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(54) STEEL WIRE MESH FOR MINES AND OTHER SUBTERRANEAN CONSTRUCTIONS

(57) The invention relates to a steel wire mesh for supporting walls of mines and other subterranean constructions. The mesh comprises a number of parallel first mesh wires (1, 1'), which are arranged at a first distance from each other, as well as a number of parallel second mesh wires (2, 2'), which are arranged at a second distance from each other, perpendicular to the first mesh wires. The first and second mesh wires are attached to each other at the intersections of the mesh wires, preferably by welding. Furthermore the steel wire mesh comprises third mesh wires (3, 3') which are parallel to the first mesh wires, wherein an individual third mesh wire is arranged at a distance of 2 - 20 mm from the first mesh wire. The number of third mesh wires is smaller than the number of first mesh wires.

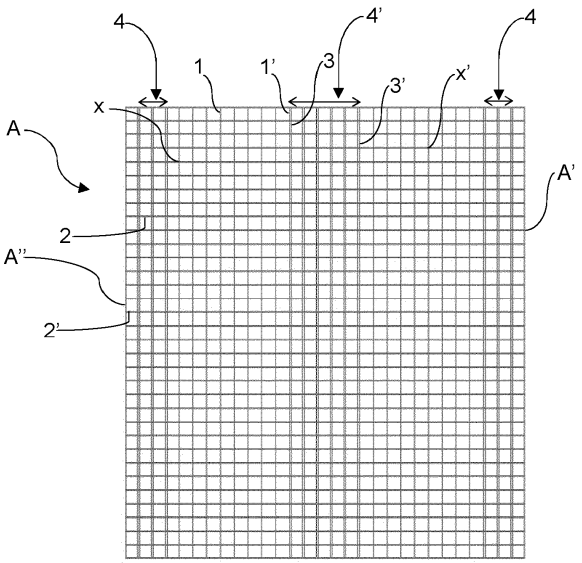

Fig. 1

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Description

[0001] The invention relates to a steel wire mesh for supporting walls of mines and other subterranean constructions. In particular, the invention relates to a steel wire mesh according to the preamble of the independent claim.

[0002] A mesh manufactured from steel wire, a so-called mining mesh, is attached to the walls of mine tunnels and similar subterranean structures, for example subterranean parking lots, to reinforce the structure itself and/or to prevent the falling of loose and/or detaching rocks. The used mining mesh should conform to the walls of the structure, so the mining mesh is to be manufactured from a wire having appropriate ductility. Depending on the application, the mesh is subject to specific strength requirements to ensure that the structure made from it is safe and meets the regulations. The mining mesh should, however, be relatively easy to form, so that it can be shaped by mechanical pressing to conform to the walls of the tunnel.

[0003] It is an object of the present invention to further develop prior art approaches and to eliminate or at least reduce problems present in prior art.

[0004] An object of the invention is a steel wire mesh which is easy to form and which meets the required strength and other requirements.

[0005] To attain these objects, the steel wire mesh according to the invention is primarily characterised in what is presented in the characterising part of the independent claim.

[0006] The dependent claims present some preferable embodiments of the invention. These embodiments are freely combinable with each other, if not otherwise stated.

[0007] A typical steel wire mesh according to the present invention, for supporting walls of mines and other subterranean constructions, comprises

- a number of parallel first mesh wires, which are arranged at a first distance from each other,
- a number of parallel second mesh wires, which are arranged at a second distance from each other, perpendicular to the first mesh wires,
  wherein the said first and second mesh wires are attached to each other at the intersections of the mesh wires, preferably by welding, and
- third mesh wires which are parallel to the first mesh wires, wherein an individual third mesh wire is arranged at a distance of at most 20 mm from the first mesh wire, and wherein the number of third mesh wires is smaller than the number of first mesh wires.

[0008] Now it has been surprisingly found that by arranging in a part of the mesh a third mesh wire adjacent to the first mesh wire, at a distance of at most 20 mm from the first mesh wire, it is possible to manufacture a steel wire mesh which is extremely strong but at the same time easy to shape, whereby it can be simply mechanically pressed to conform to the walls of the tunnel. Especially the steel wire mesh comprises third mesh wires which are parallel to the first mesh wires, which third mesh wires are arranged at a distance of 2 - 20 mm from the first mesh wires.

