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(54) **ANCHORED MINE VENTILATION  
STRUCTURE**

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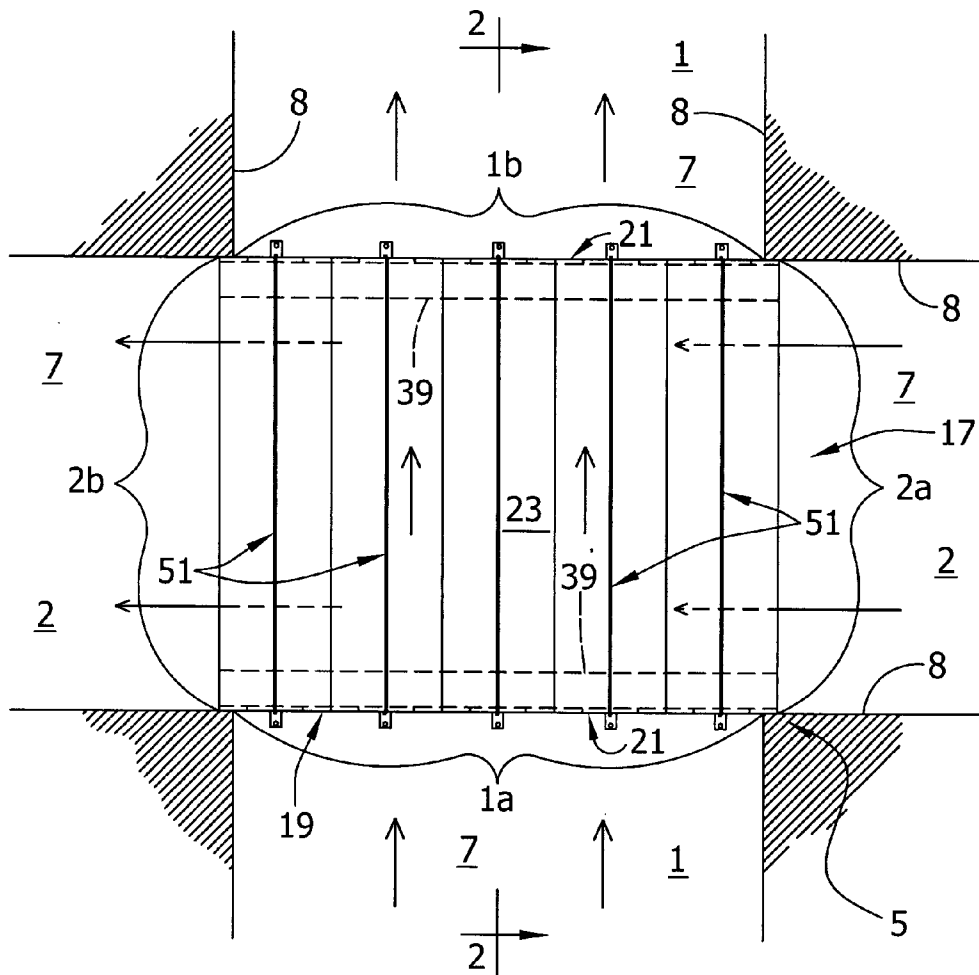
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(57) **ABSTRACT**

A ventilation structure for installation at a mine intersection includes first and second generally parallel side walls. Each side wall is of such height as to wall off at least a portion of a respective mouth of the first airway. A deck extends between the side walls and is connected thereto. A mooring system includes first and second anchors that restrain upward movement of the structure.

