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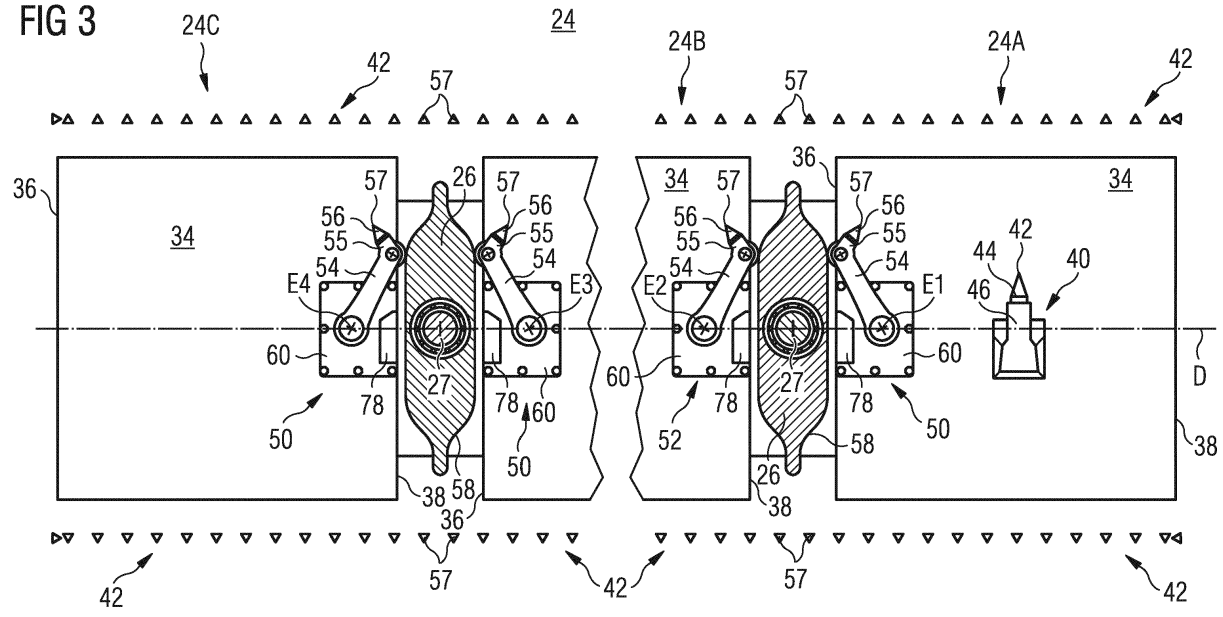
(54) CUTTING DRUM WITH PIVOT CUTTER UNIT

(57) The present disclosure relates to a cutting drum (24A; 24B; 24C) for a mobile mining machine (10). The cutting drum (24A; 24B; 24C) comprises an outer circumferential face (34) extending between first and second end faces (36, 38). The cutting drum (24A; 24B; 24C) further comprises at least one first support arm (54) including a cutting tool (56) and being pivotably mounted to the outer circumferential face (34). The first support arm (54) is pivotable into a working position, in which the cutting tool (56) of the first support arm (54) is positioned beyond the first end face (36) in a direction of a central longitudinal axis (D) and away from the second end face (38). Thus, for example, material remaining in the interspaces between neighboring cutting drums arranged side by side can be cut by the cutting tool (56) of the first support arm (54).

FIG 3



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Description

Technical Field

[0001] The present disclosure relates to continuous mining. More particularly, the present disclosure relates to a cutting drum for a mobile mining machine, a related cutting drum assembly for a mobile mining machine, and a related mobile mining machine, particularly a continuous mining machine.

Background

[0002] In underground mining, continuous mining machines are used to extract material from a mine face. Typically, continuous mining machines include a machine frame with a ground engaging device such as track chains for moving the continuous mining machine. A cutting drum assembly including a plurality of cutting drums is pivotably connected to the main frame by a boom assembly. In mining operation, the boom assembly and the cutting drum assembly are pivoted up and down against the mine face for extracting material therefrom. Extracted material is loaded onto a loading table positioned generally below the boom assembly and the cutting drum assembly. The material loaded onto the loading table is gathered and directed to a conveyor of the continuous mining machine that transports the material away from the mine face to a desired dropping zone.

[0003] The cutting drums of the cutting drum assembly, for example two outer cutting drums encompassing a central cutting drum, are provided with a clearance between one another. The clearance is required for connecting the cutting drums to the boom arms of the boom assembly. As the interspaces between the cutting drums are free of cutting bits, material remains uncut in a region of the interspaces. As a result of pivoting the cutting drum assembly up and down against the mine face, elongate material cores form that vertically extend along the mine face.

[0004] The elongate material cores at the mine face have to be removed to allow forward travel of the continuous mining machine. As the boom assembly may be pivotable in the vertical direction only, the continuous mining machine may have to move back for shifting the continuous mining machine sideways, to subsequently advance in direction to the mine face for removing the elongate material cores with the cutting drums. However, that approach is laborious and time consuming.