[0009] The steel wire mesh according to the invention comprises a number, i.e. plurality, of parallel first mesh wires which are arranged adjacently at a first distance from each other, and a number, i.e. plurality, of parallel second mesh wires which are arranged adjacently at a second distance from each other, perpendicular to the first mesh wires. It can be thought that the first mesh wires are arranged vertically and the second mesh wires are arranged horizontally. The first distance between the first mesh wires may be 45 - 150 mm, preferably 45 -100 mm, more preferably 45 - 70 mm. The second distance between the second mesh wires may be 45 - 150 mm, preferably 45 - 100 mm, more preferably 45 - 70 mm. According to one embodiment, the first distance between the first mesh wires may be different from the second distance between the second mesh wires. In the steel wire mesh, the distances between the first mesh wires are normally the same, constant, that is, the first distance does not vary in one mesh. Similarly, the distances between the second mesh wires are also normally the same, constant, that is, the second distance does not vary in one mesh.

[0010] The first and second mesh wires are attached to each other at the intersections of the mesh wires, preferably by welding, to form the steel wire mesh. When manufacturing the mesh, the wire used for the mesh is cut to a desired length, and cut wire lengths are used to form the described mesh-like structure, i.e. wire mesh, and in the structure the overlapping mesh wires are welded together at the points where the wires intersect.

[0011] In the present invention third mesh wires are thus arranged parallel with the first mesh wires to the mesh structure of the steel wire mesh. The third mesh wire is arranged relatively close to the first mesh wire, at a distance of at most 20 mm, preferably at most 15 mm, more preferably at most 10 mm, from the first mesh wire. This distance is so small that, for example, bolts intended for fastening the steel wire mesh do not fit between the first and third wires. According to one embodiment of the invention, the distance between the first mesh wire and the third mesh wire may be preferably 2 - 15 mm, more preferably 5 - 10 mm. The distance between the first and third mesh wire is measured from the outer surface of the third mesh wire to the outer surface of the closest first mesh wire.

[0012] Preferably, only one third mesh wire is arranged in the immediate vicinity of an individual first mesh wire. One third mesh wire is thus arranged adjacent to the first mesh wire, either on its first or second side. In case one third mesh wires are arranged in the immediate vicinity of several separate individual first mesh wires, each third mesh wire is arranged on the same side of each first mesh wire; that is, all the third mesh wires are arranged

on the same side of the first mesh wires, either on the first or the second side.

[0013] In the steel wire mesh the number of third mesh wires is smaller than the number of first mesh wires. In practice, this means that third mesh wires are arranged in the immediate vicinity of the first mesh wires only in certain areas of the steel wire mesh. Areas of the steel wire mesh where third mesh wires are arranged in the vicinity of the first mesh wires, can be called reinforcement areas.

[0014] According to one embodiment, third mesh wires are arranged adjacent only to certain first mesh wires. In case the steel wire mesh thus comprises several reinforcement areas, all the reinforcement areas are parallel with each other.

[0015] According to another embodiment, the steel wire mesh may also comprise third mesh wires parallel to the second mesh wires, wherein the individual third mesh wire is arranged at a distance of at most 20 mm, preferably at most 15 mm, more preferably at most 10 mm, from the second mesh wire, wherein the number of third mesh wires is smaller than the number of second mesh wires. The distance between the second mesh wire and the third mesh wire may in a range of 0 - 20 mm, preferably in the range of 2 - 20 mm, more preferably in the range of 2 - 15 mm, even more preferably in the range of 5 - 10 mm. The distance between the second and third mesh wires is measured from the outer surface of the third mesh wire to the outer surface of the closest second mesh wire.

[0016] According to yet another embodiment, the steel wire mesh may comprise third mesh wires parallel with both the first and the second mesh wires. In this case, the reinforcement areas of the steel wire mesh intersect in some part of the steel wire mesh.

[0017] According to one embodiment of the invention, the steel wire mesh may comprise at least two reinforcement areas, where a third mesh wire is arranged in the immediate vicinity of the first and/or the second mesh wire. Each reinforcement area may comprise at least two, preferably at least three, adjacent first and/or second mesh wires. This means that each reinforcement area comprises at least two adjacent first and/or second mesh wires, each of which has preferably one third mesh wire arranged in their immediate vicinity. Between the adjacent reinforcement areas remains a number of single first and/or second mesh wires, which have no third mesh wire arranged in their immediate vicinity, at a distance of less than 20 mm. The distance between the adjacent reinforcement areas may be in a range of 65 - 250 cm. The distance between the adjacent reinforcement areas may be, for example, 65 - 115 cm, especially if at least three parallel reinforcement areas are arranged in the steel wire mesh.

