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(54) REINFORCEMENT WIRE HAVING SPIRAL PROFILE

(57) The invention can be used in producing prestressed reinforcement for reinforcing items made of concrete and provides maximally strong adhesion to concrete in any potentially possible direction of displacement, and a high level of specific strength, relaxation resistance and fatigue resistance. In a reinforcement wire having a spiral profile, three ruled surfaces, separated from one another by sections of a cylindrical surface, are applied to the surface of the wire along a spiral line. Trapezoidal projections are arranged on the ruled surfaces at an incline in a direction counter to the direction of the spiral line along which the ruled surfaces themselves are arranged.

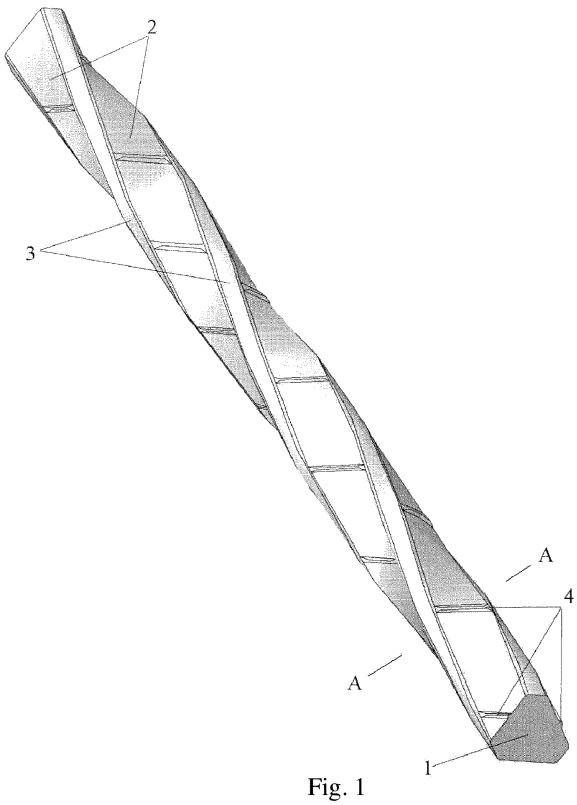

Fig. 1

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Description

[0001] The invention relates to wire drawing production and can be used in producing prestressed reinforcement intended for reinforcing hollow core slabs formed without use of formwork and other items made of concrete.

[0002] A reinforcement wire having a full-circle section is known, on the surface of it a periodic profile in the form of rounded dents under a cylindrical surface generator is applied, the dents being disposed in two longitudinal rows on the opposite sides of the surface (see GOST 7348-81 "CARBON STEEL WIRE FOR REINFORCEMENT OF PRESTRESSED CONCRETE CONSTRUCTIONS. SPECIFICATIONS").

[0003] The disadvantage of the known reinforcement wire is a low specific strength, fatigue resistance and relaxation resistance, which is due to the presence of stress concentrators at transition areas of the periodic profile, the stress concentrators being located in the areas with a reduced section area. The other disadvantage of the known reinforcement wire is a low adhesion to concrete. This factor is due to a very low depth of periodic cavities and narrow angles of inclination of the edges of these cavities to the wire axis, as a result of which Poisson narrowing of the wire during its operational tensioning leads to the projections of concrete formed when filling periodic cavities on the wire surface losing adhesion bond with cavities and at the same time being loaded with longitudinal force in the plane of wide areas of the wire between the cavities. In this case it should be noted that the creation of a more developed profile in this structure will certainly lead to a further weakening of the section and an increase in stress concentrators.

[0004] The closest prior art of the reinforcement wire according to the invention is a reinforcement wire having spiral profile, having a full-circle section with four trapezoidal projections, the outward-facing surface portion of which is arcs of a circle coaxial with the main surface of the reinforcement wire, the projections being disposed above the main surface helically and being continuous along the whole length of the wire (see the standard of the People's Republic of China GB/T 5223).

[0005] This structure of reinforcement wire has a higher specific strength, fatigue resistance and relaxation resistance thanks to the section uniform along the whole length, meaning that the process of pressure shaping is stationary and, consequently, the resultant properties are homogeneous along the length. Also the known structure of the wire provides for a stronger adhesion to concrete thanks to a multiply larger height of the profile and a larger relative crushing area, however, as a whole, does not provide for a strong adhesion to concrete because of a volume of concrete limited by the height of the projections, loaded by the lateral sides of the projections upon the crushing/shear, whereas the outward-facing cylindrical surface of the projections is involved only in adhesion and friction bond, as well as a possibility of spiral displacement of the wire in concrete according to its own impress without destruction thereof.

[0006] The purpose of the invention is to develop a structure of the reinforcement wire, which provides for simultaneously maximally strong adhesion to concrete, including mechanical adhesion in any potentially possible direction of displacement, and a high level of specific strength, relaxation resistance and fatigue resistance.