[0005] A technology for removing the elongate material cores is to provide core breakers in the interspaces between the cutting drums, which break the elongate material cores as the continuous mining machine advances in direction to the mine face. For example, US 2,808,253 (A) discloses a cutting drum assembly with core breakers.

[0006] The present disclosure is directed, at least in part, to improving or overcoming one or more aspects of prior systems.

Summary of the Disclosure

[0007] In one aspect of the present disclosure, a cutting drum for a mobile mining machine is disclosed. The cutting drum may comprise an outer circumferential face extending between a first end face and a second end face about a central longitudinal axis. The cutting drum may further comprise a plurality of cutting tools mounted to and distributed over the outer circumferential face, and at least one first support arm including a cutting tool and being pivotably mounted to the outer circumferential face. The first support arm may be pivotable into a working position, in which the cutting tool of the first support arm may be positioned beyond the first end face in a direction of the central longitudinal axis and away from the second end face.

[0008] In another aspect of the present disclosure, a cutting drum assembly for a mobile mining machine is disclosed. The cutting drum assembly may comprise a plurality of cutting drums connected side by side. At least one of the plurality of cutting drums may be configured as exemplary disclosed herein, with the cutting tool of the at least one first support arm being pivotable into the working position, which may be positioned between the neighboring cutting drums in the direction of the central longitudinal axis.

[0009] In yet another aspect, a mobile mining machine is disclosed. The mobile mining machine may be a continuous mining machine. The mobile mining machine may comprise a cutting drum as exemplary disclosed herein or a cutting drum assembly as exemplary disclosed herein.

[0010] Other features and aspects of this disclosure will be apparent from the following description and the accompanying drawings.

Brief Description of the Drawings

[0011] The accompanying drawings, which are incorporated herein and constitute a part of the specification, illustrate exemplary embodiments of the disclosure and, together with the description, serve to explain the principles of the disclosure. In the drawings:

Fig. 1 shows a schematic drawing of an exemplary mobile mining machine in a top view;

Fig. 2 shows a schematic drawing of the exemplary mobile mining machine of Fig. 1 in a side view;

Fig. 3 shows a schematic drawing of a cutting drum assembly with pivotable cutter arms according to the present disclosure; and

Fig. 4 shows a schematic drawing of an exemplary embodiment of a pivotable cutter arm according to the present disclosure.

Detailed Description

[0012] The following is a detailed description of exemplary embodiments of the present disclosure. The exemplary embodiments described therein and illustrated in the drawings are intended to teach the principles of the present disclosure, enabling those of ordinary skill in the art to implement and use the present disclosure in many different environments and for many different applications. Therefore, the exemplary embodiments are not intended to be, and should not be considered as, a limiting description of the scope of patent protection. Rather, the scope of patent protection shall be defined by the appended claims.

[0013] The present disclosure is based in part on the realization that although core breakers allow breaking the elongate material cores at the mine face as the continuous mining machine advances, material cores at the roof and at the floor having a rectangular cross-section remain uncut. The reason is that cutting bits of the cutting drums extend beyond the core breakers. It was found that those cores may negatively affect the mining operation. On the one hand, the remaining floor material cores prevent the loading tray or ramp to fully contact the floor. Instead, the material loading ramp rests on the material cores on the floor with the result that the cut material cannot be completely loaded. On the other hand, the material cores at the roof favor the initiation and formation of cracks, which increases the risk of roof collapses.

[0014] Accordingly, herein it is suggested to provide pivotable cutting tools at outer circumferential faces of the cutting drums. The pivotable cutting tools can be pivoted into working positions in the interspaces between the cutting drums to cut material such that no material cores remain at the roof, the mine face and the floor. Additionally, the pivotable cutting tools can pivot back into a resting position, in which the cutting tools do not substantially extend into the interspaces to prevent a collision with a boom arm for rotatably supporting the cutting drums.

[0015] Referring to the drawings, and particularly to Figs. 1 and 2, a continuous mining machine (continuous miner) for use in underground mines to extract material from a mine face is generally designated by numeral 10.

[0016] Continuous mining machine 10 includes a mobile frame assembly 12 longitudinally extending between a front end portion 14 and a rear end portion 16. Mobile frame assembly 12 includes a traction unit 18 with a crawler chain 20 at each longitudinal side for propelling continuous mining machine 10.

[0017] Continuous mining machine 10 also includes a boom assembly 22 supporting a cutting drum assembly 24 at a front end portion 26. Boom assembly 22 is attached on one end to front end portion 14 of mobile frame assembly 12. Specifically, boom assembly 22 is pivotably connected to front end portion 14 to allow pivoting boom assembly 22 about a boom pivot axis B being substantially perpendicular to a longitudinal axis A of continuous mining machine 10. Said connection allows to swing boom assembly 22 and cutting drum assembly 24 in a vertical direction between a ground cut position and a roof cut position (indicated by dashed lines in Fig. 2).

[0018] In the shown embodiment, cutting drum assembly 24 includes three rotatable cutting drums 24A to 24C for extracting material from a mine face. Cutting drum assembly 24 is described in detail when referring to Figs. 3 and 4.

