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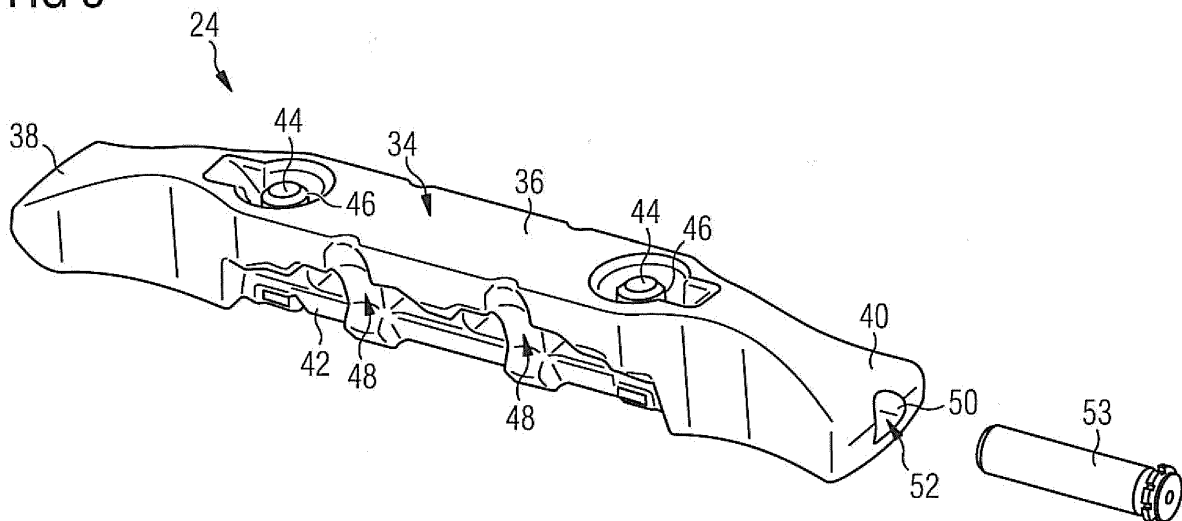
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(54) **Device and method for longwall installation course determination**

(57) The present disclosure relates to a device and method for position and orientation measurements of a longwall mining installation (1). Specifically, a course measuring flight bar (24) for a chain conveyor (8) of a longwall mining installation (1) is disclosed. The course measuring flight bar (24) comprises a chain mount (48)

for mounting the course measuring flight bar (24) to a conveyor chain (17) of the chain conveyor (8). The course measuring flight bar (24) further comprises a course measuring device (52) for measuring a position and/or an orientation of the course measuring flight bar (24).

FIG 3



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Description

Technical Field

[0001] The present disclosure relates to longwall mining installations in underground mines, and, more particularly, to a device and method for measuring a course of a longwall mining installation extending along a longwall face.

Background

[0002] In longwall mining, a longwall mining installation extends along a longwall face to extract material therefrom, and subsequently advances in a working direction perpendicular to the longwall face. During each advancing step, the components of the longwall mining installation such as a face conveyor and shield supports move towards the longwall face.

[0003] For monitoring and/or controlling purposes, it is generally desirable to know the exact position and orientation of the longwall mining components along the longwall face. Accordingly, mining equipment manufacturers developed several position and/or orientation measuring systems for the longwall mining installation in the past.

[0004] For example, EP 2 446 207 A2 of Caterpillar Global Mining discloses a method and apparatus for determining the position and/or situation of installation components of a longwall mining installation. A measuring system may include a detection unit with measurement sensor. The detection unit may be movable to and fro between two points of a guiding system along at least one installation component at the longwall face. The movement of the detection unit as disclosed in EP 2 446 207 A2 is decoupled from an extraction machine.

[0005] Further examples of position measuring units are discussed in DE 1 246 647 A and GB 2 263 292 A.

[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 course measuring flight bar for a chain conveyor of a longwall mining installation is disclosed. The chain conveyor may include a first conveyor chain. The course measuring flight bar may comprise a main body, a first chain mount for mounting the course measuring flight bar to the first conveyor chain, and a course measuring device for measuring a position and/or an orientation of the course measuring flight bar. The course measuring device may be integrated in the main body.

[0008] In another aspect of the present disclosure, a chain conveyor for a longwall mining installation is disclosed. The chain conveyor may comprise a plurality of flight bars, at least one of which being a course measuring

flight bar as exemplary disclosed herein.

[0009] In yet another aspect of the present disclosure, a longwall mining installation is disclosed. The longwall mining installation may comprise a chain conveyor as exemplary disclosed herein for arranging along a longwall face for transporting away extracted material. The longwall mining installation may further comprise an extraction machine for extracting material from the longwall face, and a remote control unit. The remote control unit may be configured to receive position and/or orientation measurements from at least one course measuring flight bar of the chain conveyor, and to determine a course of the chain conveyor along the longwall face based on a plurality of received position and/or orientation measurements. The remote control unit may be further configured to output the determined course of the chain conveyor to a display device, to control advancing of the longwall mining installation in a working direction based on the determined course of the chain conveyor, and/or to control the extraction machine based on the determined course of the chain conveyor.

[0010] According to yet another aspect of the present disclosure, a method for measuring a course of a chain conveyor along a longwall face is disclosed. The chain conveyor may comprise at least one flight bar as exemplary disclosed herein. The method may comprise operating the chain conveyor, and during operating the chain conveyor, measuring at least one position and orientation of the at least one flight bar by the course measuring device.