[0018] The reinforcement areas, where a third mesh wire is arranged next to the first and/or second mesh wire, can be arranged at the parallel edges of the mesh. In case reinforcement areas are arranged only at the parallel edges of the steel wire, their distance from each other may be, for example, 120 - 250 cm. According to one embodiment, a reinforcement area is arranged at all edges of the mesh. Furthermore, the steel wire mesh may comprise preferably at least one central reinforcement area, arranged between the reinforcement areas arranged at the edges of the mesh. Thus, at least three reinforcement areas are arranged in the steel wire mesh. In case the steel wire mesh comprises reinforcement areas arranged at the edges and further at least one central reinforcement area, the said at least one central reinforcement area and the reinforcement areas arranged at the edge may comprise different numbers of first and/or second mesh wires, next to which is arranged a third mesh wire. In practice, this means that the width of the reinforcement areas at the edges of the mesh differs from the width of the central reinforcement area(s).

[0019] The width of an individual reinforcement area may be 100 - 500 mm, preferably 150 - 400 mm. The width of a reinforcement area arranged at the edge of the mesh may be 100 - 300 mm, preferably 150 - 300 mm, and the width of each individual central reinforcement area may be 150 - 500 mm, preferably 220 - 400 mm. The width of the reinforcement area is measured as the distance between the outer sides of its outermost wires.

[0020] In case the steel wire mesh comprises third mesh wires parallel with both the first and the second mesh wires, the steel wire mesh comprises at least one first and one second reinforcement area which are perpendicular to each other and intersect each other somewhere in the steel wire mesh. The steel wire mesh may comprise several first and/or second reinforcement areas.

[0021] The diameter of the first mesh wires may be 3 - 6 mm, preferably 4 - 5.5 mm, more preferably 5.5 mm.

[0022] The diameter of the second mesh wires may be 3 - 10 mm, preferably 3 - 9 mm, more preferably 4.5 - 8.5 mm, sometimes more preferably 8 mm.

[0023] The diameter of the third mesh wires may be 3 - 10 mm, preferably 3 - 9 mm or 3 - 6 mm, more preferably 4 - 5.5 mm, sometimes more preferably 5.5 mm. The diameter of the third mesh wire is at most as great as the diameter of that first and/or second mesh wire, in the immediate vicinity of which the third mesh wire is arranged. The diameter of the third mesh wire may be equal to or smaller than the diameter of that first and/or second mesh wire, in the immediate vicinity of which the third mesh wire is arranged.

[0024] According to one a preferable embodiment of the invention, the diameter of the second mesh wires may be greater than the diameter of the first mesh wires. Especially, if third mesh wires are provided essentially or solely adjacent to or in connection with the first mesh wires, the diameter of the first mesh wires may be smaller than the diameter of the second mesh wires.

[0025] The diameter of the third mesh wires may be equal to the diameter of the first and/or second mesh

wires. In case third mesh wires are arranged in connection with both first and second mesh wires, the first and second mesh wires are preferably equal in diameter.

[0026] According to one preferable embodiment, third mesh wires are arranged only adjacent to the first mesh wires, wherein the diameters of the first and third mesh wires are identical, and 3 - 6 mm, preferably 4 - 5.5 mm, more preferably 5.5 mm. The diameter of the second mesh wires is in that case greater than the diameter of the first mesh wires, and 3.5 - 9 mm, preferably 4.5 - 8.5 mm, more preferably 8 mm.

[0027] The wire used as the mesh wire may be a rod wire made from steel by hot rolling, the rod wire having an essentially circular diameter. In a steel wire mesh according to the invention, can be used for example a rod wire having an elongation at break (A10) of about 20 - 35%. Typically, the mesh wire has a tensile strength R_m of about 370 - 450 N/mm^2 and a yield strength $R_{P0,20}$ of about 320 - 400 N/mm^2.

