June 20, 1961 R. F. PROX, JR 2,989,295

CUTTER BIT AND HOLDERS AND ALIGNMENT MEANS THEREFOR

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Fig. 1.

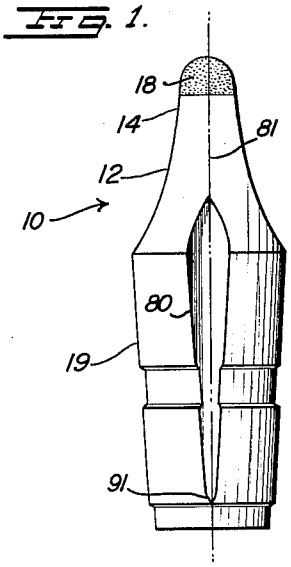


Fig. 4.

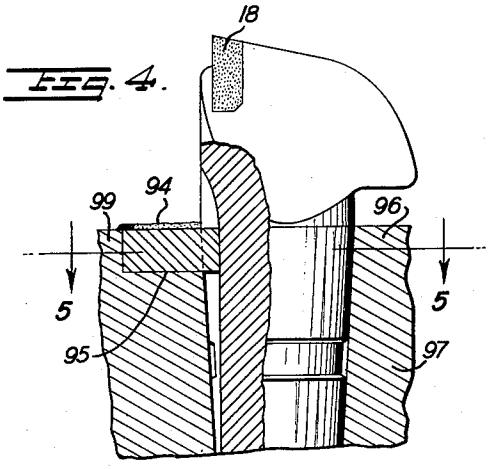


Fig. 5.

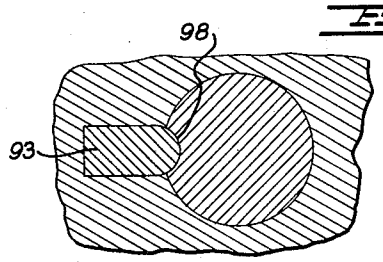


Fig. 2.

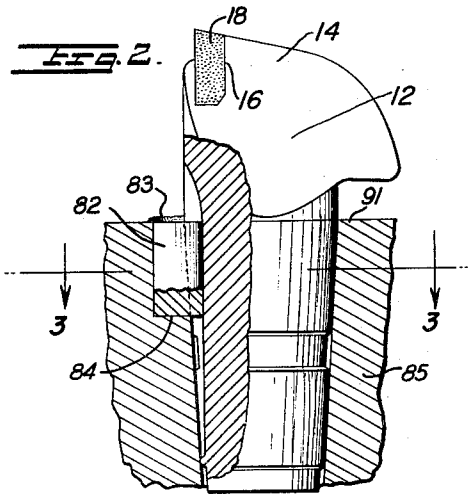
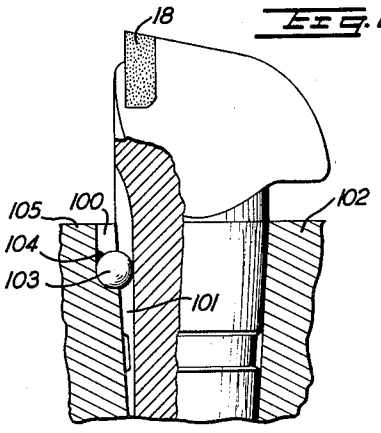


Fig. 6.



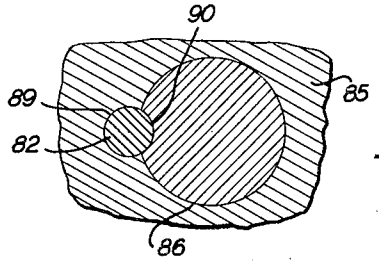


Fig. 3.

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CUTTER BIT AND HOLDERS AND ALIGNMENT MEANS THEREFOR

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Fig. 7.

