ELASTIC COUPLINGS WHIT DAMPING TO REDUCE THE SHOCKS AND VIBRATIONS AT EQUIPEMENTAND TO ENHANCE THEIR RELIABILITY

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ABSTRACT

This paper is a presentation of the new types of couplings with controlled elasticity and damping for the control, limitation and damping of shocks and vibrations associated to equipment and to enhance their reliability.

1. INTRODUCTION

The transfer of the rotation movement and of the torque moment in the process systems is requiring the coupling of the driven shaft to the resistant shaft between various equipment.

In many cases the operation regimes may lead to distortions of the equipment supporting structure they are coupled to and which in their turn, are generating overloads in the couplings between the driving shaft and the resistant shaft due to the occurred misalignment.

The installation of the equipment in the industrial units is often carried out with rather large radial and angular deviations between driving and driven shaft, deviations which may amplify during operation. Such deviations lead to the occurrence of some vibrations which generate large stress in the equipment shafts and bearings as well as an accelerated wearing-out or even the complete damage of the equipment.

To avoid the loads caused by the shaft deviations (that might be due to installation errors, bearing warning-out or distortions of the supporting structure) this research-development paper is presenting the results obtained with a model of elastic coupling which can overtake large deviations with small additional mechanical loads, without generating vibrations.

The new types of couplings can be practically made for any diameter of shafts and for any transferred torque moment sine their construction is relatively simple. Some alternatives of elastic couplings may overtake and transfer axial forces simultaneously with torque moments.

2. ELASTIC COUPLING HAVING HELICAL SPRINGS AS ELASTIC ELEMENTS

SERB-ARC Coupling (Fig.1) is made of two cylindrical concentric parts provided between them with elastic elements in the form of helical springs symmetrically installed at the separation surface between the two parts, in cylindrical housings. A clearance, function of the size of the deviations overtaken by the coupling, are provided between the two parts.

The overtaking of the torque moment and of the deviations between the driving shaft and the resistance shaft is accomplished by the radial compression load of the helical springs.

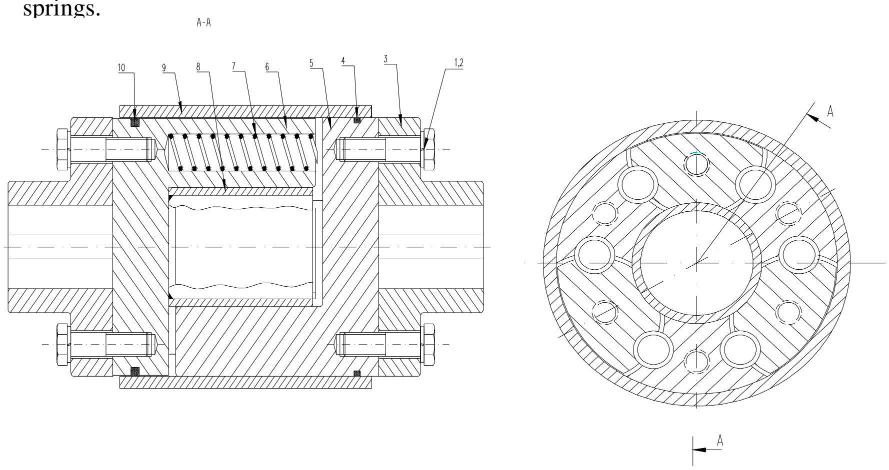

Fig 1. SERB-ARC-01 type coupling – longitudinal and cross section

SERB-CAR-01 Coupling (Fig.2) is made of two cylindrical concentric parts provided between them with elastic elements in the form of reinforced rubber tubes or sticks, usually with helical springs symmetrically installed at the separation surface of the two parts, in cylindrical housings.

