TRIESKOVÉ A BEZTRIESKOVÉ OBRÁBANIE DREVA, 8(1): 175–178, 2012
Zvolen, Technická univerzita vo Zvolene, ISBN 978-80-228-2385-2

INVESTIGATION OF OSCILLATION IN THE CLASSICAL WEDGE BELTS IN WOODWORKING MACHINES

Georgi Kovachev – Zhivko Gochev

Abstract

The proposed work is an overview study of the use of classical wedge belts to drive the modern woodworking machinery. Simple construction, quiet operation, no special maintenance and low cost of the product makes it a leading choice of drive gear. The article examines the behavior of the belt during operation. It helps us to get accurate information for the impact on individual elements and nodes of the machine. The data is directly link to the quality of treated products, the load of machine parts, with their wear and others.

Key words: *woodworking machines, wedge belts, vibrations*

INTRODUCTION

In modern manufacturing wedge belts are very widely use. The principle of their work, belt drives belong to a gear by mechanical friction. They transmit rotary motion and torque from one shaft to another. A belt drive works quietly, easy to replace the old with the new belt in case of failure and doesn't use special maintenance of gear. Calm operation and possibility to belt slip, protect mechanisms from adverse loads, overloads and appearance of too many oscillations [2, 3]. In mhodern woodworking machines classic wedge and narrow wedge belts are used to drive the cutting and feeling mechanisms. The imposition of this trend is the result of their primary advantages over flat belts. Some of their positive qualities are:

- They work lightly, quietly without vibration;
- They have more quality grip with pulley;
- Large traction capacity;
- They work well at horizontal and vertical placement of the gear;
- Loaded shafts and bearings less than flat belts;
- Wedge belts are produce closed;

The purpose of this work is to review investigate the behavior of the belt during machine operation. This helps us to receive accurate facts for the formation of the load on individual nodes of the machine. For the exact study of the behavior the belt during operation, it is important to analyze various factors witch influence over the process. Belt tension on the pulleys is an important factor for its working capacity. Between the belt and

University of Forestry, 10 "Kliment Ohridski " Blvd., 1756 Sofia, Bulgaria
e-mail: g.kovatchev@gmail.com; zhivkog@yahoo.com

the pulley friction forces should be large. They overcome all work resistance applied to the shaft of the machine [2, 3, 5]. The belt must be constantly and sufficiently tight. That allows normal flow of work processes. Failure analysis shows us their direct ascendancy over the efficiency of the gear and the capacity of the machine. The correct setting of the belt drive allows optimization of technological process. This is directly related with the quality of the products. At the same time one can avoid undesirable vibrations in the cutting mechanisms in woodworking machines, caused by the dynamic forces acting on them [6, 7]. Rise and development of the defects in drive mechanisms at machines change dynamic forces. These changes alter the performance of oscillation. By reported changes we can establish the problem in cutting mechanism [8].

Fig.1 shows the load of the belt when belt drive is idling.

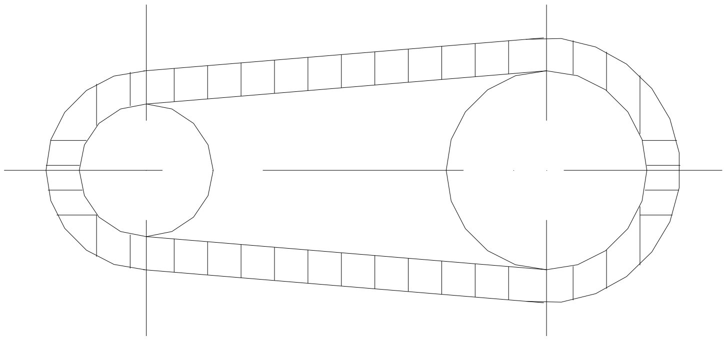

Fig. 1.1 Belt loaded by idle

In a working tread forces in both parts of the belt is changed. Fig.2 shows that the tensile force on the driving pulley decreases and over the driven pulley it increase.

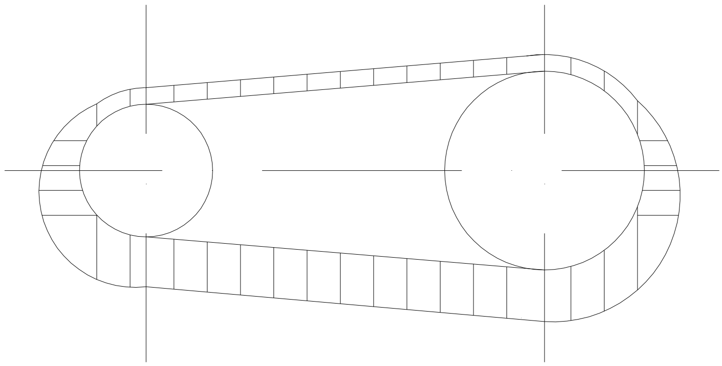

Fig. 1.2 Belt loaded by working stroke

Collapse by reason of insufficient strength is not allowed if we keep strength condition for maximum tension in belt [1]:

$$\sigma_{max} = \sigma_1 + \sigma_2 + \sigma_3 \leq [\sigma] \text{ , N/mm}^2 \qquad (1.1)$$

where: σ_1 is a stress from stretch power, N/mm^2;
σ_2 – stress from a centrifugal force, N/mm^2;
σ_3 – bending stress on a belt pulley, N/mm^2;
σ – admissible stress from belt type, N/mm^2;

