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Kniff et al.

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[45] **Oct. 15, 1974**

[54] **CUTTER CHAIN WITH STAGGERED ROTARY BITS**

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[73] Assignee: **Kennametal Inc.,** Latrobe, Pa.

[22] Filed: **Mar. 19, 1973**

[21] Appl. No.: **342,533**

Related U.S. Application Data

[63] Continuation of Ser. No. 130,209, April 1, 1971, abandoned.

[52] **U.S. Cl.** ..... **299/84,** 37/142 R, 299/86

[51] **Int. Cl.** **E21c 35/18,** E21c 13/00, E02f 9/28

[58] **Field of Search** 37/142, 191, 192; 299/82, 299/83, 86, 84

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[57] **ABSTRACT**

A cutter chain, especially for the excavation of formations, in which the chain is made up of links pivotally interconnected in end to end relation with blocks mounted on the links and inclined at relative angles in opposite directions relative thereto and carries a pick type bit having a point end inclined forwardly in the direction of movement of the chain. Advantageously, each bit is rotatably mounted in a sleeve which, in turn, is rotatably mounted in a respective block.

2 Claims, 9 Drawing Figures

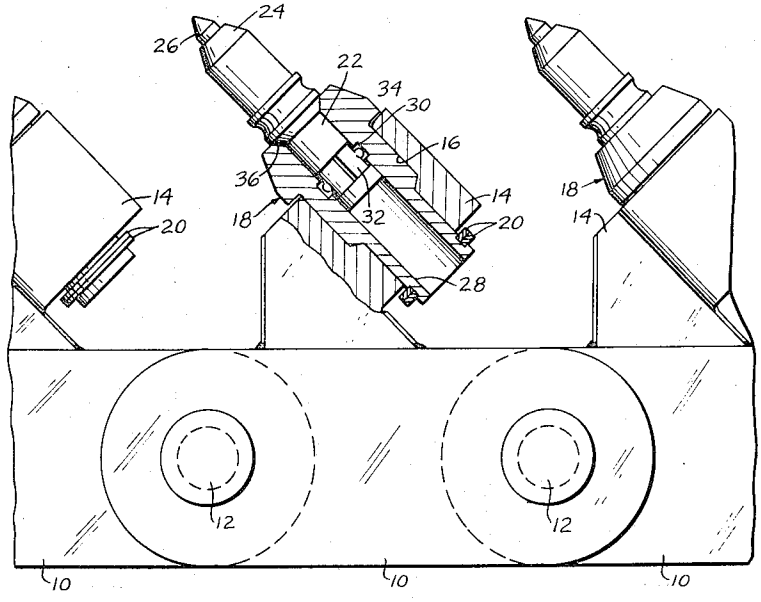


FIG-1

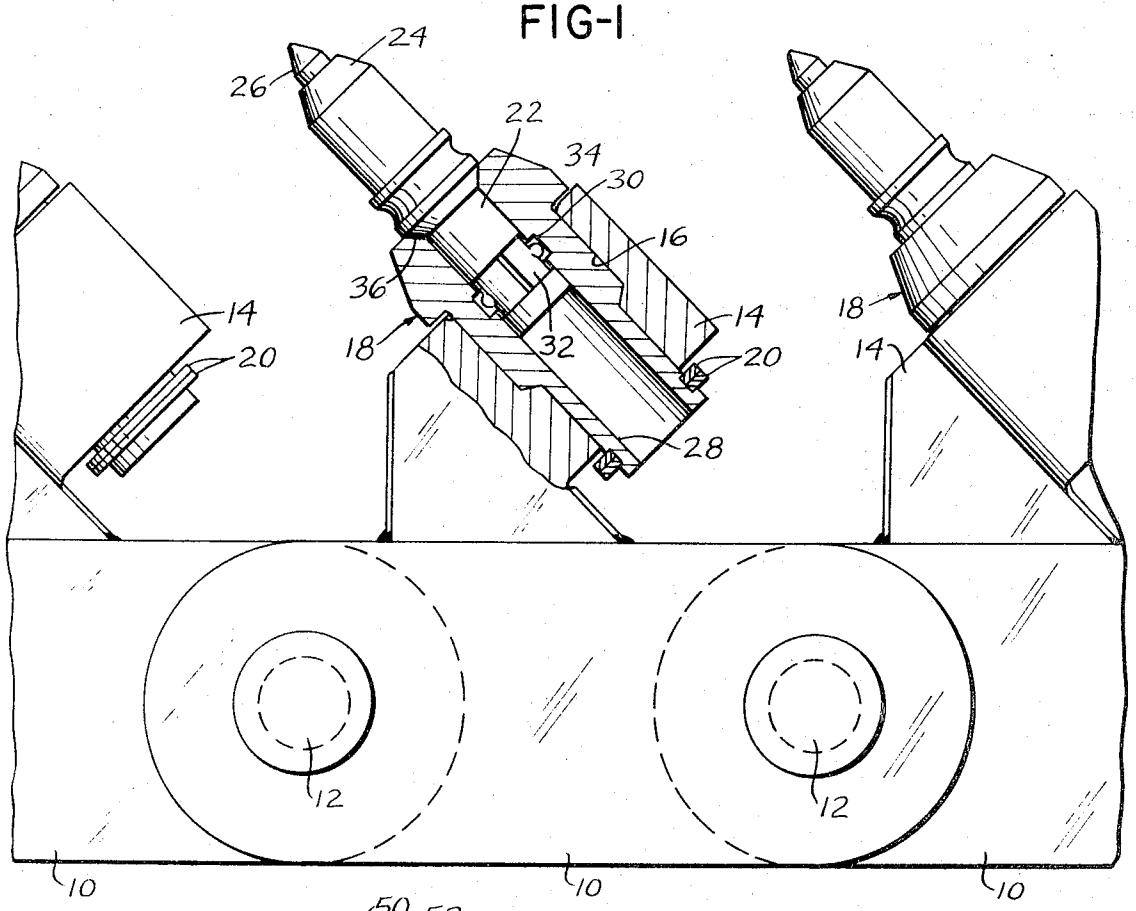


FIG-2A

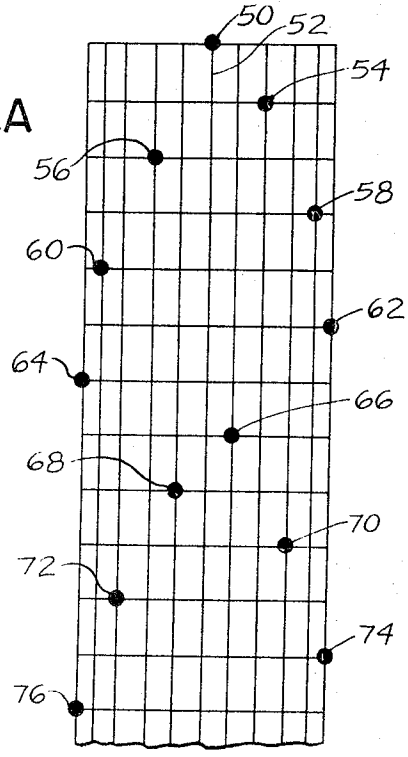
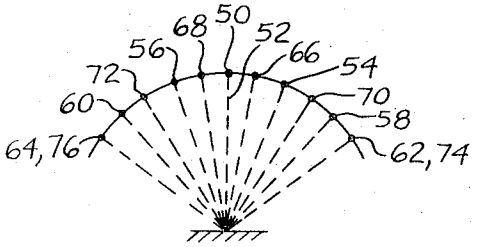


