Jan. 26, 1937. R. K. JEFFREY 2,068,984

CUTTER CHAIN AND BAR

Filed March 14, 1935 2 Sheets-Sheet 1

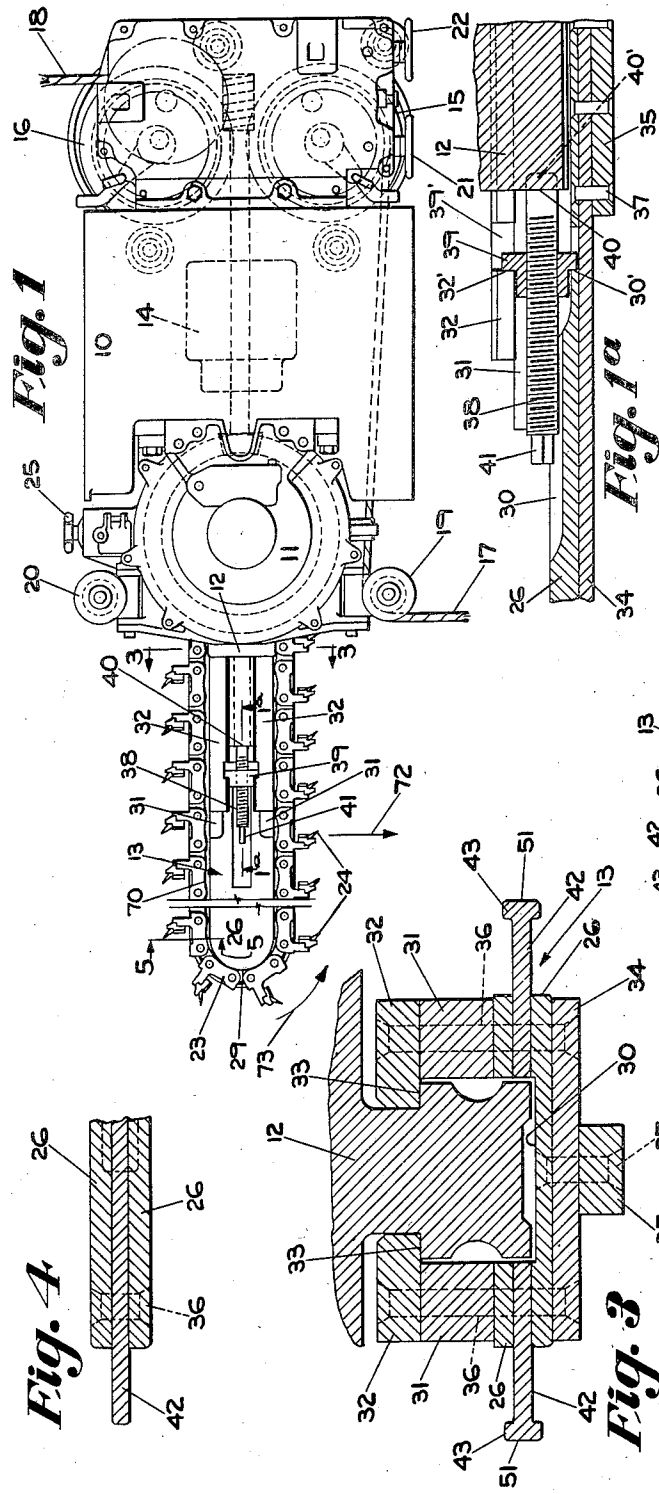


Fig. 1

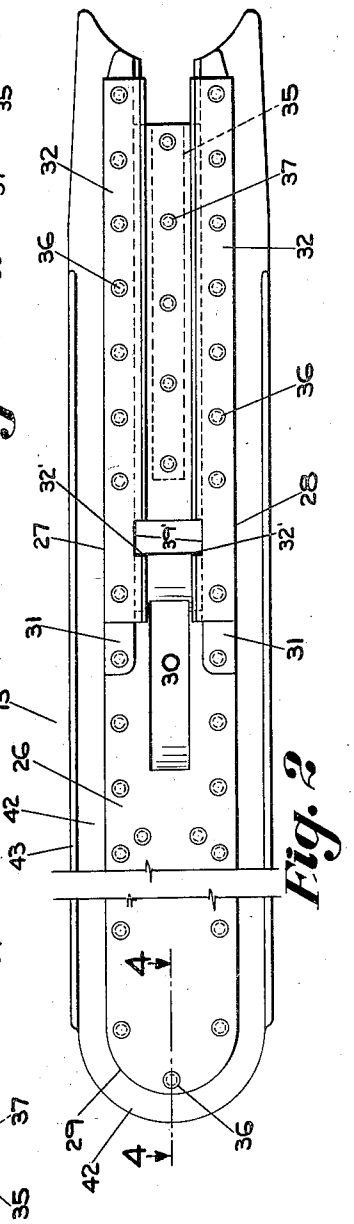


Fig. 2

Fig. 1a

Fig. 3

Fig. 4

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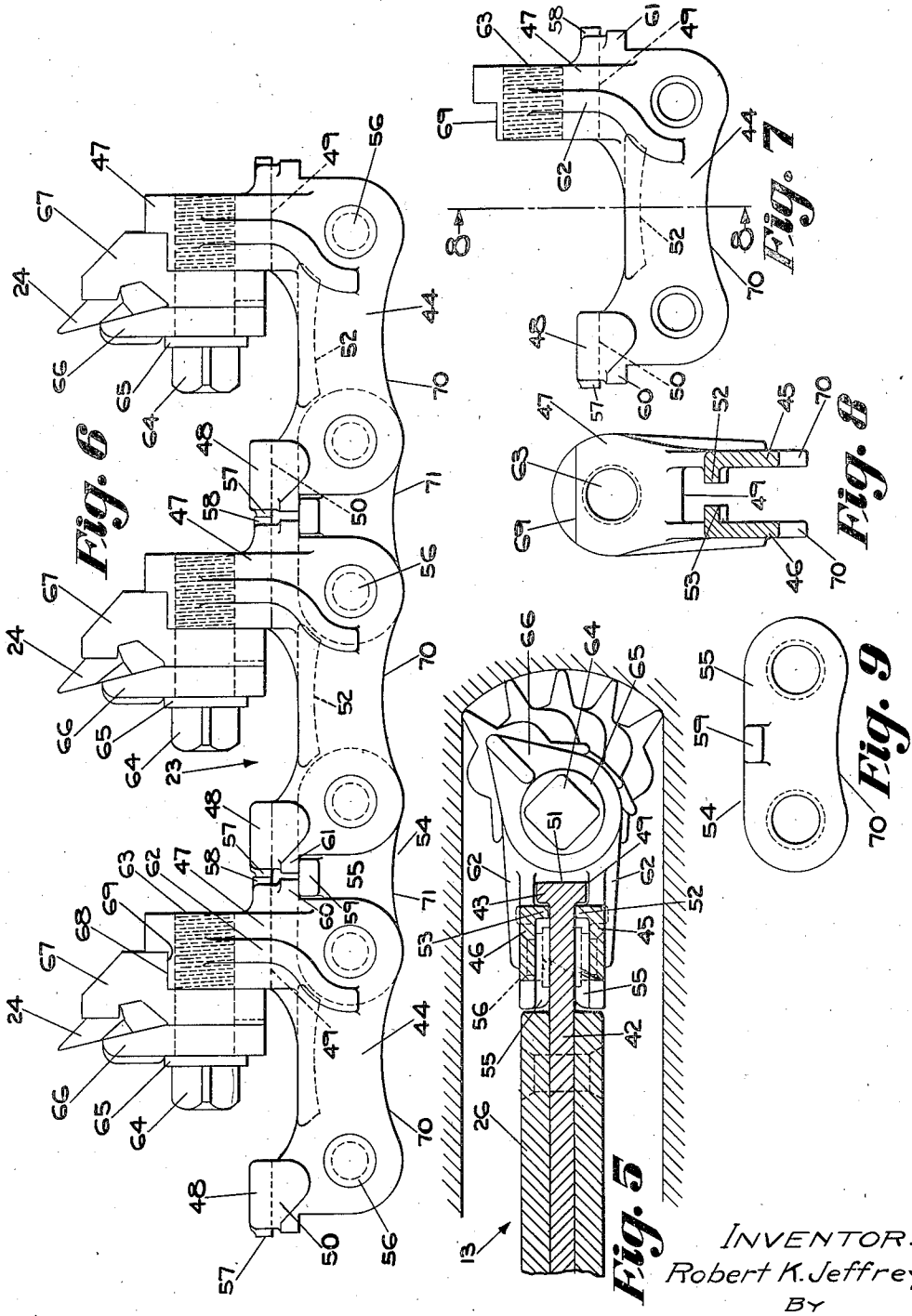


Fig. 6

Fig. 7

Fig. 8

Fig. 9

Fig. 5

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CUTTER CHAIN AND BAR

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Application March 14, 1935, Serial No. 11,048

37 Claims. (Cl. 262—33)

This invention relates to a mining machine, and particularly to a coal cutting machine.

An object of the invention is to provide a coal cutting machine with a cutter mechanism comprising a relatively thin elongated cutter bar having substantially parallel sides and a rounded outer end, which cutter bar comprises a central body portion presenting a minimum "dead" area, with integral or removable projecting T-shaped side webs forming a guide and support for an endless cutter chain which straddles said webs, and provided with a flat-faced web adjacent the rounded outer end to act as a guide and support for the cutter chain at this position.

Another object of the invention is to provide a new cutter bar for a mining machine, which cutter bar has a relatively thin and relatively narrow central body portion with parallel sides and presenting a minimum "dead" area, and