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Linking Devices for Wide Cables to Balance Winding Installations

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ABSTRACT. Linking devices for wide balancing cables connect between extraction vessel and wide cable to compensate for vertically transported masses. Such a device is made up of a series of elements of resistance that make connection between the bottom of the extraction vessel and the exterior core, whose operational width is determined by the width of the wide cable and a series of fixing clamps of the cable end wrapped around the core. In the paper is present the numerical analysis with finite elements DLCLE118 device.

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1. INTRODUCTION

Linking devices for wide balancing cables connect between extraction vessel and wide cable to compensate for vertically transported masses.

Constructive/functional characteristics of linking devices for wide balancing cable are shown in table 1.

Table 1

No	Characteristic		Unit	Value of characteristic		
				DLCLE-118	DLCLE-129	DLCLE-135
1	Strict maximum load		ton/kN	2/20	3.5/35	5.5/55
2	Wide cable section		mm	106×15.5 118×17	124×18 129×19	135×20
3	Specific mass of cable		kg/m	5.447/6.726	7.558/8.128	8.865
4	Way of fixing cable		-	With loop and exterior core		
5	Bolt diameter		mm	60	70	70
6	Stiffening plate thickness		mm	40	48	40
7	No of fixing clamps for wide cables		pcs.	6	6	6
8	Space between clamps		mm	120	120	120
9	Size	Length (height)	mm	1327	1577	1706
		width	mm	380	460	500
		thickness	mm	238	250	258
10	Mass		kg	190	248	290

2. CONSTRUCTION AND OPERATION OF THE DEVICES

The main constructive-operational part of DLCLE-118, DLCLE-129 and DLCLE-135 linking devices for wide balancing cables are shown in Figure 1.

The three typo dimensions of linking devices for wide balancing cables have the same design shape, the difference lying in the sizes of component parts that are submitted to various trials function of the characteristics of the wide cable of compensation.

According to fig. 1, such a device is made up of a series of elements of resistance that make connection between the bottom of the extraction vessel and the

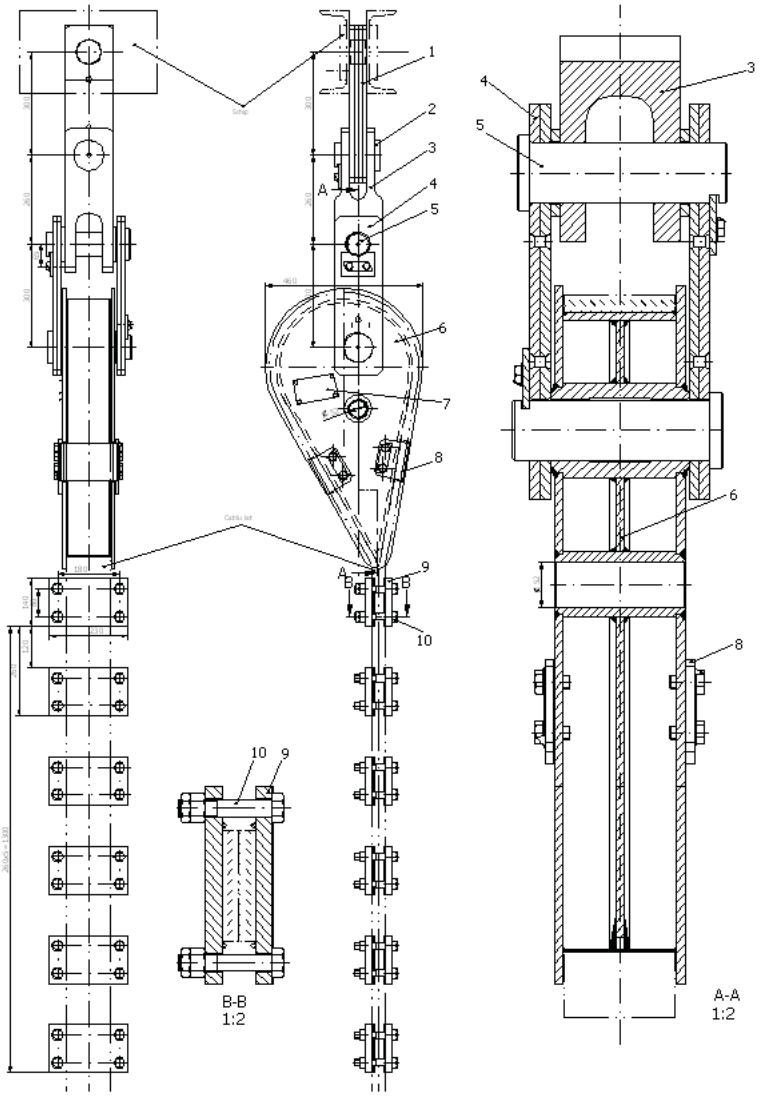

FIGURE 1. DLCLE 118, 129, 135 linking device for wide balancing cable

exterior core, whose operational width is determined by the width of the wide cable and a series of fixing clamps of the cable end wrapped around the core.

