WEAR-RESISTANT INSERTS FOR IN SURFACES OF THE LINKS OF CUTTER CHAINS AND THE LIKE TO RETARD WEAR THEREOF

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ABSTRACT

Hard wear resistant inserts for those surfaces of the links of cutter chains vulnerable to sliding-type wear as they pass about a cutter bar or other supporting means. The inserts are of circular cross section and are affixed in holes in the link surfaces with their exposed end or ends flush with the surfaces they protect. Similar inserts may be provided for those supporting means surfaces with which the chain links are in sliding contact.

19 Claims, 18 Drawing Figures
WEAR-RESISTANT INSERTS FOR IN SURFACES OF THE LINKS OF CUTTER CHAINS AND THE LIKE TO RETARD WEAR THEREOF

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to means to retard wear of the link elements of cutter chains and the like and/or the surfaces with which they are in contact, and more particularly to the provision of wear-resistant inserts in association with those surfaces subject to sliding-type wear.

2. Description of the Prior Art

Prior art workers have devised many types of mining machines. These machines range from the large, complex, self-propelled, continuous mining machines capable of cutting entire entries, to the more specialized types such as the well known mining machines having cutter bars adapted to make undercut cuts in the face of the material being mined.

A great many of the mining machines utilize one or more cutter chains. A wide variety of cutter chains has been developed by prior art workers. In general, however, they constitute continuous chains made up of link elements, all of which, or selected ones of which, carry one or more cutter bits.

In the large continuous mining machines the primary cutting operations are accomplished by rotating, bit-carrying drums, arms, endless chains or wheels. Many such continuous mining machines utilize one or more cutter chains as secondary cutting means to make clearance cuts and to reach that material not cut by the primary cutting means. Such cutting chains are frequently referred to as trim chains. The trim chains are generally sprocket driven and frequently pass over or through guide means so as to be subject to sliding-type wear.

In other types of mining machines, such as the cutter bar type, the cutter chain constitutes the primary cutting means. In the cutter bar-type of machine the cutter chain is normally sprocket driven and is in sliding contact with the peripheral edges of the cutter bar throughout most of its travel thereabout.

In many types of mining machines chains are also used as conveyor means for the material having been cut. Such chains frequently travel over trough-like support surfaces.

As used hereinafter and in the claims, the term "chain" is intended to cover any type of bit-carrying chain, conveyor chain or the like subject to sliding-type wear in a part or a preponderance of its path of travel. The term "chain" is intended to encompass not only conveyor chains and ordinary cutter chains, but also the more specialized types of cutter chains such as trim chains and the like. In its broad aspects, the present invention is not limited to a particular chain usage or a particular type of mining machine. For purposes of an exemplary showing, however, the cutter chain of a cutter bar-type mining machine will be described, since it presents an excellent example of sliding-type wear to which a chain is subjected.

The typical mining machine utilizing a cutter bar comprises a body portion to which the rearward end of the cutter bar is pivotally affixed. The body may be self propelled and the cutter bar extends forwardly of the body. The pivotal mounting of the rearward end of the cutter bar to the body is such as to permit at least a horizontal traversing or sweeping action of the cutter bar.

In some machines, the cutter bar may be oriented other than horizontally. A cutter chain is provided and is adapted to pass about the peripheral edges of the cutter bar. At the rearward end of the cutter bar the chain passes about a sprocket means by which the chain is driven. At the forward or free end of the cutter bar, the chain passes about a driven or idler sprocket. Alternatively, the forward end of the cutter bar may be provided with an integral or removable semi-circular shoe about which the chain passes in sliding engagement. The chain is also slideably engaged along the longitudinal edges of the cutter bar.

In general, the sliding engagement of the chain with the cutter bar (and the shoe if present) may take one of two basic forms. In the most common embodiment, the cutter bar is so constructed as to have a peripheral channel or passageway in which the chain rides. The cutter bar, for example, may comprise a pair of parallel spaced beams having plate members affixed to the top and bottom surfaces thereof. Edge portions of the plate members define the side walls of the chain channel while the beams themselves form the channel bottoms.

When a shoe is used in place of an idler sprocket or the like, it will be configured so as to provide a semi-circular channel, making the chain channel continuous about the sides and forward end of the cutter bar.

Chains for use with a cutter bar have taken many forms. In some versions, all of the chain link members carry cutter bits. In other forms, the cutter bit carrying links are joined together by connecting links. In either event, the cutter bit carrying links each have one or a spaced pair of legs adapted to straddle and slidingly engage the peripheral edge of the cutter bar (and the shoe if used).

Since both cutter bar embodiments involve a sliding-type engagement between the chain and the cutter bar, it will be understood that both the chain and the peripheral portion of the cutter bar engaged by it are subject to sliding-type wear. As will be shown hereinafter, it is common practice to provide the peripheral edge portion of the cutter bar (and the shoe if used) with removable and replaceable wear strips. This expedient greatly prolongs the service life of the cutter bar.

The chains are equally subject to wear. As the leg portions of the chain links, engaging the peripheral edge portion of the cutter bar, become worn, their tracking characteristics about the cutter bar deteriorate. This, in turn, not only tends to increase the wear on the leg portions of the chain, but also to increase the wear on the cutter bar or its wear strips.

