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(54)

ARRANGEMENT FOR FEEDING BULK-LIKE RESIN, MINING MACHINE AND METHOD

- (57)

An arrangement for resin injection, a mining machine, and a method. The arrangement comprises separate reservoirs (13, 14) and pumping units (17, 18) for a base component A and resin component B. There is also a reservoir (15) and a feed unit (23) for an accelerator
- component K which is implemented for adjusting setting time for the produced grouting resin (Gr). The components of the grouting resin are mixed together in one or more mixers (M, M1, M2).

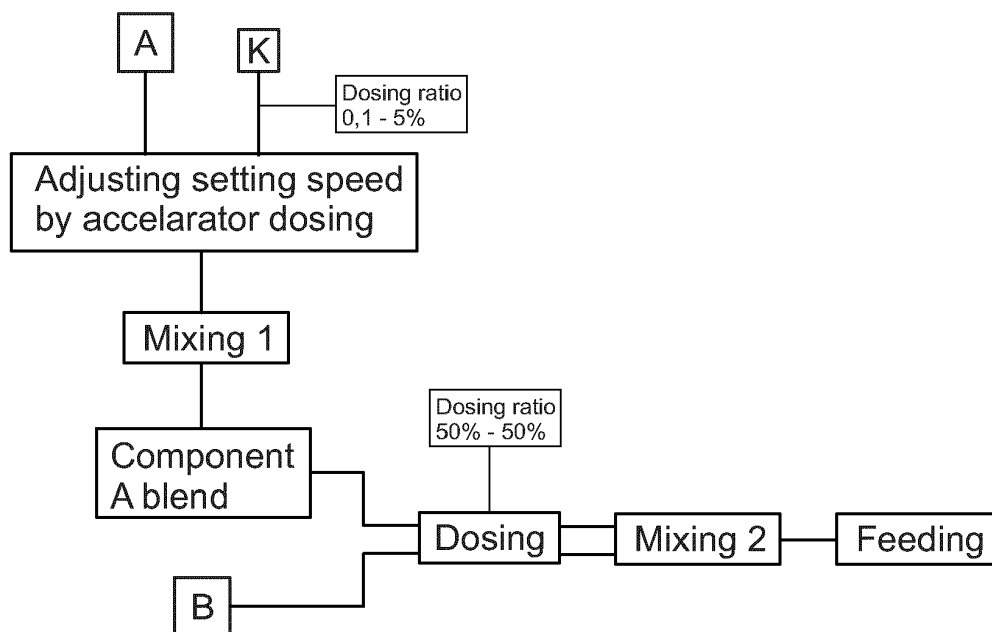


FIG. 8

Description

Background of the invention

[0001] The invention relates to an arrangement for feeding bulk-like grouting resin into drilled holes when reinforcing rock surfaces. More specifically the solution relates to use of different resin components.

[0002] The invention further relates to a mining machine provided with an apparatus for injecting grouting material and to a method of feeding bulk-like grouting resin into a drilled hole.

[0003] The field of the invention is defined more specifically in the preambles of the independent claims.

[0004] In mines, construction sites and at other work areas exists a need to reinforce rock surfaces and to thereby ensure their safety and suitability for the intended purposes. A common method for rock reinforcement is rock bolting. In such reinforcement system several rock bolts are fastened in drilled holes by grouting material. In this way rock layers are bonded together so that the risk for collapse is reduced. There are several different systems for feeding the grouting material. However, the present solutions have shown to contain some disadvantages.

Brief description of the invention

[0005] An object of the invention is to provide a novel and improved arrangement, mining machine and method for feeding grouting material to drilled holes.

[0006] The arrangement according to the invention is characterized by the characterizing features of the first independent apparatus claim.

[0007] The mining machine according to the invention is characterized by the characterizing features of the second independent apparatus claim.

[0008] The method according to the invention is characterized by the characterizing features and steps of the independent method claim.

[0009] An idea of the disclosed solution is that bulk-like resin in pumpable form is injected into drilled holes before inserting rock bolts or other reinforcements into the drilled holes. Further, the inserted grouting resin is a mixture comprising a resin base component A and a resin component B for activating the hardening process of the produced two-component resin material. Further, the produced grouting resin mixture is provided with an accelerator component K in desired mix ratio for providing the mixture with different setting times. The accelerator component K is blended in the base component A and thereby determines how fast hardening process the grout resin has.

[0010] The disclosed arrangement comprises at least three separate reservoirs for the components of the grouting resin. A first reservoir is for the resin base component A, a second reservoir is for the resin component B, and a third reservoir is for the accelerator component.

There are also dedicated pumping units for feeding the base component A and for feeding the resin component B. A separate and independently controllable feed unit is provided for feeding the accelerating component K.

5 The arrangement comprises one or more mixers for mixing the components A, B and K for producing the hardening grouting resin. The produced grouting resin with the desired setting time can be conveyed to an injector head which is to be inserted inside the drilled hole for injecting the grouting resin.

10 **[0011]** In other words, the disclosed solution is configured to mix at least one pumpable base component A with the accelerator component K and to mix them with the resin component B. The arrangement for making the grouting resin with the desired setting time comprises two independently controllable pumping units for the base component A and the resin component B, and also an independently controllable feed unit for dosing the accelerator component K.

15 **[0012]** An advantage of the disclosed solution is that by varying relative amount of the accelerator component K, setting times of the produced grouting resins can be adjusted in a versatile manner. Changes in required setting times of the used grouting resins can be executed quickly without preparatory measures. Savings in time and component materials can be achieved since there is no need to empty the system when change in the resin hardening speed is needed. The base component A may be of type having very slow setting time. The base component A may in some cases be nearly in-active material as such. The use of accelerator component K speeds up the setting time. The speed of the setting time is dependent on the amount of the accelerator component K. The greater is the dosing of the accelerator component K, the greater is the setting speed. The actual hardening initiates when the base component blend A+K is mixed with the resin component B.

20 **[0013]** According to an embodiment, the mentioned at least three separate reservoirs for components of the grouting resin are all located onboard a mining vehicle. Thus, the mining vehicle is provided with the reservoirs for the components A, K and B.

25 **[0014]** According to an embodiment, the mentioned at least three separate reservoirs for the components A, K and B are sealed onboard reservoirs. Further, the reservoirs may be thermally insulated so that temperatures of the used components may be controlled, and effects of temperature circumstances may be reduced.

30 **[0015]** According to an embodiment, the reservoirs for the components A, K and B may be easily replaceable reservoirs whereby empty reservoirs can be substituted quickly with new full reservoirs. The reservoirs may be handled by means of cranes or forklift trucks, for example.

35 **[0016]** According to an embodiment, the mixing ratio between the components A and K is 0.1 - 5%. In other words, only few percentages, or per mil of accelerator component K is needed. Then the third reservoir for the accelerator component K may be with relatively small

size and volume.

