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(71) Applicant(s)
Bucyrus DBT Europe GmbH

(72) Inventor(s)
Wesselmann, Johannes

(74) Agent / Attorney
Davies Collison Cave, 1 Nicholson Street, Melbourne, VIC, 3000

(56) Related Art
US 5087099 A
GB 2350919 A
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ABSTRACT

Face support control system for a self-advancing face support in underground mining with a conveyor (1; 51), a mining machine (2; 52), a plurality of support shields (3; 53), each of which is associated with a control device (4; 54) for controlling the function of the support shields (3; 53), a communication device (5; 55) for interconnection of the control devices, a face master control (12; 62) arranged outside the face and communication means for transmitting data between the control devices (4; 54) in the face and the face master control (12; 62) outside the face, **characterised in that** the communication means comprise a first face sided radio transmission device (8; 58) and a second face master control sided radio transmission device (9; 59), wherein the radio transmission devices (8, 9; 58, 59) each having receiver and transmitter modules used to carry out wireless and cable-free bi-directional data transmission (11; 61) in the end region of the face.

Title: Face support control system

The invention relates to a face support control system for a self-advancing face support in underground mining with a conveyor, a mining machine, a plurality of support shields, each of which is associated with a device for controlling the function of the accompanying support shields, a communication device for interconnection of the control devices, a face master control arranged outside the face and communication means for transmitting data between the control devices in the longwall face and the face master control outside the face.

In the face support control system known from DE 198 47 901 C1, the communication device for interconnection of the control devices, and the communication means of the control devices with the face master control each consist of a face bus designed like the so-called PROFIBUS. All data is exchanged in the order for bus access rights established for the bus system. By using a PROFIBUS, the expense of cabling in the underground face can be reduced by about 40% as compared with conventional cable engineering. However, all control devices still need to be wired to each other and to the face master control.

DE 199 25 721 A1 filed by the applicant discloses an actuation of individual control devices of an underground face support by means of an infrared remote control, which the miner carries as a hand-held control device. A radio transmission and receiving unit is associated not with each individual support control unit but only with one group of support control devices to be able to exchange data by means of infrared radio transmission between the hand-held control device and the control devices.

DE 100 18 481 A1 discloses to transmit the condition data of the mining machine by radio via a transmitter moving with the mining machine to radio receivers arranged at a distance from each other in the face and connected to each other by a cable line system. Data is transmitted in one direction from the mining device to the face master control, and a cabled line system is arranged between individual control devices of the shield projections and the face master control.

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DE 100 18 597 A1 discloses a face control system in which control means with a radio receiver and an infra-red transmitter are associated with individual shield control devices in the face to give the miner the possibility of actuating a support shield by radio. The miner's hand-held control device has a display on which the operating conditions of each shield can be displayed. The shield controls are connected to each other by a cabled line system.

The object of the invention is to further reduce the expense of cabling for an underground face support control system and to increase the safe function and reliability of the face support control system.

The object is achieved in accordance with the invention by a face support control system for a self-advancing face support in underground mining with a conveyor, a mining machine, a plurality of support shields, each of which is associated with a control device for controlling the function of the support shields, a communication device for interconnection of the control devices, a face master control arranged outside the face and communication means for transmitting data between the control devices in the face and the face master control outside the face, characterised in that the communication means comprise a first face sided radio transmission device and a second face master control sided radio transmission device, wherein the radio transmission devices each having receiver and transmitter modules used to carry out wireless and cable-free bi-directional data transmission in the end region of the face.

According to the invention, the bus or bus cable connection between the face master control and the control devices or the communication device in the face connecting said control devices for data exchange is replaced by radio transmission used to transmit data about control and condition in both directions. This feature has the particular advantage that there is no need for cable or connection lines in particularly dangerous face end regions in which the main and auxiliary drives for the mining machine and the conveyor are mounted, with the

result that there is no longer a risk in these very dangerous areas of cable or line failure and, consequently, no risk of interruptions in data exchange.

In the preferred embodiment, the one face sided radio transmission device is arranged on one face edge or two face sided radio transmission devices are arranged on the two face edges, respectively, to keep the radio transmission path in the face end area to a minimum.

