DOI: https://doi.org/10.53052/9788366249974.05

Peter KAŠŠAY[1], Matej URBANSKÝ[2]

Supervisor: Robert GREGA[3]

WŁASNOŚCI PNEUMATYCZNEGO SPRZĘGŁA PODATNEGO

Streszczenie: W artykule omówiono pneumatyczne podatne sprzęgła. Przedstawiono mechaniczne własności tychże sprzęgieł, a mianowicie charakterystyki ich obciążenia statycznego. Główną zaletą pneumatycznych podatnych sprzęgieł wałów jest możliwość zmiany ich sztywności skrętnej. W niniejszej pracy, przedstawiono dwa wybrane typy sprzęgieł pneumatycznych.

Słowa kluczowe: podatne sprzęgło pneumatyczne, własności mechaniczne, charakterystyki obciążenia statycznego

PNEUMATIC FLEXIBLE SHAFT COUPLINGS PROPERTIES

Summary: The article deals with pneumatic flexible shaft couplings and their mechanical properties, namely static load characteristics. The main advantage of pneumatic flexible shaft couplings is the possibility to change their torsional stiffness. In the article, two selected types of pneumatic couplings are presented.

Keywords: pneumatic flexible shaft couplings, mechanical properties, static load characteristics

1. Introduction

Torsional oscillating mechanical systems are systems of mechanical drives containing rotating machinery [1-3]. In any mechanical system, containing rotating components, torsional oscillation during startup, shutdown or continuous operation may occur. The biggest sources of torsional oscillations are machines working with periodically alternating torque (e.g. piston combustion engines, piston compressors, ship propellers or ventilator fans,). In these torsional oscillating mechanical systems, especially in the resonant condition, there is a possibility that there may occur excessive torsional vibration, which can cause noise, decrease of lifetime or even

[1-3] Technical University of Košice; Faculty of Mechanical Engineering, Department of Engineering for Design of Machines and Transport Equipment.
[1] Peter.Kassay@tuke.
[2] Matej.Urbansky@tuke.sk
[3] Robert.Grega@tuke.sk

damage of drive components. The condition of resonance in systems working with constant speed can be avoided by a properly selected flexible shaft coupling [1], [5]. Each flexible shaft coupling has to transfer the torque from driving to driven shaft, compensate angular, radial and axial misalignments and minimize shock and vibration [1]. At our Department we deal with the development of pneumatic flexible shaft couplings, which in addition to other flexible couplings are able to change their torsional stiffness by adjusting the air pressure in their flexible elements [1 - 4]. The goal of this article is to present the properties of selected pneumatic flexible shaft couplings developed at our department.

2. Design of Pneumatic Flexible Shaft Couplings

Pneumatic flexible shaft couplings (Fig. 1) consist of two hubs flexible connected with air springs. There were developed various types of these couplings [1], [4]. Specific types of pneumatic coupling are characterized with numbers and configuration of flexible elements and also with connection between compression spaces of pneumatic flexible elements. Two main types are the tangential and differential pneumatic flexible shaft couplings.

Tangential pneumatic flexible shaft coupling (Fig.1a.) consists of driving *(1)* and driven part *(2)* that are flexibly connected with four flexible elements *(3)* positioned on the circumference. Two elements are pressed and two pulled. The compression spaces of elements are filled up with gaseous medium. Flexible elements are single or double bellows air springs.

Differential pneumatic flexible shaft coupling (Fig.1b.) consists of driving *(1)* and driven part *(2)* flexible connected with three differential flexible elements *(3)* positioned on the circumference. Differential flexible element consists of two air springs with mutually interconnected compression spaces. One of the air springs is pressed and the second one is pulled.

The compression spaces of flexible elements for both coupling types can be connected with air hoses *(6)*.

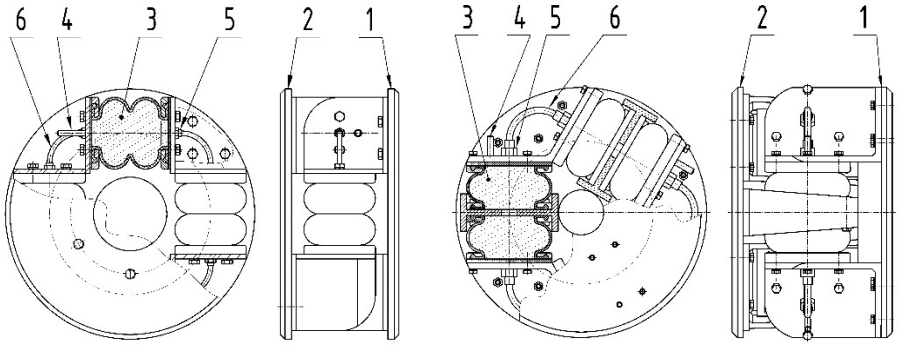
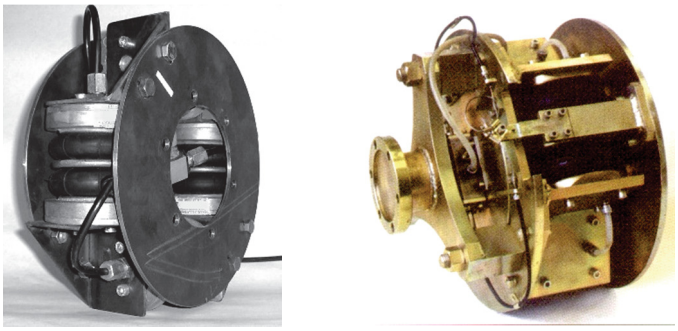


