July 24, 1951 F. L. FULKE 2,561,657

MINING MACHINE

Filed May 12, 1948

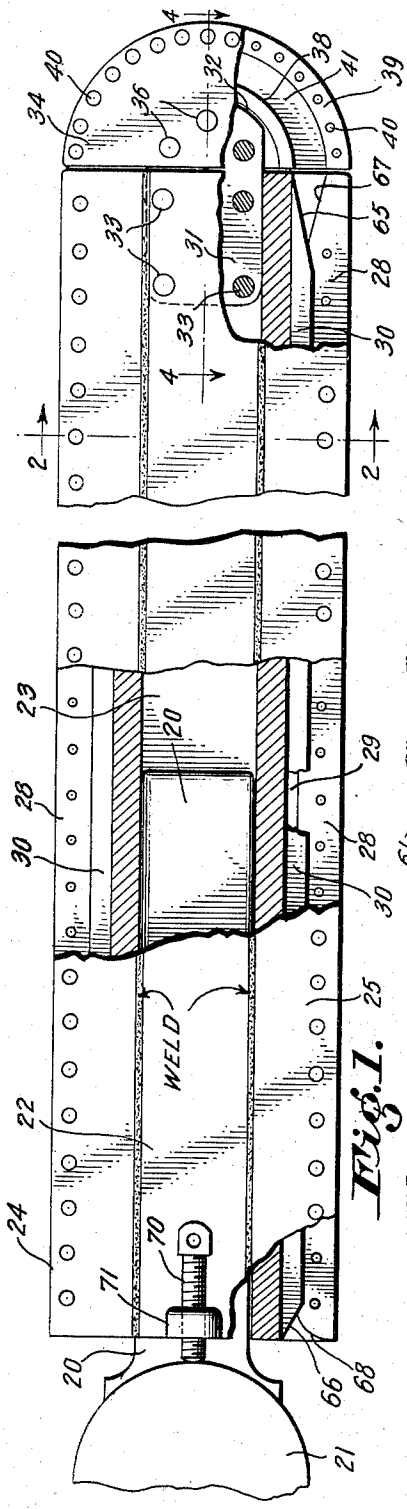


Fig. 1.

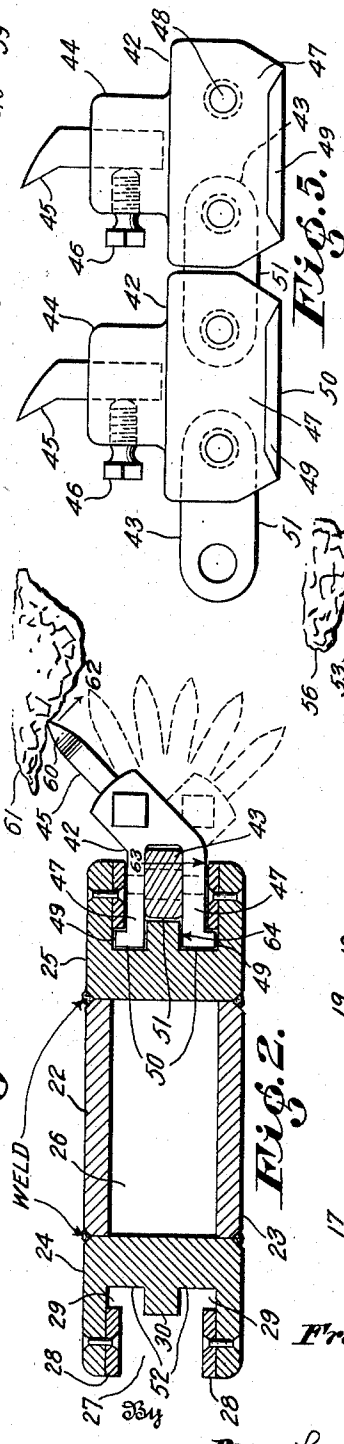


Fig. 2.

Fig. 5.

