THE STUDY OF THE IMPROVEMENT OF THE FUNCTIONING OF HIGH CAPACITY BELT CONVEYERS TMC 1800 FROM JILȚ SUD QUARRY

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Abstract: The totality of the machines which ensure the excavation, transportation and depositing of the minig masses make up a flow sheet. High capacity belt conveyers are transport equipments in continuous flux with very high transportation capacities. They are designed to function within a continuous transportation flux from coal minig plants. One condition on which depends the good functioning and obtaining a transportation cost as reduced as possible is the correct choosing of the type and main parameters of the transporter, depending on the concrete minig conditions. In this work, we show a study concerning the enhacning of the funtioning of high capacity conveyer belts.

Key words: conveyer belt, reducer.

1. INTRODUCTION

The increase of the efficiency of mechanization of the extraction of the strata of lignite and sterile rocks from their stripping requires the undertaking of some processes of retechnologisation and modernisation, as well as as improving the performance indicators regarding the exploitation of some technological systems used in concrete exploitation conditions and the technical endowing of the quarries. Lignite quarries in Romania ar endowed with technological lines that have rotor excavators, conveyer belts, dumpers, depositing and complementation equipments, which ensure a theoretical hourly capacity of 200.000 cubic meters/hour, and for transportation and dumping 300.000 cubic meters/hour. In the lignite quarries from Romania, we can count 99 excavators with rotor, 50 dumpers, 584 conveyer belts, which amount to around 325 kilometers and other depsoiting and complmenetation equipments. The actuator stations of the conveyer belts are very different, both as types and from the point of view of their construction. The most spread actionings are the ones with a

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drum, actioned by one or two actioning groups, which can be found at the beginning or at the end of the conveyer.

Revolution reducers with gears are mechanisms which are organised as independent ensambles, with a constant transmission report, built în closed and insulated cases, designed to reduce revolution by amplifying the transmitted torque. Sometimes the movement direction is also changed.

In figure 1, we show a high capacity conveyer belt with a mobile delivery end.

Fig. 1. High capacity conveyer belt with a mobile/non-stationary delivery end.

2. THE STUDY OF HIGH CAPACITY CONVEYER BELTS WITH A NON-STATIONARY DELIVERY END

The most expensive ellement of a conveyer belt isthe conveyer carpet, which can make up to 70%of the transporter's cost, and on its life duration depends the economic afficiency of the conveyer belt.

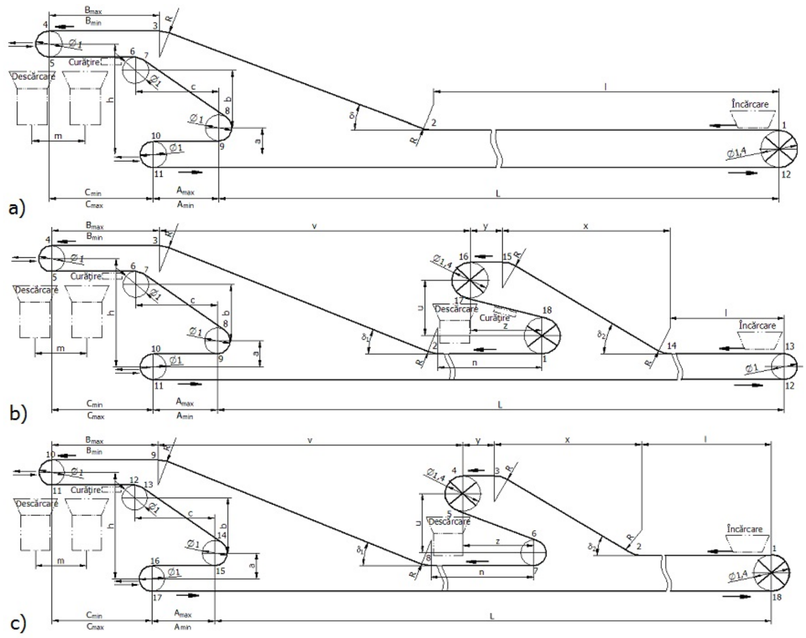

Fig. 2. The outline of the conveyer belt in its three constructive variants.

Starting from this problem of the economic efficiency of the conveyer belt, we used the software MatCAD to realise a calculation program of the conveyer with a belt width of 1800 mm, for the constructive variants of positioning the actuator stations.

