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(54) **Method and arrangement for manufacturing a steel wire mesh, and its use**

(57) Method and system for manufacturing a steel wire mesh (1), in which method

- wire rod (2) having a specific diameter is directed to the further processing stage (10),
- treated wire rod (3) is straightened and cut into parts having a desired length,
- the desired mesh (1) is welded from the cut wire parts

(4, 4'),

and in which method and system the average diameter of the wire rod (2) remains substantially the same in the further processing stage, and that the method and system are free from heat treatment stages.

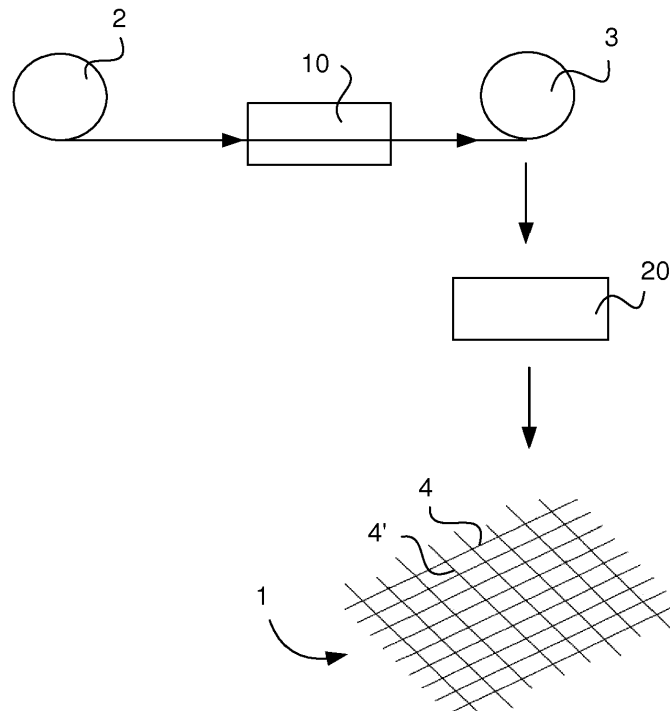


Fig. 1

Description

Field of the invention

[0001] The invention relates to a method and system for manufacturing a steel wire mesh according to the preambles of the enclosed independent claims. The object of the invention is also the use of the product manufactured by the method in the walls of mine tunnels and corresponding structures.

Background of the invention

[0002] A mesh manufactured from steel wire, a so-called steel wire mesh for mining applications, is attached to the walls of mine tunnels and respective structures to reinforce the tunnel structure and to prevent the falling of loose rocks. The used steel wire mesh for mining applications should conform to the walls of the tunnel, so the steel wire mesh for mining applications should be manufactured from a wire having an appropriate ductility. However, there are certain strength requirements for the steel wire to be used in the manufacture of the mesh depending on the purpose of use, so that the mesh structure manufactured from it will last in the purpose of use. The steel wire mesh for mining applications manufactured should, however, be relatively easy to shape, so that it can be shaped by mechanical pressing to conform to the walls of the tunnel.

[0003] Typically, the steel wire meshes for mining applications are manufactured from wire rod, so that the wire rod made of steel having a specific diameter is first guided to a cold forming stage, in which the diameter of the wire rod is substantially decreased to a desired wire diameter to be used in the final mesh structure. The diameter of the wire rod is typically decreased by 8-30%. Cold forming can either be carried out by rolling or cold extension. Cold forming requires one or several successive rolls or drawing stones having a different aperture, since the diameter of the rod can only be decreased a certain amount at once. Cold forming reinforces the wire, so that after the cold forming the steel wire has to be heat treated in order to achieve the desired softness and shapability, so that the wire can be used in the manufacture of steel wire mesh for mining applications. The heat treatment consumes remarkable amounts of energy and increases thus the production costs of the mesh manufactured from the steel wire. After the heat treatment the annealed steel wire is straightened and cut into the desired length, after which a desired mesh structure is prepared from the wire by welding.

Object and description of the invention

[0004] The object of the present invention is to provide a method and system for manufacturing a steel wire mesh, preferably a steel wire mesh for mining applications, from a wire rod, which method is simpler and thus

more cost-effective than the conventional production method.

[0005] To achieve this object, the method and system according to the invention is primarily characterised in what is presented in the characterising parts of the independent claims.

[0006] The other, dependent claims present some preferred embodiments of the invention.