[0017] According to an embodiment, mixing ratio between the base component blend A+K and the component B is 1:1.

[0018] According to an embodiment, each of the pumping units comprises a dedicated pump and a dedicated motor. The motor may be an electrical motor.

[0019] According to an embodiment, the arrangement comprises a flushing system for flushing the resin production system. The flushing system can flush the mixer configured to mix the resin components and can also flush a feed line wherein the hardening resin is conveyed forwards in the system. The flushing system comprises a solvent or cleaner reservoir and at least one pumping unit. There may be two pumping units so that component lines prior to mixers may be flushed.

[0020] According to an embodiment, the arrangement comprises a flushing system for flushing. The flushing system comprises a solvent reservoir and at least one solvent pumping unit. There may be two solvent pumping units so that component lines prior to the mixer may also be flushed.

[0021] The flushing system may use solvent or any suitable cleaner media for the flushing.

[0022] According to an embodiment, the arrangement may be configured to flush the system by means of the base component A which may have very long setting time.

[0023] According to an embodiment, the arrangement comprises a valve assembly, or valve block, provided with several non-return valves for allowing resin component flows towards the mixer and preventing back flow. The non-return valves may be spring loaded valves, for example. The valve assembly may be located prior the mixer wherein all the resin components are mixed together.

[0024] According to an embodiment, the base component A and the accelerating component K are mixed together prior being mixed with the resin component B. Therefore, the arrangement comprises a preliminary mixer for receiving the base component A and the accelerator component K and mixing the base component A and the accelerator component K for providing a base component blend A+K. There is also a primary mixer for receiving and mixing the base component blend A+K and the component B for producing the hardening grouting resin. Thus, this embodiment comprises at least two mixers.

[0025] According to an alternative embodiment, the base component A and the accelerating component K are not premixed but are fed directly and simultaneously together with the component B to the primary mixer. Thus, the arrangement comprises a shared primary mixer configured to receive the base component A, the accelerator component K, and the component B for producing the hardening grouting resin. In this solution all three components are conveyed to the primary mixer through dedicated lines. One mixer i.e., the primary mixer, is suf-

ficient to mix all the components of the grouting resin.

[0026] According to an embodiment, the base component A and the accelerator component K are fed through a common feed line to the mentioned primary mixer, whereby the fed components may mix together inside the feed line at least in some extent even though there is not necessarily any separate preliminary mixer device involved.

[0027] According to an alternative embodiment, at least one control unit is configured to control the first pumping unit and the feed unit for determining ratio of the base component A and the accelerator component K for providing the produced grouting resin with selected setting time. In other words, it is possible to produce grouting resins with different hardening speeds by simply controlling the first pumping unit and the feed unit under control of the control unit. Thereby, it is possible to change the ratio between the components A and K at any time and with desired amount. Stepless adjustment may be implemented. Resin hardening times can be adjusted for the whole injection length.

[0028] According to an embodiment, the disclosed solution allows injecting different grouting resin zones inside the drilled holes. Further, it is possible to change the properties of the injected grouting resin in a sliding manner so that there are no clear transition points detectable between successive injected zones. Thus, the setting times of the injected grouting material can change continuously on the fly.

[0029] According to an embodiment, the control unit is configured to control the blending or mixture of the components A and K in response to control commands or instructions provided by an operator through a user interface. Alternatively, the control unit is provided with a grouting plan or program and is configured to control the blending of the components A and K automatically in accordance with the received data.

[0030] According to an embodiment, the control unit is provided with data on circumstances at a work site and is configured to adjust the ratio between the A and K components in accordance with the received data. The received data may comprise for example data on temperature and pressure conditions of the work site. This way the effect of the circumstances to the hardening speed of the grouting resin can be taken into consideration and compensated by the blending ratio.

[0031] According to an embodiment, the feed unit for feeding the accelerator component K is a dosing cylinder device. The device comprises a dosing piston arranged movably inside a dosing cylinder and separates two dosing spaces capable of receiving doses of the accelerator component K. In other words, the accelerator component K is dosed by means of the dosing cylinder device wherein the dosing piston pushes the received dose forwards in the system. An advantage of the dosing cylinder is that it is accurate for small doses. Further, the structure is relatively simple, reliable, and inexpensive.

[0032] According to an embodiment, the dosing piston

can be moved by means of a dosing actuator, which may be a fluid operated cylinder or motor, or alternatively, electrically operable actuators can be implemented for moving the dosing piston.

[0033] According to an embodiment, the dosing cylinder device is a double-acting device and is configured to execute dosing of the accelerating component in both movement directions of the dosing piston. This embodiment improves dosing effectivity.

[0034] According to an embodiment, the feed unit may alternatively be a third pumping unit comprising a third pump and a third motor.

[0035] According to an embodiment, the feed unit may alternatively be a unidirectional feed cylinder provided with one volume for receiving the dosed component, or the feed unit may comprise a gear pump or an diaphragm pump, for example.

[0036] According to an embodiment, the feed unit may comprise both a dosing cylinder device and the third pumping unit. Then, operation of the dosing cylinder device and the third pumping unit can be selected in accordance with need.

[0037] According to an embodiment, the resin component B is a substrate for a chemical reaction to start turning the resin mixture A+K+B from liquid to solid.

[0038] According to an embodiment, the resin component B comprises isocyanates.

[0039] According to an embodiment, the base component A comprises modified water glass material.

[0040] According to an embodiment, the disclosed solution relates also to a mining machine comprising: a movable carrier; at least one boom connected movably on the carrier; an arrangement for injecting bulk-like grouting resin into drilled holes; at least one bolting unit at a distal end of the boom for feeding rock bolts into the drilled holes after being injected with the grouting resin. The arrangement for injecting the grouting resin is in accordance with the features and embodiments disclosed in this document.

[0041] According to an embodiment, the disclosed solution may be implemented in different rock drilling rigs, bolting jumbos and vehicles designed for rock reinforcing. The system may also be retrofitted to the existing mining vehicles.

[0042] According to an embodiment, the disclosed solution relates also to a method of injecting bulk-like grouting resin into a drilled hole. The method comprises: feeding at least one resin base component A and resin component B to a mixer for producing grouting resin; feeding the produced grouting resin from the mixer to an injector head inserted inside the drilled hole; and inserting a metallic rock reinforcement inside the drilled hole provided with the grouting resin. The method further comprises providing the produced grouting resin with an accelerator component K and varying blending ratio of the base component A and the accelerator component K for adjusting hardening speed of the grouting resin fed inside the drilled hole.

[0043] According to an embodiment, the method further comprises varying the blending ratio of the base component A and the accelerator component K during injection of the grouting material into one drilled hole whereby the grouting resin inside the drilled hole comprises at least two different hardening speeds. In other words, the blending ratio is varied during the injection process of one drilled hole.

