

## ARRANGEMENT FOR FASTENING OF WALL COVERING IN ROCK CAVITIES

The present invention relates to an arrangement for fastening of a covering in a rock cavity which is bored or  
5 blasted out in rock, where the covering comprises a cloth material for diverting water from the roof and wall portions of the rock outside the cloth material, to a water-diverting system at the lower edge portion of the walls or at the transition between roof and side walls.

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During blasting out of rock cavities, the ground water-conducting channels and fissures in the rock will as a rule rupture, so that water leakages occur in to the rock cavity. Such water leakages can be more or less permanent.

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The problems with this water, and possibly other moisture, have previously been solved in various ways. Thus dissimilar types of funnel constructions are employed with associated hoses which conduct the water to a guide trench  
20 or to a similar drain system at the floor of the rock cavity. It is also customary to install in the rock cavity constructions of timberwork, steel or concrete including a covering of walls and roof with dissimilar types of roofing sheets and wall covering boards or other conducting  
25 systems. Examples of this are shown in the German patent specifications 874,317 and 926,255. It is also customary to fasten in place such roofing sheets and wall boards only on the exposed portions of walls and roof where there is a danger of water penetration. Sprayed concrete is also

employed to a great extent to cover such sections. It is also customary to employ dissimilar types of vault constructions for sealing off the arch of the roof, and contact moulding of concrete against the rock perhaps  
5 employing enclosed sealing membrane.

It is also known hitherto to mount an arch of watertight cloth corresponding to the profile of the rock cavity, so that a space is formed between the cloth and the rock, and  
10 where the cloth along the two lower edge portions (along the portions of the trench) passes over the material of the ground such as gravel, sand and the like in a sealing manner. The space between the cloth and the rock wall can be defined as the moisture space, while the utility space  
15 beneath the ceiling of cloth, within the surface of the cloth, can be designated as the dry space.

In the instances where a cloth is used which is mounted as an arch against the rock, a space is thus formed between  
20 the cloth and the rock surface. It has been found that the part of the cloth which is in the lower portion against the trench which leads out the water, has hitherto not been sufficiently tight, so that both moisture, and the falling down of loose stones from the rock, has been able to  
25 penetrate towards and down on the floor level of the rock cavity.

In recent years attention has been drawn besides to dangerous radioactive gases such as radon which can leak  
30 out from fissures in the solid rock and penetrate into the rock cavity.

One of the afore-mentioned cloth solutions, which indeed are only employed sporadically nowadays, aims at arranging  
35 the lower edge portions or flaps of the pieces of cloth with a U-shaped contour forming a duct which is fashioned in the floor of the rock cavity along the lower edges of the walls. In the hollow space of the U shape shingle can

be filled in, while beneath (and partially at the side of) the U shape there can be filled in coarser gravel. A concrete surface, an asphalt surface or similar floor surface, can be arranged tightly adjacent to the hollow space of the U shape.

It is an object of the present invention to provide a new arrangement which in a better manner than hitherto can be employed to prevent water or gas (radon) from penetrating into the utility space of the rock cavity, and at the same time attending to a sufficient removal of water seepage.

It is thus an object with the present invention to completely or partially be able to seal the space between the cloth and the rock. Thus it is also an object to be able to prevent the penetration of radon gases.

With the present invention it is a further aim to provide a new way of fastening the lower longitudinal edge portions of a sealing cloth which clothes the rock wall and the roof of a rock cavity, in order to achieve thereby a maximum tight seal.

The arrangement according to the invention is characterised in that a lower longitudinal portion of the cloth material is joined to a longitudinal edge portion of the floor covering or a wall portion adjacent to this.

The preferred constructions of the arrangement according to the invention are evident from the dependent claims.

Further features of the present invention will be evident from the following description having regard to the accompanying drawings, in which:

Fig. 1 shows a cross-section of a rock cavity having a cloth covering mounted in.

Fig. 2 shows (as enlarged detail) in cross-section a preferred solution for joining the cloth material of the rock cavity to the region adjacent to the bottom of the rock cavity.