The first constructive variant is shown in figure 2a, and the actuator station is at the loading end and the belt's course is relatively simple, with 12 infelxion points of the belt. The dimensions of the conveyer's course are: L = 875,863 m; A = 9,56 m; B = 15 m; C = 21,99 m; a = 1 m; b = 5 m; c = 13,5 m; h = 7 m; R = 150 m; m = 11 m; δ = 7 degrees. For the superior (carrying) branch, we used a roller train C3g with a troughing angle of 36 degrees, a mass of 66,75 kg and a step of 1,2 m. The surface of the maximum transversal section by the load on the carrying branch of the belt is of 0,4 square meters, form table 30 STAS 7539-84. On the inferior (turning) branch,a roller train B2g with a mass of 60,22 kg and a step of 3 m. The mass of the belt for one meter length for steel cable insertions and resistance class ST 2500 is of 68,04 kg, according to I. Marian – Loading and mining transportation equipments, page 33. The verifying of the belt carpet is made according to the safety coefficient in stationary stance (S_{st}=9), which is made up of the safety factors regarding the behaviour of the belt in time (S_0=4), the supplementary elongation due to the passing over drums, at troughing and junctions (S_1=3) and of the maximum tensions in the belt at starting or stopping (S_2=2). Also, the full load for the breaking of the belt is determined according to the maximum solicitation of the belt, the safety coefficient and the resistance loss at binding (by hot vulcanization with cables in 5 steps).

In figure 3awe show the safety coefficient established between the resistance to tearing of the belt (2500 N/mm) and the full load of tearing, and in figure 3b we show the solicitation degree of the belt according to the conveyer load.

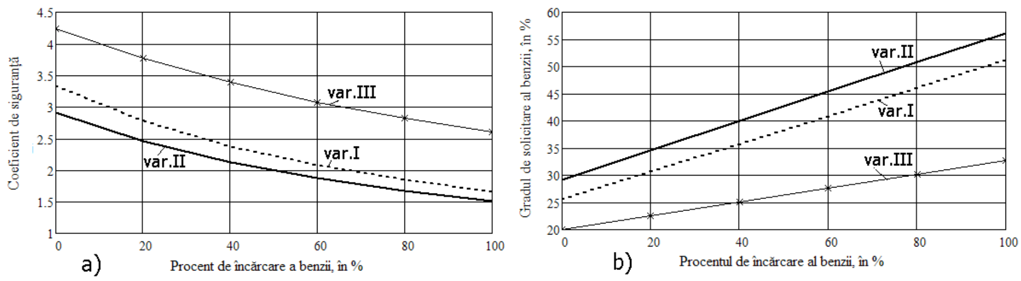

Fig. 3. The safety coefficient and the solicitation degree of the belt

From the diagrams in figure 3, we can see that the maximum solicitation degree (57%) and the minimum safety coefficient (1,5) of the belt meet at variant II of conveyer belt for the maximum loading of the conveyer.

From the above and from the analysis (calculus) of the three constructive variants of conveyer belts TMC 1800, we determined that the best variant to follow is variant II, which results from the following:

- Variant III has the lowest tension in the carpet belt, but it is very hard to sincronize the start of the two actuator groups, which are separated by a distance of 600

m. Such attempts were made on quarry conveyers without positive results, due to commanding from a distance.

- In comparison with the fisrt constructive variant which was applied in the quarry, it has the following advantages:

- The traction force in the belt is better distributed, and on the inferior (empty) branch it is with 67% lower, although the solicitation degree of the belt is higher with 4...5%.

- The wearing of the belt carpet produced by the variation of resistance to movement from the carrying branch is transmitted directly to the actuator drum, on a small length and with small elongations, and not on great lengths with great elongations, all the inferior branch, for the first variant

- By using two driving barrels the angle of coiling of the belt was enlarged with 68,3%, from 180 degrees to 303 degrees, which enhances the transmission conditions of the force from the drum to the belt (reduces slipping), but the distribution of the power transmitted is not uniform, due to different friction coefficients between the drum and the working and un working face of the belt

- The tensile force necessary at the pulley is with 76% smaller, with a lower slope between empty and maximum capacity, which allows the transporter to function in better conditions, because there is no system to adjust the tensile force, and it is adjusted by testing

- From the point of view of durability of the bearings from the stretching drum and the free drums we obtain an increase of over 2,5 for a transportation capacity of 3200 t/h (50%), the increase at the stretching drum is from 3400 hours to 8400 hours, and at the most solicited free drum from 5450 hours to 12700 hours..

Due to these advantages, the second constructive variant of modernisation of the conveyer belt was executed and put into practice at Jilț Sud Quarry (figure 4), and the pre-grounding installation was also installed.

