Aug. 5, 1969 E. F. BRILL ET AL 3,459,453

CONTOUR CUTTER FOR CONTINUOUS MINER

Original Filed Sept. 16, 1966 3 Sheets-Sheet 1

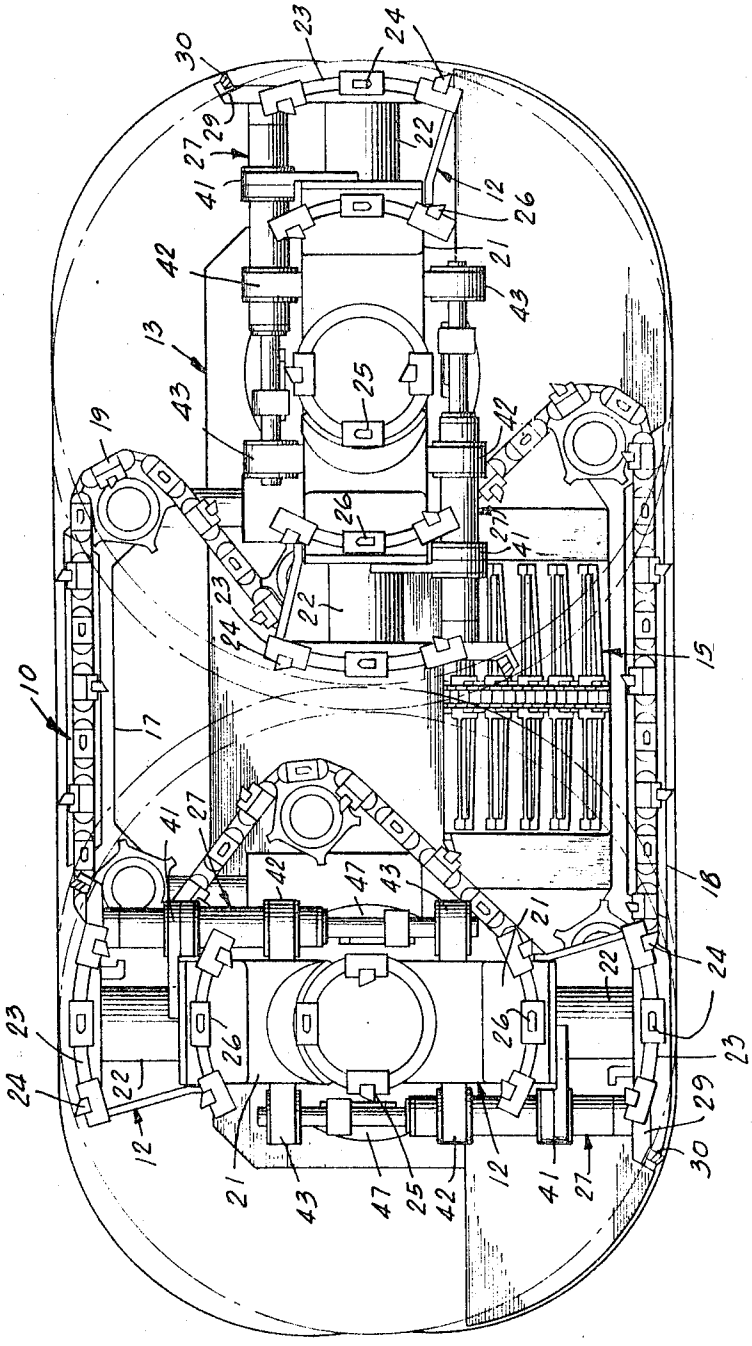


Fig. 1

INVENTORS
EDWARD F. BRILL
HOWARD E. SHELLEY

BY Hill, Sherman, Meroni, Gross & Simpson ATTORNEYS

Aug. 5, 1969 E. F. BRILL ET AL 3,459,453

CONTOUR CUTTER FOR CONTINUOUS MINER

Original Filed Sept. 16, 1966 3 Sheets-Sheet 2

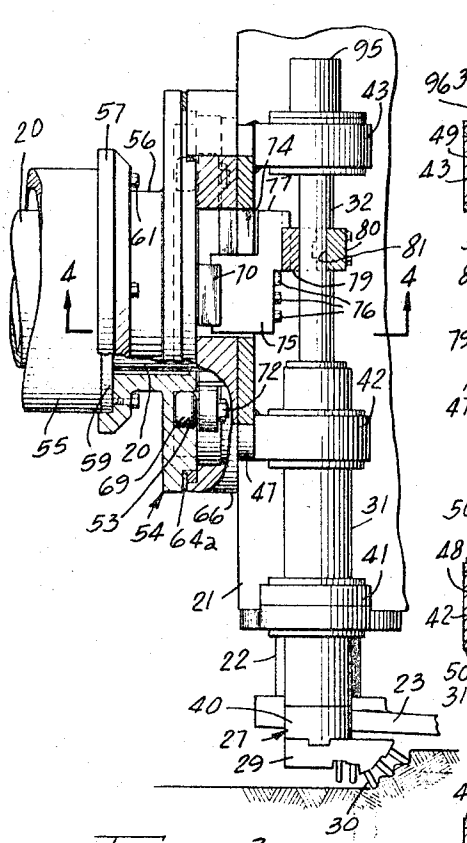


Fig. 3

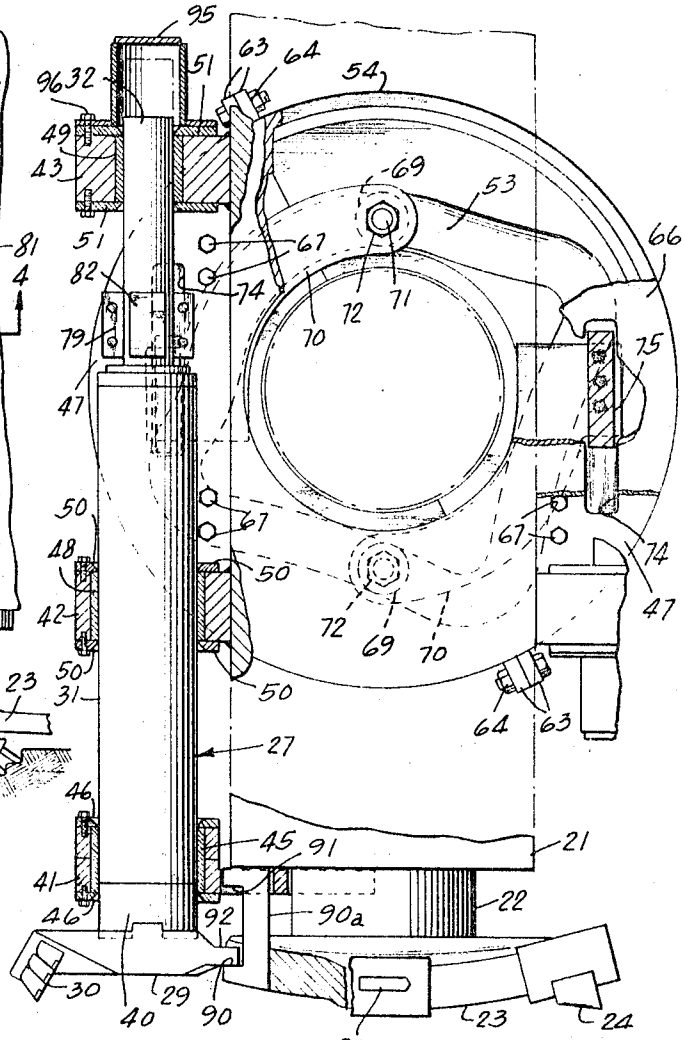


Fig. 2

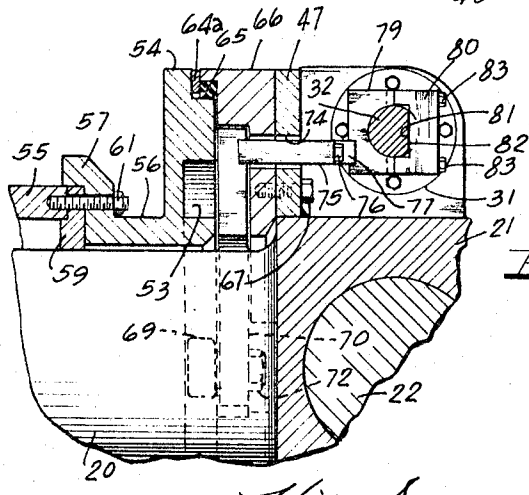


Fig. 4

INVENTORS
EDWARD F. BRILL
HOWARD E. SHELLEY

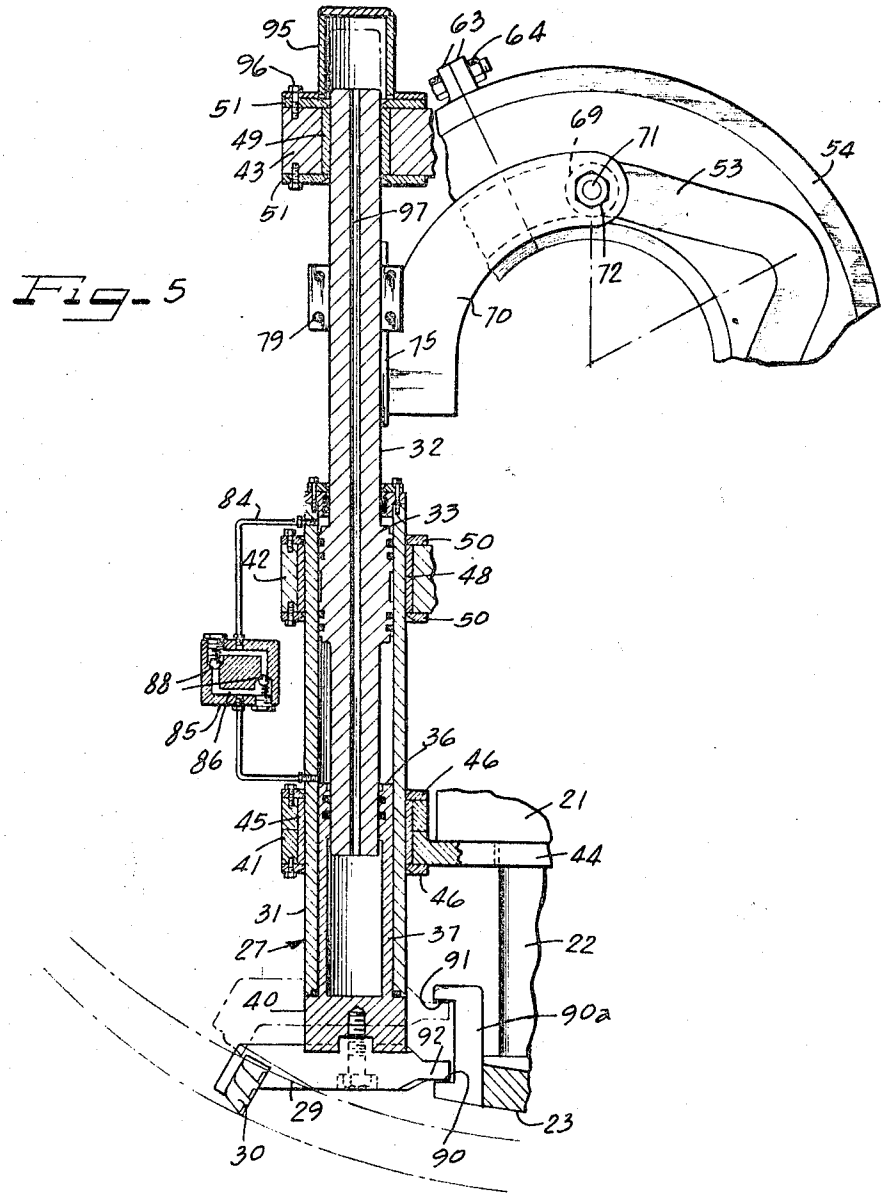
BY Hill, Sherman, Meroni, Gross & Simpson
ATTORNEYS

Aug. 5, 1969 E. F. BRILL ET AL 3,459,453

