# THE STUDY OF USING A SAFETY COUPLING WITH BALLS AT THE ROTATION GEAR OF THE EXCAVATOR WITH ROTOR EsRc-1400

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**ABSTRACT:** *E It is well known that couplings are linkage and driving organs which have the role of transmitting the rotation movement from one shaft to another or from one machine organ to another. The transmission is made without the modification of the value or the direction of movement. In some situations, couplings are conceived in such a way that they ensure the protection against solicitation at overload or to maintain the link only between certain speed limits. In this work, we show the study of the possibility of using a safety coupling with balls at the rotation gear of the excavator with rotor.*

**KEYWORDS:** Excavator with rotor, safety coupling with balls;

## 1. INTRODUCTION

The increase of the efficiency of mechanization of extracting lignite strata and sterile rocks from their stripping requires the undertaking of some retechnologisation and modernisation processes, as well as improving the performance indicators for the explooitation of technological systems that are used in concrete exploitation conditions and the technical endowment of the quarries.

Lignite quarries in Romania are endowed with technological lines fitted with excavators with rotor, conveyer belts, dumpers, depositing and complementation devices, which ensure a theoretical hourly capacity of 200.000 cubic meters/hour, and for transportation and dumping 300.000 cubic meters/hour.

The excavator with rotor EsRc 1400·30/7·630 is the basic device in lignite quarries in our country, arounf 70% from the volume of excavations is made with this type of equipment.

Using safety couplings with balls instead of friction couplings. In this work, we show in detail two types of such safety couplings, one with balls and trapesoidal canals and one with balls only. This safety coupling, with functioning chracaterstics which are superior to the one with friction disks, is fitted between the electrical actioning engine and the revolution reducer.

Using this type of safety coupling leads to the substantial increase of the functioning safety of the rotation gear and, implicitly, of the whole excavator.

## 2. FITTING THE ROTATION GEAR IN THE ENSEMBLE OF THE EXCAVATOR

In figure 1 we show a general perspective of the EsRc-1400 excavator in which we can emphasize the rotation gear which is fitted between the inferior platform on tracks and the superior parte with the cutting organ, the lifting mechanism and its metallic structure.

The superior platform of the excavator is placed above the basic chassis and can rotate relative to it by using the support and rotation bearing Ø 8650 mm with a crown with toothing.

The crown with toothing and the inferior runway are solidarised with the basic chassis,

and the superior runway is solidarised with the rotating platform.

Fig. 1. General perspective of the excavator with rotor EsRc-1400.

The rotation of the platform with all the superior construction that leans on it is realised with the help of the rotation gear. The rotation gear is protected by the safety coupling, which stops the actioning at overload. In the middle of the platform, we have the bearing of the linking bridge between the excavator itself and the loading carriage.

