United States Patent

[11] 3,622,206

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[73] Assignee The Cincinnati Mine Machinery Co.
Cincinnati, Ohio
Continuation-in-part of application Ser. No. 753,398, Aug. 19, 1968, now abandoned. This application June 30, 1969, Ser. No. 842,791

[54] **CUTTER BITS AND MEANS FOR MOUNTING THEM**
54 Claims, 53 Drawing Figs.

[52] U.S. Cl. .... 299/92, 37/142 A, 287/119 R, 299/83
[51] Int. Cl. E21c 25/46
[50] Field of Search 299/91, 92, 93; 37/141, 142; 287/119

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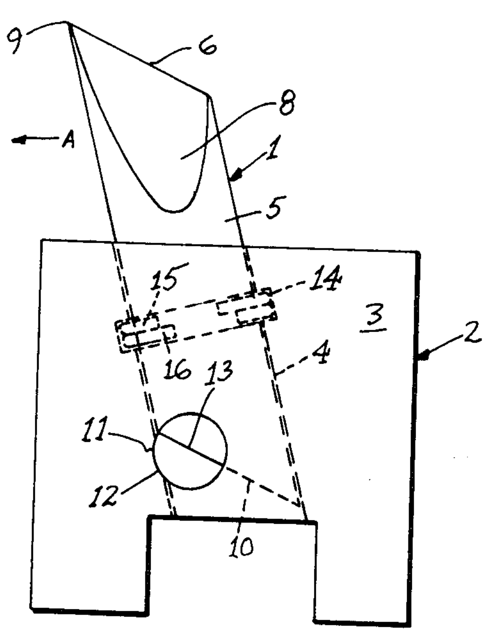
Primary Examiner—Ernest R. Purser
Attorney—Melville, Strasser, Foster & Hoffman

ABSTRACT: Nonrotating cutter bits and mounting means for use on mining, excavating and earth working machines and the like. The cutter bits comprise elongated elements having a shank portion with a cutting tip at at least one end and a gauge-determining abutment surface at at least the other end. The mounting means each comprise a body having a shank receiving perforation, and means in association with the bottom of the perforation having an abutment surface adapted to cooperate with the abutment surface on the cutter bit. Means are provided to frictionally retain the cutter bit shank within the shank receiving perforation, and means are also provided to prevent rotation of the cutter bit within the shank receiving perforation.



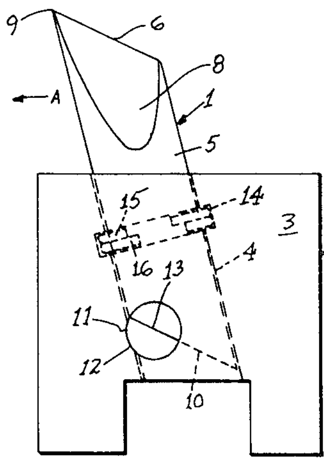


FIG.1

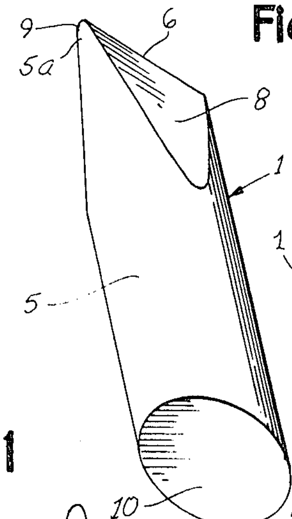
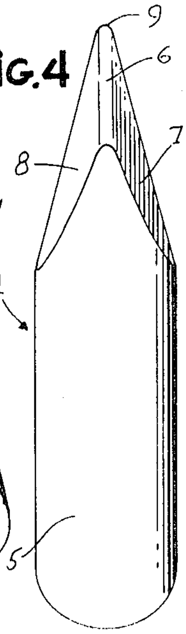


FIG.2

FIG.4



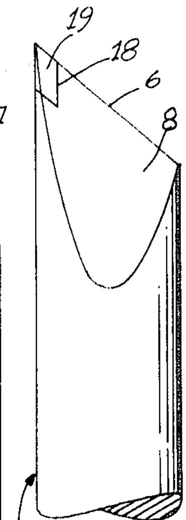


FIG.5

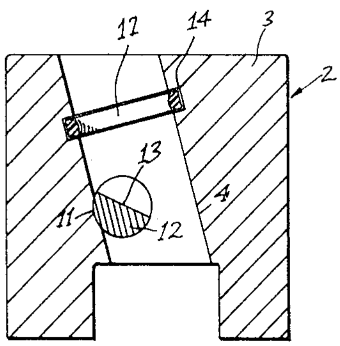


FIG.6

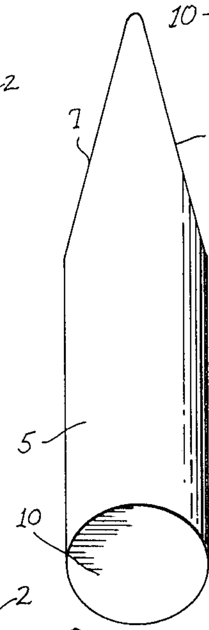


FIG.3

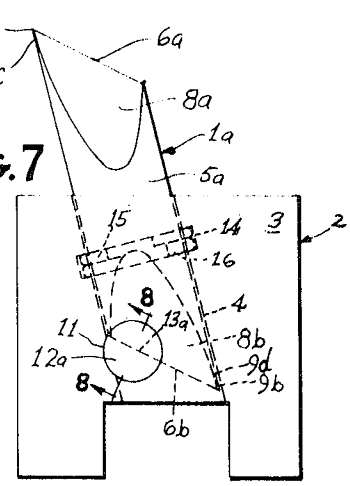


FIG.7

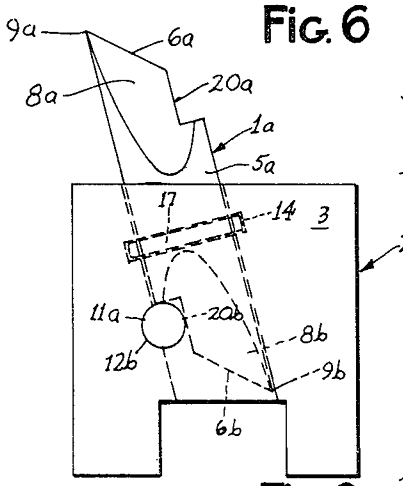


FIG.9

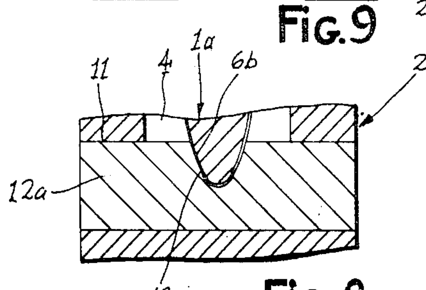


FIG.8

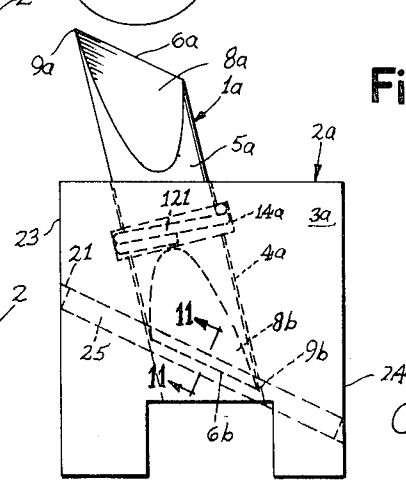
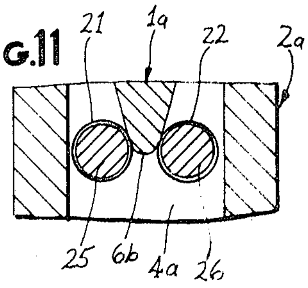


FIG.10

FIG.11



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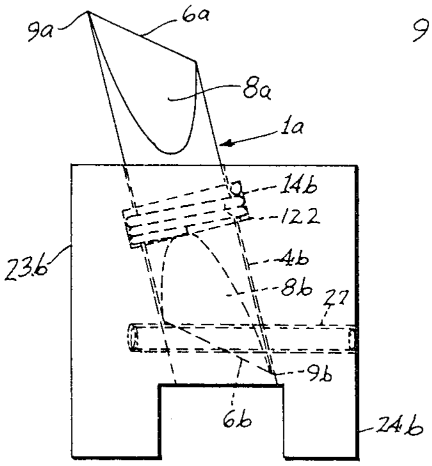

FIG. 12

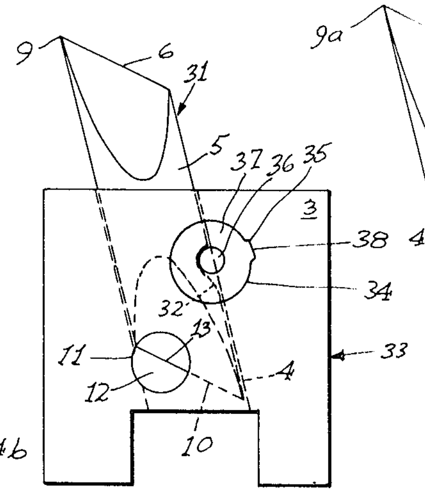

FIG. 14

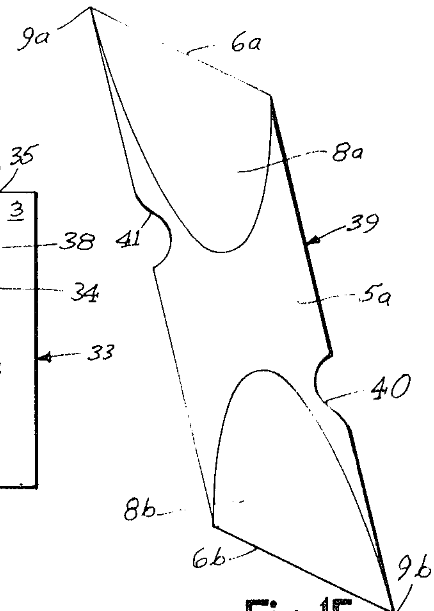

FIG. 15

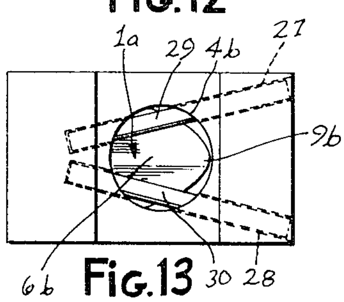

FIG. 13

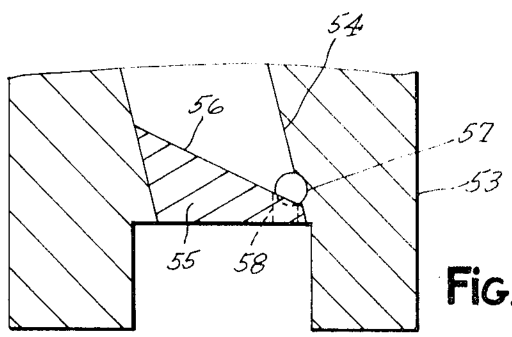

FIG. 16

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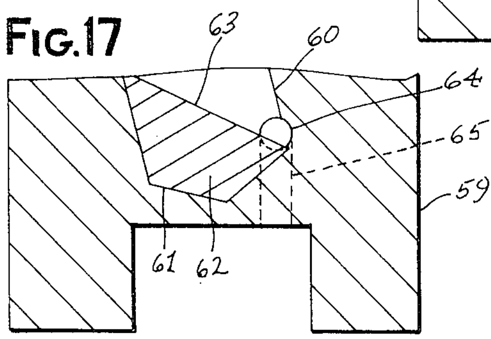

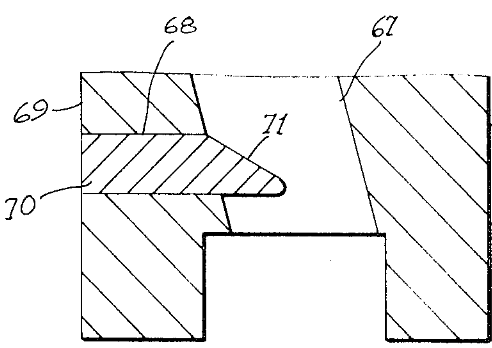

FIG. 18

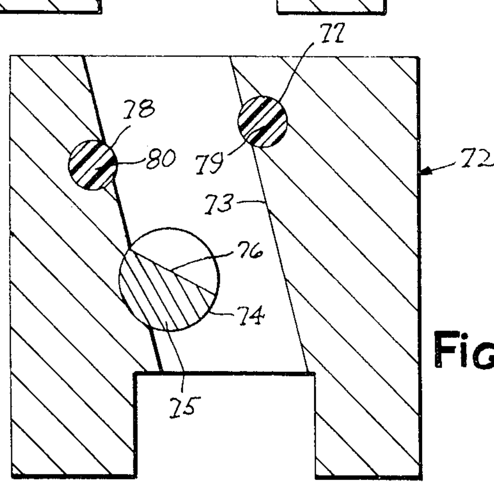

FIG. 19

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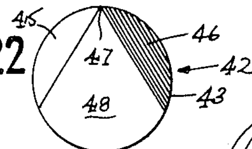


Fig. 22

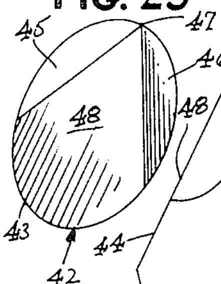


Fig. 23

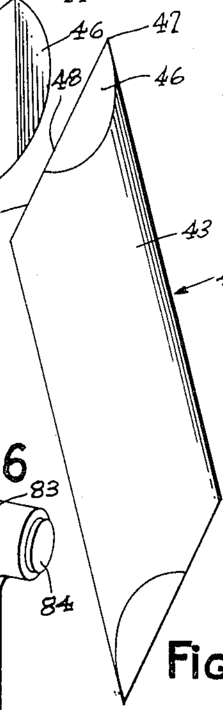
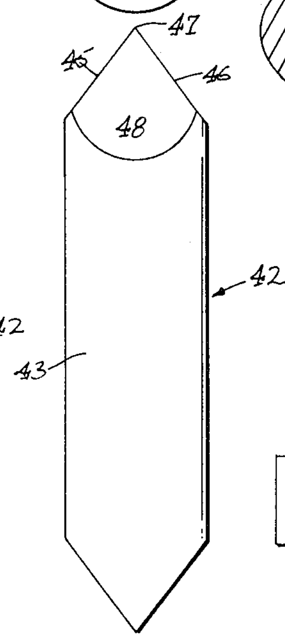