CONTOUR CUTTER FOR CONTINUOUS MINER

Original Filed Sept. 16, 1966 3 Sheets-Sheet 3

Fig. 5



INVENTORS
EDWARD F. BRILL
HOWARD E. SHELLEY

BY Hill, Sherman, Meroni, Gross & Simpson
ATTORNEYS

United States Patent Office

3,459,453

Patented Aug. 5, 1969

3,459,453

CONTOUR CUTTER FOR CONTINUOUS MINER

Edward F. Brill, Oconomowoc, Wis., and Howard E. Shelley, Niles, Ill., assignors to Westinghouse Air Brake Company, Pittsburgh, Pa., a corporation of Pennsylvania

Continuation of application Ser. No. 580,029, Sept. 16, 1966. This application Apr. 15, 1968, Ser. No. 721,512

Int. Cl. E21b *11/06;* E21c *1/02, 13/00*

U.S. Cl. 299—59 15 Claims

ABSTRACT OF THE DISCLOSURE

Contour cutter for contouring the circular bores being formed by the boring heads of boring types of continuous mining machines. The contour cutter is in the form of a cutter arm supplemental to the main boring arm of the machine. The contour cutter arm includes a cylinder, piston and piston rod unit bodily moved translationally as a unit by rotation of the boring head relative to its support and held in an extended boring position by a hydraulic lock. The lock is releasable by pressure to accommodate the telescopic boring arm to shorten the cylinder with respect to its piston as the boring arm is contracted into a tramming position. A cam and follower drive is provided to translationally move the contour cutter arm as the contour cutter arm and boring head rotate.