In the particularly advantageous embodiment of a face support control system according to the invention, the communication device in the face comprises radio transmission means with transmission and receiver modules spaced a plurality of support shields from each other. Bi-directional data exchange of control and condition data of individual or groups of support shields is possible using the radio

transmission means, and there is no need for the redundant bus connections as has been previously installed in the underground faces. The radio transmission means can also be used to communicate rapidly in both directions between the two ends of the face.

Another advantageous embodiment of a face support control system according to the invention is characterised in that there is associated with the mining machine a radio transmission means with a transmission and receiver module for bi-directional transmission of control and condition data to the face sided radio transmission means located on the end of the face or, if the face is very wide, to the radio transmission means integrated into the communication device. For this purpose, a control device attached to the communication device in the face is associated with the mining machine to evaluate the control data and the condition data available when data is exchanged and to synchronise them with the control data for the support shields.

Further advantages and configurations of the face support control system according to the invention will become apparent from the following description of embodiments shown schematically in the drawings, in which:

Fig. 1 represents a first embodiment of a face support control system according to the invention; and

Fig. 2 represents a second embodiment of a face support control system according to the invention.

In Fig. 1, reference number 10 designates a face support control system for an underground self-advancing mining facility in its entirety. Of the mining facility mounted in the face are shown schematically a conveyor 1, a mining machine 2 shown here as a shearer, which can be displaced between the left face edge and the right face edge and is preferably supported on the conveyor 1, and a plurality of adjacent support shields 3. A control device 4 is associated with each support shield 3 to be able to carry out the individual functions of the support shield 3, such as setting or drawing, advancing the conveyor 1 by extending a pusher cylinder, or bringing up the support shield when the lifting prop and supporting shields are drawn off.

For mining safety reasons, each particular shield 3 is controlled by a control device 4, which is mounted on the neighbouring shield. The individual control devices 4 are

connected to each other via a connection line 5 in the form of a cabled communication device to exchange information between adjacent control devices 4. A data transmission unit 6 is associated with each sixth (as shown) or respectively, for example, each tenth shield 3, the individual spaced data transmission units 6 being connected to each other via a redundant ZBUS connection line 7 for data exchange. A transmission unit 8 arranged on the right face edge in Fig. 1 takes the form of a radio transmission device with receiver and transmission modules to transmit data via the bi-directional, wireless and cable-free radio transmission represented by arrow 11 to a face master control 12 set up, for example, on the surface. The face master control 12 is connected via suitable, in this case, cabled data transmission lines 13 to a second face master control sided radio transmission device 9, which device is preferably located as close as possible to the face edge and also comprises receiver and transmission modules to guarantee bi-directional radio data transmission 11 between the two radio transmission devices 8, 9. Radio data transmission 11 therefore spans the face end region, where the main and auxiliary drives for the conveyor 1 or the mining machine 2 are set up (not shown) and the risk of cable damage or tears is particularly high.

The embodiment of Fig. 1 also shows that the mining machine 2 can optionally be provided with a radio transmission station 15, which can be used to transmit to the transmission means 6 by radio connection 17 the control data and condition data of the mining machine 2 and also condition data such as rock type and rock hardness, which is determined by sensors (also not shown), and as indicated by arrow 16 are forwarded to the radio transmission station 15. It should be clear that the transmission means 6 then are also equipped with receiver and transmission modules for this purpose and, for example, have the same structure as the face sided radio transmission device 8 located on the face end. Data is transmitted between the radio transmission station 15 moving with the mining machine 2 and the radio transmission units 6 that are stationary in any case with respect to the shields 3, preferably in each case only to the closest radio transmission unit 6 that is stationary with respect to the shield 3, as indicated by the filled-in line arrow 17 and the dotted-line arrows 17'. A further control device (not shown) can be associated with the mining machine.

In the embodiment of a face support control system 50 as shown in Fig. 2, there is also a conveyor 51 in a face, a mining machine 52 that can be moved backwards and forwards between both face edges and a plurality of adjacent support shields 53