Prior art workers have not given much attention to the wearing of the leg portions of the chain links. One reason for this lies in the fact that it was not deemed economically feasible to do so because the chains, or at least worn links thereof, were intended to be replaceable after a given service life. Prior art workers, for example, provided some at least of the surfaces of certain chain links subject to sliding type wear with a hard surfacing. While this expedient tends to retard
wear of surfaces so protected, it leaves something to be desired. First of all, the degree of hardness imparted to the surface to be protected is limited, secondly, it is difficult to hold the hard surfacing in place. The hard surfacing is subject to cracking, breaking and spalling, and when cracking occurs, it can continue on into the base material of the chain link. Finally, the depth of the hard material applied to the surface to be protected is also limited.

The present invention, however, provides a simple and economical means by which the sliding-type wear of the chain links may be greatly retarded. This, in turn, results in a greatly increased service life for the chain links and less wear on the cutter bar. As will be developed hereinafter, the teachings of the present invention may also be applied to those surfaces with which the chain links are in sliding contact.

**SUMMARY OF THE INVENTION**

The present invention contemplates the provision of wear-resistant inserts for those surfaces of the links of chains vulnerable to sliding-type wear. The inserts are embedded in the vulnerable surfaces by permanently affixing them in holes in the surfaces with the exposed portions of the inserts being substantially flush with the surfaces they protect. While the cross sectional configuration of the inserts does not constitute a limitation on the present invention, in many instances a cylindrical insert will be easiest to use since it only requires the drilling of an appropriately sized hole.

In one of the exemplary embodiments of the invention disclosed, the upper surfaces of the laterally extending lower leg flanges of the bit carrying links are provided with inserts spaced evenly therealong. In another embodiment, the inserts extend completely through the lower leg flanges of the bit carrying links so as to protect both the upper and lower surfaces of these flanges. In yet another embodiment, both the upper and lower surfaces of the lower leg flanges are protected, each by their own set of spaced, wear-resistant inserts. The inserts may also be so located as to simultaneously protect two adjacent surfaces.

The present invention also contemplates the protection of the side surfaces of the bit carrying link legs as well as the lower surface of the upper link flanges.

While all of the embodiments just described are illustrated in the form of bit-carrying links of the type having pairs of spaced legs adapted to be slidably engaged in a peripheral groove about a cutter bar, as will be shown and described hereinafter, the present invention is equally applicable to single-legged bit-carrying links and to bit-carrying links of the type having spaced pairs of legs adapted to straddle the peripheral portion of a cutter bar.

The wear-resistant inserts of the present invention may also be applied to connecting links, pintle means and the like. While in most instances the inserts are permanently mounted in the surfaces they protect, they may be removable mounted, as will be described.

As indicated above, the invention is not intended to be limited to cutter chains of the type used with cutter bars, but may in fact be applied in the manner taught to any surface of any type of chain subject to sliding-type wear. It will also be shown that the guideways or other surfaces against which the chains slide may be similarly protected.

**BRIEF DESCRIPTION OF THE DRAWINGS**

FIG. 1 is a side elevational view of a bit-carrying chain link illustrating an exemplary embodiment of the present invention.

FIG. 2 is a fragmentary cross-sectional view illustrating the link of FIG. 1 mounted on a cutter bar.

FIG. 3 is a perspective view of an exemplary form of wear resistant insert of the present invention.

FIGS. 4, 5 and 6 are elevational views similar to FIG. 1 and illustrating additional embodiments of the present invention.

FIG. 7 is a fragmentary cross sectional view illustrating the link of FIG. 6 mounted on a cutter bar.

FIG. 8 is a fragmentary cross-sectional view illustrating the present invention as applied to a link having a single leg slidably engaged in a cutter bar peripheral groove.

FIG. 9 is a fragmentary side elevational view of a bit-carrying link of the type adapted to straddle the peripheral portion of a cutter bar and embodying the present invention.

FIG. 10 is a fragmentary cross sectional view illustrating the link of FIG. 9 mounted on a cutter bar.

FIG. 11 is a perspective view of another embodiment of the wear-resistant inserts of the present invention.

FIG. 12 is a front elevational view of a link of the type shown in FIGS. 1 and 2 illustrating a modified embodiment of the present invention.

FIG. 13 is a perspective view of a wear-resistant insert for use with the link of FIG. 12.

FIG. 14 is a front elevational view of a link similar to that of FIG. 10 illustrating the provision of clearance holes for mounting the inserts.

FIG. 15 is a fragmentary cross sectional view of a cutter bar provided with the wear-resistant inserts of the present invention.

FIG. 16 is a fragmentary perspective view of a wear strip provided with wear-resistant inserts in accordance with the present invention.

FIG. 17 is a fragmentary elevational view, partly in cross section, and illustrating an insert removably mounted with respect to a surface to be protected.

FIG. 18 is a fragmentary perspective view of a leg of a link of the type shown in FIGS. 1 and 2 illustrating alternative mounting modes for the wear-resistant inserts.

**DESCRIPTION OF THE PREFERRED EMBODIMENTS**

An exemplary embodiment of the present invention is illustrated in FIGS. 1 through 3. Turning first to FIGS. 1 and 2, a typical cutter chain link is generally designated at 1. In FIG. 2, the link is shown in association with a cutter bar, generally indicated at 2.

