(22) Date de dépôt/Filing Date: 2016/10/04
(41) Mise à la disp. pub./Open to Public Insp.: 2018/04/04
(51) Cl.Int./Int.Cl. E04H 17/26 (2006.01), E04H 17/16 (2006.01)
(71) Demandeur/Applicant: STURDA INC., CA
(72) Inventeur/Inventor: LAMOND, ROBERT, CA...
(74) Agent: GOWLING WLG (CANADA) LLP

(54) Titre : CLOTURE DE REMPLISSAGE, ET METHODE ET SYSTEME D'INSTALLATION ASSOCIEE
(54) Title: FILL FENCE AND METHOD AND SYSTEM FOR INSTALLING SAME

(57) Abrégé/Abstract:
A method of installing a fill fence at a preselected location in an unsafe zone. The method includes providing a carrier system including a carrier assembly, locating the carrier assembly in a safe zone adjacent to the unsafe zone, and positioning an
(57) Abrégé(suite)/Abstract(continued):
assembled fill fence on the carrier assembly. The carrier assembly and the fill fence are moved from the safe zone to a
predetermined location in the unsafe zone. With the carrier assembly at the predetermined location, the fill fence is positioned
substantially vertically at the preselected location, and installed therein. Shotcrete is applied at least partially to the fill fence in the
preselected location, to substantially seal the fill fence around its edges. The carrier assembly is disengaged from the fill fence and
moved from the unsafe zone to the safe zone.
ABSTRACT

A method of installing a fill fence at a preselected location in an unsafe zone. The method includes providing a carrier system including a carrier assembly, locating the carrier assembly in a safe zone adjacent to the unsafe zone, and positioning an assembled fill fence on the carrier assembly. The carrier assembly and the fill fence are moved from the safe zone to a predetermined location in the unsafe zone. With the carrier assembly at the predetermined location, the fill fence is positioned substantially vertically at the preselected location, and installed therein. Shotcrete is applied at least partially to the fill fence in the preselected location, to substantially seal the fill fence around its edges. The carrier assembly is disengaged from the fill fence and moved from the unsafe zone to the safe zone.
FILL FENCE AND METHOD AND SYSTEM FOR INSTALLING SAME

BACKGROUND OF THE INVENTION

[0001] As is well known in the art, fill fences are used in underground mining to hold backfill in a mined-out stope, or other opening. Construction of the fill fence, previously a labour-intensive task, is now less so due to recently-developed fill fences, for example, as described in Canadian patent application no. 2,892,348.

[0002] However, there are a number of unresolved problems in the prior art. First, installing the fill fence typically requires workers to be present at the locations at the side walls and the back where the fill fence is to be installed, to secure the fill fence to the side walls and the back. Because these locations are immediately adjacent to a relatively large mined-out region, they are usually considered unsafe, and the workers are at risk when they are working in these locations. Second, the problem of securing the fill fence to the back and the side walls has typically been addressed using labour-intensive methods.

SUMMARY OF THE INVENTION

[0003] For the foregoing reasons, there is a need for a fill fence and a method and system for installing same that overcome or mitigate one or more of the disadvantages or defects of the prior art. Such disadvantages or defects are not necessarily included in those described above.

[0004] In its broad aspect, the invention provides a carrier assembly for at least partially installing a fill fence. The carrier assembly includes a chassis subassembly having a chassis and a motive means mounted to the chassis, for propelling the chassis, and a mast subassembly to which the fill fence is securable. The mast subassembly includes a mast frame and movable fastening elements mounted on the mast frame and controllable for alternately securing one or more preselected portions of the fill fence to the mast frame and releasing the preselected portions therefrom. The carrier assembly also includes a lifting subassembly for raising the mast frame from a lowered position in which the mast frame is substantially horizontal to a substantially vertical raised position when the fill fence is secured to the mast frame, and for lowering the mast frame from the raised position to the lowered position when the fastening elements have released the preselected portions.
[0005] In another aspect, the invention provides a carrier system including the carrier assembly and a control unit for remote control of the carrier assembly, the control unit being operably connected with one or more securing means for securing the fill fence to a plurality of walls at a preselected location, to control the securing means.