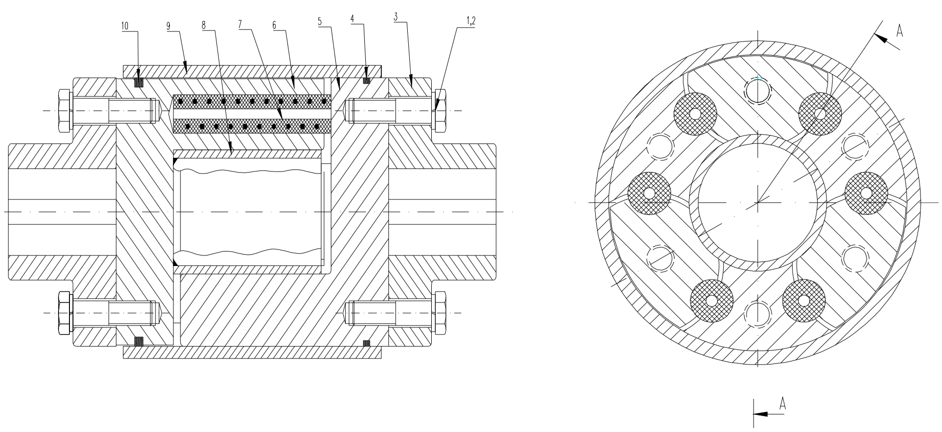

Fig.2. SERB-CAR-01 type coupling – longitudinal cross section

The overtaking of the torque moment and of the deviations between the driving shaft and the driven shaft is accomplished by a radial and shearing compression load by the reinforced rubber tubes/sticks.

SERB-CAR-02 coupling (Fig.3) is made of two cylindrical concentric parts provided between them, with elastic elements in the form of rectangular reinforced rubber blades, usually with a spring steel mash, symmetrically installed at the separation surface between the two parts, in cylinder segment housings.

The overtaking of the torque moment and of the deviations between the driving shaft and the resistant shaft is accomplished by a normal compression load of the reinforced rubber rectangular blades.

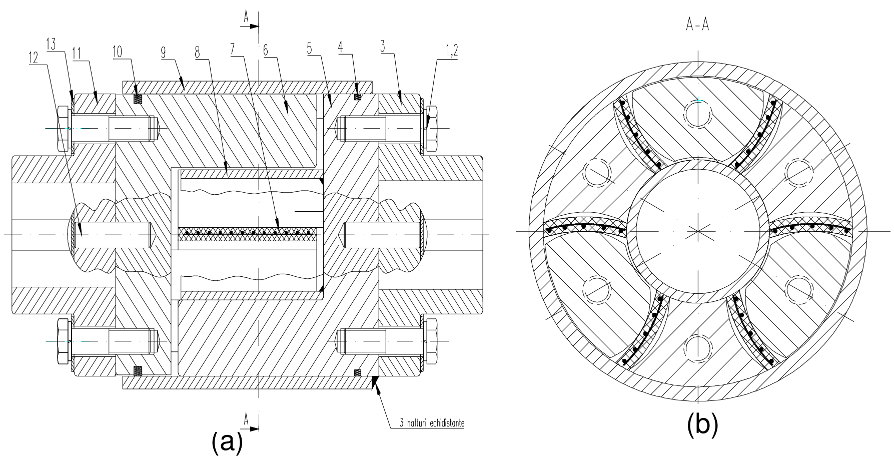

Fig. 3. SERB-CAR-02 type coupling – longitudinal section (a) and cross section (b).

SERB-CAR-03 coupling (Fig4) is made of two cylindrical concentric parts provided between them with elastic elements in the shape of reinforced rubber corrugated blades, usually with a spring steel mash, symmetrically installed at the separation surface of the two parts.

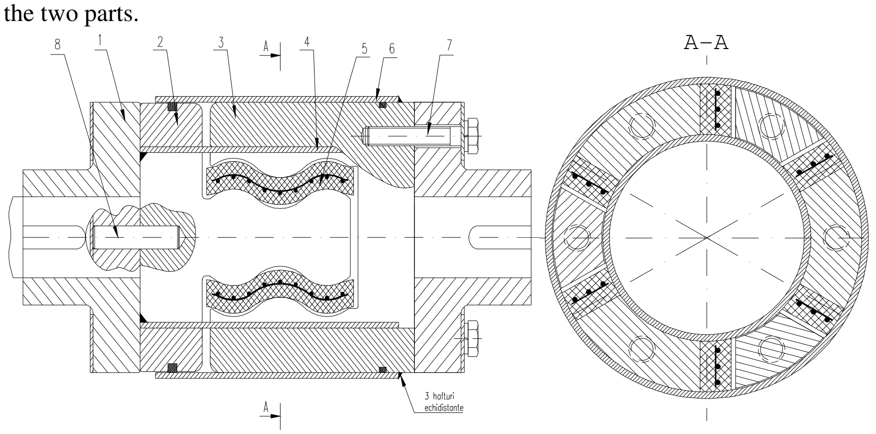

Fig. 4. SERB-CAR-03 coupling – longitudinal and cross section

This type of coupling is capable to elastically overtake and damp the torque moments and axial forces.

