ELASTIC AND SAFETY CLUTCHES WITH INTERMEDIATE RUBBER ELEMENTS

STROE Ioan
"Transilvania" University of Braşov, e-mail stroei@unitbv.ro

Key words: clutches, elastic, safety, function, simple.

Abstract: The modular design imposes finding the optimal solutions from constructive and functional point of view. The constructive design must be correlated with the technological one. Thus, it is possible to obtain mechanical components with reduce building limit and weight, with high durability and small price. In this context, the present paper presents the conceiving and the design of a new clutch with multiple functions, the elastic and safety clutch. This type of clutch combines the functions of elastic and safety clutches, and it will be denoted as elastic and safety clutch with metallic roles and elastic rubber elements.

1. INTRODUCTION

In general expression, by mechanical clutch it's understand a technical system which makes the bundle between two shafts, with relative fix and relative variable position and it ensures the unmodified transmission of the torque and of the rotation moment between the shafts; the bundle between the shafts realized by the clutch, must also ensures the power transmission in the condition of the existence of meaningful linear and/or angular deviations.
The elastic clutch could take over, overloads up to a certain torque value. Over this value, when the transmission is not provided with a load disengagement system, the elastic elements of the clutch are destroyed, this corresponding with the placing of transmission out of the operation.
The safety clutch fulfils (besides the main function of the torque transmission) the function of torque limitation or automatic interruption of the connection between the coupled shafts, in the case of some overloads' occurrence, during the performance. The safety clutches assure the transmission performance up to the limit torque value, for what the safety elements are designed. Over this value, it appears the relative slipping between the semi-clutches, which involves the mechanical transmission protection. Taking the data above into consideration, it results the necessity of some clutches, that by the associated functions to allow the load disengagement before that the elastic elements to be destroyed.
In the case of diverse applications, there can be combined the simple functions, obtaining a combined coupling. In this case, the combined coupling is obtained by the connection, of two or more simple clutches, in a certain manner, on purpose to accomplish accordingly the imposed complex functional role of mechanical transmission [1], [2].

2. THE STRUCTURAL SCHEME OF CLUTCH

The paper presents a new type of clutch named "Elastic and Safety Clutch", that can accomplish the functions of an elastic and of a safety clutch, but which is not a combined clutch [3], [4]. The angle of relative rotation between the two semi-clutches depends on the number of rolls.
The elastic and safety clutches are characterized by the following functions [3], [4] (functional and technical criteria):

- they make the bundle between two shafts (with relatively fix variable position) and ensure the moment transmission and the rotation motion between the shafts (according to the general definition);

- the power transmission is braked off when the resistive moment outruns an imposed limit value;
- the braking off of the energy flux is realized on the basis of an elastic element deformation.

Out of the analysis of the properties corresponding to the elastic and safety clutches, a distinctive importance goes to the elastic element modelling, in order to ensure the automated braking off every flux, at the torque limit value.
Figure 1 presents the structural schemes of now the elastic and safety clutch. The clutch is part from a new family of clutches which combines the functions of the elastic clutches with the ones of the safety clutches - Figure 1, [4].
The clutch has in its structure a cam which is degenerate in an element with multiple metallic roles (3 in Figure 1), radial disposed, slipping mounted on the bolts; the followers are degenerate in multiple rubber roles (2 in Figure 1), equiangular disposed.

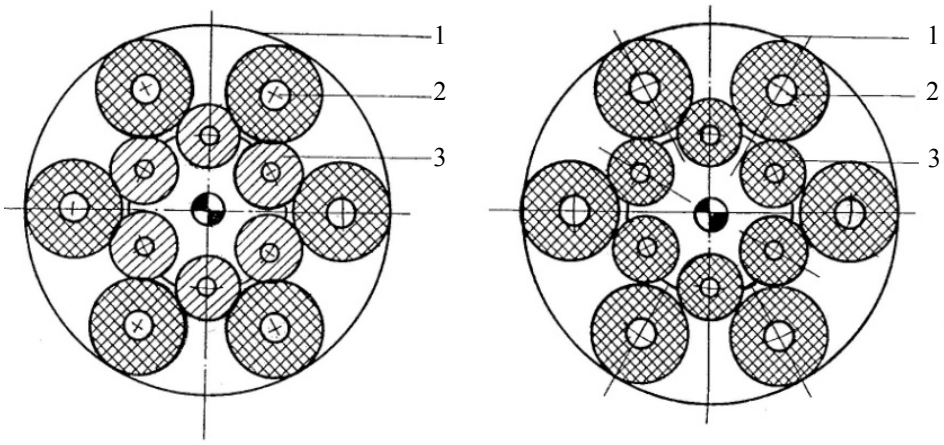

Fig.1 The structural scheme of three – elastic and safety clutches – variants

Figure 2 presents the elastic prototype of the elastic and safety clutch with metallic roles. The characteristic of the clutch is determined statically by fixing the semi-clutch 1 and applying different loads to the semi-clutch 2.

Fig.2 Elastic and safety clutch with metallic roles and elastic rubber elements.