The link 1 is of the bit-carrying type and comprises a pair of legs 3 and 4 joined together by an integral block or lug 5. The lug 5 comprises the mounting means for a cutter bit and is shown as having a shank receiving perforation 6 and a transverse hole 7.

For purposes of an exemplary showing, a cutter bit 8 is shown mounted in the lug 5. The cutter bit is of the general and well known type taught in U.S. Pat. No. 3,114,537. The bit comprises a head portion 9 and a shank 10. The head portion has a hard cutting tip 11 and the shank is provided with a hook-shaped notch 12. As is clearly seen in FIG. 1, the bit shank 10 is received
in the shank receiving perforation 6 of the lug 5. The hook-shaped notch 12 of the shank is engaged by a resilient retaining means 13 of the type taught in the above-noted U.S. patent. The combination of the bit 8 and retaining means 13 renders the bit of the knock-in, pry-out type. A pry-out notch is provided on the head portion of the bit at 14.

The leg 3 of the link 1 has an upper laterally extending flange portion 15 and a lower laterally extending flange portion 16. The purpose of these flanges will be apparent hereinafter. The leg 3 also has a pair of transverse perforations 17 and 18. The perforations 17 and 18 are adapted to receive pinteles by which the link 1 is pivotally connected at both of its ends to connecting links (not shown) which in turn are connected to additional bit-carrying links identical to the link 1. The link leg 4 is a mirror image of the leg 3 and has upper and lower laterally extending flange portions 19 and 20, substantially identical to the flange portions 15 and 16 of leg 3. It will be understood that the leg 4 will have transverse pintle-receiving perforations coaxial with the perforations 17 and 18 of leg 3.

Reference is now made to FIG. 2, wherein the cutter bar 2 is fragmentarily illustrated. It will be understood by one skilled in the art that in most applications the cutter bar will be horizontally oriented. However, in FIG. 2 (as in FIGS. 7, 8, 10 and 15) the cutter bar is oriented vertically for purposes of clarity of description.

FIGS. 2 fragmentarily illustrates only an edge portion of the cutter bar 2. The edge is provided with a U-shaped channel or notch 21 having a base surface 21a and side surfaces 21b and 21c.

Since their use is common in the art, for purposes of an exemplary showing the cutter bar 2 is illustrated as being provided with removable and replaceable wear strips 22, 23 and 24. The wear strip 22 comprises an elongated member affixed to the bottom or base surface 21a of the cutter bar notch 21. The wear strip 23 is of inverted L-shaped cross section and lies along the side surface 21b of the notch 21. It will be noted that a portion of the wear strip 23 also overlies the outside edge of the cutter bar. The wear strip 24 is identical to the wear strip 23 and overlies the cutter bar notch surface 21c and a portion of the outermost cutter bar surface. The manner in which the wear strips are affixed to the cutter bar does not constitute a limitation on the present invention. They are normally removable affixed, being held in place by machine screws or the like.

With the wear strips 22 through 24 in place, the peripheral notch in the cutter bar takes on an inverted T-shaped cross section. When the link 1 is located in the cutter bar notch, the lateral lower flanges 16 of leg 3 and 20 of leg 4 are located between the wear strip 22 and the lower edges of wear strips 23 and 24, respectively (as viewed in FIG. 2). Clearances are such between the wear strips and the link legs 3 and 4 that the link is readily slideable in the cutter bar notch, although it is captively held therein by the interaction of wear strips 23 and 24 and leg flanges 16 and 20. The particular exemplary link illustrated has upper lateral leg flanges 15 and 19 which ride along the uppermost surfaces of wear strips 23 and 24, respectively (as viewed in FIG. 2.). It will be evident from FIGS. 1 and 2 that in the embodiment shown the contact point between the cutter bit tip 11 and the material being mined (not shown) lies at a considerable distance from the line of force on the chain passing through the chain pintles. As a result, when the chain is driven in the cutting direction (indicated by the arrow A in FIG. 1), there is a strong tendency for the lug bearing link members to pivot in a direction opposite to the cutting direction. As a consequence of this, the upper surfaces of the lower leg flanges 16 and 20 contact the lower ends of wear strips 23 and 24, respectively, and these upper flange surfaces (particularly at the forward end thereof) constitute surfaces especially vulnerable to sliding type wear.

To protect these surfaces and retard their wear, the flange 16 is illustrated in FIG. 1 as having a plurality of evenly spaced holes 25 formed therein. The holes 25 extend from the upper surface of flange 16 down into the flange, but not through it. Located in each hole 25 there is an insert of wear-resistant material 26. The inserts 26 may be made of any suitable wear-resistant material such as tungsten carbide, titanium carbide, hardened steel or other hard alloys, or nonmetallic wear-resistant material such as ceramic material. The inserts 26 are permanently affixed within the holes 25 in any suitable manner such as a force fit, brazing, or through the use of an appropriate adhesive. It will be noted that the uppermost ends of the inserts 26 are flush with the upper surface of flange 16. As indicated in FIG. 2, the lower flange 20 of leg 4 will similarly be provided with holes 25 and wear-resistant inserts 26, each one of which is shown in the figure.