[0011] Other features and aspects of this disclosure will be apparent from the following description and the accompanying drawings.

Brief Description of the Drawings

[0012] 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 is a schematic drawing of an exemplary longwall mining installation;

Fig. 2 is a perspective view of a conventional flight bar;

Fig. 3 is a perspective view of a course measuring flight bar according to the present disclosure;

Fig. 4 is a perspective view of another embodiment of a course measuring flight bar according to the present disclosure; and

Fig. 5 is a schematic drawing of a course measuring system according to the present disclosure.

Detailed Description

[0013] The following is a detailed description of exemplary embodiments of the present disclosure. The exem-

plary 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.

[0014] The present disclosure is based in part on the realization that a measuring device may be integrated in a flight bar of a chain conveyor to form a course measuring flight bar. The course measuring flight bar is - similar to conventional flight bars - fastened to at least one conveyor chain of the chain conveyor. Thus, the course measuring flight bar revolves with the conveyor chain(s) in an upper strand and a lower strand of the chain conveyor, and, thereby, measures a course of the chain conveyor along the longwall face. In particular, a combination of a plurality of measurements acquired by the measuring flight bar during travel in the upper strand and lower strand of the chain conveyor, respectively, may be combined to determine the course of the chain conveyor along the longwall face.

[0015] As used herein, the term "course" relates to a plurality of spacial positions and spacial orientations (also referred to as poses) representing a spacial route (path) along which a respective component such as a conveyor extends.

[0016] In the following, a longwall mining installation utilizing a measuring flight bar is described in connection with Fig. 1. Thereafter, a conventional flight bar is described with reference to Fig. 2, and two embodiments of a course measuring flight bar are described with reference to Figs. 3 and 4. Under specific reference to Fig. 5, an exemplary course measuring device is explained.

[0017] Referring to Fig. 1, a longwall mining installation is referred to in its entirety by reference numeral 1. Longwall mining installation 1 extends along a longwall face 2, and comprises a plurality of installation components such as an extraction machine 4, shield supports 6, and a face conveyor 8.

[0018] In operation, extraction machine 4 cuts along longwall face 2 in a reciprocating manner to extract material 10, for example, coal. As an example, extraction machine 4 may be a shearer, a mining plow or a hard rock cutter.

[0019] To maintain longwall face 2 accessible, shield supports 6 are arranged in series along the longwall face 2. Surrounding rock can only break in and form the so-called old workings after advancing of shield supports 6.

[0020] Moving devices 12 are connected between shield supports 6 and face conveyor 8. Said moving devices 12 may comprise a pushing or walking bar, which is hydraulically loadable in two directions. In case moving device 12 is loaded in one of the two possible directions, a respective face conveyor segment 9 of face conveyor

8 is pushed forward in a work direction (indicated by an arrow A in Fig. 1). If loaded in the other one of the two possible directions, moving device 12 pulls up individual shield supports 6 in work direction (arrow A).

[0021] Material mined by extraction machine 4 drops onto face conveyor 8, which transports the extracted pieces of rock and minerals to a main roadway 14 (also referred to as drift). There, the extracted pieces are passed to a pass-over conveyor or roadway conveyor 16. The transported pieces may be crushed and further transported via, for example, a belt conveyor.

[0022] Particularly, face conveyor 8 extends along longwall face 2 and builds up of a plurality of face conveyor segments 9. Said face conveyor segments 9 are connected in series so as to resist separation when a tensile force is applied, and to restrict relative angular movement. Face conveyor 8 is formed as a so-called chain conveyor including two conveyor chains 17, which are redirected by sprockets 15 accommodated in respective stations at each end of face conveyor 8. Specifically, conveyor chains 17 are guided in a first direction in an upper strand of face conveyor 8 when transporting material to roadway conveyor 16, and are guided in a second direction, which is oppositely directed to the first direction, in a lower strand of face conveyor 8 during return travel. To drive face conveyor 8, a main drive 18 is arranged in main roadway 14, and an auxiliary drive 20 may be arranged in an auxiliary roadway 22.

[0023] To facilitate a material transport by means of traveling conveyor chains 17 of chain conveyor 8, a plurality of flight bars (scrapers) 23, 24 are fastened at conveyor chains 17 at preset distances. Of the plurality of flight bars 23, 24, at least one flight bar is considered as course measuring flight bar 24, one of which is exemplary shown in Fig. 1. For the purpose of the present disclosure, the remaining flight bars are considered as conventional flight bars 23.

[0024] Course measuring flight bar 24 differs from conventional flight bar 23 at least in that course measuring flight bar 24 is equipped with a course measuring device 52. Course measuring device 52 is configured to transmit position and orientation information of course measuring flight bar 24 to a control unit 68 as is described in greater detail herein later on. The information may be in the form of raw measuring data, and/or may be at least partially preprocessed.

[0025] Referring to Fig. 2, a conventional flight bar 23 is depicted. Conventional flight bar 23 is mountable to two conveyor chains 17 only one of which is exemplary shown in Fig. 2 in a simplified manner by way of three chain links 28, 30, 32 for the purpose of clarity.

[0026] Conventional flight bar 23 comprises a main body 34. Said main body 34 includes a top web 36, a first and second flight bar wing 38 and 40 at each end, and a clamp 42. Flight bar wings 38, 40 may be integrally formed with top web 36. Clamp 42 is mounted below an underside of top web 36, for example, by means of a screw mechanism.

