SIMPLE PULLEY BLOCK TO HOIST THE SKIP IN LUPENI MINE

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***ABSTRACT*:** *In the conditions of economic crisis, of low investment funds, the adaptation of existing tolls and equipments was required, in order to create a skip manoeuvring installation in Lupeni Mine at Shaft 2. The use of the 45 kW pulley in place of the 75 kW one, which had been damaged, required a simple pulley block to be made inside the shaft transportation space. This block should create a lifting force of over 300 kN at a 5 ... 7 m/min speed and lifting distance of more than 30 m. In the design of the block, the existing deviating rolls at tower level 57, the upper junction plates at DEC-12, the DLC-1 cable connecting device, and the upper frame of the cage 2/1 were used. The pulley block construction in the mine transport section resulted in minimal costs for the skip hoisting installation.*

KEY WORDS: simple pulley block, hoist, skip

1. INTRODUCTION

In conditions of economic crisis, of reduced investment funds, the problem of adapting existing equipment in order to carry out a skip manoeuvring installation, tending skip hoist installation at Shaft No. 2 in Lupeni Mining Plant, becomes an issue. It is necessary therefore to be familiar with the design and technical characteristics of the equipments, devices and components existing in Lupeni Mine.

The technical characteristics of the 45 kW trolley and the 14 ton skip that should be lifted in Lupeni Mine being known, a kinematic scheme of principle for the skip manoeuvring installation has been drawn up.

Fig. 1 shows the kinematic scheme of principle of the skip manoeuvring installation in Lupeni Mining Plant, where: 1 – concrete tower of the winding machine; 2 – ȚȘ 3,25x4 type winding machine; 3 – winding cable; 4 – skip; 5 – flat balancing cable; 6 – shaft; 7 – 45 kW trolley; 8 – large deviation roll; 9 – small deviation roll; 10 – simple pulley block (crane); 11 – skip stopping device; 12 – DLC-1cable connecting device; 12 – cable connecting device; 13 – 2/1 cage rod; 14 – inflexible support.

The 45 kW trolley is placed at 0 level in the building and on the foundation of the old 75 kW trolley, and the simple pulley block is carried out with the help of existing deviation rolls placed at level 57 of the skip tower.

Due to the necessity of execution of the first step of the reducing gear, which has been damaged, and of reducing the torsion moment on the outlet shaft required by the safety coefficients of the trolley transmission.

As if the electric motor driving power had to be reduced from 45 kW to maximum 30 kW for the same rotation at the trolley drum.

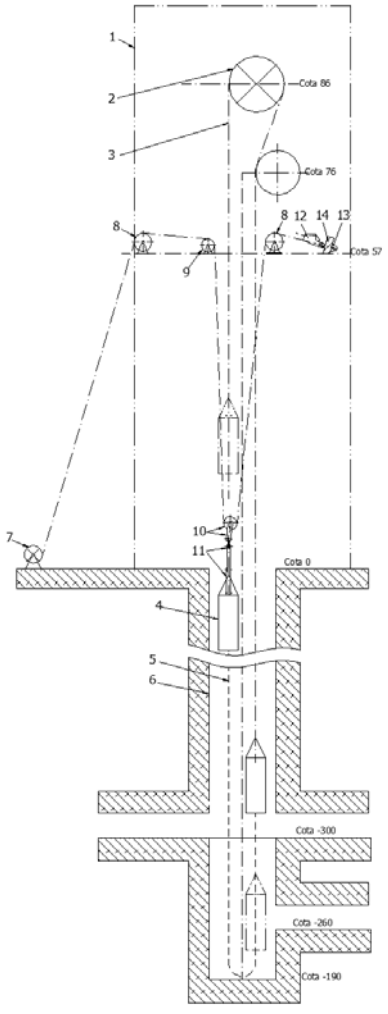

Fig. 1. Kinematic scheme of principle of skip manoeuvring installation

All these issues were solved by reducing the value of the transmission ratio of the first step from i = 5,21 to i = 3,06, 1,7 times, and by using a simple pulley block to double the lifting force.

Based on the kinematic scheme principle of the skip manoeuvring installation, its technical characteristics have been set, shown in Table 1.