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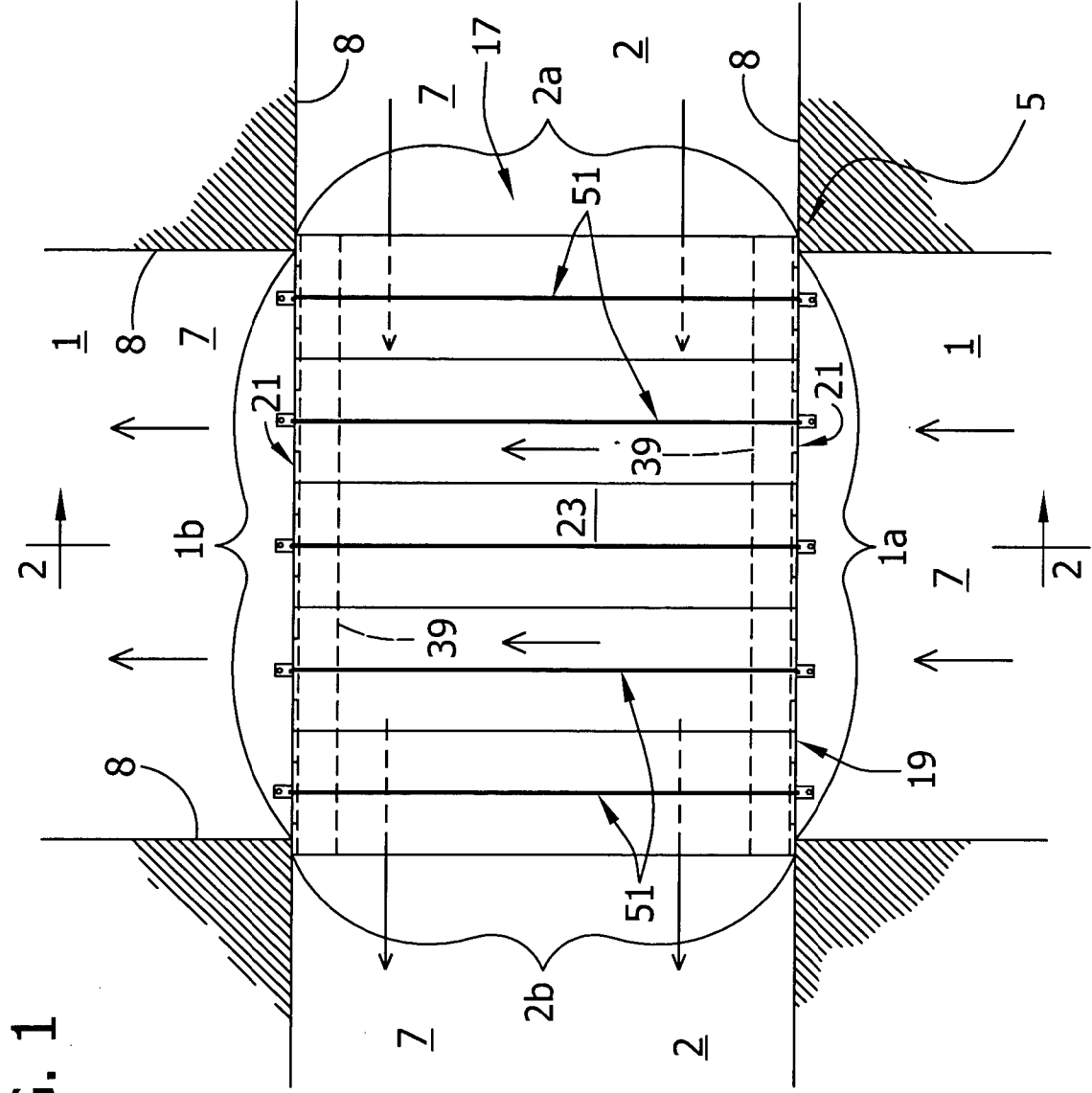