[0007] Said purpose is achieved in that the reinforcement wire having spiral profile according to the invention has a triangular section with rounded angles, the ribs and the faces of the wire, which are formed by the rounded angles and the sides of the triangle, respectively, being disposed helically, and a periodic profile in the form of inclined trapezoidal projections with rounded transition areas being formed on the surface of the faces along the line of their positioning.

[0008] Also the reinforcement wire can have a section in the shape of a quadrangle with rounded angles or an oval.

[0009] In addition, the faces of the wire surface can be both ruled and convex or concave.

[0010] Such a design of the wire provides for transmission of tensioning of the wire to concrete by means of normal stresses of the supporting force emerging due to the wedging of the spiral side faces inclined to the axis of the wire - studies of adhesion of reinforcement ropes to concrete have proved safety and exceptional efficacy of this method for implementation of adhesion; for instance, when loading hollow core slabs formed without use of formwork, reinforced with three-edged ropes, slabs were destroyed because the strength of the ropes was fully exhausted under the loads higher by 25-35% than for identical slabs reinforced with a set of standard ropes equivalent according to the number of ropes, their section, strength and actual tensioning. In this case the presence of a periodic profile on spiral faces of the reinforcement wire prevents its slipping through own impress in concrete, wherein a configuration of the periodic profile in the form of projections above the surface precludes a weakening of the section in the places where it is positioned and displaces the stress concentrators to the area reinforced through increasing the section.

[0011] The invention is explained by drawings.

Fig. 1 schematically illustrates an outer appearance of a reinforcement wire having spiral profile;

Fig. 2 schematically illustrates the cross section of a reinforcement wire having spiral profile.

[0012] The reinforcement wire having spiral profile according to one of the embodiments of the invention is given in Fig. 1, 2. On the surface of the wire 1 (Fig. 1, 2) three ruled surfaces 2 separated from one another by the areas of a cylindrical surface 3 are applied along a spiral line. Trapezoidal projections 4 are disposed on the ruled surfaces 2 at an incline in a direction reversed to the direction of the spiral line of positioning of the ruled

surfaces 2 themselves.

[0013] The reinforcement wire is manufactured, for example, as follows.

[0014] A wire 1 of circular section is manufactured beforehand. Afterwards, the wire is supplied through the roller cartridge revolving around it, having three inclined rollers that have cylindrical working surfaces with inclined grooves cut out on them. In addition, the ruled surfaces 2 are formed helically on the surface of the wire 1 by the action of the cylindrical rollers, and in the places where grooves are made on the cylindrical surface of the rollers trapezoidal projections 4 are formed opposite to them. On a portion of the wire surface, which is not deformed by rollers, the areas of cylindrical surface 3 are kept.

[0015] Simultaneously with the process of shape change the reinforcement wire being manufactured is tensioned up to a force of 30-70% of the breaking force by any known method, for example, between two capstans each of them being a set composed of a driving pulley and a non-drive pulley, or two driving pulleys. During the interval between passing the first and the second capstans when the reinforcement wire is in a straight-line tensioned state, it is heated up to the temperature of 370-430 degrees, for example, by means of an inductance furnace, followed by forced cooling of the tensioned wire by a water sprayer also in a straight-line tensioned state during the interval between the first and the second capstans.

[0016] Upon completion of cooling the wire passes through the second capstan and is fed to an accumulating unit from which it is wound up in coils or is fed to a scissors where it is cut to specific lengths. Afterwards, the wire wound or cut to specific lengths is packed by the known methods.

[0017] Apart from the described method, the wire may be subjected to shape change in a single process run with a wire drawing operation.

Claims

1. A reinforcement wire having spiral profile, having a triangular section with rounded angles, the ribs and the faces of the wire, which are formed by the rounded angles and the sides of the triangle, respectively, being disposed helically, and a periodic profile in the form of inclined trapezoidal projections with rounded transition areas being formed on the surface of the faces along the line of their positioning.