Table 1. Technical characteristics of skip manoeuvring installation

No	Technical characteristic	Unit	Value
1.	Maximum driving power	kW	45
2.	Rotation of electric motor	rot/min	1450
3.	Trolley transmission ratio	-	425,99
4.	Diameter of trolley drum at the first winding	mm	1180
5.	Trolley drum rotation	rot/min	3,4
6.	Diameter of trolley cable	mm	30
7.	Specific weight of the cable (STAS 1689-80)	kg/ml	3,071
8.	Trolley cable length	m	300
9.	Cable rupture load (STAS 1689-80)	kN	412,8
10.	Maximum force of trolley traction	kN	197
11.	Trolley traction speed	m/min	12,6
12.	Pulley block performance	-	0,9
13.	Minimum diameter of cable deviation roll	mm	900
14.	Maximum pulley block hoisting force	kN	385
15.	Maximum skip weight (with devices and flat balancing cable)	kN	291,5
16.	Skip hoisting speed	m/min	6,3
17.	Skip hoisting stroke	m	30

The technical characteristics of the skip manoeuvring installation meet the requirements necessary to attend to the ȚȘ 3,25x4 type winding machine with skip at Shaft no. 2 Lupeni Mining Plant, in order to achieve the periodic revisions required by the occupational health and safety requirements for winding installations, such as: cable verification and change, changing cable connecting and cable strain balancing devices, during skip changing.

2. CONSTRUCTIVE SOLUTION OF THE SIMPLE PULLEY BLOCK

The constructional solution of the simple pulley block is shown in Fig. 2, made up of: 1 – roll support frame; 2 – large deviation roll; 3 – framework with compartments to let the cables through; 4 – small deviation roll; 5 – inflexible support for the cage rod 2/1; 6 – cage rod; 7 – DLC-1 cable connecting device; 8 – pulley with junction plates; 9 – skip stopping device.

The existing cable deviation rolls at level 57 of the No. 2 shaft with skip in Lupeni Mining Plant, Fig. 3, and of the other components, allowed an easy design and execution of the simple pulley block to double the hoisting force.

From a small 900 mm diameter deviation roll, the pulley roll was made, and as cover plates the upper cover plates from the DEC-12 cable strain balancing device were used, which had been taken from Lonea Mining Plant.

In order to ensure the passage of the pulley through the winding machine cables, of 265 mm distance between those, the length of the roll axis and of the connecting bolt to the skip stopping device had to be less than 260 mm.

Therefore, the laterals of the roll hub had been worked, reducing its height from 162 to 152 mm, the width of the covers had been changed from 20 mm to 10 mm, and the sealing system of the bearing greasing had been changed, respectively, from rotation sleeve to felt ring.

Similarly, low-head screws had been used to fix the bearing covers and to fix the stopping plates on the junction plates.

In order to connect the junction plates and the fork of the skip stopping device, two muffs were put in the 111 mm bores of the junction plates, with 70 mm inside bore diameter, the same as the fork bore.

Fig. 4 shows the constructional solution of the pulley with junction plates, where: 1 – DEC-12 upper junction plate; 2 – muff; 3 – Φ70×260 bolt; 4 – stopping plate I; 5 – low-head screw M12×30, 6 – roll for the pulley; 7 – cover; 8 – low-head screw M10×25; 9 – radial ball bearing on one row 6040; 10 – stopping plate II; 11 – pulley roll axis; 12 – distance ring; 13 – felt ring.

The cable end was fixed through a cable connecting device DLC-1, which is attached to the rod of a 2/1 type cage, fixed in a 2/1 cage parachute mechanism box and supported by the cable deviation roll support.

The constructive solution of the fixed support for the 2/1 cage rod is shown in Fig. 5, made up of: 1 – support legs for cable deviation rolls; 2 – box of the 2/1 cage parachute mechanism; 3 – support and positioning bracket at 20°; 4 – stay of U30; 5 – framework consolidation bracket; 6 – arm of U16.

This constructive solution has been adapted due to the existence of most of the component in Lupeni Mining Plant and the support legs for the cable deviation rolls from the old winding machine.

The positioning of the parachute mechanism framework at 20° to the vertical, was made due to the use of the large wheel to deviate the pulley block cable and to position the rod as well as possible on the yoke of the parachute mechanism framework.

To consolidate the side rails of the U16 framework, the side rails were welded to the bearing support sheet by using the bearings and using the consolidation bracket (poz. 5, fig. 5).