[0028] An embodiment of the invention is described in more detail in the appended Figure 1 which illustrates a steel wire mesh according to one embodiment of the invention.

[0029] In Figure 1 is shown a steel wire mesh A comprising parallel first mesh wires 1, 1' and parallel second mesh wires 2, 2'. In the shown steel wire mesh, the distance between the first mesh wires 1, 1' is approximately the same as the distance between the second mesh wires 2, 2'. Thus, the openings formed in the steel wire mesh have a substantially square shape. The first mesh wires 1, 1' and the second mesh wires 2, 2' are attached to each other at the intersections x, x' of the mesh wires, normally by welding.

[0030] The steel wire mesh A further comprises third mesh wires 3, 3' parallel to the first mesh wires 1, 1'. The third mesh wires 3, 3' are arranged at the immediate vicinity of some of the first mesh wires 1, 1', at a distance of at most 20 mm from the first mesh wire 1, 1'. In this way, in the steel wire mesh are formed reinforcement areas 4, 4', where the third mesh wires 3, 3' are arranged in the immediate vicinity of the first mesh wires 1, 1'. Reinforcement areas 4, 4' are formed at edges A', A" of the steel wire mesh A, as well as in its centre part. In the embodiment shown in the figure, the reinforcement areas 4 arranged at the edges A', A" of the steel wire mesh A are narrower than the central reinforcement area 4' formed in the centre part of the mesh A.

[0031] The invention is not intended to be limited to the above-presented exemplary embodiments, but the intention is to apply the invention widely within the inventive idea defined by the claims defined below.

Claims

1. A steel wire mesh for supporting walls of mines and other subterranean constructions, which mesh comprises
   - a number of parallel first mesh wires, which are arranged at a first distance from each other,
   - a number of parallel second mesh wires, which are arranged at a second distance from each other, perpendicular to the first mesh wires,

   wherein the said first and second mesh wires are attached to each other at the intersections of the mesh wires, preferably by welding,
   characterised in that
   the steel wire mesh comprises third mesh wires which are parallel to the first mesh wires, wherein an individual third mesh wire is arranged at a distance of 2 - 20 mm from the first mesh wire, and wherein the number of third mesh wires is smaller than the number of first mesh wires.

2. The steel wire mesh according to claim 1, **characterised in that** the diameter of the second mesh wires is greater than the diameter of the first mesh wires.

3. The steel wire mesh according to claim 1, **characterised in that** it comprises third mesh wires which are parallel to the second mesh wires, wherein an individual third mesh wire is arranged at a distance of at most 20 mm from the second mesh wire, wherein the number of the third mesh wires is smaller than the number of the second mesh wires.

4. The steel wire mesh according to any of claims 1 - 3, **characterised in that** the distance between the third mesh wire and the first mesh wire is at most 2 - 15 mm, preferably 5 - 10 mm, and/or the distance between the second mesh wire and the third mesh wire is 0 - 20 mm, preferably 2 - 20 mm, more preferably 2 - 15 mm, even more preferably 5 - 10 mm.

5. The steel wire mesh according to any of the claims 1 to 4, **characterised in that** the mesh comprises at least two reinforcement areas, in which a third mesh wire is arranged adjacent to the first and/or the second mesh wire.

6. The steel wire mesh according to claim 5, **characterised in that** each reinforcement area comprises at least two, preferably at least three adjacent first and/or second mesh wires.

7. The steel wire mesh according to claim 5 or 6, **characterised in that** reinforcement areas are arranged at parallel edges of the mesh.

8. The steel wire mesh according to claim 7, **characterised in that** the mesh comprises at least one central reinforcement area arranged between the rein-

forcement areas arranged at the edges.

9. The steel wire mesh according to claim 8, **characterised in that** at least one central reinforcement area and a reinforcement area arranged at an edge comprise different numbers of first and/or second mesh wires with an adjacent third mesh wire.

10. The steel wire mesh according to any of the claims 1 to 9, **characterised in that** the first distance between the first mesh wires is 45 - 150 mm, preferably 45 - 100 mm, more preferably 45 - 70 mm.

11. The steel wire mesh according to any of the claims 1 to 10, **characterised in that** the second distance between the second mesh wires is 45 - 150 mm, preferably 45 - 100 mm, more preferably 45 - 70 mm.

