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(54) **SUPPORT PILLAR FOR MINE ROOF**

(57) The subject matter of the invention relates to an artificial pillar, especially an inter-room pillar, formed of a spatial structure filled with waste rock, which is applicable in underground mining, especially in mines of non-ferrous metal ores and chemical raw materials. The spatial structure is made of flexible grid and comprises

sidewalls (6, 7, 8) and a closing sidewall (9) and a bottom (5) resting on the floor (2), whereas at the top the sidewalls (6, 7, 8) and the closing sidewall (9) are suspended to the roof (1) by rock bolts (10, 11, 12, 13), wherein the rock bolts (12, 13) suspending the closing sidewall (9) are equipped with additional fastening elements (14).

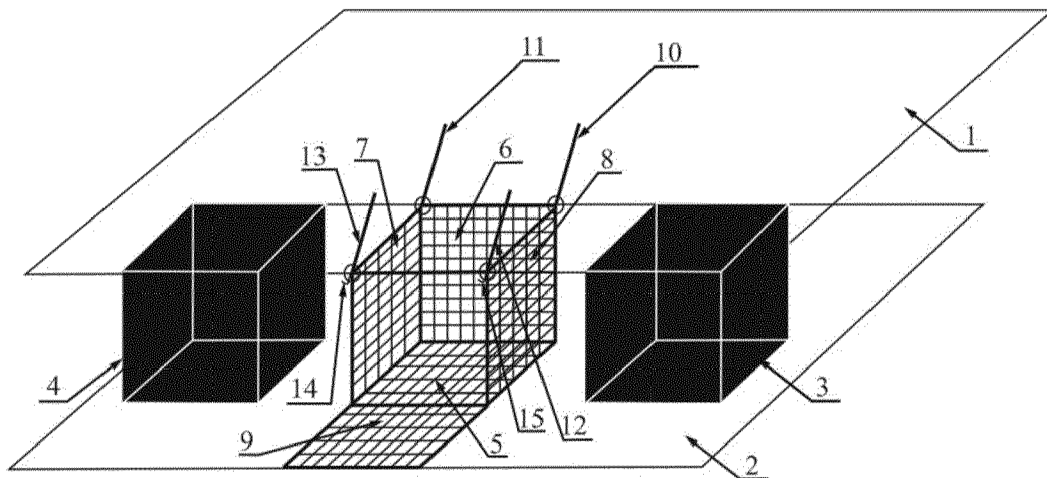


Fig. 1

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Description

[0001] The subject matter of the invention is an artificial pillar, especially an inter-room pillar, for use in underground mining, especially in the mines of non-ferrous metal ores and chemical raw materials where single-layer, room and pillar or strip mining methods are used.

[0002] In order to minimize the loss of raw material left in the goaf, and to facilitate the transition of pillars into the range of operation under the post-destruction characteristics, inter-room pillars are removed to residual dimensions, and waste rock, being a part of the exploitation gate, can be located within the post-exploitation space so-called goaf, as dry backfill. The Polish patent description PL158092B1 discloses a room and pillar method of deposit exploitation in which the pillars located near the roof falls are partially removed by means of cuttings whereas the post-exploitation void is eliminated by roof collapse forced by blasting works, and at the same time the remains of pillars left in the post-exploitation void are blasted. In order to minimize the loss of raw material, the most efficient use of the deposit is sought. The Polish patent description PL 189980 B1 discloses a technology for the clean removing of mineral deposits using a room and pillar method, which lie in that the row of pillars located near the goaf line is mechanically removed after previously placing a substitute support pillar formed from the waste rock in the vicinity thereof.

[0003] The Chinese patent description CN107524470B discloses an artificial pillar which consists of a specific fluid-permeable geotextile bag reinforced with steel hoops. In the upper part, the pillar comprises a supply spigot and a vent spigot. The filling of the pillar is a mixture of a solidifying substance and broken waste rock. A similar solution is also disclosed in the Chinese patent description CN103562497B.

[0004] The polymer geo grids, are used in the mining industry as elements of backfill dam or as safety grids, forming the lining of the excavation. For example, international patent application WO2008/087537A2 discloses the use of a flexible polypropylene-polyethylene grid as a reinforcement for a geotextile in a backfill dam. Similarly, a polymeric safety grid made of polypropylene with flame retardant additives is known from US patent description US5096335A. The grid provides additional protection of the roof and the underground sides of work to which it is anchored and can also be used in room and pillar mining methods. The location of the safety grid on the pillars sidewalls and along the rooms prevents the rock from falling into the excavation and reducing its lateral dimensions, while at the same time it does not constitute an obstacle, in case of the need of ripping the pillars.