Fig. 4. The intermediary station of the conveyer belt

The way in which we can improve the constructive solution of the free drum, so that we can increase the technical performances of the conveyer belt. In figure 5, we show the new constructive solution of the free drum, consisting in using a hollow arbour and a central disk to increase the rigidity of the drum. The new construction of the free drum is made up of: 1 – hollow arbour; 2 – the rigidised metallic construction of the drum; 3 – rubber stratum; 4 – distance ring; 5 – adapter sleeve of the bearing H2340 (STAS 5814 – 73); 6 – self-aligning radial roler bearing barrel on two rows with adapter sleeve 22340K (SR 3918: 1994); 7 – lock washer MBB 36 (STAS 5815 – 77); 8 – bearing screw nut KM 36 (STAS 5816 – 77); 9 – exterior lid; 10 – M16 X 30 screw; 11 – Grower collar N16; 12 – the metallic construction of the bearing; 13 – interior lid; 14 – felt ring Φ220..

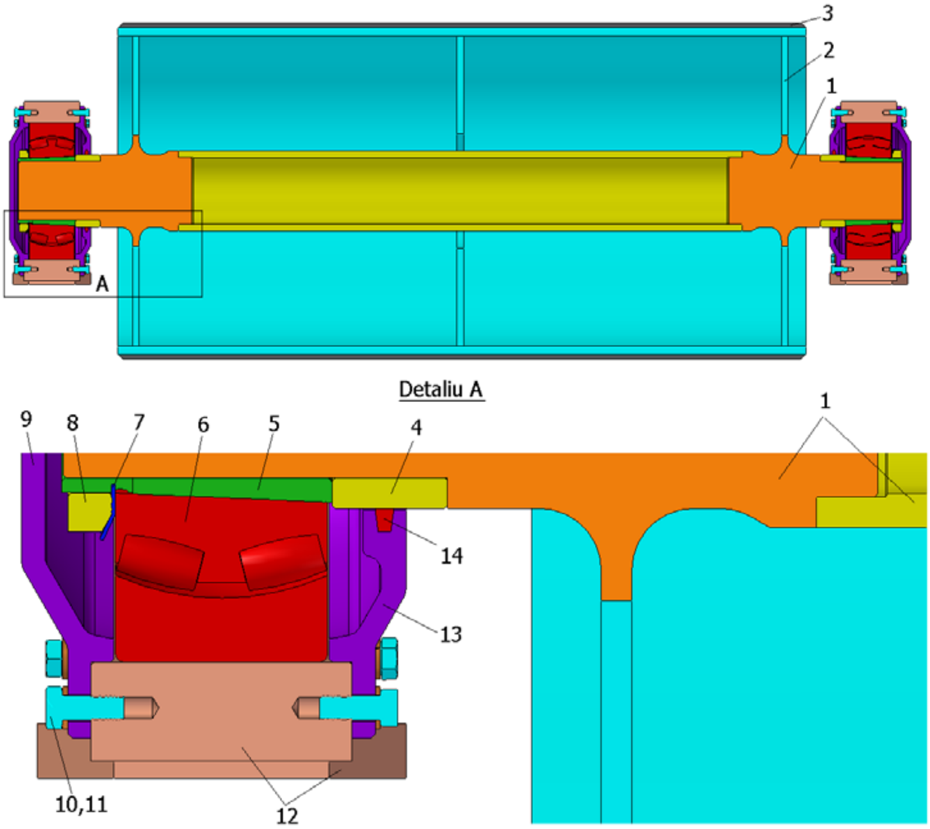

Fig. 5. 3D model of the free enhanced drum

3. THE STUDY OF THE CONICAL-CYLINDRICAL REDUCER 2KC-P-630 FROM THE ACTIONING OF THE TMC TRANSPORTERS

The conical-cylindrical reducer 2KC-P-630for actioning the high capacity belts from surface mining plants produced at S.C. Neptun S.A. Câmpina was assimilated after the reducer of the firm Eickhoff-Germany.

In figure 61, we show the 3D model of the reducer's transmission, and in figure 6b a section through the ensamble of the conical pinion, where the following were noted: 1 – conical pinion ensamble; 2 – conical wheel; 3 – cylindrical pinion; 4 - self-aligning radial roler bearing barrel on two rows 23072 – SR 3918 – 94; 8 – conical pinion; 9 - self-aligning radial roler bearing barrel on two rows 22334 – SR 3918-94; 10, 12, 14, 17 – distance rings; 11 – axial oscillating bearing with on one row with cylindrical bore; NU330 – SR 3043 – 94; 18 –lock washer for the screws of the bearings MBB26 – STAS 5815 – 77; 19 –bearing screw KM26 – STAS 5816 – 77.

