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THE SPATIAL MANIFESTATION OF NOMINAL CONVEYING ABILITY OF TEETH BELTS– CONTRIBUTION FOR OPTIMIZATION

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ABSTRACT
In all expressions for calculating the conveying ability of belts there are two variables: the number of rotations and the kinematic diameter of the steering pulley. From this it is concluded that the nominal conveying is a two-variable function. Through planar diagrams it is possible to express the conveying ability as a function of the number of rotations for the constant value of the kynematic diameter of the steering pulley and vice-versa. Spatial diagrams have precedence over planar diagrams because the the conveying ability can be expressed simultaneously by treating as variables both the number of rotations and the kinematic diameter of the steering pulley. Therefore, we have the spatial function $P_{n1} = f(n,d_w)$*. Contoural diagrams are derived if this function is cut in equidistant plateaus* P_{n1} *= const., and are of unique contribution for optimizing the nominal conveying ability.*
Key words: teeth belts, conveying ability.

1. INTRODUCTION
All tests done on the nominal conveying ability of teeth belts show that the number of rotations and the kynematic diameter of the steering pulley are the two main parameters with direct effect.
Also, it is known that the width of the belt effects the value of the power that can be carried by the belt of respective profile. For practical calculations belt of respective profile it is important to determine the number of rotations and the diameter of the steering pulley for which the conveying ability will have a maximum value. A concrete answer can be derived through contoural diagrams.

2. NOMINAL CONVEYING ABILITY AS A SPATIAL FUNCTION
The nominal conveying ability can be expressed in a general mathematical function as a function of two variables.

$$P_{n1}(n, d_w) = f(n, d_w) \qquad \ldots(1)$$

It is known that such functions in space in general express a curved surface, the form of which depends on the mathematical expression (1.0)

From these diagrams is derived the physical understanding of of the influence of the number of rotations and the diameter of the steering pulley on the nominal conveying ability. This paper presents the spatial and contoural diagram of the nominal conveying ability for the XL profile.
The mathematical model for calculating the nominal conveying ability for the XL profile is:

P r o f i l e XL, step p=5.08 mm, width b=25.4mm:

$$P_{n1}(n, d_w) := c_1 \cdot \left[c_2 \cdot (d_w \cdot n) - c_3 \cdot (d_w \cdot n)^3 \right] \qquad \ldots(2)$$

where:
P_{n1}(kW)-nominal conveying ability,
n(min^{-1})-number of rotations of the steering pulley,
d_{w1}(mm)-steering pulley kinematic diameter,
c_i (i =1,2,3) – constants.

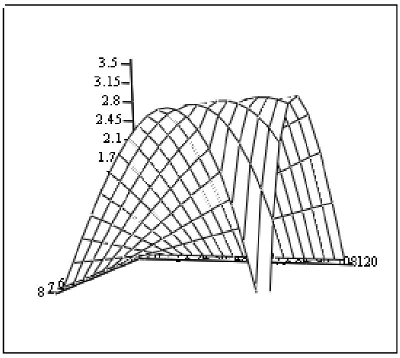


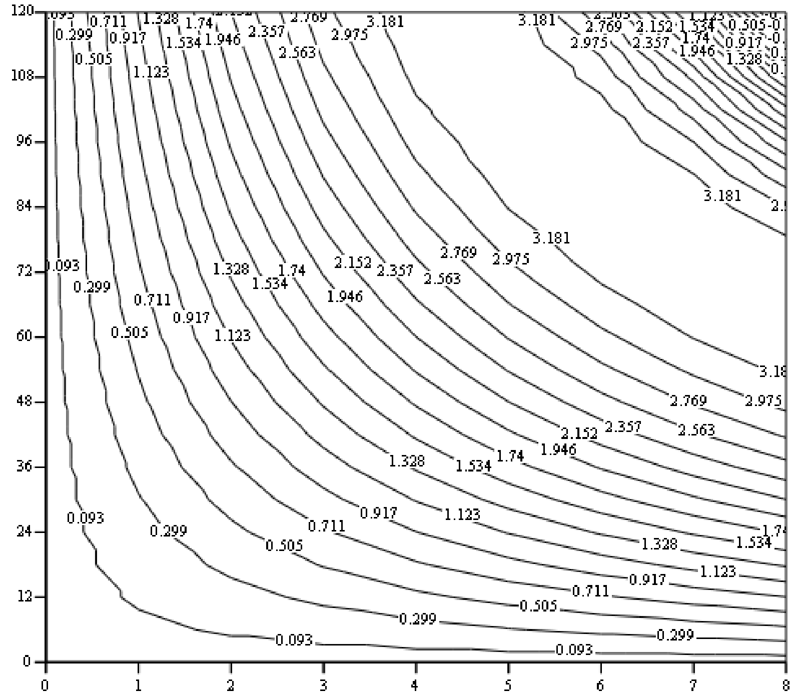
Figure 1. The spatial diagram of the nominal conveying ability for the XL profile.