[0006] In another of its aspects, the invention provides a method of installing a fill fence at a preselected location in an unsafe zone. The method includes providing the carrier system, and locating the carrier assembly in a safe zone adjacent to the unsafe zone. With the mast frame in the lowered position, one or more preselected portions of the fill fence are positioned on the mast frame, the preselected portions of the fill fence being securable to the mast frame by the fastening elements. With the fastening elements, the preselected portions of the fill fence are secured to the mast frame. The carrier assembly, with the fill fence secured to the mast frame, is moved from the safe zone to a predetermined location in the unsafe zone from which the fill fence may be positioned in the preselected location by the carrier system. With the carrier assembly at the predetermined location, the mast frame is raised to the raised position, to position the fill fence substantially vertically at the preselected location. Via the control unit, the securing means is activated, to secure the fill fence in a substantially vertical position to the plurality of walls in the preselected location. Shotcrete is applied at least partially to the fill fence in the preselected location, to substantially seal the fill fence around its edges. With the fastening elements, the preselected portions of the fill fence are released from the mast frame. The mast frame is moved to the lowered position. The carrier assembly is moved from the unsafe zone to the safe zone.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The invention will be better understood with reference to the attached drawings, in which:

[0008] Fig. 1 is an isometric view of an embodiment of a carrier assembly of the invention;

[0009] Fig. 2A is an isometric view of the carrier assembly of Fig. 1 with a central post of a fill fence positioned on a lowered mast frame of the carrier assembly;

[0010] Fig. 2B is an isometric view of the central post and the carrier assembly of Fig. 2A in which fastening elements are positioned to secure the central post to the mast frame;
[0011] Fig. 3 is an isometric view of the central post and the carrier assembly of Fig. 2B with a portion of a cross-member of the fill fence is attached to the central post;

[0012] Fig. 4 is an isometric view of the carrier assembly and the central post of Fig. 3, with a number of cross-members of the fill fence attached to the central post, drawn at a smaller scale;

[0013] Fig. 5 is an isometric view of the cross-members and central post of Fig. 4 with side plates secured at the ends of the cross-members;

[0014] Fig. 6 is an isometric view of the central post and cross-members of Fig. 5 with a number of air cylinder subassemblies mounted to one of the side plates, including rebar elements respectively;

[0015] Fig. 7A is an isometric view of the cross-members and other elements of the fill fence of Fig. 6 with an inner side of a section of an expandable mesh element attached to the side plates;

[0016] Fig. 7B is an isometric view of a portion of the section of the expandable mesh element of Fig. 7A and an air cylinder subassembly, drawn at a larger scale;

[0017] Fig. 8A is a partially exploded isometric view of the section of the expandable mesh element and the air cylinder subassembly of Fig. 7B with a connector element;

[0018] Fig. 8B is an isometric view of the section of the expandable mesh element and the air cylinder subassembly of Fig. 8A in which the connector element secures an outer end of the rebar element at an outer side of the expandable mesh element;

[0019] Fig. 9A is an isometric view of a screen positioned on the cross-members mounted to the central post, drawn at a smaller scale;

[0020] Fig. 9B is an isometric view of end portions of wires of the screen of Fig. 9A positioned in a hole in the side plate, drawn at a larger scale;

[0021] Fig. 10A is an isometric view of a geotextile fabric sheet covering the screen of Fig. 9A, drawn at a smaller scale;
Fig. 10B is an isometric view of the end portions of Fig. 9B positioned through an outer strip of the geotextile fabric sheet of Fig. 10A, with the end portion positioned substantially parallel to the side plate, drawn at a larger scale;

Fig. 10C is an isometric view of the end portions of Fig. 10B in which the end portions are bent inwardly to be non-parallel to the side plate;

Fig. 10D is an isometric view of the assembled fill fence positioned on the carrier assembly, drawn at a smaller scale;

Fig. 11 is an isometric view of the system with the fill fence positioned on the carrier assembly, and the fill fence and the carrier assembly moving into an unsafe zone, drawn at a smaller scale;

Fig. 12 is an isometric view in which the mast frame is between its lowered position and its raised position, with the carrier assembly being at a predetermined location in the unsafe zone;

Fig. 13 is an isometric view of the mast frame of Fig. 12 in a further raised position;

Fig. 14A is an isometric view in which the carrier assembly is in the predetermined location and the mast is in a substantially vertical position, to locate the fill fence in the preselected location;

Fig. 14B is an isometric view of the carrier assembly and the fill fence of Fig. 14A in which the air cylinder subassemblies have been activated, to extend the rebar to engage the side walls so that the expandable mesh elements are expanded;

Fig. 14C is an elevation view showing the expandable mesh element in an expanded condition, with the rebar elements engaging the side wall, drawn at a larger scale;

Fig. 15 is an isometric view showing the mast frame disengaged from the central post, drawn at a smaller scale;

