June 12, 1956 F. CARTLIDGE 2,750,176

COLLAPSIBLE BORING HEAD FOR MINING MACHINES

Filed May 21, 1954 3 Sheets-Sheet 1

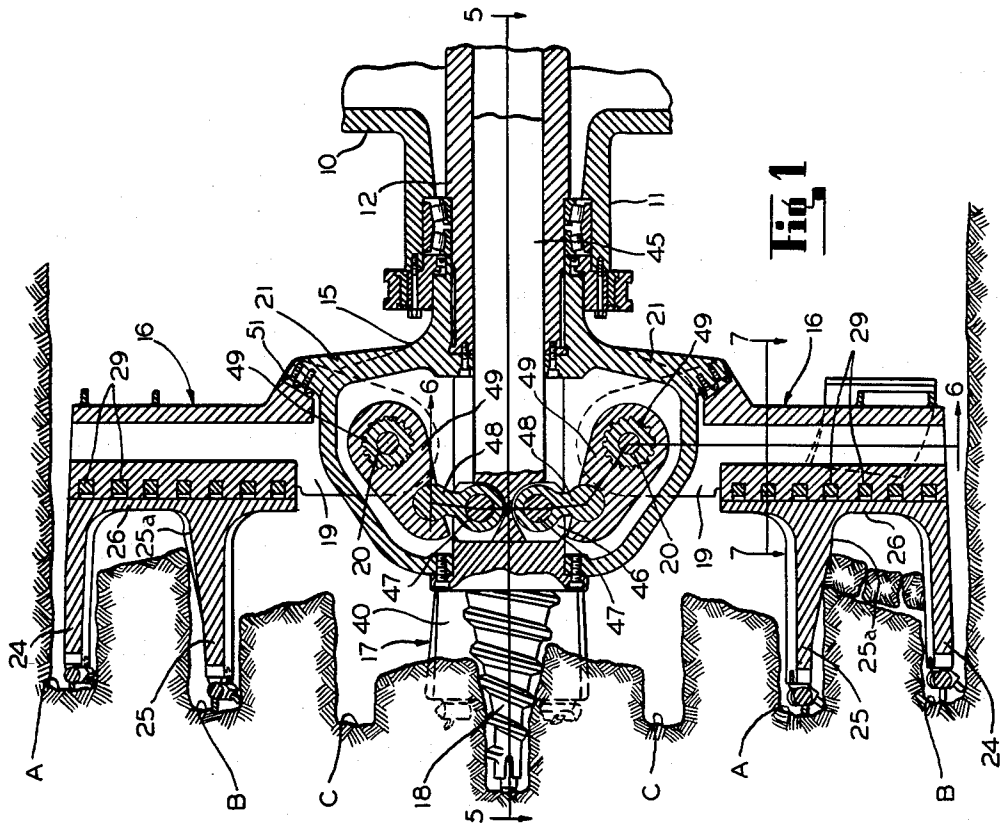


Fig. 1

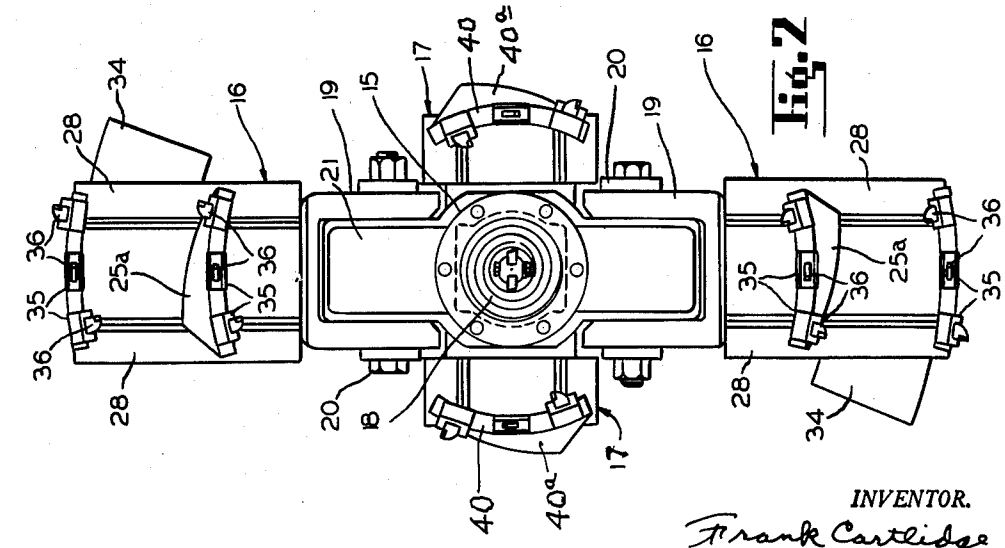


Fig. 2

INVENTOR.
Frank Cartlidge
BY
Murray A. Gleeson
ATTORNEY

June 12, 1956 F. CARTLIDGE 2,750,176

COLLAPSIBLE BORING HEAD FOR MINING MACHINES

Filed May 21, 1954 3 Sheets-Sheet 2

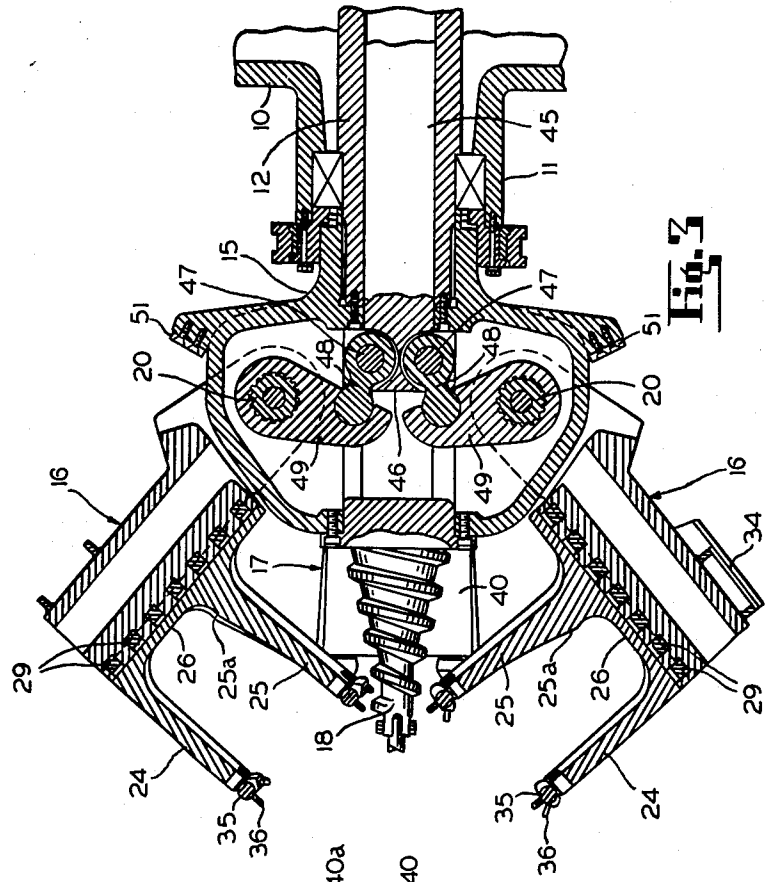


Fig. 3

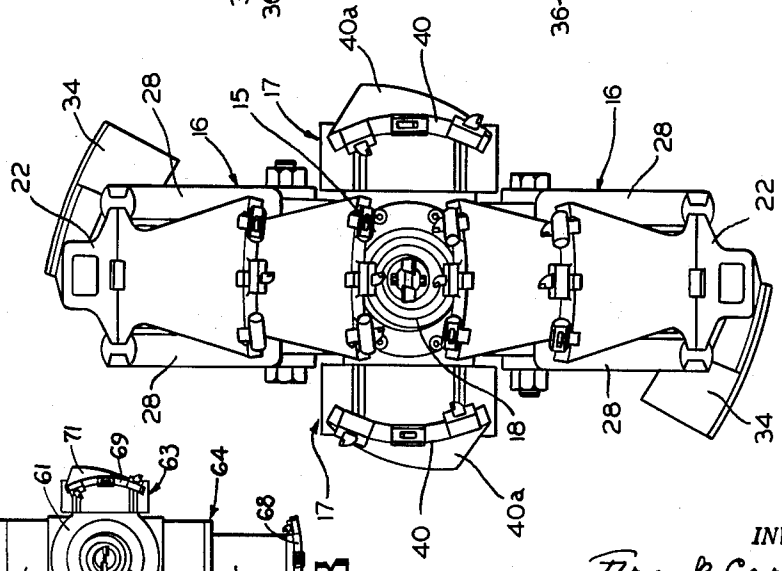


Fig. 4

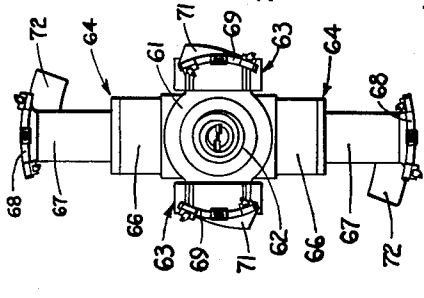


Fig. 8

INVENTOR.
Frank Cartlidge
BY
Murray A. Gleeson
ATTORNEY

June 12, 1956 F. CARTLIDGE 2,750,176

COLLAPSIBLE BORING HEAD FOR MINING MACHINES

Filed May 21, 1954 3 Sheets-Sheet 3

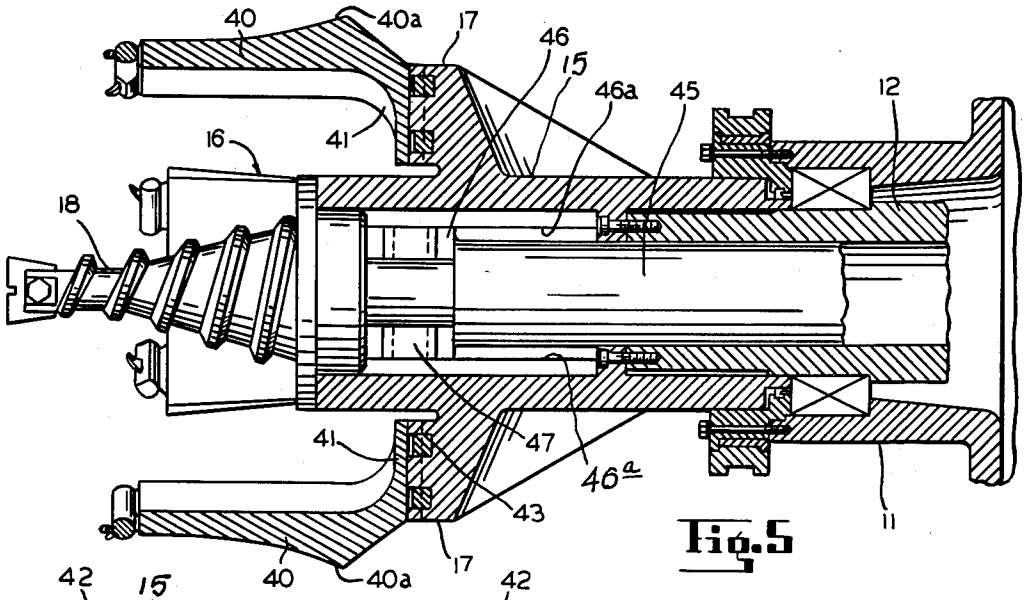


Fig. 5

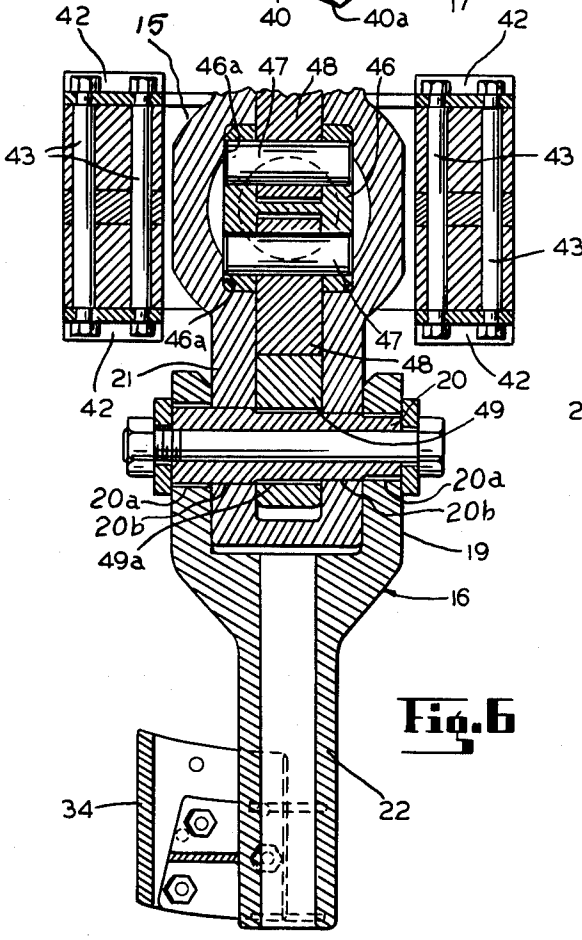


Fig. 6

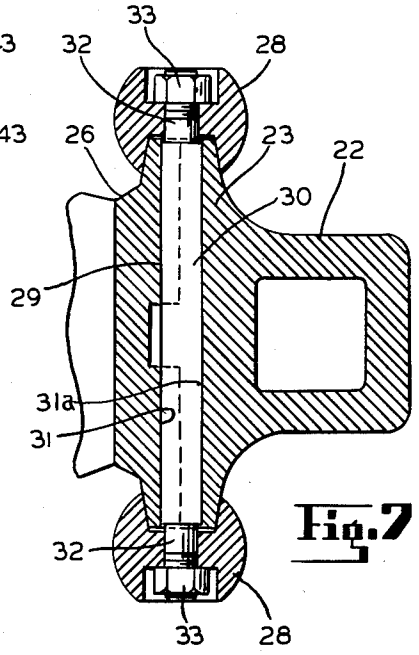


Fig. 7

INVENTOR.
Frank Cartlidge
BY
Murray A. Gleeson
