ASPECTS REGARDING THE IMPROVEMENT OF THE VULCANIZING TECHNOLOGY OF METAL INSERT CONVEYOR BELTS MOUNTED ON BAND CONVEYORS

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Abstract: *The increasing tendency to obtain conveyor belts with longer lengths with high productivity, reliability and longer life lead to extensive research in the field. Market demands force researchers to react quickly, respond to new challenges, come up with flexible, sustainable, and productive work structures. The dominant feature of the current development phase of this field is the modernization, improvement, innovation of technological processes and products or services with the ultimate goal of satisfying customers.*

Key words: vulcanization technologies, analysis, specific resistance, conveyor belts.

1. INTRODUCTION

They are mechanical installations designed to transport materials on a fixed path of a given length, starting from a point of supply and leading to a discharge point, with variable or constant speed depending on the needs of the technological process and the energy strategy of the manufacturer [1-3].

Depending on the field of application, conveyor belts may be:

- Fixed

- with band for inclinations up to 20%;
- with inclined skids for 35% to 40% inclinations;
- with elevators for inclination of 85% - 90%;

- Mobile used in various work environments, can be transported in various workspaces.

Figure 1 shows a steel cord insert. The casing is made of parallel steel strands and covered with a rubber layer. The rubber compound in the casing is intended to provide good adhesion to the metal inserts and a cohesive bond with the coating faces. Covering faces must be wear resistant, atmospheric and working conditions. For these features are tables with resistance classes, from which the parameters corresponding to transport conditions can be chosen.

The cables used are made of steel with a tear resistance of 1300-6300 N / mm, and to protect them against corrosion, they are covered with a layer of brass or zinc. Cord diameter is between 3.8 and 8.3 mm.

The ratio of the cords and their diameter decreases as the diameter increases and typically has values between 2 and 3 for cords with a diameter of 4 mm and 1.5-2 for larger diameter cords. Steel cord inserts are only made with covered edges. Steel cord conveyor belts are based on rubber-metal adhesion, are generally used to equip high-capacity conveyors with very good resistance to breaking reliability and flexibility [4].

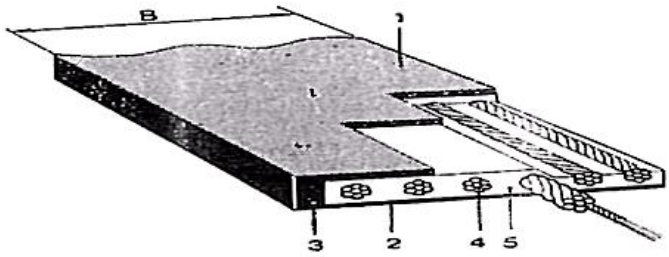

Fig. 1. Structure of conveyor belt with metal inserts.
1 - the carrier face; 2 - rolling face; 3 - rubber edge; 4 - steel cables; 5 - rubber bonding layer;
B - band width.

2. COMBINING CONVEYOR BELTS WITH METAL INSERTS BY HOT VULCANISATION

The method of joining steel bands has a high degree of complexity compared to the bundles of textile inserts. The joining of the rubber band ends with a metal insert can be done: in a single step; in two steps; in three steps [5].

In order to fit the rubber band on the conveyor, it is brought to the spot, measured and cut to the required length, taking into account the loss of joint. If the tape is long, it is placed on the conveyor and vulcanizes in the position. Measure and trace the area to be uncovered, then remove with a special knife the rubber strap of the rubber band along the length of the joint to the first edge cables, Figure 2. From one of the sharp edges of the marked area for scraping, with a knife, remove the cover layer from above the cable layer.

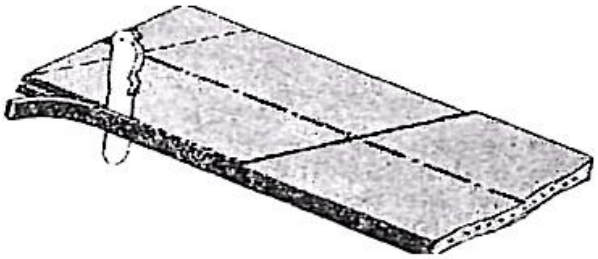

Fig. 2. Drawing of the joint area and cutting of the rubber edges

The deformed tip picks up with a pinch or trifle and rises as it detaches with a knife the rubber plate.

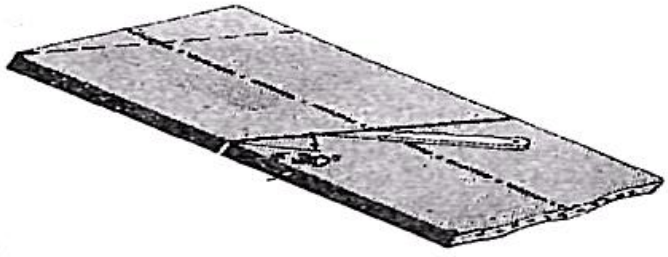

Fig. 3. Removing the cover faces along the joint length

For larger width bands the cover plates can be split and removed in steps by longitudinally sliding into 500mm plates.