Fig. 16 is an isometric view showing the fill fence installed at the preselected location and the carrier assembly being withdrawn from the predetermined location;
[0033] Fig. 17 is an isometric view of the fill fence installed in the preselected location and the carrier assembly further withdrawn from the predetermined location;

[0034] Fig. 18 is an isometric view showing the fill fence installed in the preselected location and the mast frame on the withdrawn carrier assembly in the lowered position;

[0035] Fig. 19 is an isometric view of the fill fence installed in the preselected location;

[0036] Fig. 20A is an elevation view of the fill fence installed in the preselected location, drawn at a larger scale;

[0037] Fig. 20B is an elevation view of the installed fill fence of Fig. 20A to which shotcrete has been applied, to form a fill fence system; and

[0038] Fig. 21 is a cross-section in plan view of the fill fence system of Fig. 20B, drawn at a smaller scale.

DETAILED DESCRIPTION

[0039] In the attached drawings, like reference numerals designate corresponding elements throughout. Reference is first made to Figs. 1-14B and 15-18 to describe an embodiment of a carrier assembly of the invention indicated generally by the numeral 20. As will be described, the carrier assembly 20 is for at least partially installing a fill fence 22 (Figs. 10D, 17, 18). In one embodiment, the carrier assembly 20 preferably includes a chassis subassembly 24 having a chassis 26 and a motive means 28 mounted to the chassis 26, for propelling the chassis 26, and a mast subassembly 30 to which the fill fence 22 is securable (Figs. 1-10D). Preferably, the mast subassembly 30 includes a mast frame 32 and movable fastening elements 34 (Figs. 1-2B) mounted on the mast frame 32 and controllable for alternately securing one or more preselected portions 36 of the fill fence 22 to the mast frame 32 and releasing the preselected portions 36 therefrom, as will also be described. In one embodiment, the carrier assembly 20 preferably also includes a lifting subassembly 38 for raising the mast frame 32 from a lowered position (Figs. 1-11), in which the mast frame 32 is substantially horizontal, to a substantially vertical raised position (Figs. 14A, 14B, 15) when the fill fence 22 is secured to the mast frame 32, and for lowering the mast frame 32 from the raised position to the lowered position when the fastening elements 34 have released the preselected portions 36.
[0040] In one embodiment, the motive means 28 preferably includes wheels 39 suitably mounted to the chassis 26, for engagement with the floor "F" (Fig. 20A) to move the chassis relative thereto. Preferably, the motive means 28 includes a suitable motor (not shown) operably connected with the wheels 39 by a suitable drive train. Those skilled in the art would be aware of suitable motors and drive trains. For example, in one embodiment, the motive means may include two motors (i.e., one for each side of the unit), so that the carrier assembly may be steered in a "skid steer" technique. In one embodiment, for instance, the carrier assembly may include a chain drive and two air motors or electric motors, one motor for each side.

[0041] In one embodiment, the chassis assembly 20 preferably is controllable in an unsafe zone 40 by an operator 42 who is located in a safe zone 44 (Fig. 11). Accordingly, an embodiment of the invention preferably includes a carrier system 46 (Fig. 12) that includes the carrier assembly 20 and a control unit 48 for remote control of the carrier assembly 20. Preferably, the control unit 48 is operably connected with one or more securing means 50 (Figs. 12, 13) for securing the fill fence 22 to a plurality of walls at a preselected location "X", to control the securing means 50. It is also preferred that, via the control unit 48, the operator 42 may control the securing means 50 of the fill fence 22, as will also be described in more detail below.

[0042] As will be described, the preselected location "X" preferably is in a drift "D" and proximal to an entrance to a mined-out region "R" into which backfill "BF" is to be located (Fig. 21).

[0043] In addition, the invention includes a method of installing the fill fence 22 at the preselected location "X" in the unsafe zone 40. In one embodiment, the method preferably includes providing the carrier system 46, and using the control unit 48 to locate the carrier assembly 20 in the safe zone 44 adjacent to the unsafe zone 40. With the mast frame 32 in the lowered position, one or more preselected portions 36 of the fill fence 22 are positioned on the mast frame 32. Next, the preselected portions 36 of the fill fence 22 are securable to the mast frame 32 by the fastening elements 34. With the fastening elements 34, the preselected portions 36 of the fill fence 22 are secured to the mast frame 32. With the fill fence 22 secured to the mast frame 32, the carrier assembly 20 is moved from the safe zone 44 to a predetermined location "Y" in the unsafe zone 40 (Fig. 12) from which the fill fence 22 may be positioned in the preselected location "X" by the carrier system 46. With the carrier assembly 20 at the predetermined location "Y", the mast frame 32 is raised to the raised position, to position the fill fence 22 substantially vertically at the preselected location "X". Via the control unit 48, the
securing means 50 are activated, to secure the fill fence 22 in a substantially vertical position to at least the walls of the drift "D" in the preselected location "X". With the fastening elements 34, the preselected portions 36 of the fill fence 22 are released from the mast frame 32. The mast frame 32 is moved to the lowered position. Finally, the carrier assembly 20 is moved from the unsafe zone 40 to the safe zone 44.