[0007] In a typical method of the invention for manufacturing a steel wire mesh, preferably a steel wire mesh for mining applications, from wire rod,

- wire rod having a specific diameter is guided to a further processing stage,
- the processed wire rod is straightened and cut into parts having a desired length,
- the desired mesh is welded from the cut wire parts,

and in which method the average diameter of the wire rod does not substantially change in the further processing stage and that the method is free from the heat treatment stages.

[0008] A typical system of the invention for manufacturing a steel wire mesh, preferably a steel wire mesh for mining applications, from wire rod, comprises at least

- means for guiding wire rod into a further processing stage,
- means for further processing the wire rod,
- means for straightening the processed wire rod and cutting it into parts having a desired length, and
- means for welding the mesh from the wire parts.

[0009] The system is free from heat treatment means and the further processing means of the wire rod are arranged so that the average diameter of the wire rod does not substantially change in the further processing stage.

[0010] In a method and system according to the invention the average diameter the wire rod does not substantially change, i.e. the average diameter of the wire rod remains substantially the same.

[0011] Typically, the steel wire mesh, which is manufactured by the method of the invention, is used in the walls of mine tunnels and corresponding structures to reinforce the tunnel structure and to prevent the falling of loose rocks. Typically, the mesh manufactured by the method according to the invention is thus used as a so-called steel wire mesh for mining applications. The steel wire mesh for mining applications is typically a planar and ductile steel mesh, which can be attached to the wall of the mine tunnel or corresponding structure, and after attaching the mesh the tunnel walls can be shotcreted.

[0012] It has now been surprisingly found that the steel wire mesh for mining applications or corresponding mesh structure having a sufficient strength and shapability can be easily and simply manufactured from the wire rod having a specific diameter, which wire rod meets the desired

strength and shapability requirements, without a separate heat treatment stage. The wire rod which used as a raw material in the method according to the invention for manufacturing a steel wire mesh is only guided through a further processing stage and straightening stage before forming the actual mesh structure by welding. In other words, in the method according to the invention the wire rod is typically guided straight from the further processing stage to the straightening stage, optionally through intermediate coiling, but without any intermediate stages, which would effect on the strength properties of the wire. Thus, the manufacturing method according to the invention, which method is free from the heat treatment stages of the wire rod, is remarkably simpler and more cost-effective than the manufacturing method according to the prior art.

[0013] In the method according to the invention the further processing stage is only a so-called calibration stretch, the meaning of which is not to substantially change the average diameter of the wire rod, but the average diameter of the wire rod is mainly the same before the further processing stage and after it. The average diameter of the wire rod means the mathematical mean value of the diameters measured at several locations of the wire. The further processing is however performed, so that roll scale and other possible slag and impurities, which hinder the welding of the mesh from the steel wire, can be removed from the surface of the steel wire rod to be used as a material of the mesh. Simultaneously, the diameter of the wire can be formed more circular, since the cross-section of the unprocessed wire rod is typically not entirely circular, but it may be oval-shaped or otherwise deformed.

[0014] In a preferred embodiment of the invention the average diameter of the wire rod decreases in the further processing stage preferably 2% at the most and more preferably 1.5% at the most in respect to the average diameter of the wire rod before the further processing stage. In an embodiment the change of the average diameter of the wire rod in the further processing stage is typically 0-2%, more typically 0-1.5%, even more typically 0.01-1.5%. In an embodiment the change of the average diameter of the wire rod is 0.01-1%, sometimes even only 0.01-0.75%.

[0015] In a method according to the invention the further processing, i.e. the calibration stretch, is performed by guiding the wire rod through at least one drawing stone, drawing stone aperture being a diameter which is substantially the same as the average diameter of the wire rod. In a preferred embodiment the wire rod is guided through only one drawing stone, wherein the process is as simple as possible. Alternatively, the further processing can be performed in a method according to the invention by directing the wire rod through one or more rolling units, so that the average diameter of the wire rod does not substantially change. In one preferred embodiment the wire rod is guided in the further processing stage through only one rolling unit so that the average

diameter of the wire rod does not substantially change.

[0016] Since the calibration stretch stage is only meant to remove roll scale from the surface of the wire rod to be used as a raw material for the steel wire mesh, the production speed of this stage can be kept high. In an embodiment of the invention the production speed, which here means the propagation speed of the wire rod in the further processing stage, is substantially the same as the maximum speed of a wire coiling unit used in the further processing. The production rate is for example about 10 m/s. The production rate is thus not affected by directing the wire rod through the further processing means, such as drawing stone or twin rolls.