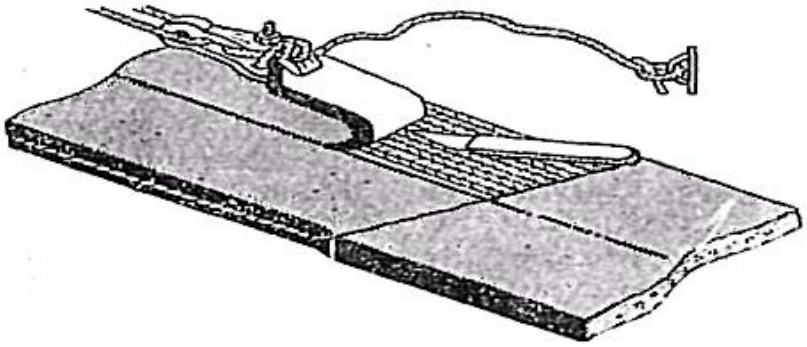

Fig. 4. Removal of rubber layer

After proper fitting of the joint area, remove excess tape ends with a grinder or scissors. Apply the brush surface with a rotating brush mounted on a grinder and clean the surface of the triclorethylene joint area. At the single-step joining of these bands, the steel cables corresponding to the two ends of the strip are introduced into each other.

The ends of the cables are not welded, they do not mate and do not bind on another mechanical path. If the corresponding cables are not properly placed then the tied resistance of the strip decreases. The system of jointing metallic transmission belts is determined by the diameter of the cables and the distance between them. When the cable diameters are small, the distance between the cables is relatively higher, the corresponding cables at both ends being interlocked. This jointing method can be applied to the following types of metallic strips: ST 800, ST 1000 and ST 1600, the joining width being 650,700 and 900 mm respectively. Regardless of the method of joining the edges of two adjoining cables in the jointed area, there must be enough space for the rubber film to be inserted between them in thickness about 2 mm. The rubber film must have high adhesion to the metal cords. Ideally it would be if these metal cables are individually wrapped with this rubber film that ensures the necessary adhesion and transmission of traction forces [6, 7].

In the multi-step joints, the cuts are executed up to about 20 mm before the joint tilts and remove the free ends of the rubber resulting from the cables. Figure 5

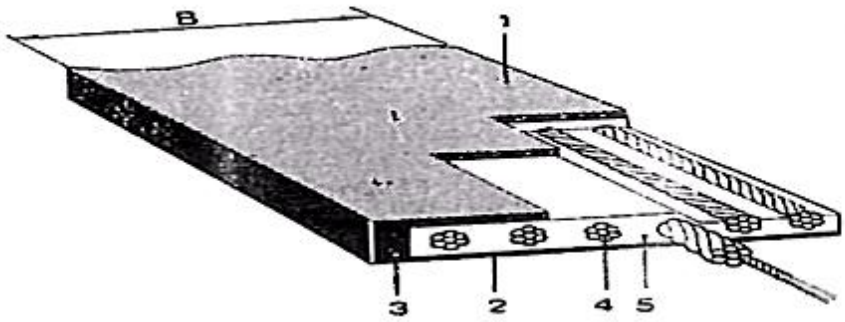

Fig. 5. Detasarea cablurilor in cazul imbinarilor in mai multe trepte

The two-step combination is made when the space between two cables does not allow the insertion of a corresponding cable. In this case, the steel cables are placed in the shape of steps, according to a well-established diagram and calculated before. Some cables are cut at different lengths and sit in front of each other and, by observing the vulcanization technology, they transmit through the flange contact to longer wires, the traction forces required in the joint area.
This two-step combination method can be applied to the following types of metal insert strips: ST1250, ST2000, ST3150 and ST 5000 [8].

ST	1250	2000	2500	3150	5000
Li (mm)	1100	1200	1500	1800	2000
l_1 (mm)	550	600	750	900	1000

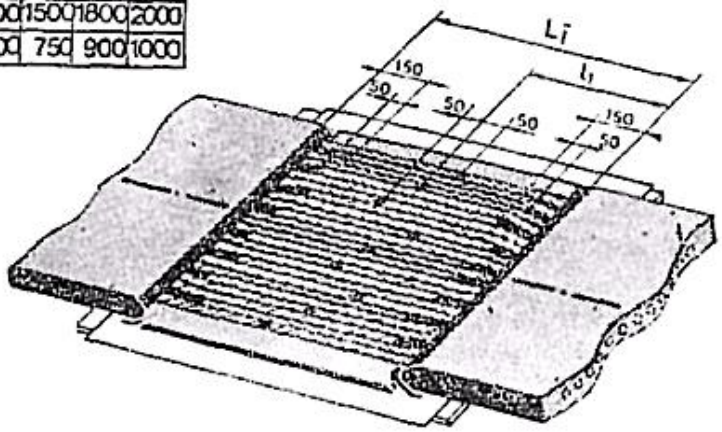

Fig. 6. Two steps joint

In the case of the two-stage joint method, as shown in Figure 6, after each cable at the left end and at the right end of the strip, the next pair of corresponding cables is cut so that they meet approximately in the middle of the joint.
The three-stage joining method Figure 7 is used for conveyor belts of the ST 4000 resistance class.