FIG-2B



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FIG-6

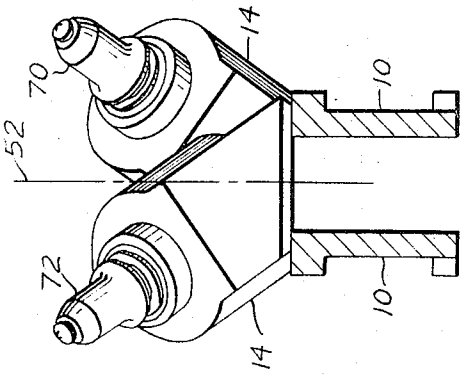


FIG-5

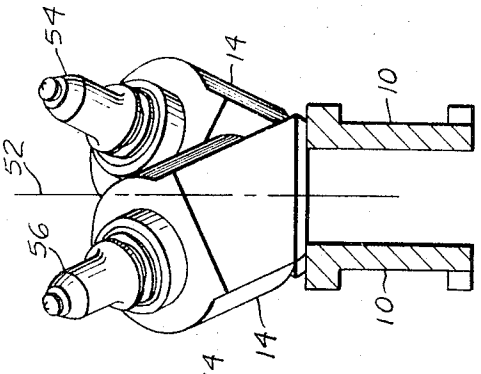


FIG-4

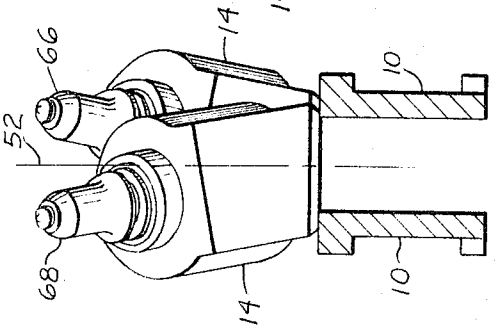


FIG-3

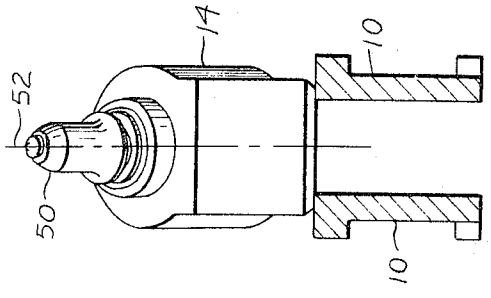


FIG-8

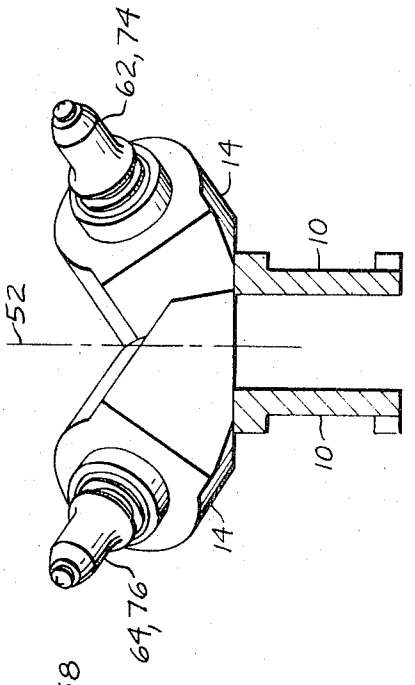
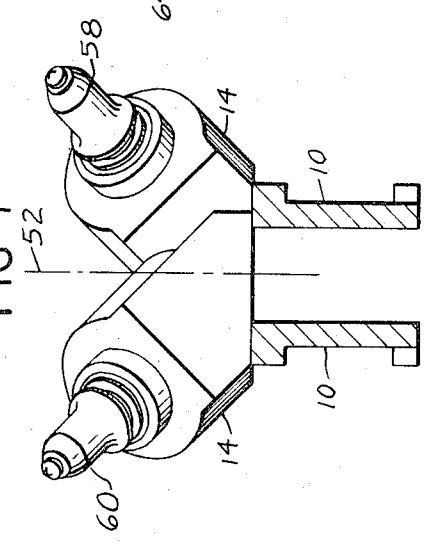


FIG-7



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CUTTER CHAIN WITH STAGGERED ROTARY BITS

The present application is a continuation of U.S. Application Ser. No. 130,209 filed Apr. 1, 1971, in the name of Thomas J. Kniff, for "Cutter Chain", now abandoned.