[0017] The wire rod used in the method according to the invention is a wire manufactured from steel by hot rolling, the diameter of which wire is typically substantially round. The elongation (A_{10}) of the wire rod used in the method according to the invention is typically about 25 - 35%. Typically, the tensile strength R_m of the wire rod is about 370 - 420 N/mm² and the yield strength $R_{P0.20}$ is about 320 - 370 N/mm².

[0018] A typical steel wire mesh, preferably a steel wire mesh for mining applications, according to the invention is manufactured from substantially smooth-surface steel wire, i.e. from further processed rod wire.

[0019] In one preferred embodiment of the invention wire rod having a diameter of 5.5 mm or 6 mm is used as a material of the steel wire mesh for mining applications. Since the method of the invention does not substantially affect to the diameter of the wire, the steel wire mesh according to the invention is thus manufactured from the steel wire, the diameter of which is about 5.5 mm or 6 mm. The diameter of the wire affects the mesh size of the mesh to be manufactured, so that the desired strength and weight of the mesh is achieved. The diameter of the wire and the mesh size of the mesh to be manufactured from it is chosen according to the purpose of use.

[0020] The mesh-like structure is formed of cut processed parts of the wire rod, i.e. steel wire, and the parts of the wire rod overlapping in the structure are welded together at locations, where the parts intersect.

Detailed description of the invention

[0021] In the following the invention will be described in more detail with reference to the appended Figure 1, which illustrates the method and system of the invention.

[0022] In the method of Figure 1 wire rod 2 used as a raw material of the mesh-like structure 1 is guided to a further processing stage 10, in which the wire rod 2 is guided either through at least one drawing stone or rolling unit so that the roll scale is removed from the surface of the wire rod. After the further processing stage 10 the processed wire rod 3 can be recoiled before the processed wire rod 3, i.e. the steel wire, is further guided to the next stage 20, in which the steel wire 3 is straightened and cut into parts 4, 4' having a desired length. The

straightening of the wire means smoothing out the wire, so that substantially straight elongated parts 4, 4' can be cut from the wire.

[0023] A mesh-like structure, preferably a steel wire mesh for mining applications 1, is formed by welding from the parts 4, 4' cut from the steel wire 3. The mesh structure 1 is welded at the intersections, where the parts 4, 4' arranged in different directions relative to each other overlap.

[0024] In the following is described an example of a steel wire mesh for mining applications manufactured by the method according to the invention.

Example

[0025] The manufacture of the mesh employs a wire rod made of steel, which wire rod has

- an average diameter of 5.5 mm
- an elongation $A_{10} = 25 - 30\%$
- a tensile strength $R_m = 370 - 420 \text{ N/mm}^2$
- a yield strength $R_{P0,20} = 320 - 370 \text{ N/mm}^2$

[0026] The wire rod is drawn through a drawing stone, which has an aperture of 5.5 mm, or through a rolling unit, which is set for the diameter of 5.5 mm, so that the roll scale can be removed from the surface of the wire rod (so-called calibration stretch). The average diameter of the processed wire rod is not more than 1.5% smaller than the diameter of the unprocessed wire rod.

[0027] After the calibration stretch the smooth surface steel wire is straightened and cut into parts having a desired length. The mesh-like structure having a desired size is welded from the cut parts. The size of the steel wire mesh is for example 2270 mm x 2530 mm, and the mesh size of the mesh is 75 mm x 75 mm, wherein the desired strength and shapability properties of the mesh are achieved.

[0028] 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. Method for manufacturing a steel wire mesh (1), preferably a steel wire mesh for mining applications, from wire rod (2), in which method

- wire rod (2) having a specific diameter is guided to a further processing stage (10),
- the processed wire rod (3) is straightened and cut into parts having a desired length,
- the desired steel wire mesh (1) is welded from the cut wire parts (4, 4'), **characterized in that**, the average diameter of the wire rod (2) remains substantially the same in the further processing

stage and that the method is free from heat treatment stages.

2. Method according to claim 1, **characterized in that** the average diameter of the wire rod (2) decreases in the further processing stage preferably 2% at the most and most preferably 1.5% at the most.

3. Method according to claim 1 or 2, **characterized in that** the further processing (10) of the wire rod is performed by guiding the wire rod (2) through at least one drawing stone, the drawing stone aperture having a diameter, which is substantially the same as the diameter of the wire rod.