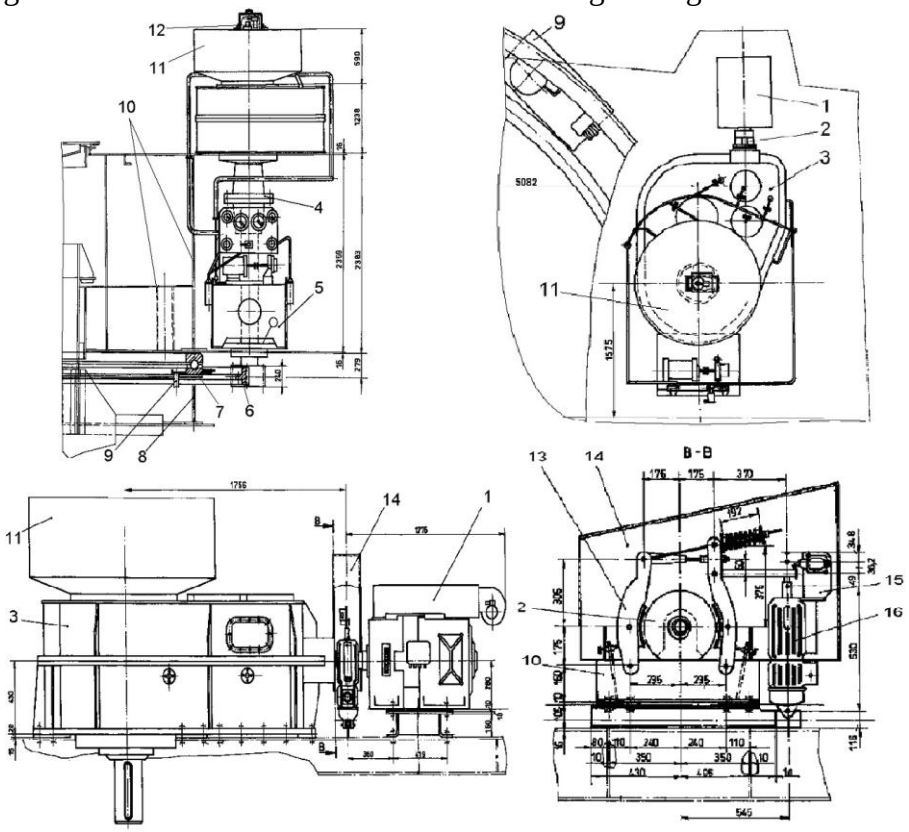


Fig. 2. Actioning of the rotating gear

In figure 2 we represent the actioning of the rotating gear, where we can fiind the following: 1 – electrical engine with continuous current; 2 – elastic coupling Ø170with braking collar Ø350; 3 – revolution reducer with transmission ratio $i_R$ = 438,612; 4 – drive pinion z=15, m=27; 5 – hydraulic group for the greasing of the rotating gear; 6 – cylindrical gear with straight toothingz=378, m=27; 7 –axial ball bearing Ø8650; 8 –excavator chassis; 9 – greasing system of the axial bearing; 10 – the pivoting part of the excavator; 11 – safety coupling; 12 – overload limitator M=11000 Nm;13 –shoe brake Ø350; 14 –fender; 15 – support with travel limitator at braking; 16 – electrohydraulic lifter EB 800-120.

The role of the safety coupling is to protect the rotating gear, and the support construction from the overload created at the lateral contact of the grab wheel with the embankment.

The safety coupling with friction, figure 3, is fitted on the exit axis of the reducer of teh actioning group. On the exit shaft of the reducer the stellar body is assembled, 1, in which are placed packages with disk springs, 2, which press on the brake drum, 4, with the brake shoes, 3. The rotation moment from the drum shaft (from the reducer's exit) is transimtted to the coupling casing, 6. From the coupling casing, the movement is transmitted through the coiled springs, 7, at the braking drum, 4, on which rhe brake shoes press, 3. The brake shoes, through three packages of disk springs, 2, transmit the movement to the stellar body, 1, which is fitted together with the bearing drive pinion on the exit shaft of the reducer..

