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(71) Applicants:
- **He, Manchao**
  Beijing 100083 (CN)
- **Xia, Min**
  Beijing 100083 (CN)

(72) Inventors:
- **GUO, Hongyan**
  Beijing 100083 (CN)
- **LI, Hongchao**
  Zhou, Hebei 062250 (CN)
- **HE, Manchao**
  Beijing 100083 (CN)
- **XIA, Min**
  Beijing 100083 (CN)

(74) Representative: **Schwarz & Partner Patentanwälte GmbH**
Patentanwälte
Wipplingerstraße 30
1010 Wien (AT)

(54) **NPR ANCHOR ROD**

(57) An NPR rock bolt according to the present disclosure comprises a bolt body (1), a tray (2) and a lock (3). The bolt body (1) is an NPR spiral steel bar, an outer surface of the NPR spiral steel bar is provided with a number of convex spiral ribs, and the spiral ribs have a spiral structure. The tray (2) and the lock (3) are directly sleeved on a tail of the NPR spiral steel bar. The NPR bolt according to the present disclosure can effectively solve the problem in the prior art that conventional rock bolts have a low elongation and cannot meet the requirement of large deformation of the surrounding rock.

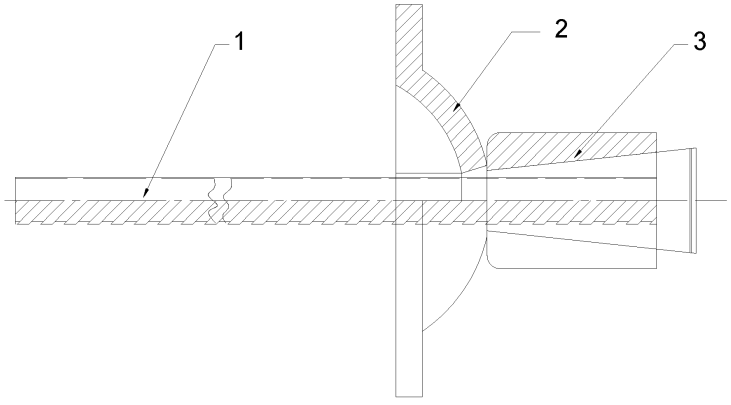

Fig. 1

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to the technical field of concrete-related new materials, in particular to an NPR rock bolt.

BACKGROUND

[0002] In the prior art, in the support of coal mine roadways and tunnels, rock bolts are the most used support equipment in terms of both scope and quantity. With the continuous increase of coal mining depth, the roadway-surrounding rock often shows the characteristics of large deformation, such as large deformation of soft rock, large deformation of rock burst, large deformation of impact, large deformation of gas outburst. In the current supporting rock bolts, the bolt body has a low elongation and is not suitable for the nonlinear large-scale deformation and failure characteristics of surrounding rock in deep roadways. Under the action of impact loads, the rock bolt may reach its yield strength instantaneously, then fracture and failure occur, and its bearing and protection capabilities are lost, which leads to destructive situations such as repeated reparation of the roadway, distortion of the steel frame, and cracking of the poured concrete.

SUMMARY

[0003] An embodiment of the present disclosure provides an NPR rock bolt to solve the problem in the prior art that the conventional rock bolts have a low elongation and cannot meet the requirement of large deformation of the surrounding rock.

[0004] In order to achieve the above object, the present disclosure provides an NPR rock bolt, comprising a bolt body, a tray and a lock; the bolt body is an NPR spiral steel bar, an outer surface of the NPR spiral steel bar is provided with a number of convex spiral ribs, and the spiral ribs have a spiral structure; and the tray and the lock are directly sleeved on a tail of the NPR spiral steel bar.

[0005] Further, the tail of the NPR spiral steel bar is untreated.

[0006] Further, the NPR spiral steel bar has a yield strength of 800-950 MPa and a tensile strength of 900-1050 MPa, and a deformation displacement of the NPR spiral steel bar is 200-350 mm/m.

[0007] Further, a nominal diameter of the NPR bolt is 14-26 mm.

[0008] Further, the tray is a metal butterfly tray.

[0009] Further, the lock comprises a metal lock piece and a lock sleeve that cooperate with each other.

[0010] Further, the spiral ribs extend along an axial direction of the NPR spiral steel bar.

[0011] Further, the quantity of the spiral ribs is 3-6.

[0012] Further, a number of the spiral ribs are evenly disposed along a circumferential direction of the NPR spiral steel bar.