SERB-LEL-01 coupling (Fig.5) is made of two cylindrical concentric parts provided between them with elastic elements in the form of a steel elastic blade package symmetrically installed at the separation surface of the two parts, in cylindrical housings.

The overtaking of the torque moment and of the deviations between the driving shaft and the driven shaft is accomplished by the distortion load of the elastic blade package.

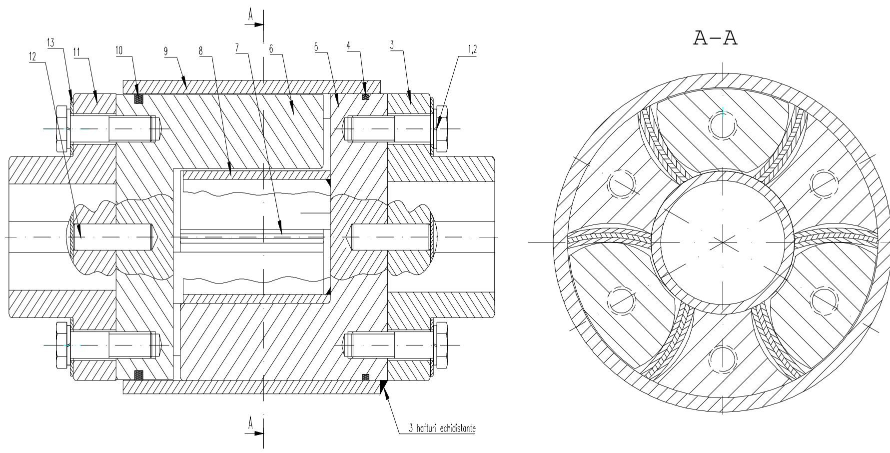

Fig. 5. SERB-LEL-01 type coupling – longitudinal) and cross section.

SERB-LEL-02 coupling (Fig.6) is made of two cylindrical concentric parts provided between them with elastic elements in the form of a steel corrugated blade package symmetrically installed at the separation surface of the two parts, in cylindrical segment housings.

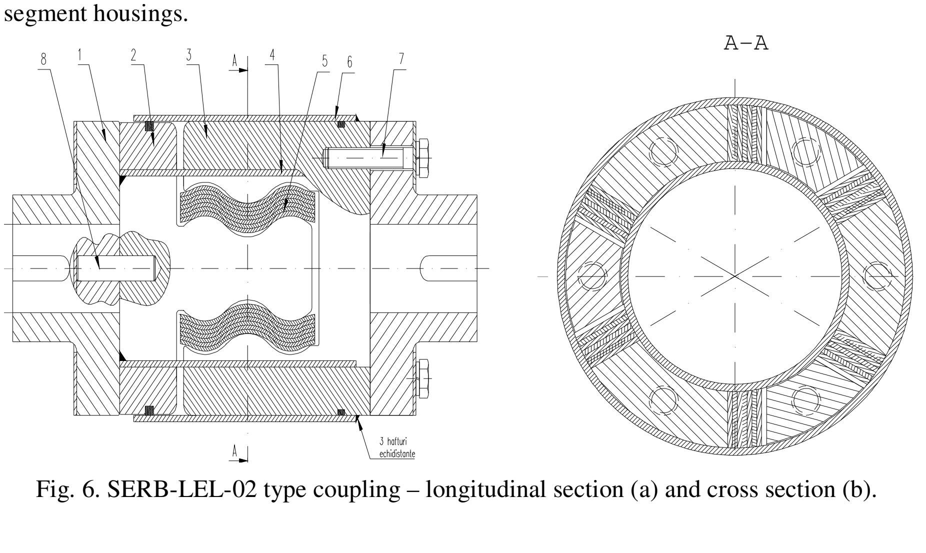

Fig. 6. SERB-LEL-02 type coupling – longitudinal section (a) and cross section (b).

The overtaking of the torque moment and of the deviations between the driving shaft and the driven shaft is accomplished by the distortion load of the corrugated elastic blade package. The coupling is capable to elastically overtake with damping the torque moments and axial forces.

