PORTABLE MINE STOPPINGS

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ABSTRACT

This disclosure relates to a portable stopping for blocking crosscuts in mine entries to facilitate ventilation thereof. The stopping consists of a sheet of fire-resistant, gas impervious flexible material adapted to be extended across a crosscut between the roof, floor, and walls or ribs thereof. A frame structure is adapted to support the sheet in substantially air-tight relationship across the crosscut. The frame carries elongated channel-like straps which are adapted to compress edge portions of the sheet against the roof, floor and side rib surfaces of the crosscut, thereby providing a substantially air-tight seal about the perimeter of the sheet.

10 Claims, 26 Drawing Figures
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PORTABLE MINE STOPPINGS

This invention relates generally to the field of mine ventilation control, and more particularly to a portable stopping for blocking crosscuts in mine entries, thereby facilitating delivery of ventilation air to the face of the mine.

Mine sections are constructed with a plurality of parallel entries extending from the opening of the section to the face of the mine where the coal, or other material, is being cut. Typically, at least one of the entries serves as an intake air course for providing ventilation to the face of the mine, while other entries serve as return air courses and for belt and trolley haulage entries for conveying the mined material from the face of the mine. As the face of the mine advances, transverse crosscuts are placed approximately every 80 feet to provide communication between the entries and thus ventilation across the entire face of the mine section. The axially extending entries and spaced transverse crosscuts thus define a plurality of pillars extending along the mine section. In order to assure delivery of fresh air to the mine face at a sufficient velocity, a pressure differential must be established between the intake and return air courses, as well as the haulage courses. Consequently, as the face of the mine advances, the crosscuts must be blocked by building stoppings across the crosscuts from pillar to pillar along the full extent of the section.

In ventilating the mine, fresh air is delivered under pressure to the face of the mine at a velocity sufficient to remove dust and gases, particularly methane gas in the case of coal mining, from the area being worked by the miners. If the intake air is not delivered at a sufficient velocity, the dust and gases will not be effectively dispersed and carried to the outside of the mine through the return air courses. As the distance between the mine opening and the face of the mine is, in many cases, several thousand feet, there exists a great pressure differential between the intake and return air courses. Consequently, if the stoppages separating the intake and return courses are not sufficiently air-tight, the cumulative pressure losses along the extent of the section will be such as to effectively reduce the velocity of the air at the mine face. For example, for a section which extends 4,000 feet, even a small amount of leakage across the approximately 50-required stoppings could yield a significant pressure loss at the mine face. It should be apparent, therefore, that effective sealing is required along the entire extent of the section in order to provide the necessary ventilation control.

Conventional stoppings consist of walls constructed of cinder block and cement, and employing header boards, wedges, and other materials in order to efficiently tighten the seal around the perimeter thereof. This type of conventional stopping is relatively difficult to construct and is extremely costly in terms of man-hours and money. Moreover, such "permanent" stoppings are not easily removed and, in many cases, have prevented the escape of miners in the case of mine disasters. Furthermore, such solid permanent stoppings provide little yield and will simply fail and blow out in the case of slight mine roof sagging or floor heaving.

U.S. Pat. No. 3,118,363 issued on Jan. 21, 1964 to J. V. Burgess, Jr. discloses a mine ventilation control system which discloses the use of sheets of fire-resistant, gas impervious materials within mine shafts for application as ventilation sheeting. The Burgess, Jr. patent discloses such sheets as being capable for use as mine curtains, check curtains, as well as for solid stoppings and the like. However, while sheets such as those disclosed in the Burgess, Jr. patent may be effectively used as curtains near the mine face where the pressure differentials are relatively low, they are not effective for permanent stoppings beyond the second or third crosscut outby the faces of the entries because they do not provide a sufficient air-tight seal about the perimeters thereof to prevent substantial leakage due to the pressure differentials thereacross.

It is, therefore, a primary object of this invention to provide a portable stopping for mine entries which will permit effective ventilation of the mine face.

More particularly, it is an object of this invention to provide a mine ventilation control system including sheeting that may be utilized as a "permanent" stopping along the entire extent of a mine section.