12. The steel wire mesh according to any of the claims 1 to 11, **characterised in that** the diameter of the first mesh wires is 3 - 6 mm, preferably 4 - 5.5 mm, more preferably 5.5 mm.

13. The steel wire mesh according to any of the claims 1 to 12, **characterised in that** the diameter of the second mesh wires is 3 -10 mm, preferably 3 - 9 mm, more preferably 4.5 - 8.5 mm.

14. The steel wire mesh according to any of the claims 1 to 13, **characterised in that** the third mesh wire has a diameter which is at most as great as the diameter of the first or second mesh wire.

15. The steel wire mesh according to any of the claims 5 to 14, **characterised in that** the distance of the adjacent reinforcement areas from each other is in a range of 65 - 250 cm, preferably 65 - 115 cm or 120 - 250 cm.

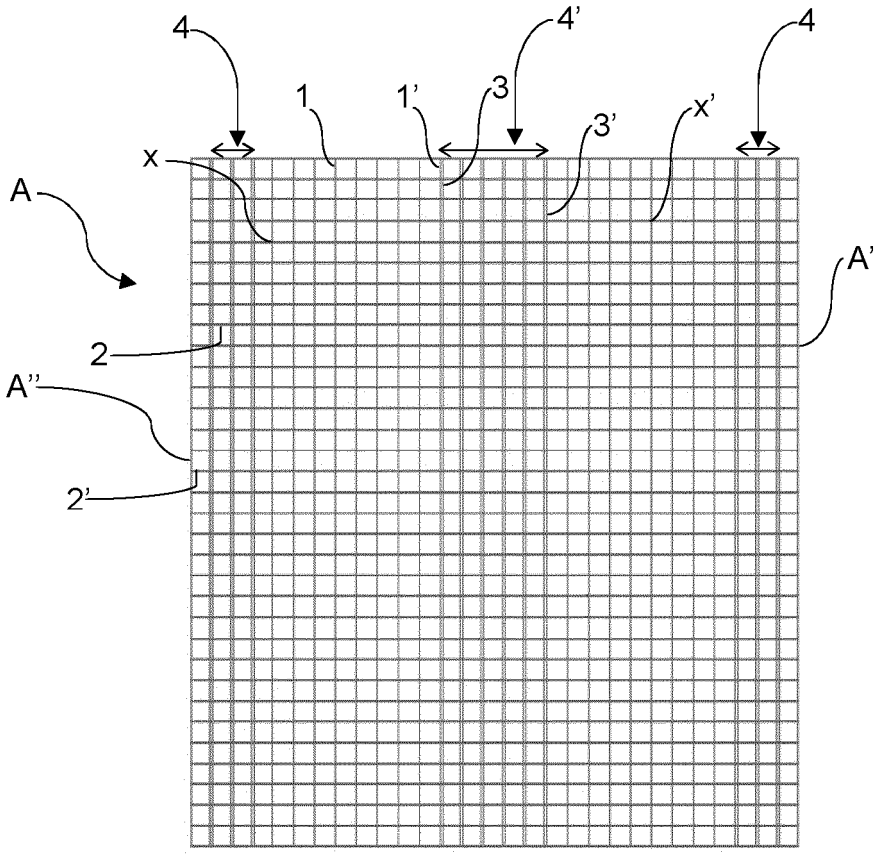

Fig. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 21 20 8703

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	AU 2007 202 992 A1 (ONESTEEL REINFORCING PTY LTD [AU]) 17 January 2008 (2008-01-17) * page 3, line 4 - line 32 * * page 9, line 11 - page 11, line 29 * * page 13, lines 6-7 * * page 15, line 5 - line 11; figure 1 *	1,2,5-7, 10-15 3,4,8,9	INV. E21D11/15
Y	WO 2017/098082 A1 (TAMMET OY [FI]) 15 June 2017 (2017-06-15) * page 1, line 1 - page 2, line 31; figures 1, 2 *	3,4,8,9	
Y	DE 88 03 465 U1 (DRAHTWERKE RÖSLER SOEST) 24 August 1989 (1989-08-24) * the whole document *	3,4,8,9	
			TECHNICAL FIELDS SEARCHED (IPC) E21D E02D E04C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	7 April 2022	Jucker, Chava

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WO 2017098082 A1	15-06-2017	NONE	
DE 8803465 U1	24-08-1989	NONE	

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