[0013] The NPR rock bolt according to the present disclosure can achieve uniform elongation (200-350 mm/m) when the roadway-surrounding rock deforms greatly, and maintain a substantially stable working resistance. Therefore, the NPR bolt according to the present disclosure can absorb the energy of the surrounding rock by means of transverse resistance and large deformation, so as to still have a good supporting effect under the condition of large deformation of the surrounding rock to ensure the stability of the roadway.

BRIEF DESCRIPTION OF DRAWINGS

[0014]

FIG. 1 is a schematic diagram of the structure of an NPR rock bolt according to an embodiment of the present disclosure; and

FIG. 2 is a schematic diagram of a stress-strain curve of the NPR rock bolt according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

[0015] The present disclosure will be described in further detail below with reference to the drawings and specific embodiments, but they are not intended to limit the present disclosure.

[0016] Referring to FIG. 1 and FIG. 2, according to an embodiment of the present disclosure, a NPR rock bolt with constant resistance and large deformation is provided. The NPR rock bolt comprises a bolt body 1, a tray 2 and a lock 3. The bolt body 1 is an NPR spiral steel bar, an outer surface of the NPR spiral steel bar is provided with a number of convex spiral ribs, and the spiral ribs have a spiral structure. The tray 2 and the lock 3 are directly sleeved on a tail of the NPR spiral steel bar.

[0017] The NPR rock bolt according to the present disclosure can achieve uniform elongation (200-350 mm/m) when the roadway-surrounding rock deforms greatly, and maintain a substantially stable working resistance. Therefore, the NPR bolt according to the present disclosure can absorb the energy of the surrounding rock by means of transverse resistance and large deformation, so as to still have a good supporting effect under the condition of large deformation of the surrounding rock to ensure the stability of the roadway.

[0018] Preferably, the tail of the NPR spiral steel bar is untreated. For example, the tail of the NPR spiral steel bar is not subject to any treatment such as thread rolling. Such structure has the advantage of avoiding the stress concentration at the tail thread, thereby avoiding the occurrence of tail thread cracking, and effectively improving the elongation of the rock bolt.

[0019] Refer to the schematic diagram of stress-strain curve shown in FIG. 2, in the present embodiment, the

NPR spiral steel bar has a yield strength of 800-950 MPa and a tensile strength of 900-1050 MPa, and the deformation displacement of the NPR spiral steel bar is 200-350 mm/m. The maximum stress of bolt body is >210 KN, the elongation is >20%, the anchoring force of bolt body is >200 KN, the anchoring length is >1 m, the bearing capacity of bolt lock is >210 KN, and the bearing capacity of tray is >210 KN.

[0020] Preferably, the nominal diameter of the NPR bolt is 14-26 mm. As shown in FIG. 1, the tray 2 is a metal butterfly tray. The lock 3 comprises a metal lock piece and a lock sleeve that cooperate with each other. A hole is formed at the center part of the tray 2 for the bolt body 1 to pass through. The metal lock piece is sleeved on the tail of the bolt body and cooperates with the lock sleeve to form a lock 3.

[0021] The structure of the bolt body 1 is as follows. The spiral ribs extend along the axial direction of the NPR spiral steel bar. The quantity of spiral ribs is 3-6. A number of spiral ribs are evenly disposed along the circumferential direction of the NPR spiral steel bar.

[0022] The NPR bolt according to the present disclosure can realize constant resistance and large deformation, and in the roadway where the NPR bolt according to the present disclosure is used as a supporting equipment, when the roadway-surrounding rock is subject to a certain deformation, the NPR bolt will be evenly stretched and the deformation energy in the surrounding rock can be released, and when there is large tensile deformation, the relatively stable working resistance can be maintained, the stability of the roadway can be realized, and the hidden safety hazards such as roof fall and collapse can be eliminated.

[0023] It should be noted that the terminology used herein is only for describing specific embodiments and is not intended to limit the exemplary embodiments according to the present disclosure. As used herein, the singular forms are intended to include the plural forms as well, unless the context clearly indicates otherwise. It should also be understood that when the terms "include" and/or "comprise" are used in this specification, they indicate there are features, steps, operations, devices, components, and/or combinations thereof.

[0024] It should be noted that the terms "first" and "second" in the specification, claims and drawings of the present disclosure are used to distinguish similar objects, and are not necessarily used to describe a specific order or sequence. It should be understood that the terms used in this way are interchangeable under appropriate circumstances so that the embodiments of the present application described herein can be implemented in an order other than those illustrated or described herein.

[0025] Of course, the above are only preferable embodiments of the present disclosure. It should be noted that those skilled in the art can make improvements and modifications without departing from the basic principles of the present disclosure, and these improvements and modifications shall also fall within the protection scope of the present disclosure.