Another object of this invention is to provide a portable stopping for blocking crosscuts in mine entries comprising a sheet of fire-resistant, gas impervious flexible material adapted to be extended across a crosscut between the floor, roof, and ribs thereof, and including means for effectively sealing the perimeter of the sheet to provide a substantially air-tight seal across the crosscut.

Another object of this invention is to provide a stopping which is easily and quickly installed, can be easily and quickly taken down and reused, is compact, and has sufficient strength for the purpose for which it is intended as required by law.

A further object of this invention is to provide a stopping which will accommodate slight movements in the mine walls without failing.

Another object of this invention is to provide a mine stopping that accommodates uneven roof conditions and will fit almost any contour of a mine roof or floor.

Yet another object of this invention is to provide a mine stopping which is easily penetratable by miners seeking to escape from one entry to another.

Briefly, these and other objects that may become apparent hereinafter are accomplished in accordance with this invention by providing flexible fire-resistant, gas impervious sheeting material adapted to be extended across a crosscut between the roof, floor, and ribs thereof. The material may be of any type that satisfies Bureau of Mines requirements for use in coal mines, for example, a laminated, nylon reinforced plastic such as Koroseal Clear Brattice Cloth No. 64-37-3172-00 manufactured by The B. F. Goodrich General Products Company, Marietta, Ohio. The sheet material is supported on a frame structure consisting of separate vertical jacks, or, in other embodiments of the invention, a folding framework that may be extended to easily facilitate vertical height adjustments and which may be folded up in a compact unit.

The frame structure carries elongated metal straps which extend above the perimeter of the sheet adjacent the mine roof, floor, and rib surfaces, and which are adapted to force continuous compressible sealing means against the mine surfaces to establish a substantially air-tight seal about the perimeter of the sheet.

In accordance with this invention, the compressible sealing means includes edge portions of the flexible sheet which extend over the metal straps and which are adapted to be compressed against the adjacent mine
surfaces. In one embodiment, the edge portions are folded over to provide plural layers of the edge portions between the metal straps and the mine surfaces. In another embodiment, additional compressible sealing material is positioned between the edge portions of the sheet and the mine surfaces. Additionally, in the embodiment wherein the edge portions are folded over to provide plural layers, the additional compressible sealing material, such as asbestos or fill plastic, may be positioned between the folded-over layers to provide additional sealing.

While the frame structure of the invention includes support rods having jack means for forcing the metal straps into sealing engagement against the mine surfaces, additional jacking means may be provided in the form of spikes which are adapted to extend through the metal straps and the sealing means and retainably penetrate the mine surfaces. The spike means include screw threads adapted to cooperate with a nut for jacking the metal straps and the compressible material against the mine surfaces.

With the above and other objects in view that may become hereinafter apparent, the nature of the invention may be more clearly understood by reference to the attached drawings, the following detailed description thereof, and the appended claimed subject matter:

IN THE DRAWINGS

FIG. 1 is a fragmentary horizontal sectional view through a mine section, and illustrates three entries extending to the mine face providing intake and return air courses, crosscuts extending transversely between the entries thereby establishing mine pillars, a plurality of stoppings extending between the pillars, and air-directing check curtains disposed near the mine face; FIGS. 2–6 are elevation views of various embodiments of mine stoppings constructed in accordance with this invention, and illustrate sheets of fire-resistant, gas impervious flexible material extending across the crosscuts and being supported by the novel frame structures of this invention;

FIG. 7 is an enlarged fragmentary elevation view of a portion of the frame structure illustrated in FIG. 2, and illustrates in more detail one novel corner construction thereof;

FIG. 8 is another enlarged elevation view of the portion of the frame structure illustrated in FIG. 2, and illustrates in more detail the novel construction of another corner thereof;

FIGS. 9 and 10 are fragmentary perspective views of portions of the support rods illustrated in FIGS. 7 and 8, respectively;

FIG. 11 is an enlarged fragmentary perspective view of a bearing plate utilized in conjunction with the support rods illustrated in FIGS. 7 and 8;

FIG. 12 is a perspective view of the overlapping corner plates utilized with the corner constructions of FIGS. 7 and 8;