moving forward with the face advance, each of which is provided with a control device 54. The control devices 54 are connected to each other by a cable connection 55. A radio transmission device 58 provided with transmission and receiver modules is arranged on the left and on the right face edge respectively. Data is transmitted by radio transmission from said radio transmission device 58 to a related face master control sided radio transmission device 59, which devices each are also equipped with transmission and receiver modules . The said data transmission is indicated by arrow 61. The two radio transmission devices 59 on the face master control side are also connected via suitable data transmission cables 63 and 73 respectively to the face master control 62 arranged on the surface. Data between the face master control 62 and the individual control devices 54 in the underground mining face can be exchanged in both directions (bi-directionally) and is exchanged partially by radio transmission in the particularly dangerous face end regions and face-gate intersections. There is arranged at particular distances extending over several shields 53, for example at every tenth shield, a radio transmission station 56, which is connected to the control devices 54 via the connection line 74 and therefore also to the communication device 55. As a result of the receiver and transmission modules of the radio transmission stations 56 and the radio transmission devices 58, bi-directional data exchange is possible by radio transmission directly between the two radio transmission devices 58, as indicated by arrow 80, between the radio transmission devices 58 and the radio transmission stations 56, as indicated by arrow 81, and also between adjacent or arbitrary radio transmission stations 56, as indicated by arrow 82. With the face support control system 50, a redundant bus connection in the face can correspondingly be discarded.

A number of modifications, which shall be covered by the scope of protection of the dependent claims, will result for a person skilled in the art from the preceding description. The face master control sided transmission devices might also be set up on the surface. Data between the transmission devices and the face master control can also be exchanged by radio. All the control devices could be wireless and connected to each other via a "wireless network" transmission system for bi-directional data exchange.

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The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

The reference numerals in the following claims do not in any way limit the scope of the respective claims.

Claims:

1. Face support control system for a self-advancing face support in underground mining with a conveyor (1; 51), a mining machine (2; 52), a plurality of support shields (3; 53), each of which is associated with a control device (4; 54) for controlling the function of the support shields (3; 53), a communication device (5; 55) for interconnection of the control devices, a face master control (12; 62) arranged outside the face and communication means for transmitting data between the control devices (4; 54) in the face and the face master control (12; 62) outside the face, **characterised in that** the communication means comprise a first face sided radio transmission device (8; 58) and a second face master control sided radio transmission device (9; 59), wherein the radio transmission devices (8, 9; 58, 59) each having receiver and transmitter modules used to carry out wireless and cable-free bi-directional data transmission (11; 61) in the end region of the face.

2. Face support control system according to Claim 1, **characterised in that** the one face sided radio transmission device (8) is arranged on one face edge, or two face sided radio transmission devices (58) are arranged on each of the face edges.

3. Face support control system according to Claim 1 or 2, **characterised in that** the communication device in the face comprises radio transmission means (56) with transmission and receiver modules, which are spaced a plurality of support shields (54) from each other.

4. Face support control system according to Claims 1 to 3, **characterised in that** there is associated with the mining machine (2) a radio transmission means (15) with transmission and receiver modules for bi-directional transmission (17) of control and condition data to the radio transmission devices (8) or to the radio transmission means (56, 6) integrated into the communication device.

5. Face support control system according to Claim 4, **characterised in that** a control device attached to the communication device in the face is associated with the mining machine.

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6. A face support control system for a self-advancing face support in underground mining with a conveyor substantially as hereinbefore described with reference to the accompanying drawings.

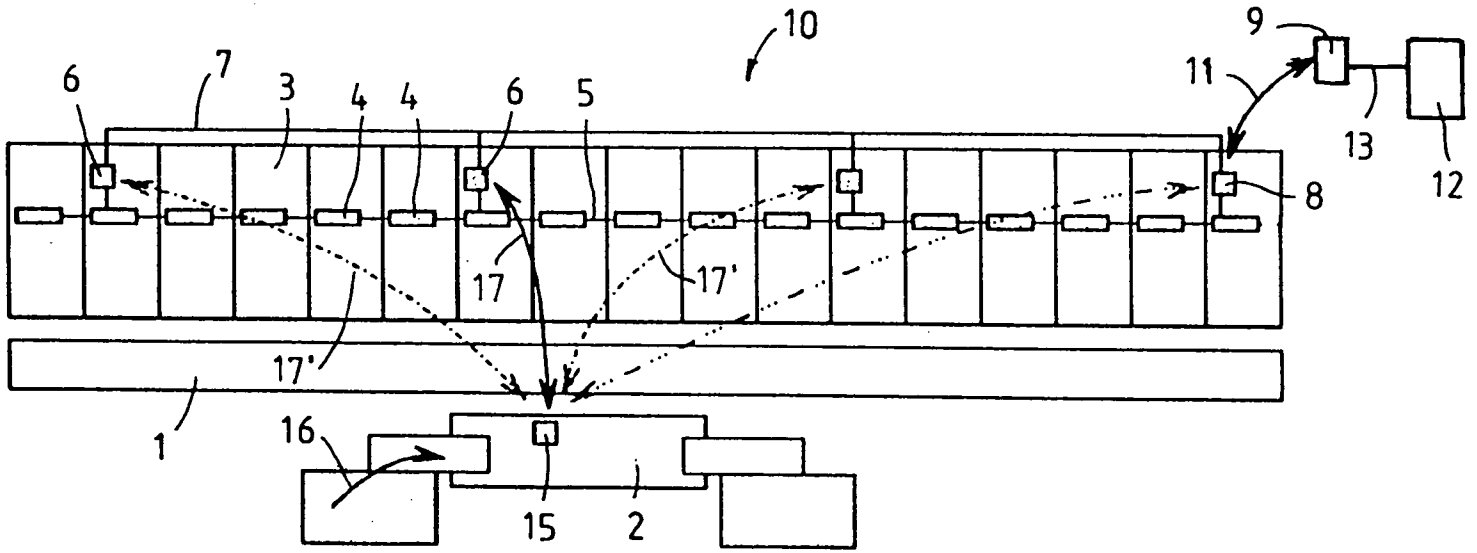
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FIG 1