Fig. 20



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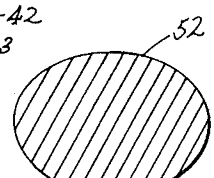

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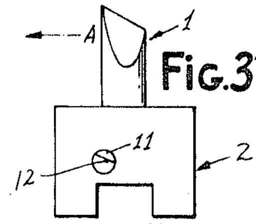

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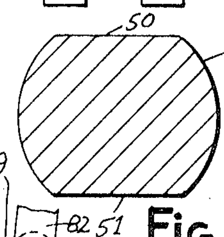

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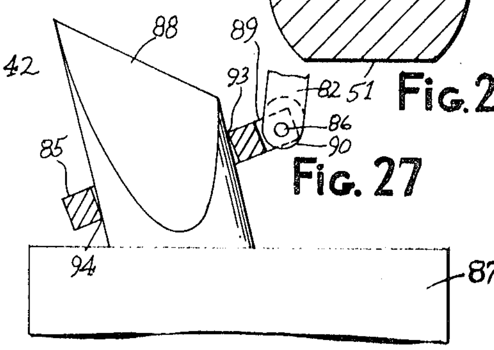

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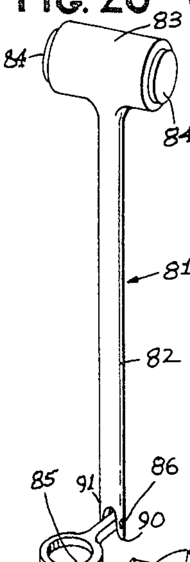

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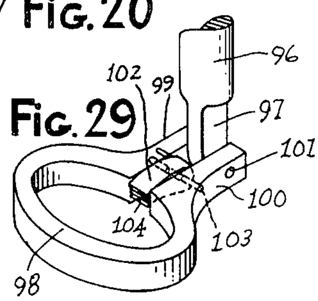

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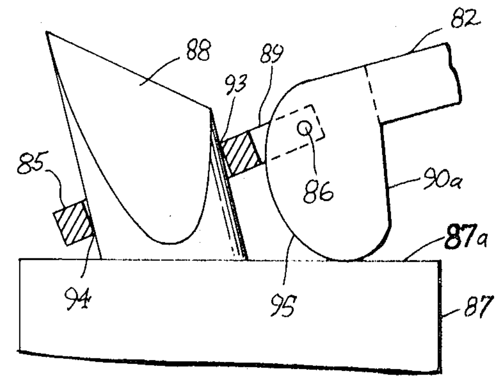

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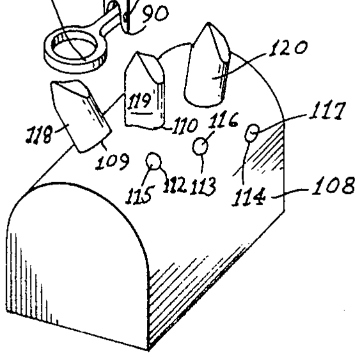

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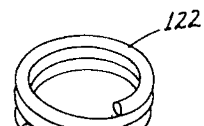

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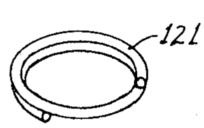

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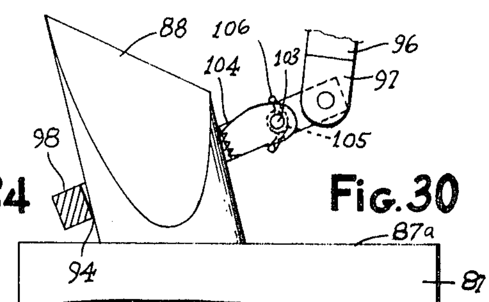

Fig. 30

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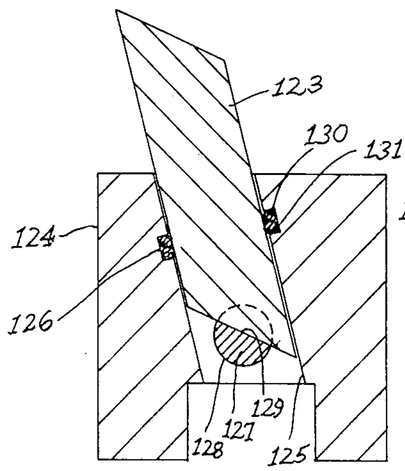
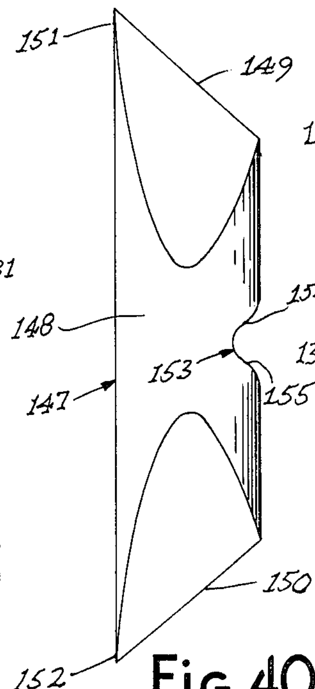


Fig. 35



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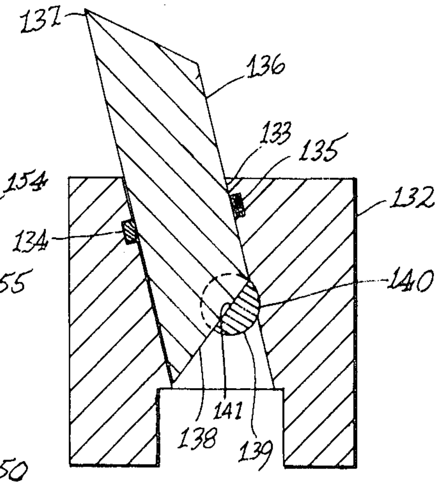

Fig. 36

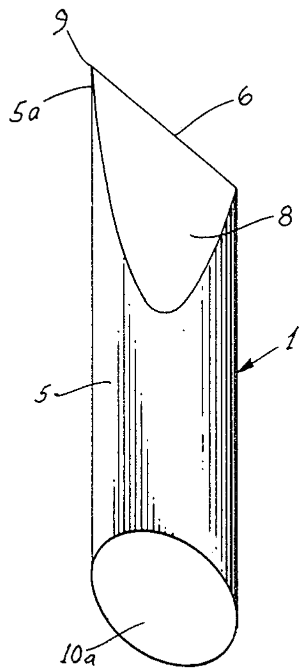

Fig. 37

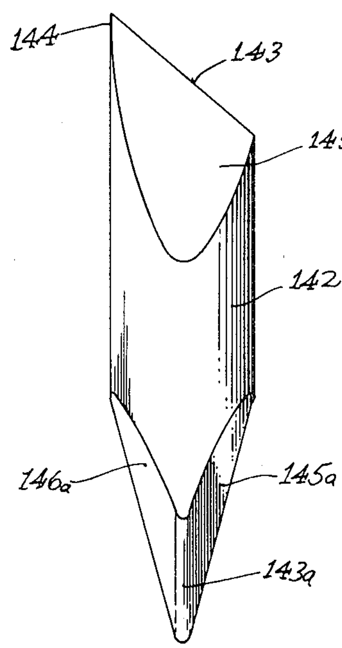

Fig. 38

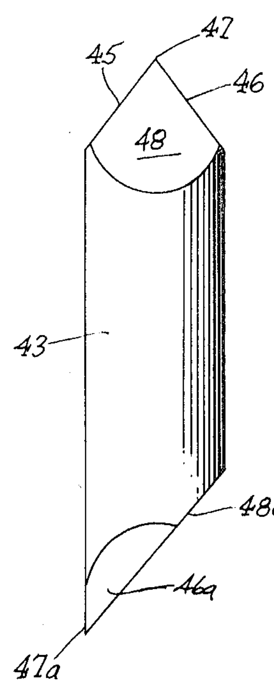

Fig. 39

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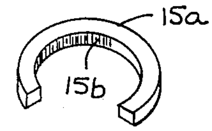

FIG 41

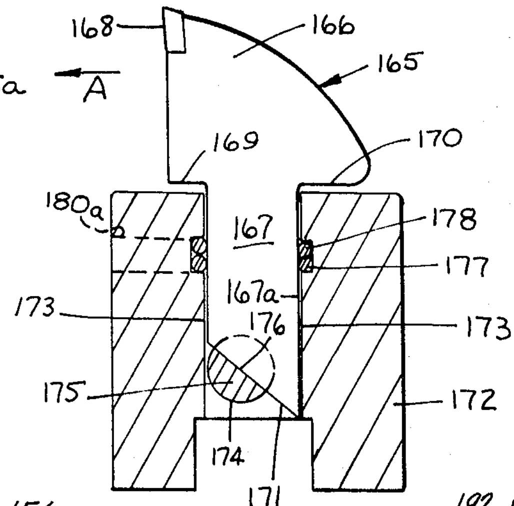

FIG. 43

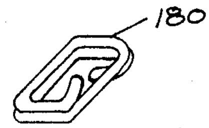

FIG. 45

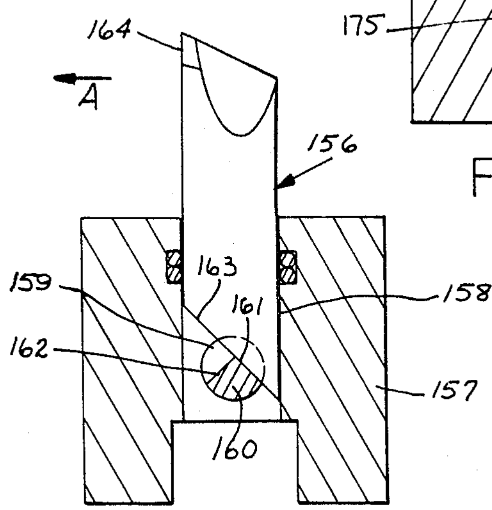

FIG. 42

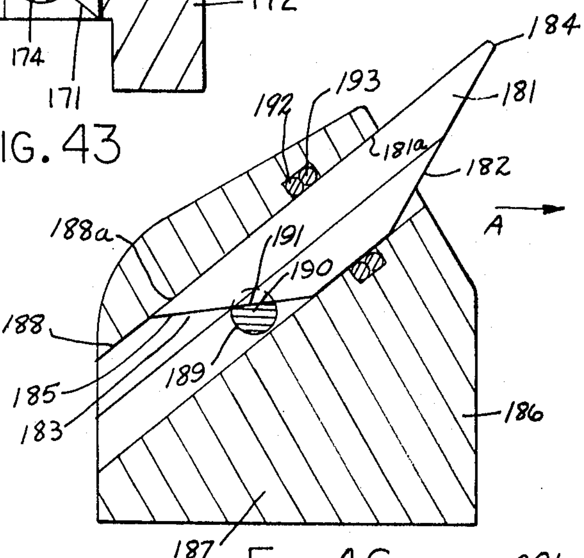

FIG. 46

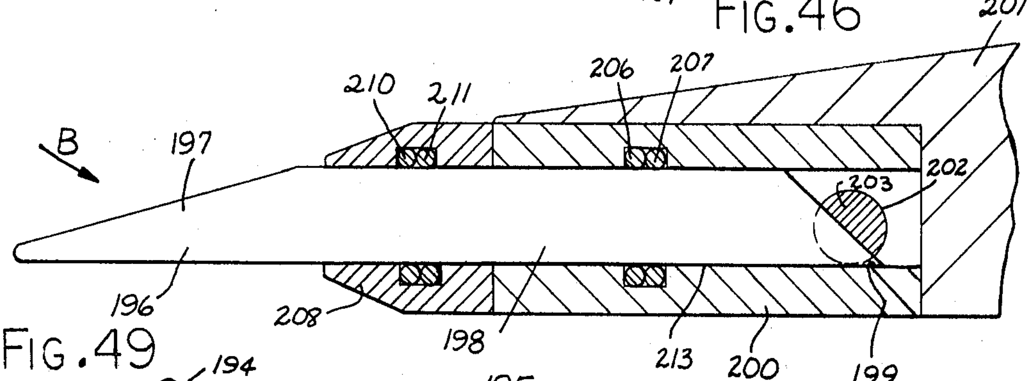

FIG. 49

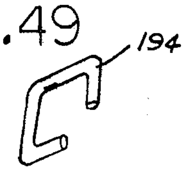

FIG. 47

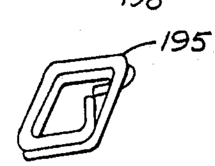

FIG. 48

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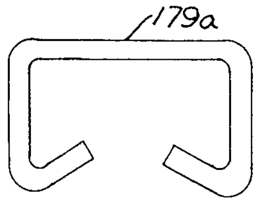