with integral or removable projecting T-shaped side webs forming a guide and support for an endless cutter chain, and which has a flat-faced web adjacent a rounded outer end thereof adapted to act as a guide and support for the cutter chain at this position.

Still another object of the invention is to provide a novel cutter chain which is adapted to straddle a T-shaped side web of a cutter bar and to be held to said cutter bar thereby for sliding movement with respect thereto.

Other objects of the invention will appear hereinafter, the novel features and combinations being set forth in the appended claims.

Referring to the drawings:

Fig. 1 is a plan view of a mining machine comprising my invention;

Fig. 1*a* is a sectional view on line 1*a*—1*a* of Fig. 1;

Fig. 2 is a plan view of the cutter bar comprising my invention;

Fig. 3 is a sectional view of the cutter bar and the support therefor taken on the line 3—3 of Fig. 1, with the cutter chain removed;

Fig. 4 is a sectional view on the line 4—4 of Fig. 2;

Fig. 5 is a sectional view on the line 5—5 of Fig. 1, illustrating the device while cutting a kerf;

Fig. 6 is a plan view of a portion of the cutter chain comprising my invention;

Fig. 7 is a plan view of one of the main links of the cutter chain of Fig. 6;

Fig. 8 is a sectional view taken on the line 8—8 of Fig. 7; and

Fig. 9 is a plan view of one of the connecting links of the chain of Fig. 6.