[0044] In one embodiment, the method of the invention preferably also includes applying shotcrete 52 (Fig. 20B) at least partially to the fill fence 22 secured in the preselected location "X", to substantially seal the fill fence 22. The installed fill fence 22, with the shotcrete 52 applied thereto (illustrated in Fig. 21), is hereinafter referred to as a fill fence system 54 (Figs. 20B, 21).

[0045] The fill fence system 54 is illustrated in Fig. 20B and Fig. 21. (Certain elements of the fill fence system 54 are omitted from Fig. 20B for clarity of illustration, as will be described.) As can be seen in Figs. 20A and 20B, the fill fence system 54 preferably provides a substantially sealed barrier around the fill fence 22 because the shotcrete 52 forms a seal between the installed fill fence 22 and each of the back "B", the side walls "SW1", "SW2", and the floor "F". As can be seen in Fig. 21, the fill fence system 54 may be positioned in the drift "D" at an entrance to the mined-out region "R". In Fig. 21, the fill fence system 54 is shown holding backfill "BF" in position in the mined-out region "R".

[0046] As can be seen in Figs. 1-10D, it is preferred that the fill fence 22 is assembled on the chassis assembly 24 in the safe zone 44, when the mast frame 32 is in the lowered position. The fill fence 22 preferably includes a central post 56. As can be seen in Fig. 2A, the central post 56 preferably is positioned on the mast frame 32, when the mast frame 32 is in the lowered position, and secured to the mast frame 32 by the fastening elements 34.

[0047] Any suitable fastening devices may be used as the fastening elements 34. In one embodiment, the fastening elements 34 preferably include pins 58 that are respectively mounted in hydraulic cylinder units 60, so that the pins 58 are movable between retracted positions (Figs. 1, 2A) and extended positions (Fig. 2B).

[0048] It will be understood that the carrier assembly may be used to carry and to install a fill fence other than the fill fence 20 described herein. In addition, the carrier assembly may be used to carry a structure (e.g., not necessarily a fill fence) and then to raise the structure to a vertical position, or a position between horizontal and vertical.
The process of assembling the fill fence 22 on the mast frame 32 begins with positioning the central post 56 on bars 62 (Fig. 1) of the mast frame 32, as shown in Fig. 2A. Once the central post 56 is in position on the bars 62, the hydraulic cylinder units 60 are suitably activated, causing the pins 58 to move to their extended positions, securing the central post 56 to the mast frame 32 (Fig. 2B). It will be understood that the parts of the central post 56 that are engaged by the extended pins 58 are the preselected portions 36 of the fill fence 22. In Fig. 2B, the direction of movement of the pins 58 from their retracted positions to their extended positions is indicated by arrow "A_1".

It will also be understood that, when the hydraulic cylinder units 60 are suitably activated, the pins 58 are retracted from their extended positions, to their respective retracted positions. The pins 58 are shown in their retracted positions in Fig. 2A. The direction of movement of the pins 58 when they are retracted is illustrated by arrow "A_2" in Fig. 2A. As can be seen in Fig. 2A, when the pins 58 are moved to their retracted positions, the central post 56 is not secured to the mast frame 32. As will be described, it is preferred that the hydraulic cylinder units 60 are remotely controlled by the operator 42, via the control unit 48.

As can also be seen in Figs. 1-2B, the mast frame 32 preferably includes pairs of stops 64. Each pair of stops 64 includes two stops (identified for convenience in one such pair illustrated in Fig. 2A as 64_L and 64_R respectively) that are substantially parallel to each other. As will be described, when the fill fence 22 has been assembled and the mast frame 32 is raised to its raised position, the stops 64 partially support the raised, assembled fill fence 22.

