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(54) **Improvements in and Relating to Long Wall Hydraulic Supply Systems**

Verbesserungen bei und im Zusammenhang mit langwandigen hydraulischen Zuführsystemen

Améliorations portant sur et se rapportant à des systèmes d'alimentation hydraulique de paroi longue

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Description

Field of the Invention

[0001] The present invention relates to long wall hydraulic supply systems, to control units for use with the same, and to methods of operating the same.

Background to the Invention

[0002] Powered roof supports are electro-hydraulic structures used for supporting the roof of a mine, e.g. a long wall coal mine, in the region above a cutting machine working at the face. As the cutting machine moves across the face the powered roof supports are called upon to deal with changes in roof load, and also to advance themselves with the cutting machine. The roof supporting and advancing operations are driven by hydraulic pressure provided by a remote hydraulic pump station, located away from the face and typically comprising a plurality of pumps. Typically a mine will comprise of a long wall hydraulic system that includes the pump station and a large number of powered roof supports, each powered roof support working as if independent of the others to perform load supporting and advancing operations across the face. The pump station is arranged to supply hydraulic pressure to all the powered roof supports.

[0003] It is desirable to maintain a set pressure in the hydraulic system, and the pump station therefore typically comprises a pressure sensor. The pressure sensor at the pump station is used to control the pump station to raise pressure in response to a sensed pressure change at the pump station. However, each pump element at the pump station is constrained to operate at a fixed pumping capacity, and controlling the operation of the pump station to give a desired supply of fluid volume and therefore maintain a set pressure at the powered roof support system according to its varying operational demands is difficult.

[0004] GB 2 329 429, considered as the closest prior art, describes a roof support arrangement having a roof support leg, means a valve connected to a hydraulic fluid supply for controlling the flow of hydraulic fluid into the roof support leg, actuator means for opening and closing the valve according to a control signal, means for determining the pressure on the leg and for transmitting a signal dependent on the pressure to a control means, which control means generates a control signal according to the pressure determined by the pressure determining means, which control signal actuates the actuator means to open a valve.

[0005] It is an aim of example embodiments of the present invention to address at least one disadvantage of the prior art, whether identified herein or otherwise.

Summary of the Invention

[0006] In a first aspect, the present invention provides

a long wall hydraulic supply system comprising: a pump station operatively coupled to a remote powered roof support to supply hydraulic fluid thereto via a hydraulic line; a remote pressure sensor located remote from the pump station in the hydraulic line; and a control unit, wherein the control unit is operatively coupled to the remote pressure sensor and to the pump station, and characterised in that the control unit is arranged to control the pump station to supply hydraulic fluid to the powered roof support via the hydraulic line in response to a remote pressure signal received from the remote pressure sensor.

[0007] Suitably, the long wall hydraulic system comprises a plurality of powered roof supports. Suitably, the powered roof supports are in use arranged between a main gate end and a tail gate end of a face. Suitably, the remote pressure sensor is located local to the powered roof support. Suitably, the remote pressure sensor is located local to the powered roof supports. Suitably, the remote pressure sensor is located proximate to the tail gate end of the face. Suitably, the remote pressure sensor is located centrally between the main gate end of the face and the tail gate end of the face. Suitably, the remote pressure sensor is located proximate to the main gate end of the face. Suitably, the remote pressure sensor is located at the powered roof support.

[0008] Suitably, the control unit comprises a set point pressure input unit, arranged to receive and store a set pressure that the pump station is intended to provide. Suitably, the control unit is arranged to cause the pump station to supply a varying volume of hydraulic fluid to the powered roof supports according to variation in the remote pressure signals by controlling operation of one or more pumps in the pump station. Suitably, the control unit comprises part of a negative feedback loop. Suitably, the control unit comprises part of a negative feedback loop that aims to maintain the set point pressure at the remote pressure sensor by controlling operation of the pump station in response to variation in the remote pressure signal.

[0009] Suitably, the control unit is arranged to control a plurality of pumping elements within the pump station. Suitably, the pump station comprises one or more positive displacement pumping elements. Suitably, one or more of the pumping elements in the pump station are driven by a variable speed drive. Suitably, the control unit is operatively coupled to a variable speed drive to control operation of a positive displacement pumping element to supply a varying volume of hydraulic fluid to the powered roof supports in response to the variation in the remote pressure signal. Suitably, the control unit is arranged first to cause one or more primary pumping elements to be driven, and then secondly to cause one or more additional pumping elements to be driven in addition, in response to variation in the remote pressure signal. Suitably, the primary pumping elements are arranged in a group including a master pump and a secondary pump. Suitably, the primary pumping elements are arranged in a group including a master pump, a sec-

ondary pump and a tertiary pump. Suitably, the pumps in the group of primary pumping elements are driven by variable speed drives. Suitably, the one or more additional pumping elements are driven by a direct on line drive.