This application comprises a continuation in part of my application Serial No. 729,704 filed June 8, 1934.

Referring particularly to the drawings, there is illustrated in Fig. 1 a mining machine comprising my invention, which is generally of the type adapted to rest directly on the mine floor and to cut a bottom kerf along the face of the mine room. This mining machine comprises a body 10 to which is rigidly attached a head 11. Extending forwardly from the head 11 and rigidly attached thereto is a post 12 which is adapted to support an adjustable cutter bar 13. The body 10 of the mining machine also carries a reversible electric motor 14 adapted to drive a pair of drums 15 and 16, which drums are provided with appropriate cables 17 and 18, respectively, which may be operated for controlling the movement of the mining machine. A pair of pulleys 19 and 20 is also provided adjacent the head 11 of the mining machine and may be employed with the cables 17 and 18 in the handling of the mining machine. Appropriate clutches are provided for effectively connecting or disconnecting each of the drums 15 and 16 to the motor 14 and individual hand wheels 21 and 22 are provided for operating these clutches, whereby the selective and individual connection of said drums 15 and 16 to said motor 14 is provided.

By directing each of the cables 17 and 18 forwardly of the mining machine and anchoring them to appropriate jacks, the cutter mechanism may be sumped into a wall of the mine room in a well-known manner. A lateral movement of the mining machine, either to the right or to the left, is provided by reeving one of the cables 17 or 18 around its proper pulley 19 or 20 and anchoring it to an appropriate jack adjacent one side wall of the mine room with the other cable anchored adjacent the other side of the mine room. One of the cables is then drawn in at the same rate that the other is paid out and lateral movement of the mining machine takes place. This lateral movement may take place while the machine is cutting a kerf across the face of the mine room in either direction. The cutter chain is reversible to provide for this mode of operation.

As illustrated in Fig. 1 of the drawings, the feed will be in the direction of the arrow 72 under which conditions the drum 15 will operate to draw in cable 17 and drum 16 will operate to pay out cable 18. After a kerf is cut across the entire face of the wall, the cables 17 and 18 may be directed rearwardly of the ma-

chine and anchored to appropriate mine jacks, whereupon the drums 15 and 16 may be operated to withdraw the cutter bar 13 from the kerf which has been cut. In addition, either of the drums 15 or 16 may be employed for a handling operation; that is, for sliding the machine on its bottom to any desired position. These handling operations are generally performed while no kerf cutting takes place.

Mounted upon the cutter bar 13 is a continuous chain 23 which is provided with appropriate star bits 24 which will be described more in detail hereinafter. Adjacent the bottom of the head 11, there is provided an appropriate sprocket for driving the cutter chain 23. This sprocket is driven from the motor 14 through appropriate gearing, including a clutch mechanism, whereby the sprocket may be connected to or disconnected from said motor 14. A clutch operating hand wheel 25 is provided for operating said clutch.

Attention is particularly directed to Figs. 2, 3 and 4 which illustrate in some detail the novel cutter bar comprising my invention. This cutter bar comprises a central body portion formed by top and bottom plates 26 and central plate 42, which body portion comprises a relatively thin and relatively narrow unitary structure. The longitudinal sides 27 and 28 of said central body plates 26 are preferably parallel and the outer end 29 of said plates forms an arcuate guide. Adjacent the rear end of the cutter bar 13, where said cutter bar is slidably adjustably supported on the post 12, the central portion thereof is milled out to form a trough 30. The bottom portion of the post 12 extends into said trough 30, as best seen in Fig. 3. At said rear portion of the cutter bar 13 and adjacent the sides thereof, there is provided a pair of longitudinally extending plates 31 which carry at their tops a second pair of longitudinally extending plates 32. The plates 32 overhang the inner edges of the plates 31 and overhang the ledges 33 of the post 12. A reinforcing plate 34 is attached to the bottom of the body plate 26 adjacent said rear end to reinforce the cutter bar 13 at this position. Additional reinforcement of the cutter bar is provided by the bottom bar 35 which also acts as a skid bar for said cutter bar 13. Appropriate rivets 36 extend through the plates 32, 31, 26, 34 and 42 adjacent each side of the cutter bar to hold all of said plates rigidly together. Rivets 37 are provided for rigidly attaching the bottom body plate 26, the plate 34 and the bar 35.

It is evident from the construction disclosed in Figs. 1, 1*a*, 2 and 3 that the cutter bar 13 may be adjusted longitudinally with respect to the post 12 to tension or loosen the cutter chain 23. To provide for this adjustment, a screw-threaded shaft 38 threads through a nut 39 which is held against rotation by plates 32 and 26 and abuts against shoulders 32′ formed by grooves 39′ in said plates 32 and a shoulder 30′ on the plate 26; which shaft 38 has its end 40 extending into a recess 40′ in the post 12. The shaft 38 is also provided with a wrench-receiving end 41 adapted to receive a wrench whereby it may be turned to adjust the length of said cutter bar 13. Grooves 39′ allow ready removal of nut 39 when it is turned off of shaft 38.

As best seen in Fig. 3, the upper and lower plates 26 are of substantially equal thickness and thus the plate 42 lies in a plane equi-distant from the top and bottom of the cutter bar 13. The central plate 42 is provided with laterally extending webs which form a part of said cutter bar 13. If desired, said plate 42 may be formed integral with the body plates 26 but in order to make said plate 42 removable, whereby it may be renewed should the webs 42 become excessively worn, I prefer the form illustrated in the drawings. Adjacent the longitudinal sides 27 and 28 of the body plates 26, the lateral webs of plate 42 are provided with heads 43, whereby the webs will be of substantially T-shaped cross section as is evident from Fig. 3. However, adjacent the outer end 29 of the body plates 26, the web of plate 42 has no head similar to the head 43 but is made with parallel sides. This allows free movement of the cutter chain 23 around the outer end 29 of the cutter bar.