FIG. 44A

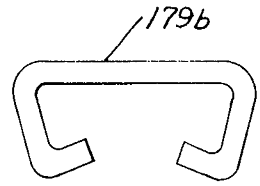

FIG. 44B

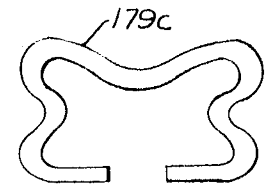

FIG. 44C

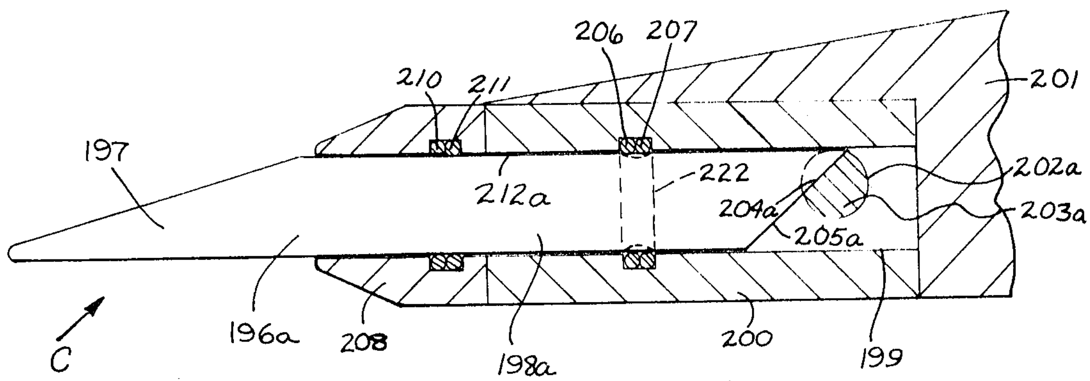

FIG. 50

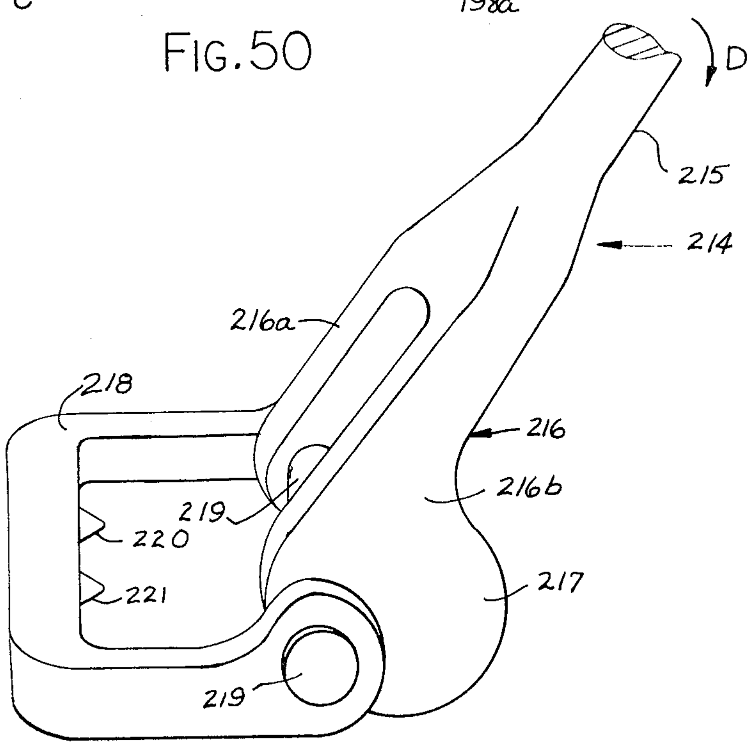

FIG. 51

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CUTTER BITS AND MEANS FOR MOUNTING THEM

CROSS-REFERENCE TO RELATED APPLICATION

This is a continuation-in-part of the copending application of the same inventor, Ser. No. 753,398, filed Aug. 19, 1968, now abandoned and entitled, CUTTER BITS AND MEANS FOR MOUNTING THEM.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to improved cutter bit means for mining, excavating and earth working machinery and the like, and improved means for mounting the cutter bits in cutting positions and for driving them against the face of material to be mined, excavated or worked.

2. Description of the Prior Art

In the present specification most of the embodiments of the present invention will be described as applied to mining machines. As will be demonstrated hereinafter, however, the teachings of the present invention are applicable to other forms of excavating and earth working machinery. Hence the term cutter bit is intended to encompass digger teeth and the like, which also will be more fully explained hereinafter.

Heretofore, nonrotating cutter bits for mining machines and the like have taken many forms. For example, one type of cutter bit has been made by cutting rolled steel rod stock into sections by means of cuts which lie aslant to the major axis of the rod. The rod itself has generally been of diamond-shaped cross section and the cuts have been so oriented as to produce bits being substantially trapezoidal in side elevation. Such a cutter bit is shown in U.S. Pat. No. 2,613,069. In some instances the cuts have been so oriented as to produce bits, the cut faces of which are parallel (see U.S. Pat. No. 2,950,096). In both instances, such cutter bits are nonrotatable and double ended. Portions of their cut faces comprise the cutting surfaces lying at an angle to the major axis of the bits or rod stock from which they are made (see U.S. Pat. No. 3,093,365). In many embodiments, when one cut face is serving as a cutting surface, the other cut face acts as a gauge-determining abutment surface, cooperating with an abutment surface in association with the bit mounting means. The clearance surface of such a bit (i.e., that upper surface which extends rearwardly and downwardly from the cutting surface in cutting position) lies parallel to the long axis of the bit or the major axis of the rod stock from which it is made.

The mounting means for such bits have comprised either lugs or bit holders adapted to be engaged in lugs. In either instance, the bit holding means have been relatively complicated and expensive multipiece structures, requiring extensive forging and machining operations in their manufacture. Removal and reversal or replacement of a bit often required disassembly of the mounting means. The structures set forth in the above mentioned U.S. Pat. Nos. 2,613,069 and 3,093,365 are exemplary of the assemblies just described.

Currently, extensive use is being made in mining and related industries of another type of cutter bit and socket member assemblies wherein the bits are nonrotatably mounted in socket members or lugs. Resilient retaining means are provided to maintain the shanks of the cutter bits in the shank receiving perforations of the socket members or lugs. The relationship of the parts is such that the cutter bits may be installed in the lugs by a driving action, and may be removed therefrom by a prying action. Such bits have come to be known as being of the "knock-in, pry-out" type. The cutter bit and socket member assemblies taught in U.S. Pat. Nos. 2,965,365 and 3,057,609, are exemplary of the structures referred to above. U.S. Pat. No. 3,114,537 illustrates a number of embodiments of nonrotatable cutter bits of the "knock-in, pry-out" type.

Typically, such cutter bits comprise a head portion of noncircular cross section and have a cutting tip and gauge determining abutment shoulders. Integral with the head, is a downwardly depending shank. The shank is of substantially rectangular cross section and is provided with a notch in at least one of its edge portions.

The lug or socket member generally comprises a body having a shank receiving perforation. The shank receiving perforation is usually vertical oriented in the body and is of rectangular cross section. The body is also provided with a transverse perforation adapted to receive a resilient retaining means. The resilient retaining means has a displaceable portion which extends into the shank receiving perforation of the lug and is adapted to engage the notch in the cutter bit shank when the cutter bit shank is in its fully seated position.

The last mentioned cutter bit and lug assemblies have proven highly successful in the field. They are characterized, however, by certain problems.

First of all, utter bits of the type described require extensive and expensive foregoing operations in addition to some machining operations. The cutter bits are characterized by stress-raising shoulders and notches which tend to concentrate the cutting strains. As a result, the cutter bits tend to fail at the position of such stress raisers.

In addition, the lugs or socket members require expensive broaching operations. Both the cutter bit shanks and the shank receiving perforations are subject to wear, particularly at the upper rear and the lower front contacting surfaces of the shank and perforation. The numerous types of resilient retaining means known in the art generally rely, in part at least, on the size and configuration of the shank receiving perforation for their holding abilities. As the shank receiving perforation becomes worn during use and the cutter bit shank is more loosely accommodated therein, the shank holding capabilities of the retaining means are diminished.

The present invention is directed to improved cutter bits, lugs and retaining means, capable of solving the above described problems. In certain embodiments of the present invention, the cutter bits are preferably made of round stock and are free of stress-raising changes in cross section. Such cutter bits can be made from rolled, round stock without the necessity of forging. When made from round stock, a bit is formed by cutting the stock aslant its long axis. In this instance, however, a portion of one cut face comprises the clearance surface lying at an angle to the long axis of the bit. Portions of this cut face are relieved so as to form a cutting surface on the peripheral surface of the stock, lying substantially parallel to the long axis of the bit. The other cut face of the bit serves as a gauge-determining abutment surface. The bits of the present invention may be double-ended.

In most embodiments, the lugs of the present invention are simple in construction and expensive broaching operations can be avoided and replaced by simple drilling operations. Certain, at least, of the retaining means of the present invention are capable of functioning with full efficiency despite wear of the shank receiving perforation.

All of the cutter bit and socket member assemblies of the present invention are of the "knock-in, pry-out" type, with all of the advantages attendant thereto. In certain embodiments, by virtue of the gauge-determining abutment surface at the rear end of the shank, the shank receiving perforations in the lugs and the cutter bits therein can be angled in such a way that the resultant cutting stresses will be aligned more nearly parallel to the axis of the cutter bits.

Recently, mining machines have been developed which are far more powerful and cut at a far more rapid rate than hitherto possible. Thus, there is a need for cutter bits and mounting means assemblies which can be easily and inexpensively manufactured and which are characterized by greater strength and longer service life. The cutter bit and socket member assemblies of the present invention are capable of fulfilling this need.

Additionally, the invention contemplates a novel combination of retaining means and cooperating abutment surfaces on the cutter bit and in association with the shank receiving perforation, such that full line or surface contact may be achieved between the rear surface of the cutting tool shank and the adjacent surface of the shank receiving perforation in the mounting means, whereby to greatly reduce wear of these parts. In addition, this combination assures that despite long use and wear of the cutter bit and mounting means assembly, the cutter bit will be tightly and adequately retained in its respective shank receiving perforation. Thus, in a mining machine for example, the life of a cutter chain, cutter wheel or the like will no longer be largely determined by wear of the shank receiving perforations.

The principle set forth herein can, in fact, be applied to existing types of cutter bit and mounting means combinations, as will be described hereinafter.

SUMMARY OF THE INVENTION

The invention relates to nonrotating cutter bits and mounting means therefor, particularly for use in mining, excavating and earth working machines and the like. The cutter bits have a cutting point at at least one end and an abutment surface at least the other. The cutter bits may be double ended, having a cutting tip and an abutment surface at both ends.

The lug or socket member comprises a body having a shank receiving perforation. Means are provided near the bottom of the shank receiving perforation to provide an abutment surface adapted to cooperate with the cutter bit abutment surface. The last mentioned means also serves, in part at least, to prevent rotation of the cutter bit within the shank receiving perforation.

In the preferred embodiments, resilient retaining means are provided which maintain the cutter bits in their respective shank receiving perforations by friction and which will function efficiently in spite of wear on the shank receiving perforations.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a cutter bit and lug assembly of the present invention, and illustrates one type of resilient retaining means.

FIGS. 2, 3 and 4 are respectively perspective, front elevational and rear elevational views of the cutter bit of FIG. 1.

FIG. 5 is a fragmentary side elevational view of a cutter bit similar to that of FIG. 1, and provided with a hard cutting tip.

FIG. 6 is a cross-sectional view of a lug similar to that shown in FIG. 1, and illustrates another form of resilient retaining means.

FIG. 7 is a side elevational view illustrating the use of a double-ended bit in a lug similar to that of FIGS. 1 and 6.

FIG. 8 is a fragmentary cross-sectional view taken along the section line 8—8 of FIG. 7.

FIG. 9 is a side elevational view of a cutter bit lug assembly, illustrating a modified form of double-ended cutter bit and a modified form of abutment means in the lug.

FIG. 10 is a side elevational view of a cutter bit lug assembly, illustrating the use of a double-ended cutter bit and a modified form of abutment means in the lug.

FIG. 11 is a fragmentary cross-sectional view taken along the section line 11—11 of FIG. 10.

FIG. 12 is a side elevational view similar to FIG. 10, but illustrating another form of abutment means in the lug.

FIG. 13 is a bottom view of the assembly of FIG. 12.

FIG. 14 is a side elevational view of a cutter bit and lug assembly illustrating the use of a conventional resilient retainer.

FIG. 15 is a side elevational view of a double-ended cutter bit for use in a lug of the type shown in FIG. 14.

FIGS. 16 through 18 are fragmentary, cross-sectional, elevational views of the lug of the present invention and illustrates various forms of abutment means which may be provided at the bottom of the shank receiving perforation.

FIG. 19 is a cross-sectional elevational view of a lug of the present invention, illustrating another form of resilient retaining means.

FIGS. 20 through 22 are views of a modified form of cutter bit, and constitute respectively a side elevational, a rear elevational and a plan view thereof.

FIG. 23 is an illustration of the end of the cutter bit of FIGS. 20 through 22, as viewed in the direction of arrow B.

FIGS. 24 and 25 are cross-sectional views of cutter bit shanks illustrating exemplary noncircular configurations.

FIG. 26 is a perspective view of a tool for installing and removing the cutter bits of the present invention into and from their respective lugs.

FIG. 27 is a fragmentary side elevational view of a cutter bit lug assembly, illustrating (partly in cross section) the tool of FIG. 26 and its use.

FIG. 28 is a view similar to FIG. 27 and illustrates a modified extraction tool.

FIG. 29 is a fragmentary perspective view of another embodiment of the extraction tool.

FIG. 30 is a fragmentary view of a cutter bit lug assembly illustrating the use of the tool of FIG. 29.

FIG. 31 is a side elevational view of a cutter bit lug assembly of the present invention, illustrating the cutter bit as having a vertical orientation.

FIG. 32 is a perspective view of a lug of the present invention capable of mounting a plurality of cutter bits at varying angularities.

FIGS. 33 and 34 are perspective views of coiled retaining means.

FIG. 35 is a cross-sectional view of a cutter bit and lug assembly similar to that of FIG. 1 and illustrating a modified placement of the lug abutment surface.

FIG. 36 is a cross-sectional view of a cutter bit and lug assembly illustrating a modified form of cutter bit and a modified placement of the lug abutment surface.

FIGS. 37, 38, 39 and 40 are elevational views of modified forms of cutter bits of the present invention.

FIG. 41 is a perspective view of another form of retaining means.

FIG. 42 is a side elevational view, partly in cross section, of a cutting tool-lug assembly wherein the cutter bit is reversible to permit reversal of the cutting direction.

FIG. 43 is a side elevational view, partly in cross section, illustrating a modified cutter bit-lug assembly.

FIGS. 44A, 44B and 44C are plan views of retaining means for cutter bits having shanks of rectangular cross section.