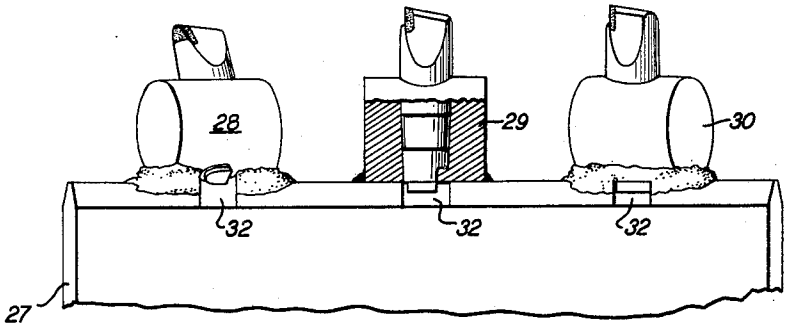
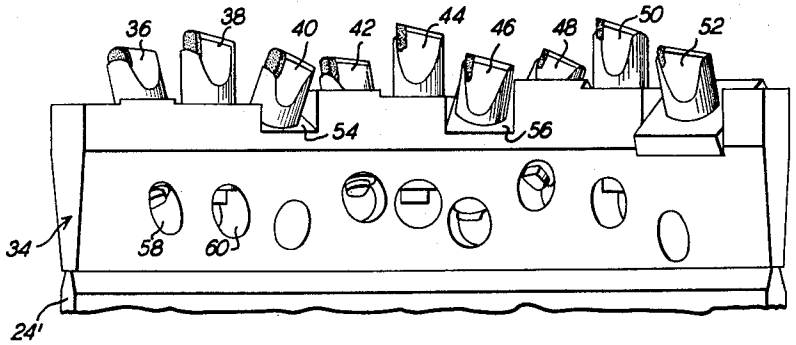


Fig. 8.



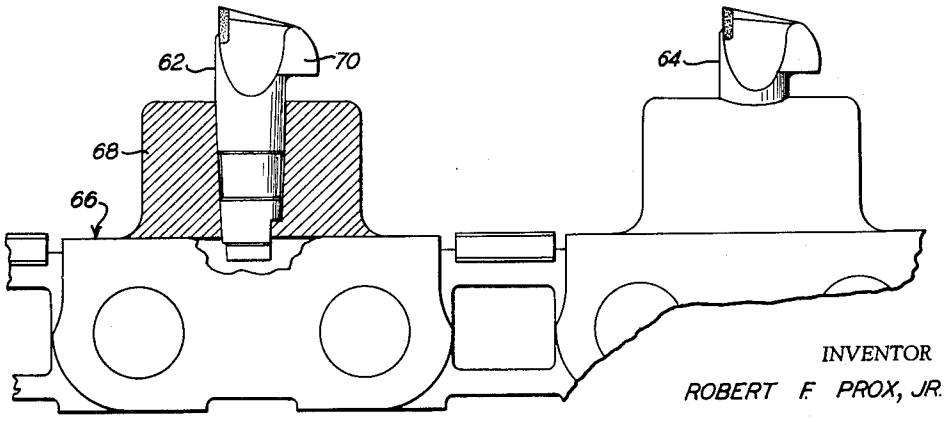


Fig. 9.

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2,989,295

CUTTER BIT AND HOLDERS AND ALIGNMENT MEANS THEREFOR

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Filed June 16, 1958, Ser. No. 742,364
12 Claims. (Cl. 262—33)

This invention relates to cutter bits for use in the mining industry and more particularly to a tapered shank cutter bit and holder assembly, and cooperating positive alignment structure in each of the above elements for orienting the cutting edge of the cutter bit in a predetermined direction making the bit and holder assembly especially useful in various coal mining applications. This application is filed as a continuation-in-part of application Serial No. 707,712 filed January 8, 1958, entitled "Cutter Bits and Holders Therefor."

A considerable problem has been encountered in the coal mining industry in providing siutable bits and cooperating bit holders for use in the mining of coal. The characteristics of cutting bits with respect to shank strength, accurate and positive cutting edge alignment, and ease and speed of changing have become much more important since the development of continuous mining machines than before such machines were introduced. The present high cost of labor and the large capital expenditure for modern mining equipment requires a maximum efficiency in mining operations, with the characteristics of the cutting bits being an important factor in achieving this efficiency.