Referring particularly to Figs. 5, 6, 7, 8, and 9, there is illustrated in some detail the cutter chain comprising my invention. Said cutter chain comprises a plurality of bit carrying links 44 which are formed by a pair of parallel side plates 45 and 46 which plates are rigidly attached together by an integral bit carrier 47 and an integral top plate 48. As best illustrated in Fig. 5, the side plates 45 and 46 have an outside diameter which is approximately the same as the thickness of the central body portion of cutter bar 13. The bit carrier 47 is provided with a bottom bearing surface 49 and the top plate 48 is provided with a somewhat similar bearing surface 50, which bearing surfaces 49 and 50 are adapted to rest against the bearing surface 51 of the heads 43 when the cutter chain is traveling rectilinearly adjacent the sides 27 and 28 of the cutter bar 13.

Side plates 45 and 46 are provided with inwardly extending flanges 52 and 53, respectively, which are adapted to hold the bit carrying links 44 on the web of plate 42 during travel of the cutter chain 23 but to provide free rectilinear movement of said cutter chain 23 with respect to the cutter bar 13.

For connecting the bit carrying links 44 to form a complete chain 23, there are provided connecting links 54 which comprise a pair of spaced straps 55. Said straps 55 rest adjacent the top and bottom of the web of plate 42, as seen in Fig. 5, and are pivotally attached adjacent the inner surface of the side plates 45 and 46 of the main links 44 by appropriate counter-bored and/or counter-sunk rivets 56. The heads of the rivets 56 are flush with the outer surfaces of the side plates 45 and 46 and the inner surfaces of the plates 55 with which they cooperate. It may be noted that between the top plate 48 and the bit carrier 47, the head 43 of the web of plate 42 will be completely exposed, thus providing a free release of any dirt which tends to accumulate on this head.

The plate 48 is provided with an abutment 57 which is adapted to abut against a somewhat similar and aligned abutment 58 carried on the bit carrier 47 of a preceding link 44. The straps 55 of the connecting link 54 are positioned entirely between the head 43 and the plates 26 and are provided with ledges 59 adapted to bear against overhanging heels 60 and 61 of adjacent bit carrying links 44. Said heels, ledges and abutments 57, 58, 59, 60 and 61 all cooperate to prevent the bending of the cutter chain 23 into a concave curve when traveling rectilinearly along the sides 27 and 28 of the cutter bar 13 but allow free articulation of said cutter chain to form a convex curve when traveling around the outer end 29 of said cutter bar. This allows

free movement of the cutter chain 23 around its drive sprocket and around the curved outer end 29 of the cutter bar 13 but tends to equalize the load on the cutting tools 24 by distributing said load throughout the entire length of the cutter chain when the cutter bar is being fed transversely of itself in a longwall operation. This tends to reduce breakage of the cutter chain to a minimum and to prevent undue wear on any portion of said cutter chain 23 or any portion of the guides of the cutter bar 13.

The bit carriers 47 of the bit carrying links 44 are preferably provided with lateral reinforcing ribs 62 which are positioned substantially centrally of said bit carriers 47 but are curved around the apertures of the bit carrying links 44 provided for the rivets 56.

Each bit carrier 47 is provided with a central screw-threaded bore 63 adapted to receive a machine screw 64 provided with an integral collar 65. Said screw 64 is adapted to clamp together forward and rearward clamping plates 66 and 67, respectively, which clamp a star bit 24 therebetween. Said clamping plates 66 and 67 are rigidly clamped to the bit carrier 47 by said screw 64. The clamping plate 67 and the bit carrier 47 are provided with cooperating bearing surfaces 68 and 69, respectively, which are effective to determine the path traveled by the star bit 24. That is, the adjacent bit carrying links 44 have their bearing surfaces 68 set at varying angles whereby the paths traveled by the star bits 24, which are attached to successive bit carrying links 44, are arranged in fan-shaped relation, as is illustrated in Fig. 5. In addition, the star bits 24 are each provided with a plurality of cutting points, of which there are three illustrated in Fig. 5 and, when one cutting point becomes worn, the star bit 24 may be removed and rotated 120 degrees to present a new cutting point. The structure of the star bits 24 and the mounting means therefor is described in full detail in the application of Frank L. Fulke, Serial No. 675,419, filed June 12, 1933.

By referring to Fig. 1 of the drawings, it is to be noted that during the rectilinear travel of the cutter chain 23 adjacent sides 27 and 28 of the cutter bar 13, the bottom edges 70 of the bit carrying links 44 and the bottom edges 71 of the connecting links 54 are out of contact with the longitudinal tracks of body plate 26. However, as the cutter chain 23 rounds the outer end 29 of the cutter bar 13, said bottom edges 70 and 71 ride on the arcuate guide surface of the outer end 29 of the body plates 26 as shown in Fig. 1. For this reason, the bottom edges 70 and 71 of said main links 44 and said connecting links 54, respectively, are made arcuate and have an arc equal to the arc formed by the outer end 29 of said cutter bar 13.