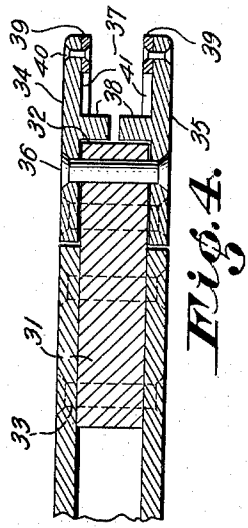


Fig. 4.

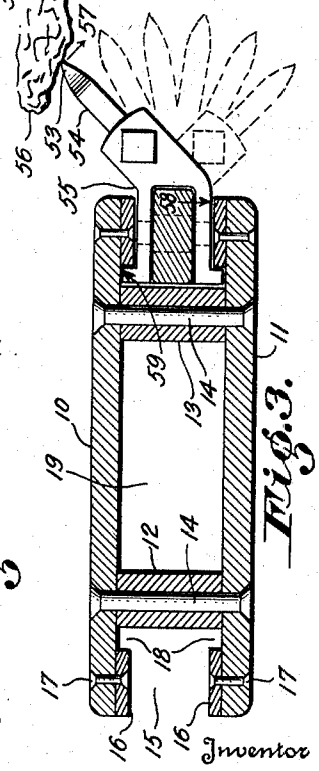


Fig. 3.

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MINING MACHINE

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4 Claims. (Cl. 262—33)

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This invention relates to a kerf-cutting coal mining machine and more particularly to the endless cutter chain of such machine and the cutterbar which supports the chain in cutting position. A mining machine cutterbar comprises a flat elongated element which projects from the machine proper. A channel extends along the lateral edges of this element and around the nose thereof for supporting and guiding the endless cutter chain which is driven by the machine.

The mutually contacting surfaces of the cutterbar and the cutter chain are subject to extreme frictional wear. Such wear is the result of almost an entire lack of lubrication and the presence of abrasive particles produced by the cutting operation. In addition, the weight of the chain and its relatively high rate of travel contribute to the rapid frictional wear of the bearing surfaces. The cutter bits which are secured to the cutter chain usually are mounted in staggered angular relationship transversely of the lateral edges of the cutterbar in order to effect a cut greater in width than the cutterbar. Accordingly, large twisting stresses are imparted to the cutter chain by the action of the cutter bits. These stresses tend to loosen the joints of the chain and also are transmitted to the cutterbar as forces which tend to spread apart the sides of the chain guideway channel. The chain joints are also subject to extreme frictional wear. A spread chain guideway permits excessive deflection of the chain cutter bits transversely of the lateral edges of the cutterbar. Such deflection results in loss of "kerf" in the cutter chain, that is, the width of the cut made by the chain is narrower than is permissible for effective operation.

The cutter chain and the cutterbar are mutually interdependent. A worn chain and loose chain joints quickly will spread apart the sides of the cutterbar chain guideway. Likewise, a worn and spread cutterbar guideway rapidly will loosen chain joints. Consequently, these elements of a mining machine are renewed frequently when the machine is in use. A cutterbar is almost always overhauled upon the installation of a new cutter chain, and sometimes several times during the life of the chain.

Accordingly, it is an object of this invention to provide a cutterbar and cutter chain that cooperate to provide maximum bearing surfaces therebetween in order to reduce frictional wear to a minimum.

It is another object of this invention to provide a cutterbar and cutter chain that cooperate to more effectively resist and to reduce the chain guideway spreading effect of the forces imparted to the cutterbar by the twisting action of the cutter chain.

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It is still another object of this invention to provide a cutterbar and cutter chain that cooperate to reduce the amount of transverse deflection of the chain cutter bits upon wear of the cutterbar and cutter chain.

It is still another object of this invention to provide a cutterbar and cutter chain that cooperate to reduce the chain joint loosening effect of the twisting stresses set up in the cutter chain.

It is still another object of this invention to provide an inexpensive cutterbar of simple construction but of improved strength and durability.

It is a further object of this invention to provide an improved cutter chain that cooperates with the improved cutterbar to achieve great efficiency and durability of both elements.