[0005] The purpose of the invention is to develop an easy-to-construct artificial pillar especially an inter-room pillar, which would make it possible to reduce the loss of raw material in the residual pillars left, where it is not possible to remove the deposit cleanly and, moreover,

to make it possible to manage in situ waste rock whose increasing production is associated with the small thickness of seams or pseudo-seams and the need to rip off waste rock in the roof or seam floor during mining and preparatory works.

[0006] The essence of an artificial pillar, especially an inter-room pillar formed of a spatial structure filled with waste rock, is that the spatial structure is made of a flexible grid and comprises a sidewalls and a closing sidewall and a bottom resting on the floor, whereas at the top of the sidewalls and the closing sidewall are suspended to the roof by means of rock bolts, wherein the rock bolts suspending the closing sidewall being equipped with additional fastening elements.

[0007] Advantageously the flexible grid is made of a polymer, especially polyethylene or polypropylene.

[0008] Also, it is advantageous when the spatial structure is made of a single cross-shaped grid element and it is also advantageous when the spatial structure is made of two grid sections crossing each other in the area constituting the bottom of the spatial structure.

[0009] It is advantageous when the closing sidewall is located on the side of the exploitation front.

[0010] Furthermore it is advantageous when the side edges of the adjacent sidewalls and the closing sidewall are fastened together by means of connecting elements or stitched together with cords.

[0011] It is advantageous when additional fastening elements are hooks or catches.

[0012] The subject matter of the invention is illustrated in the embodiment in the simplified drawing, in which Fig. 1 shows a spatial structure prepared for filling with waste rock, and Fig. 2 - the completed artificial inter-room pillar.

[0013] The artificial inter-room pillar (Fig. 1, Fig. 2) was built in a row of inter-room pillars, in place of the support pillar that was previously removed. On the floor 2 is the square bottom 5 of a spatial structure made of a single, originally flat cross-shaped polypropylene grid element, the arms of which are the sidewalls 6, 7, 8 and the closing sidewall 9, wherein the closing sidewall 9 is located on the side of the face of the exploitation front, and the sidewalls 7, 8 are located on the side of the adjacent pillars 3 and 4 in the same row, and the sidewall 6 - from the side of the goafs. The sidewalls 6, 7 and 8 are suspended directly on the roof 1 by means of rock bolts 10, 11, 12 and 13. The closing sidewall 9 located on the side of the face of the exploitation front, is fastened on additional fastening elements 14 and 15, which are hooks, constituting the rock bolt 13, 14 equipment. There is waste rock 16 inside the spatial structure. The side edges of the adjacent sidewalls 6 and 7, 6 and 8, 7 and 9, and 8 and 9, are additionally fastened together at half height by means of connecting elements, not shown in the drawing, which are steel stitches.

[0014] In another embodiment of the pillar, the spatial structure is made of two intersecting sections of polyethylene grid, which overlap in the area constituting the bottom 5 of the spatial structure, and the side edges of the

adjacent sidewalls 6, 7, 8, 9 of the spatial structure are stitched along the entire height with a polyethylene cord.

[0015] The use of flexible grid for the construction of the spatial structure makes it possible to spread it on the floor 2 of the excavation and freely suspend the sidewalls 6, 7, 8, whereas the closing of the closing sidewall 9 can be realized in stages, by pinning or stitching from below a section of its edge with the edges of the adjacent walls 7 and 8 after locating a storage parts of waste rock 15 in the emerging spatial structure of the artificial pillar. After the spatial structure is completely filled with waste rock 16, the structure is finally closed by suspending the closing sidewall 9 by means of fastening elements 14 and 15 and by additionally clipping or stitching its edges with the edges of the adjacent walls 7 and 8.

Claims

1. An artificial pillar, especially an inter-room pillar, formed of a spatial structure filled with waste rock, **characterized in that** the spatial structure is made of flexible grid and comprises sidewalls (6, 7, 8) and a closing sidewall (9) and a bottom (5) resting on the floor (2), whereas at the top the sidewalls (6, 7, 8) and the closing sidewall (9) are suspended to the roof (1) by means of rock bolts (10, 11, 12, 13), wherein the rock bolts (12,13) suspending closing sidewall (9) are equipped with additional fastening elements (14).
2. The pillar according to claim. 1, **characterized in that** the flexible grid is made of a polymer, especially polyethylene or polypropylene.
3. The pillar according to claim 1, **characterized in that** the spatial structure is made of a single cross-shaped grid element.
4. The pillar according to claim 1, **characterized in that** the spatial structure is made of two grid sections intersecting in the area of the bottom (5).
5. The pillar according to claim 1, **characterized in that** the closing sidewall (9) on the side of the exploitation front is located.
6. The pillar according to claim 1, **characterized in that** the side edges of adjacent to each other sidewalls (6, 7, 8) and closing sidewall (9) are fastened together by means of connecting elements or stitched together with cords.
7. The pillar according to claim. 1, **characterized in that** the additional fastening elements (14) are hooks or catches.