4. Method according to claim 1 or 2, **characterized in that** the further processing (10) is performed by guiding wire rod (2) through one or more rolling units.

5. Method according to any of the preceding claims, **characterized in that** the wire rod is typically guided directly from the further processing stage to a straightening stage, only through an optional intermediate coiling, but without any intermediate steps.

6. Method according to any of the preceding claims, **characterized in that** in the further processing stage roll scale and other possible impurities are removed from the surface of the steel wire rod, and/or the diameter of the steel wire rod is formed more circular.

7. Method according to any of the preceding claims, **characterized in that** the propagation speed of the steel wire rod in the further processing stage is substantially the same as the maximum speed of a wire coiling unit used in the further processing.

8. Method according to any of the preceding claims, **characterized in that** the wire rod (2) is made of steel and its elongation (A_{10}) is about 25 - 35% and tensile strength R_m is 370 - 420 N/mm²

9. Method according to any of the preceding claims, **characterized in that** the average diameter of the wire rod (2) is about 5.5 mm or 6 mm.

10. Use of a steel wire mesh (1), which is manufactured by the method according to any of the preceding claims, in the walls of the mine tunnels or corresponding structures.

11. System for manufacturing a steel wire mesh, preferably a steel wire mesh for mining applications, from wire rod, which system comprises at least

- means for guiding wire rod into a further processing stage,
- means for further processing the wire rod,

- means for straightening the processed wire rod and cutting it into parts having a desired length, and
- means for welding the mesh from the wire parts.

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characterized in that the system is free from heat treatment means and the further processing means of the wire rod are arranged so that the average diameter of the wire rod remains substantially the same in the further processing stage.

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12. System according to claim 11, **characterized in that** the further processing means comprise at least one drawing stone, drawing stone aperture having a diameter, which is substantially the same as the diameter of the wire rod.
13. System according to claim 11, **characterized in that** the further processing means comprise one or more rolling units.

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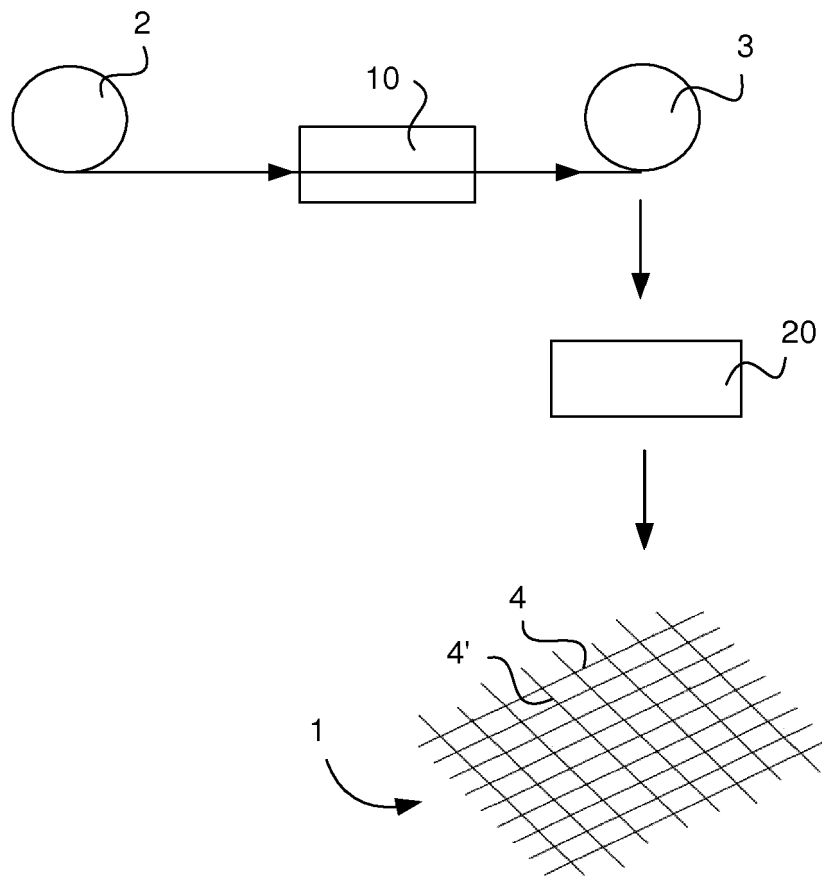


Fig. 1



EUROPEAN SEARCH REPORT

Application Number
EP 14 15 0765

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 25 April 2014	Examiner Ritter, Florian
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
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