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Opinion

Groove Making in a Tubing Lining Elements

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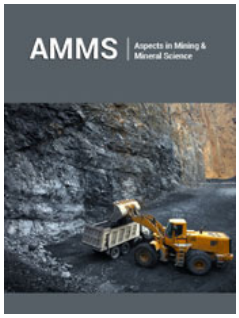

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Opinion

Tubing lining is used as the final lining of shafts sunk in extreme hydrogeological conditions, and it is composed of a cylinder made of separate rings. Individual rings are composed of separate, equal segments called tubings. Tubings can be made of reinforced concrete, cast iron and steel. Steel tubings, having dimensions depending on the shaft diameter, have the form of a metal pipe [1-4]. Despite of high durability of the tubing lining, damages of the lining in form of leakages, scratches and fractures can occur. The most common causes of these damages are material faults and hydro-geological conditions [4-9]. The damages of the tubing lining are direct danger for the shaft operation because they are usually a cause for a water inflow to the shaft. The safety of mining excavations is considered dangerous, because the devastation of the lining usually comprises a bigger zone, and the possibility of more intensive water leakage related with rock mass movements is quite realistic [5,7,10]. Different methods of tubing lining repair and protection were invented and used over the years. All of them comprise of some kind of the reinforcement of the damage to seal the tubing lining. For the purpose of efficient and safe sealing of the tubing lining, PBSz S.A. uses a sealing method by making a closed circumference groove around the sealed area in the internal shaft wall, whereas the groove depth must be smaller than the tubing depth. Then the sealing element is placed in the groove and pressed with spatial insert closed in the top side and having a hole for the injection of the sealing medium. In the next stage, the insert is mounted to the lining and then the sealing medium is injected in. When the process is finished, the insert hole is closed. A specially designed milling machine is used for making grooves in shaft tubing lining. The milling machine is composed of the power transmission system and a construction for tubing and advance mechanism mounting. A battery drill-driver is used as the milling machine driving system, and the whole device is mounted to the tubing with the use of specially designed guides with handles. A model and a photograph of the tubing milling machine is shown in Figure 1.

Figure 1: A model and a view of the tubing milling machine.

The described device is designed for shaft tubing lining and is used during the renovation and repairs of shafts, particularly for the needs of the mining industry. Use of the milling machine allows the solution of technical problems occurring during repairs to the iron tubing lining of the shaft made of cast iron tubings. The application of the milling machine allows the development of the new method of tubing shaft lining, comprising suitable stages for mounting the sealing insert in the tubing and the injection of the sealing medium. The new method comprises milling a closed circumference groove in the internal shaft lining, whereas the groove depth must be smaller than the tubing thickness. Then the sealing element is placed in the groove and pressed with a spatial insert with a hole for the injection of the sealing medium. In the next stage, the spatial insert is mounted to the shaft lining and then the sealing medium is injected to the sealed area via a hole in the spatial insert before the insert hole is corked. A construction of the milling machine is shown in Figure 2. The milling machine is composed of a driving system, a construction used for mounting the milling machine on the tubing and an advance mechanism. A Bosch battery grill-driver drives the central shaft of the epicyclic gear (planetary wheel). Then the movement is transferred from the central wheel into satellites connected in a single shackle via an immobile wheel with inner teeth. The planetary gear ratio amounts to 68/11. The rotating shackle drives the worm shaft which in turn drives the worm wheel with a ratio of 40/1, whereas the worm wheel is permanently connected to a rotary mandrel on which the milling machine head will be mounted. The indicative rotation of the drill-driver on the first run amounts to a maximum of 420 rpm, and on the second run the rotation amount is 1800 rpm. The advance mechanism comprises a mandrel with a cut metric threading of 16mm with a lead of 1.5mm. A single revolution of the advance mechanism knob results in a 1.5mm jump of the milling head displacement. Maximal displacement of the milling head amounts to 25mm. The total ratio of the milling head amounts to 247,3. The device is mounted on the tubing with specially designed handles. The construction should be covered with an anti-corrosion coating according to documentation recommendations. The total weight of the device amounts to 90.5kg. The sealing method of the tubing lining proposed by PBSz S.A. is an innovative solution and the application of this method facilitates the repair process, as well as solving numerous technological problems accompanying repairs of this type. In addition, this device possesses all of the required certificates assuring operational safety. Application of the milling machine for tubing renovation (related to sealing) allows the considerable reduction of time needed for repair, also leading to shortening the time of the mine shaft technical stopover.

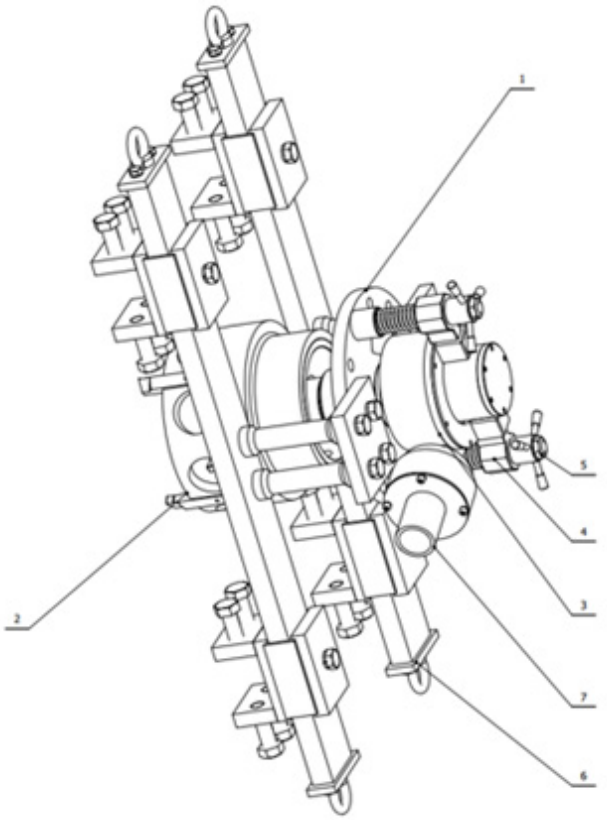

Figure 2: Milling machine construction; 1-main plate with mandrel and threaded sleeve; 2-milling head; 3-worm gear, 4-hub with guides and mounting device, 5-mounting to main plate device, 6-guides with mounting-depending on the chosen option: •round for mounting milling machine with handles, •rectangular for mounting the milling machine with handles; 7-planetary gear with driving system housing.

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