[0010] Suitably, the control unit is operatively coupled to the remote pressure sensor and to the pump station by a wired, or wireless connection.

[0011] Suitably, the control unit comprises a first input unit arranged to receive a set point pressure. Suitably, the control unit comprises a second input unit arranged to receive a remote pressure signal. Suitably, the control unit comprises a subtraction operator to determine a difference between the set point pressure and a remote pressure signal. Suitably, the control unit comprises a control unit arranged to store information relating the pressure difference to characteristics of the pump station. Suitably, the control unit comprises an output interface for coupling to the pump station.

[0012] In a further aspect, the present invention provides a method of operating a long wall hydraulic supply system comprising: a pump station operatively coupled to a remote powered roof support to supply hydraulic fluid thereto via a hydraulic line; a remote pressure sensor located remote from the pump station in the hydraulic line; and a control unit, the method comprising: receiving a pressure signal from the remote pressure sensor; and characterised by the step of controlling the pump station to supply hydraulic fluid to the powered roof support in response to the pressure signal received from the remote pressure sensor.

[0013] Suitably, the method comprises receiving and storing a set point pressure. Suitably, the method comprises determining a difference between the set point pressure and the pressure signal received from the remote pressure sensor. Suitably, the method comprises supplying a control signal to the pump station to cause the pump station to match the pressure signal received from the remote pressure sensor with the set point pressure. Suitably, the method comprises a feedback control method. Suitably, the method comprises operating one or more primary pumping elements in response to sensed variation in the demand for hydraulic fluid, and then according to the pressure signal received from the remote pressure sensor additionally operating one or more additional pumping elements. Suitably, the method comprises operating one or more of the primary pumping elements using a variable speed drive. Suitably, the method comprises operating one or more of the additional pumping elements using a direct on line drive.

[0014] In a further aspect, the present invention provides a computer program product, recorded on a machine-readable data carrier, and containing instructions arranged, when loaded on a suitable computing platform to cause the system according to the first aspect to perform a method according to the third aspect of the present invention.

[0015] According to the present invention there is pro-

vided an apparatus and method as set forth in the appended claims. Other features of the invention will be apparent from the dependent claims, and the description which follows.

Brief Introduction to the Figures

[0016] For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings in which:

Figure 1 shows a schematic illustration of a long wall hydraulic supply system according to an example embodiment of the present invention;

Figure 2 shows a schematic illustration of a control unit for a long wall hydraulic supply system according to an example embodiment of the present invention;

Figure 3 shows a schematic flow diagram illustrating a method of maintaining a set pressure to operate a powered roof support system, the method according to an example embodiment of the present invention; and

Figure 4 shows a group of machine-readable carriers containing instruction thereon, each machine-readable carrier in the group according to an example embodiment of the present invention.

Description of Example Embodiments

[0017] Example embodiments of the present invention will be described in detail with reference to the accompanying drawings. Referring now to Figure 1 there is shown a long wall hydraulic supply system 100 comprising: a pump station 10 operatively coupled to a set of remote powered roof supports 20 to supply hydraulic pressure thereto via a hydraulic line 30. The powered roof supports comprise a number of independently actuable powered roof support elements, all coupled to the hydraulic line 30. The pump station 10 comprises a pump 12 and a drive 14 to actuate the pump 12. A remote pressure sensor 40 is located in the hydraulic line 30 at a position local to the powered roof supports 20 and remote from the pump station 10. A control unit 50 is operatively coupled to the remote pressure sensor 40 and to the pump station 10, and is arranged to control the pump station 10 to supply hydraulic pressure to the powered roof supports 20 via the hydraulic line 30 in response to a remote pressure signal received from the remote pressure sensor 40. In this document, "remote" means away from the pump station, and includes locations at or proximate to the powered roof supports 20.

[0018] The long wall hydraulic supply system 100 operates with feedback control, such that the control unit

50 compares the remote pressure signal with a set point pressure, and controls the pump station 10 to try to maintain the set point pressure at the powered roof support 20 despite changes in pressure caused by changes in loading of and operation of the powered roof supports 20. The feedback control operation of the control unit 50 is illustrated schematically by the subtraction operator 52 shown in the control unit 50. The set point pressure is determined according to the load rating of the powered roof supports 20, which itself is a dependent on the characteristics of the installation in which the powered roof support system is to operate. The set point pressure is received and stored at a set point pressure input unit of the control unit 50, for example in response to user input.