FIG. 45 is a perspective view of a retaining means for cutter bits having shanks of rectangular cross section.

FIG. 46 is a side elevational view, partly in cross section, illustrating yet another cutter bit-lug assembly.

FIGS. 47 and 48 are perspective views illustrating retaining means for cutter bits of the type illustrated in FIG. 46.

FIGS. 49 and 50 are side elevational views, partly in cross section, illustrating combinations of a mounting means and a cutter bit or digger tool for excavating or earth working machines.

FIG. 51 is a perspective view of another type of cutter bit extraction tool.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates a cutter bit-lug assembly of the present invention. The cutter bit is generally indicated at 1 and the lug is generally indicated at 2. The lug comprises a body 3.

The lugs of the present invention may be installed upon cutter chains, cutter wheels, rotary cutter bars or cutter arms of mining machinery (usually by welding them to the driven elements which carry them) and they may be oriented at different angularities to the driven elements so that the cutting points of the various bits will form a cut of sufficient width to permit the passage of the driven element and its appurtenances.

The body 3 has a shank receiving perforation 4. The axis of the shank receiving perforation 4 is inclined toward the cutting direction (indicated by arrow A). As used herein, the term "cutting direction" refers to the direction in which the cutter bit-lug assembly is moved by the driven element to which they are mounted, irrespective of any movement of the entire mining machine itself.

The angularity of the shank receiving perforation axis to the cutting direction does not constitute a limitation on the present invention. This angularity may be 90° or less. An angularity of less than 90° is generally preferred so that the component of force tending to shove the cutter bit into the shank receiving perforation is greater and so that the resultant cutting stresses on the bit will be more nearly in line with the bit axis.

As illustrated in FIGS. 1 through 4, the bit 1 comprises an elongated shank 5, preferably of circular cross section. The upper end of the shank terminates in a clearance surface 6 lying at an angle to the shank axis and is relieved on opposite sides as at 7 and 8 so as to form a cutting tip 9 having a cutting surface 9*a* substantially parallel to the axis of the shank 5. The lower end of the shank 5 terminates in an abutment surface 10 lying at an angle to the shank axis.

Returning to FIG. 1, the lug body 3 has a transverse hole 11 extending through the body and intersecting the shank receiving perforation 4. A pin 12 is located in the hole 11 and may be replaceably held or permanently affixed therein as by welding or the like. The pin 12 may have a length equal to or less than the length of the hole 11. The pin 12 is relieved to form an abutment surface 13 adapted to cooperate with the abutment surface 10 on the cutter bit. The abutment surface 13 may exist only on that portion of the pin lying within the shank receiving perforation. On the other hand, the surface 13 may extend the full length of the pin. The latter arrangement has two advantages. First of all, it provides lateral bleed holes for fines and other foreign material which might tend to accumulate in the shank receiving perforation. It is for this same reason that the shank receiving perforation 4 preferably extends through the lug body 3 forming an opening both at the top and bottom thereof. Secondly, if the surface 13 extends throughout the length of the pin 12, this would enable the insertion of a drift through the open portion of hole 11 should difficulty be encountered in removing the cutter bit, or if the exposed part of the cutter bit were to be broken away, leaving a portion of the bit inside the shank receiving perforation.

FIG. 1 also illustrates an exemplary form of retaining means for maintaining the shank 5 in the shank receiving perforation 4. In this instance, the inside surface of the perforation 4 has an annular notch or groove 14 formed therein. The notch 14 is adapted to receive one or more resilient, C-shaped elements of metal or the like. For purposes of an exemplary showing, two C-shaped metal elements 15 and 16 are illustrated. The elements 15 and 16 are substantially identical. They have an outside diameter greater than the diameter of the shank receiving perforation but slightly less than the diameter of the annular notch 14. The rings 15 and 16 have an inside diameter slightly less than the diameter of the cutter bit shank 5. In use, the C-shaped elements are contracted (which can be accomplished by virtue of the fact that the ends of each element are spaced from each other) and are shoved into the shank receiving perforation 4 until they reach the annular notch or groove 14. When the notch 14 is reached, the C-shaped elements are captively held in annular notch or groove 14.

The cutter bit 1 may be mounted in the lug 2 by inserting it into the shank receiving perforation. Since the diameter of the cutter bit 5 is greater than the inside diameter of the elements 15 and 16, the bit must be forced therethrough. A blow by a suitable tool will be sufficient to cause the bit 1 to assume its proper seated position against the abutment surface 13, as shown in FIG. 1. The elements 15 and 16 frictionally engage the shank 5 and prevent removal thereof by centrifugal force or other forces operating to remove the bit. During normal cutting conditions, there will be a large component of force tending to urge the bit toward its seated position.

Removal of the cutter bit 1 may be accomplished merely by engaging the exposed portion of the bit by a suitable tool and pulling upwardly thereon. An exemplary tool for this purpose will be described hereinafter.

FIG. 6 illustrates a lug in every way identical to that shown in FIG. 1, and like parts have been given like index numerals. The figure illustrates, however, the use of another form of resilient retainer. In this instance, a resilient ring 17 of rubber or the like provided. The ring has an outside diameter greater than that of the shank receiving perforation 4, but less than that of the annular notch 14. As in the case of the elements 15 and 16 of FIG. 1, the inside diameter of the ring 17 is less than the diameter of the cutter bit shank 5. Insertion and removal of a cutter bit in the lug of FIG. 6 can be accomplished in the same manner described with respect to FIG. 1. The resilient ring 17 will maintain the cutter bit in place in substantially the same manner as described with respect to elements 15 and 16. The use of a ring such as the ring 17 is illustrated, for example, in FIG. 9.

With respect to the retainers just described, it is important to note that their retaining action is not affected by wear of the shank receiving perforation 4. They frictionally engage the cutter bit shank and operate primarily on the upper and lower faces of the annular notch or groove 14. These retaining means are not as constantly worked as are prior art resilient retainers so that hysteresis in the case of rubber or the like and fatiguing in the case of metal or the like are greatly reduced.

The resilient C-shaped elements 15 and 16 may have any suitable cross-sectional configuration. This is illustrated for example, in FIG. 41. Here the resilient C-shaped element 15*a* is shown as having a rectangular cross-sectional configuration. Further, the elements 15 and 16 or 15*a* may be provided with serrations on that portion thereof which engages the cutter bit shank. Such serrations are illustrated at 15*b* in FIG. 41.

In the assembly shown in FIG. 1, it will be understood that although the shank 5 and the shank receiving perforation 4 are circular in cross section, the angularity and interaction of the shank abutment surface 10 and the lug abutment surface 13 will prevent any rotation of the bit about its axis. The same interaction and angularity will also tend to cause the bit 1 to be self-aligning during insertion into the shank receiving perforation 4.

In FIG. 1, as in most of the Figures, the cutter bit shank 5 and shank receiving perforation 4 are (for purposes of clarity) illustrated by separate dashed lines. These dashed lines are not intended to be indicative of clearance dimensions. It will be understood by one skilled in the art that the respective diameters of the shank 5 and perforation 4 will be so sized as to permit a sliding fit of the shank within the perforation. Prolonged use of the assembly will cause wear of the parts, particularly the perforation 4, and the clearance dimensions will be changed thereby.

Most of the embodiments of the present invention are, however, adapted to both reduce and counteract such wear. The combination of two factors, the interaction of abutment surfaces 10 and 13 and the frictional engagement of the retaining means 15–16 on the bit shank while not being fixedly held in the lug, yield two important results. First of all, when the assembly is moved in the cutting direction (arrow A) the material being cut will exert a force on the cutter bit, one component of which is directed rearwardly (in a direction opposite that of arrow A) and another component of which is directed downwardly. The nature of the retaining means and the cooperation of abutment surfaces 10 and 13 not only permit but also encourage a full line or surface-to-surface contact between adjacent rear surfaces of the perforation 4 and shank 5. Thus all along the surface to which the lead line of index numeral 4 is directed there will be contact between the shank and the surface of the shank receiving perforation. It has been found in actual field use that this greatly reduces wear of the parts, particularly wear of the shank receiving perforation 4.

As wear does occur, the two above mentioned factors together with the two above mentioned components of force cooperate to insure that the cutter bit remains fully seated with the above noted line or surface-to-surface contact. Meanwhile, the retaining means of the present invention maintain their full effectiveness.

These two results or features (i.e., full line or surface-to-surface contact and proper seating and retention in spite of wear) have rendered the useful life of cutter chains, cutter wheels, cutter arms and the like no longer so dependent upon wear of the shank receiving perforations. Thus, service life is greatly increased.

These two important results or features of the present invention are characteristic of all embodiments herein save those illustrated in FIGS. 9, 14, 15, and 36–40. These last mentioned embodiments (to be discussed hereinafter) do have all the remaining advantages of the present invention such as simplicity of manufacture and use, and the like.

FIG. 7 illustrates a lug substantially identical to that illustrated in FIGS. 1 and 6, and like parts have been given like index numerals. In this instance, however, the lug is illustrated as having a double-ended bit mounted therein. The bit, generally indicated at 1*a* has a clearance surface 6*a*, relieved portions (one of which is shown at 8*a*) a cutting tip 9*a* with a cutting surface 9*c* and a circular shank 5*a*. As thus far described, the bit is substantially identical to that shown in FIGS. 1 through 4.

The opposite end of the bit 1*a*, differs from that of bit 1 in that it is identical to the first described end. Thus, it has a clearance surface 6*b* (substantially parallel to the surface 6*a*), side reliefs (one of which is shown at 8*b*), and a cutting tip 9*b* with a cutting surface 9*d*. The cutting surfaces 9*c* and 9*d* are substantially parallel to the axis of the shank 5*a*.

In the bit 1*a* of FIG. 7, the clearance surfaces 6*a* and 6*b* may alternately serve the same function as the surface 10 of bit 1 of FIG. 1. In other words, either clearance surface 6*a* or clearance surface 6*b* may constitute an abutment surface adapted to cooperate with an abutment surface in the shank receiving perforation 4. Again, as in the lug 2 of FIGS. 1 and 6, a transverse hole 11 is provided, intersecting the shank receiving perforation 4. A pin 12*a* is permanently or removably affixed in the lug, the pin having an abutment surface 13*a* adapted to cooperate with either of the surfaces 6*a* and 6*b* of the cutter bit.

FIG. 8 most clearly illustrates the abutment surface 13*a*. The surface 13*a* comprises a notch in the pin 12*a* which will receive the portion 6*a* or 6*b* of the cutter bit 1*a*, as shown.

It will be understood by one skilled in the art that the hole 11 and pin 12*a* may have any desired cross section. In the preferred embodiment, both the hole 11 and pin 12*a* have a circular cross section, primarily because such a construction is simpler and more economical to manufacture. Again, the length of pin 12*a* may be equal to or less than the length of the hole 11.

For purposes of an exemplary illustration, a retaining means of the type illustrated in FIG. 1 is shown in FIG. 7. The retaining means and its operation are identical to that described above, as is the method of insertion and removal of the bit 1*a*.

FIG. 5 is a fragmentary elevational view of the cutting end of bit 1 of FIGS. 1 through 4. Like parts have been given like index numerals. FIG. 5 illustrates that the cutting surface of bit 1 may be notched as at 18 and provided with a hard cutting tip 19 of appropriate alloy material, and appropriate configuration as is well known in the art. Such a tip may be provided on any of the bits of the present invention. It is also within the scope of the invention to make the entire bit from a suitable alloy of sufficient strength to provide a hard cutting tip.

All of the cutter bit embodiments of the present invention (save that shown in FIG. 46 to be described hereinafter) are characterized by clearance surfaces lying at an angle to the long axis of the bit and cutting surfaces lying substantially parallel to this axis. Both in the present description and the claims which follow, the term "substantially parallel" is intended to distinguish the orientation of the cutting surface of a bit of the present invention from the orientation of the cutting surfaces of bits of the general type shown in the above mentioned U.S. Pat. Nos. 2,613,069 and 3,093,365 which lie at a considerable angle to the long axis of their respective bit. The term "substantially parallel," however, is intended to include small departures from parallelism which might occur when a separate hard cutting tip is used, or when it is desired to provide a flat cutting surface on the bits of the present invention.

FIG. 9 illustrates a socket member substantially identical to that of FIG. 7 and a double-ended bit, also similar to that shown in FIG. 7. Like parts have been given like index numerals. In this instance, however, the rear portions of the bit ends have been notched, as indicated at 20*a* and 20*b*. The notches 20*a* and 20*b* comprise bit abutment surfaces.

In this embodiment, the lug 2 may have transverse hole 11*a*. The transverse hole 11*a* is similar to the hole 11 of FIG. 7, but may have a slightly smaller diameter. A pin 12*b* is removably or permanently affixed in the hole 11*a* and constitutes the abutment surface in the shank receiving perforation 4. Again, the length of the pin 12*b* may be equal to or less than the length of the hole 11*a*. The pin 12*b* is adapted to cooperate with either of the notches 20*a* and 20*b* as shown. Again it will be understood by one skilled in the art, that the hole 11*a*, the pin 12*b* and the notches 20*a* and 20*b* may have any suitable configuration. The configuration of these elements, as illustrated in FIG. 9, are simple and inexpensive to manufacture.

Again, for purposes of an exemplary showing, FIG. 9 illustrates the use of a resilient ring retainer of the type described with respect to FIG. 6. Insertion and removal of the bit of FIG. 9 may be accomplished in the manner described above.

Reference is now made to FIGS. 10 and 11. In these Figures the cutter bit is identical to that shown in FIG. 7 and like parts have been given like index numerals. The lug of FIG. 10 is substantially identical to that of FIG. 7 and like parts have been given like index numerals followed by "*a*." The lug 2*a* differs from the lug 2 of FIG. 7 only with respect to the abutment means provided therein. In this instance, the transverse perforation 11 has been replaced by a pair of perforations 21 and 22. The perforations 21 and 22 are parallel and extend from the forward face 23 of the lug 2*a* through the rearward face 24 of the lug. The perforations 21 and 22 are angled with respect to the lug body 3*a* at substantially the same angle as the surface 6*b* of the cutter bit 1*a*. Rods 25 and 26 are removably or permanently affixed within the perforations 21 and 22 respectively. As indicated in FIG. 11, the rods will be parallel and will intersect the shank receiving perforation 4*a*, forming together an abutment means adapted to cooperate with either of the surfaces 6*a* or 6*b* of the cutter bit 1*a*, in the manner shown in FIG. 11.