Table 1. Nominal conveying ability for XL profile

n(min^{-1})	d_w (mm)	P_{n1} (kW)	n(min^{-1})	d_w (mm)	P_{n1} (kW)
500	16.18	0.078	2700	51.664	0.419
700	19.406	0.109	2900	54.889	0.450
900	22.631	0.14	3100	58.115	0.481
1100	25.857	0.171	3300	61.341	0.481
1300	29.083	0.202	3500	64.567	0.543
1500	32.309	0.233	3700	67.793	0.573
1700	35.535	0.264	3900	71.018	0.604
1900	38.76	0.295	4100	74.244	0.635
2100	41.986	0.326	4300	77.47	0.665
2300	45.212	0.357	4500	80.696	0.696
2500	48.438	0.388	4700	83.922	0.726

Table 1. is calculated using expression (2) in Mathcad. In this diagram, the x axis represents the number of rotations of the steering pulley dived by 1000, whereas the y axis is the kinematic diameter P_{n1}(kW).
The diagram in figure 1 shows the physical understanding of the influence of the number of rotations and the steering pulley kinematic diameter on the nominal conveying ability.
The diagram shows that the conveying ability represents a spatial surface comprised of two characteristic parts:
- *increasing monotonous, and*
- *decreasing monotonous.*

Fig.1. shows that as both variables (n and d_w) increase, the spatial surface narrows down. This means that pulleys of bigger diameters should not have a large number of rotations.
The lowering part of the surface is also shown which represents the decreasing field of conveying ability and where the number of rotations and diameters should not be considered. The diagram also shows the point where the conveying ability start getting negative values. If the spatial surface depicted in figure 1 is cut in several equidistant plateaus P_{n1}=const the contoural diagram shown in fig. 2 can be concluded.



P n1

Figure 2. The contoural diagram of the conveying ability for XL profile.

The abscissions on fig. 2 diagram shows the number of rotations n/1000, whereas the ordinate shows the kynematic diameter d_{w1}(mm). The curvatures on the diagram represent the tracks of the cutting of surface in P_{n1}=const plateaus shown in fig. 1. These curvatures represent the contoural diagram. The numbers next to each curvature represent the respective value of the conveying ability. From a mathematical aspect the curvatures resemble a hyperbole . The fig. 2 diagram shows that the nominal conveying ability determined value can be calculated through a series of combinations of the number of rotations and the kynematic diameter of the steering pulley.

Therefore, the job of the constructor to determine the optimal variant is made easier through this diagram. This diagram shows a track without contours. This track separates the part where the conveying ability increases from the part where it decreases. The nominal conveying ability will have the maximum value on the symmetry of the track.

3. CONCLUSION

The spatial manifestation of the conveying ability is calculated for 100…8000 min^{-1} number of rotation and the kynematic diameter of the steering pulley of 13…130 mm. The spatial surface depicted in this figure represents the values of the nominal conveying ability $P_{n1}(n,d_w)$(kW). The various colors in this diagram represent different levels of power P_{n1}. The contoural diagrams represent a unique contribution in the field of optimization of the conveying ability of teeth belts. Through these diagrams the builder has available a series of possible combinations of the number of rotations and the kynamatic diameter to calculate the assigned power.

4. REFERENCES

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