[0019] In this way the control unit 50 is able to accurately match the output of the pump station 10 to variations in requirement for hydraulic fluid volume of the powered roof supports 20. Providing a remote sensor 40 at the powered roof supports 20 enables the control unit 50 to provide an improved response over systems that measure the pressure at a point close to the pump station. The feedback from the pressure sensor to the pump station is not distorted by factors such as losses in a long run of hydraulic hose between the pump station and the powered roof support, or a mis-match in the capacity of the hydraulic hose and the capacity of the pump station for fluid delivery. A wired or wireless connection between the remote pressure sensor and the control unit, such as a connection 60 shown in Figure 1, can be made more robust and accurate than operating the control unit solely based on sensed pressure at the pump station in combination with unknown and possibly variable characteristics of the hydraulic coupling between the pump station and the powered roof support.

[0020] Further improvements are provided by increasing flexibility of the pump station 10 to respond in stages according to variable demand for hydraulic fluid volume supply. The pump 12 and drive 14 in this example embodiment are provided as multiple pumping and driving elements. The pumping elements are positive displacement pumps driven by a plurality of drives. The control unit 50 is arranged in such example embodiments to control the plurality of pumping elements within the pump station 10. In example embodiments of the present invention one or more of the pumping elements in the pump station are driven by a variable speed drives. The control unit 50 is arranged first to cause the primary pumping element to be driven, for example by a variable speed drive to respond quickly and efficiently to a change in demand according to the remote pressure signal, and then secondly to cause further pumping elements to be simultaneously driven with and in addition to the primary pump, for example by a direct on line drive to provide a base pumping capacity. This allows greater variability of supply, while maintaining the ability to achieve fine control. Using this type of scheme allows the pumps to operate away from their maximum capacity rating for more of the time, despite variations in demand. The pump sta-

tion 10 suitably also includes a local pressure sensor (not shown) as a safety feature to prevent over-pressuring the system.

[0021] Figure 2 shows a schematic illustration of the control unit 50 for a long wall hydraulic supply system according to an example embodiment of the present invention. The control unit 50 comprises a first input unit 501 arranged to receive a set point pressure and a second input unit 502 arranged to receive a remote pressure signal. The set point pressure and remote pressure signal are compared in the subtraction operator 52, with the results of the subtraction passed to a controller 54. The controller 54 stores information relating the pressure difference to characteristics of the pump station 10, in terms of its pump(s) 12 and drive(s) 14, and provides an output interface 503 for controlling the drive(s) 14 to operate the pump(s) 12.

[0022] Figure 3 shows a schematic flow diagram illustrating a method of operating a long wall hydraulic supply system according to an example embodiment of the present invention. At step S101 the controller is arranged to receive and store a set point pressure. The set point pressure may be provided at a user interface such as a touch screen, control panel or the like. At step S102 the remote pressure sensor information is received at the controller. The controller then determines the difference between the set point pressure and the remote pressure signal to determine a pressure error at step S103. The controller then transforms the pressure error into a control signal for the pump station, before supplying the control signal to the pump station in steps S104 and S105 respectively.

[0023] The method of Figure 3 may be described as machine readable program instructions provided on a data carrier 200 such as the example data carriers shown in Figure 4. The carriers 200 comprise a machine-readable optical disc, a Universal Serial Bus (USB) memory stick, and an application specific solid state memory device.

[0024] By enabling more accurate control and increasing pump station efficiency as above, it is possible to improve the availability of hydraulic fluid at the powered roof supports, which in turn enables increased speed of response and therefore operation. Increased speed of operation of powered roof supports is a major advantage in mining operations.

[0025] The present invention will be understood readily by reference to the above description of example embodiments and the accompanying drawings. The present invention may, however, be embodied in many different forms and should not be construed as being limited to the example embodiments described above. Rather, these embodiments are provided so that this disclosure will be thorough and complete and will fully convey the concept of the invention to those skilled in the art. The present invention is defined by the statements of aspects of the invention in the summary of invention section above, and with reference to any appended claims.

[0026] The example embodiments are described above with reference to flowchart illustrations, methods, and computer program products. It is to be understood that each block of the flowchart illustrations, and combinations of blocks in the flowchart illustrations, can be implemented by computer program instructions. These computer program instructions can be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other programmable data processing apparatus, create means for implementing the functions specified in the flowchart block or blocks.