[0027] In the shown embodiment of Fig. 2, the screw mechanism consists of threaded shanks 44 and fastening nuts 46. For mounting clamp 42 below top web 36, threaded shanks 44 are inserted into aligned through-holes in clamp 42 and top web 36, respectively. Fastening nuts 46 are screwed onto threaded shanks 44 to rigidly connect clamp 42 to top web 36.

[0028] In an assembled state, in which clamp 42 is attached to top web 36, both clamp 42 and top web 36 form two chain mounts 48 between one another for mounting conventional flight bar 23 to two conveyor chains 17, only one of which is shown in Fig. 2.

[0029] Referring to Fig. 3, course measuring flight bar 24 is shown. Similar to conventional flight bar 23 of Fig. 2, course measuring flight bar 24 of Fig. 3 includes main body 34 with top web 36, first and second flight bar wing 38 and 40 at each end, and clamp 42. Likewise, clamp 42 is mounted to top web 36 via threaded shanks 44 and fastening nuts 46.

[0030] As outlined before, course measuring flight bar 24 of Fig. 3 differs from conventional flight bar 23 of Fig. 2 in that course measuring flight bar 24 is provided with course measuring device 52.

[0031] Course measuring device 52 is integrated in main body 34 of course measuring flight bar 24. In particular, course measuring device 52 may be integrated in, for example, top web 36, first flight bar wing 38, second flight bar wing 40, clamp 42, or threaded shank 44.

[0032] In some embodiments - as the one shown in Fig. 3 - , but not necessarily, course measuring device 52 may be provided in a cartridge 53, which is insertable into a cartridge cradle 50 in course measuring flight bar 24.

[0033] Cartridge 53 is exemplary depicted in Fig. 3 in a separate view next to course measuring flight bar 24 in a not inserted state. For example, cartridge 53 may be securable in cartridge cradle 50 by means of a screw mechanism, and/or a snap-fit mechanism.

[0034] For example, cartridge 53 may have an outer shape of a cylinder, a polyhedron, or combinations thereof. Likewise, cartridge cradle 50 may be designed with inner faces at least partially matching with the outer shape of respective cartridge 53.

[0035] In the shown embodiment of Fig. 3, cartridge cradle 50 for housing cartridge 53 is disposed in second flight bar wing 40. Alternatively, cartridge cradle 50 may be arranged at any other conceivable location of main body 34 such as top web 36, first flight bar wing 38, second flight bar wing 40, and/or clamp 42. As a further alternative, cartridge 53 and threaded shank 44 may be integrally formed with one another such that aligned through-holes in top web 36 and clamp 42 form a cartridge cradle.

[0036] In Fig. 4, a further embodiment of a course measuring flight bar is referred to with reference numeral 54.

[0037] Course measuring flight bar 54 of Fig. 4 differs from course measuring flight bar 24 of Fig. 3 in that course

measuring flight bar 54 is shorter and provided with one chain mount 48' only. For example, course measuring flight bar 54 may be fastened to the sole conveyor chain of a single chain conveyor (not shown), or to one of conveyor chains 17 of (double) chain conveyor 8 shown in Fig. 1.

[0038] To facilitate course measurements, course measuring device 52' is integrated in main body 34' of course measuring flight bar 54'. Specifically, course measuring device 52' is provided in cartridge 53', which in turn is inserted in cartridge cradle 50'. Said cartridge cradle 50' at least partially extends through top web 36' of main body 34'. As explained, course measuring device 52' may be not necessarily provided in cartridge 53', but may be directly integrated in main body 34', similar to measuring flight bar 24 of Fig. 3 described herein.

[0039] In Fig. 5, course measuring device 52 is depicted. Said course measuring device 52 forms part of a course measuring system 60 further including a remote control unit 68.

[0040] Course measuring device 52 includes a measuring unit 62, a data storage 64, a microprocessor 65, a transmitter 66, and an electric power supply 70.

[0041] Course measuring unit 62 is configured to measure and output any kind of information facilitating position and/or orientation determination of course measuring unit 62, and, thus, of course measuring flight bar 24 or 54.

[0042] In the shown embodiment of Fig. 5, course measuring unit 62 is embodied as inertial measurement unit (often referred to as IMU in literature). The IMU has three accelerometers 72 and three gyroscopes 74. The three accelerometers 72 and three gyroscopes 74 are configured and arranged to measure three accelerations and three angular velocities along three linearly independent axes, respectively.

[0043] In some embodiments, a sensor integrated in position measuring unit 62 may be capable to measure the gravitational direction for providing a reference direction in relation to the direction of the three accelerations and three angular velocities.

[0044] Alternatively or additionally, course measuring unit 62 may include more or less accelerometers, and/or gyroscopes, and/or may include at least one sensor with a different measuring principle, which facilitates position and/or orientation measurements.

[0045] Measured data from course measuring unit 62 is at least temporarily stored in data storage 64. To transmit data between course measuring unit 62 and data storage 64, a wireless or wired connection 76 is provided between the same. For the purpose of storing data, data storage 64 may include any type of temporally, and/or permanent memory known in the art.

[0046] Microprocessor 65 is configured and linked to process any kind of data and to perform any kind of command and operation, which are required for operating course measuring unit 62, data storage 64, transmitter 66, and/or electric power supply 70 as desired.

[0047] Transmitter 66 is capable of transmitting stored data from data storage 64 to remote control unit 68. A wireless or wired connection 78 connects data storage 64 and transmitter 66 to transmit data between both. Alternatively or additionally, transmitter 66 may be able to directly transmit measured data from measuring unit 62 to remote control unit 68 without using an intermediate storage such as data storage 64.