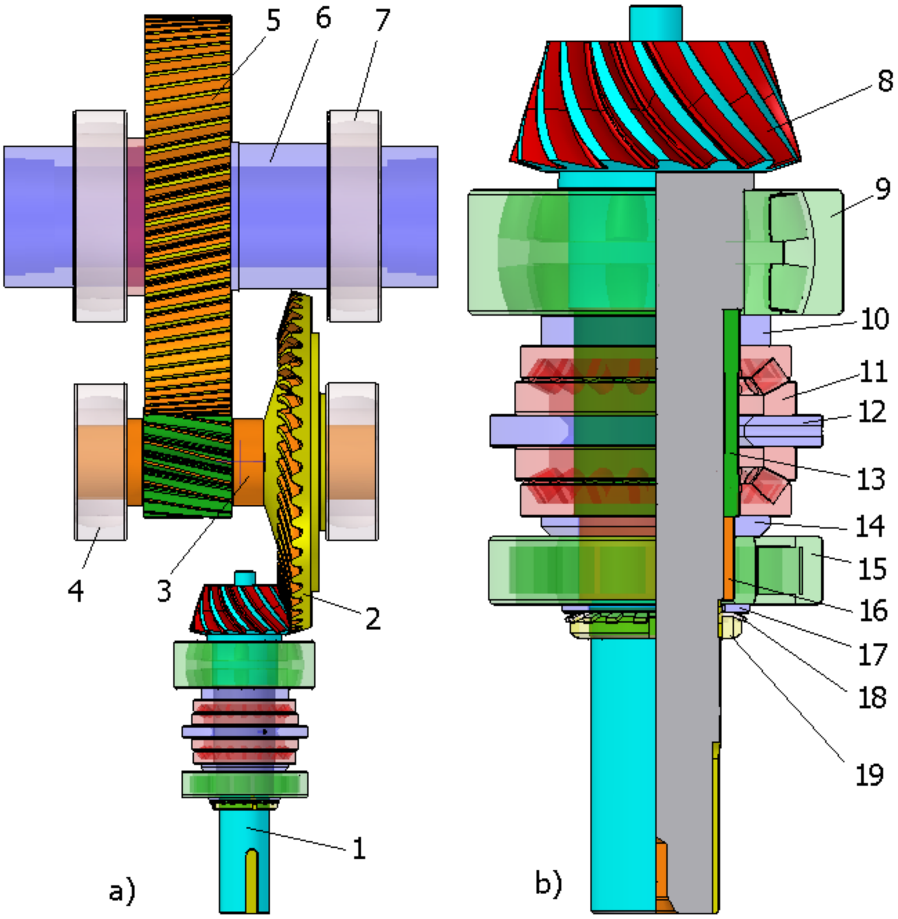

Fig. 6. 3D model of the transmission of the reducer

The wearing mode of the toothing of the reducer, photographed at the dismantling for capital revision and shown in figure 7, confirms the necessity of studying this reducer.

We can observe that the toothing of the pinion of the cylindrical gearing is worn due to pitting, progressive pitting which led to the destruction of the surfaces of the sides of the toothing, of the cemented stratum and regarding the sharpening of the toothing's e.

Fig. 7. The wearing mode of the toothing of the reducer 2KC-P-630

4. CONCLUSIONS

The high capacity belt conveyer analysed has a special construction, without tin roller on the delivery end, a solution which is very rarely seen in practice. From the analysis of the three constructive variants of conveyer belt and of the reducer 2KC-P-630 the following conclusions were drawn:

- The first variant was initially applied in JilțSud Quarry, with high exploitation costs, due to the reduced durability of the belt carpet;
- The second constructive variant, in comparison with the first variant, besides constructive complexity, has the following advantages: the stretching force in the belt is better distributed, reduces the wearing degree of the carpet belt, increases the angle of contact on the tin rollers, improves the functioning of the belt stretching device and increases the durability of the bearings on the stretching drum and on the free drums;
- The third variant, besides the advantages of training the belt on the unworking surface, of reducing the parallelism precision of the axes of the tin rollers and the realization of the lowest solicitation degree of the belt carpet, has the great disadvantage of synchronizing the command from distance of the actuator groups;
- By implementing the second constructive variant, with intermediary station and pre-grounding installation at the conveyer belt from JilțSud Quarry, the exploitation expenses were reduced;
- The proposal of constructive enhancement of the free drum and of changing the ratio of transmission of the reducer;
- Reducing the fabrication cost of the reducer by modifying the constructive solutions of the big gears..

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