[0027] These computer program instructions may also be stored in a computer usable or computer-readable memory or data carrier that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer usable or computer-readable memory or data carrier produce an article of manufacture including instruction means that implement the function specified in the flowchart block or blocks.

[0028] The computer program instructions may also be loaded into a computer or other programmable data processing apparatus to cause a series of operational steps to be performed in the computer or other programmable apparatus to produce a computer implemented process such that the instructions that execute on the computer or other programmable apparatus provide steps for implementing the functions specified in the flowchart block or blocks.

[0029] And each block of the flowchart illustrations may represent a module, segment, or portion of code, which comprises one or more executable instructions for implementing the specified logical function(s). It should also be noted that in some alternative implementations, the functions noted in the blocks may occur out of the order. For example, two blocks shown in succession may in fact be executed substantially concurrently or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved.

[0030] The terms "module" or "unit", as used herein, means, but is not limited to, a software or hardware component, such as a Field Programmable Gate Array (FPGA) or an Application Specific Integrated Circuit (ASIC), which performs certain tasks. A module or unit may advantageously be configured to reside in an addressable storage medium and configured to execute on one or more processors. Thus, a module or unit may include, by way of example, components, such as software components, object-oriented software components, class components and task components, processes, functions, attributes, procedures, subroutines, segments of program code, drivers, firmware, microcode, circuitry, data, databases, data structures, tables, arrays, and variables. The functionality provided for in the components, units and modules may be combined into fewer compo-

nents, units and modules or further separated into additional components, units and modules.

[0031] Although a few preferred embodiments have been shown and described, it will be appreciated by those skilled in the art that various changes and modifications might be made without departing from the scope of the invention, as defined in the appended claims.

10 Claims

1. A long wall hydraulic supply system (100) comprising: a pump station (10) operatively coupled to a remote powered roof support (20) to supply hydraulic fluid thereto via a hydraulic line (30); a remote pressure sensor (40) located remote from the pump station (10) in the hydraulic line; and a control unit (50), wherein the control unit (50) is operatively coupled to the remote pressure sensor (40) and **characterised in that** the control unit (50) is operatively coupled to the pump station (10) arranged to control the pump station (10) to supply hydraulic fluid to the powered roof (20) support via the hydraulic line (30) in response to a remote pressure signal received from the remote pressure sensor.
2. The long wall hydraulic system of claim 1, comprising a plurality of powered roof supports (20) arranged between a main gate end and a tail gate end of a face, with the remote pressure sensor (40) located local to the powered roof supports.
3. The long wall hydraulic system of claim 1 or 2, wherein the control unit (50) comprises a set point pressure input unit arranged to receive and store a set pressure that the pump station (10) is intended to provide, with the control unit (50) arranged to cause the pump station (10) to supply a varying volume of hydraulic fluid to the powered roof support or powered roof supports (20) according to variation in the remote pressure signal, by controlling operation of one or more pumps (12) in the pump station (10).
4. The long wall hydraulic system of claim 1, 2 or 3, wherein the control unit (50) comprises part of a negative feedback loop that aims to maintain the set point pressure at the remote pressure sensor (40) by controlling operation of the pump station (10) in response to variation in the remote pressure signal.
5. The long wall hydraulic system of any preceding claim, wherein the control unit (50) is operatively coupled to a variable speed drive (14) to control operation of a positive displacement pumping element (12) to thereby supply a varying volume of hydraulic fluid to the powered roof support or powered roof supports (20) in response to the variation in the remote pressure signal.