This application is a continuation of application Ser. No. 580,029, filed Sept. 16, 1966 and now abandoned.

This invention relates to improvements in continuous mining machines having a pair of rotary boring arms mining contiguous intersecting bores in a mine face, and is particularly directed to such machines in which the circular contours mined by the boring arms are modified to predetermined non-circular forms.

The present invention in general principles is somewhat similar to that of our application Ser. No. 546,974 filed May 2, 1966, but differs from the disclosure of this application in that contour cutter means are provided which are adapted for assembly to conventional continuous mining machines, without materially altering the machine.

It is a principal object of the present invention to provide a novel and improved form of contour cutter for contouring the circular bore mined by the rotary boring head of a continuous mining machine, and arranged with a view towards assembly to the machine, without materially altering the construction of the machine.

Another object of the invention is to provide a novel and simplified form of controlled contour cutter means adaptable for continuous mining machines in which contour cutters follow the cutter supports of the rotary boring head and are mounted for rotational and translational movement during the mining operation, to modify the circular bore mined by the boring head to a non-circular conformation.

A further object of the invention is to provide an improved form of contour cutter adapted for assembly to a continuous mining machine for modifying the circular bore mined by the rotary boring head of the machine in which the contour cutter includes a telescopic arm mounted and guided on the boring head in trailing relation with respect to the cutter supports thereof, and rotated by said rotary boring head and extended and retracted by relative rotary motion of said rotary boring head with regard to the main supporting housing for the boring head in accordance with the contour required for the final bore.

Still another object of the invention is to provide a simple and improved contour cutter for modifying the circular contour mined by the boring head of a continuous mining machine so arranged as to be adapted for assembly to various forms of boring heads and continuous mining machines.

These and other objects of the invention will appear from time to time as the following specification proceeds and with reference to the accompanying drawings wherein:

FIGURE 1 is a view of a continuous mining machine constructed in accordance with the principles of the present invention, looking at the machine toward the front end thereof and diagrammatically illustrating the cutting paths of the boring heads and contour cutters;

FIGURE 2 is an enlarged fragmentary front end view of a portion of the rotary boring head shown in FIGURE 1, with parts broken away and other parts shown in section, in order to illustrate certain details of structure and support for the contour cutter;

FIGURE 3 is a partial fragmentary view in side elevation of the boring head shown in FIGURE 2 with certain parts in vertical section in order to show certain details of the adapter housing and contour cutter not shown in FIGURE 2;

FIGURE 4 is a partial fragmentary detail sectional view taken substantially along line **4**—**4** of FIGURE 3; and

FIGURE 5 is an enlarged front end detail view, with parts of the boring head broken away, and showing the contour cutter in generally vertical section.

In the embodiment of the invention illustrated in the drawings, we have shown in FIGURE 1 a front end view of a continuous mining machine **10**, of the rotary boring type. The mining machine **10** is supported on the usual laterally spaced continuous traction tread devices (not shown) which serve to tram the machine from working place to working place and to feed a pair of rotary boring heads **12**, **12** into the working face of a mine in a conventional manner. The rotary boring heads **12**, **12** are rotatably supported on a main supporting housing **13**, for rotation about parallel horizontal axes extending perpendicular to the working face of the mine and disposed on opposite sides of a conveyor **15** extending along the center of the machine for picking up and loading the loose material mined.

An individual motor (not shown) is conventionally provided for driving each boring head to rotate in directions toward the center of the machine and progress the material mined towards the center of the conveyor **15** to be picked up by said conveyor **15** as the boring operation progresses. A conventional transmission gearing (not shown) driven by the motors is housed in the main supporting housing **13** and tied together to drive the two boring heads to rotate in timed relation with respect to each other. The motors and geared drive connections to the boring heads are no part of the present invention, so need not herein be shown or described further.

The main supporting housing **13** is supported to extend in advance of the main frame of the machine in vertically spaced relation with respect to the ground on the usual hydraulic jacks (not shown) and also forms a support for an upper trimmer bar **17** and a lower trimmer bar **18**. The trimmer bars **17** and **18** form rectilinear guides for a trimmer chain **19**, and guide said trimmer chain to trim the cusps left between the boring heads and depending from the mine roof and extending upwardly of the mine floor.

The trimmer bars **17** and **18** are adjustably supported on the main supporting housing **13** in conventional manners, to position the trimmer chain **10** to mine along the roof and floor of the mine to provide a clean level roof and floor. The trimmer chain is guided to pass along the upper and lower trimmer bars and is driven from the

transmission gearing in the main supporting housing **13**, rotatably driving the rotary boring heads **12**, in a well known manner which is no part of the present invention so need not herein be shown or described further.