It has been conventional in the prior art to provide coal cutting bits with shank portions of rectangular cross section, these shank portions being received in correspondingly-shaped cavities of a bit holding device, with set screws being used to hold the respective bits in place. However, bits of rectangular cross section have proven unsatisfactory in a number of respects. In the use of rectangular cross section bits, numerous cases of shank failure are experienced since these bits cannot satisfactorily absorb the thrust of the tool in operation. Furthermore, a great number of these bits are lost due to various reasons, such as improper tightening of the set screws, improper contact between the set screw and the shank due to the hardness of the material of the shank, and binding of the set screws which results in improper tightening action. The set screws, in common with other securing devices such as pins or wedges sometimes used to hold the bit in position, are often hindered in their proper operation by the presence of rust, corrosion, and dirt inherent in the environment of a coal mine or other similar operating location.

Accordingly, it is an object of this invention to provide a cutting bit for use in the mining industry in which the shank of the bit is less subject to failure due to bending and breaking than bits of the prior art.

It is another object of this invention to provide an improved cutting bit particularly useful in coal mining and the like which does not require the use of fastening means such as screws, wedges, pins or the like for securing it in a cooperating bit holder.

It is still another object of this invention to provide a bit particularly useful in coal mining in which the bit is securely and accurately held in the socket or cavity of a cooperating bit holder without the use of auxiliary securing means, but which may be easily removed from the bit holder when necessary.

A still further object of the invention is to provide a tapered cutter bit and cooperating holder in which the bit cutting edge can be accurately and positively aligned

with a minimum of difficulty in various mining machine applications.

A still further object of the invention is to provide an improved multiple bit holder of improved space factor as compared to the prior art including a plurality of bits mounted in a minimum space without the necessity of fastening means such as set screws or the like for securing the bits to the holder and including positive and accurate bit and holder alignment means.

Further objects and advantages of the invention will become apparent from the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a side elevational view of a cutter bit showing a bit alignment modification consisting of an elongated circular groove along the shank of the bit;

FIG. 2 is a side elevation view; partially in cross section, showing the bit of FIG. 1 mounted in a cooperative holding socket showing one type of cooperating bit and socket alignment structure;

FIG. 3 is a sectional view taken along line 3—3 of the bit and socket mounting of FIG. 2 in the direction of the arrows;

FIG. 4 is a side elevation view, partially in cross section, showing the bit of FIG. 1 mounted in a holding socket showing another modification of a cooperating bit and socket alignment structure;

FIG. 5 is a sectional view taken along line 5—5 of the bit and socket mounting of FIG. 4;

FIG. 6 is a side elevation, partially in cross section of the bit of FIG. 1 mounted in a cooperating holding socket showing a still further modification of a cooperating bit and socket alignment structure;

FIG. 7 is a side elevation view, partially in section, of a plurality of individual bit holders mounted on an arm of a continuous mining machine;

FIG. 8 is a side elevation view of a multiple bit head mounted on an arm of a continuous mining machine; and

FIG. 9 is a side elevation view, partially in section showing cutter bits mounted on a continuous mining chain.

Referring now to the drawings, and more particularly to the view of FIGS. 1 and 2 inclusive, there is shown a cutter bit generally indicated at **10** for use in the mining industry and which is particularly useful in the mining of coal. The outer portion of the bit body or upper portion with respect to the views shown in the drawings is tapered laterally inwardly from opposite sides thereof toward the outer end of the bit, as indicated at **12**, the tapered surfaces terminating in laterally spaced flat surface portions **14**. A notch **16** extends between the flat surface portions **14** of the bit body adjacent the outer or upper end of the bit and an inserted cutting element, **18**, such as a tungsten carbide cutting element, is secured rigidly in notch **16**. The remainder of the body portion of bit **10** defines a shank portion **19** of circular cross section which tapers inwardly from the outer end of the body portion to the inner end thereof.

The tapered shank **19** of the bit body is an important feature of the bit construction since the tapered construction causes the bit to hold securely in a cooperating socket or cavity of a bit holder without the need for set screws or other auxiliary fastening means, yet permits the bit to be withdrawn from the bit holder without excessive force when required.

Furthermore, the tapered shank and the corresponding tapered socket provide a greater contact area between the bit and the holder at the back of the bit than is provided in the rectangular cross section bits and sockets of the prior art. This greater area of contact of the tapered bit is beneficial in absorbing the thrust of the tool in operation, and avoids much of the shank failure experienced

with rectangular cross section bits. There is less play between the tapered bit and socket than between the rectangular bit and socket, resulting in a more rigid support for the bit, such support being particularly advantageous with tungsten carbide insert cutting bits.