[0019] Continuous mining machine 10 includes a loading ramp or tray 28 positioned generally below boom assembly 22 and cutting drum assembly 24. In operation, loading ramp 28 collects material removed from the mine face by cutting drums 24A to 24C. Two rotatable collector wheels 30, 32 are mounted to loading ramp 28 to gather material. The material loaded onto loading ramp 28 is then directed to a longitudinally extending conveyor 31 of continuous mining machine 10.

[0020] Conveyor 31 may be configured as a chain scraper conveyor, and extends from front end portion 14 in direction to rear end portion 16 and beyond to transport material from loading ramp 28 to a desired location below a rear end portion 33 of conveyor 31. In some embodiments, conveyor 31 may be pivotably connected to mobile frame 12 to allow pivoting the same in a vertical direction as indicated in Fig. 2 and/or to allow pivoting the same in a horizontal direction (not shown in the Figs.).

[0021] Referring to Fig. 3, a cut view through boom assembly 22 along line C-C as depicted in Fig. 2 is shown that provides a view onto outer circumferences of first outer cutting drum 24A, central cutting drum 24B, and second outer cutting drum 24C.

[0022] First outer cutting drum 24A, central cutting drum 24B and second outer cutting drum 24C are aligned with respect to a central longitudinal axis D, and rotatably supported by boom end portions 26 for rotating about central axis D. Cutting drums 24A - 24C are operatively coupled to at least one cutter drive motor (not shown) via drive shafts 27 that rotate cutting drums 24A to 24C. Drive shafts 27 are rotatably mounted in boom end portions 26.

[0023] In some embodiments, the cutter drive motor may be a hydraulic motor or an electric motor that may be powered by an internal power source of continuous mining machine 10, such as an internal combustion engine, and/or an external power source being arranged remote from continuous mining machine 10.

[0024] Cutting drums 24A to 24C each comprise an outer circumferential face 34 extending between a respective first end face 36 and a respective second end face 38 about a central longitudinal axis D. The cutting drums 24A to 24C are equipped with a plurality of cutting tools 40, for example picks, mounted to the respective outer circumferential face 34 in a distributed manner. For the sake of clarity, in Fig. 3, not each and every cutting tool 40 is depicted, but merely one exemplary cutting tool 40 is shown. The presence and distribution of the remaining cutting tools is indicated by a plurality of cutting bit tips 42 of those cutting tools. For example, cutting tools

40 may be spirally distributed over the respective outer circumferential face 34.

[0025] In some embodiments, cutting drums of the cutting drum assembly may not have a common central axis as exemplary disclosed herein. For example, rotation axes of the cutting drums may be (slightly) angled to one another.

[0026] Cutting tools 40 may each include a replaceable cutting bit 44 with the respective cutting bit tip 42, and a cutting bit holder 46 for receiving cutting bit 44. Cutting bit holders 46 are secured to outer circumferential face 34, for example by a weld joint or a plurality of bolts (not shown).

[0027] As can be seen in Figs. 1 and 3, first outer cutting drum 24A, central cutting drum 24B and second outer cutting drum 24C are arranged spaced apart from one another. The interspaces between adjacent cutting drums are required for mounting cutting drum assembly 24 to boom end portions 26. For example, depending on the overall dimensions of cutting drum assembly 24, a clearance between first end face 36 of first outer cutting drum 24A and first end face 36 of central cutting drum 24B may be within a range between 200 mm and 300 mm.

[0028] Cutting tools 40, which are fixedly mounted to outer circumferential faces 34 of cutting drums 24A to 24C, do not reach into the interspace between neighboring cutting drums. As described in the following, a plurality of pivot cutter units 50, 52 are provided for pivoting into the interspace for cutting the material cores at the roof, the mine face, and the floor, which remain uncut by cutting tools 40.

[0029] Pivot cutter units 50 and 52 each include a pivotable support arm (cutter arm) 54. Support arm 54 is pivotably mounted to outer circumferential face 34 of a respective cutting drum to pivot between a working position and a resting position about a pivot axis E, which extends perpendicular to central axis D. Support arm 54 includes a tool holder 55 and a replaceable cutting tool 56 received by tool holder 55. In the working position (not shown in Fig. 3), cutting tool 56, for example a pick, is positioned beyond the confines of an adjacent cutting drum end face 36 or 38 in a direction of central axis D and away from the respective other, remote cutting drum end face 36 or 38. On the other hand, in the resting position (shown in Fig. 3), cutting tool 56 is positioned within the confines of circumferential face 34 with respect to central axis D. In other words, cutting tools 56 are positioned in the interspaces between neighboring cutting drums in their working positions, and cutting tools 56 are not positioned in said interspaces in their resting positions. As used herein, the interspaces radially extend from central axis D in the clearance region between two neighboring cutting drums.

[0030] For example, cutting tool 56 supported by support arm 54 of first pivot cutter unit 50 is positioned in the interspace between central cutting drum 24B and second outer cutting drum 24C in the working position, and is pivoted inwards to be positioned within the confines of circumferential face 34 of central cutting drum 24B with respect to central axis D in the resting position. Similarly, cutting tool 56 supported by support arm 54 of second pivot cutter unit 52 is positioned in the interspace between central cutting drum 24B and first outer cutting drum 24A in the working position, and is pivoted inwards to be positioned within the confines of circumferential face 34 of central cutting drum 24B in the resting position.