3. DETERMINATION THE TORQUE MOMENT OF THE ELASTIC CHARACTERISTIC

The elastic and safety clutches are characterized through a variable rigidity (nonlinear characteristic) – relation (1) – and the protection condition of the mechanical transmission is expressed with relation (2).

$$k(\varphi) = \frac{dMt(\varphi)}{d\varphi} \tag{1}$$

$$M_{t\,lim}(1+\Delta) \le M_{t\,max\,a} \tag{2}$$

Where:
k – the clutch rigidity; φ – the relative rotation angle of the semi clutches; $M_t(\varphi)$ – the torsion moment which corresponds to the clutch deformation with angle φ; $M_{t\ lim}$ – the moment when is produced or is ended the decoupling; $M_{t\ max\ a}$ – the maximum torque moment that is admitted by the resistance of the weakest element of the clutch; Δ – the relative error of the safety clutch.
Figure 3 presents the geometrical model for the torque determination moment.
The torsion moment that can be transmitted by the clutch is given by equation (3), while the relative torsion angle between the two semi-clutches is given by equation (4).

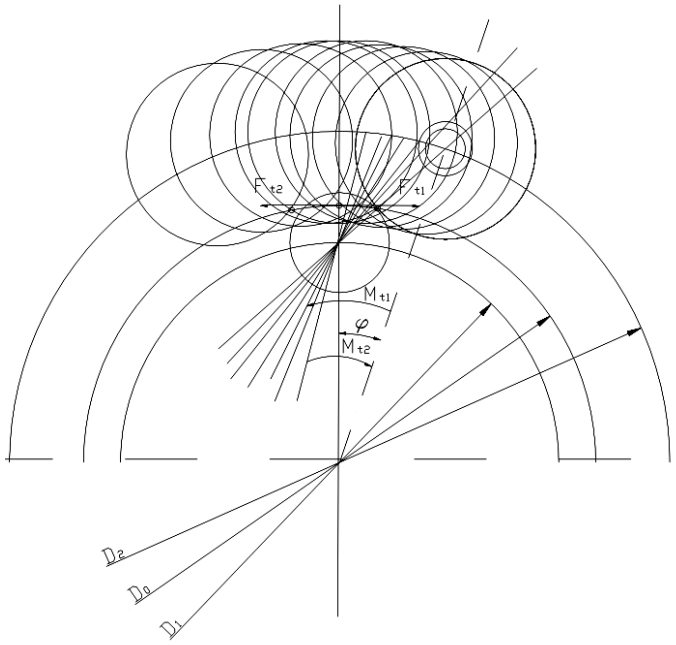

Fig.3 Geometrical model for the torque moment determination

$$M_{tcap} = \frac{1}{2} D_0 z A_0 E_1 \left(\frac{\varphi_{max}}{\frac{2h}{D_0} - \varphi_{max}} \right) \ge M_{tc} \tag{3}$$

$$\varphi = \frac{2M_t h}{D_0 \left(M_t + \frac{1}{2} D_0 z A_0 E_1 \right)} \tag{4}$$

where:
D_0 – the winding diameter of the rolls in the relative motion between the semi-clutches;
z – the number of rolls equiangular dispossed;

A_0 – initial section surface of the rubber elastic elements;
E_1 – the elastic moduls of the elastic element in pre-compressed state;
h – the thickness of the elastic element in post-compressed state.
Figure 4 presents the characteristic of the clutch is determined statically by fixing the semi-clutch 1 and applying different loads to the semi-clutch 2.

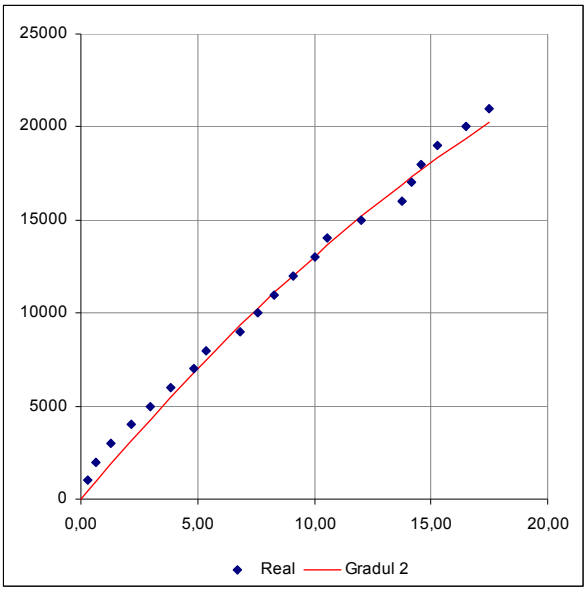

Fig.4 The elastic characteristic of the clutch

4. CONCLUSIONS

The elastic and safety clutches with metallic roles and elastic rubber elements present the following advantages:

- the clutches ensure the limitation and the adjustment of the transmitted moment;
- the clutch can take over technological and assembling deviations;
- the clutch allows the damp of the torsion shocks transmitted in different transient regimes of the mechanical transmission;
- the clutch has a progressive characteristic and depends on elasticity of the rubber elements;
- the relative torsion angle between the semi-clutches depends on the number of roles.

5. REFERENCES

[1] Drăghici, I., s.a.: Calculul şi construcţia cuplajelor. Editura Tehnică, Bucharest (1978)
[2] Pampel, W., Kupplungen, Band I Berlin, VEB Verlag Technik, 1959.
[3] Stroe, I., Jula, A., Chişu, E.: Elastic and Safety Clutch, Invention Brevet no. 41957/1210. - National Institute of Brevets and Inventions, Bucureşti, Romania, 1994.
[4] Stroe, I.: Contribuţii teoretice şi experimentale privind conceperea şi modelarea unei noi clase de cuplaje cu funcţii multiple – Cuplaje elastice şi de siguranţă. Ph.D. Thesis, Transilvania University of Braşov, 1999.