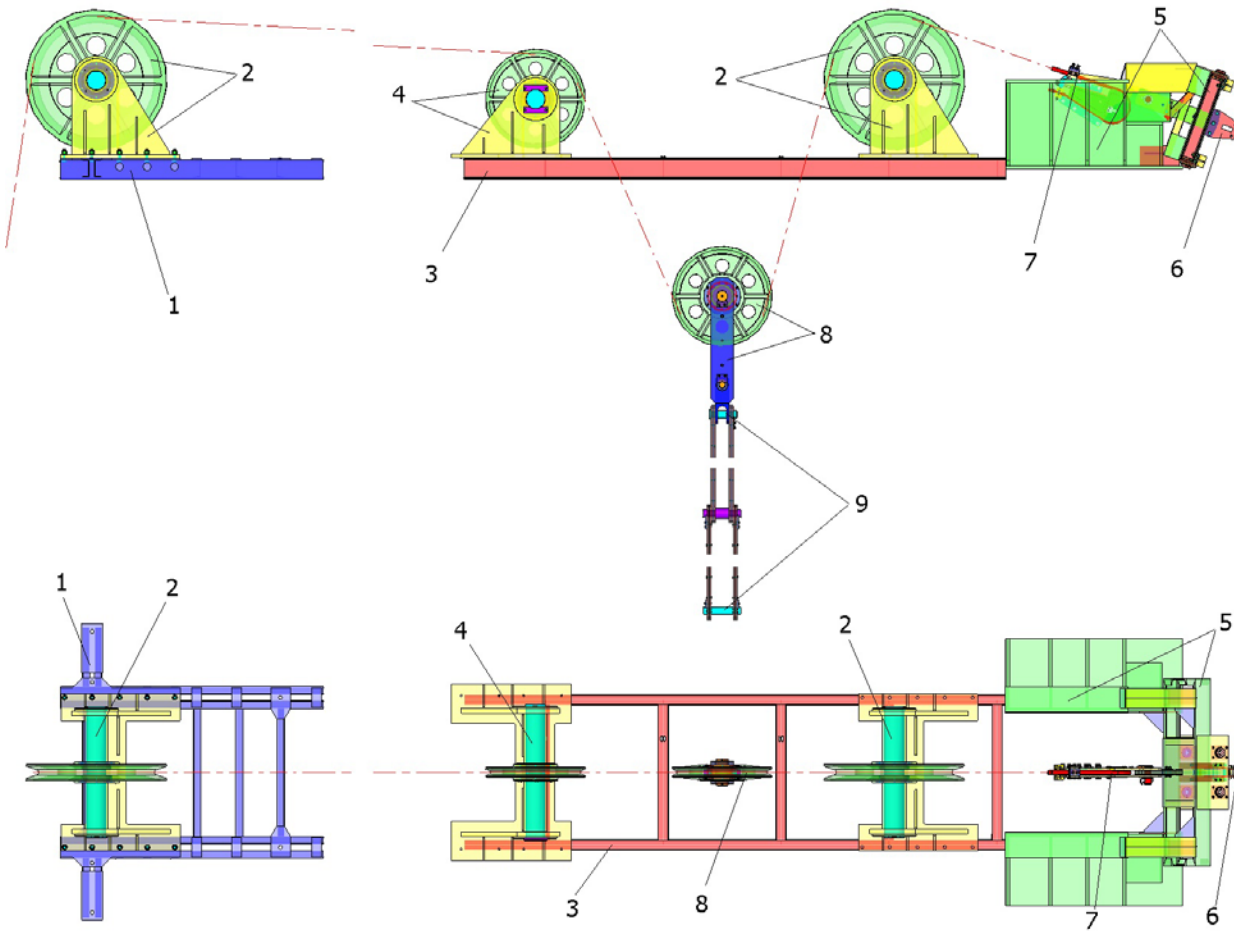

Fig. 2. Construction of the simple pulley block

Fig. 3. Cable deviation rolls existing at level 57 of No. 2 Shaft

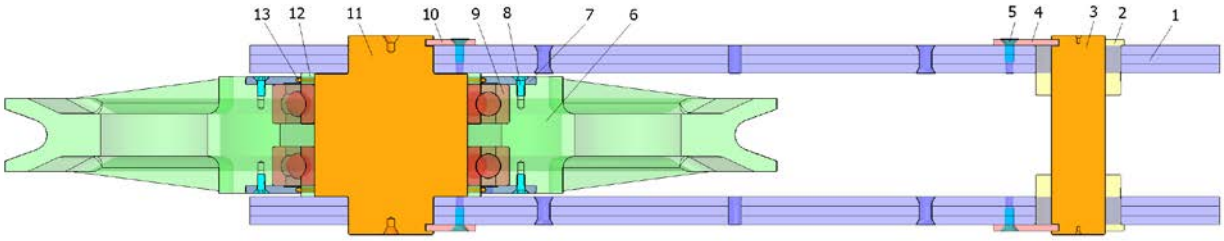

Fig. 4. Constructive solution of the pulley with junction plates

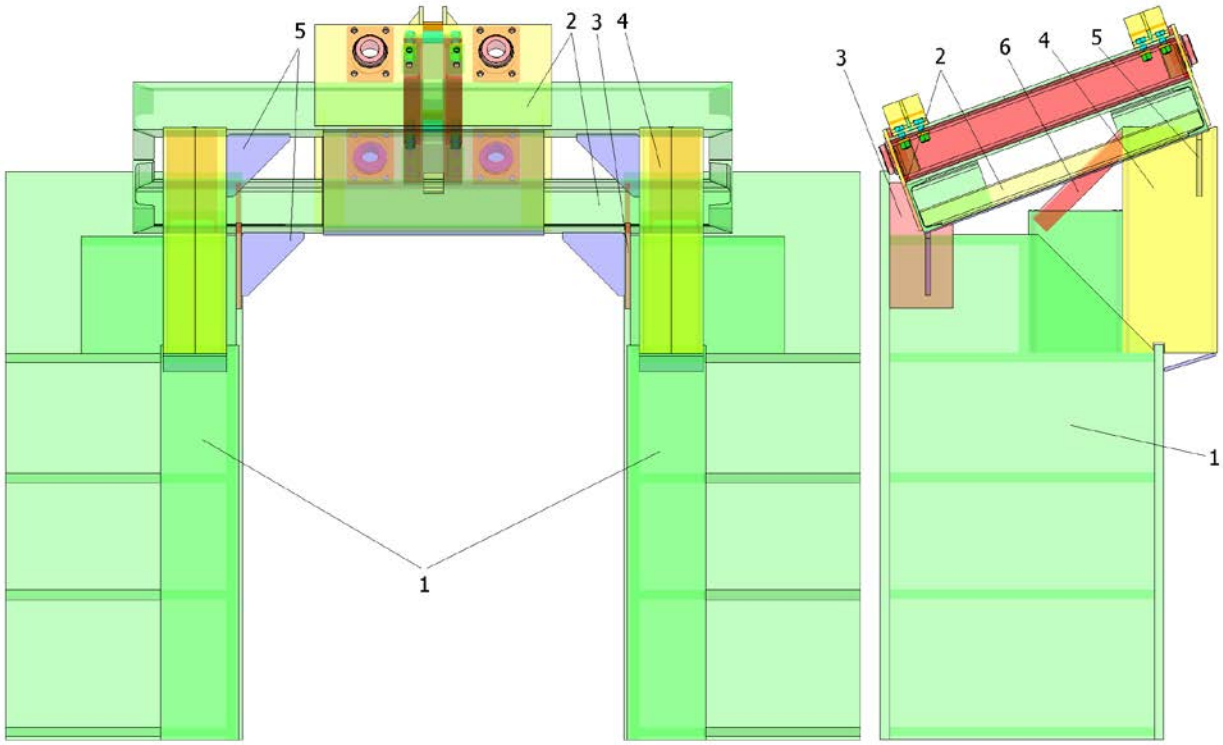

Fig. 5. Constructive solution of the inflexible support for the cage rod

3. FUNCTIONING AND TESTING THE SKIP MANOEUVRING INSTALLATION

Fig. 6 shows the functioning of the skip manoeuvring installation, made up of: 1 – trolley; 2 – cable deviation roll at the tower inlet; 3 – intermediary cable deviation roll; 4 –DLC-1 cable connecting device; ; 5 – pulley with junction plates; 6 – skip stopping device; 7 cable deviation roll at the fixed end; 8 – 2/1 cage rod; 9 – inflexible support; 10 – skip compartment 4; 11 – skip compartment 3; 12 – wood bridge.