The device assembly is fixed to the extraction vessel by means of 1 stiffening plate, which is a structure of resistance, made up of four steel plates riveted among them, and processed by chipping to nominal sizes. The link to the 6 exterior core is made by means of a 3 bracket and of two 4 stiffening plates, made

up of two steel plates riveted among them, and the connection between the three elements is made by 2 and 5 bolts, in alloyed and thermally treated steel.

The exterior core is a welded metal structure, with a central plate giving the shape and the position of the two sleeves, and the wrapping plate and external plates make up the groove around which the end of the wide cable is wrapped up for compensation. Besides 5 bolt sleeve, the core has a hole used to support the device in view of mounting the cable. Label 7 is applied to the core, for the identification of the device and two 8 briddles with the role of fixing the wide cable in the groove of the metal core.

The free end of the cable is wrapped for approximately 1500 mm around the cable entering the core, the two branches being fixed in six 9 double clamps, each having four 10 tightening screws, with nuts and counter nuts.

The material of the important part, that is the plates of the stiffening plates to the extraction vessel, all connecting bolts, the linking bracket, the plates of the intermediate stiffening plate, the lower and upper plate of the exterior core will be controlled for fault detection without destroying, before cutting materials and will meet the prescriptions specified in the technical documentation.

In the manufacturing of fastening plates to the skip, of intermediary fastening plates and the lower and higher plates of the exterior core will meet the following conditions:

- hot straightening of the sheet of which the mentioned subassemblies are manufactured is not admitted;
- cutting out the pieces from the sheet will be done on the contour by chipping or thermal cutting, case in which a processing addition of minimum 10 mm is left, which will be removed by chipping;
- the piece is cut out so that the lamination direction of the sheet would coincide with the direction of stressing the piece, alongside it.

In the execution of the subassemblies made out of sheets, the exterior and interior plates are fastened in packages and bore holes are done for rivets, after which they are fastened by riveting, then the other bore holes will be processed. After the plate package is riveted together, the end of the rivet is processed not to pass over the surface of the exterior plate.

To make the connecting bolts and brackets, the material will not be forged out, it will only be mechanically processed. Before being mounted where they are used, all the component parts of the device are checked. Component elements with flaws or damages are not admitted, not to affect adversely the functioning of the device.

The extraction vessel to which the balancing device is fastened is placed on pegs or on a safety bridge.

At its upper part the device is joined by bolts to the extraction vessel, and at the lower part the wide cable is mounted by wrapping it up around the exterior core and fixing it by clamps.

Daily check of devices is done by careful eye examination and by hammering, to see if the component parts show fissures or deformations.

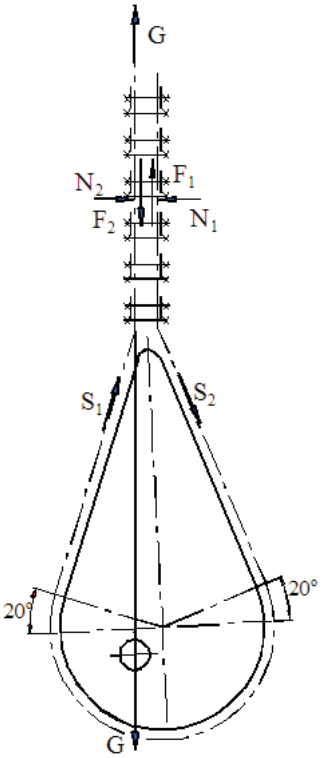

FIGURE 2. Mathematical model of cable fixing forces

3. DIMENSIONAL VERIFICATION OF DEVICES

Starting from the mathematical model of cable and metal core balance, shown in Fig. 2, and the condition of non-slipping at the end of the cable blocked between the clamps and the cable, the relationship of determination of clamps straightening forces results:

$$N_1 = \frac{G \cdot e^{-\mu \cdot \theta}}{\mu_1 \cdot (1 + e^{-\mu \cdot \theta})}$$

where: G is the maximum balancing cable mass, G = 20000 N; μ - friction coefficient between cable and metal core, $\mu = 0.1$; θ - angle of cable wrapping around the metal core, $\theta = 220°$; μ_1 - friction coefficient between cables, $\mu_1 = 0.1$.

