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(54) ANCHOR HOUSING LOAD ABSORBER

(57) The invention relates to a load absorber of the roof bolting having a connection with the end of the bolting embedded in the rock mass, characterized in that it is constituted by a dome bolting washer (6) and a special bolt having at one end a cylindrical section (5a) provided with a thread, passing into tapered shaft (5b), the diameter of which increases towards the other end, equipped with a head (5d) of any known shape, while in the working position, the bolt is passed through a hole in the domed bolting washer (6), inverted convexly towards the excavation and connected to the bolting rod (1) by means of a connecting sleeve (4) screwed onto the threaded end of the bolting rod (1) and onto the threaded cylindrical section (5a) of the bolt so that the hole of the dome bolting washer (6), encompasses tapered shaft (5b) of the bolt in the vicinity of half of its length, and, in addition, the section of tapered shaft (5b) on the side of the head (5d) has a graduated strain marker (5c).

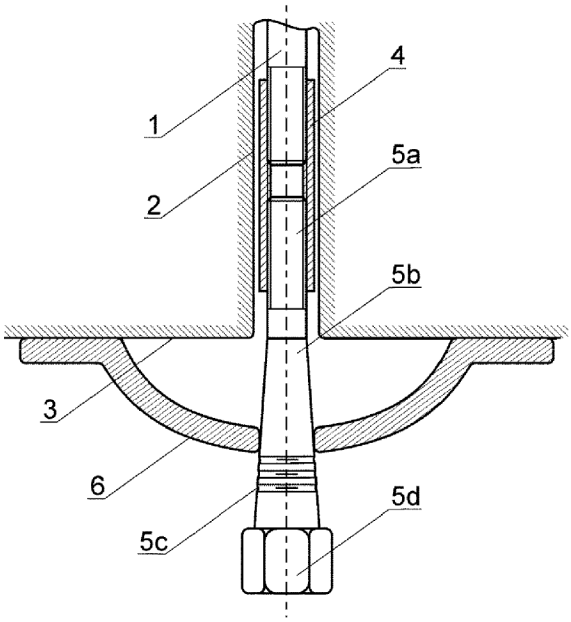

Fig. 1

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Description

[0001] The subject of the invention is a roof bolting load absorber for use especially in the roofing of underground mine workings exposed to additional dynamic loads from shocks and damping.

[0002] Polish patent description PL226879B1 discloses a dynamometric bolting washer comprising a pair of cylinders, outer and inner, facing concave sides to each other and able to slide freely over each other, containing at least one elastic element providing resistance to the sliding cylinders, with the washer having coaxial centrally located holes in both cylinders and the elastic element(s). On the inner cylinder, below the edge of the outer cylinder, there are closely overlapping measuring rings, which are placed on the cylinder using a fitting that prevents them from moving spontaneously, but which can move due to the compression force of the cylinders. Upon placing the rings on the cylinder, a fitting has been applied that prevents them from moving on their own. As a result of this, the rings can only move due to a force of a known value, transmitted through the cylinder with a larger diameter. Both cylinders and the elastic element have coaxial, centrally located holes with a diameter corresponding to the bolting rod. A similar solution is presented in a publication by W. Korzeniowski et al. entitled: "Remote, non-electric indicator WK-2/8 of the value of the bolting load force in the mine workings" (Zeszyty Naukowe IGSMiE PAN, 2018, no. 103, pp. 53-64). On the rod, between the outline of the excavation (e.g., the roof) and the nut or head of the bolting, a device is placed, which is also a dynamometric bolting washer, consisting of two cylinders, between which there are calibrated elastic elements that absorb the energy of the bolting load. As a result of the compressive load, during the operation of the bolting, the cylinders move relative to each other, and this displacement is proportional to the bolting loading force. On the inner cylinder, measuring rings are placed using a tight fit that prevents them from slipping on their own, but can shift due to the relative displacement of the cylinders. The thickness of each measuring ring is selected according to the load-deformation characteristics of the elastic element. After the individual measuring rings of known thickness slide and fall off, the number of rings is determined visually and in this indirect way the values of the increment of the axial force of the load on the boltings are determined. From the US patent description US5185595A, a bolting load indicator is known, which is installed between the bolting washer and the excavation surface. The indicator consists of disc springs bounded by two flat thrust washers. The disc springs form the lining component of the bolting that operates as a load absorber for the roof bolting. The lower washer on the side of the excavation has a hole in which there is a threaded sleeve. Inside the sleeve there is a pin that can slide along the longer sleeve. The upper inner part of the sleeve has a spring wound around the pin to ensure constant contact with the upper thrust washer. The extended part of the pin on the excavation side consists of two distinctive sections. The first outer section, extending beyond the nut, is painted black, while the second section, hidden in the nut, is painted red. During the installation of the roof bolting, an initial tension force is given until the pin extends so that the section marked in black shows. Under the influence of the load, the disc springs are compressed, and the pin slides out of the measuring sleeve. The value of the load is inferred from the appearance, the ejection of the section of the pin painted in red. Knowing the thread pitch of the nut and the number of turns needed to establish the level between the red and black ranges on the measuring pin, the load on the bolting can be qualitatively estimated. In another variant of the embodiment of the invention, the moving pin can cause the closing of an electrical circuit, connected to the signalling device. An embodiment is also possible, in which the disc springs are enclosed inside two cylinders, with the inner one, located on the side of the excavation, painted red, and the outer one having holes made in the cylindrical wall. After installing the bolting with the indicator, the protruding parts are spray-painted white. When there is any relative movement of the cylinders, caused by a change of force in the bolting, the red parts of the inner cylinder become visible through the holes in the outer cylinder. From the Polish description of utility model PL67289Y1, a bolting load indicator is known, containing a prone element, which has the form of a sleeve with weakened walls, on the side of which four, symmetrically spaced, longitudinal holes are made. The sleeve is placed on the end of the bolting protruding from the rock mass, between its washer and nut. The indicator is inserted on the end of the bolting protruding from the rock mass, between its washer and nut. As the bolting is loaded, the weakened sleeve walls lose stability, resulting in swelling and a decrease in sleeve height, signalling the magnitude of the forces applied to the bolting. The change in the height of the sleeve indicates the impending overloading of the bolting and the need for countermeasures against its dangerous rupture. A similar solution is disclosed in Polish patent description PL192588B1, in which the energy absorber, in a variant embodiment designed for mining boltings, contains two sections of thin-walled columns of different lengths and different wall thicknesses, which are placed concentrically between plates that are typical flat washers used in boltings. The absorber elements are connected to each other by a bolting rod, one end of which is fixed in the rock mass, while the other passes through holes in the washers and is provided with a nut. An additional energy of the sudden load of the bolting is absorbed by way of forcing a deformation of the thin-walled columns. Visual evaluation of the permanent deformation of the columns can also provide general information about the load put on the bolting.