FIG. 3 illustrates an exemplary insert 26. It will be noted that the insert is a simple cylindrical member. The precise configuration of the insert and its cross section do not constitute a limitation on the present invention. The cylindrical configuration illustrated in FIG. 3 has the advantage that the insert 26 may be located in a hole formed by a simple drilling operation.

FIG. 4 illustrates another embodiment of the present invention and shows a lug, cutter bit and retaining means assembly substantially identical to that of FIG. 1. As a consequence, like parts have been given like index numerals. The embodiment of FIG. 4 differs from that of FIG. 1 in that the lower flange 16 of leg 3 is provided with a plurality of spaced holes 27 which extend from the upper surface of the flange through the lower surface of the flange. Each of the holes 27 is provided with a wear-resistant insert 28 similar to those shown at 25 in FIGS. 1 through 3, but of such length that its ends are flush with the upper and lower surfaces of flange 16. It will be understood that the lower lateral flange of the other leg of the link 1 will be similarly protected. The link of FIG. 4 may be used in the cutter bar 2 of FIG. 2 and it will be evident that the wear-resistant inserts 28 will not only protect the upper surfaces of both leg flanges but also the lower surfaces of these flanges as they make sliding contact with the base wear strip 22.

FIG. 5 illustrates another embodiment wherein both the upper and lower surfaces of the lower leg flanges are protected. FIG. 5 is substantially identical to FIG. 1 and like parts have been given like index numerals. As in the case of the structure of FIG. 1, the upper surface of the leg flange 16 is provided with holes 25 and wear-resistant inserts 26. The flange 16 has a second set of holes 29 extending upwardly from its lower surface and containing wear-resistant inserts 30. It will be noted that the lowermost ends of inserts 30 are flush.
with the lower surface of flange 16 and will serve to retard sliding-type wear of this lower surface by contact with the base wear strip 22. It will be understood that the lower lateral flange of the other leg of link 1 will be similarly protected.

In the embodiments of FIGS. 4 and 5, and the additional embodiments described hereinafter, the wear-resistant inserts may be made of any of the materials discussed with respect to the embodiments of FIGS. 1 through 3 and may be held in place by any appropriate one of the methods described above.

FIGS. 6 and 7 illustrate how the wear-resistant inserts of the present invention may be applied to other surfaces of the link vulnerable to the sliding-type wear. The link of FIGS. 6 and 7 and the cutter bar of FIG. 7 are identical to those of FIGS. 1 and 2 and the lower leg flanges of the link are protected in an identical manner. Therefore, like parts have been given like index numerals. As will be evident from FIG. 7, the outside surfaces of legs 3 and 4 will have sliding contact with the cutter bar wear strips 23 and 24, respectively. The same is true of the underside of the upper leg flanges 15 and 19.

Referring particularly to FIG. 6, the outside surface of leg 3 may be provided with a plurality of appropriately placed holes 31. As is evident from FIG. 7, the holes 31 extend from the outside surface of leg 3 inwardly, but do not pass through the leg. Each of the holes 31 is provided with a wear-resistant insert 32. Again it will be evident from FIG. 7, the exposed end of each insert is flush with the outside surface of leg 3. The legs 4 may similarly be provided with holes 31 and inserts 32. The number and location of the holes 31 and inserts 32 may vary from one type of lug to another and based upon the severity of the wear, can be readily determined by one skilled in the art.

The sliding-type wear of the lower surface of lateral flange 15 at the top of leg 3 can be retarded by the provision of a plurality of spaced holes 33, each containing a wear-resistant insert 34. The perforations 33 extend from the lower surface of flange 15 but do not extend through the flange. The free end of each insert 34 is flush with the lower surface of flange 15. It will be understood that the similar flange 19 of leg 4 may be provided with identical perforations 33 and inserts 34, one each of which is shown in FIG. 7. It will be understood from FIGS. 6 and 7 that all of the link leg surfaces contacting the cutter bar wear strips 23 and 24 are protected by wear-resistant inserts. Any sliding-type wear produced on the lower surfaces of leg flanges 16 and 20 by contact with the cutter bar base wear strip 22 could be retarded by treating the lower flanges 16 and 20 in either of the ways taught with respect to FIGS. 4 and 5.

FIG. 8 illustrates a bit-carrying chain link of the type having a single leg adapted to ride in a peripheral cutter bar groove. This link element comprises a body portion or lug 35 having a single leg 36 terminating in a pair of diametrically opposed lateral flanges 37 and 38. The lug portion 35 may be provided with a shank receiving perforation and a transverse perforation (not shown) equivalent to the shank receiving perforation 6 and transverse perforation 7 of FIG. 1. In such an instance, the lug 35 may carry a cutter bit 39 identical to the cutter bit 8 of FIG. 1. At its forward end the lug portion 35 is illustrated as having a pair of spaced forward projections 40 and 41 with coaxial, transverse perforations 42 and 43 therein, respectively. One end of a connecting link (not shown) may extend between the projections 40 and 41 and be pivotally affixed thereto by pin relationships through the perforations 42 and 43. The other end of the connecting link will, in turn, be similarly connected to another bit-carrying link member of the same type shown in FIG. 8. To this end, the lug portion 35 of the link member may have projections similar to projections 40 and 41 at its other end.