This invention relates to excavating equipment and is particularly concerned with an excavating or cutter chain.

Cutter chains are known which are mounted on drive sprockets and supporting rollers and driven while being moved into a formation. Cutters of this nature have hard cutting elements mounted thereon for engagement with the formation so as to reduce the formation by cutting along the line of the chain.

The present invention is particularly concerned with a chain arrangement of the nature referred to and is particularly characterized in an improved cutter structure and support therefor and in an improved arrangement of the cutters on the chain leading to more efficient cutting of a formation to which the chain is presented.

The exact nature of the present invention will become more clearly apparent upon reference to the following detailed description taken in connection with the accompanying drawings in which:

FIG. 1 is a fragmentary side view of a portion of a cutter chain constructed according to the present invention.

FIG. 2A is a diagram, in plan, illustrating the lines along which the cutting tips of the cutters of the chain are located in lateral distribution.

FIG. 2B is a diagram, in end elevation, showing the distribution of the cutting tips of the cutters of the chain when viewed in the direction of the length of the chain.

FIGS. 3 through 8 are sectional views showing the various cutters along the chain and the lateral distribution thereof.

BRIEF SUMMARY OF THE INVENTION

The cutter chain according to the present invention comprises a series of chain links pivotally interconnected in conventional manner with blocks fixed to the chain links and with pick type bits rotatably supported in the blocks.

The blocks are arranged so as to support the pick type bits with the point ends thereof inclined in the direction of movement of the chain and distributed laterally of the chain and also vertically relative thereto so that as the chain is driven against a formation, a substantial area of the formation is engaged by the bits and reduced thereby.

DETAILED DESCRIPTION OF THE INVENTION

Referring more in detail to FIG. 1, the chain consists of a plurality of links 10 connected by pins 12. The chain may comprise further links between links 10, if desired. Each link 10 has a block 14 mounted thereon, as by welding, and each block has a shouldered bore 16 in which is rotatably mounted a shouldered sleeve 18.

Sleeve 18 projects beyond the block at the small end of bore 16 and is retained in place by snap rings 20 which permit the sleeve 18 to rotate in the block. Cooperating abutment means are provided on the block and the sleeve in the form of interengaging seat regions to sustain the axial thrust imposed on the sleeve while leaving the sleeve free to rotate in the block.

Sleeve 18 is adapted for receiving shank 22 of a pick type bit having a conical outer end 24 with a hard wear resistant insert 26 therein made of, for example, cemented tungsten carbide.

The bore 28 of sleeve 18 rotatably receives shank 22 of the bit and has an annular recess 30 adapted for engaging a resilient split keeper ring 32 mounted in annular groove 34 formed in shank 22 of the bit. Keeper ring 32 resiliently retains the bit in sleeve 18 and permits rotation of the bit therein and also provides means whereby the bit can readily be pried out of bore 28 or pressed therein.

The mouth of bore 28 and the back end of the outer portion of the bit comprise cooperating seating surfaces at 36, preferably tapered, for firmly supporting the bit while permitting relatively free rotation thereof within sleeve 18.

The block 14 illustrated in FIG. 1 is typical, but in order for a cutter chain to cover the formation to be removed properly, various ones of the blocks 14 are inclined laterally from the vertical central plane of the chain. The cutters mounted on the chain are arranged in groups along the length of the chain and a typical grouping thereof is shown in FIG. 2A. FIG. 2A is a plan view looking down on top of a chain and showing the location of the tips of the bits mounted thereon.