FIG. 1

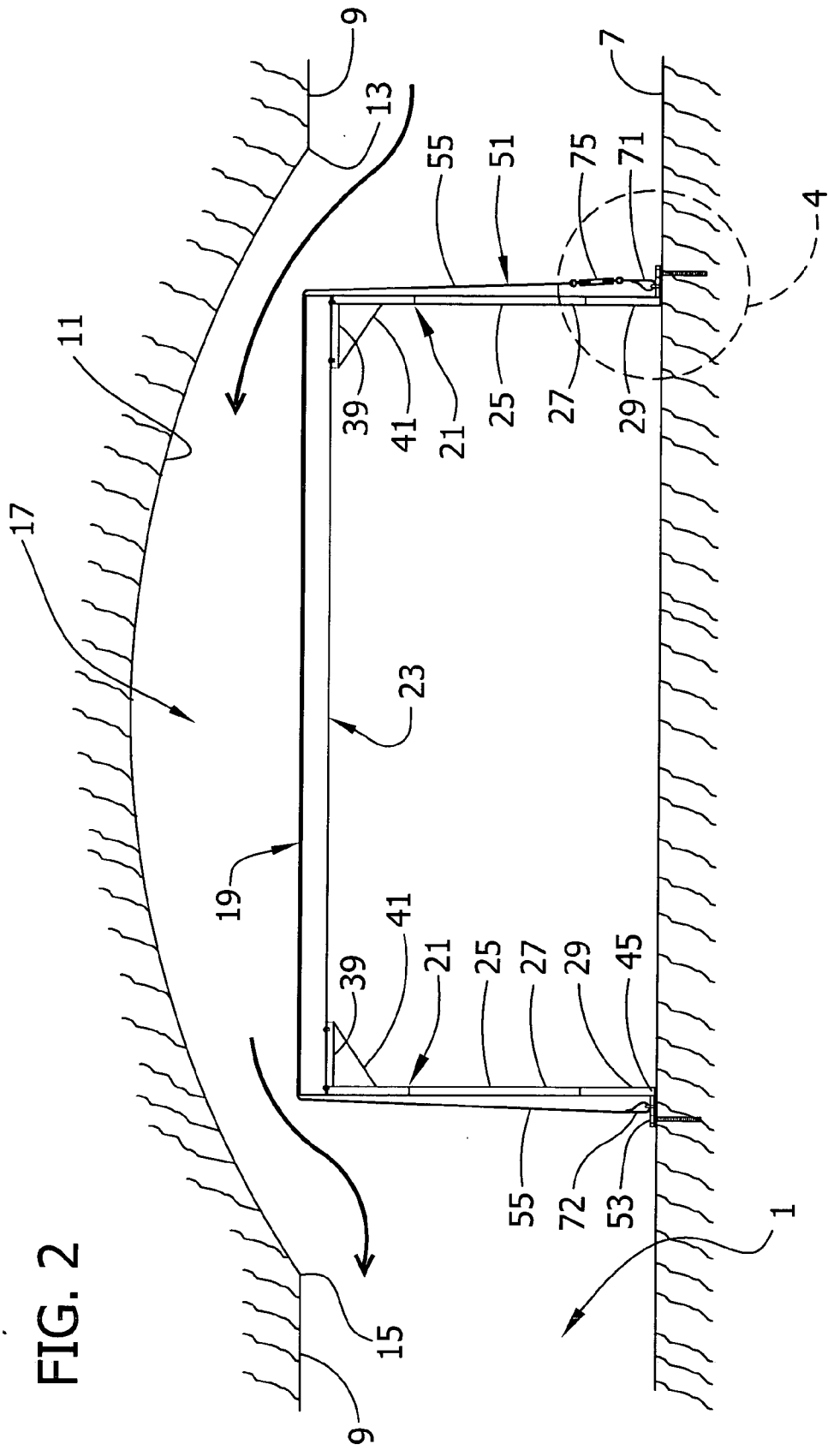


FIG. 2