Other objects and advantages of the invention will be evident from the following description and accompanying drawings in which:

Figure 1 is a plan view of a cutterbar embodying this invention operatively connected to a mining machine, a portion only of which is shown. Certain parts are broken away to show details more clearly.

Figure 2 is a transverse sectional view through the cutterbar taken on line 2—2 of Figure 1. A cutter chain embodying this invention is shown in assembled working position on one side of the cutterbar.

Figure 3 is a transverse sectional view, corresponding to Figure 2, of a conventional cutterbar and assembled cutter chain.

Figure 4 is a sectional view through the cutterhead of the cutterbar taken on line 4—4 of Figure 1.

Figure 5 is a plan view of a portion of a cutter chain embodying this invention.

Referring first to Figure 3, a conventional cutterbar comprises a pair of elongated parallel plates 10 and 11 supported in spaced position by two side bars 12 and 13 to form a box-like structure. The plates are secured to the bars by rivets 14, usually spaced on three inch centers. The opposite longitudinal margins of the plates 10 and 11 overhang the outer sides of the bars 12 and 13 to provide longitudinal, channel-shaped, cutter chain guideways, generally indicated at 15. The outer marginal portions of the opposite side walls of the guideways 15 usually are provided with renewable liners or wear plates 16, secured thereto by rivets 17. The

inner edges of the wear plates 16 are spaced from the bottom or back wall of the guideways 15 to form side wall grooves 18, for a purpose later described. One end of the central opening 19, which extends through the cutterbar, slidably receives a snugly fitting, supporting post or bar 20 which projects from the head section of a conventional mining machine 21 (such as shown in Figure 1) to support the cutterbar in operative position thereon.

Referring now to Figures 1 and 2, the improved cutterbar embodying this invention comprises a pair of spaced parallel plates 22 and 23 having a pair of outwardly directed channel members 24 and 25 welded to the lateral edges thereof, as indicated in the drawings. The outer surfaces or sides of the plates are flush with the sides of the channel members. This box-like construction provides a conventional central opening 26, one end of which slideably receives the mining machine post 20. Relative separation between the mining machine 21 and the cutterbar, to properly tension a cutting chain, is effected by means of a screw 70. The screw is threaded through a block 71 secured to one side of the cutterbar and has its nose bearing against an arcuate surface on the head section of the mining machine 21.

Each channel member 24, 25 has a longitudinal chain guideway 27 integrally formed therein, as best shown in Figure 2. The outer marginal portions of the opposite side walls of the guideways 27 have renewable liners or wear plates 28 riveted thereto and spaced from the bottom of the guideways to form side wall grooves 29, as in a conventional cutterbar construction. Centrally projecting from the bottom of each guideway 27 is a longitudinal rib or flange 30, rectangular in transverse section as shown in Figure 2, and preferably formed integrally with the channel members 24, 25 during their fabrication. The purpose of this rib is described later. This welded cutterbar construction has been found to be cheaper to fabricate than a conventional riveted cutterbar. The solid channel members 24, 25 may be formed economically of rolled steel requiring no machining. Furthermore, the operation of drilling multiple rivet holes in the plates and side bars of a conventional construction for the rivets 14 is dispensed with. Of greater importance, however, is the fact that this welded structure resists the spreading forces (later described) exerted against the side walls of the guideways, by the twisting action of the cutter chain, to a far greater extent than a riveted structure. In a riveted construction, these spreading forces are resisted only by the rivets 14. Rivets, because of their very nature, are not hard and tough, and consequently stretch under the load imposed thereon by the spreading forces. In contrast, the welded construction contains no soft rivets 14 to yield under the load imposed by the spreading forces and the guideways 27 may spread only through the bending of a large mass of solid metal. In actual practice, it has been found that the integral guideways 27 of the improved welded structure resist, without spreading, much greater forces than those necessary to cause rivet failure.