For a 1.6 to 2 dynamic coefficient of the extraction and a safety coefficient higher than 10, twenty one M20 screws result made of OLC35q, of 370 Mpa flow limit. Because clamps with 4 tightening screw are used, six clamps are required to safely fasten the end of the cable.

The fastening plates and the bracket were checked for tear and shear stress in the bolts area and for contact pressure between their bore hole surfaces and bolts. The bolts were checked for complex bend and shear stress, and for a higher than

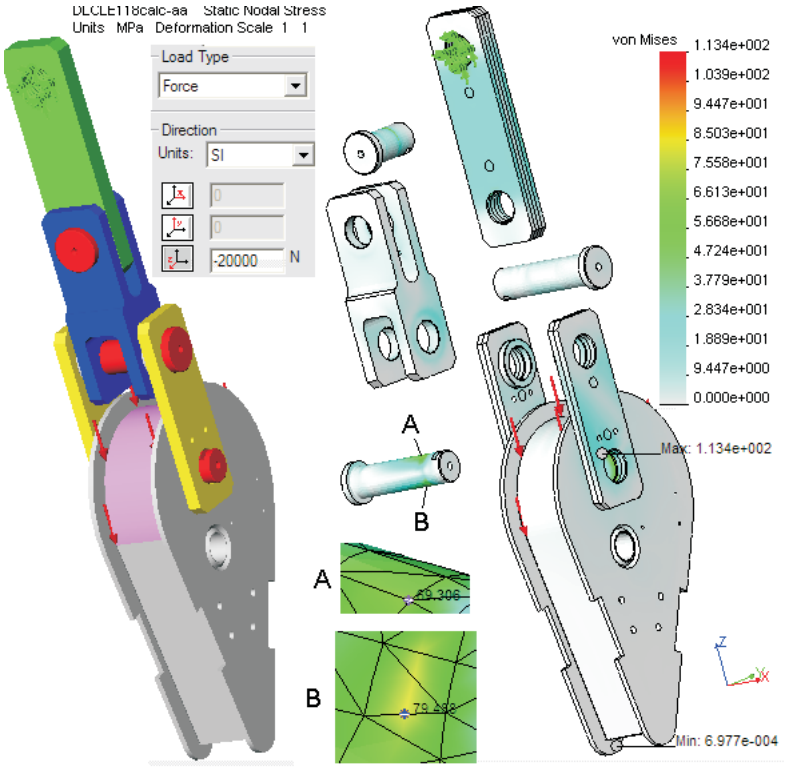

FIGURE 3. Numerical analysis with finite elements of DLCLE 118 device

10 safety coefficient, 42MoCr11, 31MoCr11, 31MnCrSi11 or 25MnCrSi11 alloyed steels of improvement resulted.

Fig. 3 shows the numerical analysis with finite elements DLCLE118 device, having in Fig. 3 the way of charging, fixing the fastening bolt bore hole to the skip, and application to the metal core of a force equal to the maximum cable weight, 2000 N. Fig. 3 b shows that the maximum stress of the bolts is in the separation area between the fastening plate and the sleeve of the metal core due to the shear stress. This is highlighted by detail A and B, where tensions equivalent to 69.306 MPa and 79.468 Mpa occur, confirming the necessity of using alloyed steels of improvement.

4. CONCLUSIONS

In drawing up the documentation of execution for the linking devices for wide balancing cables in contract no. 193/ASL/2006 concluded with CNH Petroșani, the following technical-economic aspects were held in mind:

- simplifying design solution from technological point of view (exterior core and welded opposite to cast clamps);

- as far as possible, design solutions for linking devices for wide cables for multi-cable extraction installations in Jiu Valley. This was especially difficult since it is necessary to keep up the possibility of interchanges with the existing construction;
- the use of design solutions that were verified in practice for similar devices;
- maintaining the present safety coefficient and in some cases increasing it;
- reducing costs by cutting down labor.

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