The central post 56 preferably extends between top and bottom ends 66, 68 thereof (Figs. 2A, 19). As illustrated in Figs. 2A and 19, the central post 56 preferably also includes a jack assembly 70 located at the top end 66 (and partially extendible past the top end 66) and a foot plate 72 mounted at the bottom end 68 of the central post 56. As will also be described, when the fill fence 22 is positioned in the preselected location "X" (Fig. 21), the jack assembly 70 is activated, to engage the back "B" and to urge the foot plate 72 against the floor "F", so that the central post 56 is secured in a substantially vertical position at the preselected location "X". It will be appreciated that the back "B", the floor "F", and the side walls "SW_L", "SW_R" are omitted from Figs. 12-14B and 15-19 for clarity of illustration.

It will be understood that the jack subassembly 70 and the foot plate 72 are included in the securing means 50. Once the fill fence 22 is in the preselected location "X", the
operator preferably activates the jack subassembly 70 via the control unit 48, to secure the central post 56 between the back "B" and the floor "F".

[0054] The fill fence 22 preferably also includes a number of cross-members 74 that are attached to the central post 56 (Figs. 3, 4). As can be seen in Figs. 3 and 4, in one embodiment, each of the cross-members 74 preferably includes a number of segments 76 that are connected to each other to form the cross-member 74. For clarity of illustration, the segments that are included in the lowest cross-member (identified in Fig. 4 by reference numeral 74a for convenience) are respectively identified in Fig. 4 as S1, S2, S3, and S4. As can be seen in Fig. 3, it is preferred that S1 and S2 are first attached to the central post 56. Subsequently, the segments S3 and S4 are respectively attached to the segments S1 and S2. Any suitable means of attachment may be used. Once assembled, each of the cross-members 74 extends between left and right ends (identified as "L" and "R" in Fig. 4) and is attached at its center to the central post 56. (Such orientation refers to how the fill fence 22 is viewed by an observer in the drift "D", once the fill fence 22 is installed.)

[0055] As can be seen in Fig. 5, in one embodiment, the fill fence 22 preferably also includes left and right side plates 78, 79. The left side plate 78 preferably is attached to each of the left ends "L" of the cross-members 74, and the right side plate 79 preferably is attached to the right ends "R" of the cross-members 74. Those skilled in the art would be aware that the side plates 78, 79 may be attached to the cross-members 74 in any suitable manner, e.g., by suitable fasteners such as bolts and nuts.

[0056] Preferably, and as can be seen in Fig. 5, the side plates 78, 79 both have a number of larger holes "H" in them, spaced apart at predetermined intervals. As shown in Fig. 6, it is preferred that an air cylinder subassembly 80, from which a length 81 of a rebar element 82 projects, is mounted to a selected one of the side plates to locate the length 81 in the hole "H". The air cylinder subassembly 80 includes an air cylinder "AC" and the rebar element 82, which is mounted in the air cylinder "AC". As will be described, the rebar element 82 is movable by the air cylinder "AC", when the air cylinder is activated, from its retracted position (shown in Fig. 6) to an extended position thereof.

[0057] Accordingly, and as can be seen in Fig. 6, the air cylinder subassemblies 80 are mounted at selected intervals along each of the side plates 78, 79, so that the lengths 81 of the rebar elements 82 of each are positioned in the holes "H" respectively to partly extend past the
side plates. As will be described, the air cylinder subassemblies 80 are included in the fill fence 22, and the air cylinders "AC" are connected to the control unit 48 so that they may be remotely controlled by the operator 42 via the control unit 48. As will also be described, once the air cylinder "AC" has been activated, the air cylinder will secure the rebar element 82 in the extended position thereof.

[0058] It will be understood that the elements operably connecting the air cylinder subassemblies 80 with the control unit 48 have been omitted from the drawings, for clarity of illustration. Also, in Figs. 6 and 7A, only the air cylinder subassemblies 80 that are secured to the left side plate 78 are shown, for clarity of illustration. It will be understood that a number of the air cylinder subassemblies 80 are also secured to the right side plate 79.

[0059] It will be understood that the air cylinder subassemblies 80 are also included in the securing means 50. It is preferred that, once the fill fence 22 is in the preselected location "X" and the central post 56 has been secured between the back "B" and the floor "F", the operator activates the air cylinder subassemblies 80 via the control unit 48, to extend the rebar elements 82 until their ends 88 engage the side walls "SW_1", "SW_2".

[0060] In one embodiment, the fill fence 22 preferably includes an expandable mesh element 84 (Fig. 7A), two sections of which are respectively secured to the side plates 78, 79. (In Fig. 7A, for clarity of illustration, only the section of the expandable mesh element 84 secured to the left side plate 78 is shown.) As will be described, each section of the expandable mesh element 84 preferably is mounted to the side plate in a folded configuration, with an inner side 86 of the expandable mesh element 84 secured to the side plate, and an outer side 87 thereof preferably positioned a short distance outwardly from the side plate, as can be seen in Fig. 7B. As can be seen in Fig. 7B, the inner side 86 of the expandable mesh element 84 preferably is secured to the side plate using any suitable fasteners 85.

