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SPRZĘGŁO WYSOKOELASTYCZNE ZE SPRĘŻYNAMI SPIRALNYMI NADAJĄCE SIĘ DO ZASTOSOWANIA W PRZEMYŚLE MOTORYZACYJNYM

Streszczenie: W pracy przedstawiono nowy typ sprzęgła opracowany przez autorów artykułu, w którego konstrukcji zastosowano sprężyny spiralne zapewniające jego wysoką elastyczność, a w rezultacie duży kąt skrętu, a także dobre własności tłumiące. Sprężyny cechują się dużą odpornością na „starzenie się" i wysoką wytrzymałością zmęczeniową. Tego rodzaju sprzęgła mogłyby znaleźć zastosowanie w budowie samochodów jako element dwumasowych kół zamachowych.

Słowa kluczowe: sprzęgło wysokoelastyczne, sprężyna spiralna, patent

HIGHLY-FLEXIBLE SPIRAL SPRING SHAFT COUPLING SUITABLE FOR USE IN AUTOMOTIVE INDUSTRY

Summary: Article presents a new shaft coupling design. Metal spiral springs as flexible elements allows to achieve large twist angle, low torsional stiffness, good damping properties and metal springs don't change their properties due to aging and fatigue. Presented coupling is suitable for use in automotive industry as dual mass flywheel.

Keywords: highly flexible shaft coupling, spiral spring, patent

1. Introduction

Flexible shaft couplings are used to provide flexible torque transfer which is ensured by use of metal or rubber flexible elements. In addition to transmitting torque, they

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also provide accommodation of radial, axial and angular misalignments of connected shafts, as well as damping torsional shocks and vibrations.
An important parameter of flexible shaft couplings incorporated in mechanical systems with periodically alternating torque is their dynamic torsional stiffness because it affects the natural frequency of torsional oscillation of the mechanical drive system [3]. In general, as the torsional stiffness of the flexible coupling decreases, the value of the natural torsional vibration frequency of the mechanical system decreases too. If some of the system's natural frequencies is equal to the excitation torque harmonic component frequency, then the system is in resonance. Such a state is undesirable for the mechanical system, since it increases the amplitude of the transmitted torque and thus increases the stress and noise of the mechanical system.
For tuning the mechanical system in terms of torsional vibration, it is necessary to select a flexible shaft coupling with a suitable dynamic torsional stiffness where in the whole operating speed range there is no resonance between excitation frequencies and natural frequencies. It seems advantageous to use a flexible shaft coupling with such a low torsional stiffness that, if possible, that all the natural frequencies of the system are lower than the excitation frequencies. The transition through resonance then occurs only during start-up and run-down, which, however, due to the speed of these transients, cannot cause any serious problem. Therefore, they tend to use flexible shaft couplings with the lowest possible torsional stiffness, the so-called highly-flexible shaft couplings. Such an approach is currently applied also to dual-mass flywheels used in automobiles, which are also characterized by a large twist angle and low torsional stiffness [1–2].
This article presents a new type of highly-flexible coupling to which a patent application has recently been filed [4] and a protection by means of a utility model has been given [5].

2. Proposed flexible shaft coupling

Highly-flexible spiral spring shaft coupling represents a new approach to achieve the lowest possible torsional stiffness of flexible shaft couplings. Spiral springs are manufactured in various designs, either as springs with a constant force or as springs with a given force characteristics depending on stroke.
Highly-flexible spiral spring shaft coupling (Fig. 1) consists of a driving *(1)* and a driven hub *(2)* flexibly connected via spiral springs *(3)*. The spiral springs are mounted between support surfaces *(4)* in two groups winding in opposite direction. The ends of spiral springs are the spiral springs are inserted into sockets *(5)* and their position is secured by adjusting screws *(6)*. A cover *(7)* is attached to the front of the driving disc, which prevents the windings of the spiral springs from popping out of the space between the support surfaces. The cover is fixed to the disc by screws *(8)* and washers *(9)*.
The torque between the driving and driven disc is transmitted by pressure at the contact points between the support surfaces and the windings of spiral springs. The proposed flexible coupling allows flexible transfer of load torque in both directions.
The use of metal spiral springs as a flexible element allows to achieve a large twist angle and thus low torsional stiffness. Low torsional stiffness is advantageous from the point of view of mechanical system tuning as well as for shock absorption. It is

also possible to achieve a desired load characteristic of flexible coupling by applying a suitable spiral spring.