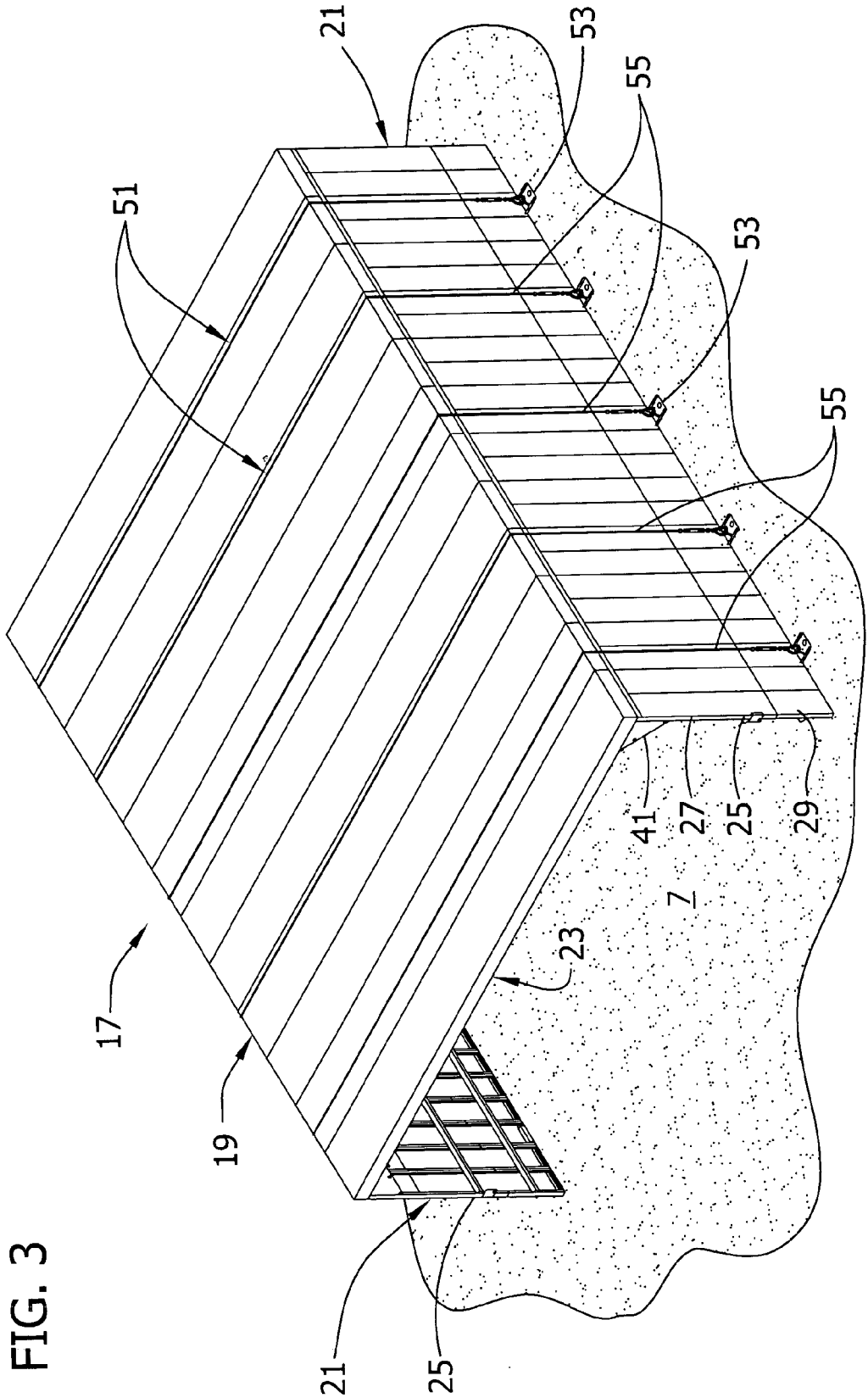
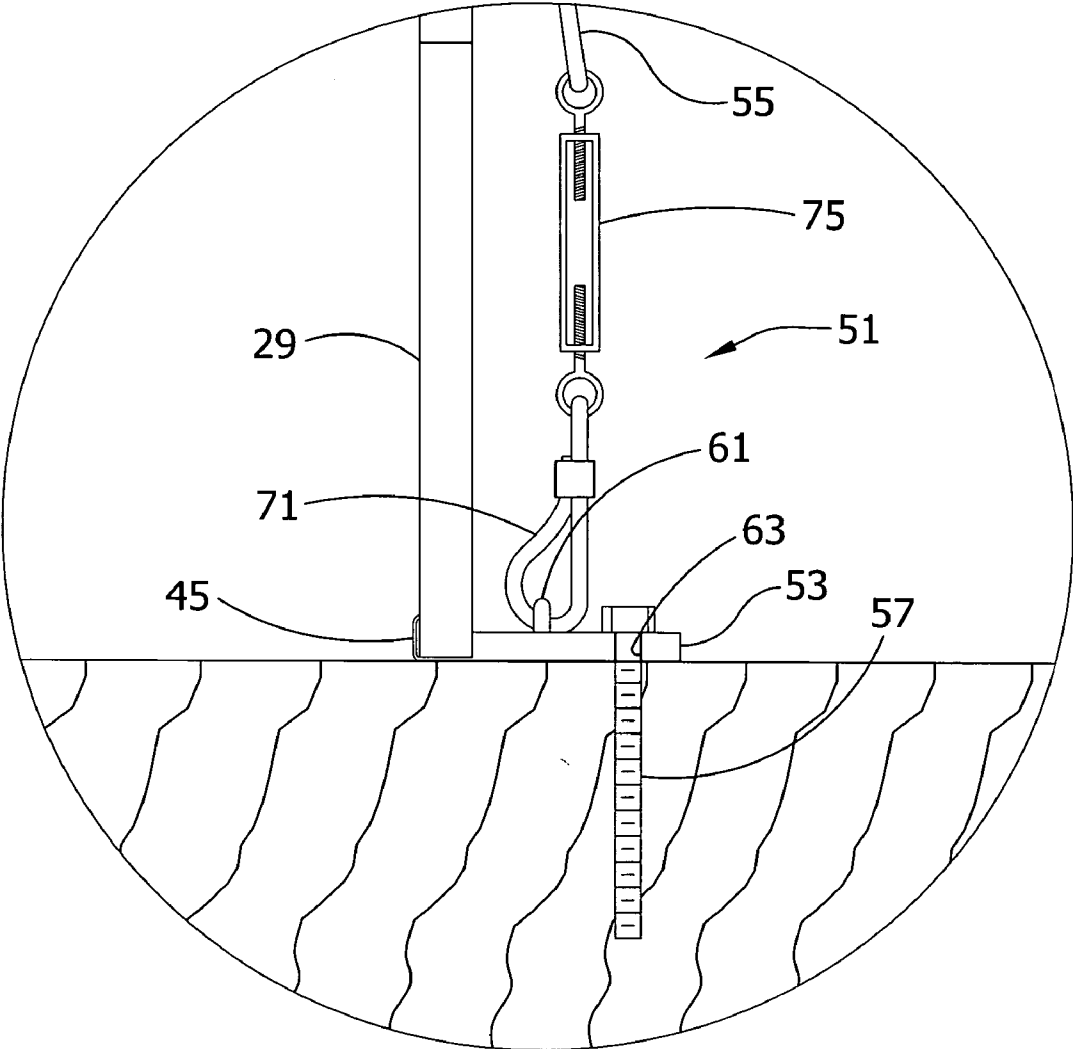