[0044] According to an embodiment, the blending ratio is varied between neighboring drilled holes.

[0045] According to an embodiment, the method further comprises adjusting the hardening speed of the grouting material continuously during the injection of the grouting resin. In other words, the amount of the dosed accelerator component K may be changed steplessly for the duration of the entire injection process of one drill hole, or at one or more periods of injection process of one drill hole.

[0046] According to an embodiment, the method further comprises premixing the base component A and the accelerator component K in a preliminary mixer for producing a base component blend A+K; feeding the produced base component blend A+K and the resin component B to a primary mixer and producing the hardening grouting resin in the primary mixer; and varying blending ratio of the base component A and the accelerator component K fed to the preliminary mixer for adjusting the hardening speed of the grouting resin.

[0047] According to an embodiment, the method further comprises providing an injection head with the primary mixer and mixing the base component blend A+K and the resin component B together inside the drilled hole.

[0048] According to an embodiment, the method further comprises mixing the base component blend A+K and the resin component B together outside the drilled hole and feeding the mixed grouting resin to an injection head inside the drilled hole.

[0049] According to an embodiment, the method further comprises feeding the base component A, the accelerator component K, and the resin component B separately to a primary mixer wherein the three components are mixed together.

[0050] According to an embodiment, the method further comprises dosing the accelerator component K by means of a movable piston of a dosing cylinder device.

[0051] According to an embodiment, the drilled holes may be equipped with rock bolts, rock anchors, cables or corresponding elongated metallic or non-metallic reinforcing elements after the grouting material has been injected. Thus, there are several alternative rock reinforcements that can be mounted inside the drill holes.

[0052] According to an embodiment, the apparatus comprises a solvent or cleaner feeding system configured to feed solvent medium or cleaning medium for flushing the injector head and the mixing device. The aim of the system is to prevent clogging in situations when there are breaks between the injections of the drilled

holes. The mentioned control unit may also control the solvent or cleaning system and its pumping units.

[0053] According to an embodiment, the mixing device comprises screw surfaces, spirals, a maze, or corresponding form surfaces for causing the fed resin component fluid flows to be mixed and to form one homogenous resin mass. The mixing device or element may be a static mixer with several non-movable mixing elements or surfaces for mixing the fed components together.

[0054] The above disclosed embodiments and features may be combined in order to form suitable solutions having those of the above features that are needed.

Brief description of the figures

[0055] Some embodiments are described in more detail in the accompanying drawings, in which

Figure 1 is a schematic side view of a mobile mining machine intended for underground drilling and rock reinforcing,

Figure 2 is a schematic side view of a drilled hole after being filled with resin material zones with different setting times,

Figure 3 is a schematic side view of a drilled hole after being filled with resin material wherein sliding change in different setting times of the resin material occurs,

Figure 4 is a schematic diagram illustrating motivation for use of different resin compositions and setting times,

Figure 5 is a schematic diagram showing basic principles of one embodiment for producing grouting resin with a blend of three components A, K, and B,

Figure 6 is a schematic view of an arrangement for producing and feeding grouting resin,

Figures 7 is a schematic view of another arrangement for producing grouting resin,

Figure 8 is a schematic view of a basic principle of another embodiment wherein premixing of the base component A and the accelerator component K is utilized,

Figure 9 is a schematic side view of an injector head arranged inside a drilled hole for injecting the grouting resin, and

Figure 10 is a schematic side view of drilled hole provided with a rock bolt and grouting resin zones with different hardening speeds.

[0056] For the sake of clarity, the figures show some embodiments of the disclosed solution in a simplified manner. In the figures, like reference numerals identify like elements.

Detailed description of some embodiments

[0057] Figure 1 shows a rock drilling rig, which is an example of a mining machine 1. The rock drilling rig com-

prises a movable carrier 2 and at least one boom 3 connected movably to the carrier 2. At a distal end portion of the boom 3 is a drilling unit or bolting insertion unit 4. The unit 4 may comprise a feed beam 5 and a rock drilling machine 6 supported on it. A drilling tool is connectable to the rock drilling machine 6. The rock drilling machine 6 comprises at least a rotating device for rotating the drilling tool around its longitudinal axis. The rock drilling machine 6 and the boom 3 may be turned so that drill holes 7 can be drilled to walls 8 and ceilings 9 of tunnels and other underground spaces in order to mount reinforcing rock bolts. The unit 4 may also be provided with a bolting unit 10 and an apparatus 11 for feeding grouting resin mixtures. The drilling machine 6, the bolting unit 10 and the resin feeding apparatus 11 may be connected to the drilling unit 4 so that they can be indexed on central axis of the drilled hole 7, or alternatively they all or some of them can be mounted to dedicated booms or other support structures. At the distal end of the boom 3 is at least one feed device 12 for moving the devices 6, 10, 11 relative to the distal end of the boom 3. Further, on the carrier 2 there may be a first reservoir 13 provided for a base component A, a second reservoir 14 provided for a resin component B, a third reservoir 15 for an accelerator component K, and a fourth reservoir 16 for solvent medium S. For clarity reasons, pumping units in connection with the reservoirs are not disclosed in Figure 1. The mining machine 1 comprises a control unit CU, which is configured to control the reinforcing operation and related apparatuses.

[0058] Figure 2 discloses a drilled hole 7 provided with an opening end part 7a and a bottom end part 7b. Inside the drilled hole 7 is injected hardening grouting resin Gr which is produced on-board the mining machine. Several different compositions of the grouting resin can be implemented so that the drilled hole 7 may comprise several zones Z1-Z3. Each zone Z1-Z3 may have different setting speed.

[0059] It is possible to inject to the bottom part 7b grouting resin zone Z1 with slower setting time so that the grouting resin has no time to get hardened before a rock bolt has been fed inside the drilled hole. This is beneficial especially when the drilled holes are long and the feeding of the grouting resin takes time.

[0060] In cases when preloaded rock bolts are used, it is possible to feed fast setting grouting resin mixture to the bottom part 7b of the drilled hole 7 so that the grouting resin hardens faster at the bottom and allows tensioning of the rock bolt.

[0061] Further, it is possible to implement different hardening zones at desired points of the drilled rock to allow filling of cracks in the rock. When the setting time of the grouting resin can be adjusted in a versatile manner, the filling process is facilitated.

[0062] Number of the zones Z1 - Zn may be greater than the exemplary three, such as four or five, or there may be only one or two zones. Any zone Z may be provided with any possible hardening speed and for any rea-

son. Thus, the disclosed solution allows providing individual grouting resin patterns for different needs, situations, and rock conditions.

[0063] Figure 3 discloses that instead of clear hardening zones there may be sliding type of change in composition of the grouting resin Gr and the implemented setting times. This allows an alternative way to provide different grouting resin patterns for the drilled holes.