[0061] The expandable mesh 84 may be any suitable mesh or screen that, once expanded, will retain its expanded or stretched condition. The manner in which the expandable mesh 84 is expanded is described further below.

[0062] As can be seen in Figs. 8A and 8B, the outer side 87 of the expandable mesh element 84 preferably is secured to an outer end 88 of each of the rebar elements 82 by a suitable connector 89. The connector 89 is shown connecting the outer side 87 to the outer end 88 of the rebar element 82 in Fig. 8B.
[0063] Preferably, the fill fence 22 also includes one or more screens 90 that are preferably made of wire elements 91. In one embodiment, end portions 92 of selected wire elements 91 preferably are extended through holes in the side plates 78, 79 and in the expandable mesh element 84, and bent away from the side plate and in a direction substantially parallel to the side plate, as can be seen in Fig. 9B. Preferably, this is done at numerous locations along each of the side plates, as can be seen in Fig. 10A, to secure the screen 90 to the side plates 78, 79. The end portions 92 preferably are also used to secure another element to the side plates, as follows.

[0064] The fill fence 22 preferably also includes a geotextile fabric sheet 93 that is positioned on the screen 90 (Fig. 10A). As can be seen in Fig. 10B, an outer strip 94 of the geotextile fabric sheet 93 preferably extends over the side plates 78, 79, so that the end portions 92 may be pushed through the outer strip 94. As can be seen in Fig. 10C, the end portions 92 of the wires 91 preferably are then bent inwardly at approximately right angles relative to the side plates, in order to hold the geotextile fabric sheet 93 in place. As can be seen in Fig. 10D, the end portions 92 of the wires 91 along each of the sides of the fill fence 22 are preferably bent as described above in order to hold the geotextile fabric sheet 93 in position in the fill fence 22, to complete the assembly of the uninstalled fill fence 22. The assembled, uninstalled fill fence 22 is shown in Fig. 10D.

[0065] When the fill fence 22 is installed, the screen 90 laterally supports the geotextile fabric sheet 93, to help the geotextile fabric sheet 93 resist the pressure to which the sheet 93 is subjected by the backfill.

[0066] As noted above, the assembly of the fill fence 22 (described above) preferably takes place in the safe zone 44. Those skilled in the art would appreciate that, in an alternative arrangement, the fill fence may be assembled elsewhere and, once assembled, may be positioned on the carrier assembly when the carrier assembly is in the safe zone 44. That is, the process may be "palletized" in part, with the previously-assembled fill fence delivered to the carrier assembly in the safe zone.

[0067] As illustrated in Figs. 2A-10D, the fill fence 22 preferably is assembled when the mast frame 32 is in its lowered position. Preferably, the assembled fill fence 22, positioned on the carrier assembly 20, is then moved from the safe zone 44 into the unsafe zone 40. As can be seen in Figs. 11 and 12, this movement preferably is accomplished by the operator 42, via the
control unit 48, activating the motive means 28 of the carrier assembly 20, thereby causing the
carrier assembly 20 to move into the unsafe zone 40 while the operator 42 remains in the safe
zone 44. As can be seen in Fig. 11, it is preferred that the mast frame 32 remains in its lowered
position (i.e., with the assembled fill fence secured to it) while the carrier assembly 20 is moved
to the predetermined location "Y" (Fig. 12). It will be understood that, when the carrier assembly
20 is in its predetermined location "Y", the assembled fill fence 22 (or at least the lowermost
portion thereof, when installed) is positioned at its preselected location "X".

[0068] As can be seen, for example, in Fig. 12, the carrier assembly 20 preferably includes
a stabilization mechanism 95. Preferably, the stabilization mechanism 95 is used once the carrier
assembly 20 is located in the predetermined location "Y" therefor. It will be understood that the
stabilization mechanism 95 raises the chassis and positions the chassis 26 so that the fill fence
may be substantially vertical when installed. This is needed in order to ensure that the assembled
fill fence 22 will be properly installed at the preselected location "X" therefor.