A cutterhead supporting block 31, having a nose portion provided with a rounded edge 32, is positioned in the other or forward end of the central opening 26 with the nose portion projecting therefrom. The block 31 is secured to the box-like structure of the cutterbar preferably by rivets 33, although any suitable securing means will serve this purpose. A pair of cutterhead plates 34 and

35, substantially semi-circular in plan view, as shown in Figure 1, are secured to the opposite sides of the projecting nose portion of the block 31, preferably by rivets 36. The arcuate margins of the plates 34, 35 overhang the rounded edge 32 of the projecting nose portion of the block to form an arcuate cutter chain guideway 37. The arcuate guideway 37 connects the longitudinal guideways 27 extending along the lateral edges of the cutterbar to enable the cutter chain to travel around the forward end of the cutterbar. Projecting from the inner faces of the cutterhead plates 34, 35, which form the side walls of the arcuate guideway 37, are opposed arcuate ribs or flanges 38 that overlie the arcuate edge 32 of the nose portion of the block 31. These ribs 38 provide a chain guideway back wall against which the base of the cutter chain bears while travelling through the arcuate guideway 37. Suitable wear plates 39 are replaceably secured to the outer marginal portions of the side walls of the guideway 37, as by rivets 40, and spaced from the guideway back wall to form side wall grooves 41.

The novel cutter chain which cooperates with the improved cutterhead is best illustrated in Figure 5. The chain comprises alternate bit links 42 and connecting links 43. The bit links have socketed lugs 44 in which cutter bits 45 are replaceably mounted, as by set screws 46. The bit links 42 are of the saddle type having spaced side plates 47 between which the connecting links 43 are received. The ends of the links are pivotally connected by hardened journal pins 48. Lateral guiding flanges 49 project from the side plates 47 of each bit link adjacent the inner edge or base 50 thereof. The inner edge or base 51 of the connecting links is offset inwardly of the chain from the base 50 of the bit links. This construction provides, in effect, a central longitudinal groove, rectangular in transverse section, in the base or inner surface of the chain. When the chain is assembled with the cutterbar, the groove in the base of the chain receives the central longitudinal rib or flange 30 of the guideways 27 while the lateral guiding flanges 49 on the chain are received in the guideway side wall grooves 29 and 41.

Thus the cutterbar guideways 27 have two bearing surfaces which are effective laterally of the cutterbar, the edge of the rib 30 and the guideway back wall surfaces 52 on either side thereof. The base 51 of the connecting links rides against the edge of the rib 30, while the base 50 of the bit link side plates rides against the guideway back wall surfaces 52. These bearing surfaces at the bottom of the guideways 27 are subject to intensive friction during operation of the chain and consequently wear away relatively rapidly. The wear is uniform, however, on all the surfaces, so that the relative distance, laterally of the cutterbar, between the rib edge bearing surface and the back wall bearing surfaces 52, or, to put it another way, the height of the rib 30, remains substantially constant.

Referring to the conventional cutterbar and cutter chain construction shown in Figure 3, it will be noted that there is no interfitting guideway rib and chain groove as in the improved construction and that the base of the bit links and the connecting links are substantially flush, i. e. are in a common plane. When the point 53 of the angularly disposed bit 54, mounted in the bit link 55 of the conventional chain, encounters a hard impurity 56, a large force tends to deflect the bit 54 in the direction of the arrow 57, thus exert-

ing a twisting force on the bit link **55**. This force is transmitted by the bit link **55** to the cutterbar in two components, which act substantially oppositely against the side walls of the guideways **15**. One force component is substantially concentrated near the outer edge of a wear plate **16** at the point and direction indicated generally by the arrow **58**. The other force component is concentrated near the inner or bottom edge of the opposite guideway side wall at the point and direction indicated generally by the arrow **59**. It will be noted that the bit link force component indicated by the arrow **59** is exerted at an acute angle against the corresponding side wall. This angular application results in a semi-wedging action of the bit link **55** against the side walls of the guideways **15**. Therefore, the guideway side wall resistance to transverse bit deflection also is angular. Such impositive resistance does not positively prevent transverse deflection of the bit **54**. When the chain and guideway **15** are closely fitting, the angular deflection of the bit **54**, upon such an impurity encounter, is relatively small. When the mutual side bearing surfaces of the chain and guideway wear with use, however, the wedge-like action of the bit link **55** is accentuated, thus permitting the bit **54** to be deflected through relatively large angles. If this angular deflection amounts to as much as 10°, the chain is said to lose its "kerf." The consequent result is that the width of the cut made by the chain does not exceed the width of the cutterbar sufficiently to permit the cutterbar to "follow" the chain into the cut. When this condition arises, the cutterbar must be replaced.