Thus, in FIG. 2A, a sequence of bits commences with the one indicated at 50, and it is located on a line 52 in the vertical central plane of the chain. Immediately following bit 50 is a bit 54 which is tilted outwardly 25° from the vertical central plane of the chain.

Following bit 54 is a bit 56 tilted leftwardly 25° from the central plane of the chain and following bit 56 is bit 58 tilted rightwardly 45° and then a bit 60 tilted leftwardly 45°. The first stage of the sequence illustrated also comprises bits 62 and 64 tilted to the right and left respectively at angles of 55 degrees from the central plane of the chain.

The second stage of the sequence commences with a bit 66 tilted to the right 10°, then a bit 68 tilted to the left 10° and then bits 70 and 72 tilted to the right and left, respectively, at 35 degrees and finally to terminal bits 74 and 76 tilted to the right and left respectively at angles of 55°.

FIG. 2B shows the distribution of the tips of the bits when viewed in the direction of the length of the chain.

The foregoing typical sequence is repeated along the length of the chain to make up a complete endless cutter chain. It will be understood that the length of the chain is preferably a multiple of the length of a complete sequence but can be somewhat shorter, or longer, and certain adjustments can be made in the distribution of the bits in the lateral direction of the chain under these circumstances if so desired.

It will be noted that each stage of the complete sequence illustrated in FIG. 2A has the bits arranged so that the cut taken by the respective stage progressively widens from the front to the rear of the respective stage with successive bits following the first bit in each stage being alternately tilted to one side of the central pin of the chain and then to the other side thereof.

FIG. 3 shows center bit 50 of FIG. 2A, and it will be noted that it is disposed on the vertical central plane 52 of chain 10.

FIG. 4 illustrates bits 66 and 68 which are tilted outwardly 10° from central plane 52.

FIG. 5 illustrates bits 54 and 56 which are tilted outwardly at angles of 25° from plane 52.

FIG. 6 shows bits 70 and 72 which are tilted outwardly at angles of 35°, and FIG. 7 shows bits 58 and 60 which are tilted outwardly at angles of 45°.

Finally, FIG. 8 shows bits 62, 74 and 64, 76 which are tilted outwardly at angles of 55°.

Each sequence thus consists of a center bit at the leading end and two bits at the extreme sides at the trailing end of the sequence with two more bits at the extreme sides at the trailing end of the first stage of the sequence.

Highly efficient cutting of a formation results from the described distribution of the bits with each bit being loaded to about the same extent as all other bits. It will be noted, upon reference to FIGS. 3 to 8, together with FIG. 2B, that the blocks in which the bits are supported are so arranged that the working ends of the bits approach the chain as the bits are tilted farther and farther outwardly from the vertical central plane of the chain.

The working ends of the bits are thus distributed laterally in each sequence as shown in FIG. 2A and are also distributed in the direction toward and away from the chain, as shown in FIG. 2B. This distribution of the bits over the region being cut by the chain assists in distributing the load relatively uniformly amongst the several bits to provide for long life of the chain and of the individual bits.

Due to the mounting of the bits rotatably in the respective supporting sleeves therefor and the rotatable mounting of the supporting sleeves in the blocks that are connected to the chain, and the inclination of the axes of the bits to the formation being reduced thereby, the bits will all rotate on their axes during working, either in the sleeves, or together with the sleeves, and will wear off substantially uniformly in the peripheral direction, and each bit will thereby remain in sharp efficient cutting condition as long as any of the carbide insert material remains in the top of the bit.

By tilting and inclining the blocks, as shown, each block can be substantially identical with all other blocks except for the shaping of the bottom of the support leg of the block, and this materially simplifies the manufacture of the block while, at the same time, all of the tools are presented to the formation being worked in the most advantageous position and at the most advantageous angle.