FIG. 3

FIG. 4



**ANCHORED MINE VENTILATION STRUCTURE**

**BACKGROUND OF THE INVENTION**

[0001] This invention relates generally to mine ventilation structures and more particularly to a mine ventilation structure anchored in the mine.

[0002] Structures which can be easily assembled and disassembled have many applications, but are particularly useful in underground mining operations where sturdy, but temporary structures are required. An example of such a structure is a mine ventilation structure at the intersection of two mine passageways for separating the air flow in the two passageways. Such a structure is shown in co-assigned U.S. Pat. Nos. 5,466,187 and 6,264,549, which are incorporated herein by reference.

[0003] For example, overcast and undercast mine ventilation structures are widely used in underground mining to prevent the mixture of forced (or induced) ventilation air flowing through a first mine passageway with forced (or induced) ventilation air flowing through a second mine passageway at the intersection of those passageways. An overcast ventilation structure is a tunnel erected in the first passageway and extending through its intersection with the second passageway. The tunnel blocks communication of air between the first passageway and the second passageway at the intersection, but permits air in the second passageway to travel through the intersection in a passage created by a space between the roof of the tunnel and the mine passageway ceiling. An undercast is of similar construction, except that the air in the second passageway passes under the erected tunnel in a slot cut in the floor of the mine passageways at the intersection. In both cases, there is a large flat deck that is subjected to the air pressure flowing through the mine.

[0004] As mines get bigger and deeper, there is a greater emphasis on proper ventilation. Consequently, ventilation pressure in the mine increases greatly. The increased pressure causes new problems for ventilation structures. In the case of an overcast or undercast, increased pressure under the deck subjects the deck to a large uplift force.

[0005] For example, an overcast defining a 20x30 foot tunnel may include a deck comprising 15 sections, each measuring 20x2 feet and weighing about 15-20 pounds. If the mine air pressure is 20 inches water gauge (0.0361 psi), each section is subjected to an uplift force of about 4200 pounds, and the total uplift force on the deck is about 62,400 pounds. Obviously, the overcast will be unstable due to the uplift force and will need to be strengthened.

[0006] Prior art solutions to the problem have included ballasting the deck, as by pouring concrete or similar material on it, or placing props between the roof and the deck. The concrete makes the structure permanent so that it cannot be re-used, thereby increasing the cost of the structure. The concrete itself also increases the cost of the structure. The props are unsatisfactory because mine roofs tend to converge or move closer to the floor over time. Such convergence will cause the props to crush the deck.

**SUMMARY OF THE INVENTION**

[0007] In one aspect of the invention, a ventilation structure for installation at intersecting mine passages comprises

first and second generally parallel side walls. Each side wall is of such height as to wall off at least a portion of a respective mouth of the first airway. A deck extends between the side walls and is connected thereto. A mooring system includes first and second anchors extending into and fixed to at least one of the mine floor and the mine ribs. The first and second anchors are connected to and fixed relative to the side walls and deck so as to restrain upward movement of the structure.

[0008] In another aspect, an overcast at the intersection comprises the first and second side walls and a deck extending over the side walls. The mooring system includes a plurality of anchors, each anchor being fixed in the mine floor, and a plurality of restraining members.

[0009] Other features will be in part apparent and in part pointed out hereinafter.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0010] FIG. 1 is a partially schematic view generally in horizontal section on the plane of the roof of two intersecting passages of a mine looking down, showing an overcast of this invention at the intersection of the passages;

[0011] FIG. 2 is a partial section view taken generally on line 2-2 of FIG. 1;

[0012] FIG. 3 is a perspective view of the overcast; and

[0013] FIG. 4 is an enlarged view of a portion of FIG. 2.