FIGS. 12 and 13 illustrate another form of lug abutment means. In these figures, the cutter bit is again identical to that of FIG. 7, and like parts have been given like index numerals. The lug of FIGS. 12 and 13 is substantially identical to that of FIG. 7 and like parts have been given like index numerals followed by "*b*."

The embodiment of FIGS. 12 and 13 differs from that of FIG. 10 primarily in the type of abutment surface means provided in the lug 2*b*. In this instance, the lug is provided with two horizontally oriented holes 27 and 28, both of which are substantially parallel to the top surface of the lug. The holes 27 and 28 are angled toward each other. Pin means 29 and 30 are removably or permanently located in the holes 27 and 28 respectively. The pin means provide surfaces against which the lower end of the bit 1*a* may abut. The perforations 27 and 28 and the pins 29 and 30 therein angle toward each other so as to conform to the configuration of the bit end.

FIG. 14 illustrates a cutter bit and lug assembly similar to that shown in FIG. 1, but utilizing a different type of resilient retaining means. In this instance, the bit, generally indicated at 31 is in every way similar to that shown in FIG. 1 (like parts having been given like index numerals), with the exception that the rear surface of the shank 5 has a notch 32 formed therein. The notch 32 may be of the same general type described in U.S. Pat. No. 3,114,527. As taught in that patent, the notch may have a hook-shaped configuration so that a resilient retaining means engaged in the notch will tend to urge the cutter bit toward its seated position.

The lug, generally indicated at 33, is substantially the same as that shown in FIG. 4 and like parts have been given like index numerals. In this instance, however, the annular notch 14 is replaced by a transverse hole 34, preferably incorporating a keyway 35. The hole 34 is adapted to receive a resilient retainer, which may be of any suitable type such as that disclosed in the above mentioned U.S. Pat. No. 3,114,537. The retainer comprises a pin 36 encased in a resilient body 37 having an integral key 38 molded thereon. A portion of the body 37 is discontinuous so that a part of the pin 36 is exposed and extends into the shank receiving perforation 4. By virtue of its resilient backing, the pin 36 is displaceable transversely of the shank receiving perforation 4 so as to permit insertion of the cutter bit. When the cutter bit is in seated position the pin 36 will engage in the notch 32. Insertion and removal of the cutter bit 31 may be accomplished in the same manner as that described with respect to the cutter bit 1 of FIG. 1.

FIG. 15 illustrates a double-ended cutter bit for use in the lug of FIG. 14. The bit of FIG. 15, generally indicated at 39, is substantially identical to the bit 1*a* of FIGS. 10 and 12. For this reason, like parts have been given like numerals. The bit differs from that of FIGS. 10 and 12 only in that it is provided with a pair of oppositely oriented notches 40 and 41 adapted to serve the same purpose as the notch 32 in FIG. 14. When the cutting tip 9*a* of the bit is being used, the notch 40 will be engaged by the resilient retainer. Similarly, when the cutting tip 9*b* is being used, the notch 41 will be engaged by the resilient retainer.

FIGS. 20 through 23 illustrate another form of cutter bit, generally indicated at 42. In this instance, the shank 43 of the cutter bit is preferably circular in cross section and the top of the cutter bit (generally indicated at 44), is angled with respect to the bit axis.

The cutter bit 42 has two reliefs 45 and 46 forming a cutting point 47. The reliefs 45 and 46 are, however, far shallower than the reliefs illustrated at 7 and 8 in FIGS. 1 through 4. In this way, the cutter bit 42 has a flat wedge-shaped clearance surface 48 formed at the end thereof.

The cutter bit of FIGS. 20 through 23 may be provided at its other end with an abutment surface identical to that shown at 10 in FIGS. 1 through 4. However, the cutter bit 42 is particularly adapted to be double-ended in construction. This is true because, despite the fact that it would have a cutting tip 47 at both ends, it would also have a flat clearance surface 48. Such a clearance surface could serve as a bit abutment surface and would readily cooperate with any flat, angled lug abutment surface, such as that shown at 13 in FIG. 1.

It is within the scope of the invention to form any of the cutter bits above described with a noncircular cross section. FIGS. 24 and 25 illustrate exemplary noncircular cross sections. In FIG. 24 a bit 49 is shown having a circular cross section with a pair of diametrically opposed, longitudinally extending flats 50 and 51. In FIG. 25 a bit 52 of oval cross section is shown. The provision of a noncircular cross section would eliminate the necessity of providing means for preventing rotation of the bits. For example, when noncircular bits are used, the shank receiving perforation would have a matching cross section and could be provided with a lower abutment surface normal to its axis. For many reasons, however, a bit of circular cross section is preferred. For example, the bits may be made of ordinary rolled, round stock. In addition, no expensive broaching or the like would be required to form the shank receiving perforation in the lug.

FIGS. 16 through 18 illustrate alternate ways of forming an abutment surface in the shank receiving perforation of a lug of the general type shown in FIG. 1. In FIG. 16, a lug 53 has a shank receiving perforation 54. In the bottom of the perforation 54 there is affixed a plug 55 having a surface 56 of the proper angularity and intended to serve as an abutment surface. A transverse perforation 57 may be formed in the lug 53 to serve as a bleed hole for fines and foreign material accumulating in the shank receiving perforation 54. Instead of the transverse perforation 57, however, it would be possible to provide a bleed hole in the plug 55 as indicated in dotted lines at 58.

In FIG. 17, a lug 59 with a shank receiving perforation 60 is illustrated. In this instance, the shank receiving perforation does not extend all the way through the lug and may terminate in a surface 61 having a configuration equivalent to the configuration of the end of the drilling tool used to form the shank receiving perforation 60. The perforation 60 may be provided with an abutment surface by inserting and affixing therein a plug 62 of appropriate configuration. The upper surface 63 of the plug will serve as the abutment surface. Again, a transverse bleed hole 64 may be provided in the lug, equivalent to the bleed hole 57 of FIG. 16. Alternatively, a vertical bleed hole may be drilled through the lug and the plug 62, as indicated in dotted lines at 65.

FIG. 18 illustrates a lug 66 having a shank receiving perforation 67. In this instance, the perforation 67 extends through the lug body so that no bleed hole is required. As indicated in FIG. 18, the lug is also provided with a horizontal perforation 68 extending from the forward face 69 of the lug to the shank receiving perforation 67. Affixed in the perforation 68 is a rod member 70, the end of which is appropriately configured to provide a suitable abutment surface 71.

FIG. 19 illustrates a lug similar to that shown in FIG. 1, but having a different type of resilient retaining means mounted therein. The lug, generally indicated at 72, has a shank receiving perforation 73, a transverse perforation 74, with a pin 75 mounted therein and providing an abutment surface 76. In this instance, a pair of transverse holes 77 and 78 are formed in the body of the lug 72. The holes 77 and 78 are so located as to intersect the shank receiving perforation and to lie on opposite sides thereof. Rodlike members 79 and 80 are affixed in the perforations 77 and 78 respectively. The rodlike members are made of any suitable resilient material such as natural rubber, synthetic rubber or the like. A portion of each resilient member 79 and 80 extends into the shank receiving perforation 73 and is in position to frictionally engage the shank of a cutter bit (not shown) located in the lug 72. Preferably, the holes 77 and 78 are so located that those portions of the rodlike members 78 and 80 extending into the shank receiving perforation are diametrically opposed. Under such circumstances the holding power of the rodlike members is not diminished by wear of the shank receiving perforation. The invention is not intended to be so limited however, and those portions of the rodlike members extending into the shank receiving perforation need not be diametrically opposed.

Again, it will be understood that insertion and removal of a cutter bit in the lug 72 may be accomplished in the same manner as that described with respect to the assembly of FIG. 1. It will further be understood that the lug 72 could be provided with only one of the two transverse holes 77 or 78 and only one of the two resilient rodlike members 79 or 80. In such an instance, the bit will be frictionally engaged between the rodlike member and the opposite or facing inside surface of the shank receiving perforation 73. For example, if only resilient rodlike member 80 were present, the above-mentioned full line or surface-to-surface contact would be achieved between the bit shank and the rear surface of the shank receiving perforation.

In all of the embodiments thus far described, the cutter bits may be mounted in the lugs by inserting them in the shank receiving perforations and imparting to them a blow by means of a suitable tool. In each instance, the cutter bits may be removed from the shank receiving perforations in the lugs by pulling axially on the cutter bits by means of a suitable tool. Exemplary embodiments of a tool for inserting and removing the cutter bits of the present invention are illustrated in FIGS. 26 through 30.

FIG. 26 illustrates a combination tool, capable of assisting in both the insertion and removal of the cutter bits of the present invention with respect to a lug member. The tool, generally indicated at 81, comprises a shank 82. One end of the shank has a head 83 suitably configured to serve as a hammering device for knocking the cutter bits into their seated positions within their respective shank receiving perforations. Preferably, the head 83 will comprise a socket element which contains a material 84 which is relatively soft when compared with the metal of the bit. In this way, the bit will not be damaged when blows are administered to it by the tool. The material 84 can be of any suitable nature. For example, it can comprise a body of rolled and compressed leather or rawhide, a body of soft metal, a body of resilient rubbery substance, a body of wood or the like.

The other end of the shank 82 has a ring member 85 pivotally affixed thereto by means of a pin or the like 86. FIG. 27 more clearly illustrates the ring 85 and its use. The ring comprises a means for removing a cutter bit from a lug.

In FIG. 27, a lug is shown at 87 having a cutter bit 88 mounted therein. The lug 87 and the cutter bit 88 may be of the type described with respect to any of the foregoing embodiments. The ring 85 has an internal diameter slightly larger than the diameter of the bit 88, so that the ring may be readily placed about the bit as illustrated. The ring has a rearwardly extending shank 89 which extends between bifurcations 90 and 91 at the end of the tool shank. The pivot pin 86 extends through coaxial perforations in the bifurcations 90 and 91 and the shank 89. It will be understood by one skilled in the art that it would not constitute a departure from the present invention to provide the ring 85 with a pair of spaced shanks adapted to lie on either side of the end of the tool shank 82 and to be pivotally affixed thereto.

As will be evident from FIG. 27, when an upward pulling force is applied to the shank 82, the pivoted ring 85 will engage the bit 93 and 94 with a sort of wedging action. Having thus been engaged, the bit 88 can be pulled from the shank receiving perforation of the lug 87. Since the ring 85 frictionally engages the cutter bit as at 93 and 94, the inside edges of the ring should be relatively sharp to insure a better engagement.

In FIG. 28, the tool shank, the ring, the cutter bit and the lug are substantially identical to that shown in FIG. 27 and like parts have been given like index numerals. In this instance, however, the bifurcations of the tool shank are enlarged (one of which is shown at 90*a*) so as to provide a cam surface 95 adapted to cooperate with the top surface 96 of the lug 87. Removal of the bit 88 is accomplished in the same manner described with respect to FIG. 27, but is aided by the interaction of the cam surface 95 on the lug surface 87*a*.

FIGS. 29 and 30 illustrate another embodiment of the present invention. In this instance, a tool shank 96 is shown, equivalent to the shank 82 of FIG. 26. The bottom end of the shank 96 is reduced in width as indicated at 97. A circular ring 98 is shown, having a pair of spaced, rearwardly extending shanks 99 and 100, adapted to be pivotally affixed to the portion 97 of the tool shank 96 by a pivot pin or the like 101.

Between the spaced rearwardly extending ring shanks 99 and 100 there is pivotally mounted a dog 102 by means of a pivot pin 103, the ends of which extend into perforations in the shanks 99 and 100. The dog 102 has a series of teeth 104. When the dog is in the position shown in FIGS. 29 and 30, the distance between the dog teeth 104 and the diametrically opposed inside surface of the ring at 94 is slightly less than the diameter of the bit 88. Spring means 105 may be engaged on the pivot pin 103 with one end 106 engaging the bottom surface of the dog, the other end 107 engaging the top surface of the shank 99. The spring means 105 will tend to pivot the dog upwardly toward a position where the teeth 104 do not extend into the inside opening of the ring 98.

The use of the embodiment of FIGS. 29 and 30 is substantially the same as that described with respect to FIG. 27. The difference lies in the fact that the cutter bit 88 will be engaged by the ring as at 94 and by the dog teeth 104, as illustrated. Such an arrangement is particularly desirable when the cutter bit 88 is made of very hard and durable material.

It will also be understood by one skilled in the art that the reduced portion 97 of the tool shank may be provided with a configuration similar to the configuration of the bifurcations in FIG. 28. Thus, a cam surface would be presented, adapted to cooperate with the upper surface 87*a* of the lug 87.

In all of the embodiments shown in FIGS. 27 through 30, the tool shank 82 or 96 may or may not be provided with the head means 83–84 of FIG. 26. The combination of these elements is desirable, primarily as a matter of convenience, so that the tool may be used for both the insertion and removal of the cutter bits. It will further be understood by one skilled in the art that the pivoted ringlike elements 85 and 98 need not necessarily be circular in configuration. They may be rectangular or of any suitable shape, having an opening which again, may be of any configuration based largely on the cross-sectional configuration of the cutter bit to be extracted.

As indicated above, the angularity of the shank receiving perforation in the lug and the angularity of the cutter bit with respect to the cutting direction may be 90° or less. In FIG. 31, for purposes of an exemplary showing, the cutter bit-lug assembly of FIG. 1 is illustrated with the shank receiving perforation and the cutter bit so oriented as to form an angle of 90° with respect to the cutting direction A. For most purposes, however, the orientation of the cutter bit at an angle of less than 90° with respect to the cutting direction is preferred since under these circumstances the resultant cutting stresses will be more nearly in line with the bit shank axis and the component of force tending to urge the bit towards its seated position will be greater.