In a preferred embodiment, the taper of the surface of shank portion **19** of the bit in progressing toward the inner end of the bit is at the rate of 1⅜ inch per foot, with an included taper angle of 6°33'26" between oppositely disposed surfaces of the shank portion, or an angle of 3°16'43" from the central longitudinal axis of the bit body to the outer tapered surface. The optimum taper of 1⅜ inch per foot just described was arrived at after considerable experimentation in the range of tapers between the #4 Morse taper of 0.62326 inch per foot and the 1⅜ inch taper per foot which is the optimum and most satisfactory taper. The #4 Morse taper was found to be too gradual, with the result that the bit seized in its holder and could be dislodged only with great difficulty. With the 1⅜ inch taper to the foot of the bit body shank, the bit body remains in the socket or cavity of the holder without falling out and at the same time the pressure required to remove the bit from the holder is acceptable. Experimentation also indicated that tapers of the surface of the shank portion **19** of the bit between the ranges of 1.258" inches per foot to 1.468 inches per foot, with a range of included taper angles from a minimum of 6° to a maximum of 7° would also give preferred satisfactory results.

In order to reduce the frictional contact between the surface of the shank portion of the bit and the adjacent surface of the socket or cavity in which the bit is positioned, the shank portion **19** is preferably provided intermediate its length with an annular grooved portion **20** which reduces the diameter of the shank in that area, thereby reducing the frictional contact between the shank and the socket in which the shank is received.

In most applications it is necessary to orient the cutter bit with the cutting edge **18** located in a predetermined direction. One method of doing this is to have the lower end of the shank portion provided with a cut away region extending to the inner end of the bit to form a tang which engages an abutment or web in the otherwise aperture or recessed socket.

In many applications it has been found that alignment of the bit in its socket by the use of the above base tang constructions will be satisfactory, however, in certain instances other methods and construction must be used. In particular, considerable difficulty has been encountered in making up special holders and chain blocks to accommodate a taper shank bit with a base tang alignment member. It has also been found extremely difficult to use a taper bit with a base tang in many applications where it is necessary to utilize a so called "blind" socket. To solve the above problems three bit and socket modifications as shown in FIGS. 1 through 6 have been developed. FIG. 1 shows a cutter bit modification in which a longitudinally disposed circular mill groove **80** is placed. This groove is formed simply by starting at the bottom of the bit shank and milling parallel to the center line **81** of the bit shank to a predetermined depth, in this case approximately ⅛ inch was used.

The particular bit thus formed, as shown in FIG. 1 may be used with the three types of cooperating holders shown in the remaining FIGURES. FIGS. 2 and 3 show the above bit inserted in a holder in which a circular rod **82** of the same radius as the bit shank groove **80** is inserted and affixed as by welding **83** into another milled slot **84** in holder **85**.

This milled slot is prepositioned on the circumference **86** of the socket surface so as to guide and position the shank of the bit **10** when it is inserted therein. This in turn will place the fixed cutting edge **18** of the bit in a predetermined direction. The aligning rod **82** is affixed in the socket groove **84** as by welding and the portion of the rod shown by **89** is embedded in the face of socket **85** so as to leave only a circular longitudinal guiding portion **90** to accurately mate with groove **80** in the bit shank. The rod **84** may be of any length as long as it does not extend below the bottom of the bit shank groove **91** nor above the top surface of the bit holder **85**.

FIGS. 4 and 5 show a further modification of the aligning means in which an insert **93** is affixed as by welding **94** in a rectangular slot **95** made in the top surface **96** of the socket holder **97**. The slot is radially prepositioned to align with the aforementioned groove **80** in the bit shank, the position of the slot will determine the position of the insert. This insert is substantially a rectangular shaped thin metal slug with a rounded protruding edge **98** of the same radius as the shank groove **80** with which it cooperates. The top surface **99** of the insert must be flush with the top **96** of the holder. This particular type of alignment means is extremely useful in inserting bits in holders where all guiding must be done from the top surface of the holder.