Claims

1. An NPR rock bolt, comprising a bolt body (1), a tray (2) and a lock (3), wherein

   the bolt body (1) is an NPR spiral steel bar, an outer surface of the NPR spiral steel bar is provided with a number of convex spiral ribs, and the spiral ribs have a spiral structure; and
   the tray (2) and the lock (3) are directly sleeved on a tail of the NPR spiral steel bar.

2. The NPR bolt according to claim 1, wherein the tail of the NPR spiral steel bar is untreated.

3. The NPR bolt according to claim 1, wherein the NPR spiral steel bar has a yield strength of 800-950 MPa and a tensile strength of 900-1050 MPa, and a deformation displacement of the NPR spiral steel bar is 200-350 mm/m.

4. The NPR bolt according to claim 1, wherein a nominal diameter of the NPR bolt is 14 - 26 mm.

5. The NPR rock bolt according to claim 1, wherein the tray (2) is a metal butterfly tray.

6. The NPR rock bolt according to claim 1, wherein the lock (3) comprises a metal lock piece and a lock sleeve that cooperate with each other.

7. The NPR rock bolt according to claim 1, wherein the spiral ribs extend along an axial direction of the NPR spiral steel bar.

8. The NPR bolt according to claim 1, wherein the quantity of the spiral ribs is 3-6.

9. The NPR rock bolt according to claim 1, wherein a number of the spiral ribs are evenly disposed along a circumferential direction of the NPR spiral steel bar.

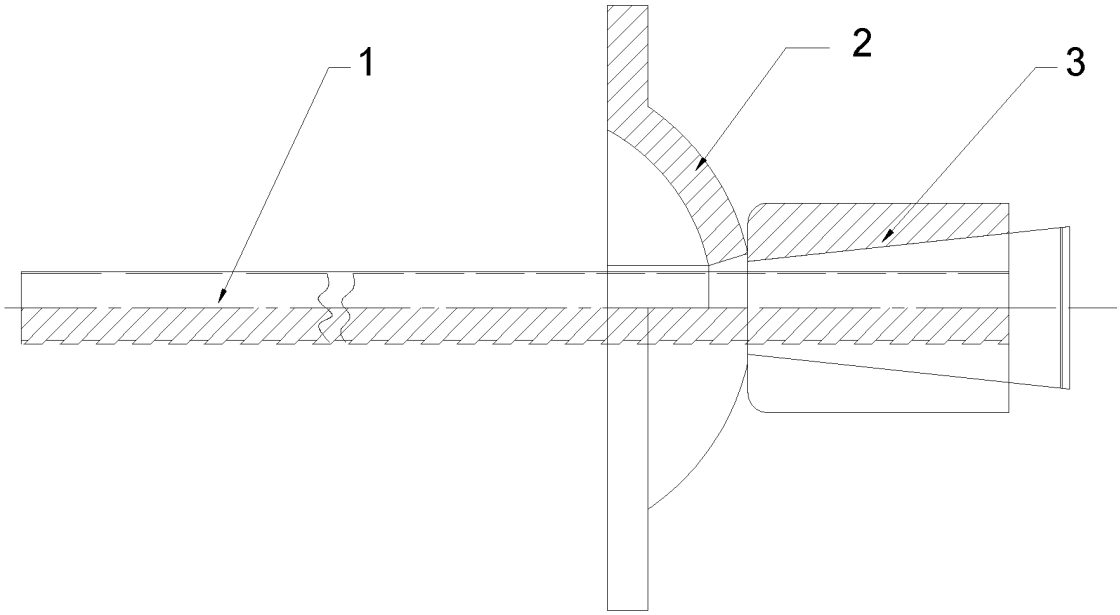

Fig. 1

specimen shape	rock bolt	size (mm)	812	
maximum tensile force (kN)	244.00	ultimate elongation	211.71	
elongation at maximum force	200.84			