[0048] In some embodiments, transmitter 66 may be integrated with a receiver (not shown in further detail in Fig. 5) to form a so-called transceiver for facilitating bi-directional communication between the transceiver and remote control unit 68. For example, signals sent from remote control unit 68 may indicate that position measurements are required, electric power supply 70 shall switch-off, or data sent by transmitter 66 was not accurately received by control unit 68.

[0049] Electric power supply 70 is provided to energize course measuring unit 62, data storage 64, microprocessor 65, and transmitter 66. Electric power supply 70 may be replaceably provided in cartridge 53, or in flight bar 24 or 54 (see Figs. 3 and 4). Alternatively or additionally, electric power supply 70 may be rechargeable, for example, by means of a vibration powered generator mounted in flight bar 24 or 54, and/or via wireless power transmission. As an example, electric power supply 70 may be a (non-) rechargeable battery.

[0050] In some embodiments, course measuring device 52 may further include a dampening device 82 as schematically indicated by a dashed rectangular in Fig. 5. Dampening device 82 may dampen shocks and vibrations, which may damage any component of course measuring device 52, and/or may degrade the quality of the measurements taken.

[0051] Dampening device 82 may feature any type of active or passive dampening mechanism known in the art. For example, dampening device 82 may be a rubber or a cushion provided about a specific, some, or each component of course measuring device 52 to dampen vibrations and shocks.

[0052] Course measuring device 52, or one, or more components thereof may be included in cartridge 53 described in particular in connection with Fig. 3.

[0053] To receive data via a communication link 80 from transmitter 66, remote control unit 68 is equipped with a receiver. In embodiments with bi-directional communication as explained, remote control unit 68 may further include a transmitter. For example, communication link 80 may be a wireless communication link.

[0054] Remote control unit 68 may be positioned at any suitable location of the longwall mining installation 1 shown in Fig. 1. For example, remote control unit 68 may be arranged next to one of drives 18 and 20 in roadway 14 and 22, respectively. For controlling longwall mining installation 1, remote control unit 68 may be integrated with and/or coupled to a central control unit (not shown in further detail), which may be configured to control the components of longwall mining installation 1 at least in

part.

Industrial Applicability

[0055] The course measuring device as generally disclosed herein is applicable in mining installations. Particularly, the course measuring device is applicable in longwall mining installations extending along a longwall face for the purpose of extracting material therefrom. The longwall mining installation includes a chain conveyor for transporting the extracted material to a roadway.

[0056] In the following, operation of the course measuring device 52 is described with reference to Figs. 1 to 5.

[0057] During operation of longwall mining installation 1, face conveyor 8 transports material extracted by extraction machine 4 to a pass-over station for passing the material to roadway conveyor 16. As face conveyor 8 is embodied as double chain conveyor, two conveyor chains 17 revolve in the upper and lower strand of the same. Fastened to the conveyor chain(s) 17, a plurality of flight bars 23, 24 is provided, at least one of which being a course measuring flight bar 24.

[0058] Course measuring flight bar(s) 24, and, thus, course measuring device(s) 52, travel with conveyor chain 17 and further conventional flights bars 23 of face conveyor 8 during operation. As a result, course measuring flight bar 24 moves in the upper strand of face conveyor 8 in a first direction, which is the material transport direction, and moves in the lower strand of face conveyor 8 in a second direction opposite to the first direction. This allows to continuously determine a three-dimensional position and/or orientation of face conveyor segments 9 connected in series to form face conveyor 8 and passed by course measuring flight bar(s) 24 or 54.

[0059] Specifically, if activated, sensors 72, 74 of course measuring unit 62 continuously measure accelerations and angular velocities, for example, at a rate of 1 kHz or higher. Transmittal of measured data may be performed in a continuous manner, in which as soon as new measurements are taken, the same are transmitted to remote control unit 68 via communication link 80. Alternatively or additionally, measured data may be provided in packages, which may include preprocessed data to reduce package size, at preset timings, and/or upon request from remote control unit 68 or when passing by remote control unit 68.

[0060] Based on the measured accelerations and angular velocities, which are transmitted to remote control unit 68, a position and an orientation of flight bar 24 at the time the measurements were taken are determined, for example, by remote control unit 68, or a specific control unit for processing the position and orientation data.

[0061] Further, based on a plurality of determined positions and orientations received from one or more course measuring flight bars 24 or 54, a course of face conveyor 8 along longwall face 2 is determined. The resolution and accuracy of the determined course of face conveyor 8 along longwall face 2 depends on the number of included

measurements. For example, higher measuring and transmitting frequencies, and/or providing more than one course measuring flight bar 24 or 54 with measuring unit 62 may result in a higher resolution and accuracy of the determined course of face conveyor 8.

[0062] The measurements may be further improved by providing a certain redundancy. For example, course measuring unit 62 may include redundant accelerometers and gyroscopes, and/or several flight bars 24 may be coupled to the conveyor chain(s) 17 of face conveyor 8.

[0063] Naturally, during operation of longwall mining installation 1, the course of face conveyor 8 along face 2 constantly changes due to advancing of longwall mining installation 1 in the working direction (arrow A in Fig. 1) such that the determined course needs to be updated regularly by new measurements from one or more course measuring units 62.