3. RESULTS AND CONCLUSIONS

In the research activity, SITON designed the prototype of SERB-ARC-01, SERB-CAR-01, SERB-CAR-02, SERB-CAR-03, SERB-LEL-01, SERB-LEL-02 coupling and SIGMA SS manufactured one prototype for SERB-ARC-01 and two prototypes for SERB-LEL-01 and the obtained results showed the following advantages:

- the coupling can be installed and dismantled without requiring the dismantling of the equipment (electric motor, pump, fan, etc);
- the coupling is not generating overloads and vibrations on large radial or angular deviations between the driving shaft and the resistant shaft;
- the vibrations generated by one of the equipment it is coupled to (e.g. electric motor, pump, fan, etc) are not transferred to the other equipment and they are attenuated by the coupling damping;
- the coupling may be installed and operational upon reliable and safety conditions including high explosion risk environments;
- the coupling is not requiring special technologies and machining for to be made since the coupling is robust and reliable;
- the coupling requires no maintenance .

Fig.7. SERB-LEL-01 type coupling prototype

Fig.8. SERB-LEL-01 type coupling prototype

To determine the stiffness characteristics, experimental determinations on packages of elastic blades) on the elastic coupling were conducted.

The diagrams of the force-distortion and moment/rotation angle experimentally determined are also presented in Fig. 10. By the modification of the elastic blade thickness one may obtain an important variation of the stiffness and damping of the coupling for the same size of coupling (see Fig. 10 and Fig.11).

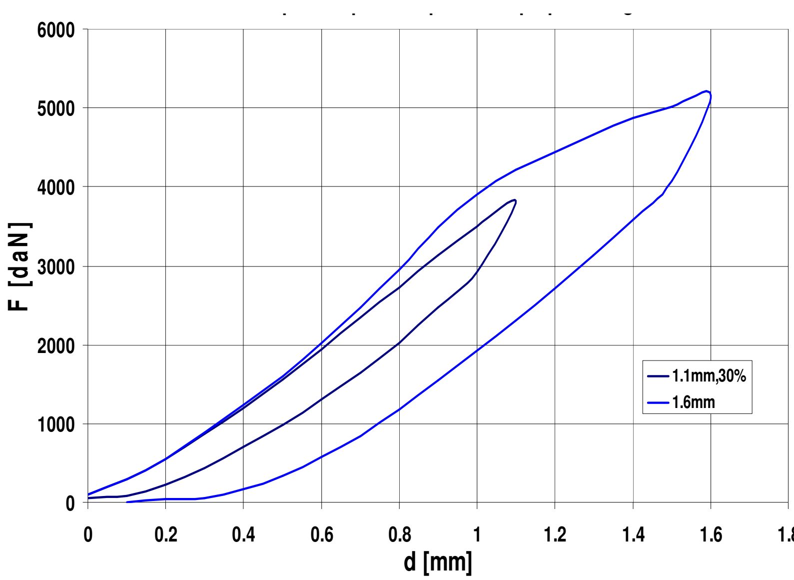

Fig. 10. The force-displacement characteristic for 6 elastic blades of 1 mm thickness

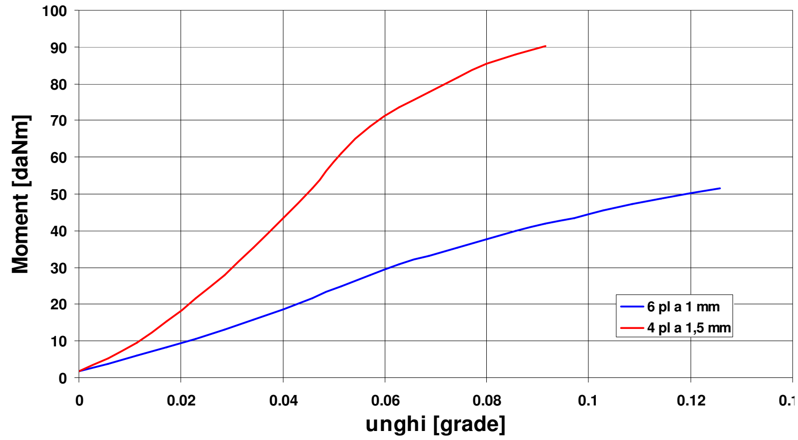

Fig. 11. The moment- angle characteristic for various sets of blades of different thickness.

4. REFERENCES

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