6. The long wall hydraulic system of any preceding claim, wherein the control unit (50) is arranged first to cause one or more primary pumping elements to be driven, and then secondly to cause one or more additional pumping elements to be additionally driven, in response to variation in the remote pressure signal. 5
7. The long wall hydraulic system of claim 6, wherein the pumps in the group of primary pumping elements are driven by variable speed drives, whereas the one or more additional pumping elements are driven by a direct on line drive. 10
8. The long wall hydraulic supply system of any preceding claim, wherein control unit (502) comprises a first input unit (501) arranged to receive a set point pressure, a second input unit (502) arranged to receive a remote pressure signal and subtraction operator (52) to determine a pressure difference between the set point pressure and a remote pressure signal. 15
9. The long wall hydraulic supply system of claim 8, wherein the control unit is arranged to store information relating the pressure difference to characteristics of the pump station. 20
10. A method of operating a long wall hydraulic supply system comprising: a pump station operatively coupled to a remote powered roof support to supply hydraulic fluid thereto via a hydraulic line; a remote pressure sensor located remote from the pump station in the hydraulic line; and a control unit, the method comprising: receiving a pressure signal from the remote pressure sensor (S102); and **characterised by** the step of controlling the pump station to supply hydraulic fluid to the powered roof support in response to the pressure signal received from the remote pressure sensor (S103-S105). 25
11. The method of claim 10, comprising receiving and storing a set point pressure (S101), determining a difference between the set point pressure and the pressure signal received from the remote pressure sensor (S103) and supplying a control signal to the pump station to cause the pump station to match the pressure signal received from the remote pressure sensor with the set point pressure (S104, S105). 30
12. The method of claim 10 or 11, comprising operating one or more primary pumping elements in response to sensed variation in the demand for hydraulic fluid, and then according to the pressure signal received from the remote pressure sensor additionally operating one or more additional pumping elements. 35
13. The method of claim 12 comprising operating one or 40

more of the primary pumping elements using a variable speed drive and comprising operating one or more of the additional pumping elements using a direct on line drive.

14. A computer program product, recorded on a machine-readable data carrier (200), and containing instructions arranged, when loaded on a suitable computing platform to cause the system according to claims 1-9 to perform a method according to any one of claims 10-13. 45

Patentansprüche

1. Streb-Hydraulikversorgungssystem (100), das Folgendes umfasst: eine Pumpstation (10), die betriebstechnisch mit einem ferngespeisten Stollenausbau (20) gekoppelt ist, um diesen über eine Hydraulikleitung (30) mit Hydraulikflüssigkeit zu versorgen; einen entfernten Drucksensor (40), der sich entfernt von der Pumpstation (10) in der Hydraulikleitung befindet; und eine Steuereinheit (50), wobei die Steuereinheit (50) betriebstechnisch mit dem entfernten Drucksensor (40) gekoppelt ist und **dadurch gekennzeichnet ist, dass** die Steuereinheit (50) betriebstechnisch mit der Pumpstation (10) gekoppelt ist und ausgelegt ist, um die Pumpstation (10) zu steuern, damit sie den gespeisten Stollenausbau (20) über die Hydraulikleitung (30) in Reaktion auf ein entferntes Drucksignal, das von dem entfernten Drucksensor empfangen wird, mit Hydraulikflüssigkeit versorgt. 50
2. Streb-Hydrauliksystem nach Anspruch 1, das mehrere gespeiste Stollenausbauten (20) umfasst, die zwischen einem Haupttorende und einem Untertorende eines Strebs angeordnet sind, wobei sich der entfernte Drucksensor (40) lokal an den gespeisten Stollenausbauten befindet. 55
3. Streb-Hydrauliksystem nach Anspruch 1 oder 2, wobei die Steuereinheit (50) eine Solldruckeingabeeinheit umfasst, die ausgelegt ist, um einen Solldruck, den die Pumpstation (10) bereitstellen soll, zu empfangen und zu speichern, wobei die Steuereinheit (50) ausgelegt ist, um zu bewirken, dass die Pumpstation (10) durch das Steuern des Betriebs einer oder mehrerer Pumpen (12) in der Pumpstation (10) den einen oder die mehreren gespeisten Stollenausbauten (20) gemäß der Variation des entfernten Drucksignals mit einem variierenden Volumen von Hydraulikflüssigkeit versorgt.
4. Streb-Hydrauliksystem nach Anspruch 1, 2 oder 3, wobei die Steuereinheit (50) einen Teil einer negativen Rückkopplungsschleife umfasst, die darauf zielt, den Solldruck an dem entfernten Drucksensor

(40) durch Steuern des Betriebs der Pumpstation (10) in Reaktion auf die Variation des entfernten Drucksignals aufrechtzuerhalten.