[0064] Figure 4 discloses some reasons for using different resin compositions in the rock reinforcement and a need to adjust setting times. Conditions at a mine may vary. Especially operating depth in mine i.e., position of a work site needs to be considered when determining setting times for the grouting resins. Temperature, pressure circumstances and humidity usually have effect on the setting time.

[0065] Also, type and length of used rock bolts i.e., rock bolt specific requirements, as well as rock properties and rock quality, may require that the grouting resin hardening time needs to be adjustable and variable case by case.

[0066] Figure 5 discloses a simplified diagram of an arrangement for producing and feeding hardenable grouting resin. Variable dosing is utilized for feeding the base component A and the accelerating component K with a desired dosing ratio. The dosing ratio i.e., relative amount of the base component A and the accelerating component K determines the setting time of the produced grouting resin. The dosing ratio may vary between 0.1 - 50, for example. The resin component B, the base component A, and the accelerating component K are subjected to mixing process whereafter hardening of the mixture initiates. The produced hardenable grouting resin is thereafter fed or injected to a drilled hole.

[0067] Figure 6 discloses an arrangement comprising a dedicated first pumping unit 17 for feeding a base component A from a first reservoir 13 and a dedicated second pumping unit 18 for feeding resin component B from a second reservoir 14 via dedicated feed lines 19 and 20 towards a valve assembly 21 comprising several non-return valves 22. A feed unit 23 is configured to feed an accelerating component K from a third reservoir 15 via the feed line 19 towards the valve assembly 21. The feed line 19 may be common for the base component A and the accelerating component K whereby the components can mix together during the convey inside the feed line 19. Alternatively, there may be separate feed lines for the base component A and the accelerating component K. There are also two solvent pumping units 24 and 25 and corresponding solved feed lines 26 and 27 for feeding solvent from a solvent reservoir 16 towards the valve setting 21. The pumping units 17, 18, 24 and 25 comprise motors and pumps. The motors may be electrical motors and may be individually controlled by a control unit CU. The control unit CU may receive control commands and instructions via a user interface UI and may be provided with a grouting plan GB so that the control unit CU can control for example dosing ratios by controlling motors

of the pumping units 17, 18 and 22.

[0068] Resin components A, K and B fed to the valve setting 21 are conveyed to a mixer M wherein they are mixed properly together for activating hardening of the produced grouting resin. The produced grouting resin is conveyed from the mixer M to a grouting device GD for injecting the hardening grouting resin into a drilled hole.

[0069] The feed unit 23 may comprise an independently controllable pumping unit 28 provided with a motor and a pump. Alternatively, or in addition to, there may be a cylinder dosing device 29 comprising a feed cylinder 30 inside which a feed piston 31 is moved by means of an actuator 32. By means of a controllable selection device 33 it is possible to select whether the pumping unit 28 or the cylinder dosing unit 29 is utilized as the feed unit 23. However, it possible that there is only of the pumping unit 28 and the cylinder dosing unit 29 provided in the system.

[0070] The reservoirs 13 - 16 may comprise sealing structures 34 as well as heat insulating structures. This way surrounding effects, such as humidity, temperature, and pressure, to the used substances, can be diminished.

[0071] The solvent feed system can be used for flushing the resin components out of the mixer M and the feed system. The pumping unit 24 and the feed line 26 are for flushing the base component B, and the pumping unit 25 and the feed line 27 are for flushing the base component blend A+K out of the system.

[0072] Figure 7 discloses an arrangement which differs from the one shown in Figure 7 in that there are two mixers M1 and M2. M1 is a primary mixer and corresponds to the mixer M in Figure 6. M2 is a preliminary mixer for mixing the dosed base component A with the accelerating component K prior conveying them towards to the valve setting 2 and the primary mixer M1. In this solution a base component blend A+K is at first produced with desired mix ratio and only thereafter the base component blend A+K is mixed in the primary mixer M1 with the resin component B.

[0073] Figure 8 further demonstrates the solution of Figure 7 and shows the implemented two mixing and dosing steps.

[0074] Figure 9 discloses an injector head 35 arranged inside a drilled hole 7 and arranged to feed grouting resin Gr therein. The grouting resin Gr is submitted to the injector head 35 means of a feed line 36 and the injector head 35 is reversed R out of the drilled hole 7 during the injection process. Mixed grouting resin may be submitted to the injector head 35, or alternatively, there may be a primary mixer M1 in connection with the injector head 35 whereby the resin components are submitted to the drilled hole 7 and the final mixing is executed therein for producing the hardening grouting resin Gr.

[0075] Figure 10 discloses a drilled hole 7 provided with a rock bolt, or metallic rock reinforcement 37, and grouting resin Gr with zones Z1 and Z2 having different hardening speeds. The disclosed grouting resin feed sys-

tem is utilized for generating the zones Z1 and Z2.

[0076] The drawings and the related description are only intended to illustrate the idea of the invention. In its details, the invention may vary within the scope of the claims.

Claims

1. An arrangement for feeding bulk-like grouting resin (Gr) into a drilled hole (7) for rock reinforcement; wherein the arrangement comprises:

at least two separate reservoirs for components of the grouting resin, wherein a first reservoir (13) is for resin base component A and wherein a second reservoir (14) is for component B; pumping units (17, 18) for feeding the base component A and the component B from the reservoirs (13, 14);

at least one mixer (M, M1) for mixing at least the base component A and the component B together for producing the grouting resin (Gr) which is to be inserted inside the drilled hole (7);

characterized in that the arrangement further comprises:

a third reservoir (15) for an accelerator component K;

a feed unit (23) for feeding the accelerator component K from the third reservoir (15); and wherein the accelerator component K is configured to be blended with the base component A and the resin component B and wherein setting time of the produced grouting resin (Gr) is dependent on amount of the accelerator component K in the mixture comprising the base component A, the resin component B, and the accelerator component K.

2. The arrangement as claimed in claim 1, **characterized in that**, the arrangement further comprises:

a preliminary mixer (M2) for receiving the base component A and the accelerator component K and mixing the base component A and the accelerator component K for providing a base component blend A+K; and

a primary mixer (M1) for receiving and mixing the base component blend A+K and the component B for producing the hardening grouting resin (Gr).

3. The arrangement as claimed in claim 1, **characterized in that**,

the arrangement comprises a shared primary mixer (M) configured to receive the base component A, the

accelerator component K, and the component B for producing the hardening grouting resin (Gr).

4. The arrangement as claimed in any one of the preceding claims 1 - 3, **characterized in that**,

the arrangement comprises a first pumping unit (17) for feeding the base component A; and at least one control unit (CU) is configured to control the first pumping unit (17) and the feed unit (23) for determining ratio of the base component A and the accelerator component K for providing the produced grouting resin (Gr) with selected setting time.

