexes at the joint. The pins may be slightly over size to fit into the openings by a press fit.

It will be noted from FIG. **3** that when the chain is under tension and the group GA of links is pulled away from the group GB of links, both pins at the joint between the links are urged outwardly with respect to the group of links into which they are wedged, to hold the pins tightly against rubbing action with that group of links. There is a slight clearance **46** behind each pin and the outer wall of the opening into which the pin is wedged to eliminate the possibility of the pin seating on the outer surface instead of seating on the wedging surfaces of the opening. Although the pins pass through the other group of links (that is, the group in which they are not wedged), they do not normally contact that other group of links. Thus, when the chain is under tension, the pins are wedged, by means of straight, relatively shallow, sloping, complementary wedging surfaces on pin and opening, against rubbing action in the opening. The pins rock against each other, as in conventional rocker joint type silent chain, to permit flexure of the chain.

It is significant to note that in the present invention, the two pins at each joint substantially fill the channel through the openings in both groups of links. This is important to add strength, rigidity, and inelasticity to the chain. Since substantially all of the channel is used for the pins, without any significant wasted space, the openings are as small as possible (to strengthen the links) and the pins are as large as possible (to strengthen the joint). The pins do not flex significantly under tension in the chain, and the ends of the links do not yield under such tension. Instead, a rigid, strong chain, without significant elasticity or stretch, is provided. Because the pins are wedged between relatively shallow angled walls, the pins are firmly held against rubbing in the opening.

Although the best mode contemplated for carrying out the present invention has been herein shown and described, it will be apparent that modification and variation may be made without departing from what is regarded to be the subject matter of the invention.

What is claimed is:

1. A silent chain having a plurality of groups of links with sprocket engaging teeth, said links having openings at each end, the openings at one end of one group of links aligned with the openings at the opposite end of the adjacent group of links, said aligned openings defining a channel having opposing boundaries each defined by both said one group of links and said adjacent group of links, at least one of said boundaries defined by two substantially straight elongated wedging surfaces inclined to diminish the lateral span of the channel towards the outer edges of the channel, and a pair of pins and only a pair of pins received in said channel, said pins having arcuate facing surfaces for rocking engagement and having opposite surfaces for engagement with the opposing boundaries of the channel, said opposite pin surfaces extending substantially the full width of the pin and being complementary to the opposing channel boundaries for wedging engagement therewith, said pins substantially filling the channel when in rocking engagement.

2. A silent chain having a plurality of groups of links with sprocket engaging teeth, said links having openings at each end, the openings at one end of one group of links aligned with the openings at the opposite end of the adjacent group of links, said aligned openings defining a channel having opposing boundaries each defined by both said one group of links and said adjacent group of links, both of said boundaries defined by two substantially straight elongated wedging surfaces inclined to diminish the lateral span of the channel towards the outer edges of the channel, and a pair of pins and only a pair of pins received in said channel, said pins having arcuate facing surfaces for rocking engagement and each having substantially straight opposing surfaces extending substantially the full width of the pin for engagement with one side of the opposing surfaces of said channel, said opposing pin surfaces being complementary to the opposing channel boundaries for wedging engagement therewith, said pins substantially filling the channel when in rocking engagement.

3. A silent chain having a plurality of groups of links with sprocket engaging teeth, each group of links having openings at each end, each of said openings having substantially straight, elongated converging opposing walls, the openings at one end of each group of links aligned with the openings at the opposite end of the adjacent group of links to define a channel with the opposing walls of one group of links converging oppositely to the opposing walls of the adjacent group, said walls converging as they extend outwardly from the center of the channel, a first pin received through openings of both of said groups of links, said first pin having converging substantially straight opposing walls extending substantially the full width of the pin to be received tightly between the converging walls of the openings in one of said group of links, a second pin received through openings of both of said groups of links, said second pin having converging substantially straight opposing walls extending substantially the full width of the pin to be received tightly between the converging walls of the openings in the adjacent group of links, said pins having facing arcuate surfaces for rocking engagement, said first and second pins alone received in said channel and said pins substantially filling the span between the outer edges of the channels.

4. The mechanism of claim 1 in which each of said openings comprises opposite arcuate segments and opposite sloping straight segments.

5. The mechanism of claim 2 in which a clearance is provided between the outer edge of the link opening and the outer edge of a pin wedged therein.

6. The mechanism of claim 3 including outer links for one of said groups received tightly on the ends of one of said pins.

* * * * *