By employing the cutter bar and cutter chain of my invention, it is evident that a relatively thin central body portion may be provided, for the cutter chain 23 does not have to be housed within the cutter bar. This provides for a minimum tendency of the cutter bar to become jammed during operation and allows cutting of a kerf, the walls of which are each slightly irregular and not in a single plane. The tendency for the cutter bar to jam is also reduced by virtue of the fact that the "dead" area of the cutter bar is reduced to a minimum. It is, of course, evident that the moving parts of the cutter chain are exposed to a maximum degree and said moving parts will easily free themselves when the chain is in operation. In addition, the cutter bar is of simple construction, devoid of any moving parts, yet provides a track upon which the cutter chain may freely move.

The cutter chain itself is of simple and rugged construction and provides for the free release of any dirt which tends to accumulate between said chain and cutter bar. It is also symmetrical and may be mounted on the cutter bar to travel in either direction, as viewed in Fig. 1. Said chain is also designed to transmit the load on any cutting tool throughout the chain and thus minimize the tendency for said chain to break and to reduce wear upon said chain and cutter bar.

Removal and renewal of that part of the cutter bar which is subjected to the greatest wear is also provided. The removable plate 42 is preferably formed of hardened steel whereby its life will be maintained at a maximum, thereby preventing the necessity for frequent renewals. In the drawings, it is illustrated as made of one piece, but if desired it may be split along its longitudinal axis.

In the operation of the cutter mechanism in cutting a kerf, the machine may be fed in the direction indicated by the arrow 72 in Fig. 1. The cutter chain 23 will travel about the track of the cutter bar 13 in a direction indicated by the arrow 73 of Fig. 1. The lower run of the cutter chain 23, as seen in Fig. 1, or the run adjacent side 28 of the cutter bar 13, will therefore operate to cut a kerf. The star bits 24 of said lower run will be subjected to a thrust which will force the bit carrying links 44 against the cutter bar 13 which make a friction contact between the bearing surfaces 49 and 50 of said bit carrying link 44 and the bearing surface 51 of the guide heads 43 of plate 42 along the rectilinear path of travel of said cutter chain 23. As was previously pointed out, during this position of rectilinear travel of the cutter chain 23, the bottom edges 70 and 71 of bit carrying links 44 and connecting links 55 do not contact the plates 26. The biting of star bits 24 into the coal also tends to tilt the bit carrying links 44 about the rivets 56 positioned beneath the bit carriers 47. This tilting is resisted by a number of elements. The flanges 52 and 53 bear against the under side of head 43 to prevent said tilting. The top surfaces of straps 55 also bear against the under side of head 43. It is to be noted from Fig. 6 that the tops of straps 55 and the tops of flanges 52 and 53 present a substantially continuous surface of the cutter chain which may be in contact with the inner faces of the head 43. In addition, heels 60 and 61 cooperate with ledges 59 to transfer any tilting force from one bit carrying link 44 to the following bit carrying link 44 which would tend to rotate said following link 44 in a direction opposed to that of its own star bit 24. That is, by virtue of the heels 60 and 61 and ledges 59 providing a stiff back chain, the tilting forces on adjacent bit carrying links 44, caused by their star bits 24 biting into the coal, tend to neutralize each other. Abutments 57 and 58 perform a function supplementary to that performed by heels 60 and 61 and ledges 59. It is thus possible to omit abutments 57 and 58 or to omit heels 60 and 61 and ledges 59 but, in order to provide a maximum of strength, I prefer to employ all of said abutment elements, as illustrated in the drawings.

When the links of the cutter chain 23 round the curved end 29 of the cutter bar 13, the bottom surfaces 70 and 71 of the chain links 44 and 55, respectively, contact with the arcuate guides

on the plates 26 and the thrust received by star bits 24 is transferred to said cutter bar 13 by virtue of this sliding frictional contact. Tilting of the bit carrying links 44 is prevented during this arcuate travel of the cutter chain 23 by the tension on the lower run of said cutter chain.

Obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of the invention as defined by the claims hereto appended, and I wish therefore not to be restricted to the precise construction herein disclosed.

Having thus described and shown an embodiment of my invention, what I desire to secure by Letters Patent of the United States is:

1. In a mining machine, the combination with a cutter bar having an elongated central body and a curved outer end, of chain guide means adjacent parallel side walls of said body, said chain guide means comprising a pair of laterally extending ribs the central planes of which are substantially equally spaced from the top and bottom of said body, said ribs having enlarged heads, a cutter chain carried by said cutter bar comprising U-shaped links having longitudinally extending side plates which are carried by said guide means along the sides of said cutter bar one on each side of a rib and between the head and said central body, flanges projecting inwardly of the top portion of said side plates, which flanges cooperate with said enlarged heads to retain said chain on said cutter bar, and a guide rib adjacent the curved outer end of said cutter bar devoid of an enlarged head, said chain links having arcuate bottoms riding on the cutter bar body adjacent the curved end thereof.

2. In a mining machine, the combination with a cutter bar having an elongated central body and a curved outer end, of chain guide means adjacent parallel side walls of said body, said chain guide means comprising a pair of laterally extending ribs, said ribs having enlarged heads, a cutter chain carried by said cutter bar comprising U-shaped links having longitudinally extending side plates which are carried by said guide means along the sides of said cutter bar one on each side of a rib and between the head and said central body, flanges projecting inwardly of said side plates above the pivotal axis of said chain links, which flanges cooperate with said enlarged heads to retain said chain on said cutter bar, and a guide rib adjacent the curved outer end of said cutter bar devoid of an enlarged head, said chain links having arcuate bottoms riding on the cutter bar body adjacent the curved end thereof.