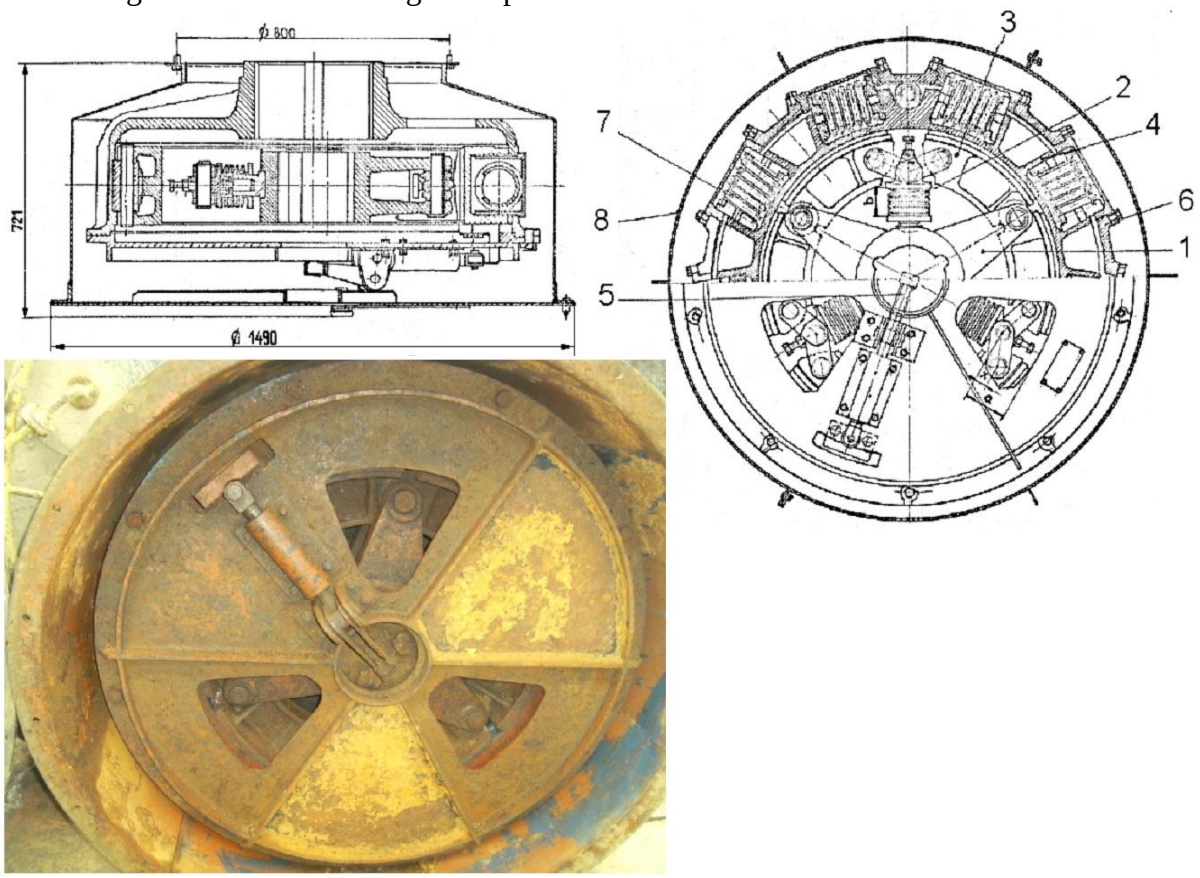


Fig. 3. Safety coupling with friction

When the trigger moment is surpassed, a relaticve movement appears between the coupling case, 6, and the brake drum, 4, and the travel limitator springs into action for lateral overload, through a levers system, 5. The travel limitator is fitted on the coupling fender, 8,

and has the role to electrically disconnect the rotating gear. In case the limitator does not function for lateral overload, the functioning of the mechanism will be interrupted by the skippage of the brake shoes, 3. The moments for which the safety coupling is adjusted are: trigger moment Md = 11000 Nm; slipping moment Mp = 12500 Nm.

The safety coupling with friction is the least reliable element from the composition of the rotating gear, and it has been affected by most failures.

## 3. CONSTRUCTING THE SAFETY COUPLING WITH BALLS AND TRAPEZOIDAL CANALS AND THE ONE WITH BALLS

The safety coupling has the role of decoupling the actioning of the rotating system when the value of the moment for which it was adjusted is surpassed.

In figure 4, we show the general solutions of the safety couplings with balls and tarpezoidal canals, figure 4a, and with balls, figure 4b, together with teh elastic coupling with brake collar. This underensamble is fitted between the electrical actioning engine and the revolution reducer.