[0003] The aim of the invention is to develop a roof bolting component that would allow the elastic lining of the bolting in cases of dynamic loading, as well as the

dissipation of certain amount of the elastic energy that occurs in the bolting rod, and that would allow a quick visual estimate of the magnitude of the tensile forces or the degree of strain on the bolting.

[0004] The essence of the load absorber of the roof bolting is that it consists of a dome bolting washer and a special bolt having at one end a cylindrical section provided with a thread passing into a tapered shaft, the diameter of which increases towards the second end, equipped with a head of any known shape, while in the working position, the bolt is passed through a hole in the dome bolting washer, inverted convexly towards the excavation and connected to the bolting rod by means of a connecting sleeve, screwed onto the threaded end of the bolting rod and onto the threaded cylindrical section of the bolt so that the hole of the dome bolting washer encompasses tapered shaft of the bolt in the vicinity of half of its length, and, in addition the section of the tapered shaft on the head side has a strain marker.

[0005] It is advantageous when a section of the tapered shaft having a diameter equal to the diameter of the hole of the dome bolting washer is located at a distance corresponding to 0.4 to 0.6 of its length.

[0006] It is advantageous when the strain marker consists of at least two circumferential undercuts of the diameter of the tapered shaft.

[0007] Also advantageous is when the strain marker consists of at least one pitch applied along the generatrix of the cone.

[0008] It is also advantageous, when the strain marker consists of at least two wooden or plastic rods, passed through radial through-holes made in the tapered shaft.

[0009] The subject-matter of the invention is depicted in the exemplary embodiment shown in the drawing wherein fig. 1 shows a simplified view of an energy absorber mounted on an bolting rod in the excavation roof, with a strain marker in the form of circumferential diameter undercuts, fig. 2 - a fragment of the bolt with a pitch applied by laser technique on the generatrix of the cone, fig. 3 - a fragment of the bolt with the pitch in the form of bars going through the radial through-holes made in the tapered shaft of the screw.