[0031] Support arms 54 are guided between working and resting positions by a respective guiding member 58. In the shown embodiment of Fig. 3, guiding member 58 is integrally formed with support end portion 26 of boom assembly 22 to provide a particular guiding contour. Said guiding contour guides support arm 54 out of engagement with the material as support arm 54 approaches support end portion 26 during a rotation of the respective cutting drum, holds support arm 54 in the resting position as the same passes support end portion 26, and guides support arm 54 back into engagement with the material as the same moves away from support end portion 26.

[0032] Guiding members 58 ensure that support arms 54 are pivoted in their resting positions to prevent a collision with a respective boom end portion arm 26, which extends in the interspace between neighboring cutting drums and rotatably supports drive shaft 27 therein. Cutting tools 56 are pivoted into the working position if facing away from boom assembly 22, in other words, facing in direction to the working face to extract material therefrom.

[0033] In some embodiments, guiding members 58 may guide support arms 54 for about a half turn about central axis D in the resting position and may allow support arms 54 to pivot in the working position for the other half turn about central axis D.

[0034] As is further indicated in Fig. 3, pivot cutter units 50, 52 are configured such that, in the working position, cutting tips 57 of cutting tools 56 in the interspaces between neighboring cutting drums 24A, 24B and 24C complete the uniform distribution of cutting tips 42 along cutting drum assembly 24 with respect to radial positions relative to central axis D and/or distance to one another measured in direction of central axis D (indicated in Fig. 3 by the uniform distribution of cutting tips 42, 57 schematically depicted below and above cutting drum assembly 24).

[0035] Pivot cutter units 50, 52 are fastened to end sections of outer circumferential faces 34 via a respective base plate 60. In the shown embodiment of Fig. 3, base plates 60 are fastened by means of a plurality of bolts or screws to respective outer circumferential faces 34. Alternatively or additionally, any other known fastening mechanism may be used to fixedly attach the base plates to the outer circumferential faces of the cutting drums, for example weld joints.

[0036] In some embodiments, a plurality of pivot cutter units 50, 52 may be mounted to the same outer circumferential face adjacent the same cutting drum end face in an equidistant arrangement to one another about the

central axis D. For example, first outer cutting drum 24A may be equipped with two, three or four pivot cutter units 50 arranged adjacent first end face 36 of cutting drum 24A.

[0037] Furthermore, in some embodiments, pivot cutter units 50, 52 of neighboring cutting drums may be arranged in a phase-shifted arrangement (not shown in Fig. 3). For example, in embodiments in which first outer cutting drum 24A has two first pivot cutter units 50 arranged adjacent first end face 36 in an equidistant arrangement to one another about central axis D, and central cutting drum 24B has two second pivot cutter units 52 arranged adjacent second end face 38 in an equidistant arrangement to one another about central axis D, one pivot cutter unit of the group of first and second cutter units 50, 52 may be arranged every 90° about central axis D, in other words, every quarter circle.

[0038] Still further, depending on the dimension of the interspace, it may be sufficient to provide pivot cutter units at one of two neighboring cutting drums only, and/or to provide more than one cutting tool at one support arm.

[0039] Depending on the size of base plate 60 and the configuration of cutting drums 24A - 24C, base plate 60 may include an arcuate bottom contact face (not shown) for matching with outer circumferential faces 34.

[0040] Support arms 54 are pivotably connected to base plates 60 via a respective pivot mechanism and preloaded in the working position via a preload mechanism. Examples of said pivot and preload mechanisms include, but are not limited to, the exemplary embodiment shown in Fig. 4.

[0041] Referring to Fig. 4, a first support arm end 66 of support arm 54 is pivotably mounted to base plate 60 via a bearing 68 and a bearing sleeve 70 fixedly attached to base plate 60. For example, bearing 68 may be a slide bearing or a roller bearing.

[0042] Additionally, support arm 54 is preloaded in the working position by a torsion spring 72 arranged in an interior of bearing sleeve 70. A bottom end of torsion spring 72 is fastened to base plate 60. A torsion spring nose 74 of torsion spring 72 is provided for connection with a cover member (not shown) of support arm 54. For preloading support arm 54, the cover member engaging with torsion spring nose 74 is turned about pivot axis E and bolted or screwed to fastening openings 76 to apply a preload against support arm 54, which presses the same against an end stop or end plate 78 in the working position. End stop 78 may be positioned adjacent to a respective cutting drum end face 36 or 38. For example, end stop 78 of first pivot unit 50 of central cutting drum 24B may be positioned adjacent to first end face 36 of central cutting drum 24B (see Fig. 3).

[0043] At a second end portion 80 of support arm 54 opposite to first end portion 66, cutting tool 56 is provided. Additionally, a guide element 82 such as a rolling element may be included in second end portion 80 of support arm 54. Rolling element 82 and guide member 58 (see Fig. 3) may interact to smoothly guide support arm 54 into the resting position.