3. In a mining machine, the combination with a cutter bar having an elongated central body and a curved outer end, of chain guide means adjacent parallel side walls of said body, said chain guide means comprising a pair of removable laterally extending ribs of T-shaped cross section which terminate short of the curved end of said body, a cutter chain carried by said cutter bar comprising longitudinally extending links having side plates which are carried by said guide means along the sides of said cutter bar, one on each side of a rib and between the head and central body but normally out of contact with the body thereof, and whose outer surfaces are spaced substantially the thickness of said body, flanges projecting inwardly of said side plates which flanges cooperate with the head of said ribs to retain said chain on said cutter bar, and a flat-faced guide rib adjacent the curved end of said body, said chain links having arcuate bottom bearing surfaces which bear against the curved outer end of said body.

4. In a mining machine, the combination with a cutter bar having an elongated central body and a curved outer end, of chain guide means adjacent parallel side walls of said body, said chain guide means comprising a pair of laterally extending ribs of T-shaped cross section which terminate short of the curved end of said body, a cutter chain carried by said cutter bar comprising links having side plates which are carried by said guide means along the sides of said cutter bar between a rib head and the central body but normally out of contact with the body thereof, spaced means connecting said side plates adjacent each end of said links, said spaced means having bearing surfaces adapted to ride on the heads of said ribs to receive thrust on said cutter chain, flanges projecting inwardly of said side plates which flanges cooperate with the head of said ribs to retain said chain on said cutter bar, and a flat-faced guide rib adjacent the curved end of said body, said chain links having arcuate bottom bearing surfaces which bear against the curved outer end of said body.

5. In a mining machine, the combination with a cutter bar having an elongated central body, of chain guide means adjacent parallel side walls of said body, said chain guide means comprising a pair of laterally extending ribs the central planes of which are substantially equally spaced from the top and bottom of said body, said ribs having enlarged heads, a cutter chain carried by said cutter bar comprising U-shaped links the side plates of which are held by said guide means along the sides of said cutter bar, and connecting links connecting said U-shaped links and positioned on each side of said rib and entirely between said side walls of said body and said enlarged head, the said U-shaped links having spaced connecting means across the tops of the side plates providing spaced bearing surfaces which contact said enlarged heads.

6. In a mining machine, the combination with a cutter bar having an elongated central body and a curved outer end, of chain guide means adjacent parallel side walls of said body, said guide means comprising T-shaped ribs extending laterally along each side edge of said cutter bar and a flat headless rib adjacent the curved outer end thereof comprising a continuation of the central portion of said T-shaped ribs, a cutter chain mounted on said bar having side plates connected together by an integral member, said side plates riding between the head of said rib and said cutter bar body, said member having a face adapted to ride on the head of said ribs along the cutter bar sides, and said side plates having arcuate bottom surfaces adapted to ride on the curved outer end of said cutter bar.

7. In a mining machine, the combination with a cutter bar having an elongated central body and a curved outer end, of chain guide means adjacent parallel side walls of said body, said chain guide means comprising a pair of laterally extending ribs of T-shaped cross-section, a cutter chain carried by said cutter bar comprising interconnected bit carrying links and connecting links, said bit carrying links comprising spaced side plates connected across their tops at one end by an integral plate and at the other end by a bit carrying post, the inner faces of said plate and post providing bearing surfaces adapted to ride

on the heads of said T-shaped ribs, the lower faces of said side plates having arcuate bearing surfaces adapted to bear against the curved outer end of said cutter bar, and flanges projecting inwardly of said side plates adapted to retain said chain on said cutter bar.

8. In a mining machine, the combination with a cutter bar having an elongated central body and a curved outer end, of chain guide means adjacent parallel side walls of said body, said chain guide means comprising a pair of laterally extending ribs of T-shaped cross-section, a cutter chain carried by said cutter bar comprising interconnected bit carrying links and connecting links, said bit carrying links comprising spaced side plates connected across their tops at one end by an integral plate and at the other end by a bit carrying post, the inner faces of said plate and post providing bearing surfaces adapted to ride on the heads of said T-shaped ribs, and flanges projecting inwardly of said side plates adapted to retain said chain on said cutter bar.

9. In a mining machine, the combination with a cutter bar having an elongated central body and a curved outer end, of chain guide means adjacent parallel side walls of said body, said chain guide means comprising a pair of laterally extending ribs of T-shaped cross-section, a cutter chain carried by said cutter bar comprising interconnected bit carrying links and connecting links, said bit carrying links comprising spaced side plates connected across their tops at one end by an integral plate and at the other end by a bit carrying post, the inner faces of said plate and post providing bearing surfaces adapted to ride on the heads of said T-shaped ribs, the lower faces of said side plates having arcuate bearing surfaces adapted to bear against the curved outer end of said cutter bar.

10. In a mining machine, the combination with a cutter bar having an elongated central body and a curved outer end, of chain guide means adjacent parallel side walls of said body, said chain guide means comprising a pair of laterally extending ribs of T-shaped cross-section, a cutter chain carried by said cutter bar comprising interconnected bit carrying links and connecting links, said bit carrying links comprising spaced side plates connected across their tops at one end by an integral plate and at the other end by a bit carrying post, the inner faces of said plate and post providing bearing surfaces adapted to ride on the heads of said T-shaped ribs.

11. In a mining machine, the combination with a flat cutter bar having a web extending from the body side edges thereof, said web having an enlarged head, of a cutter chain having bit carrying links U-shaped in cross-section, the sides of which are positioned adjacent said web, bit carrying lugs carried by said bit carrying links and positioned between the ends thereof, and spaced apart bearing surfaces at each end of said links formed by connecting bridges between said link sides, said bearing surfaces being adapted to slide on the aforementioned enlarged head.