For commissioning , the hydraulic trolley cable end is passed through from level 86 under the intermediary deviation roll(position 3) and over the deviation roll at the tower inlet(position 2) and its end is lowered until zero level, where it is sixed with clips to the end of the 30 diameter trolley cable.

When the trolley cable end is passed over the deviation roll at the tower inlet and under the intermediary deviation roll, so that more than 10 m of trolley cable should go from the intermediary roll, the trolley cable end is blocked with clips supported by the window edge made in the parting wall at level 577.

Then the trolley cable end is passed over the intermediary deviation roll and its end is fastened to DLC-1 cable connecting device, which together with an additional weight of 50 kg, is lowered with the hydraulic trolley in the transportation space of the tower with skip. When under the weight of the DLC-1 device and of the additional weight the blocking clips are are getting loose from the parting wall, the winding of the cable is stopped on the trolley drum and the blocking clips are getting loose from the trolley cable. The DLC-1 device goes further down, by unwinding the cable from the skip manoeuvring installation trolley drum and from the hydraulic trolley drum, the cable of which stays connected to the DLC-1 device bolt.

All these cable unwinding operations from the skip manoeuvring installation trolley are done with the winding machine being stopped and with the skips positioned under zero level, and by carrying out a solid and rigid wooden safety working bridge, position 12, on the consolidated at level zero. Similarly, the communication between the command points, shaft ramp, level 57 and

86the winding machine is done only by trained operators, who are familiar with how the trolley works, and the load manoeuvring is carefully carried out, the received signals having been acurately received.