With the exception of the cutter bits illustrated in FIGS. 14 and 15, all of the bits thus far described are characterized by the fact that they have no stress-raising shoulders or notches. They can be made from ordinary rolled, round stock with a minimum of machining and without the necessity of forging. The cutter bits of the present invention also are characterized by improved strength and service life, by virtue of the fact that they are made from rolled, round stock. The bits of FIGS. 14 and 15 are similarly characterized by increased strength and service life. This is true because of the fact that the notches 32, 40 and 41 are very shallow and constitute but a small portion of the peripheral surface of the bits.

From the foregoing descriptions, it will also be understood that the lugs of the present invention are far cheaper and easier to manufacture than those of the prior art. When, as in the preferred embodiments, a bit of circular cross section is used, expensive broaching operations, heretofore required in the manufacture of lugs, can be supplanted by simple drilling operations.

The cutter bit-lug assemblies thus far described possess an additional advantage. With the exception of the embodiment of FIG. 14, no large, space-consuming retaining means, located behind the cutter bit, is required. It will be noted, for example, from FIG. 1 that from the front surface to the rear surface of the lug very little internal volume of the lug is required beyond the shank receiving perforation 4. As a result, lugs may be provided which carry more than one bit, but are of smaller dimensions than hitherto possible. FIG. 32 illustrates such a lug.

The lug 108 is provided with three shank receiving perforations 109, 110 and 111. In addition, the lug has three transverse perforations 112, 113 and 114 to accommodate rodlike abutment means 115, 116 and 117, respectively. The rodlike abutment means may be similar to that shown at 12 in FIG. 1. Cutter bits 118, 119 and 120 can be of any suitable type set forth above. For purposes of an exemplary illustration, they are shown as being of the type set forth in FIGS. 1 through 4.

It will be noted that the shank receiving perforations 109 through 111 and the transverse holes 112 through 114 are suitably angled within the lug 108 so that the cutter bits 118 through 120, themselves, lie at different angularities. In this way, a cut can be made which is of sufficient dimensions to permit passage of the lug assemblies and their appurtenances therethrough.

FIGS. 33 and 34 illustrate additional embodiments of resilient retaining means for the cutter bits of the present invention. In FIG. 33, there is illustrated a retaining means 121 comprising a single piece of coiled, resilient wire having about 1¾convolutions. The retainer 122 in FIG. 34 is similar to that of FIG. 33, but has about 2¾convolutions. The resilient retaining means 121 and 122 are adapted to be used much the same way as the C-shaped elements **15** and **16** in FIG. **1**. The retainers **121** and **122** will have an outside diameter greater than the diameter of the shank receiving perforation **4** of the lug, but less than the diameter of the notch or groove **14**. Either of the retainers **121** and **122** may be spirally or transversely compressed and inserted into the shank receiving perforation **4**, and will snap into place when they reach the notch or groove **14**.

The retainers **121** or **122** have an inside diameter slightly less than the diameter of the cutter bit shank. In this way, when the cutter bit shank is inserted into the shank receiving perforation in the lug, it will be frictionally engaged by the resilient retainer **121** or **122**.

Retainers **121** and **122** function in an identical manner. It has been discovered that, by utilizing a series of loops, the holding power of a resilient retainer can be appreciably multiplied. Thus, the resilient retainers **121** and **122** can be expected to have a greater holding power than the C-shaped elements **15** and **16**. Similarly, the holding power of retainer **122** should be greater than that of retainer **121**.

For purposes of an exemplary illustration, FIG. **10** illustrates the use of the retainer **121** of FIG. **33**. Similarly, FIG. **12** illustrates the use of the retainer **122** of FIG. **34**. It will be understood by one skilled in the art that the retainers **121** and **122** may have any desired cross-sectional configuration and may be provided with serrations, all as is shown in FIG. **41** with respect to the retainer **15*a***.

FIG. **35** is a cross-sectional view of a cutter bit and lug assembly similar to that of FIG. **1**. The cutter bit **123** may be of the type shown in FIGS. **1** through **5**, of the type shown in FIGS. **7**, **10** and **12**, or of the type shown in FIGS. **20** to **23**. The lug **24** is similar to that shown in FIG. **1** and has a shank receiving perforation **125** and an annular notch **126**. The lug abutment **127** comprises a rodlike element located in a transverse hold **128**.

The difference between the embodiment of FIG. **35**, and that of FIG. **1**, lies in the placement of the hole **128** and the abutment means **127**. In this instance, hole **128** is so placed as to completely intersect the shank receiving perforation **125**, and a portion of the rodlike element **127** is located wholly within the shank receiving perforation.

When the cutter bit **123** is of the type shown in FIGS. **1** through **5** or FIGS. **20** through **23**, the element **127** may be exactly the same as the element **12** in FIG. **1**. Thus, the rodlike element may be of a length equal to or less than the hole **128** and may have a flat abutment surface **129** extending throughout the length of the rodlike element or on only that part of the rodlike element lying within the shank receiving perforation.

When the cutter bit **123** is of the type shown in FIGS. **7**, **10** and **12**, the rodlike element **127** will be similar to that shown at **12*a*** in FIGS. **7** and **8**, and the lug abutment surface **129** will comprise a notch.

For purposes of an exemplary showing, the assembly of FIG. **35** is illustrated as including C-shaped retaining means **130** and **131** similar to the retaining means **15** and **16** of FIG. **1**. It will be understood by one skilled in the art that retaining means of the types shown in FIGS. **6**, **33**, **34** and **41** may be used.

In all of the embodiments thus far described, the cutter bits have been shown as having parallel clearance surfaces and abutment surfaces. In the case of double-ended bits, the cutting tips have been illustrated as lying on opposite sides of the bit axis and the abutment surfaces have been illustrated as parallel. Similarly, with the exception of FIGS. **12** and **13**, all of the lug abutment surfaces have been illustrated as sloping downwardly and rearwardly with respect to the shank receiving perforation. While such an arrangement is preferred, it will be understood by one skilled in the art that the invention is not so limited.

In any of the single-ended cutter bits of the present invention, the abutment surface (at one end and lying at an angle to the bit axis) may have its slope directed at any point in a 360° circle about the bit axis, with respect to the cutting point and clearance surface at the other end of the bit. Similarly, with respect to double-ended bits taught herein, the cutting point and abutment surface at one end of the bit may lie at any orientation about the bit axis, with respect to the cutting point and abutment surface at the other end of the bit.

For purposes of an exemplary showing, FIG. **36** illustrates a cutter bit and lug assembly similar to that of FIG. **1** except for the orientation of the lug and bit abutment surfaces. In this instance, the lug **132** has a shank receiving perforation **133** and an annular notch **134** for receipt of any of the above mentioned retaining means. For purposes of an exemplary showing, a retaining means **135**, similar to the retaining means **17** in FIG. **6** is shown. The cutter bit **136** has a cutting surface **137** at one end and an abutment surface **138** at the other. In this embodiment, the abutment surface **138** slopes forwardly and downwardly of the shank receiving perforation **33**.

The lug **132** has a transverse hole **139** and a rodlike abutment means **140**. The transverse hole **139** differs from the hole **11** in FIG. **1** only in that it is placed on the opposite side of the shank receiving perforation. When the cutter bit **136** is of the type shown in FIGS. **1** through **5** or **20** through **23**, the rodlike element **140** can be of the same general type shown at **12** in FIG. **1**. If the cutter bit **136** is of the type shown in FIGS. **7**, **10** and **12**, the rodlike element **140** will be of the type described at **12*a*** in FIGS. **7** and **8**. Thus, the element **140** will have an abutment surface **141** which will either be a flat surface or a notch, depending upon the configuration of the bit **136**.

In a similar manner, all of the lug abutment surfaces in all of the lugs described above may be oriented in any suitable direction depending upon the configuration of the bit used. Thus, the plug-type abutment surfaces shown in FIGS. **16** and **17** may be turned to any angle throughout 360°. Similarly, all of those lug abutment means which constitute a part of rodlike elements may have any suitable orientation depending upon the orientation of the holes in which they are located. In FIG. **18**, for example, the hole **68** could extend from either side of the lug **66** or from the back surface thereof, or even from any corner thereof. The same is true of any of the transverse holes in the lugs shown in FIGS. **1**, **6–9**, **14** and **31**. The same is also true of the holes **21** and **22** in FIGS. **10** and **11**, and the holes **27** and **28** in FIGS. **12** and **13**.

For purposes of an exemplary showing, FIG. **37** illustrates a bit of the type shown in FIGS. **1** through **4**, and like parts have been given like index numerals. In this instance, the embodiment of FIG. **37** differs from that of FIGS. **1** through **4** only in that the abutment surface **10*a*** (which lies at the same angle with respect to the bit axis as the abutment surface **10** in FIGS. **1** through **4**) is not parallel to the clearance surface **6**. It will be understood that the abutment surface **10*a*** could be oriented in any direction about the bit axis, with respect to the clearance surface **6**.

FIG. **38** illustrates a double-ended cutter bit similar to that shown in FIGS. **7**, **10** and **12**. The cutter bit comprises a shank **142** the upper end of which (as viewed in FIG. **38**) has a clearance surface **143**, a cutting surface **144**, and a pair of flats, one of which is shown at **145**. The other end of the bit is substantially the same as the end just described, and like parts have been given like index numerals followed by "*a*." The bit of FIG. **38** differs from that of FIGS. **7**, **10** and **12**, only in that the end configurations are oriented at 90° with respect to each other, about the bit axis.

FIG. **39** illustrates a bit similar to that shown in FIGS. **20** through **23**. The upper end of the bit (as viewed in FIG. **39**) is the same as that of FIGS. **20** through **23** and like parts have been given like index numerals. The lower end of the bit is configured in the same manner and like parts have been given like numerals followed by "*a*." The bit of FIG. **39** differs from that of FIGS. **20** through **23** in that the end configurations are oriented at 90° with respect to each other about the bit axis. It will be understood by one skilled in the art that the end configurations of the bits of FIGS. **38** or **39** can be oriented at any angularity with respect to each other, about the bit axis.

FIG. 40 illustrates a double-ended cutter bit for use in a socket member of the type shown in FIG. 36, but having a retaining means of the type shown at 36–38 in FIG. 14. The cutter bit, generally indicated at 147, comprises a shank 148 terminating in clearance surfaces 149 and 150, with adjacent cutting surfaces 151 and 152 respectively. The cutter bit 147 is similar to the bit 39 in FIG. 15, differing primarily in the fact that the cutting surfaces 151 and 152 lie on the same side of the bit axis.

Since the cutting surfaces lie on the same side of the bit axis, only one notch, located centrally of the rear surface of the bit, is necessary. Such a notch is generally indicated at 153. When desired, the notch may be so configured at 154 and 155 to present a hook-shaped configuration when either of the cutting surfaces 151 or 152 is in cutting position.

It will be understood by one skilled in the art, that when a bit of the type shown in FIG. 40 is used in a lug of the type shown in FIG. 36, the lug 132 will not have the annular notch 34, but rather will be provided with a transverse perforation (similar to the perforation 34 in FIG. 14) for the receipt of a resilient retaining means.

While the ends of the bit of FIG. 40 are shown as being similar to the ends of the bit of FIG. 15, it will be understood by one skilled in the art that the bit may have ends configured in the manner of the bits of FIGS. 20 through 23.

While the embodiments of FIGS. 36 through 39 possess a number of the advantages set forth above, such as simplicity of manufacture and firm retention in the shank receiving perforation regardless of perforation wear, it will be noted that they, together with the embodiment of FIG. 40, will not possess the feature of maintaining full line or surface-to-surface contact between the cutter bit shank and the rear surface of the shank receiving perforation. Nevertheless, the rearward and vertical components of force exerted on these bits during the cutting operation will tend to keep them fully seated in the shank receiving perforation by virtue of the interaction between the shank and lug abutment surfaces. This is particularly true when the ring or coil-type retainers are used.

FIG. 42 illustrates a cutter bit-lug assembly similar to that shown in FIG. 31. The cutter bit 156 may be similar to those shown in FIGS. 1 through 5 or FIGS. 20 through 23. The lug 157 has a shank receiving perforation 158 so oriented in the lug as to maintain the cutter bit 156 at an angle of 90° to the cutting direction (arrow A).

In this instance, however, a transverse hole 159 is so located that its axis intersects the axis of the shank receiving peroration 158. The hole 159 carries a rod 160 therein. Again, the rod 160 may have a length equal to or less than the hole 159. In this instance, however, the rod 160 has two abutment surfaces 161 and 162 thereon. The abutment surfaces 161 and 162 lie at equal and opposite angles so that either of them may assume an abutting relationship with the bit abutment surface 163, depending upon whether the bit is oriented in the cutting direction or in a direction opposite to that of arrow A. Thus, in this embodiment, the cutting direction can be reversed by simple reversal of the bit. The bits may be extracted, turned 180° about its axis and reinserted so that the cutting tip 164 may be oriented in a direction opposite to that of arrow A. In some instances and under some conditions, it is highly desirable to be able to reverse the cutting direction. The embodiment of FIG. 42 offers an assembly capable of such reversal, simply by reversing the orientation of the cutter bits.

It will be understood by one skilled in the art that the same reversible characteristic could by accomplished by simply providing the lug 157 with a properly sized rod of circular cross section. Such an arrangement would not, however, present as great a surface area for the bit surface 163 to abut. Alternatively, the lug 157 could be provided with a rodlike element similar to that of FIG. 1, if the rodlike element were pivotally mounted in hole 159. Such a rodlike element could assume orientations equivalent to both surfaces 161 and 162 in FIG. 42.

FIG. 43 illustrates the application of the principles of the present invention to cutter bit-lug assemblies of a type having a shank and a shank receiving perforation of noncircular cross section.

The cutter bit, generally indicated at 165 has a head portion 166, a shank portion 167 and a hard cutting tip 168. While the configuration of the head does not constitute a limitation on the present invention, it may be provided with a surface 169 or a surface 170 (or both) which may be engaged by an appropriate pry out tool.

The cross-sectional configuration of the shank 167 is not a limitation on the present invention. Bits of this type generally have shanks of rectangular cross section and for this reason the shank 167 is so illustrated. The bottom end of the shank 167 is provided with an abutment surface 171 sloping downwardly and rearwardly.