FIG. 13 is an elevation view of the vertical telescoping support rod and jack illustrated in FIG. 2, and further depicts, in cross-section, metal straps disposed at the top and bottom of the support rod which are adapted to be jacked into sealing engagement against the mine roof and floor;

FIG. 14 is an enlarged detailed perspective view of the upper portion of the support rod of FIG. 13, and illustrates the upper metal strap and a bearing pad carried by the rod;

FIG. 15 is a fragmentary perspective view of the jack portion of the support rod of FIG. 13, and has portions thereof cut away for clarity to illustrate the threaded jack screw and nut;

FIG. 16 is a fragmentary perspective view of a slip joint portion of the support rod of FIG. 13, and has portions thereof cut away for clarity to illustrate details of the slip joint and set screw;

FIG. 17 is a vertical sectional view taken through an edge portion of the stopping of this invention, and illustrates an edge portion of the flexible sheet material folded upon itself to provide a plurality of layers disposed over the metal strap, and a spike extending through the strap and sheet material and adapted to penetrate the mine roof whereupon the strap and sheet material may be jacked into compressed sealing engagement against the mine roof;

FIG. 18 is a vertical sectional view of another embodiment of the sealing arrangement of this invention, and illustrates additional compressible sealing material positioned above the flexible sheet material and adapted to be compressed against the mine roof by the metal strap;

FIG. 19 is an enlarged detailed perspective view of the spike illustrated in FIG. 17;

FIGS. 20–23 are perspective views of various details of the support structure illustrated in FIGS. 2–6;

FIG. 24 is a fragmentary elevation view, having portions thereof cut away for clarity, of pawl and ratchet means used to position the horizontal support rod illustrated in FIG. 5;

FIG. 25 is an elevation view of the telescoping support rod illustrated in FIG. 13, and further depicts a sheet of flexible material carried by the frame structure including the support rod, the sheet material having an excess which is bi-folded upon itself adjacent the lower edge thereof which permits a ballooning out, as illustrated in phantom, upon an extreme pressure differential across the sheet; and

FIG. 26 is a fragmentary elevation view of a portion of the flexible sheet material, and depicts a flap portion thereof which defines a zippered opening therethrough.

Referring now to the drawings in detail, there is illustrated in FIG. 1 a mine section designated generally by the numeral 30. The section 30 includes three entries 31, 32 and 33 defining air intake, haulage, and air return courses, respectively, and terminating at a mine face 34. Crosscuts 35 extend transverse to the entries 31, 32 and 33 providing communication therebetween as the mine face 34 advances, and providing pillars 36 of material, such as coal, extending along the extent of the entry 30. Check curtains 37 are provided between the pillars 36 in the first and second crosscuts 35 outby the mine face 34, while stoppings 38 are provided in the remaining crosscuts 35 extending to the entrance to the section 30.

As explained above, intake air (represented by the arrow X) is supplied to the face of the mine 34 through the intake entry 31, directed across the face 34 by means of the check curtains 37, and returned to the outside of the mine through the entry 33. The entry 32 may be used as a belt and trolley haulage entry for removing mined material from the face 34 of the mine.

As explained above, the stoppings 38 of the prior art were formed primarily of a cinder block construction.
In accordance with this invention, however, the stoppings 38 are formed primarily of a fire-resistant, gas-imper-venous flexible sheet 40 (FIGS. 2-6). In the embodiment of this invention illustrated in FIG. 2, the sheet 40 is supported on a frame structure 41 between the roof, floor, and side ribs of the crosscut. The frame 41 includes a plurality of telescoping vertical support rods 42, horizontal support rods 43, and diagonally disposed support rods 44. The perimeter of the frame 41 is defined by metal straps 45.

The sheet 40 is spread across the frame 41 and, as seen most clearly in FIG. 17, includes edge portions 46 which are folded back and forth over the strap 45 to provide a plurality of layers thereof disposed between the strap 45 and the adjacent mine surface S. When the support rods 42, 43 and 44 are extended by means of jacks to be hereinafter described, the metal straps 45 will press the plural layers of edge portions 46 against the mine surface S to effect an air-tight seal. Additional sealing material 47 such as asbestos fill or plastic may be provided between the layers of the folded over edge portions 46 to provide additional sealing. The straps 45 may also carry spike means 48, seen more clearly in FIG. 19, which extend through the straps 45 and sheet material 40 and are adapted to retainably penetrate the adjacent mine surface S. The spike means 48 includes a threaded portion 49 which is adapted to cooperate with a washer 50 and nut 51 to provide a jack which enables the strap 45 to be forced toward the surface S to compress the sheet material 40 thereagainst. The metal strap 45 also includes two upstanding rib portions 52 which further facilitate the sealing engagement against the mine surface S.