[0014] Corresponding reference characters indicate corresponding parts throughout the drawings.

**DESCRIPTION OF THE PREFERRED EMBODIMENTS**

[0015] Referring to FIGS. 1-2, indicated at 1 and 2 are two intersecting passages in a mine, each passage constituting an airway for flow of air (as indicated by the arrows in FIG. 1) for mine ventilation. Airway 1 may be referred to as the first airway, airway 2 as the second. Each airway has an upstream and downstream mouth at the intersection, said intersection being generally indicated by the reference numeral 5, the upstream and downstream mouths of the first airway 1 being indicated at 1a and 1b, respectively, and the upstream and downstream mouths of the second airway 2 being indicated at 2a and 2b, respectively. The floor in the airways and the intersection is indicated at 7, the ribs at 8, and the roof at 9 (see FIG. 2). The roof has a dome formation 11 extending from a point 13 somewhat upstream of the upstream mouth 1a of airway 1 to a point 15 somewhat downstream of the downstream mouth 1b of airway 1 (see FIG. 2). Airway 1 is shown as somewhat wider than airway 2; it will be understood that the airways may be of substantially the same width.

[0016] Referring also to FIG. 3, an embodiment of an overcast system (broadly, a ventilation structure) is designated in its entirety by the reference numeral 17 and occupies the intersection 5. A tunnel-forming overcast of the system is designated in its entirety by the reference numeral 19. The overcast suitably comprises a pair of generally parallel side walls, each designated in its entirety by the reference numeral 21 of such height as to wall off at least portions of a respective mouth 1a, 1b of airway 1 (and preferably the entire mouth), and further comprising a deck

designated in its entirety by the reference numeral **23** spanning the side walls **21** at the top and connected thereto. The side walls are typically spaced apart a distance corresponding to the width of airway **2**, but may be narrower or wider.

[0017] In this embodiment, each of the side walls **21** of the tunnel-forming overcast **19** comprises a plurality of elongate generally vertically extensible panels **25**, the panels in each side wall extending generally vertically in side-by-side relation. As herein illustrated, each side wall **21** is arbitrarily shown as comprising twenty-four of such panels. Each panel **25** is suitably of the type used in the mine stopping shown in the coassigned U.S. Pat. No. 6,264,549 dated Jul. 24, 2001, or the panel used in the stopping in the coassigned Ser. No. 10/951,116 filed Sep. 27, 2004, both of which are incorporated herein by reference, each said panel comprising a vertically extensible upper member herein numbered **27** and a lower member herein numbered **29**, the latter having a telescoping sliding fit in the former. The side walls **21** may include sections and/or be adapted for quick-connection as shown in coassigned U.S. patent application Ser. No. 10/266,182, filed Oct. 7, 2002 and incorporated herein by reference. The panels may be non-extensible within the scope of the invention.

[0018] Each side wall **21** has a shelf or header **39** at the top extending over the upper ends of the upper panel members thereof corresponding to shelf **70** of U.S. Pat. No. 5,412,916 which is incorporated herein by reference. The shelf is suitably secured on the upper panel members **27** of the panels of each side wall **21**, and may have the support of gussets **41** corresponding to those shown at **74** in this '916 patent. The deck **23** is essentially the same as that shown in the '916 patent but, instead of merely resting at its ends on the side walls, is connected to the shelf and thus to the upper panel members **27** of the extensible panels **25** of the side walls. The connection of the deck **23** to each shelf or side wall may be generally the same as the bayonet-slot type of connection shown in the aforesaid U.S. Pat. No. 5,412,916, or by other suitable means, including but not limited to riveting. The structure is strengthened by making the deck fixed relative to the side walls so that the deck is in effect a fixed beam (rather than a simple beam).

[0019] As shown in this embodiment, as to each side wall **21**, the upper panel members **27** of the panels **25** extend down from the respective shelf **39** in side-by-side relation, and the lower panel members **29** extend down from the upper panel members **27** to their respective footers **45** that engage the floor **7**. The panels **25** are held in the stated relation by reason of the upper panel members **27** being fastened to the shelf or header **39** and by suitable means, such as a bar and wire ties in generally the same manner as shown for the bars and wire ties in our aforesaid mine stopping patents, by the means shown in the aforesaid Ser. No. 10/951,116, or by other suitable means.