[0064] In some embodiments, the determined course of face conveyor 8, and, thus, longwall mining installation 1 may be visualized via a display to an operator, and/or may be used to control longwall mining installation 1. For example, advancing of longwall mining installation 1 may be controlled based on the determined course of face conveyor 8. In particular, the actual course of face conveyor 8 along longwall face 2 may be adjusted based on the determined course to form a straight line along longwall face 2. Additionally or alternatively, extraction machine 4 may be controlled based on the determined course of face conveyor 8.

[0065] The system for measuring positions and orientations of conveyor segments 9 as disclosed herein may allow a robust determination of the course of face conveyor 8 along longwall face 2 for a couple of reasons.

[0066] For example, the degrees of freedom of the movement of course measuring flight bar 24, and, thus, of course measuring device 52 is limited due to the fixation at conveyor chain(s) 17. Being aware of this, it is clear that the velocity direction of flight bar 24 in a body fixed coordinate system of course measuring flight bar 24 is constant over averaged time. Further, due to the fixation of course measuring flight bar 24 to conveyor chain 17, orientation changes of course measuring flight bar 24, and, thus, course measuring device 52 are limited.

[0067] As a further reason, a multiple measurement of a specific segment 9 of face conveyor 8 by one specific course measuring flight bar 24 is facilitated as course measuring flight bar 24 alternately travels in the upper strand and, in an upside-down state, in the lower strand of face conveyor 8. Naturally, the specific segment 9 of chain conveyor 8 may not be advanced in due time.

[0068] Specifically, a first position and orientation of flight bar 24 during travel in an upper strand of a first conveyor segment 9 of face conveyor 8 may be measured. Then, a second position and orientation of course measuring flight bar 24 during travel in a lower strand of the first conveyor segment 9 of face conveyor 8 may be

measured. Afterwards, the first position and orientation may be averaged with the second position and orientation.

[0069] Knowing that course measuring flight bar 24 travels right way up in the upper strand of face conveyor 8 and upside-down in the lower strand of face conveyor 8, it may be further possible to calibrate sensors 72, 74, and/or to detect inaccurate sensors 72, 74 by comparing measurements of the individual sensors 72, 74 of measuring unit 62.

[0070] Still further, by increasing a number of course measuring flight bars 24, and, thus, course measuring devices 52, the number of available measurements for determining the course of face conveyor 8 may be increased. For example, 5, 10, 15 or even more course measuring flight bars 24 may be connected to conveyor chain(s) 17 of face conveyor 8. The number of course measuring flight bars 24 may also depend on the length of face conveyor 8, wherein as a general rule longer face conveyors 8 may be provided with a higher number of measuring flight bars 24.

[0071] It should be appreciated that the course measuring system for measuring a course of a longwall mining installation along a longwall face as generally disclosed herein, may be also suitable for measuring a course of mining components along the roadway. For example, a roadway conveyor (for example roadway conveyor 16 shown in Fig. 1) may comprise a plurality of flight bars at least one of which being a measuring flight bar as exemplary disclosed herein.

[0072] It is noted that, in some embodiments, data acquisition and/or data processing based on measurements from measuring unit 62 may be conducted in accordance with the method disclosed in EP 2 446 207 A2, which is hereby entirely incorporated herein by reference as being an actual part of the present disclosure.

[0073] According to a further aspect of the present disclosure, a device for measuring a course of a longwall mining installation along a longwall face may comprise a course measuring device accommodated in a housing. The housing may include a chain mount connectable to an extraction machine drive chain, for example, of a mining plow.

[0074] During operation of the longwall mining installation, at least one device travels with the extraction machine drive chain in an upper and/or lower strand of a respective drive chain guidance. As a result, the course of the longwall mining installation can be determined in accordance with the method described herein in connection with measurements taken by course measuring device 52 in flight bar 24 or 54.

[0075] One skilled in the art will appreciate, that embodiments of the course measuring device connected to the extraction machine drive chain may incorporate any feature, and/or feature group as described herein if applicable.

[0076] For example, the course measuring device may be embodied similar to course measuring device 52.