Industrial Applicability

[0044] In the following, operation of continuous mining machine 10 is described with particular regard to pivot cutter units 50, 52 under reference to Figs. 1 to 4.

[0045] In mining operation, continuous miner 10 pivots drum assembly 24 via boom assembly 22 up and down (see Fig. 2). Cutting drums 24A - 24C are rotated about central axis D, and cutting tools 40 perform cutting work at the mine face. Additionally, cutting tools 56 of pivot cutter units 50, 52 are pivoted into the interspaces between cutting drums 24A - 24C by the preload applied by torsion spring 72 as soon as guiding member 58 allows pivoting when the respective pivot cutter unit 50, 52 has passed the respective boom support end 26 for preventing a collision. Cutting tools 56 cut the material core at the roof, the floor, and the mine face, which remain uncut by cutting tools 40, during about a half turn of the respective cutting drum about central axis D. Thereafter, pivot cutting units 50, 52 are guided into their resting position by guiding member 58 against the preload applied by torsion spring 72 for about a half turn for preventing any collision with boom end support 26.

[0046] It should be noted that although the cutting drum and cutting drum assembly is particularly suitable for integration in a continuous mining machine used for room and pillar mining or for driving tunnels in longwall mining applications, other mobile mining and milling machines may include the systems as disclosed herein for obtaining the same and/or further advantages. For example, the system(s) as disclosed herein may be implemented in surface miners and road mills etc.

[0047] Although the preferred embodiments of this invention have been described herein, improvements and modifications may be incorporated without departing from the scope of the following claims.

Claims

1. A cutting drum (24A; 24B; 24C) for a mobile mining machine (10), the cutting drum (24A; 24B; 24C) comprising:

   an outer circumferential face (34) extending between a first end face (36) and a second end face (38) about a central longitudinal axis (D);
   a plurality of cutting tools (40) mounted to and distributed over the outer circumferential face (34); and
   at least one first support arm (54) including a cutting tool (56) and being pivotably mounted to the outer circumferential face (34), the first support arm (54) being pivotable into a working position, in which the cutting tool (56) of the first support arm (54) is positioned beyond the first

end face (36) in a direction of the central longitudinal axis (D) and away from the second end face (38).

2. The cutting drum (24A; 24B; 24C) of claim 1, wherein the at least one first support arm (54) is pivotable between the working position and a resting position, in which the cutting tool (56) of the first support arm (54) is substantially positioned within the confines of the outer circumferential face (34) with respect to the central longitudinal axis (D).

3. The cutting drum (24B) of claim 1 or claim 2, further comprising at least one second support arm (54) including a cutting tool (56) and being pivotably mounted to the outer circumferential face (34), the second support arm (54) being pivotable between a working position, in which the cutting tool (56) of the second support arm (54) is positioned beyond the second end face (38) in the direction of the central longitudinal axis (D) and away from the first end face (36).

4. The cutting drum (24B) of claim 3, wherein the at least one second support arm (54) is pivotable between the working position and a resting position, in which the cutting tool (56) of the second support arm (54) is substantially positioned within the confines of the outer circumferential face (34) with respect to the central longitudinal axis (D).

5. The cutting drum (24A; 24B; 24C) of any one of the preceding claims, wherein each support arm (54) is pivotable about a respective pivot axis (E) being substantially perpendicular to the central longitudinal axis (D).

6. The cutting drum (24A; 24B; 24C) of any one of the preceding claims, further comprising a preload mechanism (72, 74) for each support arm (54), the preload mechanism (72, 74) being configured to preload the respective support arm (54) into the working position, for example, the preload mechanism including a torsion spring (72) applying a preload onto the support arm (54).

7. The cutting drum (24A; 24B; 24C) of any one of the preceding claims, wherein:

the first support arms (54) are equidistantly arranged with respect to one another about the central longitudinal axis (D) on the outer circumferential face (34), particularly adjacent to the first end face (36); and/or
the second support arms (54) are equidistantly arranged with respect to one another about the central longitudinal axis (D) on the outer circumferential face (34), particularly adjacent to the second end face (38).

8. The cutting drum (24A; 24B; 24C) of any one of the preceding claims, wherein each support arm (54):

extends between a first end portion (66) and a second end portion (80);
is pivotably mounted to the outer circumferential face (34) at the first end portion (66) of the support arm (54); and
includes a guiding element (82), particularly a rolling element, at the second end portion (80) of the support arm (54) for contacting a guiding member (58).

9. A cutting drum assembly (24) for a mobile mining machine (10), the cutting drum assembly (24) comprising:

a plurality of cutting drums (24A, 24B, 24C) connected side by side, wherein at least one of the plurality of cutting drums (24A, 24B, 24C) is configured according to any one of the preceding claims, with the cutting tool (56) of the at least one first support arm (54) being pivotable into the working position, which is positioned between the neighboring cutting drums in the direction of the central longitudinal axis (D).