5. Streb-Hydrauliksystem nach einem der vorhergehenden Ansprüche, wobei die Steuereinheit (50) betriebstechnisch mit einem Antrieb (14) mit variabler Drehzahl gekoppelt ist, um den Betrieb eines Verdrängerpumpelements (12) zu steuern, um dadurch den gespeisten Stollenausbau oder die gespeisten Stollenausbauten (20) in Reaktion auf die Variation des entfernten Drucksignals mit einem variierenden Volumen von Hydraulikflüssigkeit zu versorgen. 5 10
6. Streb-Hydrauliksystem nach einem der vorhergehenden Ansprüche, wobei die Steuereinheit (50) ausgelegt ist, um als Erstes zu bewirken, dass ein oder mehrere primäre Pumpelemente angetrieben werden, und dann als Zweites zu bewirken, dass ein oder mehrere zusätzliche Pumpelemente zusätzlich in Reaktion auf die Variation des entfernten Drucksignals angetrieben werden. 15 20
7. Streb-Hydrauliksystem nach Anspruch 6, wobei die Pumpen in der Gruppe der primären Pumpelemente durch Antriebe mit variabler Drehzahl angetrieben werden, während die einen oder mehreren zusätzlichen Pumpelemente durch einen direkt angeschlossenen Antrieb angetrieben werden. 25 30
8. Streb-Hydraulikversorgungssystem nach einem der vorhergehenden Ansprüche, wobei die Steuereinheit (50) eine erste Eingabeeinheit (501), die ausgelegt ist, um einen Solldruck zu empfangen, eine zweite Eingabeeinheit (502), die ausgelegt ist, um ein entferntes Drucksignal zu empfangen, und einen Subtraktionsoperator (52), um eine Druckdifferenz zwischen dem Solldruck und dem entfernten Drucksignal zu bestimmen, umfasst. 35 40
9. Streb-Hydraulikversorgungssystem nach Anspruch 8, wobei die Steuereinheit ausgelegt ist, um Informationen, die die Druckdifferenz mit den Eigenschaften der Pumpstation in Beziehung setzen, zu speichern. 45
10. Verfahren zum Betreiben eines Streb-Hydraulikversorgungssystems, das Folgendes umfasst: eine Pumpstation, die betriebstechnisch mit einem ferngespeisten Stollenausbau gekoppelt ist, um diesen über eine Hydraulikleitung mit Hydraulikflüssigkeit zu versorgen; einen entfernten Drucksensor, der sich entfernt von der Pumpstation in der Hydraulikleitung befindet; und eine Steuereinheit, wobei das Verfahren Folgendes umfasst: Empfangen eines Drucksignals von dem entfernten Drucksensor (S102); und **gekennzeichnet ist durch** den Schritt des Steuerns der Pumpstation, damit sie den ge- 50 55

speisten Stollenausbau in Reaktion auf das Drucksignal, das von dem entfernten Drucksensor empfangen wird, mit Hydraulikflüssigkeit versorgt (S103-S105).

11. Verfahren nach Anspruch 10, das das Empfangen und Speichern eines Solldrucks (S101), das Bestimmen der Differenz zwischen dem Solldruck und dem Drucksignal, das von dem entfernten Drucksensor empfangen wird (S103) und das Versorgen der Pumpstation mit einem Steuersignal, um zu bewirken, dass die Pumpstation das Drucksignal, das von dem entfernten Drucksensor empfangen wird, mit dem Solldruck abgleicht (S104, S105), umfasst.
12. Verfahren nach Anspruch 10 oder 11, das das Betreiben eines oder mehrerer primärer Pumpelemente in Reaktion auf eine erfasste Variation des Bedarfs an Hydraulikflüssigkeit und dann gemäß dem Drucksignal, das von dem entfernten Drucksensor empfangen wird, das zusätzliche Betreiben eines oder mehrerer zusätzlicher Pumpelemente umfasst.
13. Verfahren nach Anspruch 12, das das Betreiben eines oder mehrerer primärer Pumpelemente unter Verwendung eines Antriebs mit variabler Geschwindigkeit umfasst und das Betreiben eines oder mehrerer Pumpelemente der zusätzlichen Pumpelemente unter Verwendung eines direkt angeschlossenen Antriebs umfasst.
14. Computerprogrammprodukt, das auf einem maschinenlesbaren Datenträger (200) aufgezeichnet ist und das Anweisungen umfasst, die ausgelegt sind, um dann, wenn sie auf eine geeignete Computerplattform geladen werden, bewirken, dass das System nach den Ansprüchen 1-9 ein Verfahren nach einem der Ansprüche 10-13 ausführt.