[0020] Referring more particularly to **FIGS. 3 and 4**, a mooring system of this embodiment is generally designated **51** and includes brackets **53** engaging the floor **7**, cables **55** (broadly, restraining members) extending over the deck **23** attached to respective brackets, and anchors **57** fixing the brackets to the floor. The brackets **53** extend outward from the footer **45** of some of the lower panel members **29** and are attached thereto, as by welding. Suitable brackets **53** are

generally thin, flat, rectangular metal plates that include a hook **61** extending upward for receiving an end of one of the cables **55**. A hole **63** spaced from the hook **61** is sized for receiving one of the anchors **57**. The brackets **53** are spaced apart along each side wall **21** and each is aligned with (e.g., generally coplanar or parallel with) another bracket on the opposite side wall. As shown, the brackets **53** suitably extend from every fourth or fifth panel **25** in the side wall, a total of ten being used in this particular embodiment. The brackets **53** can be attached to the respective panels, as by welding.

[0021] Each cable **55** includes a first end **71** attached to one of the brackets **53** on one side wall **21** and a second end **72** attached to an opposite bracket on the other side wall so that the cable extends over the deck **23** and side walls **21**. In this embodiment, each cable **55** is generally parallel with the longitudinal axes of the panels forming the deck **23** and side walls **21**. Each cable **55** includes a turnbuckle **75** interposed between its ends **71**, **72** (**FIG. 2**) for adjusting the cable tension. In this embodiment, the turnbuckle **75** is generally adjacent one of the cable ends **71**, **72**. Note that each cable or restraining member may be connected to the anchors by other suitable means.

[0022] There are five cables **55** (broadly, restraining members) in this embodiment, though any number may be used within the scope of the invention, including only one. Suitable cables are made of steel or other suitable material. Additionally, other types of restraining members are contemplated within the invention, including but not limited to straps, wires, chains, guys, rods or lines. Alternatively, one long, continuous cable may be substituted for the several cables, the long cable being "laced" through the brackets and fixed to only two of the brackets.

[0023] Where the side walls **21** and deck **23** are fixed relative to one another, a restraining member fixedly connected to either of the side walls or the deck is thereby connected to both the side walls and the deck. The restraining members need not necessarily extend over the deck, but may be secured to (directly or indirectly) or be integrally formed with the side walls or the deck. The restraining members may also be made to eliminate the need for brackets or other means of connecting the anchors to the side walls. For example, the bottom of the side wall **21** may be formed so that the anchor may bear directly against the side wall (the bracket being omitted). The restraining member may comprise a footer (such as footer **45**) disposed at the bottom of the side wall and have an opening (not shown) receiving the anchor to restrain the side wall. In such case, if the deck is fixed relative to the side walls (as by an interlocking relationship), the anchors are thereby connected to the deck and side walls, and the entire structure is restrained against upward movement.

[0024] In this embodiment, there are ten anchors **57**, one through each of the ten brackets **53**. The anchors **57** are suitably anchor bolts (broadly, anchors), such as self-anchoring bolts, extending into and fixed to the mine floor **7**. Alternatively, the anchors **57** may be permanently attached to the brackets **53**. Further, the anchors may extend into and be fixed to the mine ribs **8** or roof **9**. Other types of anchors may be used within the scope of the invention.

[0025] In a method of installation, the side walls **21** and deck **23** are installed, as by any of the methods described in

the above-referenced patents and patent applications. The brackets 53 are installed beneath some of the side wall panels 25. One of the anchors 57 is placed through each bracket 53 and driven into the mine floor 7. The first end 71 of one of the cables 55 is threaded through the hook 61 on one of the brackets 53 and secured, as by crimping (FIG. 4). The second end 72 of the cable 55 is extended over the deck 23 and down to a second bracket 53 outside the opposite side wall 21. The second end is threaded through the hook 61 and secured. The cable 55 is tightened using the turnbuckle 75. This process is repeated for each of the cables 55. The number of cables may be varied depending, for example, on the size of the ventilation structure and the anticipated air pressure therethrough.

[0026] The mooring system may also be used with an undercast. In an undercast, the deck extends between the footers of the side walls, opposite ends of the deck engaging the mine floor. In one example, anchors are secured to the mine floor outside the side walls adjacent the deck ends. The restraining members need not necessarily extend over the side walls. The restraining members extend over the deck ends of the undercast, extending between the panels of the side walls.

[0027] It is also contemplated that the overcast (or undercast) side walls and deck be formed as one piece, rather than having the deck be separable from the side walls. Further, the deck and/or side walls may be arched or curved.