The lug 172 is similar to the lug shown in the last mentioned U.S. Letters Patent and has a shank receiving perforation 173 of rectangular cross section. In this instance, however, the lug is provided with a transverse hole 174 having a rodlike element 175 therein. The rodlike element is, in every way, similar to the rod 12 in FIG. 1. The rod 175 has an abutment surface 176 cooperating with the bit abutment surface 171. With this arrangement, it is no longer necessary to provide a gauge-determining abutment surface in association with the bit head 166.

The shank receiving perforation 173 is provided with an annular notch 177. This notch may be circular in configuration to receive resilient retaining means of the general type shown in FIGS. 1, 33, 34 and 41 or the resilient band type shown in FIG. 6. Alternatively, the notch may be rectangular, conforming generally to the cross section configuration of the shank receiving perforation. When this is the case, use may be made of a resilient band type retainer, or one or more of the retainers next to be described.

A resilient retaining means is shown at 178 in FIG. 43. The retaining means 178 may comprise one or more open ringlike structures of the type shown at 179*a*, 179*b* or 179*c* in FIGS. 44A, 44B and 44C respectively or the retainer 180 of FIG. 45.

In FIG. 45, the retainer 180 is similar to that shown in FIG. 44A but is provided with more than one convolution, in the manner of those retainers shown in FIGS. 33 and 34.

All of the retainers of FIGS. 44A, 44B and 44C may be compressed and inserted in the notch 177, or they may be introduced through a slot extending from the notch 177 through any of the sides of the lug. Such a slot is indicated in dotted lines at 180*a* in FIG. 43. Once the bit shank is in place the retainer cannot exist through the slot. By the same token, the slot may be provided with shoulders at its entrance to the notch 177 so that the retainer means will be substantially captively held in the notch 177. The retainer means could be so sized and configured as to have a snap fit in the notch 177, once it had passed thereinto from the slot 180*a*.

All of the last mentioned retainers will frictionally engage the bit shank at two or more points. When desired, the bottom end of the bit shank may be provided with appropriate reliefs to aid its insertion into the retaining means.

In the embodiment of FIG. 43, the resilient retainer 178 again is captively held in the notch 177 and frictionally engages the shank 167. As illustrated, the cutter bit 165 will be adequately and firmly retained and a full surface-to-surface engagement will be maintained between the rear shank surface 167*a* and the rear shank receiving perforation surface 173*a*.

It is within the scope of the present invention to locate the rodlike element 175 in the manner shown in FIG. 35. Similarly, the rodlike element could be located as in FIG. 36, with the slope of the abutment surfaces 171 and 176 reversed. In this last mentioned instance, however, the components of force during the cutting operation would not tend to maintain a surface-to-surface contact between surfaces 167*a* and 173*a*. It is also within the scope of the present invention to provide a centrally located hole and rodlike element of the type described with respect to FIG. 42. If this were to be done, the cutter bit 165 could be reversible in the manner described with respect to FIG. 142. Finally, the retaining means of FIGS. 44 and 45 could have any cross-sectional configuration and could be provided with serrations in the manner shown with respect to the retainer of FIG. 41.

FIG. 46 illustrates the application of the principles of the present invention to cutter bit-lug assemblies of the type taught in U.S. Pat. No. 3,093,365. In this instance, the bit 181 is of the double-ended, trapezoidal type, having cut surfaces 182 and 183 each terminating respectively in cutting tips 184 and 185. While the invention is not so limited, such bits generally have a substantially diamond-shaped cross section and the bit 181 is so illustrated. When the cutting tip 184 is being used, the surface 183 will serve as an abutment surface. Similarly, when the cutting tip 185 is being used, the surface 182 will serve as an abutment surface.

The lug 186 comprises a body portion 187 with a shank receiving perforation 188 extending therethrough. It is preferable that the shank receiving perforation 188 extend all the way through the body portion 187 so as to prevent the accumulation of fines and other foreign material within the shank receiving perforation and to permit the use of a drift to remove the bit, where possible.

The cross-sectional configuration of the shank receiving perforation 188 will depend, in large part, on the cross-sectional configuration of the bit. In this instance, the perforation 188 is illustrated as having a substantially diamond-shaped cross section. It will be understood by one skilled in the art, however, that the bit 181 and the shank receiving perforation 188 could have circular or other cross-sectional configurations, as desired.

The lug 186 is provided with a transverse hole 189 having a rodlike member 190 permanently or removably affixed therein. As in the case of the rodlike element in FIG. 1, the element 190 may have a length equal to or less than the hole 189. The element 190 has an abutment surface 191 thereon, adapted to cooperate with the surface 183 or the surface 182, depending upon the orientation of the bit 181. Again, the surface 191 may extend throughout the length of the rodlike element 190 or be present only on that portion of the rodlike element which extends into the shank receiving perforation 188.

The shank receiving perforation 188 is provided with an annular notch 192 to receive retaining means, indicated at 193. The retaining means may be of the general type shown in FIGS. 1, 33, 34 or 41, or it may be a resilient band of the type shown in FIG. 6.

In FIG. 47, a retaining means similar to that shown in FIG. 1 is illustrated at 194. This retaining means differs from that of FIG. 1 only in its diamond-shaped configuration. FIG. 48 illustrates a retaining means 195 similar to that of FIG. 47 but having more than one convolution, in the manner of those retaining means shown in FIGS. 33 and 34. Again it will be understood by one skilled in the art that the retaining means of FIGS. 47 and 48 may have any desired cross-sectional configuration and may be provided with serrations in the manner described with respect to the retainer of FIG. 41.

The retaining means of FIGS. 47 and 48 will act in substantially the same manner described with respect to the embodiments of FIGS. 44A, 44B, 44C and 45. They may also be inserted into the notch 192 in any of the ways taught with respect to the retainers 179*a*, 179*b*, 179*c* and 180.

It will be noted that with the above described types of retaining means and with the orientation of the abutment surface 191 and surfaces 182 and 183, when the bit is moved in the cutting direction (arrow A) the components of force acting thereon will tend to maintain the bit in fully seated position with a full surface-to-surface contact between the bit surface 181*a* and the shank receiving perforation surface 188*a*.

It will be immediately evident to one skilled in the art that the bit-lug assembly of FIG. 46 is far simpler than previous assemblies incorporating such bits. The lug need no longer be a multipiece member having latch or other means for retaining the bit.

FIG. 49 illustrates the application of the teachings of the present invention to a bit-mounting means assembly wherein the bit serves as a digger tooth on the lead edge of a scoop, shovel, or like device of an excavating or earth working machine. In this instance, the bit 196 has a head portion 197 and a shank portion 198. While the head portion 197 is shown as terminating in a point, the configuration of the head portion does not constitute a limitation on the present invention and may be determined in part by the type of machine to which it is applied and the nature of the work performed by the machine. The shank 198 is, for purposes of illustration, shown as being cylindrical. Again, its cross-sectional configuration does not constitute a limitation on the present invention.

The bit shank 198 is received in a shank receiving perforation 199 in a mounting means 200. The cross-sectional configuration of the shank receiving perforation 199 is here shown as being cylindrical, but will be determined by the cross-sectional configuration of the bit shank. The exterior configuration of the mounting means 200, again, does not constitute a limitation on the present invention and will be dependent upon the nature of the machine device to which it is affixed. For purposes of an exemplary showing, the mounting means 200 is illustrated as being affixed to the lead edge of a shovel 201. The mounting means 200 may be affixed to the shovel in any suitable permanent or removable manner. The mounting means 200 has a transverse hole 202 adapted to receive a rodlike element 203. The rodlike element 203 has an abutment surface 204 thereon, adapted to cooperate with an abutment surface 205 on the bit or tooth 196. The cooperation of these abutment surfaces is substantially identical to that described with respect to the abutment surfaces 10 and 13 in FIG. 1.

The shank receiving perforation 199 is provided with an annular notch 206 containing retaining means 207. The retaining means 207 may be of the type shown in any of FIGS. 1, 6, 33, 34 or 41. The action of the retaining means and its frictional engagement with the shank 198 is precisely the same as that described above with respect to other embodiments utilizing such retaining means.

In order to finish the structure and avoid surfaces tending to obstruct the digging action, the bit 196 may support a ferrule element 208. The ferrule element will have a shank receiving perforation 209 similar to the perforation 199 and having an annular notch 210. The notch 210 will captively hold retaining means 211 which may be the same as the retaining means 207. The element 208 will be inserted on the bit shank and will be shoved into contact with the mounting means 200. It need not be affixed to the mounting means 200 since it can be adequately supported by the bit shank.

FIG. 49 illustrates a bit or digger tooth and mounting means therefor having all of the advantages described with respect to the embodiment of FIG. 1. Whereof the shank receiving perforation 199 will not prevent adequate and firm retention of the bit or digger tooth. Forces acting on the tooth will insure that it will remain fully seated despite wear of the parts. In many instances, the digger tooth 196 may be made of rod stock, rather than by expensive forging operation or the like. Similarly, the bit or tooth mounting means may have a simple shank receiving perforation achieved by drilling rather than by broaching or the like.

It will be understood that in the embodiment of FIG. 49, a full line or surface-to-surface contact will be maintained between the bit surface 212 and the shank receiving perforation surface 213 whenever there is a component of cutting or digging force acting on the bit in a direction ranging from a direction which is substantially parallel to the bit axis to a direction which is substantially perpendicular to the bit axis and extending vertically downwardly as viewed in FIG. 49. A typical component of force within this range is indicated by the arrow B.

FIG. 50 illustrates a structure similar to that of FIG. 49 and like parts have been given like index numerals. In this instance, however, the shank 198*a* of the bit 196*a* terminates in an abutment surface **205***a* which extends rearwardly and upwardly, as opposed to the abutment surface **205** of FIG. **49** which extends rearwardly and downwardly. The mounting means **200** is provided with a transverse perforation **202***a* similar to the perforation **202** of FIG. **49**, but positioned slightly differently, as illustrated. A rodlike element **203***a* is provided, having an abutment surface **204***a*. In this instance, the abutment surface **204***a* is oriented to lie in abutting relationship to the bit or digger tooth abutment surface **205***a*.

In all other respects, the structure of FIG. **50** is substantially identical to that of FIG. **49**. All of the components act in the same way. In this instance, however, a full line or surface-to-surface contact will be maintained between the bit surface **212***a* and the shank receiving perforation surface **213***a* whenever there is a component of cutting or digging force acting on the bit and lying within the range of directions between a direction substantially parallel to the bit axis and a direction substantially perpendicular to the bit axis and oriented vertically upwardly as seen in FIG. **50**. A typical component of force within this range is indicated by the arrow C.

It will be understood by one skilled in the art that in either of the embodiments illustrated in FIGS. **49** and **50** the transverse hole **203** or **203***a* could be centrally positioned so that its axis would intersect the axis of the shank receiving perforation. In other words, the transverse hole could be positioned in much the same way as is illustrated in FIG. **42**. In addition, it would be within the scope of the invention to provide a centrally located transverse perforation and a rodlike element having a pair of abutment surfaces, as shown in FIG. **42**. In this way, the cutter bit or digger tooth could be reversed, depending upon the type of work done by the digging or earth working machine. FIG. **51** illustrates in perspective another type of extraction tool for knock-in pry-out bits or digger teeth of the type not provided with pry-out surfaces (such as those shown at **169** and **170** in FIG. **43**) engageable by a conventional pry-out tool. The tool of FIG. **51**, generally indicated at **214**, comprises a handle **215** which may have any desired configuration and a bifurcated head portion generally indicated at **216**. The bifurcations **216***a* and **216***b* are spaced from each other by a distance substantially equal to or greater than the width of the cutter bit to be removed. The bifurcations **216***a* and **216***b* are provided with extensions (one of which is shown at **217**) which are adapted to engage a surface on the mounting means and act as cams during the pry-out operation.

A generally U-shaped member **218** is pivotally affixed to the tool head **214** by pivot pin **219**. The pivot pin extends through coaxial perforations at the ends of the legs of the U-shaped member **218** and in the bifurcations **216***a* and **216***b*. A portion **219***a* of the pin extends between the bifurcations **216***a* and **216***b*.

The inside surface of the U-shaped member **218** is provided with two or more pointed extensions. Two such pointed extensions are shown at **220** and **221**. The pointed extensions may be made of hardened metal or the like and appropriately affixed to the U-shaped member **218**. Alternatively, the points **220** and **221** may be integral with the member **218** and the entire member may be made of hardened material. It will be noted that the points **220** and **221** generally are directed toward the portion **219***a* of the pivot pin **219**.

The operation of the tool of FIG. **51** may be described as follows.

When a bit or digger tooth is to be removed from its mounting means, the U-shaped member **218** is placed over the bit and the bit is engaged between the points **220** and **221** and the pivot pin portion **219**. The tool is so configured as to cause the bit to be engaged relatively near the forward end of the shank receiving perforation in the bit mounting means. As the handle **215** is moved in the direction of the arrow D, the points **220** and **221** are caused to dig into the bit body because of the resultant diminishing horizontal distance between the point **220** and **221** and the pivot pin portion **219**.

After the points **220** and **221** have penetrated the bit shank, continued movement of the handle **215** in the direction of the arrow D will cause the bit body to be lifted from the shank receiving perforation of the mounting means. The bit body may be removed in increments if desired by performing the above described operation a number of times.

Modifications may be made in the invention without departing from the spirit of it. For example, any of the bits or digger teeth of the present invention may be provided with a shallow depression to receive the retaining means taught herein. Such a depression would increase the retaining ability of the retaining means, but should be shallow so as not to constitute a significant stress raiser. The depression should be so configured as to not present a shoulder interfering with the pry-out feature of the bits. The depression may lie on one side only of the bit, or more than one depression may be provided located at various positions about the bit. Similarly, the depression may be a continuous annular one extending fully about the bit. For purposes of an exemplary showing, an annular shallow depression is shown at **222** in dotted lines in FIG. **50**. In using the term depression it is to be understood that what is meant is a configuration which will help to increase the holding power of the retaining means with respect to the bit, but not to a degree to preclude the pry-out feature.

