Universitatea Transilvania din Brașov

HABILITATION THESIS
SUMMARY

DETERMINATION AND DESIGN OF SIMPLE   CLUTCHES WITH MULTIPLE FUNCTIONS

Domain: MECHANICAL ENGINEERING

Author: Prof. Dr. Eng. Ioan STROE

University: Transilvania University of Brașov

BRASOV, 2016

The habilitation thesis entitled "The determination and the design of the simple clutches with multiple functions" presents the author's contribution to the field of theoretical, experimental and applied research after obtaining the PhD title in the year 2000. The present paper is structured in three sections. The first section, entitled "Scientific and professional achievements" follows the main directions: the first part includes the research done in the field of mechanical clutches with respect to the determination and the design of simple clutches with multiple functions; in the second part the research done in the field of sensors that are based on the principle of electric tensometry is presented. The second section deals with future plans for career evolution and development, and the third section includes the bibliography.

In Chapter 1 the simple functions of the mechanical clutches are introduced. By combining these functions the clutches can be classified. Based on this classification the possibility of obtaining a new clutch type by combining the simple functions is presented − the elastic and safety clutch.

The second chapter of the thesis presents the systematization criteria and subcriteria for the mechanical clutches, and based on these defined criteria, the topological generations of the clutches is introduced. Through the topological synthesis carried out novel topological versions were identified and all the known main topological versions were found. Through the research realized on the new clutch type, the elastic and safety clutch, two important issues were addressed: proposing a procedure that can enable the derivation of structural schemes from the topological versions obtained; the identification and systemization, based on the proposed procedure, of the representative structural schemes that can be applied to the elastic and safety clutch.

In Chapter 3, starting from the results obtained, a method of passing from structural to the design schemes is presented. Firstly, the main criteria used to generate the design versions from a given structural scheme are formulated. The design generation criteria are defined for calculating and designing the elastic and safety clutches. Based on these criteria, examples of ten design versions from the new version of elastic and safety clutch are given, as well as their design calculations. For each of the ten versions the calculation schemes necessary for the determination of the torque, that the clutch can transmit, and the elastic and safety characteristic are elaborated.

The fourth chapter has as objective the dynamic modelling of the elastic and safety clutch, found in a mechanical transmission. The equivalent calculations scheme is generated and a dynamic analysis algorithm is prosed, that includes: formulating the dynamic modelling problem; the static and kinematic modelling of the clutch; modelling the correlations induced by the mechanical characteristics of the engines and actuators; modelling the motion of the semiclutches by means of the Lagrange equations of the second kind. The next step is

represented by the numerical simulation of the dynamic behaviour under representative working regimes, after which the conclusions regarding the dynamic modelling of the elastic and safety clutch are given.

Chapter 5 presents the experimental determinations made on the elastic and safety clutch. The aim of testing these types of clutches is to evaluate the performances that the proposed solutions are capable of delivering, and to verify the mathematical model proposed for describing the kinematic and dynamic behaviour. This also gives the possibility of validating the design and technological solution taken into account and, implicitly, the new application directions and solutions are identified. Consequently, this chapter has the following objectives: experimental determinations on the elastic and safety clutch under static regime; experimental determinations on the elastic characteristic of the elastic and safety clutch under dynamic regime; drawing conclusions regarding the testing made on the elastic and safety clutch.

The 6th chapter, "The study of the influence of the composing elements of the clutches on the torque and on the elastic characteristic", presents theoretical characteristics of the elastic and safety clutch with flat pusher and compression coil spring. By modifying the geometrical parameters and the stiffness, as well as the initial deformation of the compression coil springs, various theoretical characteristics of the studied clutch are generated.

In Chapter 7 the ten design versions of the considered elastic and safety clutches are presented. Taking into account the results discussed in the previous chapters, design algorithms for these design versions were elaborated. Based on the algorithms some types of clutches were designed.

Chapter 8 presents the conclusions of each chapter as a result of the conducted studies. After analysing design aspects and the influence of various design and control parameters general conclusions were drawn.

In the second part of the thesis, entitled "Scientific and professional achievements", scientific papers by the author in the domain of robotics sensors are presented.

Chapter 9 presents a 3D tactile sensory system. These sensors have an important function in robotics applications based on gripping. Tactile sensory systems are designed to interact with object of different sizes that need handling.

Chapter 10 presents the Sensory system for force and torque determination on three directions. The studied sensory system presents the method of obtaining the elastic element and the method of processing the measured data.

Chapter 11 presents the purpose of determining the slipping in gripping systems. Slipping gives information on the quality of the grip. The two proposed design versions, through the structure of their elements, highlight the slipping on one or two directions.