Revendications

1. Système d'alimentation hydraulique pour longues tailles (100) comprenant : une station de pompage (10) raccordée de manière opérationnelle à un système hydraulique de soutènement de toit à distance (20) pour alimenter du fluide hydraulique à celui-ci au moyen d'une conduite hydraulique (30) ; un capteur de pression à distance (40) situé à distance de la station de pompage (10) dans la conduite hydraulique ; et une unité de commande (50), cette unité de commande (50) étant raccordée de manière opérationnelle au capteur de pression à distance (40), et **caractérisée en ce que** cette unité de commande (50) est raccordée de manière opérationnelle à la station de pompage (10) et agencée de façon à commander la station de pompage (10) pour alimenter du fluide hydraulique au système hydraulique de

- soutènement du toit (20) par l'intermédiaire de la conduite hydraulique (30) en réponse à un signal de pression à distance reçu du capteur de pression à distance.
2. Système hydraulique pour longues tailles selon la revendication 1, comprenant une pluralité de systèmes hydrauliques de soutènement du toit (20) disposés entre une galerie principale et une galerie de tête d'une face, avec le capteur de pression à distance (40) situé localement aux systèmes hydrauliques de soutènement du toit.
 3. Système hydraulique pour longues tailles selon la revendication 1 ou 2, dans lequel l'unité de commande (50) comprend une unité d'entrée de pression de consigne agencée de façon à recevoir et à stocker une pression de consigne que la station de pompage (10) est supposée fournir, avec l'unité de commande (50) agencée de façon à faire alimenter par la station de pompage (10) un volume variable de fluide hydraulique au système hydraulique de soutènement du toit ou aux systèmes hydrauliques de soutènement du toit (20) conformément à la variation dans le signal de pression à distance, en commandant le fonctionnement d'une ou de plusieurs pompes (12) dans la station de pompage (10).
 4. Système hydraulique pour longues tailles selon la revendication 1, 2 ou 3, dans lequel l'unité de commande (50) comprend une partie d'une boucle de contre-réaction qui a pour objet de maintenir une pression de consigne au capteur de pression à distance (40) en commandant le fonctionnement de la station de pompage (10) en réponse à une variation dans le signal de pression à distance.
 5. Système hydraulique pour longues tailles selon l'une quelconque des revendications précédentes, dans lequel l'unité de commande (50) est raccordée de manière opérationnelle à un variateur de vitesse (14) pour commander le fonctionnement d'un élément de pompage à déplacement positif (12) pour alimenter ainsi un volume variable de fluide hydraulique au système hydraulique de soutènement du toit ou aux systèmes hydrauliques de soutènement du toit (20) en réponse à la variation dans le signal de pression à distance.
 6. Système hydraulique pour longues tailles selon l'une quelconque des revendications précédentes, dans lequel l'unité de commande (50) est agencée en premier pour faire en sorte qu'un ou plusieurs éléments de pompage primaires soit entraînés, puis en second pour faire en sorte qu'un ou plusieurs éléments de pompage supplémentaires soient entraînés en plus, en réponse à une variation dans le signal de pression à distance.
 7. Système hydraulique pour longues tailles selon la revendication 6, dans lequel les pompes dans le groupe d'éléments de pompage primaires sont entraînées par des variateurs de vitesse, tandis que le ou les éléments de pompage supplémentaires sont entraînés par un entraînement direct en ligne.
 8. Système hydraulique pour longues tailles selon l'une quelconque des revendications précédentes, dans lequel l'unité de commande (50) comprend une première unité d'entrée (501) agencée de façon à recevoir une pression de consigne, une deuxième unité d'entrée (502) agencée de façon à recevoir un signal de pression à distance et un opérateur de soustraction (52) pour déterminer une différence de pression entre la pression de consigne et un signal de pression à distance.
 9. Système hydraulique pour longues tailles selon la revendication 8, dans lequel l'unité de commande est agencée de façon à stocker des informations reliant la différence de pression à des caractéristiques de la station de pompage.
 10. Procédé de fonctionnement d'un système d'alimentation hydraulique pour longues tailles comprenant : une station de pompage raccordée de manière opérationnelle à un système hydraulique de soutènement de toit à distance pour alimenter du fluide hydraulique à celui-ci par l'intermédiaire d'une conduite hydraulique ; un capteur de pression à distance situé à distance de la station de pompage dans la conduite hydraulique ; et une unité de commande, ce procédé comprenant : la réception d'un signal de pression du capteur de pression à distance (S102) ; et **caractérisé par** l'étape de commande de la station de pompage pour alimenter du fluide hydraulique au système hydraulique de soutènement du toit en réponse au signal de pression reçu du capteur de pression à distance (S103-S105).
 11. Procédé selon la revendication 10, comprenant la réception et le stockage d'une pression de consigne (S101), la détermination d'une différence entre la pression de consigne et le signal de pression reçu du capteur de pression à distance (S103) et l'alimentation d'un signal de commande à la station de pompage pour faire en sorte que la station de pompage fasse correspondre le signal de pression reçu du capteur de pression à distance avec la pression de consigne (S104, S105).
 12. Procédé selon la revendication 10 ou 11, comprenant l'actionnement d'un ou de plusieurs éléments de pompage primaires en réponse à une variation détectée dans la demande de fluide hydraulique, puis, conformément au signal de pression reçu du capteur de pression à distance, l'actionnement sup-

plémentaire d'un ou de plusieurs éléments de pompage supplémentaires.