Stress in the stretched and slack parts in belt drive are different. By loaded belt stretch in traction part will be increase from F_0 to F_1. For F_1 can be written equality [3]:

$$F_1 = F_0 + \Delta F_1 \text{ , N} \qquad (1.2)$$

where: ΔF_1 is a value of the change of power in traction part, N;

In withdrawals part power F_0 will be fall to F_2:

$$F_2 = F_0 - \Delta F_2 \text{ , N} \qquad (1.3)$$

where: ΔF_1 is value of the change of power in withdrawals part, N;

If there is no change in centre distance and length of the belt remain unchanged. At the working movement belt extension will be equal to its shorting. Change ΔF is the same for both parts of the belt.

$$\Delta F = \Delta F_1 = \Delta F_2 \text{, N} \qquad (1.4)$$

$$F_1 + F_2 = F_0 + \Delta F + F_0 - \Delta F = 2F_0 \text{, N} \qquad (1.5)$$

$$F_1 + F_2 = 2F_0 \text{, N} \qquad (1.6)$$

Formulas (1.2) and (1.3) are transformed:

$$F_1 = F_0 + \frac{F_t}{2} \text{ , N} \qquad (1.7)$$

$$F_2 = F_0 - \frac{F_t}{2} \text{ , N} \qquad (1.8)$$

$$F_1 - F_2 = F_t \text{, N} \qquad (1.9)$$

where: F_t is peripheral belt force, N;

Equations (1.7) and (1.8) are known as Poncelet formulas [3, 4]. With their help we can find change tension in two parts of the belt depending from external load. Another important fact is the belt towing capacity, depending on the diameter of the small pulley d_1. Empirically is established interdependence between belt tension and diameter of small pulley d_1.

$$[\sigma_{\Pi}]_0 = \omega_1 - \omega_2 \frac{\delta}{d_1}, \text{ N/mm}^2 \qquad (1.10)$$

where: ω_1 is a constant according from belt type;
ω_2 – is a constant according from belt type;
δ – belt thickness, mm;
d_1 – diameter of small pulley, mm;

High preliminary belt tension σ_0 load shaft and bearings of the machine. Stresses in gear will increase. They inevitably lead to extension and fatigue in belt. This problem is connected with frequently machine stops to correct belt drive. But this correct leads to loss of working time. Experimental studies show us that preliminary tension wedge belts should be σ_0 = 1,2-1,5 MPa, in extreme cases to 1,6 MPa [1].

CONCLUSION

The article review studies the behavior of the belt during machine operation. It discusses some factors which directly influence the working process. The preliminary tension of the belt ascendancy over its working capacity was established and therefore over the whole machine efficiency. Wrong belt drive adjustment leads to undesirable oscillations during the machine work. This is a precondition for undesired side effects. In the future practical research is going to be made about the behavior of classical wedge and narrow wedge belts, used mostly to drive cutting mechanisms in woodworking machines. Oscillation caused by belt will be carefully analyzed how influence over elements and machine nodes.

REFERENCES

1. Arnaudov K., I. Dimitrov, P. Jordanov, L. Lefterov, Machine elements, Sofia (1980).
2. Dimchev G., K. Zahariev, Machine elements part 3 – mechanical gears, Sofia, (2001).
3. Popov Z., Machine elements, Sofia, (1985).
4. Sokolovski S., Machine elements, Sofia, (2007).
5. Vlasev V., Economical considerations in determining the numbers of belts of the cutting mechanisms of some wood – processing machines. Proceedings Scientific Papers – Scientific and Technical Conference 50 years University Of Forestry, pp 193-194.
6. Vukov, G. Y., B. Marinov, Identification of the Typical Defects of the Driving Mechanism of a Carved Veneer Machines Using Vibrodiagnostics, Proceedings Scientific Papers, Scientific and Technical Conference “Innovation in Forest Industry and Engineering Design”, Yundola, 2008, pp. 166 – 169.
7. Vukov, G. Y., Torsional Vibrations of the Driving Mechanism of a Carved Veneer Machine. Amplitude-Frequency Spectrum. Mechanics of machines 3 (75). Varna., 2008, pp. 13 – 16.
8. Vukov, G. Y., J. Gochev, V. Slavov, Torsional Vibrations in the Saw Unit of a Kind of Circular Saws. Mechanical-Mathematical Model. Proceedings Scientific Papers, Third Scientific and Technical Conference “Innovation in Forest Industry and Engineering Design”, Sofia, 2010, pp. 185 – 188.