If a plurality of bit-carrying link elements identical to that shown in FIG. 8 are intended to be joined directly together, the rearward end of the lug portion 35 may have a central, rearwardly extending projection adapted to be received between the projections 40 and 41 of the adjacent bit-carrying link element. The alternate location of double and single projections may be reversed. Thus, the forward end of the lug portion 35 may have a single central forwardly extending projection and its rearward surface may have a pair of spaced, rearwardly extending projections.

The cutter bar and its removable wear strips are identical to those shown in FIGS. 2 and 7, and like parts have been given like index numerals.

In FIG. 8 the upper surfaces of the lower leg flanges 37 and 38 are illustrated as being protected by the provision of holes with wear-resistant inserts in the same manner described with respect to FIGS. 1 and 2. Again, like parts have been given like index numerals. It will further be understood, however, that the flanges 37 and 38 could have both their upper and lower surfaces protected in the manner taught with respect to either FIG. 4 or FIG. 5.

It is also within the scope of the invention to protect those surfaces of the leg 36 adjacent the wear strips 23 and 24. This could be accomplished in the same manner described with respect to the embodiment of FIGS. 6 and 7. To this end, the leg 36 is shown as having holes 31 with wear-resistant inserts 32.

Finally, the overlapping shoulder portions of the lug portion 35 and the lower surfaces of extensions 40 and 41 ride along the adjacent surfaces of cutter bar wear strips 23 and 24. It would be within the scope of the invention to provide the under surfaces of extensions 40 and 41 and the shoulders of lug portion 35 with wear-resistant inserts in the manner taught with respect to laterally extending flanges 15 and 19 in FIG. 7. Such inserts are shown in dotted lines at 40a and 41a in FIG. 8.

FIGS. 9 and 10 illustrate a chain link element for use with a cutter bar, wherein the link element is of the type adapted to straddle with peripheral edge of the cutter bar. In these Figures, the link element is generally indicated at 44. It comprises a body or lug portion 45 provided with a pair of spaced projections extending rearwardly of its rearward surface. One of these extensions is indicated at 46. Extending forwardly of its forward surface, the lug portion 45 has a forward extension 47. The forward extension of an adjacent bit-carrying link element is adapted to ride between the pair of spaced extensions and to be pivotally affixed thereto by pin relationships. To this end, the rearward extensions have coaxial transverse perforations therein, one of which is shown at 48. Similarly, the forward extension has a pin receiving perforation 49 therein.

In some embodiments of such a link, a pair of spaced forward extensions is provided together with a single
rearward extension. Other than this, the coupling of adjacent bit-carrying links is essentially the same. In yet other versions, pairs of spaced extensions may be provided both at the forward and rearward surfaces of the body portion 45. In this instance, the bit-carrying link elements are intended to be joined by connecting links.

As is true of all of the embodiments thus far described, the nature of the bit carried by link 44 does not constitute a limitation on the present invention. Again, for purposes of an exemplary showing, a bit identical to that shown in FIG. 1 is illustrated in FIGS. 9 and 10. As a consequence, like parts have been given like index numerals. The body or lug portion 45 of the link 44 is provided with a shank receiving perforation 50 adapted to receive the bit shank 10. The lug portion 45 may also be provided with a transverse perforation 51 adapted to receive a resilient retaining means 52. The retaining means 52 may be identical to the retaining means 13 described with respect to FIG. 1.

The body portion 45 of the link element 44 is provided with a pair of spaced, downwardly depending legs 53 and 54. These legs terminate in turned flanges 55 and 56, respectively. The bottommost surface of the lug portion 45, between the legs 53 and 54, may in some embodiments have an arcuate relief 57, to expedite passage of the link elements 44 about a sprocket member or shoe, depending upon the type of sprocket used.

FIG. 10 fragmentarily illustrates the edge portion of a cutter bar. The cutter bar is generally indicated at 58 and comprises an elongated plate-like structure, the peripheral edges of which may be provided with inverted L-shaped wear strips 59 and 60. These wear strips essentially cover the peripheral edge of the cutter bar 58 and may be removable affixed in the manner described above with respect to wear strips 22 through 24 of FIG. 2.

As will be evident from FIG. 10, the link legs 53 and 54 straddle the wear strips 59 and 60. The bottom of the body or lug portion 45 of the link element, between the legs 53 and 54, is adapted to slide along the outermost portions of the wear strips 59 and 60. The legs 53 and 54, themselves, slidely engage the wear strips as shown and the turned leg flanges 55 and 56 slidely engage the innermost surfaces of wear strips 59 and 60, captively maintaining the bit-carrying link 44 in engagement with the cutter bar 58.

It will be understood that the upper surfaces of the turned flanges 55 and 56, the inside surfaces of the legs 53 and 54 and the bottom surface of the lug portion 45 are all in sliding engagement with one or both of the wear strips 59 and 60. By means of the present invention, any or all of these surfaces may be protected so as to retard sliding-type wear thereof.

Referring to FIG. 9, the upper surface of the turned flange 55 of leg 53 may be provided with a plurality of spaced holes 61. Each of the holes 61 contains a wear-resistant insert 62 of the type described with respect to FIGS. 1 through 3. The turned flange 56 of leg 54 may be similarly protected, as indicated in FIG. 10, the inserts 62 having their exposed ends flush with the surface they protect.