FIG. 6 shows a bit and socket alignment means in which a radially prepositioned circular groove **100** is drilled on the internal surface **101** of tapered holding socket **102**, extending longitudinally downward from the holder top surface **105** in parallel relationship to the axis of the bit shank. A steel ball **103** of the same radius as both the hole and the cooperating bit shank groove **80** is placed therein and secured as by welding **104**. The radial depth of the circular groove **100** is predetermined so as to allow only a sufficient portion of the surface of the ball **103** to protrude as will accurately mate with the bit shank groove **80**. The groove **100** extending longitudinally downward only a sufficient distance to prevent the embedded ball **103** from protruding above the top surface **105** of the holding socket **102**. This modification is extremely simple and particularly applicable in light drilling applications.

There is shown in FIG. 7 one manner in which the cutter bits hereinbefore described may be individually mounted on an arm of a continuous mining machine. The arm **27** of the mining machine has mounted on the outer edge thereof a plurality of cylindrical-shaped metal blocks, **28**, **29** and **30**, respectively, the blocks being rigidly attached as by welding to the outer edge of arm **27**. Each of the blocks **28**, **29**, **30** is provided with a socket or cavity such as that shown in the cross-sectional view of block **29**, having a taper which conforms to that of the bit shank. The upper edge of arm **27** of the mining machine is provided with a plurality of open recesses **32**, each of which is straddled by one of the respective blocks **28**, **29**, **30**. The recesses **32** permit access to the inner end of each bit shank to assist in removing the bit when desired.

In the embodiment shown in FIG. 8, a multiple bit head generally indicated at **34** is rigidly secured to the upper edge of a mining machine arm **24** and a plurality of cutter bits **36**, **38**, **40**, **42**, **44**, **46**, **48**, **50** and **52** are mounted on the upper portion of multiple bit head **34**. The outer edge of multiple bit head **34** is provided with a plurality of notches or recesses, these recesses being inclined at various angles. Each recess, such as those indicated at **54** and **56**, has extending inwardly therefrom a tapered socket which receives one of the cutting bits. The sockets which receive the respective bits are inclined at various angles in order to provide a random orientation of the cutting bits for improved coal cutting action.

The multiple bit head **34** also has a plurality of transverse apertures such as those indicated at **58** and **60**, each aperture corresponding to one of the respective cutter bits. The apertures **58** and **60** are so located as to permit access to the inner end of each respective cutter bit to aid in the ejection or removal of the cutter bit from the tapered socket which holds it, when such removal is desired.

In the view shown in FIG. 9, cutter bits such as those indicated at **62** and **64** are carried by a continuous min-

ing chain **66** of the type conventionally used in coal mining operations, the bits **62** and **64** being supported by blocks such as that indicated at **68** having a tapered recess corresponding to the taper of the bit. Block **68** is welded or otherwise rigidly attached to the upper surface of chain **66**.

The cutter bits shown in FIG. 9 are slightly modified from the cutter bits shown and described in the embodiments of FIGS. 1–8 in that cutter bits **62** and **64** include at the outer end thereof and at the trailing edge of the cutter bit a projection **70** which facilitates removal of the cutter bit from its socket when the lower end of the shank of the cutter bit is not accessible. A suitable tool may be engaged with projection **70** to facilitate the removal of the bit. This projection is not necessary where the cutter bit is accessible from the lower end thereof when it is being removed, as in the embodiment of FIGS. 7 and 8.

The multiple bit head **34** as shown in FIG. 8 may be utilized in such applications as to make access to apertures **58** and **60** impossible. In such cases apertures **58** and **60** may be dispensed with. Similarly, the continuous mining arm of FIG. 7 may also be so modified. In the above cases the bit may be removed from the holder by use of the projection **70**.

It can be seen from the foregoing that there is provided in accordance with this invention a cutter bit particularly useful in the mining industry and more particularly in the coal mining industry since the bit does not require the use of any set screw fastening means or other separate fastening means as commonly required by most coal cutting bits with their consequent disadvantages as previously pointed out, but instead is held within a tapered socket entirely by frictional engagement between the bit shank and the socket. When an optimum taper of approximately 1⅜ inch to the foot, or other taper in the indicated preferred range is used, the bits remain tightly engaged with the sockets or cavities in which they are positioned so that the bits do not fall out and become lost and yet the pressure or force required to remove the bits is acceptable and not excessive. Furthermore, the shank portions of the bit bodies do not fail because of bending or breaking as commonly occurs in bit constructions of the prior art.