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Fig. 3 and Fig. 4 show in cross-section two alternative solutions for the joint which is illustrated in Fig. 2.

Fig. 5 and 6 show in partial cross-section a cloth material  
10 which is joined to a wall.

Fig. 7A and 7B show in cross-section how the fastening of the cloth to a wall is combined with a draining system for water.

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In Fig. 1 there is shown in cross-section a rock cavity 10 with roof 11, walls 12 and bottom section 13. To the roof 11 which is illustrated with an approximately arcuate profile, there are fastened in eye bolts 23 at a spacing of  
20 for example 1-3 metres (in the lateral direction), with associated bolt eyes arranged in line with an arcuate contour. Through the eyes of the bolts there can be threaded steel wires, which in various ways can be fastened completely down against the base of the floor or to the  
25 upper parts of the wall. According to the illustrated embodiment the rock bolts 23 are at the start free-standing individually without special mutual bracing.

The wall parts of the rock cavity 10 extend largely  
30 vertically. On top of the bottom section 13 there can be laid a floor covering 14 of concrete, asphalt or another covering.

To the said system of bolts 23 cloth materials 15 are  
35 stretched in varying section sizes so as to form a panelled ceiling in the rock cavity. The lower part (the wall part) of the cloth covering has a largely rectilinear vertical

contour on each side downwards towards a trench 17 which is employed to drain water out of the rock cavity 10.

The cloth covering arrangement can be adapted for rock  
5 cavities of arbitrary form and for arbitrary objects of use.

As cloth material rectangular pieces of cloth covering can be employed in practice, for example having a length  
10 dimension corresponding to the transverse arcuate length of the roof with varying breadths which can extend across the rock cavity 10 and stretch continuously over the whole arch of the roof. Several sections of such pieces of cloth can be joined together sideways, in situ by welding or gluing  
15 in a gas- and fluid-tight manner, to form a continuous cloth covering in arbitrary lengths of the length and breadth dimensions of the rock cavity.

In Fig. 2 there is illustrated a solution for the joining  
20 of the cloth material with the region adjacent to the floor sheet 14 in the floor bottom 13. The rock wall 12 is also marked on the Figure. Along the outer edge 16 of the floor covering 14 there is arranged over the whole length of the rock cavity ( for example around the peripheral  
25 circumference of the floor) an upwardly projecting longitudinal beam 18, preferably by casting in concrete, for example cast simultaneously with the floor surface. The beam 18 can have dimensions in cross section of 10 x 10 cm. The cloth material 15 extends from the roof substantially  
30 perpendicularly downwards and flush with the perpendicular peripheral edge face 20 of the floor sheet 14. The lower flap edge of the cloth material 15 is shown at 22, it extending almost completely down to the bottom of the trench.

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From the downwardly hanging cloth material there is now made a fold 21 which is placed along the top surface 19 of the beam 18. Thereafter a strip/lath 24 of plastic or of

metal/wood is laid on top of the fold 21 which is then squeezed together against the surface 19 beneath the strip/lath 24. Then nails/bolts 26 are installed from above through the lath 24, the cloth fold and into the material of the beam (the concrete). Such nails/bolts 26 are set down with regular spaces between over the whole range of the beam from the one end of the wall and to the other, that is to say round the whole rock cavity.

10 This is carried out along all sides of the rock cavity. There is provided thereby a totally insulated space 28 between cloth and cavity wall/roof which does not have leakages to the utility-rock space, which is desired to be kept dry.

15 A variant of this securing is shown in Fig. 3. But here there is not erected any beam. Instead the fold 21 of the cloth 15 is laid directly in over the surface 30 of the floor surface 14 itself.