[0077] 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 course measuring flight bar (24) for a chain conveyor (8) of a longwall mining installation (1), the chain conveyor (8) including a first conveyor chain (17), the course measuring flight bar (24) comprising:
 - a main body (34);
 - a first chain mount (48) for mounting the course measuring flight bar (24) to the first conveyor chain (17); and
 - a course measuring device (52) for measuring a position and/or an orientation of the course measuring flight bar (24), the course measuring device (52) being integrated in the main body (34).
2. The course measuring flight bar (24) of claim 1, further comprising:
 - a cartridge cradle (50) integrated in the main body (34); and
 - a cartridge (53) accommodating the course measuring device (52), the cartridge (53) being insertable into the cartridge cradle (50).
3. The course measuring flight bar (24) of claim 2, wherein the cartridge (53) is securable in the cartridge cradle (50) by a screw mechanism, and/or a snap-fit mechanism.
4. The course measuring flight bar (24) of any of the preceding claims, wherein the main body (34) further comprises:
 - a top web (36);
 - a first flight bar wing (38) forming a first end of the main body (34);
 - a second flight bar wing (40) forming a second end of the main body (34); and
 - a clamp (42) mounted to the top web (36), the top web (36) and the clamp (42) being configured to form the first chain mount (48) between one another.
5. The course measuring flight bar (24) of claim 4, wherein the course measuring device (52) is integrated in at least one of the top web (36), the first flight bar wing (38), the second flight bar wing (40), the clamp (42), and/or a threaded shank (44) connecting the clamp (42) and the top web (36).
6. The course measuring flight bar (24) of any one of the preceding claims, wherein the course measuring device (52) comprises an inertial measurement unit (62) with three accelerometers (72) and three gyroscopes (74).
7. The course measuring flight bar (24) of any one of the preceding claims, wherein the course measuring device (52) further comprises at least one of:
 - a transmitter (66) for transmitting data from the measuring unit (62) to a remote control unit (68);
 - a data storage (64) for storing data;
 - a microprocessor (65); and/or
 - an electric power supply (70) for supplying electric power, the electric power supply (70) being replaceable and/or rechargeable.
8. The course measuring flight bar (24) of any one of the preceding claims, the course measuring flight bar (24) further comprising a second chain mount (48) for mounting the course measuring flight bar (24) to a second conveyor chain (17) of the chain conveyor (8).
9. A chain conveyor (8) for a longwall mining installation (1), the chain conveyor (8) comprising a plurality of flight bars (23, 24), at least one of which being a course measuring flight bar (24) according to any one of the preceding claims.
10. The chain conveyor (8) of claim 9, wherein the chain conveyor (8) is formed as a double chain scraper conveyor with two conveyor chains (17).
11. A longwall mining installation (1) comprising:
 - a chain conveyor (8) according to claim 9 or 10 for arranging along a longwall face (2) for transporting away extracted material;
 - an extraction machine (4) for extracting material from the longwall face (2); and
 - a remote control unit (68) configured to receive position and/or orientation measurements from at least one course measuring flight bar (24) of the chain conveyor (8), and to determine a course of the chain conveyor (8) along the longwall face (2) based on a plurality of received position and/or orientation measurements, the remote control unit (68) being further configured to output the determined course of the chain conveyor (8) to a display device;
 - control advancing of the longwall mining installation (1) in a working direction (A) based on the determined course of the chain conveyor (8); and/or
 - control the extraction machine (4) based on the determined course of the chain conveyor (8).

12. A method for measuring a course of a chain conveyor (8) along a longwall face (2), the chain conveyor (8) comprising at least one flight bar (24) according to any one of claims 1 to 8; the method comprising:

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operating the chain conveyor (8); and
 during operating the chain conveyor (8), measuring at least one position and orientation of the at least one flight bar (24) by the course measuring device (52)

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13. The method of claim 12, further comprising:

determining a course of the chain conveyor (8) based on a plurality of measured positions and orientations.

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14. The method of claim 12 or 13, further comprising at least one of:

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controlling advancing of the chain conveyor (8) in a working direction (A) towards the longwall face (2) based on the determined course of the chain conveyor (8);

controlling material extraction from the longwall face (2) based on the determined course of the chain conveyor (8);

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visualizing the determined course of the chain conveyor (8) to an operator; and/or
 calibrating the at least one course measuring flight bar (24).

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15. The method of claim of any one of claims 12 to 14, wherein the step of measuring at least one position and orientation includes:

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measuring a first position and orientation of the flight bar (24) during travel in an upper strand of a first conveyor segment (9) of the chain conveyor (8);

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measuring a second position and orientation of the flight bar (24) during travel in a lower strand of the first conveyor segment (9) of the chain conveyor (8); and

averaging the first position and orientation with the second position and orientation.

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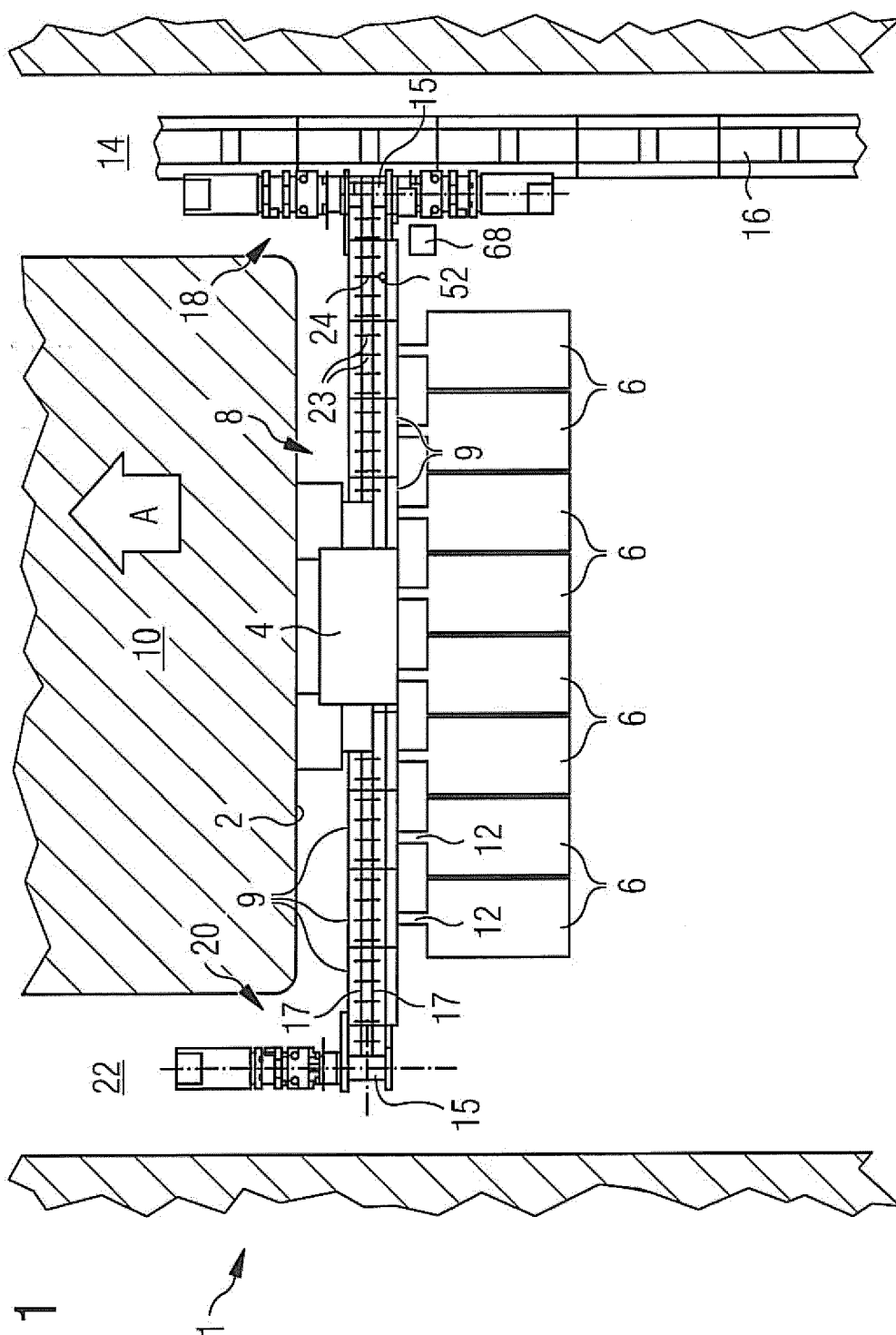