An alternate construction of the invention is illustrated in FIG. 18 wherein only one layer of the sheet material 40 extends over the strap 45. However, a mass of additional compressible sealing material 53 is disposed between the sheet material 40 and the mine surface S and extends between the upstanding ribs 52 of the metal strap 45 in such a manner as to be sealingly compressed against the mine surface S.

Referring now to FIGS. 13-16, there are illustrated details of the telescoping support rods 42. As seen most clearly in FIG. 13, the support rods 42 include upper, middle, and lower sections 54, 55 and 56, respectively, which are adapted to telescope into each other and thus fold up into a compact unit. The upper section 54 carries a bearing pad 57 of metal or rubber which is adapted to abut against the upper metal strap 45. Similarly, the lower section 56 also includes suitable bearing means (not shown) which abut the lower strap 45.

As seen most clearly in FIG. 15, the distal end of the upper section 42 includes screw threads 58 which cooperate with a jack nut 59 whereby the support rod 42 may be extended to force both the upper and lower metal straps 45 outwardly against the adjacent mine surfaces to compress the sealing material positioned therebetween, thereby effecting the air-tight seal.

As seen most clearly in FIG. 16, the lower section 56 includes a slip joint 60 consisting of a set screw 61 which extends through the lower section 56 in press fit relation against the telescoping middle section 55 which is constructed of suitable material such as black iron or galvanized steel. The slip joint 60 permits a certain amount of slippage or yield in the support rod 42 in the event of a slight movement in the roof of the mine. If such a yield provision were not provided, the support rod 42 would simply buckle or fail in the event of movement of the mine roof. Alternatively, it is contemplated that other type slip joints may be provided within the scope of this invention; for example, a hydraulic cylinder with a relief valve that is adapted to open upon the occurrence of predetermined pressure differentials therein.

Referring now to FIGS. 7 and 8, there are illustrated details of the right and left corner constructions, respectively, of the frame 41 illustrated in FIG. 2, the corner construction of FIG. 7 being viewed from behind the frame 41 as seen in FIG. 2. The horizontally disposed support rods 43, as well as the diagonally disposed support rods 44 are constructed similarly to the vertical support rods 42.

As seen in FIG. 10, the horizontal support rods 43 are joined to the vertical support rods 42 by means of a T-collar 62. Similarly, the corner construction of FIG. 7 includes a branched collar 63, as seen more clearly in FIG. 9 where only the lower half thereof is illustrated, by means of which both the horizontal support rods 43 and the diagonal support rods 44 are joined to the vertical support rod 42.

The corner constructions of FIGS. 7 and 8 also include overlapping L-shaped corner plates 64 (FIG. 12) which are adapted to fit into a corner of the crosscut formed by the mine roof and floor with the rib thereof, respectively, and between which the edge portions of the flexible sheet material 40 are adapted to be snugly received and compressed. As seen in FIG. 12, each of the L-shaped corner plates 64 is comprised of leg portions 65, 66 which are hinged together at their edges to form a flexible joint thereby facilitating accommodation of various mine surface configurations and conditions.

As seen in FIG. 7, the ends of the diagonal support rods 44 include L-shaped channel members 67 which are adapted to fit into the corners defined by the corner plates 64 to effect a tight abutment thereagainst. The horizontal support rods 43, on the other hand, have U-shaped bearing plates 68 (FIG. 11) carried on their ends which are adapted to abut against the overlapping corner plates 64.

Referring now to FIG. 3, there is illustrated an alternate embodiment of this invention having a frame structure designated generally by the numeral 70. The frame structure 70 includes the upper and lower metal straps 45, as well as the overlapping corner plates 64, described above in connection with the embodiment of FIG. 2. However, the frame structure 70 is of the folding type and includes support rods 71 which are pivotally secured to the upper and lower straps 45 by means of hinges 72.