20 Still a variant is shown in Fig. 4. According to this solution the floor surface 14 is cast completely out to the rock wall 12, that is to say over the trench 17 itself. Water is prevented from penetrating along the floor surface by carving out a continuous slot 32 from the one end of the space and to the other, parallel to the trench 17. In the channel there is cast in a longitudinal metal plate, for example about 10 cm. high (such as of metal (aluminium), plastic or another suitable plate material), and the plate is cast into a concrete beam 18 which thereby extends parallel to the wall and at a given distance from this. The securing of the folded cloth 15 beneath a strip 24 on the upper side of the beam is carried out in the same manner as indicated above. There is formed thereby an artificial trench 36 out to the rock surface, with a suitable drain gradient, for leading the water out of the rock cavity. The plate thereby forms a threshold against the penetration of water along the floor into the dry space.

Two dissimilar solutions for securing the cloth 15 to a concrete wall 38 are shown in the Figures 5 and 6, which illustrate vertical sections of a wall which either  
5 constitutes a surface out to a rock wall lying outside, or which is a partition wall for forming space sections within a greater rock cavity. In the two Figures the rock cavity 10 is indicated.

- 10 Figure 5 shows a fixing solution which can be employed if the main leakage occurs from the upper parts of the rock wall. The longitudinal water-draining can then take place higher up in the wall.
- 15 According to the solution in Figure 5 the edge surface of the cloth is installed against the vertical surface 39 of the concrete wall 38. Thereafter a lath 40 is placed over the edge of the cloth, and a number of nails/bolts are set in through the lath, the cloth and into the concrete wall  
20 38. In order that the joining region between the lath/the cloth/ the concrete wall 40/15/38 shall not be exposed to the existing seeping in of water, there is mounted in over the lath, in the concrete wall, an elongate aluminium plate 42. First there is cut into the concrete wall a slot 44 in  
25 which the plate is cast in. The aluminium plate 42 will then function as a drip edge, and water can drip down on the cloth which then deflects upwards to its bolt fastenings against the roof. The cloth can thereby form in part a drain forwards to the water-diverting system of the  
30 rock cavity.

A variant of this principle is shown in Figure 6. Here there is cast in a slot 46 in the wall 38, and the longitudinal edge portion of the cloth is inserted in the  
35 channel 46 and a lath is installed over the edge of the cloth. The lath can be fixed to the wall by inserting nails with uniform spaces between.

A special solution for providing water drainage is shown in Fig. 7A, and in an enlarged section in Fig. 7B. Starting out the cloth 15 is braced inwardly/downwardly against the rock wall by means of a set of wires 50 arranged to the roof 11 of the rock cavity, and to which the cloth is connected. The wires 50 are fixed to the rock wall 12 by means of single bolts 23 inserted in the rock wall with uniform spaces between. The cloth is anchored to the rock wall 12 in the following manner :

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A separate elongate strip 62 of cloth having a length corresponding to the length of the wall and a given breadth (for example about 0.5 metre), is secured with its one (upper) longitudinal edge side 64 in the rock wall, for example by one of the two methods which are shown in Fig. 5 and 6. A gutter 54 is anchored to the wall 12 with bolts 60 which with mutual spacing are anchored in the rock wall, and at a suitable height in the rock wall above the floor 14. The gutter 54 is preferably made of plastic. The cloth strip 62 has a breadth such that its other (lower) edge side 66 can be laid up in the gutter. The edge side 66 is joined to the roof gutter 54 by spot welding or by another appropriate joining method. The lower longitudinal edge side 70 of the sheet 68 of cloth, which runs down from the roof portion of the rock cavity, is thereafter laid downwards in the roof gutter 54, and is joined to the gutter in the same manner as the cloth strip 62. The two cloth sections together form a fold which is positioned down in the roof gutter, and if necessary they can be joined to each other overlappingly in the roof gutter, or lie substantially edge-to-edge as Fig. 7B shows in an enlarged section. The roof drain 54 extends along the whole length of the wall of the rock cavity and with a suitable incline so that the water can drain upon the cloth fold/roof gutter and out into the drainage system. There can be arranged such a roof gutter system in association with all the actual wall surfaces in a rock cavity, for example on each of the four wall surfaces when this is

rectangular, or has a square, rectangular, polygonal, or other rounded cross-section.