ATTORNEY

United States Patent Office 2,750,176
Patented June 12, 1956

2,750,176

COLLAPSIBLE BORING HEAD FOR MINING MACHINES

Frank Cartlidge, Chicago, Ill., assignor to Goodman Manufacturing Company, Chicago, Ill., a corporation of Illinois

Application May 21, 1954, Serial No. 431,454

10 Claims. (Cl. 262—7)

This invention relates to improvements in mobile mining machines of the boring type wherein one or more rotary boring heads having a plurality of radial cutter carrying arms are forced into a face of standing mineral such as coal. Mining machines of this general type are well known in the art. Since such mining machines operate within the vertical and lateral dimensions of the bore formed by the cutter head or heads of the miner, it is desirable to provide means for reducing the outer diameter of the boring heads when the machine as a whole is to be withdrawn from the bore and transported from place to place in the mine. To this end, various means have heretofore been devised for collapsing the outer ends of the radial arms of the boring head when desired. This presents a difficult problem because the radial arms must each be provided with an adequate number of forwardly projecting cutter supports of sufficient length and strength for forming a plurality of circular kerfs.

The principal object of the present invention is to provide an improved construction and arrangement of boring head wherein the maximum diameter of the radial arms can be reduced to a minimum while maintaining adequate number and strength of the cutter supports. A further object is to provide a structure affording greater stability and increased effectiveness in dislodging mineral in relatively large lumps during boring operations.

In the past, as shown for example in Cartlidge application Serial No. 376,652 filed August 26, 1953, on Adjustable Boring Head for Continuous Mining Machine, now Patent Number 2,707,626, adjustable boring assemblies have included a two- or three-armed assembly rotatable about a hub axis. Each arm carried a number of forwardly extending cutter brackets for producing a number of concentric kerfs in the working face. Since many mine roof conditions require timbering behind the miner, and quite close to the face, there must be some provision for collapsing the head when the machine is backed into the timbered part of the room. In the patent application above referred to the cutter brackets on each arm are aligned radially and the outer bracket is telescopically adjustable relative to the inner two. Since the cutter brackets are radially aligned the inner, fixed brackets are in the way of the outer bracket and thereby limit retraction of each arm, in this specific case to about six inches in a seven foot diameter working head.