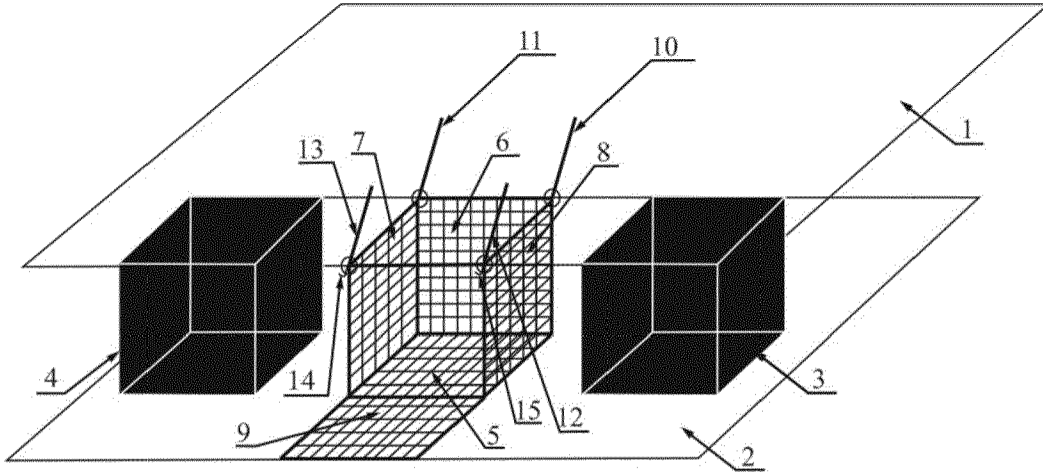


Fig. 1

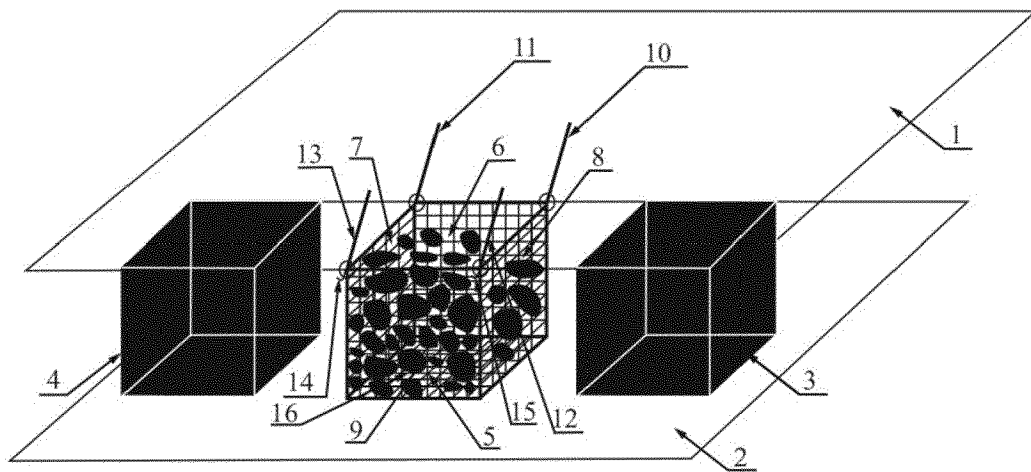


Fig. 2



EUROPEAN SEARCH REPORT

Application Number

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2005/070187 A1 (CAVENAGH EDWARD J [CA]) 31 March 2005 (2005-03-31) * paragraphs [0072], [0073] * -----	1-7	INV. E21D15/48
A	GB 2 186 607 A (BRITISH REINFORCED CONCRETE ENG CO LTD; PSB TEXTILE FAB LTD) 19 August 1987 (1987-08-19) * column 1, lines 40-98 * -----	1-7	
A	WO 91/06746 A1 (FOSROC INTERNATIONAL LTD [GB]) 16 May 1991 (1991-05-16) * the whole document * -----	1	
A	US 2012/009023 A1 (BOWER JOSEPH P [US] ET AL) 12 January 2012 (2012-01-12) * the whole document * -----	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			E21D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 3 May 2023	Examiner Manolache, Iustin
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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03-05-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005070187 A1	31-03-2005	CA 2443480 A1 US 2005070187 A1	30-03-2005 31-03-2005
GB 2186607 A	19-08-1987	NONE	
WO 9106746 A1	16-05-1991	WO 9106746 A1 ZW 15790 A1	16-05-1991 30-01-1991
US 2012009023 A1	12-01-2012	AU 2011201579 A1 US 2012009023 A1	02-02-2012 12-01-2012

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- PL 158092 B1 [0002]
- PL 189980 B1 [0002]
- CN 107524470 B [0003]
- CN 103562497 B [0003]
- WO 2008087537 A2 [0004]
- US 5096335 A [0004]