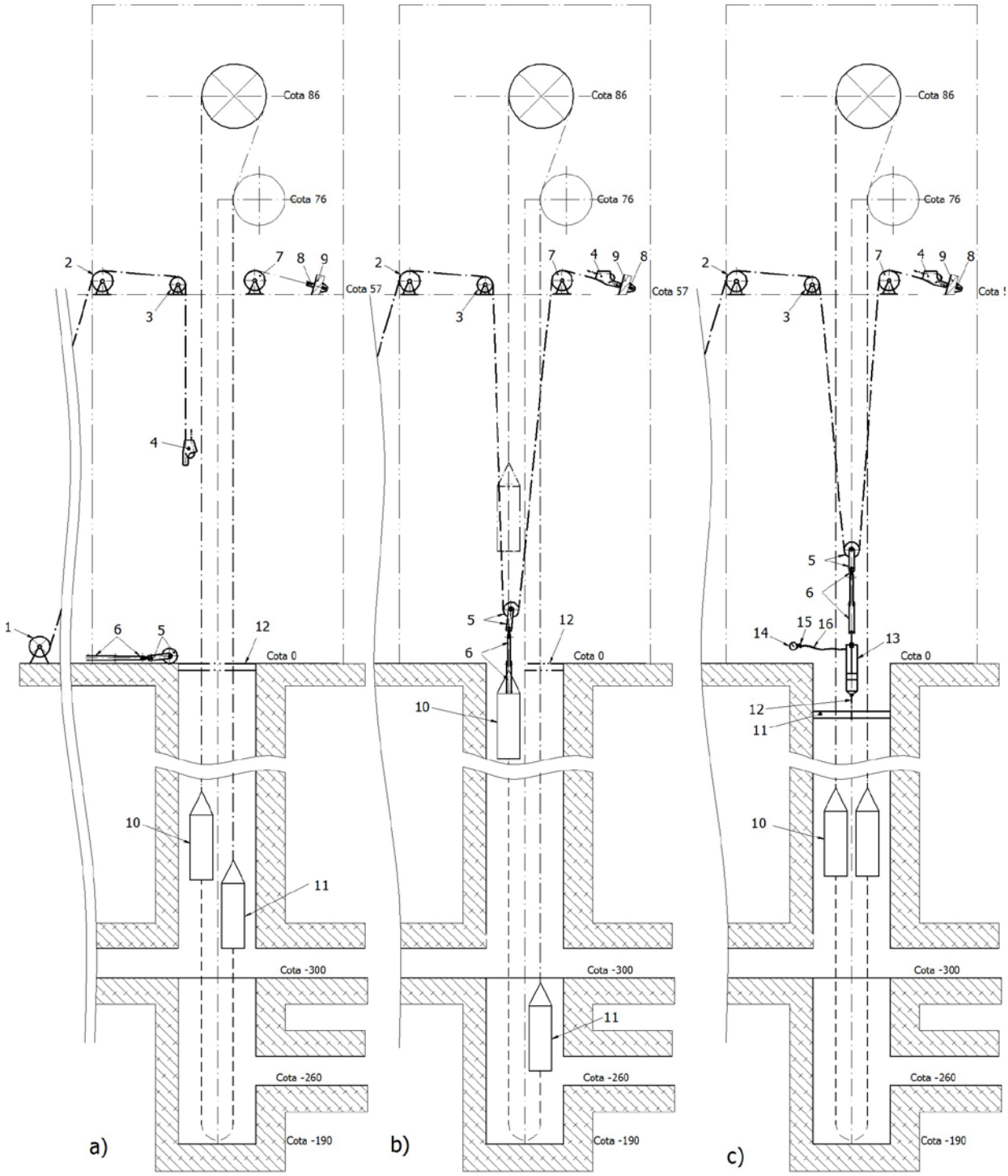

Fig. 6. Skip manoeuvring installation operation

When the DLC-1 cable connecting device reaches the shaft ramp, zero level, a pulley junction plate is detached, by unscrewing the four M12x30 screws, which fasten the axis' and bolt's blocking plates, the trolley cable is passed over the pulley roll and the junction plate is mounted back to its place, which is blocked to the axis and bolt, by mounting the two blocking plates. Then, the DLC-1 device with the additional weight is lifted, with the additional weight, with the help of the hydraulic trolley cable, until it reaches level 57 and the installation trolley cable is passed over the end deviation roll(position 7), then the additional weight and the hydraulic trolley cable are detached, and the DLC-1 device is fixed to the 2/1 cage rod with the help of the bolt. To ensure a good operation, it is necessary for speed of the cable unwinding from the installation

trolley drum to be correlated to the winding speed of the cable on the hydraulic trolley drum, and the winding of the cable on the pulley roll should be watched over, to avoid its being blocked.

After commissioning the skip manoeuvring installation three idle strokes are done, to elevate and lower the pulley with junction plates and the skip stopping device at 300 m high from zero level, to check the good functioning of the installation.

The verification of the technical characteristics of the installation and of the resistance of its components is done by mounting a beam on the binding pieces at zero level, to which by a C 18x64 chain with 380 kN tearing force, the ear of the ripping stepping cylinder body is fastened, 135/80/500, from the SMA 5H mechanized support, and the rod ear is attached between the junction plates of the skip stopping device, as in Fig. 7. Before mounting, the cylinder is closed putting emulsion in the annular chamber, and mounting a valve and a manometer at the end of the hose, to measure the pressure up the 600 bar.

Verification is done by starting the installation trolley and hauling the cylinder by reading the pressure indicated by the manometer. The connection between the haulage force and the pressure shown is given in Table 2.

Table 2. Correlation of pressure shown by the manometer with the haulage force

Pressure read on the manometer	bar	200	220	240	260	280	300	320	340	360	380	400
Haulage force	kN	186	204	223	241	260	279	297	316	334	353	371

In Fig. 6c the following notations were made in addition to Fig. 6: 11 – beam; 12 – chain loop C 18×64; 13 – ripping stepping hydraulic cylinder 135/80/500; 14 – manometer; 15 – valve; 16 – hose Dn10.

When pressure in the range of 320 and 380 bar is reached, the trolley motor is stopped and we check if the electromagnetic brake FC 315 retains the pre-tensioned installation for 10 minutes. Similarly, the pressure in the same range and the safety mechanism with latch are also checked.

At least three trials are made for each verification, and the verifications are done by a firm authorized in winding installation verifications.

4. CONCLUSIONS

The existence of cable deviation rolls at level 57 of Shaft No. 2 with skip in Lupeni Mining Plant and of the other components allowed easy design and execution of the simple pulley block to double the hoisting force.

All components of the simple pulley block were executed under own management expenses, by the Transportation Sector in Lupeni Mining Plant , with minimal costs.

After verification, trials and commissioning of the skip manoeuvring installation, of which the simple pulley block is part, the following advantages are anticipated:

- maintenance of skip transportation can be done by Lupeni Mine whenever is necessary, no external services, renting cranes etc. Being required;
- maintenance can be done with a small number of workers and meeting the occupational safety requirements;
- the cost of maintenance for the skip transportation installation in Lupeni Mine is low.

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