ST	4000
Li (mm)	2700
l_1 (mm)	900

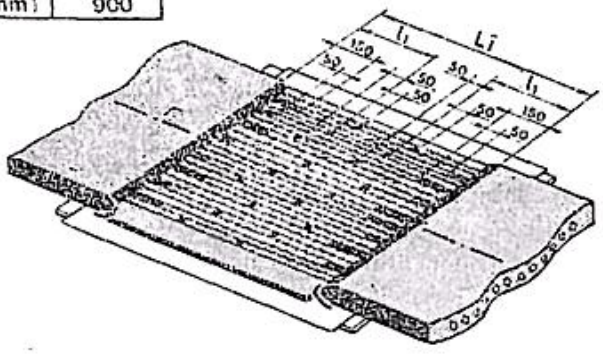

Fig. 7. Three steps joint

In this jointing method, after each cable (not cut) next to each other, at the right and left ends of the strip, the following pair of corresponding wires are cut so that the ends of the strips are moved away from one another another with a joining step. Through this process both pairs of cables that meet together can also provide the transmission of traction forces by touching their flanks. Transmission of traction forces in relation to the joint system is achieved by the appropriate dimensioning of the tread length. The joining method in one step does not lead to cable cuts, so the resistance in the joint has the highest value, ie 100%. On two- or three-stage joints, the tensile strength is reduced to 70% -80% as a result of cable cuts. In this case, the distance between the cords on the tongue portion becomes slightly smaller than the rest of the band. The smaller amount of rubber between the wires in the tied area results in a decrease in the belt traction resistance. If we note the width of the tire that exists between Z-steel wires, then its maximum value in relation to the applied jointing method will have to be at :

- One-step joint $Z = 1/2T - d$
- Two-steps joint $Z = 2/3T - d$
- Three-steps joint $Z = 3/4T - d$

Where - T is the distance between the steel ropes of the rubber band in mm;

- d is the diameter of the steel wire in mm.

If Z is too small, traction resistance is much lower in the joint area.

For the elimination of errors in Table 1, both the actual distance between the cables in the jointed area and the choice of the joint method with respect to the conveyor belt class are presented.

Table 1. Methods of selecting the joints depending on the strength class of the conveyor belt

Strength class	Diameter of the cable [mm] x no. the cables	Joining methods	The distance between the cables in the band body [mm]	The effective distance between cables in the joint portion [mm]
ST 300	2,0 × 74	Joining in one step	13,0	4,5
400	2,0 × 96	Joining in one step	10,0	3,0
500	2,4 × 83	Joining in one step	11,5	3,3
600	2,9 × 77	Joining in one step	12,5	3,3
800	3,3 × 80	Joining in one step	12,0	2,7
1000	3,9 × 74	Joining in one step	13,0	2,6
1600	4,3 × 95	Joining in one step	10,0	2,4
1250	4,6 × 96	Joining in two step	10,0	2,1
2000	5,7 × 77	Joining in two step	12,5	2,6
2500	8,3 × 51	Joining in two step	19,0	3,5
3150	9,1 × 52	Joining in two step	18,5	4,3
5000	10,0 × 58	Joining in two step	16,5	4,9
4000	10,0 × 65	Joining in three step	14,8	4,8
4500	11,3 × 59	Joining in three step	16,3	5,0

After overlapping both ends of the tape, respecting the coaxiality of the joint with that of the tape, center the upper part on the bottom so that the edges of the band are perfectly aligned.

In all three methods of bonding after laying the steel cables and their individual wrapping with a rubber film with adherence to the steel cables, the joint area is covered on both sides with another rubber film. The next step is to add the rubber insert on both sides (canvas) to the size of the removed area, then lay the rubber coating layers. The amount of raw rubber compound used in the joint must be equal to the amount of mixture used in the manufacture of the strip. Prior to the vulcanization, a pressure is pressed to remove the gas accumulated in the joint.

3. CONCLUSIONS

Consequently, it is normal to use the joining method with the highest yield if the dimensions of the joint allow this. This technological process, as part of the manufacturing process, is an ordered succession of operational systems that involve a decision-making approach on each stage of the work. In experimental research or in production conditions, the results obtained can help improve the quality of conveyor belts, resulting in the desired productivity.

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