Referring again to FIG. 9, the inside surface of leg 53 may have appropriately located thereon a plurality of holes 63 extending partway into the leg. Each hole 63 contains a wear-resistant insert 64. Again, the free ends of the inserts are flush with the inside surface of leg 53. As indicated in FIG. 10, the leg 54 may be similarly protected.

Finally, those portions of the body or lug part of the link (between legs 53 and 54), which are in sliding engagement with the outermost surfaces of wear strips 59 and 60, may be provided with holes 65 containing wear-resistant inserts 66. This is shown both in FIGS. 9 and 10.

As indicated above, the number and location of the wear-resistant inserts in all of the embodiments described may be varied depending upon the nature of the surface to be protected and the severity of the sliding-type wear to which it is subjected. In embodiments other than cutter bar applications, the vulnerable surfaces of the cutter chains may be protected in the same manner illustrated in the figures. When the chains pass over support or guide means, the nature of which is such that replaceable wear strips may not conveniently or economically be applied to them, the teachings of the present invention may be applied to the support or guide means as well. Thus, on those surfaces of the support or guide means subject to sliding-type wear, holes may be formed and wear-resistant inserts may be located therein in any appropriate number or pattern, readily ascertainable by one skilled in the art.

As indicated above, the cross sectional configuration of the wear-resistant inserts of the present invention does not constitute a limitation. FIG. 11, for example, illustrates a wear-resistant insert 67 having an oval cross section. In some instances, the wear-resistant insert 67 may be more advantageously used than the cylindrical insert 26 of FIG. 3 since it presents a greater wear-resistant end surface 67a.

FIG. 12 illustrates a bit-carrying link identical to that shown in FIGS. 1 and 2, and like parts have been given like index numerals. It will be understood that the link 1 is adapted for use with a cutter bar such as that shown at 2 in FIG. 2.

In the embodiment of FIG. 12, the upper surfaces of flanges 16 and 20 are again shown as being protected by wear-resistant inserts in a manner similar to that taught with respect to FIGS. 1 and 2. Here, however, the perforations 25a, formed in the upper surfaces of flanges 16 and 20, are angled as shown for easier drilling. As a result of the axial angularity of perforations 25a, each insert 26a must be provided with an upper surface lying at an appropriate angle to the insert axis so as to be flush with the surface of the insert is intended to protect. Such an insert, for example, is illustrated in FIG. 13. Here, the insert 26a is similar to the cylindrical insert 26 of FIG. 3 but has an upper surface 26b lying at an angle other than 90° to the insert axis. It will be understood by one skilled in the art that the upper leg flanges 15 and 19 may also be protected after the manner taught with respect to FIG. 6. Again, the perforations formed in the undersides of flanges 15 and 16 may be angled in the same manner shown with respect to perforations 25a and inserts configured like insert 26a of FIG. 13 may be used.

FIG. 14 illustrates the bit-carrying link 44 of FIGS. 9 and 10 (like parts having been given like index numerals) and shows one manner in which the perforations 63 for the inserts 64 may be formed in the inside surfaces of legs 53 and 54. For purposes of this explanation, only one perforation 63 and insert 64 is illustrated in each of legs 53 and 54. In order to form the perfora-
tion 63 in leg 53 a clearance hole 68 is provided in leg 54. The clearance hole 68 in leg 54 will be coaxial with the perforation 63 in leg 53. Once the clearance hole 68 is formed, an appropriate drill bit may be inserted therethrough to form the perforation 63 in leg 53. The perforations 63 in leg 54 may be similarly produced, through the use of an identical clearance hole 68 in the leg 53. It will be understood by one skilled in the art that the clearance holes 68 in FIG. 14 are exaggerated in diameter for purposes of clarity.

As indicated above, not all cutter bars are provided with wear strips. This is illustrated in FIG. 15 wherein a cutter bar 69 is shown. The cutter bar 69 differs from cutter bar 2 of FIG. 2 primarily in that it is not provided with wear strips 22 through 24. The cutter bar 69 is adapted for use with a chain link such as that shown at 1 in FIGS. 1 and 2.

To this end, the cutter bar 69 has formed in the peripheral edge thereof a longitudinally extending groove 70 of inverted T-shaped cross section. The sides of the groove 70 are defined by surfaces 71 and 72 which are undercut as at 73 and 74, respectively, to provide the inverted T-shaped cross section. The bottom of groove 70 is defined by surface 75.

FIG. 15 is illustrative of the manner in which the teachings of the present invention may be applied to supporting surfaces with which chain links have a sliding relationship. To this end, perforations 76 may be formed in groove surfaces 71, 72 and 75. Inserts 77 are located in the perforations 76 with the exposed insert ends being flush with the surfaces they protect. The perforations 76 and inserts 77 may be arranged in any appropriate pattern, longitudinally of the surfaces 71, 72 and 75. The inserts 77 may be of the type shown at 26 in FIG. 3 or of the type shown at 67 in FIG. 11. Other cross sectional configurations may also be used.