[0028] When introducing elements of the present invention or the preferred embodiment(s) thereof, the articles "a", "an", "the" and "said" are intended to mean that there are one or more of the elements. The terms "comprising", "including" and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements.

[0029] In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

[0030] As various changes could be made in the above constructions, products, and methods without departing from the scope of the invention, it is intended that all matter contained in the above description and shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

1. A ventilation structure at an intersection in a mine having a floor, ribs, and a roof, the ventilation system comprising:

first and second generally parallel side walls, each side wall of such height as to wall off at least a portion of a respective mouth at the intersection, and

a deck extending between the side walls,

a mooring system including:

first and second anchors extending into and fixed to at least one of the floor and the ribs,

the first and second anchors being connected to and fixed relative to the side walls and deck so as to restrain upward movement of the structure.

2. The ventilation structure of claim 1 wherein the mooring system is separable from the side walls and deck to allow disassembly and re-use of the structure.

3. The ventilation structure of claim 1 further comprising at least one restraining member connecting the first and second anchors to the side walls and deck.

4. The ventilation structure of claim 1 further comprising a plurality of restraining members connecting the first and second anchors to the side walls and deck.

5. The ventilation structure of claim 1 wherein the first anchor is disposed outside the first side wall and the second anchor is disposed outside the second side wall.

6. The ventilation structure of claim 5 wherein the mooring system further comprises a first bracket extending from outside of the first side wall and a second bracket extending from outside of the second side wall.

7. The ventilation structure of claim 6 wherein each of the brackets is fixed to a footer of the respective side walls and disposed to be in contact with the floor.

8. The ventilation structure of claim 7 wherein each of the brackets includes a hole for receiving one of the anchors.

9. The ventilation structure of claim 6 wherein the restraining member is a cable extending over the deck and having a first end fixed to the first bracket and a second end opposite the first end fixed to the second bracket.

10. The ventilation structure of claim 9 wherein the cable includes a turnbuckle disposed between the first and second ends and being adjustable for tightening the cable against the overcast.

11. The ventilation structure of claim 1 wherein the first and second anchors comprise bolts extending into the floor.

12. The ventilation structure of claim 11 wherein the side walls are spaced apart a distance corresponding to the width of the second airway.

13. An overcast at an intersection in a mine having a floor and a roof, the overcast comprising:

first and second generally parallel side walls, each side wall of such height as to wall off at least a portion of a respective mouth at the intersection, and

a deck extending over the side walls and fixed thereto,

a mooring system including:

a plurality of anchors disposed adjacent the first side wall and a plurality of anchors disposed adjacent the second side wall, each anchor extending into and being fixed in the mine floor,

a plurality of restraining members extending over the side walls and the deck and connected to the anchors so as to restrain upward movement of the overcast.

14. The overcast of claim 13 wherein the mooring system further comprises a first bracket extending from outside of the first side wall and a second bracket extending from outside of the second side wall.

15. The overcast of claim 14 wherein each of the brackets is fixed to a footer of the respective side walls and disposed to be in contact with the floor.

16. The overcast of claim 15 wherein each of the brackets includes a hole for receiving one of the anchors.

17. The overcast of claim 16 wherein the restraining member is a cable extending over the deck and having a first end fixed to the first bracket and a second end opposite the first end fixed to the second bracket.

18. The overcast of claim 17 wherein the cable includes a turnbuckle disposed between the first and second ends and being adjustable for tightening the cable against the overcast.



19. The overcast of claim 18 wherein the first and second anchors comprise bolts extending into the floor.

20. A ventilation structure for installation at an intersection of at least two mine passages, each mine passage having a roof, a floor, and ribs, the ventilation structure comprising:

first and second generally parallel side walls, each side wall being adapted to wall off at least a portion of one of said mine passages at said intersection;

a deck for extending between the side walls and being connected thereto; and

a mooring system including first and second anchors for extending into and being fixed to at least one of the mine floor and the mine ribs, the first and second anchors also being adapted to connect to at least one of

the side walls and the deck so as to restrain upward movement of the ventilation structure.

21. A ventilation structure as set forth in claim 20 wherein said first and second anchors comprise bolts, and further comprising a cable connected to the bolts and adapted to extend over the deck.

22. A ventilation structure as set forth in claim 1 wherein said first and second anchors extend into and are fixed to the floor of the mine, the ribs of the mine being substantially free of the first and second anchors.

23. A ventilation structure as set forth in claim 1 wherein the deck is releasably connected to the side walls.

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