5. The arrangement as claimed in any one of the preceding claims 1 - 4, **characterized in that**

the feed unit (23) for feeding the accelerator component K is a dosing cylinder device (29) comprising a dosing piston (31) arranged movably inside a dosing cylinder (30) and separating two dosing spaces capable of receiving doses of the accelerator component K.

6. A mining machine (1) comprising:

a movable carrier (2);

at least one boom (3) connected movably on the carrier (2);

an arrangement for injecting bulk-like grouting resin into drilled holes;

at least one bolting unit at a distal end of the boom (3) for feeding rock bolts (37) into the drilled holes (7) after being injected with the grouting resin (Gr);

characterized in that

the arrangement for injecting the grouting resin (Gr) is in accordance with any one of the previous claims 1 - 5.

7. A method of injecting bulk-like grouting resin (Gr) into a drilled hole (7), wherein the method comprises:

feeding at least one resin base component A and resin component B to a mixer (M, M1) for producing grouting resin (Gr);

feeding the produced grouting resin (Gr) from the mixer (M, M1) to an injector head (35) inserted inside the drilled hole (7); and

inserting a rock reinforcement element (37) inside the drilled hole (7) provided with the grouting resin (Gr);

characterized by

providing the produced grouting resin (Gr) with an accelerator component K;

and varying blending ratio of the base component A and the accelerator component K for adjusting hardening speed of the grouting resin

(Gr) fed inside the drilled hole (7) .

8. The method as claimed in claim 7, **characterized by**
 varying the blending ratio of the base component A
 and the accelerator component K during injection of
 the grouting resin (Gr) into one drilled hole (7) where-
 by the grouting resin (Gr) inside the drilled hole (7)
 comprises at least two different hardening speeds. 5

9. The method as claimed in claim 7 or 8, **character-** 10
ized by
 adjusting the hardening speed of the grouting resin
 (Gr) continuously during the injection of the grouting
 resin (Gr) . 15

10. The method as claimed in any one of the preceding
 claims 7 - 9, **characterized by**

 premixing the base component A and the accel-
 erator component K in a preliminary mixer (M2) 20
 for producing a base component blend A+K;
 feeding the produced base component blend
 A+K and the resin component B to a primary
 mixer (M1) and producing the hardening grout-
 ing resin (Gr) in the primary mixer (M1); 25
 and varying blending ratio of the base compo-
 nent A and the accelerator component K fed to
 the preliminary mixer (M2) for adjusting the hard-
 ening speed of the grouting resin (Gr) . 30

11. The method as claimed in claim 10, **characterized**
by
 providing an injection head (35) with the primary mix-
 er (M1) and mixing the base component blend A+K
 and the resin component B together inside the drilled 35
 hole (7). 35

12. The method as claimed in claim 10, **characterized**
by
 mixing the base component blend A+K and the resin 40
 component B together outside the drilled hole (7)
 and feeding the mixed grouting resin (Gr) to an in-
 jection head (35) inside the drilled hole (7). 40

13. The method as claimed in any one of the preceding 45
 claims 7 - 9, **characterized by**
 feeding the base component A, the accelerator com-
 ponent K and the resin component B separately to
 a primary mixer (M) wherein the three components
 are mixed together. 50

14. The method as claimed in any one of the preceding
 claims 7 - 13, **characterized by**
 dosing the accelerator component K by means of a
 movable piston (31) of a dosing cylinder device (29). 55