Each boring head **12** is of a similar form and generally includes a hollow shaft or hub **20** having rotary boring arms **21** extending diametrically therefrom, equal distances to opposite sides of the axis of rotation of the hub **20**. The boring arms **21** have telescopic arms **22** mounted therein for telescopic movement with respect thereto, to be retracted when tramming from working place to working place, and to be extended to position cutter supports **23** and cutter bits **24** carried by said cutter supports to mine rotary bores generally tangentially of the roof and floor of a mine. Each boring head also includes a central pilot cutter **25** and intermediate cutter bit supporting arms **26**, cutting annular kerfs spaced radially inwardly of the kerfs cut by the cutter bits **24** and radially outwardly of the pilot cutter.

The telescopic arms **22** are held in fixed relation with respect to the boring arms **21** during mining, and are extensibly and retractibly moved with respect to the boring arms by a conventional form of adjusting mechanism, which is no part of the present invention, so need not herein be shown or described.

It is understood that the telescopic arms **22** are held in extended positions during mining, but that these extended positions may be varied in accordance with the required diameter of the bore. The telescopic arms **22** are, therefore, only retracted their full amount when it is desired to back the machine away from the working face and to tram the machine from working place to place. At this time the lower trimmer bar **18** is raised above the floor and the upper trimmer bar **17** may be lowered to clear the roof of the mine.

Referring now in particular to the means for contouring the bore and certain novel features of the invention, contour cutter arms **27** are mounted on each of the boring heads **12** on each side of the boring arms **21**. The oppositely extending contour cutter arms **27** are spaced equal distances from the axis of rotation of the boring head and support contour cutter supports **29** on the ends thereof. The contour cutter supports have cutter bits **30** extending therefrom in trailing relation with respect to the cutter bits **24** of the associated cutter supports **23**, to contour the bore mined by said cutter bits to a preselected non-circular contour.

The contour cutter arm **27** is shown in FIGURES 2, 3, 4 and 5 as being in the form of a fluid pressure cylinder **31** having a piston rod **32** extensible therefrom and having a piston **33** formed integrally therewith intermediate the ends thereof. The piston rod **32** is sealed and guided at its inner end in a reduced diameter internal cylindrical wall **36** of an end cap and sealing sleeve **37** for the outer end of the cylinder **31**.

The end cap and sealing sleeve **37** determines one end of the cylinder **31** and is suitably sealed to said cylinder and has an enlarged diameter head **40** at its outer end, closing the end of the cylinder and transversely slotted to form a keying mounting for the contour cutter **29**. The head **40** is suitably secured to the end of the cylinder **31** to effect extensible and retractible movement of said cylinder and the piston rod **32** along bearing supports **41**, **42** and **43**, supporting and guiding the cylinder and piston rod for translation movement along an axis parallel to the longitudinal axis of the cutter support **22** as said cutter support is extended and retracted.

The means for retracting the contour cutter arm **27** and cutter bits **30**, upon retractible movement of the telescopic arm **22** and cutter support **23**, is shown in FIGURES 2 and 5 as being a generally C-shaped stop **90***a* welded or otherwise secured to the cutter support **23** and having spaced stop surfaces **90** and **91** engageable with a stop lug **92** extending from the cutter support **29**. The stop surface **90** thus serves to telescopically collapse the contour cutter arm **27** upon retractible movement of the cutter support **22** while the stop surface **91** serves to extend the contour cutter arm **27** upon extensible movement of the telescopic arm **22** and cutter support **23** into a selected cutting position. The stop surfaces **90** and **91** limit translational movement of the contour cutter and may be adjusted or interchanged as the contour of the bore may be varied.

As shown in FIGURE 5 the outermost bearing support **41** is in the form of two abutting cylindrical pieces. An arm **44** extends radially of the outer piece and is secured to the outer end of the boring arm **21** as by welding or other suitable securing means. A sleeve bearing **45** slidably engaging the periphery of the cylinder **31** is contained within the bearing support **41** and is retained to said bearing support as by end plates **46**. The bearing supports **42** and **43** are mounted on a mounting plate **47**, shown in FIGURE 2 as being of a generally crescent-like form in end view. A mounting plate **47** extends along each side of the boring arms **21**, and each mounting plate is welded or otherwise secured thereto. Each mounting plate **47** supports associated bearing upports **42** and **43** in advance of said plate. The bearing supports **42** and **43** are welded or otherwise secured to said mounting plates and to opposite sides of the boring arms **21**. The bearing supports **42** and **43** have bearing sleeves **48** and **49**, respectively, mounted therein and retained thereto by end caps **50** and **51** respectively.