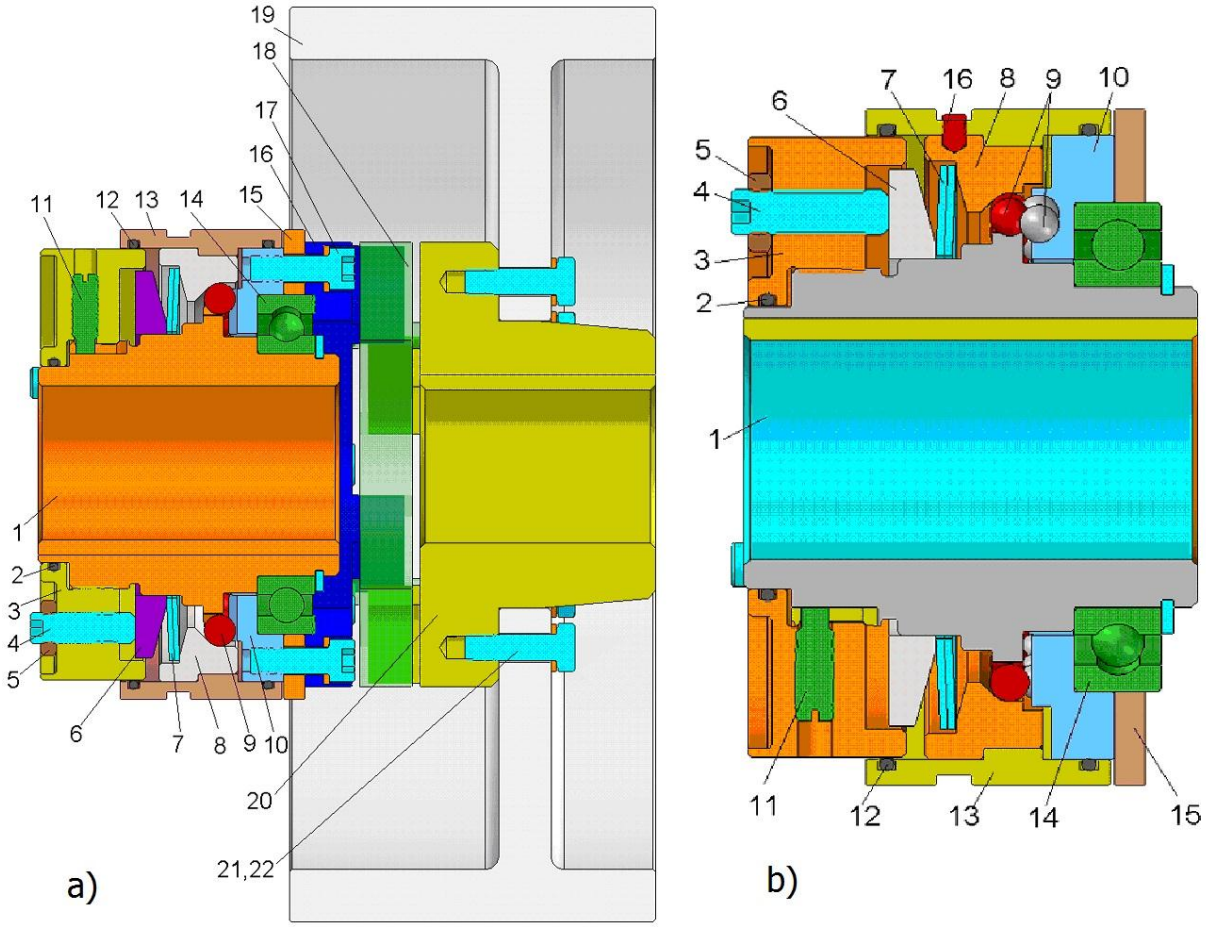


Fig. 4. The ensamble of the safety coupling with balls and trapezoidal canals together with the elastic coupling with brake collar

In the figure, the following were noted: 1 – pap; 2 – ring O 35507500; 3 – adjusting nut; 4 –screwed pin M12x40, three pieces; 5 – low nut M12; 6 – pressure ring; 7 – package of two disk springs; 8 – pressure collar; 9 – 23 BR12 balls; 10 – pressure flange; 11 – screwed pin

M10x25 (2 pieces at 120 degrees); 12 –ring O 35516500; 13 – protection case; 14 – roller bearing with balls 6017-2z;15 - spacer collar; 16 – elastic semicoupling with a flange type bow; 17 – screw with cylindrical head and hexagonal bezel M10x30and Grower collar; 18 – bow from elastic material (rubber); 19 –braking collar Φ350x140; 20 –elastic semicouplșing with pap-type bow; 21 - M10x35;22 – Grower collar.

The composing elements of the ensamble we have shown noted from 1 to 15 form the safety coupling per se, and elements 16 – 22 are part of the elastic coupling with braking collar.

The adjusting of the decoupling moment is made with the help of the adjusting nut, 3, through the pressure ring, 6, and the package formed by two disk springs, 7. When the adjusted moment is surpassed, the coupling is slipping, the thrust washer, 8, makes an axial movement and the limitator detects this movement and commands the decoupling of the actioning. The active travel for decoupling is 2,5 mm.