This means that the above-mentioned prior art head will collapse a total of twelve inches. Thus the theoretical maximum thickness of roof timber which can be employed is twelve inches. This is only theoretical for in practice, six inches clearance, top, sides and bottom must be maintained to prevent damage to the machine or the timbers as it is backed into the timbered portion. Therefore it is impossible to timber with a conventional machine as shown in the above application and its use is restricted to mines having very good roof not requiring timbering.

The applicant has found that the range of retraction and expansion of the boring head can be extended to as much as twenty-four inches on the diameter by putting the inner cutter brackets on one or more short fixed arms which are displaced circumferentially from long retractable arms. The long arms, which cut the outer kerfs, can therefore be retracted a maximum amount, into the space formerly occupied by the short fixed arms.

It is an object of the present invention to improve a boring head assembly by constructing it with at least two arms of different lengths extending radially from a rotatable hub and having cutter means extending forwardly from each arm effective to cut at least two concentric kerfs in a working face, the improvement specifically comprising adjusting means for varying the distance of the outer end of the long arm from the hub rotational axis, the short arm being spaced circumferentially from the long arm to permit maxmium radial contraction of the long arm.

The invention may best be understood by reference to the accompanying drawings, in which:

Figure 1 is a vertical section of a cutter head and the rotary support therefor forming part of a mobile mining machine.

Figure 2 is a front view of the cutter head shown in Figure 1.

Figure 3 is a view similar to Figure 1, but showing the main cutter arms in collapsed position.

Figure 4 is a front view of the cutter head, in the collapsed position shown in Figure 3.

Figure 5 is an enlarged detail section taken on line 5—5 of Figure 1, passing through the fixed arm and cutter support.

Figure 6 is a detail section taken on line 6—6 of Figure 1.

Figure 7 is a detail section taken on line 7—7 of Figure 1.

Figure 8 is a modified form illustrating the scope of the present invention.

Referring now to details of the embodiment of my invention shown in Figs. 1–7 of the drawings, 10 indicates the supporting frame of a mobile mining machine, having a bearing support 11 in which the hollow drive shaft 12 of a rotary boring head is journaled. The drive shaft is driven as usual, by suitable power means (not shown) on the machine frame.

The rotary boring head has as its principal elements a hollow hub 15, a plurality of relatively long radially extending arms 16, hinged at their inner ends to the hub 15, and a plurality of shorter arms 17 fixed to the hub intermediate the long cutter arms 16. In the form shown, two long arms 16 are employed, extending diametrically from opposite sides of the hub, with two shorter arms 17, extending at right angles to the longer arms. It will be understood however, that three, or possibly more sets of long and short arms might be employed where strength requirements permit.

A tapered burster screw 18 may be suitably fixed to the front end of the hub and project forwardly therefrom, as is often the case with boring heads of similar type.

Each of the hinged cutter arms 16 has a bifurcated base portion 19, with a pivot pin 20 having its outer ends splined therein at 20*a*, and with adjacent portions 20*b* pivotally mounted in hollow lateral extensions 21, 21 of the hub 15. Each cutter arm 16 consists of a hollow arm portion 22 integral with its base portion 19, generally rectangular in cross section (see Figures 6 and 7) having a widened front face 23 for mounting a plurality of cutter supports or brackets thereon. In the form shown herein, two such cutter supports 24 and 25 are mounted on each arm. For convenience, said supports are both mounted on a single base 26.

The cutter support base **26** is secured to the front face **23** of arm portion **22** by a pair of opposed clamping bars **28, 28** channelled along the inner edge thereof, and spanning the tapered meeting edges of the base **26** of the cutter supports and the widened face **23** of the arm portion **22**, as shown in Figure 7. The clamping bars are secured in place by a plurality of tie rods **29, 29** each having a squared intermediate portion **30** fitting in transverse registering grooves **31** and **31***a* formed in the base **26** and arm portion **22**, respectively, and terminating in bolt ends **32, 32** at opposite ends, passing through the clamping bars for engagement by nuts **33** (see Figure 7).