The contour cutter arm **27** may be translationally moved along its bearing supports **41**, **42** and **43** by a stationary cam **53** formed in the enlarged diameter end portion of an adapter housing **54** extending about the hub **20** and secured to the front of a supporting hub **55** for the bearings (not shown) for an associated boring head **12**. As shown in FIGURES 3 and 4 the adapter housing **54** has a reduced diameter intermediate cylindrical portion **56** extending about and spaced from the hub **20** and has a rearward flanged portion **57** abutting the front face of an end retainer plate **59** for the boring head supporting hub **55**, and extending over the outer periphery of said retainer plate and along the wall of the supporting hub **55**, for a short portion of the length of said hub. Studs and nuts **61**, which may be threaded in the holes for securing the retainer plate **59** to the end of the supporting hub **55**, are provided to secure the adapter housing **54** in place. The adapter housing **54** is shown in FIGURE 2 as being split along a diametral line extending through the center of rotation of the boring head to accommodate the mounting of said adapter housing on the supporting hub **55** without removing the boring head. Radially extending abutting lugs **63** extending from the adapter housing **54** and having nuts and bolts **64** extending therethrough, are provided to secure the two halves of the adapter housing in position.

The front face of the enlarged diameter end portion of the adapter housing **54** has a forwardly and outwardly opening shouldered recess therein forming a mounting for an annular bearing **64***a* and a seal **65** forming a bearing and seal for a housing **66** extending about the hub **20** of the rotary boring head and welded or otherwise secured thereto, to rotate with the rotary boring head. The housing **66** is mounted on the crescent-like mounting plates **47** as by forming machine screws **67**.

The drive from the cam **53** to the contour cutter arms **27**, for translationally moving said contour cutter arms in opposite directions, to modify the bore mined by the boring head **12** to a non-circular form includes a follower roller **69** movable along the cam **53**, it being understood that one follower roller is provided for each contour cutter arm, and that the follower rollers are spaced 180 degrees apart, as is clearly shown in FIGURE 2. The drive connections from each follower roller to each contour cutter arm are the same so one drive connection only need herein be described and the same part numbers will be applied to each drive connection.

The follower roller 69 is mounted on the end of a connecting arm 70 on a shaft 71, retained to said connecting arm as by a nut 72. The connecting arm 70 is of an arcuate form spaced outwardly of and conforming to the hub 20 (FIGURE 4). As shown in FIGURE 3 the outer end of the connecting arm 70 is partially recessed within a drive block 75 slidably movable along a slot 74 formed in the housing 66 and support plate 47. Machine screws 76 secure said drive block to said connecting arm. The drive block 75 has an arm 77 extending therealong parallel to the piston rod 32 and forming a mounting for a clamping block 79. The clamping block 79 has a semi-cylindrical recess formed therein conforming to the periphery of the piston rod 32. A cap 80 for the clamping block 79 also conforms generally to the form of the piston rod 32 and has a flattened face 81 engageable with a flattened face 82 of said piston rod. Machine screws 83 are provided to secure the cap to the clamping block 79 and to clamp the piston rod 32 to said clamping block to be translationally moved upon translational movement of said clamping block.

A fluid pressure block is provided between opposite sides of the piston 33 and opposite ends of the cylinder 31 to effect movement of the piston rod and cylinder as a unit during a contour cutting operation, and to accommodate the telescopic boring head 22 to retract the associated contour cutter support 29 and cutter bits 33 upon retractible movement of the telescopic arm 22 and cutter support 23. The fluid pressure block includes a fluid pressure line 84 connected from one side of the piston 33 to the opposite side thereof, adjacent opposite effective ends of the cylinder 31, and having a valve block 85 connected therein. The valve block 85 has a looped passageway 86 formed therein in the general form of a rectangular loop and having communication intermediate its ends with the adjacent ends of the pressure line 84. Oppositely acting check valves 88 are provided to accommodate the flow of fluid under pressure to one end or the other of the cylinder 31, dependent upon whether the telescopic cutter support 22 is being extended or retracted. The check valves 88 may both be adjustable and serve as relief valves and accommodate fluid to pass by either one check valve or the other when the arm 27 is extended or retracted by extensible or retractible movement of the telescopic arm 22, or where the cutter bits may strike a hard inclusion in the mine face which would create enough pressure on the cylinder 31 to effect retractible movement of the cylinder 31 along the piston 33 and thereby collapse the contour cutter arm. The check valves 88 will relieve pressure from one side or the other of the piston 33 upon excess pressure conditions as when the contour cutter is extended or retracted by a cutter support 23 by engagement of stop surfaces 90 or 91 with the stop lug 92. The check valves also permit the stop surfaces 90 and 91 to limit translational movement of the contour cutter arm 27 and in addition may relieve the contour cutters from excess loads.

