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THE EXPERIMENTALLY DETERMINATION FOR THE ELASTIC AND SAFETY CLUTCH

Engineering

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ABSTRACT

The paper presents the role and importance of testing simple mechanical couplings with multiple functions, elastic and safety couplings. The function, the theoretical characteristics and the operating principle of an elastic safety coupling are also presented. This mechanical coupling represents a new type coupling, which by its simple functions, performs the functions of a combined coupling. The elastic and safety coupling presented in the paper is a coupling with the equatorial cam and the degenerate fasteners in elastic lamellae elements, rubber shoes, and helical compression springs. The static and dynamic experimental characteristics necessary for analyzing the representative influences of the geometrical and functional parameters on the dynamic behavior of the clutch are presented. The paper finally presents the conclusions regarding this new type of mechanical coupling with multiple functions.

KEYWORDS

clutches, elastic, safety, simple, multiple functions

INTRODUCTION

The elastic couplings are characterized by the property of taking torsional shocks and vibrations by storing kinetic energy when a functional disturbance of the mechanical transmission occurs. By combining these functions, we obtain combined couplings that have the role of performing those functions necessary for a correct operation and at the parameters imposed by the design of the kinematic chain of the mechanical transmission.

The research carried out aimed at obtaining those couplings, which by combining the simple functions to perform the functions of a combined coupling, but with a low degree of complexity, of the type of a simple coupling, it is a simple coupling. Representative functions. A condition imposed on elastic clutches is that when an element is broken, the clutch does not fail immediately. If there is only one elastic element, the total rupture of the clutch, in the case of partial fractures or cracks, must be deducted. Another prerequisite for elastic clutches is that the fast-destructible elastic elements can be easily replaced - if possible without disassembling the clutch or axial displacement of the axle rod. The paper presents the theoretical and experimental characteristics for the elastic and safety clutches with flat pads figure 1, [1] [2] [3].

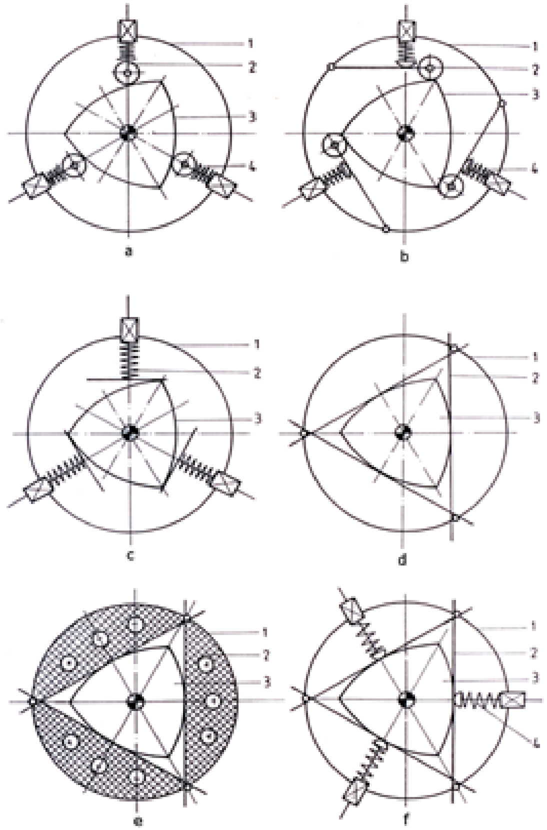

Figure 1: structural patterns of the coupling

Elastic and safety clutches are characterized by the following representative functions [2] [3]:

- it makes the connection between two shafts (with fix or variable relative position) and it ensures the transmission of the moment and of the rotation velocity between shafts;
- the strength transmission is interrupted when the resistant moment autumns an imposed limit value;
- the interruption of the energetic wave it's being realize basis on an elastic element deformation (when the deformation achieves the value which correspond to the limit moment, the connection between the semi clutches will be interrupted).

The clutch has in his component the equiangular cam 3, which represents a semi clutch; the second semi clutch it's constituted from flange1 and degenerated followers in elastic elements 2 (lamellar bow, elicoidal bow, and rubber shoes).

The charge is being transmitted from one semi clutch to the other through the degenerated followers. The pushing force of the degenerated followers is given by the compression helicoidally bows, by lamellar bows and rubber elements. When the limit torsion moment, which can be transmitted by the clutch, is over ful field, between the semi clutches appears a relative rotation movement, which allows the charge interruption of the mechanical transmission.