FIG. 16 is a fragmentary perspective view of a typical wear strip 78 identical, for example, to wear strips 23 and 24 of FIGS. 2, 7 and 8. In FIG. 16, the wear strip 78 is provided with a plurality of wear-resistant inserts arranged in an exemplary pattern along its inside surface. Any appropriate wear-resistant insert may be used and for purposes of an exemplary showing, inserts 26 (as shown in FIG. 3) and inserts 67 (as shown in FIG. 11) are illustrated in alternate positions. Thus, FIG. 16 is another example of the manner in which the teachings of the present invention may be applied to a supporting surface with which the chain links have a sliding relationship.

In a cutter bar such as that shown at 2 in FIG. 2, all of the wear strips 22 through 24 may be protected as shown in FIG. 16. Alternatively, the wear strips may be so protected only at positions where wear on the strips is greatest. Such positions are found, for example, where the chain enters and leaves the groove defined by the wear strips.

In some instances it may be desirable to have the wear-resistant inserts so mounted with respect to the surface they protect as to be removable and replaceable. This may be accomplished as shown in FIG. 17. In FIG. 17 an element 79 is illustrated having a surface 80 to be protected. The element 79 may either be a part of a chain link or a portion of a supporting surface. As described above, the element is provided with a perforation 81 extending downwardly of the surface to be protected. The perforation 81 is adapted to receive a wear-resistant insert 82. The wear-resistant insert 82 may be of the type shown at 26 in FIG. 3, of the type shown at 67 in FIG. 11 or of any other appropriate cross sectional configuration. The insert 82 may be held in place by any appropriate means such as a frictional fit, an adhesive or both. To enable replacement of insert 82, the element 79 is provided with a second perforation 83 extending inwardly from the side 84 opposite the side 80 to be protected. The perforation 83 is coaxial with the perforation 81 and opens thereinto. The insert 82 may be removed from perforation 81 by inserting in perforation 83 an appropriate drift or tool by which blows may be administered to the insert 82 to drive it out of perforation 81.

In FIG. 4 the inserts 28 were shown as protecting two surfaces, i.e., both the top and bottom surfaces of flange 16. FIG. 18 illustrates ways in which single inserts may be used to simultaneously protect two adjacent surfaces. FIG. 18 is a fragmentary perspective view of the front portion of leg 3 of the link member 1 illustrated in FIGS. 1 and 2. Like parts have been given like index numerals. In FIG. 18, the lower leg flange 16 is provided with a perforation 85. The axis of the perforation 85 is parallel to the upper surface of flange 16 and the perforation is located in such a way that it forms a narrow, transverse opening in the upper surface of the leg flange. An insert 86 is mounted in the perforation 85 and it will be evident that the exposed end of insert 86 protects the outside surface of flange 16, while a longitudinal peripheral portion of the insert will protect the upper surface of the flange 16. The exposed end of insert 86 is flush with the outside surface of flange 16, while the exposed longitudinal surface of the insert is substantially flush with the upper flange surface.

The same object may be accomplished if a perforation were formed in the flange 16 with its axis parallel to the outside surface of the flange and being so located as to partially intersect the outside surface forming a narrow, transverse opening therein. Such a perforation is shown at 87. The perforation 87 is provided with an insert 88 the exposed end of which protects the upper surface of flange 16 and a longitudinal peripheral portion of which protects the outside surface of the leg flange.

In all of the embodiments thus far described, the chain links protected by the wear-resistant inserts of the present invention have constituted bit-carrying chain links. The invention, by no means, is intended to be so limited. Connecting links may be protected in the same manner.

Reference is made to FIG. 4 wherein a connecting link is illustrated at 89. The connecting link 89 has a forward end extending between the legs 3 and 4 of link 1 and pivotally affixed thereto by pintle means 90 extending through the perforation 18 in link leg 3 and co-axial perforations in link leg 4 (not shown) and in connecting link 89 (not shown). The connecting link 89 may be provided with a similar perforation 91 adapted to receive a pintle (not shown) pivotally connecting it to the next bit-carrying link (not shown).

The connecting link 89 will contact the bottom surface of the cutter bar groove. Thus, if the structure of FIG. 4 were mounted in the cutter bar shown in FIG. 2, the connecting link would contact the lower wear strip 22. To prevent wear of the bottom surface of connecting link 89, the surface may be provided with a plu-
13 reality of perforations, some at least of which are shown in FIG. 4 at 92. In these perforations wear-resistant inserts 93 may be located and may be held in place by any of the means described above. It will be understood that other surfaces of connecting link 89 may similarly be provided with wear-resistant inserts in any of the ways described above with respect to the bit-carrying links.

Any of the bit-carrying links or connecting links may additionally be provided with wear-resistant inserts in those surface areas subjected to sliding-type wear by the connecting pintle means. This is illustrated, for example, in the connecting link 89 of FIG. 4 wherein that surface portion of the pintle-receiving perforation 91, most subject to wear by a pintle, is provided with perforations 94 containing wear-resistant inserts 95. In a like manner, the pintle itself may be provided with wear-resistant inserts on those surfaces thereof subjected to sliding type wear by the links it connects. To illustrate this, two perforations 96 are illustrated in the pintle 90 in FIG. 4. The perforations 96 carry wear-resistant inserts 97. The inserts 97 will minimize wear of the pintle by the adjacent connecting link surface.