[0069] It is also preferred that, when the stabilization mechanism 95 is activated, the
stabilization mechanism 95 raises the chassis 26 at at least one end thereof by a minimum
predetermined distance relative to the floor "F". When the chassis 26 is in this raised position, at
least the wheels 39 mounted at a front end "FE" of the chassis 26 are raised by the minimum
predetermined distance off the floor "F". For reasons that will be described below, because the
chassis 26 is in a raised position when the fill fence 22 is partially installed, the mast frame 32 is
disengagable from the cross-members by lowering the chassis 26 until the wheels 39 at the front
end "FE" thereof engage the floor "F". Preferably, the operator 42 activates the stabilization
mechanism 95 to raise the chassis 26 as described above remotely, via the control unit 48.

[0070] Once the fill fence 22 is at the preselected location "X" and the chassis 26 has
been raised by the stabilization mechanism 95, the mast frame 32 is raised from its lowered
position to its raised position (Figs. 12-14A). It will be understood that the mast frame 32 is moved
to its raised position due to activation of the lifting subassembly 38 by the operator, via the control
unit 48.

[0071] In Fig. 14A, it can be seen that the mast frame 32 is in a substantially vertical
position, and the fill fence 22 is also positioned substantially vertically. It will be understood that
the fill fence 22 is held against the mast frame 32 by the fastening elements 34, because at this
point the pins 58 are still in their extended positions. Certain of the cross-members 74 also are
engaged by the stops 64 on the mast frame 32, which assist in supporting the fill fence 22 in the vertical position. The jack assembly 70 is activated, and an engagement portion 96 thereof is moved upwardly (i.e., in the direction indicated by arrow "C" in Fig. 14A), until the engagement portion 96 is engaged with the back "B" (not shown in Fig. 14A). It will be understood that, as the jack subassembly 70 is activated, urging the engagement portion 96 against the back "B", the floor plate 72 is also pressed downwardly, urged against the floor "F", due to the activation of the jack subassembly 70. Preferably, such activation is controlled by the operator 42 via the control unit 48.

[0072] Once the jack subassembly 70 has been activated and the central post 56 is secured between the back and the floor, the air cylinder subassemblies 80 are activated. Because of such activation, the rebar elements 82 are extended outwardly from their respective retracted positions until they engage the side walls "SW₁", "SW₂" (Figs. 14B, 14C). Preferably, the air cylinder subassemblies 80 are activated by the operator 42 via the control unit 48.

[0073] The outward movement of the ends 88 of the rebar elements 82 is indicated by arrow "E" in Fig. 14C. As can be seen in Fig. 14C, when the end 88 of the rebar element 82 engages the side wall "SW₂", the rebar element 82 stops moving outwardly. The air cylinder "AC" holds the rebar element 82 in position therefor, so that the end 88 thereof is tightly held against the side wall "SW₂" by the air cylinder "AC".

[0074] As can also be seen in Fig. 14C, when the rebar elements 82 are extended outwardly to engage the side walls, the expandable mesh element 84 is also expanded, because the outer side 87 thereof, at certain locations thereof, is secured to the ends 88 of the rebar elements 82. Only one side wall is shown in Fig. 14C, to simplify the illustrations. As can be seen in Fig. 14C, after the rebar elements 82 have been extended as far as possible, the result is that the expandable mesh element 84 generally (but not completely) covers a side gap region ("G") between the side plate and the side wall. However, because the side wall has an uneven surface, there are additional gaps 97 that remain between the outer side 87 of the expandable mesh element 84 and the side wall (Fig. 14C). As will be described, the gaps 97 will be covered with the shotcrete 52, in order to complete the installation of the fill fence 22, and to provide the fill fence system 54.

[0075] Those skilled in the art would appreciate that, once the fill fence 22 has been installed as described above, and while the central post 56 is still secure to the mast frame 32,
the shotcrete 52 may be applied, e.g., along the left and right sides. However, to the extent that
the mast frame 32 obstructs the application of the shotcrete 52, the operator may prefer to apply
all the shotcrete 52 after the mast frame 32 has released the central post 56, and the carrier
assembly 20 has been moved away from the installed fill fence 22 (Figs. 17-19).

[0076] After the rebar elements 82 have been extended to engage the side walls "SW₁", "SW₂", the pins 58 are retracted, to release the central post 56 from the mast frame 32. It will be
understood that such retraction is effected by the operator 42, via the control unit 48 (Fig. 15).
Preferably, once the central post 56 has been released, the stabilization mechanism 95 is
retracted, thereby lowering the mast frame 32 relative to the cross-members 74 of the fill fence
22. The retraction of the stabilization mechanism 95 is also controlled by the operator 42 via the
control unit 48. Due to such lowering, the cross-members 74 that had been engaged with and
supported by the stops 64 are disengaged from the stops 64. At this point, the carrier assembly
20 is released from the installed fill fence 22, may be moved away from the fill fence 22.