EXPERIMENTAL DETERMINATIUN ON ELASTIC AND SAFETY CLUTCHES IN STATIC MODE

Solving the objectives presented above, under static test conditions, involves: Tracing the elastic characteristic of the torque as a function of the relative rotation angle between semi-couplings, for different position deviations of the semi-couplings.

There are presented, for different constructive variants of elastic and safety couplings, the static characteristics of these couplings The static diagrams corresponding to the couplings are presented:
a - with degenerate spots in multilamellar arcs;
b - with degenerate studs in rubber springs in the form of shoes;
c - with degenerate patches in multilamellar springs and helical compression springs.

The studied couplings have the same type of cam (with three protrusions) and the same dimensions of gauge, circle-shaped profiles not matched.

The following figures show the elastic characteristics for the three variants of elastic and safety couplings: superimposed characteristics of the three couplings, to facilitate comparative analysis, figure 2.

M_t [N mm]

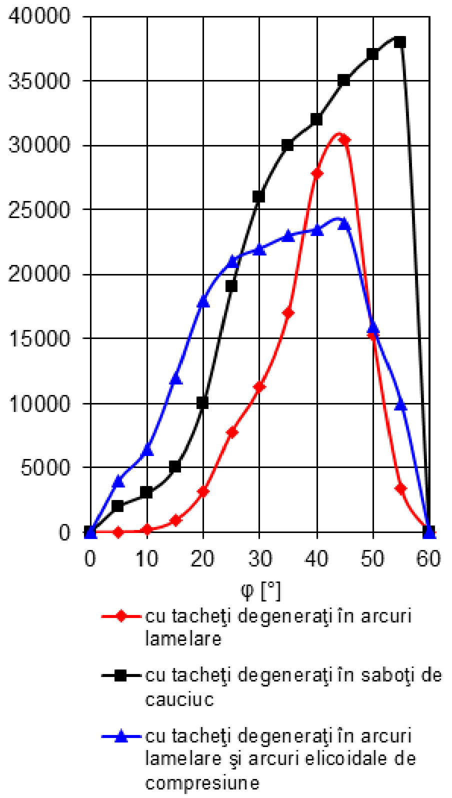

Figure 2: static experimental features for elastic and safety coupling structural

From the comparative analysis of the obtained characteristics, the following significant appraisals emerge:

the characteristics are progressive;

the couplings have a high elastic deformation capacity, with the relative turning angle depending on the number of profiles of the cam;

due to the high elasticity, the couplings have a great capacity to cushion the shocks and torsional vibrations;

the coupling with rubber shoes transmits higher torque moments;

the introduction of the compression coil springs modifies the relative rotation angle between the semi-couplings, for the same torque transmitted;

the coupling with multilamellar springs and the one with helical compression springs transmit torque at a relative rotation angle between semi-couplings up to 45o, and the one with rubber shoe up to 55o, after which the load uncoupling takes place without large shocks.

Figure 3 shows the experimental characteristics of static combined deviations for elastic and safety coupling with degenerate fasteners in lamellar arcs.

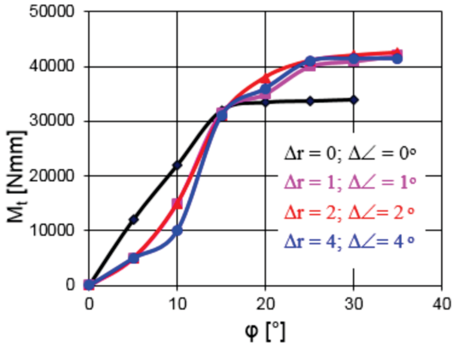

Figure 3: combined deviations

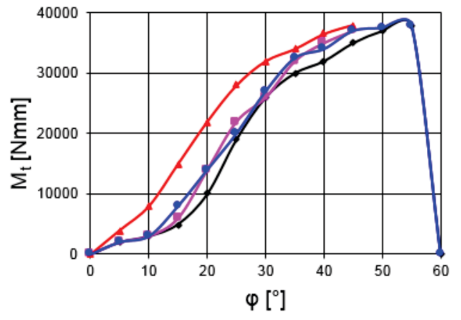

Figure 4: combined deviations

Figure 4 shows the static experimental characteristics for the elastic and safety coupling with degenerate stains in rubber shoes.

Figure 5 static experimental characteristics for elastic and safety coupling with degenerate patches in lamellar springs and compression coil springs.