As seen most clearly in FIG. 20, the metal straps 45 include slotted portions 73 which define a track in which a cooperating portion of the hinge 72 is adapted to slide in effecting vertical height adjustments of the frame structure 70.

The frame structure 70 also includes horizontal jack members 74 which are adapted to force outwardly against both the corner plates 64 and the supports rods 71 to provide a rigid structure. As seen most clearly in FIG. 21, the jack members 74 include shafts 75 and 76 having oppositely-directed screw threaded portions 77, 78, respectively. The shaft 76 is hingedly connected to a U-shaped bearing plate 79 adapted to abut against the overlapping corner plates 64, and the shaft 75 is
hingedly connected to another U-shaped bearing plate 80 having notches 81 formed therein adapted to receive the support rods 71. It should be apparent that rotation of the jack member 74 will cause the shafts 75, 76 to move apart thereby effecting the jacking force on the frame structure 70.

Referring now to FIG. 4, there is illustrated another embodiment of this invention having a novel frame structure designated generally by the numeral 90. The frame structure 90 includes the upper and lower metal straps 45 and the overlapping corner plates 64 supported by both vertical support rods 91 and horizontal support rods 92. Each of the vertical support rods 91 carries a U-shaped support member 93 pivotally secured at the top thereof by means of a hinge 94. As seen most clearly in FIG. 22, the support member 93 is also pivotally secured to the metal strap 45 by means of hinges 95 at each of the two legs thereof. Consequently, as seen in FIG. 4, the frame structure 90 is adapted to bend to conform to the shape of the mine roof and thus accommodate uneven roof conditions. It should be apparent that the pivotable U-shaped support members 93 may be positioned at the bottoms of the vertical support rods 91 and thereby accommodate uneven floor conditions of the mine.

Referring now to FIG. 5, there is illustrated yet another embodiment of this invention having a frame structure designated generally by the numeral 100. The frame structure 100 also includes upper and lower metal straps 45 and overlapping corner plates 64. A main horizontal support or beam 101 extends across the frame structure 100 and bears against the opposed corner plates 64 by means of bearing plates 102. As seen more clearly in FIG. 24, the horizontal beam 101 may be adjusted to the width of the crosscut by means of an adjustable telescoping section secured by a cooperating pawl 103 and ratchet 104. Once the beam 101 is adjusted and fixed to the predetermined width, it may be jacked outwardly against the respective corner plates 64 by means of jack nuts 105 positioned at each end thereof. Substantially vertical support members 106 extend along the length of the horizontal beam 101 and are pivotably secured thereto at their inner ends by means of hinges 107 (FIG. 23). The support rods 106 are also pivotally secured at their outer ends to the metal straps 45 by means of hinges 108. It should be understood that as the beam 101 is jacked outwardly, the support rods 106 will assume a more vertical orientation thereby forcing the metal straps 45 outwardly against the mine roof and floor to compress the edge portions of the flexible sheet 40 therebetween to effect the air-tight seal.

While the upper and lower support rods 106 are illustrated in FIG. 5 as being hingedly secured to the beam 101 at the same places, it is to be understood that the upper and lower rods 106 may be disposed in staggered relation along the extent of the beam 101 thereby more readily facilitating yield of the beam 101 to accommodate sagging of the mine roof without failure of the frame structure 100.

Still another embodiment of the frame structure of this invention is illustrated in FIG. 6 and is designated generally by the numeral 110. The frame structure 110 is similar to the frame structure 41 of FIG. 2 insofar as it includes both vertical and horizontal support rods 111, 112, respectively. However the support rods 111, 112 differ from the support rods 42, 43 in that they are not telescoping, but rather include jack members 113 similar in construction to the jack members 74 illustrated in FIG. 21.

Referring now to FIG. 25, it can be seen that the flexible sheet material 40 may include an excess of material over that which is required to extend across the crosscut, the excess being bi-folded upon itself adjacent the lower edge of the sheet 40 to provide a plurality of layers 115 whereby the sheet 40 may balloon out, as illustrated in phantom, upon the occurrence of an extreme pressure differential thereacross to at least partially relieve the pressure. This blow-out construction provides a measure of safety not present in the prior art solid stoppings. Consequently, even in the event of explosions, there is no loss of ventilation because the stopping of this invention will hold itself in place and maintain the pressure differential between the adjacent mine entries.