The securing means for the cutter supports **24** and **25** just described permits endwise adjustment of said cutter supports relative to their respective portions **22**, so as to cut bores of different diameters, when desired. It will also be understood that said cutter supports may be made with separate bases, and adjusted lengthwise of their respective arms independently of each other. The cutter supports **24**, and **25** each extend generally at right angles to their respective arm portion **22**, and as usual project a substantial distance in advance of said arm. Each of said cutter supports has a plurality of cutter-bit holders **35**, herein three in number, disposed as usual in arcuate form along said supports and having removable cutter-bits **36, 36** projecting at varying angles therefrom, so as to cut relatively deep concentric kerfs in the working face, as indicated at A and B in Figure 1. The outermost cutter support **24** on each hinged arm may be slightly shorter than the adjacent cutter support **25**, as shown in Figure 1.

The last named support may have a cam-like core-breaker **25**[a] on its outer side near base **26**, as usual, for breaking away the solid mineral between the two kerfs A and B as the machine is advanced into the working face. Each arm **20** may also have a scoop **34** mounted adjacent its outer end as usual to aid in guiding loose material into position where it will be removed from the face by suitable conveyor devices (not shown).

The shorter, intermediate cutter arms **17** are rigid with the hub **15**. Each has a single cutter support **40** on its outer end, somewhat similar to the innermost cutter supports **25** on the longer arms, including a cam-like core breaker **40**[a] near its base similar to the core breakers **25**[a] on the cutters supports **25**. In the form shown, the cutter supports **40** are slightly longer than the cutter supports **24** and **25** (see Figure 1) so as to form a circular kerf C slightly deeper than the outer kerfs A and B. As will also be observed from Figure 2, the shorter cutter arms **17** with their cutter supports **40** extend radially a distance less than that of the hollow lateral extensions **21, 21** on which the longer arms **16** are hinged.

In the form shown herein, the bases **41** of cutter supports **40** may be detachably mounted on their respective cutter arms **17** by a pair of channeled clamping bars **42, 42** and a pair of squared tie rods **43, 43** similar in construction to the clamping bars **28** and the rods **29** previously described for securing the cutter supports **24** and **25** to the hinged rotary arms **16**.

The hinged arms **16** have means for causing forward swinging movement relative to the hub **15** through a single reciprocating control rod **45** slidably mounted in the hollow drive shaft **12**. Said rod may be actuated by any suitable power means such as that disclosed in the Robbins et al. patent application Serial No. 385,849, owned by the assignee of the present invention, now Patent Number 2,711,887. The rod **45** has a head **46** slidable in opposed guide channels **46**[a], **46**[a] in the hub, and having pivot pins **47, 47** on which the inner ends of laterally extending umbrella type links **48, 48** are mounted. The outer ends of said links are pivotally connected with the forward ends of levers **49, 49**, each fixed at their rear ends as by splines **49**[a], **49**[a], to the pivot pins **20, 20** of the hinged arms **16**.

In the fully extended normal boring position shown in Figure 1, rearward hinged movement of the arm portions **22, 22** is limited by stops **51, 51** on the hollow extensions **21, 21**. In this position, the umbrella type links **48, 48** may be moved forwardly over a dead center position so that the hinged arms tend to stay in their fully extended boring position, until positively swung forwardly by retracting movement of the control rod **45**.

The use and operation is as follows:

It will be understood that for most efficient operation boring heads of the type to which the present invention relates must have their forwardly projecting supports spaced from each other a sufficient distance, and of sufficient length, to produce relatively few narrow circular kerfs in the working face, leaving substantially large circular blocks of coal therebetween to be broken out in relatively large lumps by the core breaking devices on the cutter head. For instance, the illustrative form of cutter head shown in the drawings is designed for cutting a bore of approximately seven feet in diameter in solid coal. In such case, it is usually desirable to produce no more than three substantially equal-spaced circular kerfs in addition to the tapered center screw **18**. The cutter supports which form these circular kerfs preferably extend forwardly of the arms a distance at least one-third of the radius, or one-sixth the diameter, of the bore. With such optimum proportions between the working diameter of the rotary head and the length of cutter supports, it will be seen from Figure 3, that inner hinged movement of the two hinged arms **16, 16** is limited by the intermediate pair of cutter supports **25, 25** as their outer ends approach each other and the central tapered screw **18**. Thus with only two pairs of cutter supports **24** and **25** mounted on the hinged arms, the latter can be swung inwardly to angles of approximately 40° to the axis of rotation of the cutter head. Manifestly, if the third innermost pair of cutter supports **40, 40** (now carried on the intermediate short arms **17, 17**) were also mounted on the hinged arms in the conventional manner, the two hinged arms **16, 16** could only be swung inwardly about one-half the amount now possible with my improved arrangement.