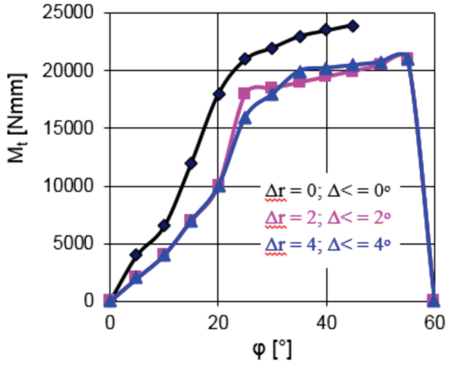

Figure 5: combined deviations

By analyzing the graphs figure 3, the following conclusions can be drawn:

- the characteristics are progressive, depending on the number of blades in the multilamellar arcs;
- the rigidity is different depending on the number of blades;
- The theoretical characteristics are close to the experimental ones, taking into account the calculation hypotheses;
- in the adopted calculation premises, the theoretical characteristics satisfactorily approximate the expressed curves;
- the introduction of the coil springs modifies the rigidity of the coupling.

Analyzing the graphs in figure 4, the following conclusions can be formulated: the characteristics are progressive; the rigidity is very close to the maximum torque that can be transmitted.

The study of the graphs in figure 5 leads to the following conclusions: the elasticity increases for the radial and combined deviations, and for the angular deviations the rigidities are approximately equal.

From the comparative analysis of the presented graphs it follows that the radial, angular and combined deviations do not significantly change the reference characteristic of the tested coupling. The elastic and safety coupling can take axial deviations depending on the dimensions of the cam, respectively of the multi lamellar springs.

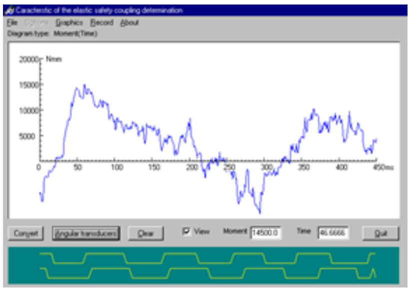

Figure 6: Transmission startup

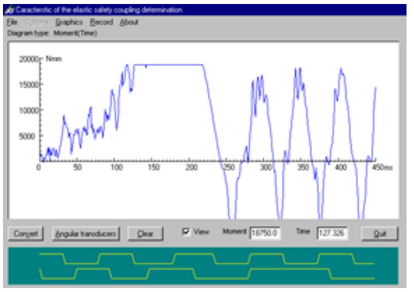

Figure 7: Transmission load decoupling

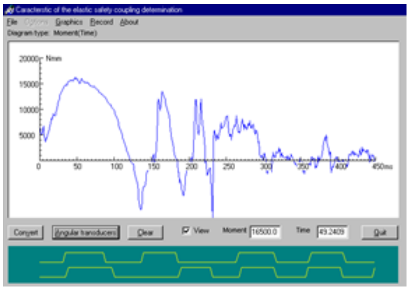

Figure 8: Stopping the transmission

Several representative test regimes are established and the corresponding diagrams are illustrated.

Starting: with a resistant moment consisting of the moment of inertia and a moment to be transmitted in load of 5000 Nmm. The diagram of this Mt (t) regime is shown in Figure 6. The resisting moment increases follows an oscillating variation of it, specific to the damping of the starting shock, after which the moment stabilization takes place.

Shock load decoupling: of 18750 Nmm, in a time interval of 127 ms and the maintenance of the shock for 93 ms is shown in figure 7. In this request regime repeated decoupling takes place, this situation requiring the immediate removal from operation of the transmission.

Stopping the stand: shown in figure 8, it is made for a torque of 10000 Nmm, the stop shock producing an oscillation of the resistant moment of 14875 Nmm, over a time interval of 146 ms; resetting the resisting moment occurs after 450 ms.

CONCLUSIONS

Following the study and analysis of the experimental, static and dynamic determinations, on the elastic and safety coupling with degenerate fasteners in multi lamellar arcs, the conclusions presented below have been established.

- The characteristics of elastic and safety couplings are progressive.
- Couplings have a high elastic deformation capacity.
- The relative twist angle between the semi-couplings depends on the number of cam profiles.
- Due to the high elasticity, the couplings have a great capacity to cushion the torsional shocks.
- The blades can take radial deviations, angular deviations, axial deviations.
- Starting and stopping is done without major shocks.
- Load decoupling during overloads or defects of the transmission is done without the destruction of the elastic elements and without additional shocks.

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