13. Procédé selon la revendication 12, comprenant l'actionnement d'un ou de plusieurs des éléments de pompage primaires en utilisant un variateur de vitesse et comprenant l'actionnement d'un ou de plusieurs éléments de pompage supplémentaires en utilisant un entraînement direct en ligne.
14. Programme informatique, enregistré sur un support de données lisible par machine (200), et contenant des instructions agencées, lorsqu'elles sont chargées sur une plate-forme informatique appropriée, de façon à faire effectuer au système selon les revendications 1 à 9 un procédé selon l'une quelconque des revendications 10 à 13.

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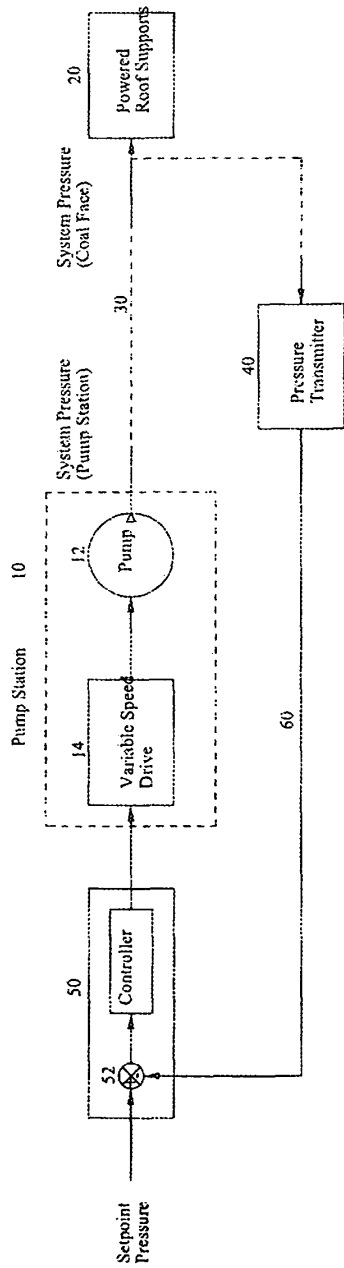


Figure 1 100

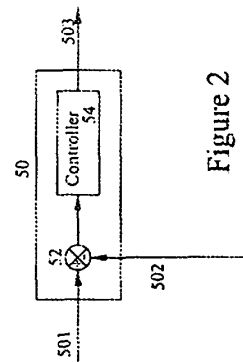


Figure 2

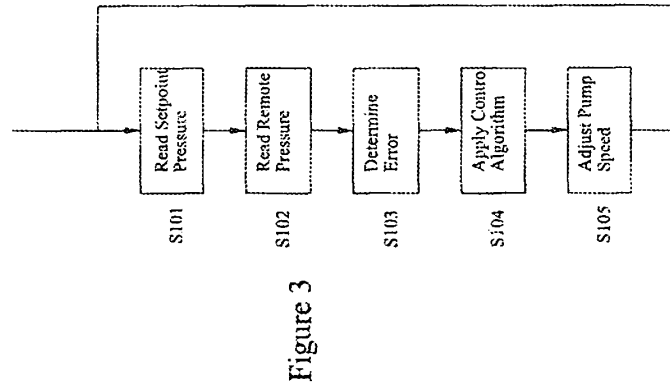
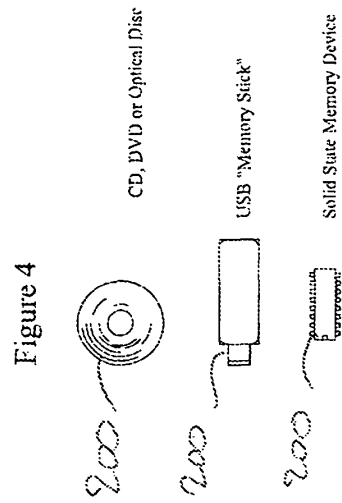


Figure 3



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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