The improved arrangement of the intermediate short arms **17** is such as to afford considerably more space for the swinging mechanism for the hinged arms **16**, and to permit all of the moving parts of the cutter head to be made more rugged and substantial than with conventional cutter arm structures.

As additional advantages, the short arms **17, 17** have a definite stabilizing effect in maintaining the boring head in centered relation during boring operations. Also, the cam-like breaker members **40, 40** on said shorter arms break out the adjacent annular core more freely without hindrance from an adjacent cutter support, as is the case with conventional boring head structures where all of the cutter supports are arranged in radial alignment along the rotary arms.

The applicant wishes to emphasize that other means of expanding and contracting the long arms, besides the hinged structure specifically shown, may be advantageously employed within the scope of this invention. The fundamental feature of this invention is that a short fixed cutter-bearing arm is displaced circumferentially from a long adjustable arm for maximum contraction of the latter into clearance provided by the circumferential displacement of the short arm.

By way of example, refer to the embodiment shown in Figure 8. There a hub **61** having a burster cone **62** on the front end thereof carries a pair of short fixed cutter bearing arms **63, 63** (similar to short arms **17** above described) and a pair of long arms generally designated **64, 64**. These long arms are generally similar to those shown in Cartlidge application Serial No. 376,652 and are telescopical, each including an inner portion **66** mounted directly to the hub and an outer telescopical portion **67** carrying a cutter bit cluster **68**. The outer cutter bit cluster **68** may be expanded and contracted by an "umbrella" linkage similar to that shown in Cartlidge applica-

tion Serial No. 376,652. The short arms **63** have a cutter bit cluster **69** for cutting an inner kerf and they also have wedges **71**, **71** for breaking off the outer annular core in the same manner as described for wedge **40***a*. The embodiment of Figure 8 employs a single cutter bit cluster on each of the long and short arms so as to produce only two concentric kerfs. Obviously, modified arrangements may be employed within the scope of this invention to produce additional kerfs if desired. In operation, the outer cutter bit cluster **68** may be retracted into the space provided by the circumferential displacement of the short arms **63**, **63**.

Although I have shown and described two forms of my invention, it should be understood that the disclosure is only illustrative and should not be understood to limit or confine my invention except by the appended claims.

I claim:

1. In a boring head for mining machines, a rotatable hub, a plurality of radially extending arms hinged to said hub at their inner ends, a plurality of bit-carrying cutter supports mounted on and extending forwardly from said radial arms for cutting a plurality of relatively deep concentric kerfs in a working face, a plurality of shorter circumferentially spaced radial arms fixed to said hub intermediate said hinged arms, each having a cutter support projecting forwardly therefrom to cut a kerf of substantially smaller diameter than the cutter supports on said hinged radial arms, said hinged arms and their cutter supports being adjustable toward the axis of rotation of said head into nesting relation in the circumferential spaces between the cutter supports carried by the adjacent shorter fixed arms.

2. The structure in accordance with claim 1, wherein the hub includes hollow extensions to which the longer radial arms are hinged, and wherein the cutter supports on the intermediate arms are disposed on shorter radii than the lengths of said hollow extensions relative to the axis of the boring head.

3. The structure in accordance with claim 2, wherein each of the hinged radial arms have bifurcated bases spanning opposite sides of the hollow extensions, pivot pins extending through the bifurcated bases and are fixed to said hollow extension, levers are enclosed in said hollow extensions and are fixed to said pivot pins, a control rod is reciprocably mounted in and extends rearwardly axially of said hub for remote control, and hinged links connect said levers to said control rod.