The outer end of the piston rod 32 is closed by a cap 95 secured to the end of an end closure plate 51 for the bearing support 43 as by machine screws 96. A passageway 97 also extends axially along the piston rod 32 from one end thereof to the other to prevent the trapping of air at opposite ends of said piston rod.

As the boring head 12 is rotatably driven, the followers 69 spaced 180 degrees apart, and movable along the cam 53 will translationally move the contour cutter arms 27 and cutter bits 30 on the ends thereof preselected amounts dependent upon the contour of the cam 53, to contour the circular bores of the two boring heads 12 to predetermined non-circular forms, as diagrammatically shown in FIGURE 1. The contour cutters thus not only increase ventilating space between the cutter frame structure and the wall of the mine, but also reduce the size of the cusps to be broken down by the cutter chain 19, and provide a wider floor area for the continuous traction devices, tramming the machine and feeding the boring heads into the working face of the mine.

While we have herein shown and described one form in which the invention may be embodied, it may readily be understood that various variations and modifications in the invention may be attained without departing from the spirit and scope of the novel concepts thereof.

We claim:

1. A contour cutter adapted to contour the circular bore mined by a rotary boring head and in combination with a rotary boring head having a boring arm extending radially therefrom, said boring arm having a cutter support on the end thereof with cutter bits projecting forwardly therefrom, and a main supporting housing for said boring head, comprising:

a rotatable contour cutter arm supplemental to said boring arm and having a cutter thereon and including a fluid pressure cylinder, piston and piston rod,

means rotatably driving said contour cutter arm and cutter concurrently with rotation of said boring head,

means supporting and guiding said contour cutter arm for movement towards and from the axis of rotation of said boring head during rotation thereof, including actuating means mounted on said main supporting housing

and operatively connected to said contour cutter arm for moving said contour cutter arm towards and from the axis of rotation of said boring head upon rotational movement of said rotary boring head and contour cutter arm, and

means locking said cylinder, piston and piston rod to bodily move translationally as a rigid unit during rotation thereof.

2. The structure of claim 1,

wherein the cutter support is extensible and retractible in a radial direction, and

wherein connecting means are provided between said cutter support and said contour cutter arm for shortening said cylinder, piston and piston rod upon retractible movement of said cutter support.

3. The structure of claim 1,

wherein a blocking fluid connection is provided between opposite ends of said cylinder to hold said cylinder, piston and piston rod for translational movement as a unit,

wherein check valves are provided in said blocking connection and are loaded to accommodate lengthening and shortening of the unit upon extensible and retractible movement of said boring arm,

wherein the actuating means comprises a cam plate secured to said main supporting housing and having a cam therein, and a follower and connecting arm operatively connecting said cam plate to said contour cutter arm,

and wherein spaced stops between said boring arm and the cylinder, piston and piston rod unit lengthen and shorten said contour cutter arm upon extensible and retractible movement of said boring arm.

4. The structure of claim 1,

wherein the means locking said cylinder, piston and piston rod to bodily move as a rigid unit comprises a fluid pressure blocking line connected to opposite ends of said cylinder, blocking flow opposite ends of said cylinder and piston to effect movement of said cylinder, piston and piston rod as a unit,

wherein the actuating means comprises a cam plate secured to said main supporting housing and having a contoured cam extending about the axis of rotation of said boring head,

and wherein the operative connection to said contour cutter arm comprises a follower and connecting arm connecting said cam to the cylinder, piston and piston rod unit to effect movement of said contour cutter arm towards and from the axis of rotation of said boring head, as said boring head is rotationally

driven, to contour the circular bore mined by said boring head to a predetermined noncircular conformation.

5. The structure of claim 4,

wherein clamping means connect said connecting arm with said cylinder, piston and piston rod unit, adjacent one end thereof,

and wherein spaced stops between said boring arm and said cylinder, piston and piston rod unit lengthen and shorten said contour cutter arm upon extensible and retractible movement of said boring arm.

6. The structure of claim 5,

wherein a fluid pressure conduit has connection with said cylinder at opposite ends of said cylinder,

wherein a check valve loop having oppositely acting check valves therein is connected in said conduit to normally form a hydraulic block between opposite ends of said cylinder and effect reciprocable translational movement of said contour cutter arm upon translational movement of said cylinder, piston and piston rod unit,

and wherein said check valves relieve pressure from one side or the other of said cylinder to accommodate lengthening and shortening of said cylinder, piston and piston rod unit upon extensible and retractible movement of said boring arm.