The twisting force of the bit link **55** is transmitted not only to the cutterbar, but also through the chain joints to adjacent bit links. The greater the deflection of the bit **54** and its supporting link **55** because of side bearing surface wear, the greater the twisting force applied to adjacent links. These adjacent bit links, in turn, apply spreading forces to the guideway side walls. Since, the chain twisting forces are transmitted to adjacent links through the chain joints, rapid loosening of the joints thus occurs. Loose joints require chain replacement. Since the joint loosening effect becomes more pronounced upon side bearing surface wear or guideway spreading, it will be seen that cutterbar and chain wear are interrelated.

Referring now to the improved chain and cutterbar shown in Figure 2, the rib **30** cooperates with the groove in the base of the chain to provide another set of mutual bearing surfaces that serve not only to reduce the spreading forces exerted against the side walls of the guideways **27** by the cutter chain, but also to reduce the twisting forces transmitted to the chain joints. The sides of the rib **30** provide bearing surfaces for the inner sides of the bit link side plates **47**. The encounter of the point **60** of the bit **45** with a hard impurity **61** imparts a twisting force **62** to the bit link **42** as in a conventional construction. Two component forces again act substantially oppositely against the guideway **27**. One of these forces is concentrated near the outer edge of a wear plate **28**, as before, as indicated generally by the arrow **63**. The other force, however, is concentrated primarily against a side of the rib **30**, as indicated generally by the arrow **64**, instead of against the other side wall of the guideway. Hence, the destructive forces tending to spread the side walls of the guideways **27** are reduced. Furthermore, the actual angular deflection of the bit **45** is

lessened because the force **64** exerted against the side of the rib **30** is almost normal to the surface thereof instead of being applied at an angle thereto like the force indicated by the arrow **59** in Figure 3. In other words, a wedging action of the bit links **42**, which permits greater bit deflection, is substantially eliminated. Since the twisting stresses imparted to the cutter chain are not continuous, but only intermittent, the mutual bearing surfaces between the sides of the rib **30** and the inner sides of the bit link side plates **47** do not wear rapidly. Thus, angular bit deflection does not increase proportionately with the wear of the other mutual bearing surfaces between the chain and the cutterbar. The reduction of bit deflection by the rib **30** also effects a reduction in the twisting forces applied to the chain joints. Consequently, the improved construction greatly increases chain life.

Since cutting is performed at the end of the cutterbar, i. e. at the cutterhead, only for a short interval while "sumping in," it usually is unnecessary to provide a bit deflection resisting rib on the back wall of the arcuate guideway **37** in the cutterhead. Accordingly, the longitudinal ribs **30** are gradually bevelled at the outer ends thereof, as indicated at **65**, to merge with the back wall surfaces of the guideways **27** and **37** in order to provide for smooth and unobstructed passage of the chain into and out of the longitudinal guideways **27**. The inner or mining machine ends of the ribs **30** are similarly bevelled, as indicated at **66**, for like reasons. The side wall grooves **41** in the cutterhead guideway **37** are wider than the side wall grooves **29** in the longitudinal guideways **27**, in order to permit the chain guiding flanges **49** to travel in a curved path through the cutterhead guideway. Hence, the cutterhead ends of the longitudinal wear plates **28** are gradually tapered in width, as indicated at **67**, to correspond to the width of the cutterhead wear plates **39** in order to provide for smooth passage of the cutter chain into and out of the cutterhead guideway **37**. The inner or mining machine ends of the wear plates **28** are similarly tapered in width, as indicated at **68**, for like reasons.

