CALCULATION THE TORQUE MOMENT OF THE CLUTCH ELASTIC AND SAFETY ROLLER. PART I

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Keywords: clutch, elastic, safety, multiple functions.

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

The main function of the clutches is characteristic to all of them and is the function of transmitting the motion and the torque moment. The other functions, specific to each clutch type are: the motion commanding, the load limitation (with or without interrupting the kinematic flux), the protection against shocks and loads; the compensation of assembling errors; the compensation of the errors which can appear during working; the limiting of revolution; the one-sense transmission of the motion. All of these functions can appear singularly or concomitantly.

These clutches are denoted as simple clutches – which constitutes simple units from structural point of view and which cannot be divided in more simple units [1, 3]. In many cases, the mechanical transmissions need multiple functions in order to work in optimal conditions and parameters. To obtain multiple functions, combined clutches are used. These clutches are obtained by connecting (usual, series connection) two or more clutches which - in this constructive shape – will adequately fulfil the complex functional role imposed by the transmission. By analysing the speciality literature it is discovered that in the machine manufacturing domain, the use of the combined functions of elastic clutches and safety clutches is frequently required and/or needed. Because combining the two types of clutches leads to a high complexity degree (from both technical and economical point of view), the necessity of conceiving a new type of clutch which joints the two groups of functions (safety and elasticity) is required. The new clutch will have from the constructive point of view a reduced complexity, similarly to a simple one [1, 3, 4].

2. ELASTIC AND SAFETY CLUTCH

Figure 1 presents the structural schemes of now the elastic and safety clutch. The clutch is part from a new family of clutches [4, 5, 6, 7, 8] which combines the functions of the elastic clutches with the ones of the safety clutches.

2.1. CONSTRUCTION OF THE CLUTCH

Starting from the structural schemes and from the representative functions and proprieties, of the elastic and safety clutch, the next criterions of constructive generation can be formulated:

- the clutch must absorb radial and angular tilts;

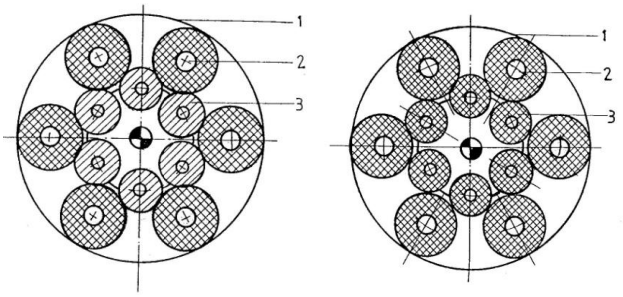

Figure 1. The structural scheme of the new type of clutch.

- the relative movement between the semi clutches, as well as the releasing must be made without shocks;
- the clutch must have a reduce rigidity; it is suggested a characteristic $M_t(\varphi)$ with a rising inclination and a big damping capacity ;
- the elasticity of the clutch could be modified, by changing or adding constructive elastic elements;
- when the clutch is turning around, big axial forces does not appear;
- the clutch must not break down when an elastic element is destroyed ;
- the elastic constructive elements, that can be destroyed fast, must be replaced fast; if it is possible without demount the clutch;
- the changing of the rotation sense must be permitted without duty cycle; for the safety enlargement in running the component elements of the clutch must not have protuberances.