The improved space factor provided by the tapered shank bits of the present invention due to the fact that set screws or other fastening means are not required permits a much greater number of bits to be mounted in a given space than in the case of bits requiring special securing means such as set screws. As a result of this improved space factor, a multiple bit head such as that shown in FIG. 8 having a large number of bits mounted on the head is possible using tapered bits in accordance with the construction hereinbefore described. The tapered shank bits on both the individually mounted bit heads and the multiple bit heads may be removed with ease and speed, thereby greatly facilitating changing of bits. The tapered construction of the bit and its socket, together with the various bit and socket alignment means as described, greatly facilitates the easy and positive alignment of the bit within its socket in many different machine applications.

While there have been shown and described particular embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and therefore, it is aimed to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. In combination a cutting bit and socket therefor for use in coal mining comprising a bit body including an outer end and an inner end spaced therefrom, a cutting surface carried by said bit adjacent said outer end, said body including a shank portion of circular cross section extending between said ends and adapted to be received in a bit holding socket, said shank portion tapering inwardly in progressing toward said inner end of said body, the included angle of taper of said shank portion being substantially in the range of 6° to 7°, said bit shank portion including a longitudinal circular groove on its surface, said groove being of a predetermined radius and depth and extending substantially the length of the bit shank parallel to the center line of said bit shank, and adapted to cooperate with the bit holding socket, said socket having projecting means complementary to said groove and extending thereinto to align said bit and to prevent it from turning.

2. In combination a cutting bit and socket therefore for use in coal mining comprising a bit body including an outer end and an inner end spaced therefrom, a cutting surface carried by said bit adjacent said outer end, said body including a shank portion of circular cross section extending between said ends and adapted to be received in a bit holding socket, said shank portion tapering inwardly in progressing toward said inner end of said body, the included angle of taper of said shank portion being substantially in the range of 6° to 7°, said bit shank portion being recessed intermediate its length to reduce frictional contact between said shank portion and the socket in which it is received, said bit shank portion including a longitudinal circular milled groove on its surface, said groove being of a predetermined radius and depth and extending substantially the length of the bit shank parallel to the center line of said bit shank, and adapted to cooperate with the bit holding socket, said socket having projecting means complementary with said grooves when said bit is firmly seated within said socket to align said bit in the socket in a predetermined manner and to prevent the bit from turning therein.

3. A cutting means for use in coal mining and the like comprising a bit body including an outer end and an inner end spaced therefrom, a cutting surface carried by said bit body adjacent said outer end, said body including a shank portion of circular cross section extending between said ends, said shank portion tapering inwardly in progressing toward said inner end of said bit body, the included angle of taper of said shank portion being substantially in the range of 6° to 7°, means including a socket for receiving said shank portion, said socket having a taper corresponding to that of said shank portion, bit and holder alignment means including an elongated circular groove in the surface of the bit shank of a predetermined depth and radius extending substantially the length of the bit shank parallel to the centerline of said bit shank, mating means on the interior surface of said receiving socket consisting of a longitudinally disposed circular rod of the same radius as the aforementioned groove in the bit shank, said rod being affixed as by welding in a longitudinal circular groove on the face of the interior surface of said receiving socket, and extending up to substantially the length of the shank of the bit, an arcuate protruding portion of the said rod mating with the aforementioned bit shank groove to guide said bit into the said socket and maintain positive alignment therebetween.

4. A cutting means as in claim 3 in which a part of the surfaces of said shank portion of the bit and said holding socket being sufficiently spaced from each other intermediate said ends of said bit body to prevent frictional engagement of said bit body and said socket where such spacing occurs.

5. A cutting means for use in coal mining and the like comprising a bit body including an outer end and an inner end spaced therefrom, a cutting surface carried by said bit body adjacent said outer end, said body including a shank portion of circular cross section extending between said ends, said shank portion tapering inwardly in progressing toward said inner end of said bit body, the included angle of taper of said shank portion being substantially in the range of 6° to 7°, means including a socket in a bit

holder receiving said shank portion, said socket having an internal taper corresponding to that of said shank portion, bit and holder alignment means including an elongated circular groove in the surface of said bit shank, said groove being of a predetermined depth and radius and extending substantially the length of the bit shank parallel to the center line thereof, said elongated circular groove in the bit shank adapted to mate with the protruding arcuate end of a substantially rectangular metal insert affixed in a radially disposed slot of predetermined limited depth and width in the top of said socket holder and substantially filling the same, said insert having its top face disposed flush with the top of said socket holder and its protruding arcuate end of the same radius as the aforementioned elongated circular groove in the bit shank, said arcuate end portion of the insert protruding from the interior surface of the bit socket to the same extent as the predetermined depth as said elongated circular groove in the bit shank, said flush protruding insert in the socket holder and said elongated groove in the bit shank cooperating to guide the bit into the socket and maintain a predetermined positive alignment thereof.