FIG 1

FIG 2

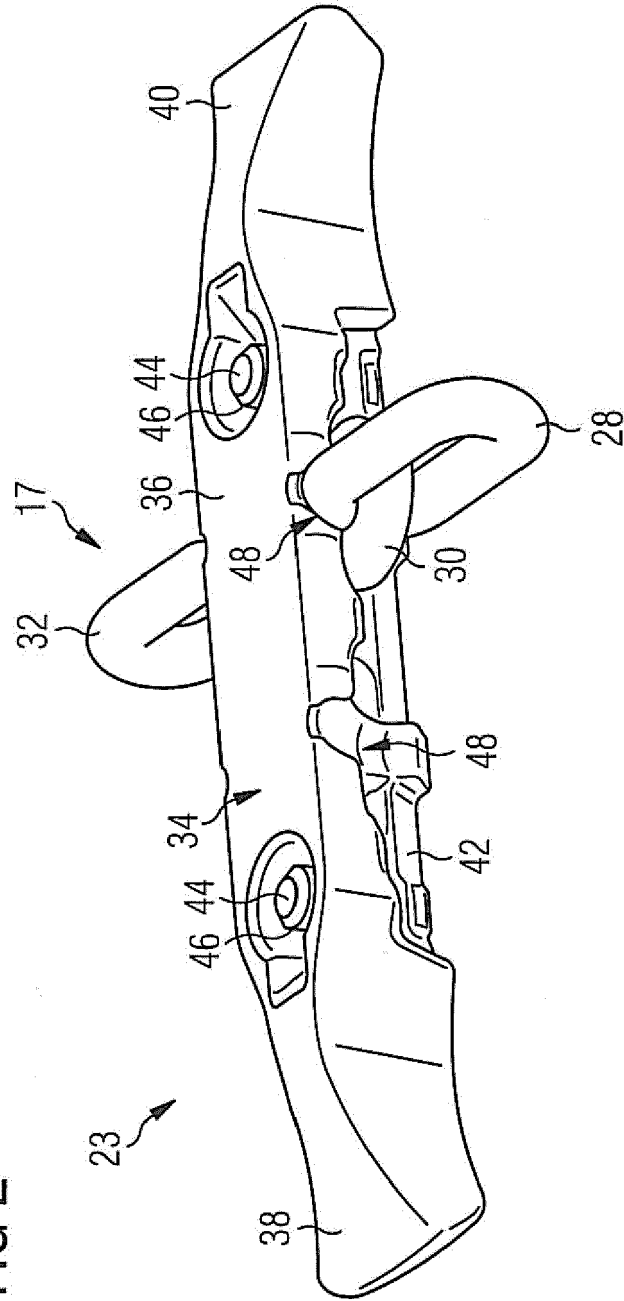


FIG 3

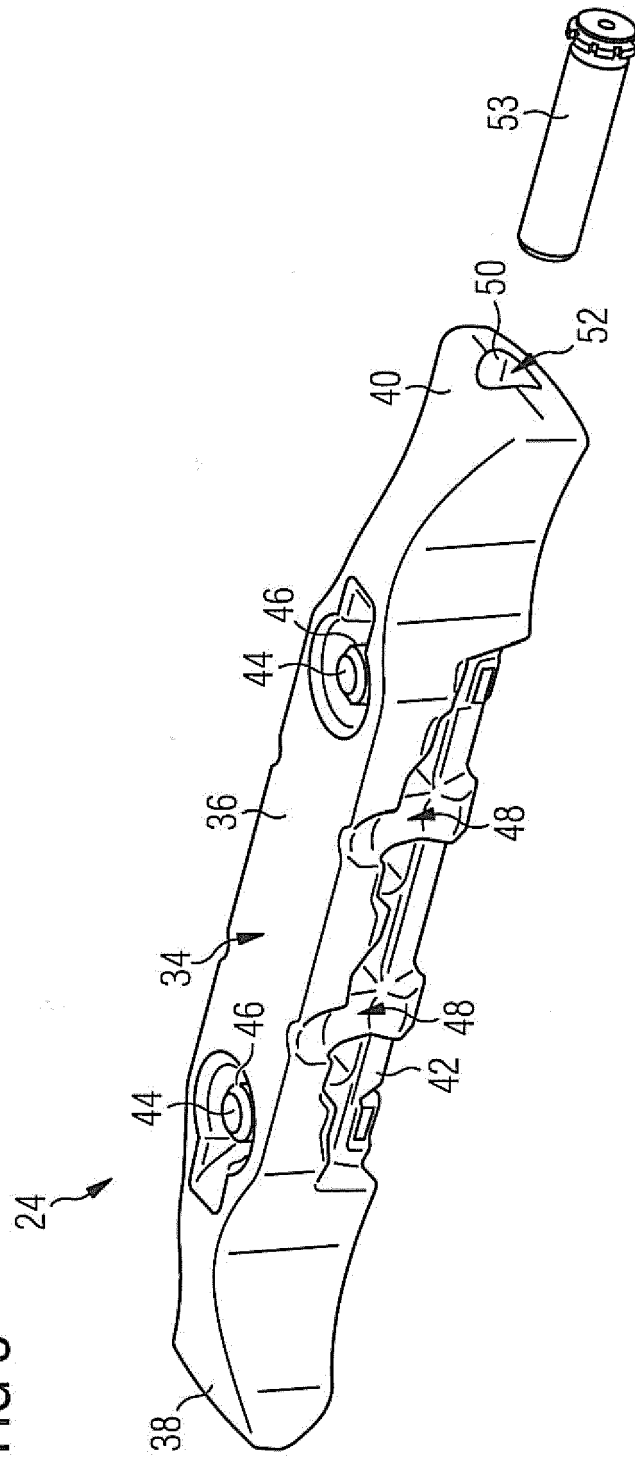


FIG 4

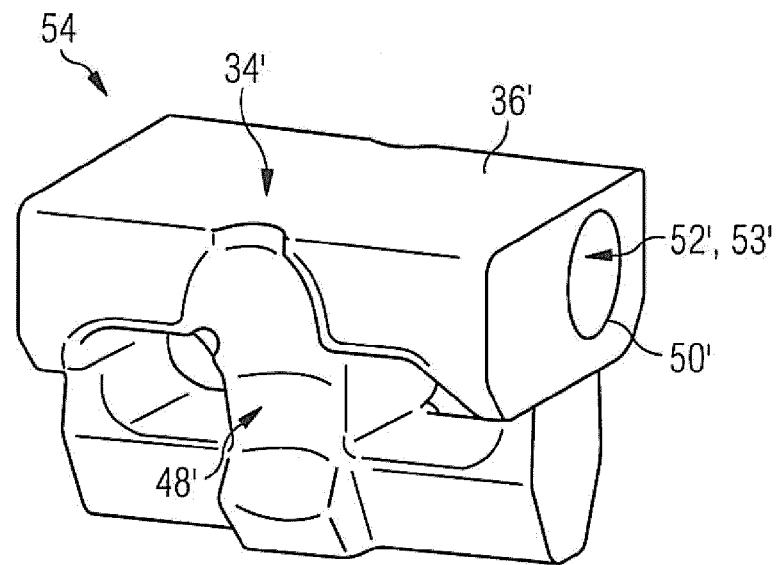