12. In a mining machine, the combination with a flat cutter bar having a web extending from the body side edges thereof, said web having an enlarged head, of a cutter chain having bit carrying links U-shaped in cross-section, the sides of which are positioned adjacent said web, a bit carrying post connected across the tops of the sides of said links at one end thereof, and a connecting strap connected across the tops of the sides of said link at the other end thereof, thereby forming an open top link, said post and said strap having bearing surfaces on the lower sides thereof, adapted to slide on said enlarged head.

13. In a mining machine, the combination with a flat cutter bar having a web extending from the body side edges thereof, said web having an enlarged head, of a cutter chain having bit carrying links U-shaped in cross-section, the sides of which are positioned adjacent said web, a bit carrying post connected across the tops of the sides of said links at one end thereof, and a connecting strap connected across the tops of the sides of said link at the other end thereof, thereby forming an open top link.

14. A cutter chain for a mining machine comprising interconnected bit carrying links and connecting links, both types of links having pintle receiving apertures adjacent their ends, pintles extending through said apertures and pivotally connecting said links, cooperating means on the bit carrying links and connecting links adapted to restrict the pivotal movement thereof in one direction, said means having bearing surfaces lying in a plane parallel to a plane passing through the axes of said pintles, means providing spaced apart cutter bar bearing surfaces on said bit carrying links adjacent their tops and at each end and disposed centrally between the sides thereof, and a bit carrying post on each bit carrying link adapted to carry a bit at a position longitudinally between the last mentioned bearing surfaces.

15. A cutter chain for a mining machine comprising interconnected bit carrying links and connecting links both types of links having pintle receiving apertures adjacent their ends, pintles extending through said apertures and pivotally connecting said links, cooperating means on the bit carrying links and connecting links adapted to restrict the pivotal movement thereof in one direction, means providing spaced apart cutter bar bearing surfaces on said bit carrying links adjacent their tops and at each end and disposed centrally between the sides thereof, and a bit carrying post on each bit carrying link adapted to carry a bit at a position longitudinally between the last mentioned bearing surfaces.

16. A cutter chain for a mining machine comprising interconnected bit carrying links and connecting links, the bit carrying links having parallel side plates connected together across the tops and at each end by spaced connecting straps thereby forming an open topped link to permit egress of dirt, the connecting links extending between the side plates of the bit carrying links, pintles pivotally connecting said chain links for pivotal movement, means limiting relative pivotal movement of said chain links in one direction to provide a stiff back chain, and a bit carrying post on said bit carrying links, said post being so constructed and arranged as to hold a bit at a position longitudinally between the pivotal axes of said bit carrying links.

17. A cutter chain for a mining machine comprising interconnected bit carrying links and connecting links, the bit carrying links having parallel side plates connected together across the tops and at each end by spaced connecting straps thereby forming an open topped link to permit egress of dirt, the connecting links extending between the side plates of the bit carrying links, pintles pivotally connecting said chain links for pivotal movement, and a bit carrying post on said bit carrying links, said post being so constructed and arranged as to hold a bit at a posi-

tion longitudinally between the pivotal axes of said bit carrying links.

18. A cutter chain for a mining machine comprising interconnected bit carrying links and connecting links, the bit carrying links having parallel side plates connected together across the tops and at each end by spaced connecting straps thereby forming an open topped link to permit egress of dirt, the connecting links extending between the side plates of the bit carrying links, pintles pivotally connecting said chain links for pivotal movement, means limiting relative pivotal movement of said chain links in one direction to provide a stiff back chain, and a bit carrying post on said bit carrying links, said post being so constructed and arranged as to hold a bit at a position longitudinally between the pivotal axes of said bit carrying links, the said connecting straps having bearing surfaces on their lower faces.

19. A cutter chain for a mining machine comprising interconnected bit carrying links and connecting links, the bit carrying links having parallel side plates connected together across the tops and at each end by spaced connecting straps thereby forming an open topped link to permit egress of dirt, the connecting links extending between the side plates of the bit carrying links, pintles pivotally connecting said chain links for pivotal movement, and a bit carrying post on said bit carrying links, said post being so constructed and arranged as to hold a bit at a position longitudinally between the pivotal axes of said bit carrying links, the said connecting straps having bearing surfaces on their lower faces.

20. As an article of manufacture, a bit carrying link for a mining machine cutter chain comprising a body formed of parallel side plates, spaced end plates across the tops of said side plates at each end thereof, providing a U-shaped link with an open top, a bit carrying post extending upwardly from the tops of said side plates and constructed and arranged to carry a bit longitudinally intermediate the end plates and laterally of said side plates, said end plates having bearing surfaces on the lower sides thereof.

21. As an article of manufacture, a bit carrying link for a mining machine cutter chain comprising a body formed of parallel side plates, spaced end plates across the tops of said side plates at each end thereof, providing a U-shaped link with an open top, a bit carrying post extending upwardly from the tops of said side plates and constructed and arranged to carry a bit longitudinally intermediate the end plates and laterally of said side plates.

22. As an article of manufacture, a bit carrying link for a mining machine cutter chain comprising a body formed of parallel side plates, spaced end plates across the tops of said side plates at each end thereof, providing a U-shaped link with an open top, a bit carrying post extending upwardly from the tops of said side plates and constructed and arranged to carry a bit longitudinally intermediate the end plates and laterally of said side plates, said end plates having bearing surfaces on the lower sides thereof, and retaining flanges spaced inwardly between said side plates.