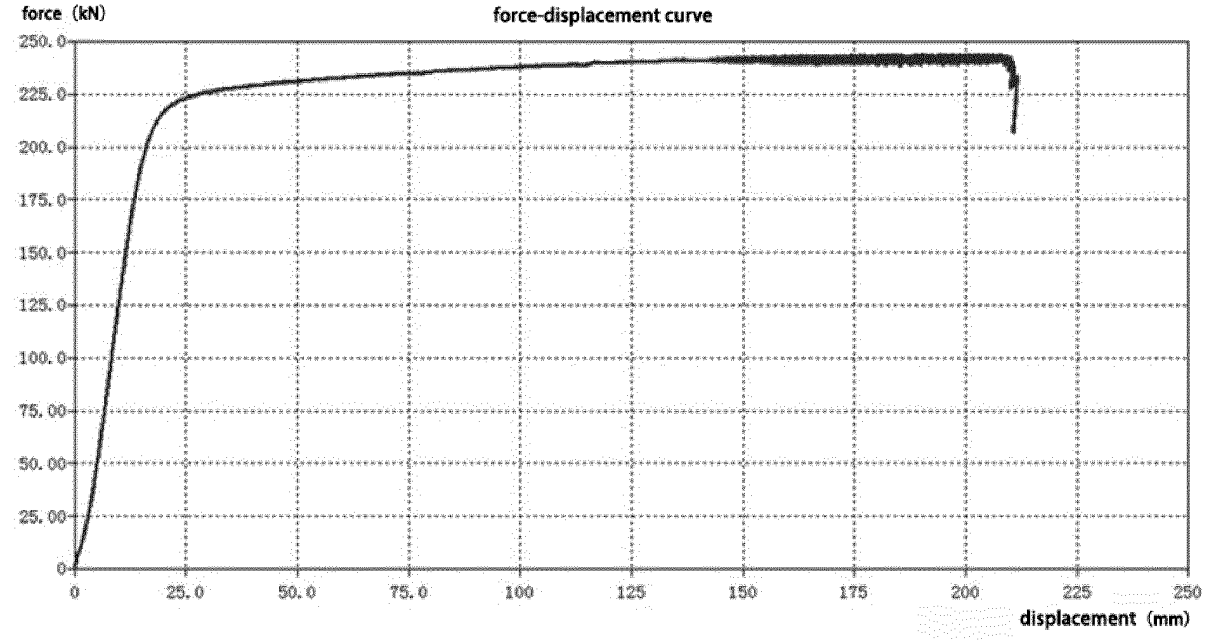

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2020/117971

A. CLASSIFICATION OF SUBJECT MATTER

E21D 21/00(2006.01)i

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)

E21D; E02D; F16B; C22C

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)

EPODOC, WPI, CNPAT, CNKI: 何满潮, 锚杆, 托盘, 锁, 螺纹, 螺旋, 肋, 钢筋, 屈服强度, 抗拉强度, NPR, anchor, rod, tray, lock+, screw, thread, rib, steel, bar, yield, tensile, strength

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 211038693 U (HE, Manchao et al.) 17 July 2020 (2020-07-17) claims 1-9	1-9
Y	CN 104343460 A (XUZHOU MINING BUSINESS GROUP CO., LTD.) 11 February 2015 (2015-02-11) description, paragraphs 16-25, figures 1-3	1-9
Y	CN 108754339 A (HE, Manchao et al.) 06 November 2018 (2018-11-06) description, paragraphs 28-51, figures 1-7	1-9
Y	CN 201212399 Y (ZHOU, Gang et al.) 25 March 2009 (2009-03-25) description, particular embodiments, and figures 1-2	1-9
A	CN 206418498 U (SHANDONG TAIJILONG ALWAYSEAL TECHNOLOGY LTD.) 18 August 2017 (2017-08-18) entire document	1-9
A	US 2016003279 A1 (FIREP REBAR TECHNOLOGY G.M.B.H.) 07 January 2016 (2016-01-07) entire document	1-9

☐ 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
10 December 2020	**31 December 2020**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088** **China**	Authorized officer
Facsimile No. **(86-10)62019451**	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2020/117971

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 211038693 U	17 July 2020	None	
CN 104343460 A	11 February 2015	None	
CN 108754339 A	06 November 2018	CN 108754339 B	19 June 2020
CN 201212399 Y	25 March 2009	None	
CN 206418498 U	18 August 2017	None	
US 2016003279 A1	07 January 2016	JP 5671672 B2	18 February 2015
		DE 102013002734 B4	05 March 2015
		US 9371850 B2	21 June 2016
		WO 2014128043 A2	28 August 2014
		EP 2959106 A2	30 December 2015
		AU 2014220903 B2	21 December 2017
		WO 2014128043 A3	23 April 2015
		SI 2959106 T1	29 September 2017
		CA 2899702 A1	28 August 2014
		EP 2959106 B1	10 May 2017
		JP 2014159728 A	04 September 2014
		DE 102013002734 A1	21 August 2014
		AU 2014220903 A1	13 August 2015

Form PCT/ISA/210 (patent family annex) (January 2015)