2. The reinforcement wire according to claim 1, wherein the section is in the shape of a quadrangle with rounded angles.

3. The reinforcement wire according to claim 1, wherein the section is in the shape of an oval.

4. The reinforcement wire according to claims 1-3, wherein the faces are convex.

5. The reinforcement wire according to claims 1-3, wherein the faces are concave.

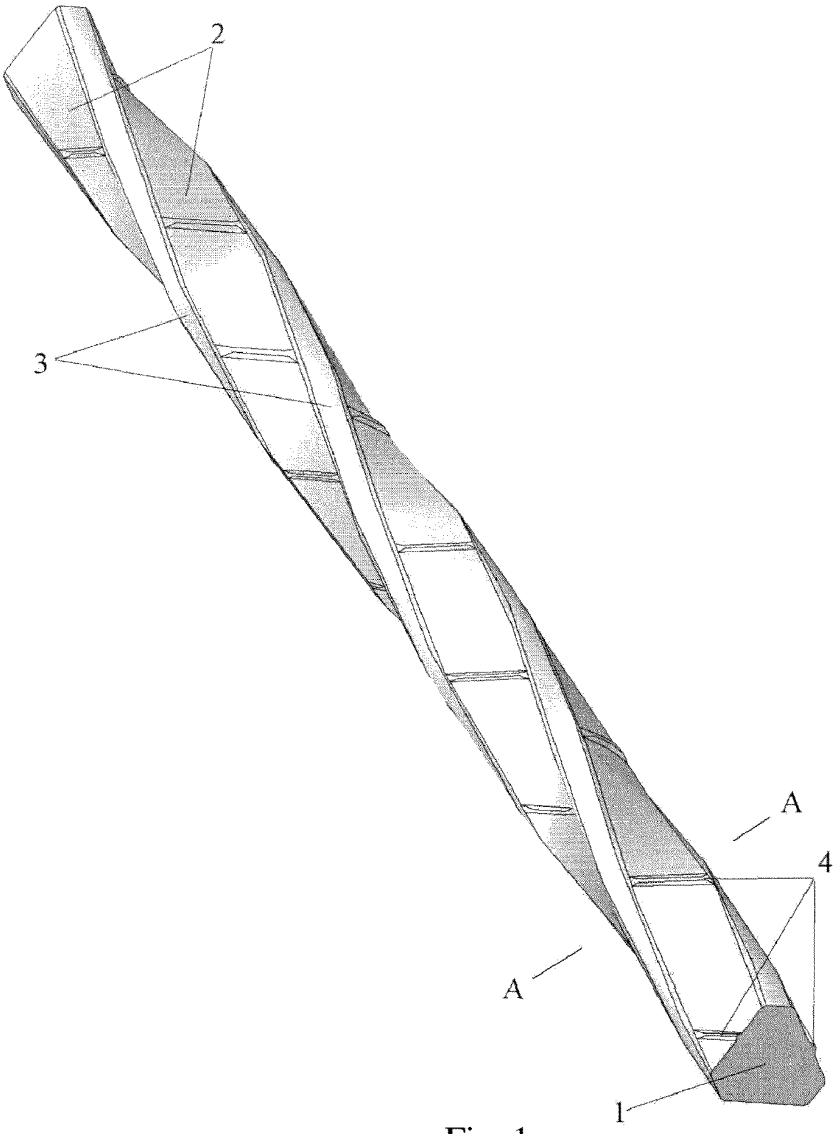

Fig. 1

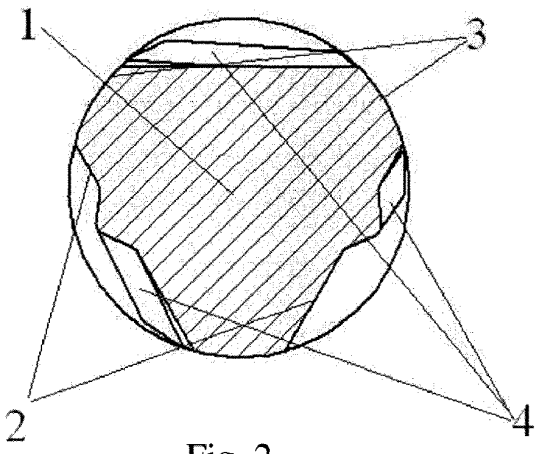

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/RU 2018/000113

A. CLASSIFICATION OF SUBJECT MATTER
E04C 5/03 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E04C 5/00-5/03, C21 D 7/00, 7/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatSearch, Esp@cenet, USPTO, Google

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	RU 170526 U1 (OTKRYTOE AKTSIONERNOE OBSCHESTVO "MAGNITOGORSKY METIZNO-KALIBROVOCHNY ZAVOD "MMK-METIZ") 27.04.2017	1-5
A	RU 2431024 C2 (ZARETSKY LEV MARKOVICH et al.) 10.10.2011	1-5
A	CN 201908390 U (HEBEI JINGPENG PRESTRESS WIRE CO LTD) 27.07.2011	1-5
A	JP 2733739 B2 (NETUREN CO LTD) 30.03.1998	1-5

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
06 September 2018 (06.09.2018)	13 September 2018 (13.09.2018)
Name and mailing address of the ISA/ RU	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (April 2005)

REFERENCES CITED IN THE DESCRIPTION

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Non-patent literature cited in the description

- CARBON STEEL WIRE FOR REINFORCEMENT OF PRESTRESSED CONCRETE CONSTRUCTIONS. SPECIFICATIONS. *GOST 7348-81* **[0002]**