[0010] The load absorber of the roof bolting, is located at the end of bolting rod 1, installed in hole 2, made in roof 3 of the mine workings (fig. 1). The special bolt is pulled through a hole in the dome bolting washer 6, turned convexly towards the excavation, and is connected to bolting rod 1 by means of a connecting sleeve 4, screwed onto the threaded end of bolting rod 1 and onto threaded cylindrical section 5a of the special bolt. The cylindrical section 5a passes into tapered shaft 5b with a diameter that increases toward the other end of the bolt, equipped with head 5d of hexagonal shape. The dimensions of the tapered shaft 5b are selected so that its diameter near the middle of its length is equal to the diameter of the hole of dome bolting washer 6 and when the initial tension force of bolting 1 is set the hole of dome bolting washer 6 covers the tapered shaft 5b at a distance not exceeding 0.6 of its length, measured from its narrower end. The section of tapered shaft 5b, extending beyond bolting washer 6, has strain marker 5c, which is constituted by three circumferential stem extension of its diameter, each of which is additionally filled with a different colour of paint. The distances between the stem extensions of strain marker 5c and their location on tapered shaft 5b are chosen so that the first stem extension corresponds to the magnitude of the initial tension force of bolting 1, the second stem extension corresponds to the value of half of the breaking force of bolting 1, and the third stem extension corresponds to the value of the force inducing in bolting 1 stresses equal to the elastic limit of the material of which the bolting rod 1 is made. The scaling of the strain marker 5c is performed on the basis of the results of laboratory tests involving the pulling of tapered shaft 5b through domed washer 6, during which the force and the corresponding relative displacement of the two elements are measured.

[0011] In another example of the implementation of the invention, the strain marker 5c is a graduated marker applied by laser technique on the forming surface of the tapered shaft 5b on its two opposite sides (fig. 2).

[0012] In a further exemplary embodiment of the invention, the strain marker 5c of bolting 1 is constituted by three rods pulled through radial through-holes made in the tapered shaft 5b of the bolt at distances corresponding to known values of longitudinal forces in bolting 1, successively: the initial tension force of bolting 1, a force equal to half of the breaking force of bolting 1, and a force inducing in bolting 1 stresses equal to the elastic limit of the material of which the bolting rod 1 is made (fig. 3).

[0013] In possible variants of embodiment of the invention, the rods can be made of any material with low shear strength and can have different colours, indicating the achieved degree of strain on the bolting 1 or the longitudinal force in the bolting 1.

[0014] In the embodiments of the invention analogous to the above, the strain marker 5c is calibrated so that it indicates only two states of load on the bolting: the initial tension force of bolting 1 and the force causing the attainment of stress in bolting 1 at the elastic limit of the material of which bolting 1 is made.

[0015] The operation of the roof bolting load absorber is that after the bolting is installed in the rock mass, an initial tension force is given so that the edge of the hole of the dome bolting washer 6 coincides with the first marking on tapered shaft 5b. During the operation of the bolting, additional tensile forces may occur, for example, due to delaminations occurring in the roof of the mine workings, the increment of which is quasi-static. The energy of elastic deformation is dissipated gradually as tapered shaft 5b is pulled through the hole of the dome bolting washer 6, i.e. to overcome the frictional resistance and the elastic and plastic deformation of the hole of the dome bolting washer 6. Thanks to the marked pitch on the strain marker 5c, information on the working point of boltings 1

can be read, and it is possible to decide on the application of additional excavation protection. In the event of a dynamic phenomenon in the rock mass, domed bolting washer 6, by deforming elastically and plastically, provides a bolting lining. In such a case, the readings of strain marker 5c are not authoritative, and only the fact of deformation of domed bolting washer 6 is noted, so that it is possible to determine the sections of excavations with compromised stability that should be fenced off or where additional protective measures should be applied.

Claims

1. A load absorber of the roof bolting having a connection with the end of the bolting embedded in the rock mass, **characterized in that** it is constituted by a dome bolting washer (6) and a special bolt having at one end a cylindrical section (5a) provided with a thread, passing into tapered shaft (5b), the diameter of which increases towards the other end, equipped with a head (5d) of any known shape, while in the working position, the bolt is passed through a hole in the domed bolting washer (6), inverted convexly towards the excavation and connected to the bolting rod (1) by means of a connecting sleeve (4) screwed onto the threaded end of the bolting rod (1) and onto the threaded cylindrical section (5a) of the bolt so that the hole of the dome bolting washer (6), encompasses tapered shaft (5b) of the bolt in the vicinity of half of its length, and, in addition, the section of tapered shaft (5b) on the side of the head (5d) has a graduated strain marker (5c).

2. The absorber according to claim 1, **characterised in that** the section of the tapered shaft (5b), the diameter of which is equal to the diameter of the hole of the domed bolting washer (6), is located at a distance corresponding to 0.4 to 0.6 of its length.

3. The absorber according to claim 1, **characterized in that** the strain marker (5c) consists of at least two circumferential undercuts of the diameter of the tapered shaft (5b).

4. The absorber according to claim 1, **characterized in that** the strain marker (5c) consists of at least one pitch is applied along the generatrix of the cone.

5. The absorber according to claim 1, **characterized in that** the strain marker (5c) consists of at least two wooden or plastic rods, passed through radial through-holes made in the tapered shaft (5b).