10. The cutting drum assembly (24) of claim 9, further comprising a guiding member (58) arranged in an interspace between neighboring cutting drums and being configured to guide the first support arm (54) between the working position and the resting position as the respective cutting drum (24A, 24B, 24C) rotates.

11. The cutting drum assembly (24) of claim 10, wherein the guiding member (58) is configured to guide the at least one support arm (54) for substantially a half turn of the respective cutting drum (24A, 24B, 24C) in the working position, and for substantially the other half turn of the respective cutting drum (24A, 24B, 24C) in the resting position.

12. The cutting drum assembly (24) of any one of claims 9 to 11, wherein the support arms (54) of neighboring cutting drums, which are pivotable into respective working positions between the neighboring cutting drums, are arranged in a phase-shifted arrangement with respect to one another.

13. The cutting drum assembly (24) of any one of claims 9 to 12, wherein the plurality of cutting drums (24A, 24B, 24C) comprises:

a first outer cutting drum (24A), with at least one first support arm (54) being pivotable into the working position, which is positioned between the first outer cutting drum (24A) and a central

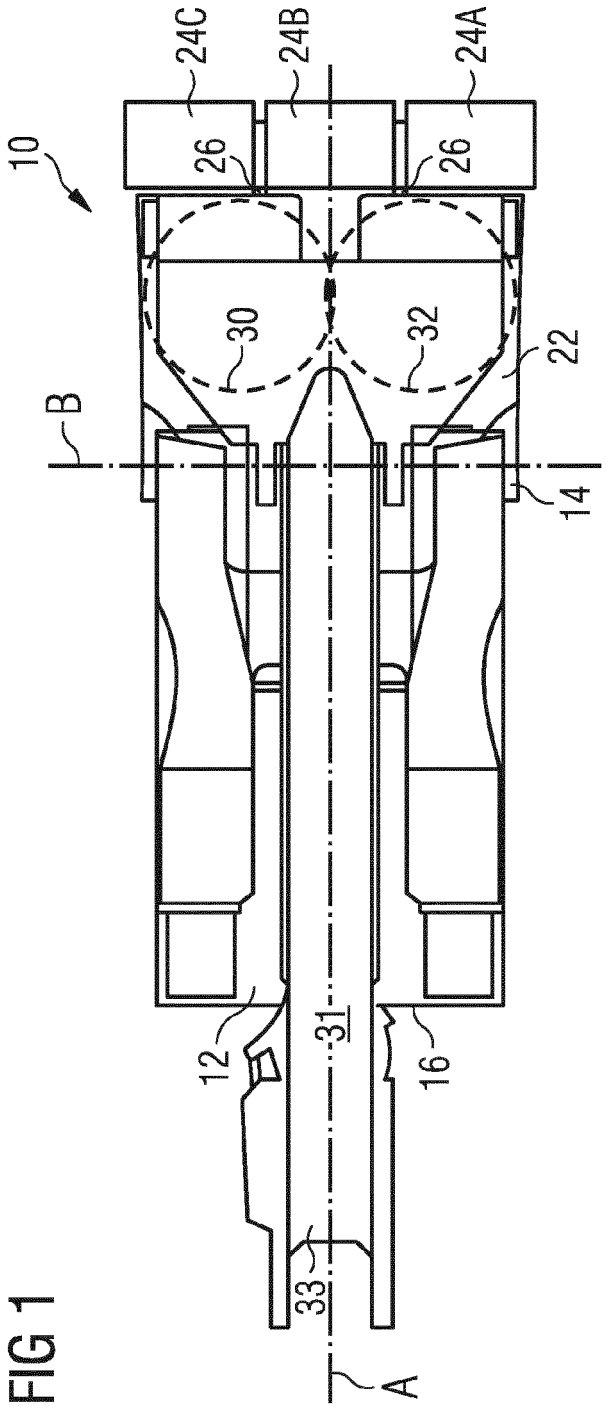
cutting drum (24B) in the direction of the central longitudinal axis (D) of the first outer cutting drum (24A);
the central cutting drum (24B), with:

at least one first support arm (54) being pivotable into the working position, which is positioned between the first outer cutting drum (24A) and the central cutting drum (24B) in the direction of the central longitudinal axis (D) of the central cutting drum (24B); and
at least one second support arm (54) being pivotable into the working position, which is positioned between the central cutting drum (24B) and a second outer cutting drum (24C) in the direction of the central longitudinal axis (D) of the central cutting drum (24B);

the second outer cutting drum (54), with at least one first support arm (54) being pivotable into the working position, which is positioned between the central cutting drum (24B) and the second outer cutting drum (24C) in the direction of the central longitudinal axis (D) of the second outer cutting drum (24C).

14. A mobile mining machine (10), particularly a continuous mining machine, comprising a cutting drum (24A; 24B; 24C) according to any one of claims 1 to 8 or a cutting drum assembly (24) according to any one of claim 9 to 13.