6. A cutting means as in claim 5 in which a part of the surfaces of said shank position of the bit and said holding socket being sufficiently spaced from each other intermediate said ends of said bit body to prevent frictional engagement of said bit body and said socket where such spacing occurs.

7. A cutting means for use in coal mining and the like comprising a bit body including an outer end and an inner end spaced therefrom, a cutting surface carried by said bit body adjacent said outer end, said body including a shank portion of circular cross section extending between said ends, said shank portion tapering inwardly in progressing toward said inner end of said bit body, the included angle of taper of said shank portion being substantially in the range of 6° to 7°, means including a socket in a bit holder receiving said shank portion, said socket having an internal taper corresponding to that of said shank portion, bit and holder alignment means including an elongated circular groove in the surface of the bit shank, said groove being of a predetermined depth and radius and extending substantially the length of the bit shank parallel to the center line thereof, said bit holder containing a metal ball recessed and affixed as by welding in a predetermined location in the interior surface of said tapered socket, said ball being of the same radius as the elongated circular groove in the aforementioned bit shank and protruding from the interior surface of the holding socket sufficiently so as to mate smoothly with the aforementioned groove in the bit shank as with a sliding fit, said ball in the holding socket and groove in the bit shank cooperating to guide the bit into the socket and maintain positive alignment therebetween.

8. A cutting means as defined in claim 7 in which a part of the surfaces of said shank portion of the bit and said holding socket being sufficiently spaced from each other intermediate said ends of said bit body to prevent frictional engagement of said bit body and said socket where such spacing occurs.

9. A cutting apparatus for use in coal mining continuous miners and the like comprising a head member having a plurality of tapered circular sockets therein, a cutting bit mounted in each of said sockets, each cutting bit having an outer end and an inner end spaced therefrom, a cutting surface carried by each bit adjacent its outer end, said body of each bit including a shank portion of circular cross section extending between its ends, each of said shank portions tapering inwardly in progressing toward the inner end of its respective bit body, the included angle of taper of the respective shank portions being substantially in the ranges 6° to 7°, each socket having a taper corresponding to that of said shank portion, a portion of the surfaces of said shank portion of the bit and said holding socket being sufficiently spaced from each other intermediate said ends of said bit body to prevent frictional engagement of said bit body and said socket where such spacing occurs, said shank portion of each bit body containing a longitudinally disposed circular groove in the surface of said bit shank extending substantially the length of said shank and parallel to the center line thereof, said groove adapted to cooperate with a circular protrusion of like radius extending from each of said tapered sockets and adapted to align the cutting edges of each of said bits in a predetermined direction.

10. A cutting apparatus as in claim 9 in which each of said socket alignment protrusion consists of a prepositioned elongated circular rod embedded longitudinally in the surface of each socket and affixed thereto as by welding, an arcuate surface of each of said rods mating with the aforementioned circular groove in the bit shank and extending substantially the length of said bit shank.

11. A cutting apparatus as in claim 9 in which each of said socket alignment protrusions consists of a prepositioned insert substantially shorter in length than the aforementioned bit shank, said insert being generally rectangular in shape with one protruding arcuate edge, said inserts being mounted and affixed in radially disposed slots in the top of said head member, a slot being adjacent to each of the plurality of tapered sockets, each of said inserts being mounted in a slot so as its top surface is flush with the face of the aforementioned head member, said arcuate edge of each insert protruding into a socket to cooperate with the corresponding groove in a bit shank.

12. A cutting apparatus as in claim 9 in which each of said socket alignment protrusions consists of a metal ball of the same radius as the aforementioned circular groove in the bit shank, said ball being dropped in a prepositioned hole in the side of the bit socket and embedded in the surface of same so as only a sufficient portion of its surface will protrude from the socket as to arcuate and slidably mate with the aforementioned shank groove.

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