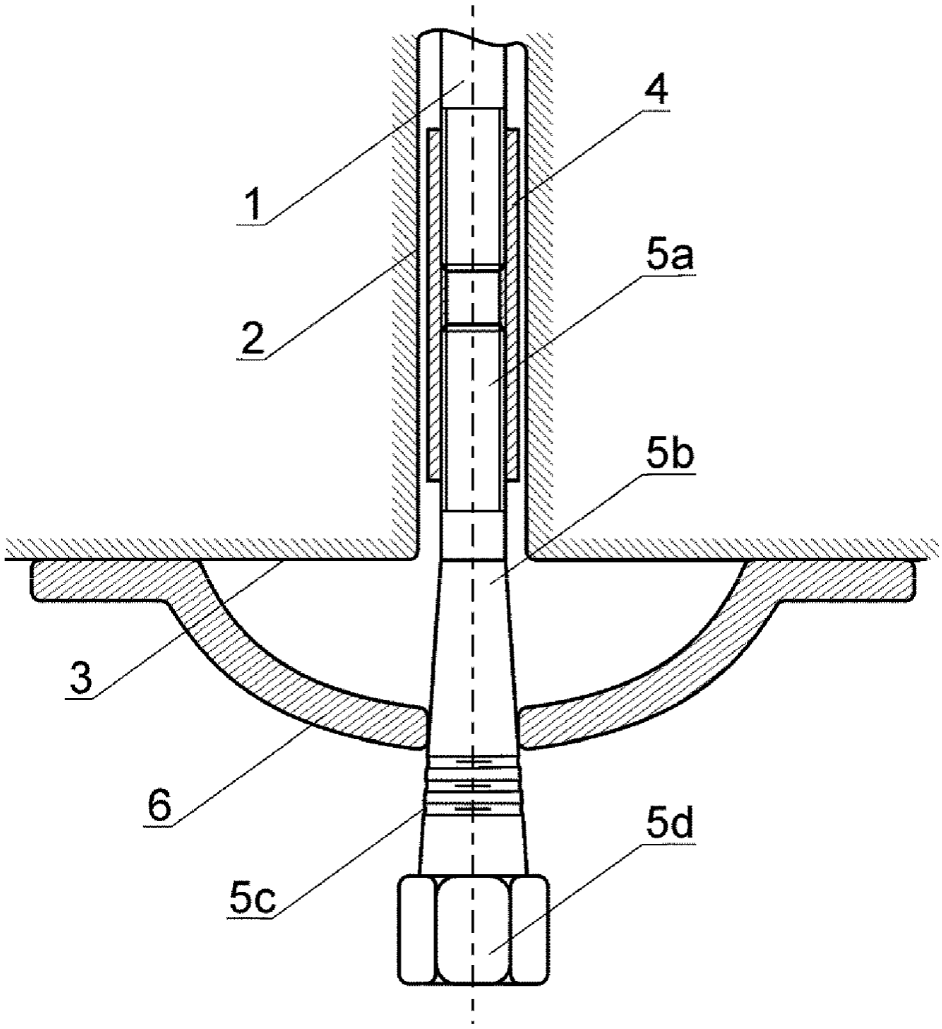

Fig. 1

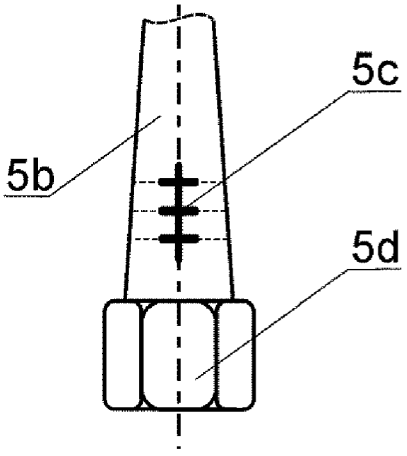

Fig. 2

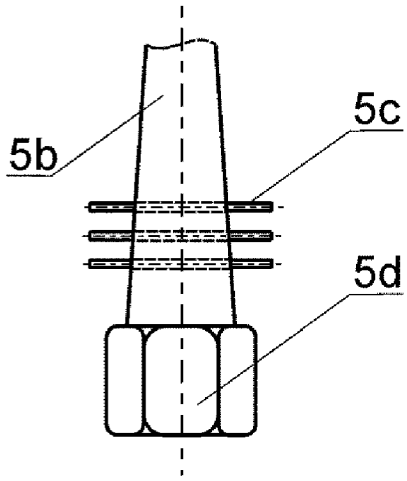

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 22 18 5478

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	RO 118 766 B1 (SZABO ADAM [RO]; HADAR ANTON [RO]; MOTOMANCEA ADRIAN [RO]) 30 October 2003 (2003-10-30) * paragraphs [0001], [0003] - [0011]; figures 1-3 *	1-5	INV. E21D21/02 E21D21/00
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	22 December 2022	Brassart, P

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

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