Figure 1. Design of pneumatic flexible shaft couplings.
a) - tangential, b) - differential

3. Static Characteristics of Selected Pneumatic Flexible Shaft Couplings

The advantages of pneumatic flexible shaft couplings can be easily demonstrated on their static load characteristic. For this article were selected two different pneumatic flexible shaft coupling. The first of them is a tangential pneumatic flexible shaft coupling *4-2/70-T-C*, (Fig. 2.a), the second one is a differential flexible shaft coupling *3-1/130-D* (Fig2.b.).



a) b)

Figure 2. Investigated pneumatic flexible shaft couplings
a) - tangential, b) - differential

Static load characteristic was measured on a special device (Fig. 3.) Static torque was obtained by means of static load hanging on lever arm. For every static torque the static torsion angle was measured [1-3].

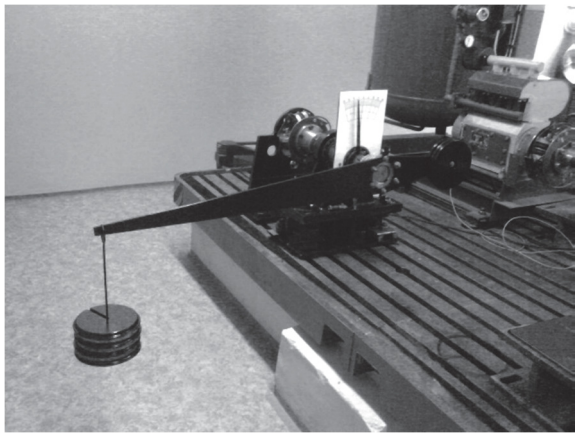


Figure 3. Device for investigation of flexible couplings properties

Static load characteristic of both pneumatic flexible shaft couplings for different air pressures in compression spaces are displayed in *fig. 4*. We can see that the function of static load characteristics strongly depends on the used air pressure. It means that pneumatic flexible shaft couplings have different properties, e.g. static torsional stiffness, dynamic torsional stiffness and damping as well as nominal torque for different air pressures.

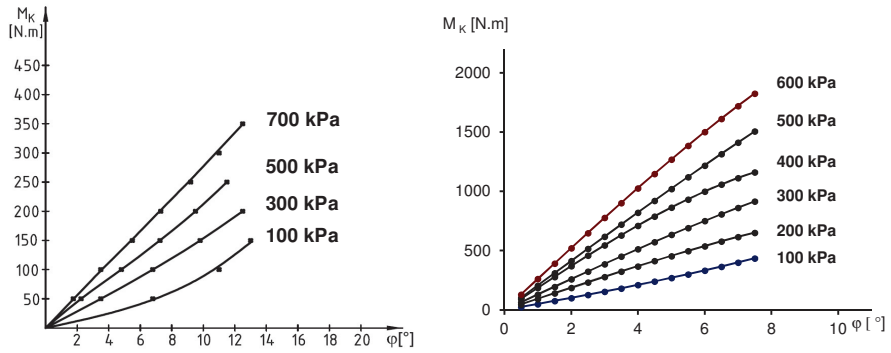


Figure 4. Investigated pneumatic flexible shaft couplings
a) - tangential, b) - differential

Conclusion

In comparison to classic flexible shaft couplings, pneumatic flexible shaft couplings are able to change their torsional stiffness. This gives us a possibility to change the resonant frequencies of torsional oscillating mechanical systems working in a wide rotational speed range even during operation. Therefore pneumatic flexible shaft couplings can be used as tuning device for torsional oscillating mechanical system [1-3].

Acknowledgement
This article was written within the framework of grant project VEGA 1/0528/20: „Solution of new elements for mechanical system tuning“;

REFERENCES

1. HOMIŠIN J.: Nové typy pružných hriadeľových spojok, vývoj - výskum – aplikácia, Košice, Vienala 2002.
2. HOMIŠIN J. GREGA R. KOPAS M.: New kinds of pneumatic flexible shaft couplings with low torsional rigidity. In: Transactions of the Universities of Košice : Research reports from the Universities of Košice. č. 1 (2007), s. 17-20. ISSN 1335-2334.
3. GURSKÝ P.: Prezentácia výsledkov statických a dynamických meraní základných vlastností rôznych typov pružných spojok. In: Acta Mechanica Slovaca. roč. 12, č. 3-c (2008), s. 65-70. ISSN 1335-2393.
4. GREGA R. KAŠŠAY P.: Porovnanie teoreticko-experimentálnych výsledkov extrému účelovej funkcie extremálnej regulácie. In: 48. Medzinárodná konferencia katedier častí strojov a mechanizmov 2007 : Zborník prednášok : Smolenice 12.-14.9. 2007. Bratislava : STU, 2007. s. 372-377. ISBN 978-80-227-2708-2.
5. TERPLÁN Z. NAGY G. HERCZEG I.: Mechanikus tengelykapcsolók, Budapest, Műszaki könyvkiadó 1966.