15. The mobile mining machine (10) of claim 14, further comprising a boom assembly (22) including a support end portion (26) for rotatably supporting the cutting drum assembly (24), wherein the guiding member (58) is configured to guide the respective support arm (54) into the resting position as the respective support arm (54) passes the support end portion (26) of the boom assembly (22) during a rotation of the respective cutting drum (24A; 24B; 24C).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24C
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FIG 1

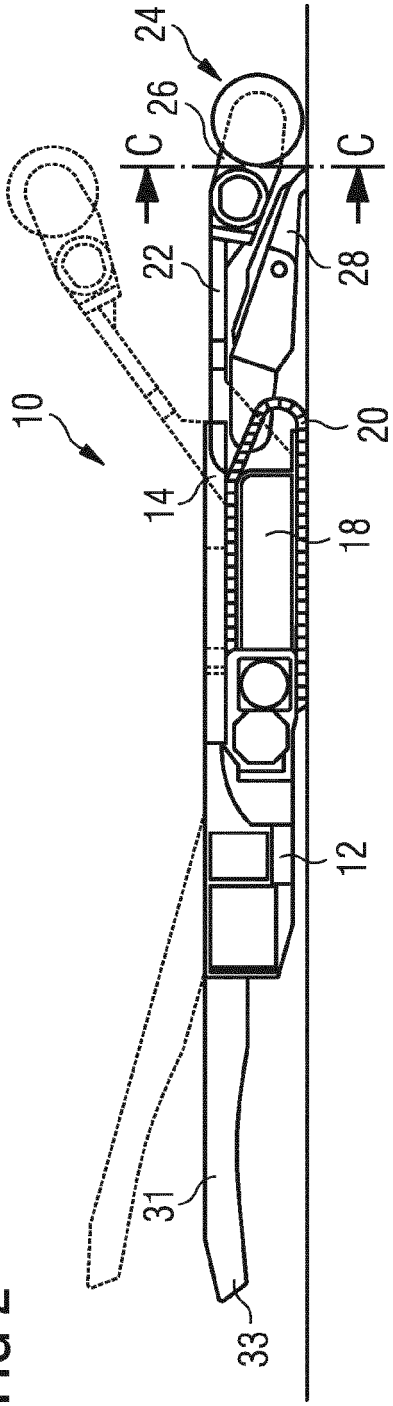
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FIG 2