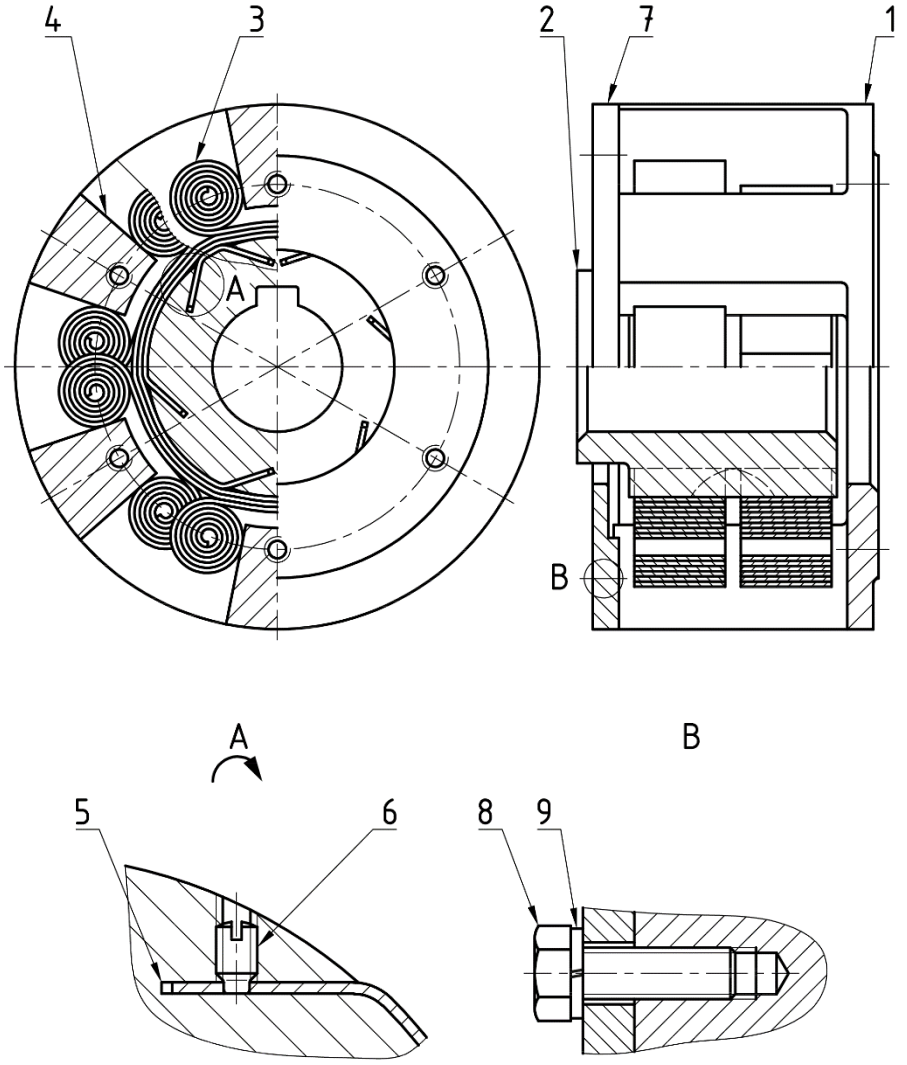

Figure 1. Highly-flexible spiral spring shaft coupling [4 -5]

When twisting, friction occurs at the contact surfaces between the winding of spiral springs and support surfaces, which increases the damping effect of the coupling necessary especially during start-up and run-down, to dampen the transient oscillation. The advantage of metal flexible members is also that they do not change their properties due to temperature, frequency of oscillation, as is the case with rubber elastic elements.

Conclusions

Highly-flexible spiral spring shaft coupling can be applied in systems of mechanical drives. The use of spiral springs as flexible elements allows us to achieve a high value of twist angle, low torsional stiffness and good damping properties. Finally, the metal springs do not change their mechanical properties due to aging and fatigue. Spiral spring flexible couplings will therefore increase the technical level and reliability of the mechanical systems in which it will be applied.

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