A similar variant, but a lot more functionally performant, is that of the safety coupling with balls, whose general construction is shown in figure 4b. The active travel for decoupling for this type of coupling is of 2,3 mm.

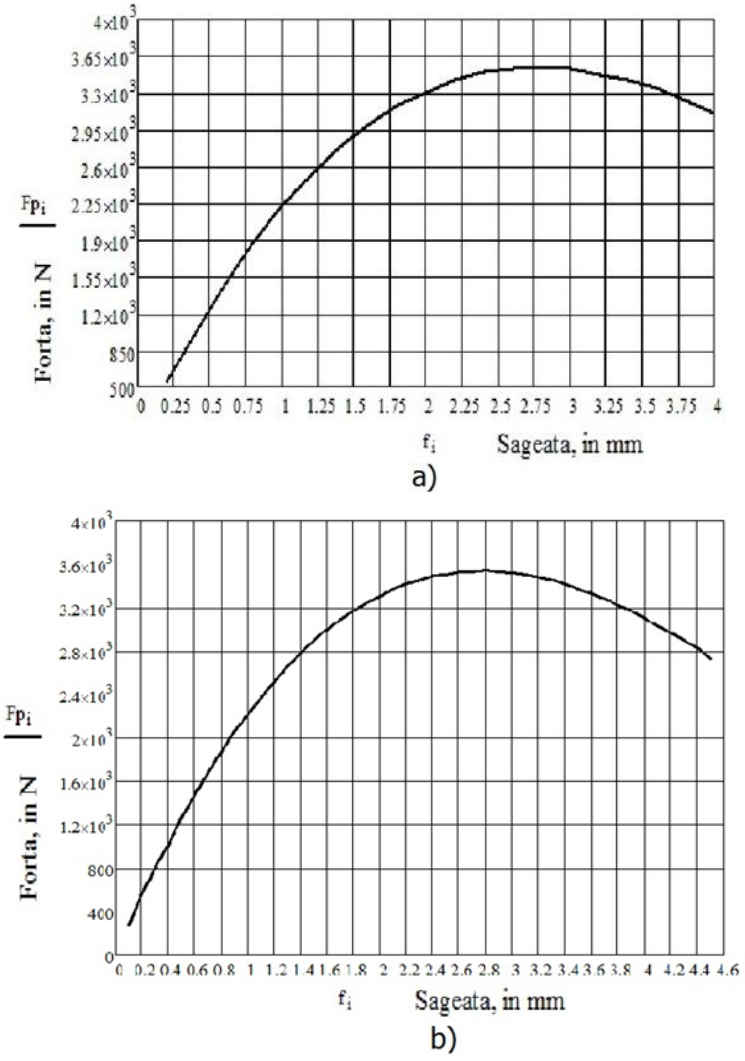


Fig. 5. The pretensioning characteristic of the disk springs at the coupling with balls and trapezoidal canals and at the coupling with balls

As a functioning principle, safety couplings with balls allow the decoupling of the movement between shafts if the load exceeds a certain value. The balls are pressed by the elastic element in spherical alveoles made on the interior surface of the disk of the semicoupling. When the limit load is exceeded, the balls are pushed out from the alveoles by the spring's compression. Between the two couplings, a relative movement appears, accompanied by noise due to the repeated pushing out of the balls from the alveoles. The phenomenon goes on for as long as the load exceeds the accepted value. When the load decreases, the balls are pressed back into the alveoles, and the slippage between the two couplings ceases.

The characteristic of pretensioning of the disk springs packages is shown in the diagram of figure 5a, for the coupling with balls and trapezoidal canals and in figure 5b for the coupling with balls.

## 4. CONCLUSIONS

In comparison with the safety coupling with friction of the excavator with rotor EsRc-1400, the new safety coupling with balls has the following advantages: is more reliable and better functioning; the limitation precision, at a certain imposed value, of the torsion moment transmitted, is better; has a greater sensibility at decoupling; has the posibility to adjust the moment of torison transmitted; teh capacity to automatically reestablish the kinematic flux, after the overload ceases its action; simpler construction.

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