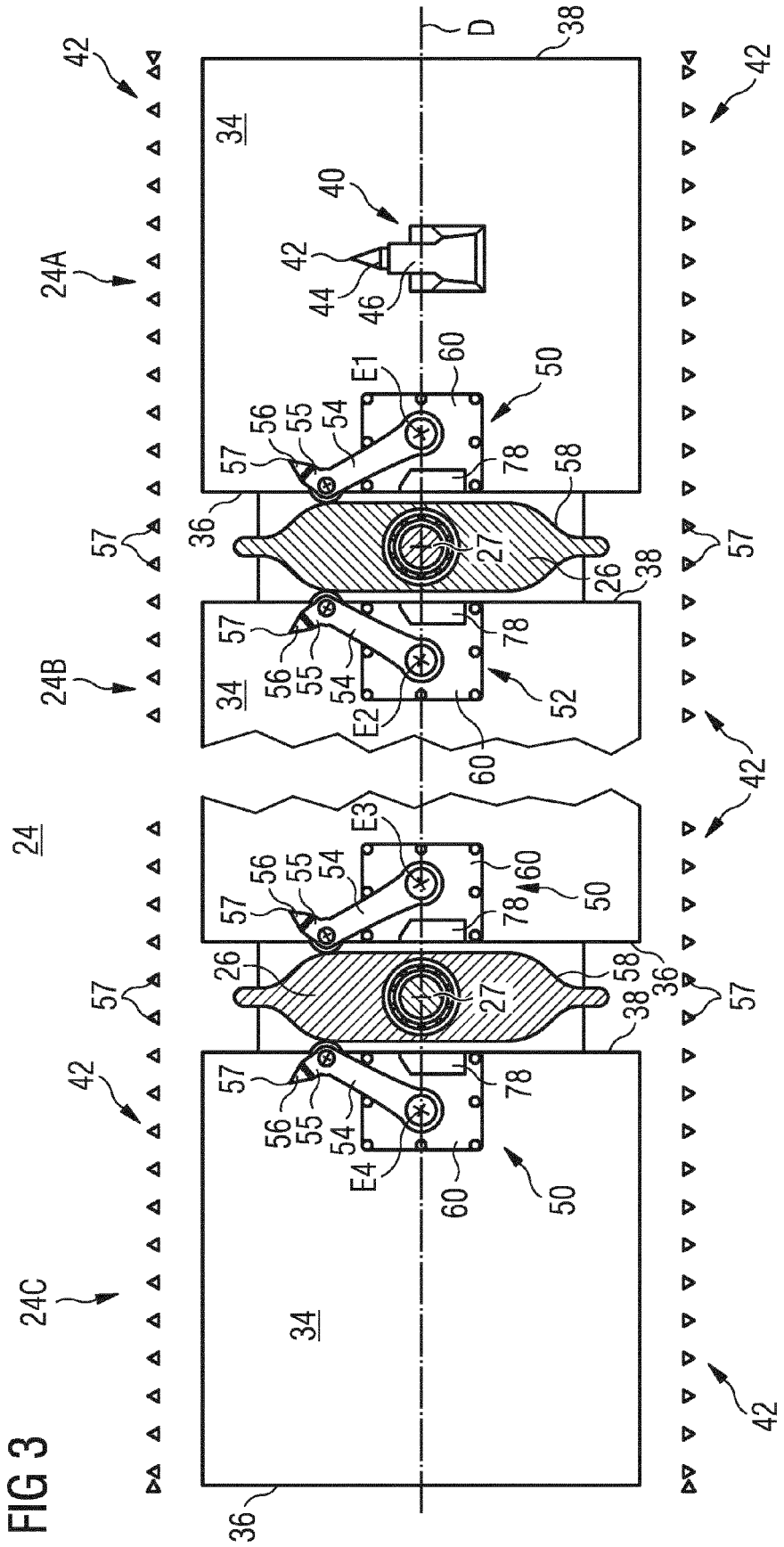
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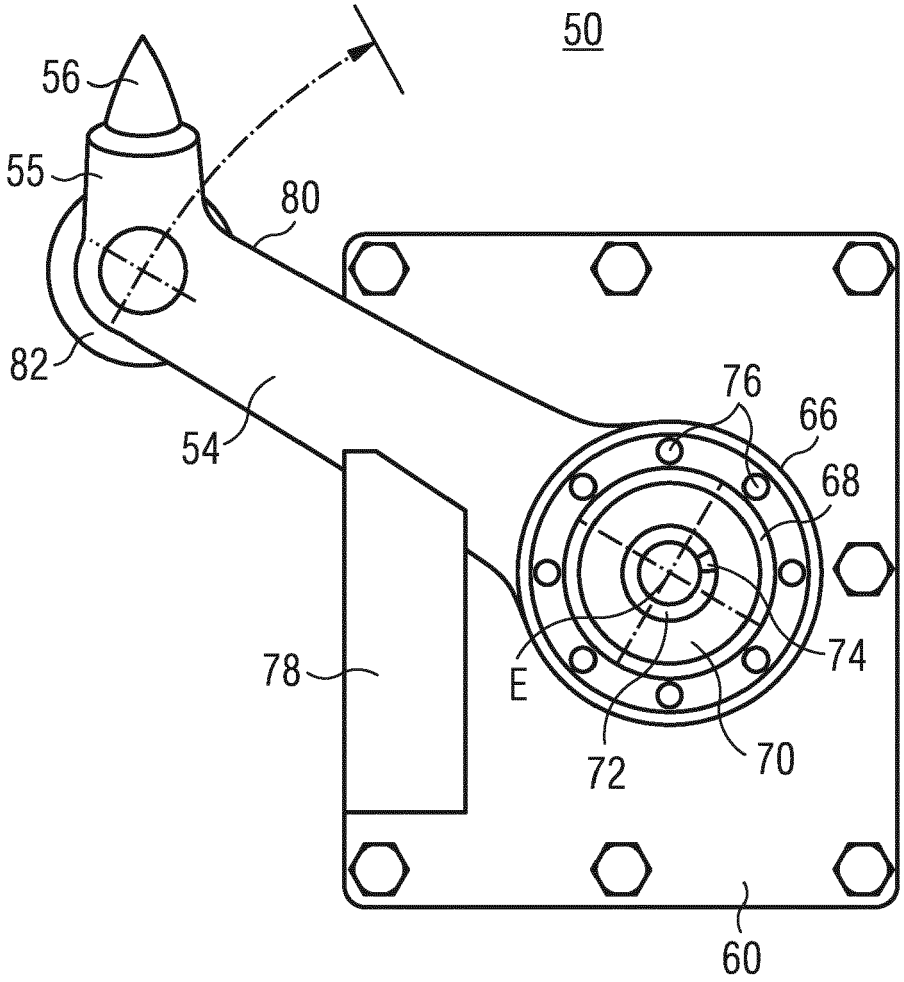
FIG 3

FIG 4



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EUROPEAN SEARCH REPORT

Application Number
EP 15 18 0016

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 37 37 864 A1 (GEWERK EISENHUETTE WESTFALIA [DE]) 18 May 1989 (1989-05-18) * figures 1-3 * * the whole document * * Rückstellfedern; Ruhestellung; column 2, lines 50-54 *	1-12,14, 15	INV. E21C25/10 E21C27/24 E21D9/10 E02F3/20
X	US 4 391 472 A (KREKELER CLAUDE B) 5 July 1983 (1983-07-05) * column 3, lines 17-24; figures 2,3,5,7-9 * * the whole document *	1-15	
X	EP 1 350 893 A1 (SPIE FOND S [FR]) 8 October 2003 (2003-10-08) * the whole document *	1-12,14, 15	
X	US 3 290 099 A (LUNDQUIST RICHARD C) 6 December 1966 (1966-12-06) * claim 6; figure 1 * * the whole document *	1	
			TECHNICAL FIELDS SEARCHED (IPC) E21C E21D E02F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	9 February 2016	van Berlo, André

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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