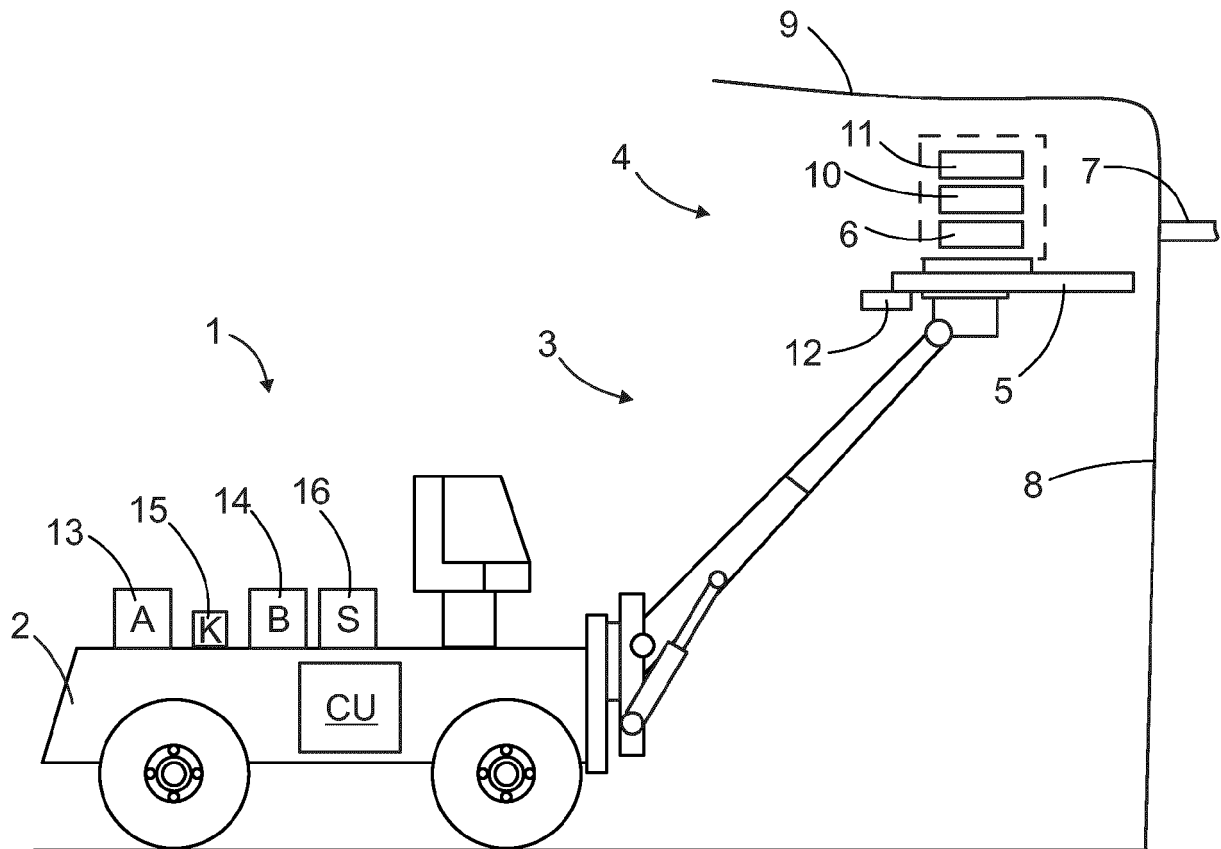


FIG. 1

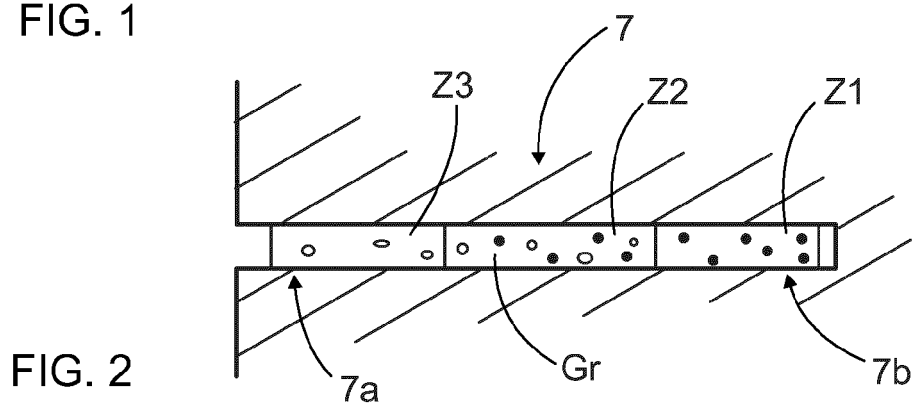


FIG. 2

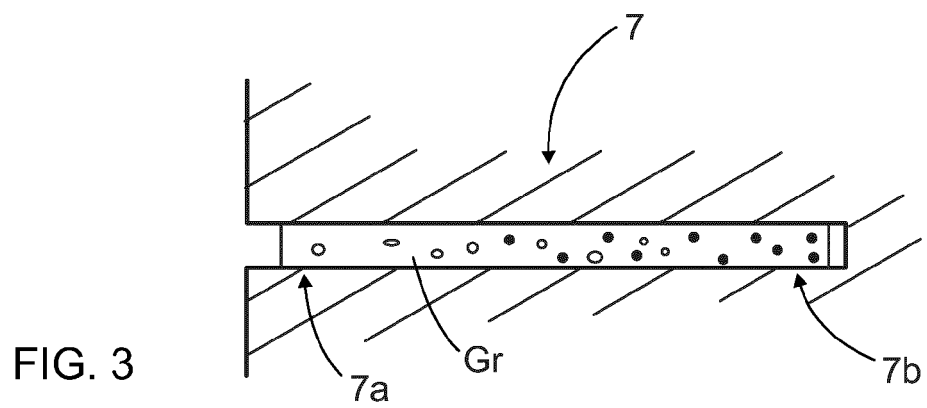


FIG. 3

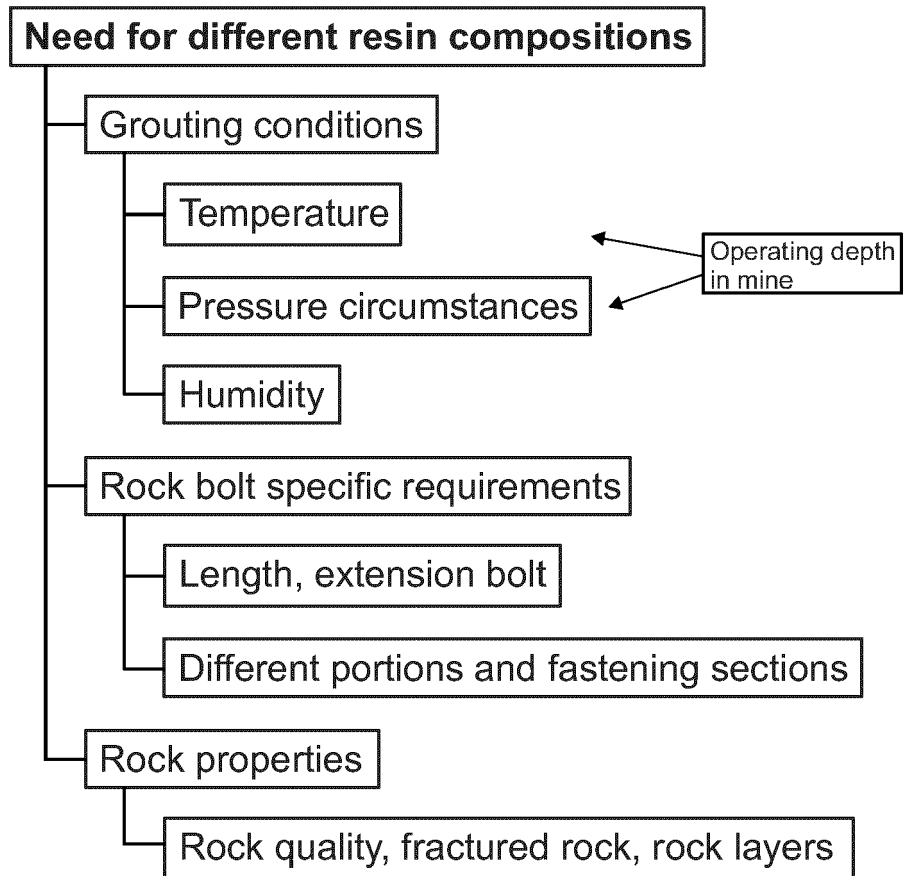


FIG. 4

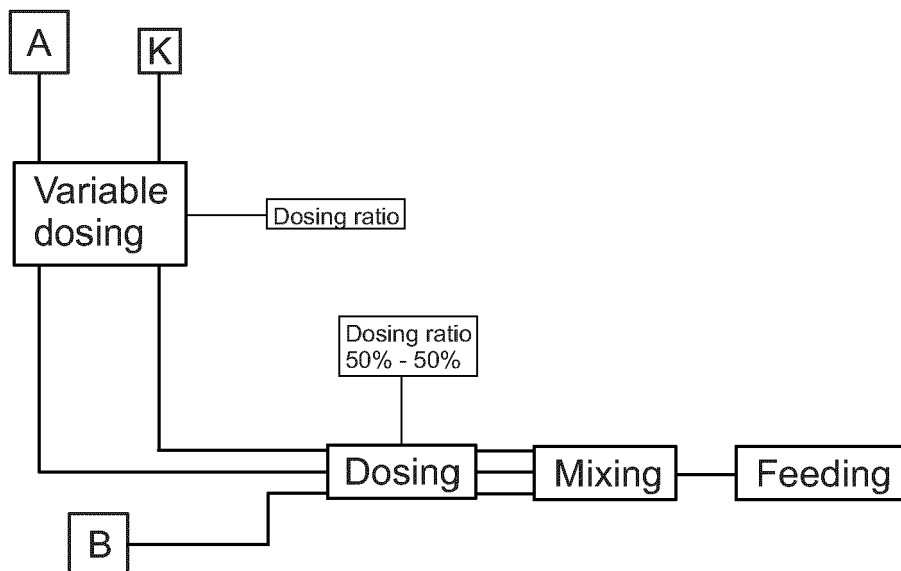


FIG. 5

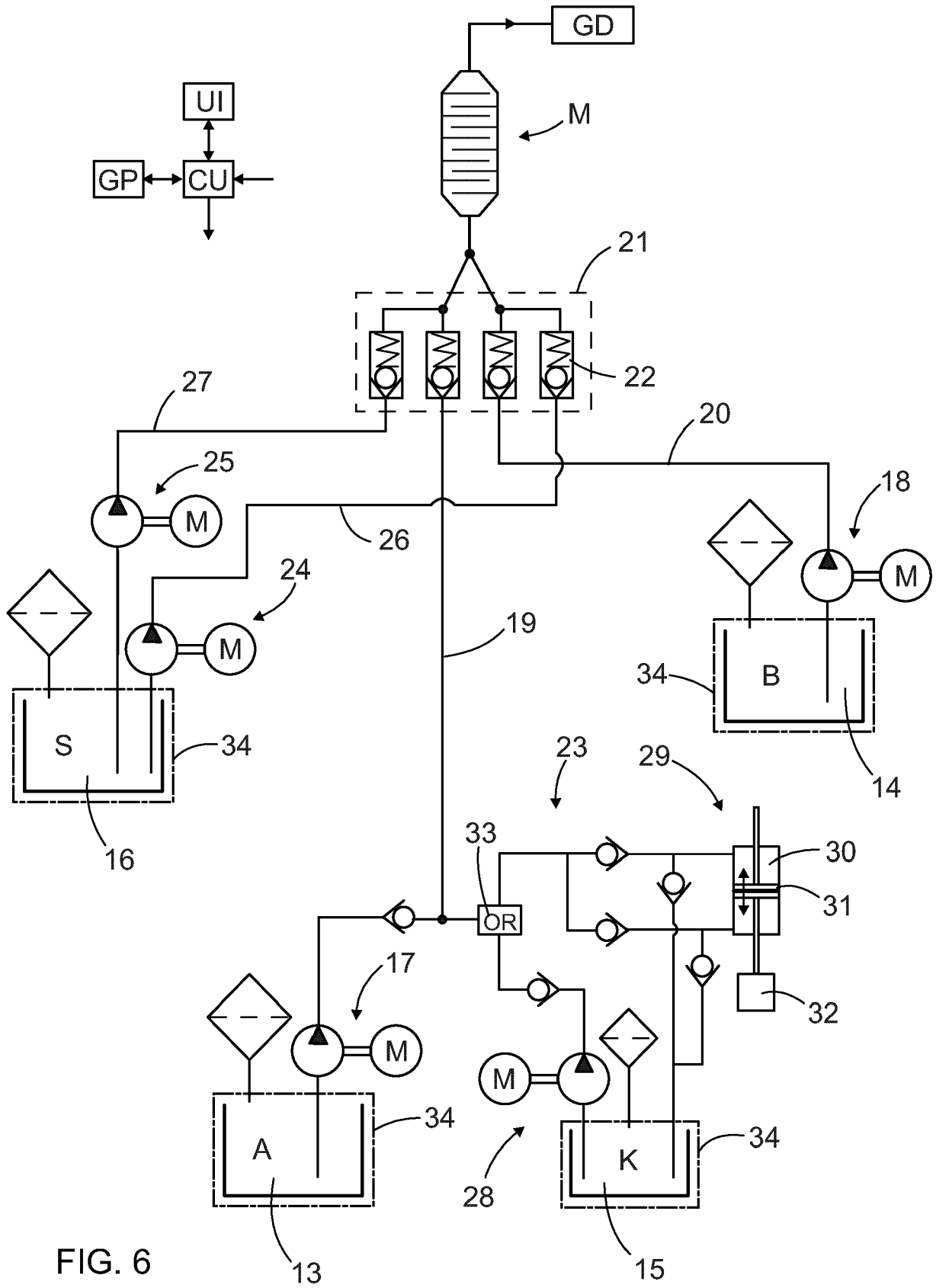


FIG. 6

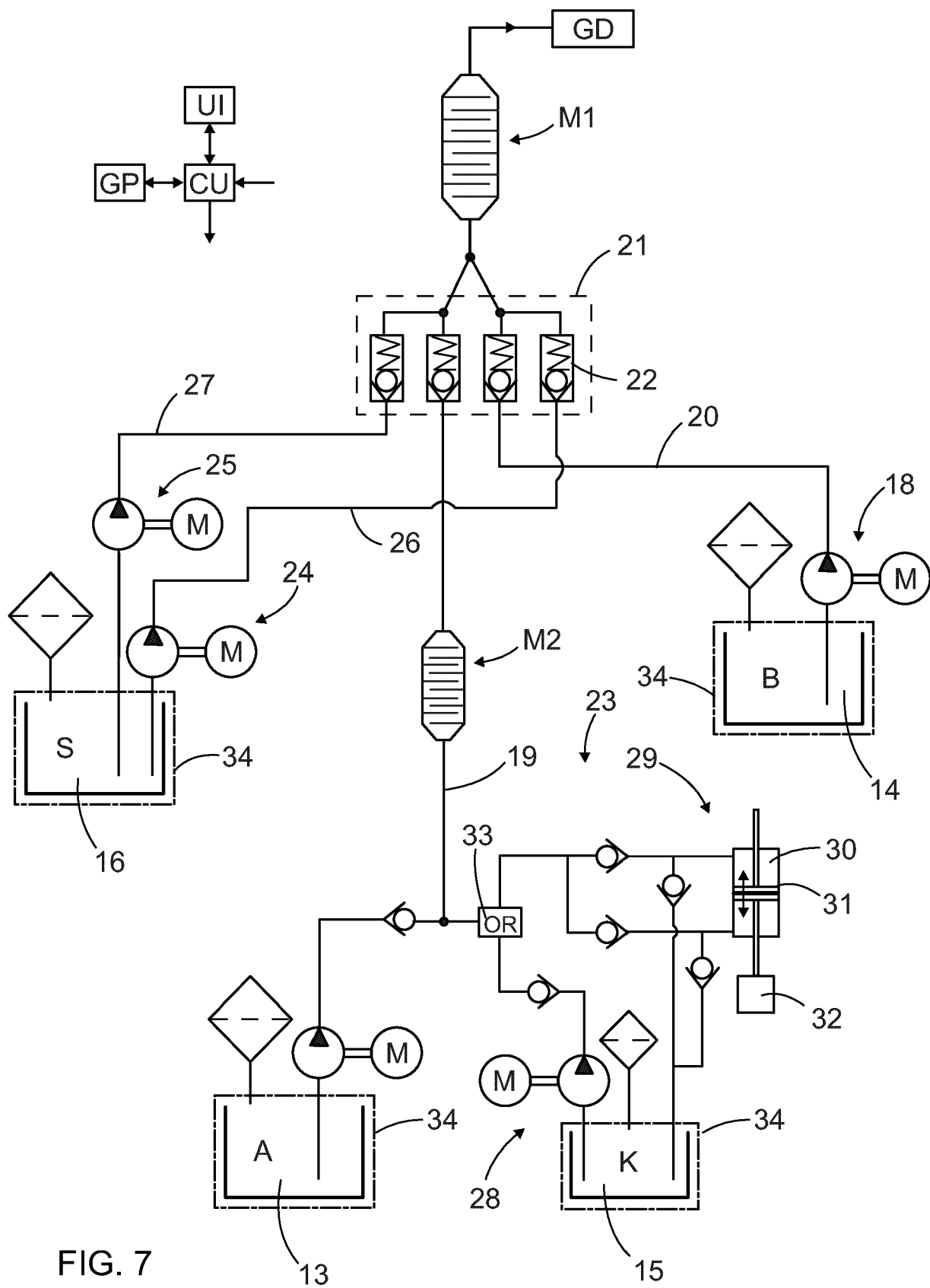


FIG. 7

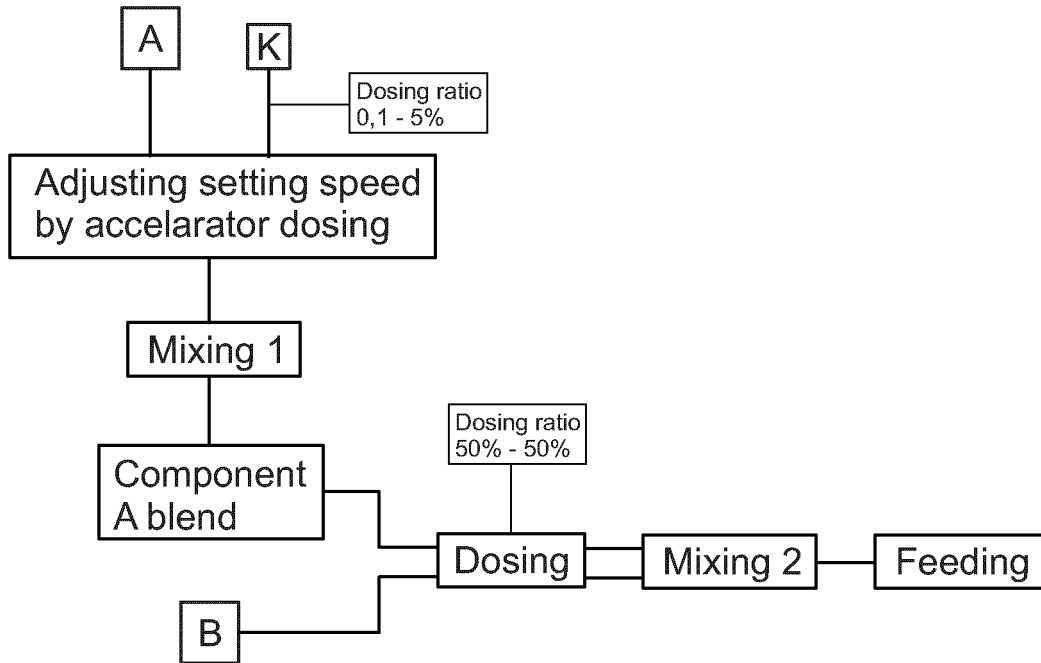


FIG. 8

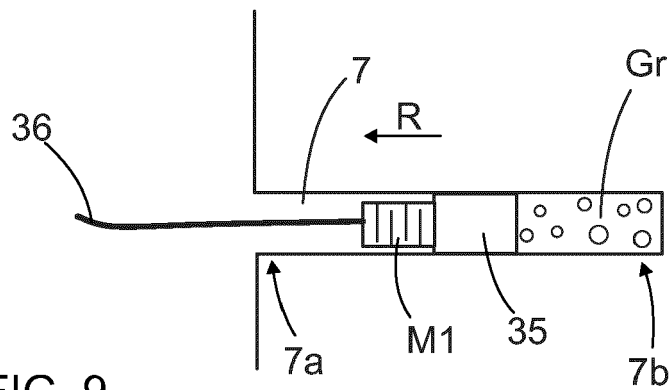


FIG. 9

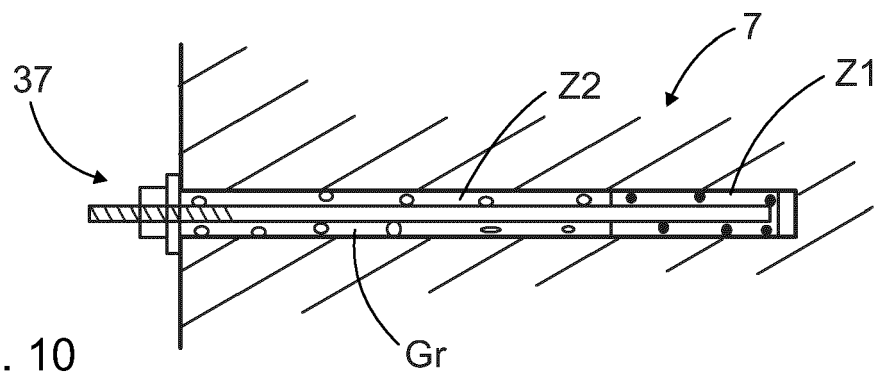


FIG. 10



EUROPEAN SEARCH REPORT

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	FR 3 123 679 A1 (WEBER MINING & TUNNELLING [FR]) 9 December 2022 (2022-12-09)	1-4, 7, 12, 13	INV. E21D20/02
Y	* paragraphs [0003] - [0034]; figure 1 *	6, 8, 10	E21D20/00
A	-----	5, 14	
Y	EP 3 901 410 A1 (SANDVIK MINING AND CONSTRUCTION LYON SAS [FR] ET AL.) 27 October 2021 (2021-10-27)	6, 8, 10	
A	* paragraphs [0032] - [0034]; figures 1-6 *	1-5, 7, 12-14	

			TECHNICAL FIELDS SEARCHED (IPC)
			E21D E02D
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		26 September 2023	Brassart, P
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			



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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

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- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

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- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

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LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

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see sheet B

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- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

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- ☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

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- ☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

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1-8, 10, 12-14

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- ☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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**LACK OF UNITY OF INVENTION
SHEET B**

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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-8, 10, 12-14

a dosing cylinder device,

2. claim: 9

**continuously adjusting the hardening speed of the grouting
resin**

3. claim: 11

an injection head provided with a primary mixer

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 23 16 8438

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

26-09-2023

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