As illustrated in FIG. 26, the sheet 40 may include a flap portion 120 which may be opened to provide access from one side of the stopping to the other. The flap 120 may be secured by zippers 121, 122 provided in the sheet 40. Consequently, in the event of a mine disaster, personnel can simply pass through the zippered openings provided in the stoppings to escape from one entry to another.

It should be apparent, therefore, that there is provided in accordance with this invention a novel portable stopping for blocking crosscuts in mine entries which is easily and quickly installed, can be easily and quickly taken down and reused, is compact, and has sufficient strength for the purpose for which it is intended as required by law. Moreover, the novel frame structures of this invention can be constructed to accommodate any mine condition, be hooping bottom, sagging top, uneven top, uneven bottom, or uneven ribs. Crosscuts having any or all of these conditions can be effectively sealed by means of the frame structure, sheet material, and sealing means of this invention.

Furthermore, the novel portable stopping of this invention provides various safety features not present in the prior art solid stoppings. For example, in addition to including no flammable parts, the flexible sheet material may be readily cut by miners with any suitable tool or sharp edged instrument thereby permitting personnel to quickly escape from one side thereof to the other if necessary. This, of course, not possible with the conventional solid stoppings. Moreover, the fact that the portable stopping and frame structure may be quickly set up is an extraordinary feature and advantage in the case of mine emergencies. For example, if the stoppings are blown out in the case of an explosion, ventilation can be quickly reestablished at the face of the mine by setting up the portable stoppings in a much shorter time than it would take to reconstruct the prior art solid stoppings. Additionally, the portable stoppings can be set up as barricades to close off a portion of the mine containing poisonous gases. Furthermore, another important advantage of the portable stopping of this invention is that the novel frame structures permit roof sag without losing their ability to maintain the required pressure differentials across the adjacent mine entries.

Although only preferred embodiments of this invention have been specifically illustrated and described herein, it is to be understood that other minor modifi-
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It is claimed:

1. A portable stopping for blocking crosscuts in mine entries having roof, floor and side rib surfaces; comprising a sheet of fire-resistant, gas impervious flexible material adapted to be extended across a crosscut between the roof, floor and ribs thereof, a frame structure for supporting said sheet in substantially air-tight relationship with said surfaces, said frame means including means for compressing said sealing means and providing a substantially air-tight seal about the perimeter of said sheet, and wherein said means include telescopic support jacks.

2. A stopping as defined in claim 1, wherein said sealing means includes edge portions of said sheet.

3. A stopping as defined in claim 2, wherein said edge portions are folded over to provide plural layers of said edge portions of said sheet between said strap means and said surfaces.

4. A stopping as defined in claim 3, and further including additional compressible sealing material positioned between said layers.

5. A stopping as defined in claim 1, wherein said forcing means include telescopic support jacks.

6. A stopping as defined in claim 5, wherein said telescoping support jacks include compression relief means.

7. A stopping as defined in claim 6, wherein said relief means comprises a slip joint.

8. A stopping as defined in claim 1, wherein said sheet includes a zippered opening to provide safety access from one side thereof to the other.

9. A stopping as defined in claim 1, wherein said strap means includes at least two upstanding axially extending ribs.

10. A portable stopping for blocking crosscuts in mine entries having roof, floor and side rib surfaces; comprising a sheet of fire-resistant, gas impervious flexible material adapted to be extended across a crosscut between the roof, floor and ribs thereof, a frame structure for supporting said sheet in substantially air-tight relationship between said surfaces, said means means for compressing said sealing means and said surfaces, means for forcing said strap means toward said surfaces for compressing said sealing means and providing a substantially air-tight seal about the perimeter of said sheet, and wherein said means includes an excess of material over that which is required to extend across the crosscut, said excess being bifolded upon itself adjacent one edge of said sheet, whereby said sheet may balloon out upon the occurrence of an extreme pressure differential to at least partially relieve the pressure.