4. In a boring head for mining machines, including a hub, a rotable, radially extending arm hinged at its inner end to said hub having a bit-carrying cutter mounted on and extending forwardly from said hinged arm for cutting a relatively deep concentric kerf in a working face, and a shorter radial arm fixed to said hub and spaced circumferentially from said hinged arm, said shorter arm having a cutter support extending forwardly therefrom to cut a kerf of less diameter than the cutter support on said hinged radial arm, and means on said hub for adjusting said hinged radial arm toward and away from the axis of rotation of said head in a path offset circumferentially of the cutter support carried by the fixed shorter arm, so as to permit reduction of the overall diameter of the boring head without interference between the cutter supports on the hinged arm and the cutter supports on the fixed arm.

5. In a boring head for mining machines, a hub having two pairs of circumferentially spaced arms extending radially therefrom, each of said arms including cutter supports extending forwardly substantially at right angles therefrom to cut concentric kerfs in a working face, one of said pairs of arms being fixed on said hub in circumferentially spaced relation to the second pair of arms, the second pair of arms being normally substantially longer than the first named pair of arms and adjustable toward and away from said hub in paths spaced circumferentially from the cutter supports on the shorter arms.

6. The structure of claim 5, wherein each of the longer arms includes a cutter support on an outer end portion which is adjustable toward and away from the hub by telescopic movement radially of said arm.

7. In a boring head for mining machines, a hub having a plurality of circumferentially spaced arms extending radially therefrom, each of said arms having cutter supports extending forwardly substantially at right angles therefrom to cut concentric kerfs in the working face, certain of said arms being shorter than the other arms, and fixed on said hub in circumferentially spaced relation to the other arms, the cutter supports on said shorter arms being disposed to cut a kerf of substantially less diameter than that cut by the adjacent innermost cutter supports on the longer arms, means for adjusting said longer arms toward and away from the axis of rotation of said hub, and wedges fixed on the cutter supports on said shorter arms in radial alignment with the latter for breaking away the core left between the concentric kerfs formed by the cutter supports on the shorter arms and said adjacent cutter supports on the longer arms.

8. In a boring head for mining machines, a hub having two circumferentially spaced arms extending radially therefrom, each of said arms including cutter supports extending forwardly substantially at right angles therefrom to cut concentric kerfs in a working face, one of said arms being fixed on said hub in circumferentially offset relation to the second arm, the second arm being normally substantially longer than the first named arm and adjustable toward and away from said hub in a path spaced circumferentially from the cutter support on the shorter arm.

9. In a boring head for mining machines, a hub having at least two circumferentially spaced arms extending radially therefrom, each of said arms having cutter supports extending forwardly substantially at right angles therefrom to cut concentric kerfs in the working face, certain of said arms being shorter than the other arm, and fixed on said hub in circumferentially offset relation to the other arm, the cutter support on said shorter arm being disposed to cut a kerf of substantially less diameter than that cut by the adjacent cutter support on the longer arm, the longer of said arms being adjustable toward and away from the axis of rotation of the hub in a path spaced circumferentially from the cutter support on the shorter arm, and said hub having outwardly-facing core breaking wedge means thereon for breaking away the core left between the concentric kerfs formed by the cutter support on the shorter arm and said adjacent cutter support on the longer arm.

10. In a boring head for mining machines, a hub having two circumferentially spaced arms extending radially therefrom, each of said arms including cutter supports extending forwardly substantially at right angles therefrom to cut concentric kerfs in a working face, one of said arms being fixed on said hub in circumferentially offset relation to the second arm, the second arm being normally substantially longer than the first named arm and adjustable toward and away from the axis of rotation of said hub in a path spaced circumferentially from the cutter support on the shorter arm.

References Cited in the file of this patent

UNITED STATES PATENTS

789,991	Miller	May 16, 1905
1,149,707	Wolf	Aug. 10, 1915
1,603,621	McKinlay	Oct. 19, 1926
1,667,155	Higdon	Apr. 24, 1928
1,726,963	McKinlay	Sept. 3, 1929
2,550,202	Robbins	Apr. 24, 1951
2,575,975	Robbins	Nov. 20, 1951