23. As an article of manufacture, a bit carrying link for a mining machine cutter chain comprising a body formed of parallel side plates, spaced end plates across the tops of said side plates at each end thereof, providing a U-shaped link with an open top, a bit carrying post extending upwardly from the tops of said side plates and constructed and arranged to carry a bit longitudinally intermediate the end plates and laterally of said side plates, said end plates having bearing surfaces on the lower sides thereof, and abutment means adjacent each end of said link having abutment surfaces parallel with the longitudinal axis of said link.

24. As an article of manufacture, a bit carrying link for a mining machine cutter chain comprising a body formed of parallel side plates, spaced end plates across the tops of said side plates at each end thereof, providing a U-shaped link with an open top, a bit carrying post extending upwardly from the tops of said side plates and constructed and arranged to carry a bit longitudinally intermediate the end plates and laterally of said side plates, said end plates having bearing surfaces on the lower sides thereof, and abutment means adjacent each end of said link having abutment surfaces both parallel with and at right angles to the longitudinal axis of said link.

25. As an article of manufacture, a bit carrying link for a mining machine cutter chain comprising a body formed of parallel side plates, spaced end plates across the tops of said side plates at each end thereof, providing a U-shaped link with an open top to permit egress of fines, and a bit carrying post extending upwardly from the tops of said side plates, said end plates having bearing surfaces on the lower sides thereof.

26. As an article of manufacture, a bit carrying link for a mining machine cutter chain comprising a body formed of parallel side plates, spaced end plates across the tops of said side plates at each end thereof, providing a U-shaped link with an open top to permit egress of fines, and a bit carrying post extending upwardly from the tops of said side plates.

27. As an article of manufacture, a bit carrying link for a mining machine cutter chain comprising a body formed of parallel side plates, an end plate connected across the tops of said side plates at one end, and a spaced bit carrying post connected across the tops of said side plates at the other end, thereby providing a U-shaped link with an open top to permit egress of fines, said end plate and post having bottom bearing surfaces.

28. As an article of manufacture, a bit carrying link for a mining machine cutter chain comprising a body formed of parallel side plates, an end plate connected across the tops of said side plates at one end, and a spaced bit carrying post connected across the tops of said side plates at the other end, thereby providing a U-shaped link with an open top to permit egress of fines.

29. A cutter chain for a mining machine comprising interconnected bit carrying links and connecting links, the bit carrying links having parallel side plates connected together across their tops at one end by an integral plate and at the other end by a spaced bit carrying post, thereby providing an open top U-shaped bit carrying link, the bottom faces of said plate and post having flat bearing surfaces.

30. A cutter chain for a mining machine comprising interconnected bit carrying links and connecting links, the bit carrying links having parallel side plates connected together across their tops at one end by an integral plate and at the other end by a spaced bit carrying post, thereby providing an open top U-shaped bit carrying link.

31. In combination, a cutter chain and a cutter bar to support the same, the chain including a plurality of bit carrying links and a plurality of interspersed connector links, each of said bit carrying links including a U-shaped portion straddling the bar and within which the connector links are arranged, one on either side of the cutter bar, said U-shaped portion being of sufficient length to overlie substantially the entire length of the connector links.

32. In combination, a cutter chain and a headed cutter bar to support the same, the chain including a plurality of bit carrying links and a plurality of interspersed connector links, each of said bit carrying links including a U-shaped portion straddling the bar and within which the connector links are arranged, one on either side of the cutter bar and beneath the head of the latter, said U-shaped portion being of sufficient length to overlie substantially the entire length of the connector links.

33. In combination, a cutter chain and a cutter bar to support the same, the chain including a plurality of bit carrying links, each including a substantially U-shaped portion adapted to straddle the cutter bar, connector links within and joining adjacent bit carrying links and arranged in pairs, one on each side of the cutter bar, the connector links being provided with laterally and outwardly extending projections, and the U-shaped portion of the bit carrying links extending over the projections upon the connector links to prevent the links from turning upon a transverse axis.

34. In combination, a cutter chain and a headed cutter bar to support the same, the chain including a plurality of bit carrying links each including a substantially U-shaped portion adapted to straddle the cutter bar, connector links within and joining adjacent bit carrying links and arranged in pairs, one beneath each side of the head of the cutter bar, the connector links being provided with laterally and outwardly extending projections, the U-shaped portion of the bit carrying links extending over the projections upon the connector links, the bit carrying links being provided with inwardly facing projections intermediate their ends adapted to engage beneath the head of the cutter bar to prevent the bit carrying links from turning upon a transverse axis.

35. In combination, a cutter bar and a cutter chain including U-shaped bit carrying links straddling the bar, the bight portion of each of said links including spaced-apart flat bearing surfaces one adjacent each end thereof and adapted to contact with the outer surface of the cutter bar to prevent tilting of said links on an axis transverse to said bar.

36. In combination, a cutter chain and a cutter bar to support the same, the chain including a plurality of bit carrying links and a plurality of interspersed connector links, each of said bit carrying links including a U-shaped portion straddling the bar and within which the connector links are arranged, one on either side of the cutter bar, the bight portion of said bit carrying links including flat bearing portions adjacent each end thereof adapted to bear on the outer edge of said cutter bar, said connector links being provided with outward projections intermediate their ends, and said bit carrying links being provided with shoulders at each end thereof to bear on said projections.

37. In combination, a T-shaped cutter bar and a cutter chain including U-shaped bit carrying links straddling the bar, the bight portion of each of said links including a flat bearing surface adjacent one end thereof adapted to contact with the outer surface of the cutter bar, and said links each being provided with a projection intermediate its ends extending inwardly beneath the head of the T-shaped cutter bar to prevent tilting of said links on an axis transverse to said bar.

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