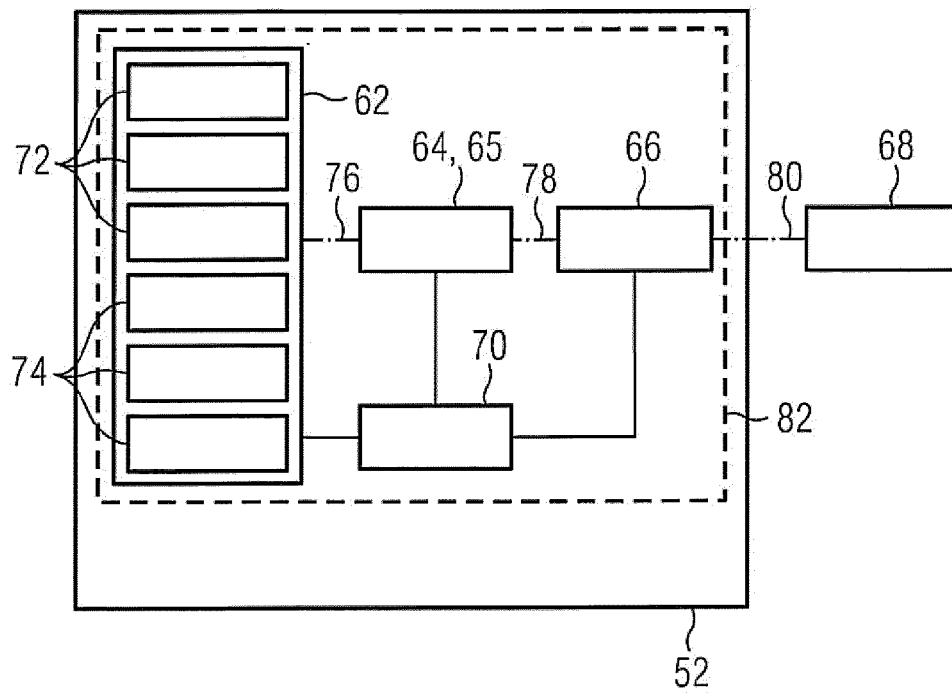


FIG 5

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Application Number
EP 14 15 4389

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