7. In a rotary boring head adapted for continuous boring operations,

a main supporting housing for said boring head,

said boring head having a hub journalled in said main supporting housing and at least one telescopic boring arm extending radially of said hub and having a cutter support on the end thereof, having cutter bits projecting therefrom for cutting a circular bore,

at least one contour cutter arm comprising

a cylinder, piston and piston rod supported for translational movement as a unit with respect to said boring arm and having cutter bits on the outer end thereof, projecting forwardly therefrom for contouring the circular bore mined by said boring head to a predetermined conformation,

operative connections between said boring arm and the cylinder, piston and piston rod unit for shortening said contour cutter arm upon retractible movement of said boring arm,

and drive means connected between said main supporting housing and said cylinder, piston and piston rod unit for effecting translational movement of said contour cutter arm and cutter bits upon rotational movement of said boring arm.

8. The structure of claim 7,

wherein the operative connections between said boring arm and said contour cutter arm for shortening said contour cutter arm upon retractible movement of said boring arm comprise spaced stops on said boring arm and abutment means on said contour cutter arm engaged by said stops.

9. The structure of claim 7,

wherein the drive means for translationally moving the contour cutter arm comprises cooperating cam and follower means and a connecting arm having operative connection with said contour cutter arm for effecting translational movement of said contour cutter arm upon operative movement of said cam and follower means.

10. The structure of claim 8,

wherein a fluid pressure blocking connection is provided between opposite ends of said cylinder to normally hold said cylinder, piston and piston rod for translational movement as a solid unit,

and wherein check valve means are provided in said blocking connection relieving fluid under pressure from one end of said cylinder to the other accommodating telescopic contractible movement of said

cylinder and piston rod, effected by retractible movement of said boring arm.

11. The structure of claim 10,

wherein the cam and follower means comprises an adapter secured to said main supporting housing and having a cam therein extending about said hub,

said connecting arm secured to said contour cutter arm and having a follower thereon engageable with said cam, to effect translational movement of said contour cutter arm with respect to said boring arm and thereby contour the circular bore mined by said boring arm to a predetermined non-circular conformation.

12. An attachment for the rotary boring head of a continuous mining machine rotatable about a horizontal axis, and adapted to contour the circular bore made by the boring head to a non-circular form, comprising:

a mounting plate mounted on the boring head for rotation therewith,

a cam fixed from rotary movement and extending about the horizontal axis of the boring head for cooperation with said mounting plate,

guide means mounted on said mounting plate,

a contour cutter arm guided in said guide means for translational movement with respect thereto and having a cutter support on the outer end thereof having cutter bits projecting therefrom,

said contour cutter arm including a cylinder having a piston therein and a piston rod extensible therefrom and means blocking flow between opposite ends of said piston to provide a rigid arm structure,

a follower cooperating with said cam,

and a connecting arm guided in said mounting plate and forming a mounting for said follower and a drive member for said cylinder, piston and piston rod, translationally moving said cylinder, piston, piston rod and cutter support as a unit during rotatable movement of said mounting plate.

13. The structure of claim 12,

wherein the means blocking flow between opposite ends of the piston comprises a blocking fluid pressure connection between opposite ends of said cylinder and said piston.

14. The structure of claim 13,

wherein the blocking fluid pressure connection has a check valve loop therein having oppositely acting check valves therein, set to normally effect a hydraulic block between opposite ends of said piston and effect reciprocable translational movement of said contour cutter arm upon translational movement of said piston,

and wherein said check valves relieve pressure from one side or the other of said cylinder to accommodate extensible and retractible movement of said cylinder with respect to said piston rod.

15. The structure of claim 14,

wherein the rotary boring head has a radially adjustable boring arm,

and wherein spaced stops extend from said boring arm toward said contour cutter arm, and cooperate therewith to adjustably move said contour cutter arm upon adjustable movement of said boring arm.

References Cited

UNITED STATES PATENTS

2,882,031	4/1959	Hlinsky	299—61
3,108,788	10/1963	Allimann	299—60 X

FOREIGN PATENTS

1,321,556	2/1963	France.
118,437	4/1958	U.S.S.R.

ERNEST R. PURSER, Primary Examiner

U.S. Cl. X.R.

175—91; 299—10, 80

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,459,453 Dated August 5, 1969

Inventor(s) Edward Brill and Howard E. Shelley

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 22, "upports" should read --supports--;

Column 7, line 66, "8" should read --9--.

SIGNED AND
SEALED
MAR 24 1970

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR
Commissioner of Patents