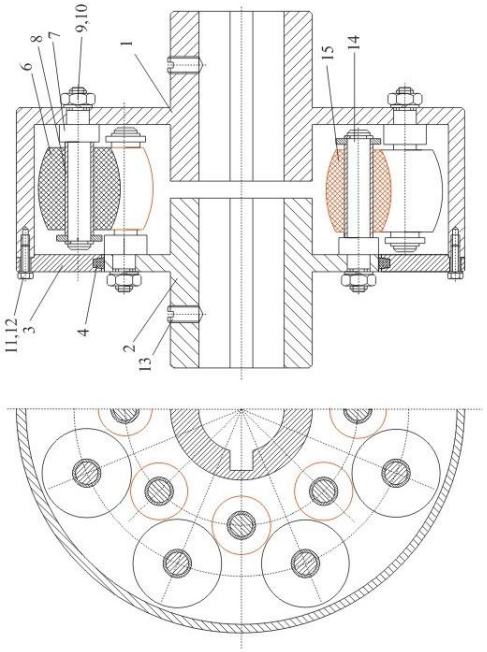

Figure 2. The design of the clutch

The constructive solution allows the pretension adjustment without taking to pieces the clutch, Figure 2 [4, 5, 9]. The connection between the two semi-clutches 1 and 2 is realized through the rubber roles 6, which are fixed on bolts 7 using antifriction mechanical sleeve 8. The charge is transmitted from semi-clutch 1 to semi-clutch 2 through (throughout) the rubber roles 6 and the rubber roles 15.

Task 2 is transmitted from the coupling parts coupling parts 1 through rubber rollers 15 (coupling parts 2), in contact with elastic rubber rollers 6 (coupling parts 1). The coupling operation are two important phases: the first phase, which corresponds to a normal functioning mechanical transmission, rubber rollers will wrap each with a relative motion between the two coupling instead, the second phase corresponds to a transmission overloads beyond permissible, since the relative motion of the coupling parts swell, deform elastic elements stronger, which leads to breaking the transmission of torque.

Figure 3. The design of the clutch

2.2. THE TORQUE MOMENT OF THE CLUTCH

Figure 4 presents the geometrical model for the torque determination moment [9].

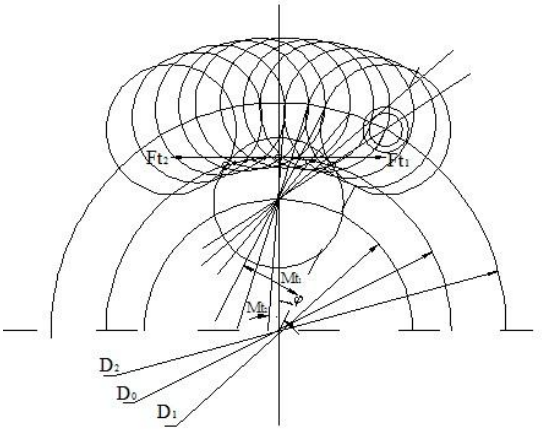

Figure 4. Geometrical model for the torque moment determination.

- **Computation of the elastic and safety clutch rubber roller**

$$M_{t\,max} = \frac{1}{2} D_0 z (d_1 + d_2) l \sigma_{as} \tag{2.1}$$

$$M_{tcap} = \frac{1}{2} D_0 z l (d_1 + d_2) E_1 \left(\frac{\varphi_{max}}{\frac{h_1 + h_2}{D_0} - \varphi_{max}} \right) \geq M_{tc} \tag{2.2}$$

where:
z - number of rollers located echiunghiular,

d1 - diameter bushings rubber or polyurethane bushings for the two coupling parts,
d2 - diameter rubber bushings of the coupling parts 1,
E1 - modulus of elasticity of the elastic element in prestressed state,
h1 - the height of the compression rubber bushings or polyurethane bushings for the two coupling parts,
h2 - height of the rubber bushings compress the coupling parts 1,
φ - angle of rotation relative to the coupling half.

- **Calculul de verificare**

$$\sigma_s = \frac{2M_{tc}}{D_0 zl(d_1 + d_2)} \leq \sigma_{as} \quad (2.3)$$

$$\sigma_{as} = 5...7MPa \quad (2.4)$$

3. CONCLUSIONS

Constructive solution of elastic and safety clutch set has the following advantages:

• ensure the compensation of deviations axial, radial and angular, within relatively large;
• provide good torsional damping shock and vibration by phone contact between: elastic elements led cam coupling parts degenerate, the rubber rollers of the two coupling parts;
• provide relative rotation between the two coupling parts according to the nature and arrangement of elements of the coupling half, above the permissible limits, elastic coupling is one of safety;
• limits the torque able to be transmitted;
• couplings shown are simple construction, small dimensions and low cost compared to the combined meeting the same functions.

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