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

1. A nonrotating cutter bit and mounting means therefor for a mining machine and the like, said cutter bit comprising an elongated shank having a longitudinal forward peripheral surface portion facing in the cutting direction and a longitudinal rearward peripheral surface portion facing in the opposite direction, said forward and rearward surface portions being parallel to the axis of said shank, at least one end of said shank terminating in a bit abutment, at least the other end of said shank having a clearance surface sloping rearwardly and downwardly from said forward surface portion to said rearward surface portion thereof, said cutter bit having a cutting tip at the juncture of said forward surface portion of said shank and said clearance surface, said mounting means comprising a lug having a body with a shank receiving perforation, said perforation having a longitudinal rearward surface portion facing in the cutting direction and a longitudinal forward surface portion facing said rearward surface portion, said last mentioned forward and rearward surface portions being parallel to the axis of said shank receiving perforation, a lug abutment in association with said shank receiving perforation, at least one of said bit and lug abutments comprising an abutment surface sloping in a direction rearwardly and downwardly of the interface between said forward surface portions of said shank and said shank receiving perforation, said lug and shank abutments lying in abutting relationship and being so configured as to direct said cutter bit downwardly in said shank receiving perforation and to direct said rearward surface portion of said shank toward full line contact with said rearward surface portion of said shank receiving perforation when said cutter bit is subjected to the resultant forces of the cutting operation, and means for retaining said cutter bit in said shank receiving perforation.

2. The structure claimed in claim **1** wherein said bit abutment and said lug abutment each comprises an abutment surface sloping in a direction rearwardly and downwardly of the interface formed between said forward surface portions of said shank and said shank receiving perforation.

3. The structure claimed in claim **1** wherein said bit abutment comprises said sloping abutment surface.

4. The structure claimed in claim **1** wherein said lug abutment comprises said sloping abutment surface.

5. The structure claimed in claim **1** wherein said cutter bit shank and said shank receiving perforation are of circular cross section.

6. The structure claimed in claim **1** wherein said lug is movable in a cutting direction, said axis of said shank receiving perforation being substantially perpendicular to said cutting direction.

7. The structure claimed in claim 1 wherein said lug is movable in a cutting direction, said axis of said shank receiving perforation sloping toward said cutting direction and forming an angle of less than 90° therewith such that the resultant cutting stresses will be sustained more nearly in line with said axis of said cutter bit shank.

8. The structure claimed in claim 1 wherein said lug abutment lies within said shank receiving perforation.

9. The structure claimed in claim 1 wherein said cutter bit is free of stress raising changes in diameter.

10. The structure claimed in claim 1 wherein said lug has two parallel transverse holes lying on opposite sides of said perforation and partially intersecting said perforation at diametrically opposed positions, said retaining means comprising a rodlike member of resilient material located within each of said holes, a portion of each of said rodlike members extending into said perforation and frictionally engaging diametrically opposed portions of said shank.

11. The structure claimed in claim 1 wherein said shank receiving perforation extends through said body.

12. The structure claimed in claim 1 wherein said lug body has a hole partially intersecting said shank receiving perforation, a resilient retaining means located within said hole and having a portion extending into said perforation, said cutter bit shank having a notch, said portion of said resilient retaining means engaging said notch.

13. The structure claimed in claim 1 wherein said lug has at least one hole partially intersecting said perforation, said retaining means comprising a rodlike member of resilient material located within said hole, a portion of said rodlike member extending into said perforation and frictionally engaging said shank.

14. The cutter bit and mounting means of claim 1 in which said elongated shank is provided with a shallow, tapered depression adapted to be engaged by said means for retaining said cutter bit in said shank receiving perforation.

15. The structure claimed in claim 1 wherein said retainer means retains said cutter bit in said shank receiving perforation in a knock-in, pry-out relationship.

16. The structure claimed in claim 1 wherein said lug body has a hole at least partially intersecting said shank receiving perforation near the bottom thereof, a member mounted within said hole, a portion of said member at least partially lying within said perforation, said portion of said member comprising said lug abutment.

17. The structure claimed in claim 16 wherein said hole extends transverse said lug body, said member having a flat extending the length thereof and sloping in a direction rearwardly and downwardly of the interface formed between said forward surface portions of said shank and said shank receiving perforation.

18. The structure claimed in claim 16 wherein said portion of said member has a flat thereon sloping in a direction rearwardly and downwardly of the interface formed between said forward surface portions of said shank and said shank receiving perforation.

19. The structure claimed in claim 1 wherein said cutter bit has a cutting tip and a bit abutment surface at both ends of said shank, said bit abutment surfaces forming an angle other than 90° to said shank axis, each of said bit abutment surfaces extending rearwardly and downwardly of the adjacent cutting tip when said adjacent cutting tip is in cutting position.

20. The structure claimed in claim 19 wherein each of said shank abutment surfaces comprises a portion at least of a pair of opposed flats sloping toward each other and meeting in an elongated surface sloping rearwardly and downwardly from said adjacent cutting tip when said cutting tip is in cutting position.

21. The structure claimed in claim 20 wherein said lug body has a hole at least partially intersecting said shank receiving perforation near the bottom thereof, a member mounted within said hole, a portion of said member lying within said perforation, said lug abutment surface comprising a notch in said portion of said member.

22. The structure claimed in claim 20 wherein said body has a pair of holes lying in a plane parallel to said cutting direction, said holes converging toward each other and at least partially intersecting said perforation near the bottom thereof, rodlike members mounted in said holes, portions of each rodlike member extending into said perforation and providing said lug abutment.

23. The structure claimed in claim 20 wherein said body has a pair of holes parallel to each other and lying in a plane parallel to said bit abutment surface, said holes at least partially intersecting said perforation, rodlike elements mounted within said holes, portions of said rodlike elements extending into said perforation and providing said lug abutment.

24. A lug for mounting a cutter bit of a mining machine and the like, said cutter bit being of the nonrotatable type having an elongated shank with a longitudinal forward peripheral surface portion facing the cutting direction and a longitudinal rearward peripheral surface portion facing in the opposite direction, said shank forward and rearward surface portions being parallel to the axis of said shank, at least one end of said shank terminating in a bit abutment, at least the other end of said shank having a clearance surface sloping rearwardly and downwardly from said forward surface portion to said rearward surface portion of said bit, said cutter bit having a cutting tip at the juncture of said clearance surface and said last mentioned forward surface portion, said lug having a body with a shank receiving perforation, said perforation having a longitudinal rearward surface portion facing in the cutting direction and a longitudinal forward surface portion facing said rearward surface portion, said forward and rearward surface portions being parallel to the axis of said shank receiving perforation, a lug abutment in association with said shank receiving perforation, said lug abutment comprising a surface sloping in a direction rearwardly and downwardly of said forward surface portion of said shank receiving perforation, said lug abutment adapted to lie in abutting relationship with said bit abutment and to cooperate therewith to direct said shank to its seated position in the shank receiving perforation and toward full line contact with said rearward surface portion of said shank receiving perforation when said cutter bit is subjected to the resultant forces of the cutting operation.

25. The structure claimed in claim 24 wherein said shank receiving perforation is of circular cross section.

26. The structure claimed in claim 24 wherein said body is movable in a cutting direction, the axis of said shank receiving perforation forming an angle of 90° to said cutting direction.

27. The structure claimed in claim 24 wherein said body is movable in a cutting direction, the axis of said shank receiving perforation forming an angle of less than 90° to said cutting direction whereby the cutting stresses on said cutter bit will be sustained more nearly in line with the axis of said cutter bit shank.

28. The structure claimed in claim 24 including at least one hole in said body partially intersecting said shank receiving perforation, said hole being adapted to receive a resilient retaining means and being so located that a portion of said retaining means extends within said shank receiving perforation.

29. The structure claimed in claim 24 wherein said shank receiving perforation bottoms within said body, plug means being affixed within said perforation at said bottom, the upper surface of said plug means comprising said lug abutment surface.

30. The structure claimed in claim 24 including two transverse holes in said body partially intersecting said perforation on opposite sides thereof, rodlike members of resilient material being located in said holes, a portion of each of said rodlike members extending into said perforation, said portions being adapted to engage the shank of a cutter bit.

31. The structure claimed in claim 27 wherein said lug body has a hole at least partially intersecting said shank receiving perforation near the bottom thereof, a member mounted within said hole, a portion of said member at least partially lying within said perforation, said portion of said member comprising said lug abutment.

32. The structure claimed in claim 31 wherein said hole extends transverse said lug body, said member having a flat extending the length thereof and sloping in a direction rearwardly and downwardly of said forward surface portion of said shank receiving perforation.

33. The structure claimed in claim 31 wherein said portion of said member has a flat thereon sloping in a direction rearwardly and downwardly of said forward surface portion of said shank receiving perforation.

34. The structure claimed in claim 31 wherein said lug abutment surface comprises a notch in said portion of said member lying within said perforation.

35. The structure claimed in claim 24 wherein said shank receiving perforation extends through said body, said lug abutment lying within said perforation.

36. The structure claimed in claim 35 including a plug mounted in the bottom end of said perforation, the top surface of said plug comprising said lug abutment surface.

37. The structure claimed in claim 35 wherein said body has a hole intersecting said perforation near the bottom thereof, a rodlike member located within said hole and having an end portion extending into said perforation, said end portion of said rodlike member being configured to provide said lug abutment surface.

38. The structure claimed in claim 35 wherein said body has a pair of holes, said holes lying in a plane parallel to said cutting direction, said holes converging toward each other and at least partially intersecting said perforation near the bottom thereof, rodlike members mounted in said holes, portions of each rodlike member extending into said perforation and providing said lug abutment.

39. The structure claimed in claim 35 wherein said body has a pair of holes parallel to each other and at least partially intersecting said perforation, rodlike elements mounted within said holes, portions of said rodlike elements extending into said perforation and providing said lug abutment.

40. A nonrotatable cutter bit for use with a mounting means on a mining machine and the like, the mounting means being of the type having a shank receiving perforation with a mounting means abutment in association therewith and with a longitudinal rearward surface portion facing the cutting direction and a longitudinal forward surface portion facing said rearward surface portion, said perforation rearward and forward surface portions being parallel to the axis of said perforation, said cutter bit comprising an elongated shank having a longitudinal forward peripheral surface portion facing the cutting direction and a longitudinal rearward peripheral surface portion facing in the opposite direction, said shank forward and rearward surface portions being parallel to the axis of said shank, at least one end of said shank terminating in a bit abutment, at least the other end of said shank having a clearance surface sloping rearwardly and downwardly from said forward surface portion to said rearward surface portion of said bit, said cutter bit having a cutting tip at the juncture of said clearance surface and said last mentioned forward surface portion, said bit abutment comprising a surface sloping rearwardly and downwardly of said forward surface portion of said shank, said bit abutment adapted to lie in abutting relationship with said mounting means abutment and to cooperate therewith to direct said shank toward its seated position in said perforation and to direct said rearward surface portion of said shank toward full line contact with the rearward surface portion of said perforation when said bit is subjected to the resultant forces of the cutting operation.

41. The structure claimed in claim 40 wherein said cutter bit is of the knock-in, pry-out type.

42. The cutter bit of claim 40 in which said elongated shank is provided with a shallow, tapered depression adapted to be engaged by a retaining means provided in said mounting means.

43. The structure claimed in claim 40 wherein said cutter bit is free of stress raising changes in cross section.

44. The structure claimed in claim 40 wherein said cutting tip comprises a hard cutting tip affixed to said cutter bit.

45. The structure claimed in claim 40 wherein said shank has a notch adapted to be engaged by a retaining means.

49. The structure claimed in claim 40 wherein said shank is of circular cross section, and including additional clearance surfaces comprising a pair of flats, one on each side of said first mentioned clearance surface and sloping downwardly and outwardly therefrom.

47. The structure claimed in claim 46 wherein said flats are diametrically opposed.

48. The structure claimed in claim 40 including a cutting tip and a cutter bit abutment surface at both ends of said shank.

49. The structure claimed in claim 48 wherein each of said bit abutment surfaces slope downwardly and rearwardly of the adjacent cutting tip when said adjacent cutting tip is in cutting position.

50. The structure claimed in claim 40 wherein said shank has a circular cross section, the ends of said shank terminating in bit abutment surfaces lying at an angle to the axis of said shank, each of said ends having a pair of flats lying on either side of and sloping toward the adjacent bit abutment surface, said pair of flats and adjacent abutment surface at each shank end forming a cutting tip, said cutting tips comprising the most remote longitudinal points of said cutter bit, each of said abutment surfaces extending rearwardly and downwardly of the adjacent cutting tip when said adjacent cutting tip is in cutting position.

51. The structure claimed in claim 50 wherein the flats of a pair are diametrically opposed.

52. The structure claimed in claim 50 wherein said bit abutment surfaces are planar, the flats of a pair being so angled with respect to each other that the adjacent bit abutment surface is a substantially wedge-shaped surface.

53. The structure claimed in claim 50 wherein said shank has two oppositely oriented notches, each of said notches lying on the opposite side of said shank axis from one of said cutting tips, each of said notches being adapted to be engaged by a retaining means when said cutting tip on the opposite side of said shank axis therefrom is in cutting position.

54. A lug for mounting a knock-in pry-out cutter bit of a mining machine and the like, said cutter bit being of the nonrotatable type having an elongated shank terminating at one end in a bit abutment and at the other end in a cutting tip, said lug having a body with a shank receiving perforation, said perforation having a longitudinal rearward surface portion facing in the cutting direction and a longitudinal forward surface portion facing said rearward surface portion, said forward and rearward surface portions being parallel to the axis of said shank receiving perforation, a lug abutment in association with said shank receiving perforation, said lug abutment comprising a surface sloping in a direction rearwardly and downwardly of said forward surface portion of said shank receiving perforation, said lug abutment adapted to lie in abutting relationship with said bit abutment and to cooperate therewith to direct said shank to its seated position in said shank receiving perforation and toward full line contact with said rearward surface portion of said shank receiving perforation when said cutter bit is subjected to the resultant forces of the cutting operation.

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