It will be noted that the point end of each bit is disposed outside the limits of the support block either in the upward direction or in both upward and lateral directions, when the chain is viewed from the front, whereby the formation being worked is broken away ahead of the blocks, and outside the range of the blocks, thereby inhibiting wear of the blocks and permitting the blocks to be used for a substantial long period of time during which a plurality of replacement bits will be mounted therein.

The cutter chain of the present invention is particularly useful for excavating purposes, such as in connection with long wall mining and the like. The rotatable pick type cutter bits are so distributed on the chain as to span a substantial cross sectional area of the formation being worked adjacent the chain and efficiently break up the material into which the bits are driven.

The bits are tilted so as to be presented to the formation at an angle with the point ends of the bits foremost and advance into the formation in such a manner that the bits rotate in the support blocks therefor and remain sharp throughout the life thereof. Highly efficient operating conditions are thus provided while imposing less load on the driving mechanism than is the case when conventional bits are employed and which operate by a shearing action as opposed to the action of the pointed bits of the present invention.

Still further, the sharply pointed rotary pick type bits greatly reduce the amount of fines produced in reducing a formation, such as coal or the like, and, instead, cause the formation to come apart in pieces of substantial size with a minimum amount of fines being generated.

Modifications may be made within the scope of the appended claims.

What is claimed is:

1. A cutter chain, especially for excavating operations comprising: a plurality of links pivoted together in end to end relation to form an endless chain adapted for being supported and driven in the direction of the length of the chain with both reaches of the chain in a single plane, a block fixed to each said link and projecting outwardly therefrom in the general direction of said plane, bores in said blocks, pick type bits each symmetrical about a respective longitudinal axis and each having a rearward shank portion which is round in cross section and a front portion which tapers inwardly to a point at the front end of said bit, a sleeve rotatable in the bore in each block and each bit having the shank portion thereof rotatably mounted in a respective sleeve, each sleeve and block and each bit and sleeve comprising interengaging elements of abutment means for sustaining axial thrusts imposed on the bits in operation, said blocks supporting said sleeves and bits with the longitudinal axes of the bits diverging from said chain in the forward direction when said chain is viewed from the side, each block having a planar bottom surface engaging the respective link of the chain, each said bottom surface being disposed at a respective angle with respect to a central axial plane of the block when viewed longitudinally of the chain for supporting the blocks on the chain so that some of said blocks are tilted on said chain in respective directions lateral to said plane when said chain is viewed in lateral cross section, at least said some of said blocks being positioned on the chain with the longitudinal axes thereof disposed at an angle to the said plane in which the reaches of the chain are disposed when the chain is viewed from above so the longitudinal axes of the respective bits therein diverge from said plane in respective directions in the forward direction and at respective angles, the said tilting of said blocks on said chain and the said angular positioning of the said longitudinal axes thereof relative to said plane disposing the point ends of the bits therein in laterally distributed relation with respect to the said plane in which the reaches of the chain are disposed, said blocks and bits being arranged in successive groups along said chain, an adjacent pair of groups forming a sequence, the leading group of blocks and bits in a sequence including a leading block whic presents the bit therein with the longitudinal axis in said plane, the other blocks of said groups presenting the bits carried thereby at respective angles of inclination to said plane so the point ends of the bits

are disposed alternately on opposite sides of said plane, each group terminating at the trailing end in blocks disposed to support the bits therein with the point ends at the extreme side edges of the path spanned by the point ends of the bits of the sequence, the angle at which the axis of each bit following said leading bit diverges from said plane in the forward direction when viewed from above the chain increasing from front to back in each said group, the point ends of the bits of said groups being so disposed that when a sequence of bits is viewed in the direction of movement of the chain, the point end of each bit of the trailing group of the sequence other than the terminal bits thereof is disposed about midway between adjacent point ends of bits of the leading group of the sequence.

2. A cutter chain according to claim 1 in which the point ends of the bits viewed in the direction of the length of the chain are disposed substantially on a circular arc.

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