[0077] Next, the carrier assembly 20 preferably is moved away from the installed fill fence
22, with the mast frame 32 still in its raised position. At this point also, the shotcrete 52 may be
applied, at least in the upper area and along the sides of the fill fence.

[0078] The carrier assembly 20 preferably is moved further away from the partially
installed fill fence 22 (Fig. 17) (ultimately, from the unsafe zone 40 to the safe zone 44), and as
can be seen in Fig. 18, the mast frame 32 preferably is moved to the retracted position thereof.
The partially installed fill fence 22 is also shown in Fig. 19. An elevation view of the partially
installed fill fence prior to the application of shotcrete is provided in Fig. 20A, with a partial cross-
section of the surrounding ground. (It will be understood that a number of components of the fill
fence 22 (e.g., the screen 90, and the geotextile fabric sheet 93) are omitted from Figs. 20A and
20B for clarity of illustration.) As can be seen in Fig. 20A, in addition to the gaps 97 between the
outer side 87 of the expandable mesh element 84 and the side walls "SW₁", "SW₂", there are gaps
98, 99 between an uppermost cross-member 74₁ and the back "B", and also between the
lowermost cross-member 74₈ and the floor "F", respectively.

[0079] As can be seen in Fig. 20B, the shotcrete 52 preferably is applied to fill the gaps
97, 98, 99, and also to cover the expandable mesh element 84 along the sides of the fill fence 22.
Those skilled in the art would appreciate that the shotcrete 52 sets relatively quickly, to cover and
seal the gaps 97, 98, 99, and also to cover the mesh 84, and to provide a seal thereon.
[0080] Those skilled in the art would appreciate that the geotextile fabric 93 permits drainage of water from the backfill "BF" through the fill fence system 54.

[0081] It will be understood that the carrier assembly 20 may be provided in more than one unit at the site. For example, the chassis subassembly 26 may be provided separately from the mast subassembly 30 and the lifting subassembly 38, and such different elements may be combined at the site.

[0082] It will be appreciated by those skilled in the art that the invention can take many forms, and that such forms are within the scope of the invention as claimed. The scope of the claims should not be limited by the preferred embodiments set forth in the examples, but should be given the broadest interpretation consistent with the description as a whole.
I claim:

1. A carrier assembly for at least partially installing a fill fence, the carrier assembly comprising:

   a chassis subassembly comprising a chassis and a motive means mounted to the chassis, for propelling the chassis;

   a mast subassembly to which the fill fence is securable, the mast subassembly comprising a mast frame and movable fastening elements mounted on the mast frame and controllable for alternately securing at least one preselected portion of the fill fence to the mast frame and releasing said at least one preselected portion therefrom; and

   a lifting subassembly for raising the mast frame from a lowered position in which the mast frame is substantially horizontal to a substantially vertical raised position when the fill fence is secured to the mast frame, and for lowering the mast frame from the raised position to the lowered position when the fastening elements have released said at least one preselected portion.

2. A carrier system comprising:

   the carrier assembly according to claim 1; and

   a control unit for remote control of the carrier assembly, the control unit being operably connected with at least one securing means for securing the fill fence to a plurality of walls at a preselected location, to control said at least one securing means.

3. A method of installing a fill fence at a preselected location in an unsafe zone, the method comprising:

   (a) providing the carrier system according to claim 2;

   (b) locating the carrier assembly in a safe zone adjacent to the unsafe zone;
(c) with the mast frame in the lowered position, positioning at least one preselected portion of the fill fence on the mast frame, said at least one preselected portion of the fill fence being securable to the mast frame by the fastening elements;

(d) with the fastening elements, securing said at least one preselected portion of the fill fence to the mast frame;

(e) moving the carrier assembly, with the fill fence secured to the mast frame, from the safe zone to a predetermined location in the unsafe zone from which the fill fence may be positioned in the preselected location by the carrier system;

(f) with the carrier assembly at the predetermined location, raising the mast frame to the raised position, to position the fill fence substantially vertically at the preselected location;

(g) via the control unit, activating said at least one securing means to secure the fill fence in a substantially vertical position to the plurality of walls in the preselected location;

(h) with the fastening elements, releasing said at least one preselected portion of the fill fence from the mast frame;

(i) moving the mast frame to the lowered position; and

(j) moving the carrier assembly from the unsafe zone to the safe zone.

4. A method according to claim 3 additionally comprising:

(k) applying shotcrete at least partially to the fill fence in the preselected location, to substantially seal the fill fence.