The elimination of rivets for resisting guideway spreading forces overcomes the necessity of taking the improved cutterbar apart and re-riveting conventional plates **10**, **11** (Figure 3) to side bars **12**, **13**. The hardened steel wear plates **28** receive most of the frictional chain wear on the side walls of the guideways **27**. These plates **28**, when worn, are relatively easily replaced. The wearing of other surfaces of the guideways **27**, particularly the back wall and the edge of the rib **30**, and the wear of the sides of the chain and its bases does not result in rapid deterioration of the efficiency of either the cutter chain or the cutterbar. The side surfaces of the rib **30** do not wear sufficiently to prevent adequate cooperation with the chain before the cutterbar is worn out. Hence, both the chain and guideways cooperate to greatly prolong the effective life to both of these elements.

It is realized that various structural changes may be made by one skilled in the art without departing from the principles of the invention. Accordingly, this invention encompasses all embodiments that come within the spirit and scope of the following claims.

I claim:

1. In a mining machine, the combination of a cutterbar with a cutter chain; said cutterbar having a chain guideway along each of the lon-

gitudinal edges thereof, each said guideway being in the form of an outwardly directed channel having wear plates secured to and projecting from the opposite channel side walls adjacent the outer edges thereof and a central longitudinal rib projecting outwardly from the channel back wall; said cutter chain having bit links alternating with connecting links, said bit links being adapted to support cutter bits and being provided with spaced parallel side plates having base surfaces adapted to bear against said guideway back wall, the opposed inner surfaces of said side plates being adapted to bear against the opposite sides of said guideway rib; said connecting links being pivotally connected to said bit links between said side plates and having base surfaces offset inwardly of said side plate base bearing surfaces and adapted to bear against the outer edge of said rib.

2. In a mining machine, the combination of a cutterbar with a cutter chain; said cutterbar having cutter chain guideways along the longitudinal edges thereof, each said guideway comprising an outwardly directed channel having spaced parallel side walls to bear against the sides of said chain and a backwall to bear against the base of said chain, said side walls being provided with opposed longitudinal grooves adjacent said back wall and said backwall being provided with a central outwardly projecting longitudinal track of rectangular section, certain links of said chain having their bases adapted to straddle said longitudinal track and being provided with lateral guiding flanges adapted to project into said grooves and other links of said chain having their bases disposed in a plane outward of the plane of the bases of said certain links whereby the said other links may ride upon the top of said longitudinal track.

3. In a mining machine, the combination of of cutterbar with a cutter chain; said cutterbar having a chain guideway along each of the longitudinal edges thereof, each said guideway being in the form of an outwardly directed channel having opposed longitudinal side wall grooves adjacent the backwall of said channel and a central longitudinal backwall rib; said cutter chain having bit links alternating with connecting links, said bit links being adapted to support cutter bits and being provided with spaced parallel side plates having base surfaces disposed in a plane offset from the base surfaces of said connecting links and adapted to bear against said guideway backwall, the opposed inner surfaces of said side

plates being adapted to bear against the opposite sides of said central backwall rib and said side plates having lateral guiding flanges adapted to project into said side wall grooves to confine said chain in said guideway; said connecting links being pivotally connected to said bit links between said side plates and having base surfaces adapted to bear against the outer edge of said central backwall rib.

4. In a mining machine, the combination of a cutterbar with a cutter chain; said cutterbar having cutter chain guideways along the longitudinal edges thereof, each guideway comprising an outwardly directed channel having spaced parallel side walls and having a back wall, wear plates secured to said side walls and spaced from said back wall forming opposed longitudinal grooves, each of said grooves being defined by an edge of said wear plates, a portion of said side wall, and a portion of said back wall, said back wall being provided with a central outwardly projecting longitudinal rib having side walls parallel to and spaced from said channel side walls, said cutter chain having bit links alternating with connecting links, said bit links of said chain having a central longitudinal groove in the base thereof adapted to receive said projecting longitudinal rib, the opposite side walls of said groove being parallel to and adapted to bear against the side walls of said longitudinal rib, said bit links of said chain having laterally projecting guide flanges adjacent the base thereof projecting into said opposed longitudinal grooves to retain said chain in said guideway.

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