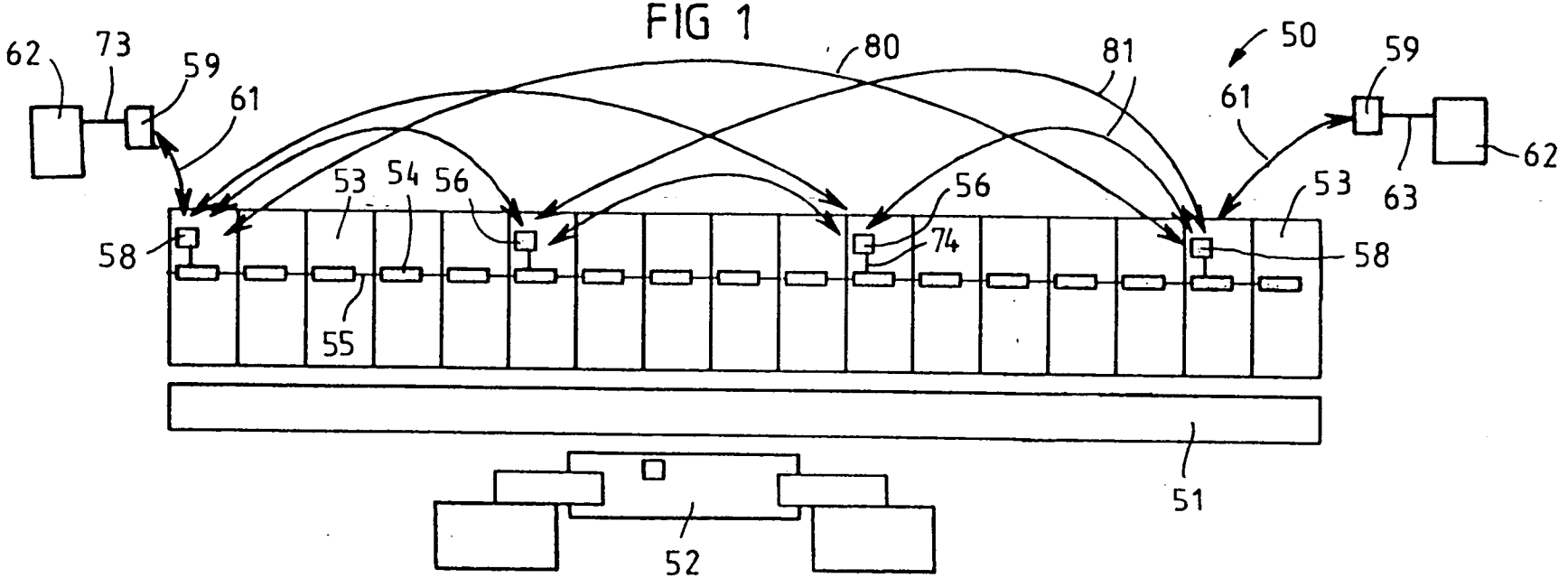
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FIG 2