5 There are described here the main principles for dissimilar solutions for sealing off the space between a sealing cloth covering and a rock wall lying outside, in such a manner that minimal moisture, solid particles, and possibly types of gas dangerous to health can penetrate into the rock cavity.

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This represents a large advance in this area, and will come to be of use in the formation of all types of rock halls.

### PATENT CLAIMS

1. Arrangement for fastening of a wall covering such as a cloth (15) in a rock cavity (10), in that the wall covering is arranged in the rock cavity at a certain distance from the walls (12, 38) and roof (11) of the rock cavity, such as via rock bolts (23), in that a lower longitudinal edge portion (21) of the cloth material (15) is joined to a longitudinal edge portion of the floor surface (14) or the wall portion (12, 38) adjacent  
10 to this, especially adjacent to the floor surface (14) of the rock cavity, so that the space which is formed between the cloth (15) and the walls (12,38) of the rock, is insulated from a use space (10) designated the dry space, characterised in that the longitudinal edge portion (21) of the cloth material (15) is fixed between a clamping means in the form of a longitudinal strip (24, 40) and a longitudinal edge portion (16) of  
15 the floor portion (14) or the wall portion (12, 38) and that it preferably is fixed by means of clamping means in the form of nails/bolts (26).
2. Arrangement according to claim 1, characterised in that nails/bolts (26) are  
20 inserted through the strip (24, 40) through the clamped-in cloth edge (21) and into the edge portion (16) of the wall portion (14) or the wall portion.
3. Arrangement according to claims 1 or 2, characterised in that the combination of strip/cloth edge (24,21) is joined to a substantially horizontal and/or a substantially vertical portion of the floor portion (14).  
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4. Arrangement according to claim 1 or 2, characterised in that the combination of strip/cloth edge (24,21) is joined to a mainly vertical wall portion (38).
5. Arrangement according to any of preceding claims, characterised in that  
30 adjacent to the lower longitudinal portion of the cloth material (15) is folded (21), the

fold (21) extending substantially parallel to the floor/wall portion (14,12;38) of the rock cavity, and the cloth fold (21) being fixed to floor/wall portion (14,12;38).

6. Arrangement according to claim 4, characterised in that a longitudinal lower cloth edge (64) is anchored in the adjacent rock wall (12), a relatively free portion (70) of the cloth extending along the wall (12) of the rock cavity being placed with a U shape in a gutter (54) designated a roof gutter, in order to define a water-drainage gutter out of the rock cavity, the gutter (54) is fixed to a part of the rock wall (12) within the space which is defined the dry space.

7. Arrangement according to claim 6, characterised in that it comprises the cloth (15) folded U-shape in the gutter (54) being formed by:

that a separate elongate cloth strip (62) is fixed with its one (upper) longitudinal edge side (64) in the rock wall (12),

that the other (lower) edge side (66) of the cloth strip (62) is arranged in the roof gutter the edge side (66) being joined to the roof gutter (54),

that the lower longitudinal edge side (70) of the cloth sheet (68), from the roof portion, is arranged in the roof gutter (54), and is joined to the gutter (54), and

that the roof gutter (54) is anchored to the wall (12) at a suitable height in the rock wall above the floor.

8. Arrangement according to claim 7, characterised in that the cloth sections (15) extending upwardly towards the roof (11) of the rock cavity are stretched outward and downward towards the rock wall section adjacent a drainging system by means of vires, cables (50) or the like tension means, in order to establish the relatively free edge portion (70) of the cloth (15) mounting the cloth fixing to the rock wall (12).

9. Arrangement according to any of preceding claims, characterised in that the floor covering (14) includes a continuous extending slot (32) extending in parallel to the rock wall (12), in which an elongate sheet/plate (34) of plastic or metal is cast in (moulded), which plate (34) is arranged to establish a threshold towards seeping in of water along the floor and into the dry space, including an extending section which is cast into a concrete beam (18), said beam extending in parallel to the wall (12) of the rock space.