Modifications may be made in the invention without departing from the spirit of it. For example, FIG. 19 illustrates a modified form of wear-resistant insert particularly adapted for use in instances where the hole receiving the insert extends through the element in which the hole is formed. In FIG. 4, for example, the perforations or holes 27 extend through the flange 16. In FIGS. such as FIG. 7, the holes 31 in the link legs could extend through the link legs. In such instances, the wear-resistant insert 98 of FIG. 19 might be used. The insert 98 is frusto-conical in configuration and the hole receiving it would, of course, have a complementary configuration. Therefore, in addition to whatever one of the above expedients might be used to hold the insert 98 in place in its hole, there will be a mechanical holding advantage achieved through the cooperation of the frusto-conical shape of the insert and the complementary shape of the hole receiving it. Under most circumstances, the larger end of the insert 98 would be flush with the surface to be protected, thereby exposing as much of the hard insert material as possible.

FIGS. 20 and 21 illustrate other embodiments of wear-resistant inserts. The insert of FIG. 20 has a first cylindrical body portion 99 and a second cylindrical body portion 100. The body portion 100 is of greater diameter than the body portion 99 and provides a large flat protective end surface 101.

The embodiment of FIG. 21 is “pill-shaped.” That is, the insert (indicated at 102) is cylindrical in configuration, its axis being shorter than its diameter.

The inserts of FIGS. 19 and 21, when compared to the previously described wear-resistant inserts, have the advantage that they may provide the same or greater wear surface, while requiring less wear-resistant material in their manufacture. The embodiment of FIG. 26, as described with respect to the embodiment of FIG. 19, also offers greater resistance to movement in the direction of compression when it is used in a hole which passes through the element, the surface of which is to be protected.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In the combination of a chain for a mining machine or the like and a supporting means for said chain with which said chain has sliding contact, wherein said chain is made up of a plurality of links and wherein at least some of said chain links and said supporting means have surfaces subject to sliding-type wear therebetween, means for protecting at least selected ones of said surfaces, said means comprising discrete hard wear-resistant insert elements of circular cross section embedded axially in preformed holes in said surfaces to be protected.

2. The structure claimed in claim 1 wherein each of said inserts is held in its respective hole by means of a forced-fit between said insert and its respective hole.

3. The structure claimed in claim 1 wherein each of said inserts is held in its respective hole by adhesive means.

4. The structure claimed in claim 1 wherein each of said inserts is held in its respective hole by brazing.

5. The structure claimed in claim 1 wherein said inserts are frusto-conical each having a large diameter end and a small diameter end, said large diameter end comprising the portion of said insert protecting said surface to be protected, said holes for said inserts also being frusto-conical.

6. The structure claimed in claim 1 wherein each of said inserts is cylindrical and has one end of enlarged diameter so as to have a T-shaped longitudinal cross section, each of said holes for said inserts being correspondingly shaped, said end of said insert of enlarged diameter protecting said surface to be protected.

7. The structure claimed in claim 1 wherein said inserts are removably mounted in said holes.

8. The structure claimed in claim 1 wherein said holes are of circular cross section, said inserts being cylindrical.

9. The structure claimed in claim 8 wherein the axis of each of said cylindrical inserts is shorter than its diameter.

10. The structure claimed in claim 1 wherein each of said inserts has a surface substantially flush with said surface it protects.

11. The structure claimed in claim 10 wherein said surfaces to be protected comprise first and second integral surfaces oriented at an exterior angle of 270° to each other, said holes extending inwardly from said first surface and partially intersecting said second surface, the axes of said holes being perpendicular to said first surface and parallel to said second surface, said inserts each having an exposed end substantially flush with said first surface and a longitudinal peripheral exposed portion substantially flush with said second surface.

12. The structure claimed in claim 1 wherein said supporting means comprises a cutter bar having grooves at least along its longitudinal edges, said grooves each having side and bottom surfaces and being of inverted T-shaped cross section, said chain being of the type wherein some at least of said links comprise a body and leg means projecting from said body, said leg means engageable and slideable within said cutter bar grooves.

13. The structure claimed in claim 12 wherein said surfaces to be protected comprise surfaces of said leg means.
14. The structure claimed in claim 2 wherein said surfaces to be protected comprise some at least of said side and bottom surfaces of said groove;

15. The structure claimed in claim 12 including wear strips affixed to said side and bottom surfaces of said grooves, said wear strips having surfaces subject to said sliding type wear, selected ones at least of said last mentioned surfaces comprising said surfaces to be protected.

16. The structure claimed in claim 1 wherein said supporting means comprises a cutter bar having longitudinal edge surface portions, said chain being of the type wherein some at least of said links each comprises a body having a pair of leg means projecting from said body and in parallel spaced relationship, said pair of leg means being configured to straddle and slidably engage said longitudinal edge surface portions of said cutter bar.

17. The structure claimed in claim 16 wherein said surfaces to be protected comprise surfaces of said pair of leg means.

18. The structure claimed in claim 16 wherein said surfaces to be protected comprise some at least of said longitudinal edge surface portions of said cutter bar.

19. The structure claimed in claim 16 including wear strips affixed to said longitudinal edge surface portions of said cutter bar, said wear strips having surfaces subject to sliding type wear, selected ones at least of said last mentioned surfaces comprising said surfaces to be protected.

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