Results of the study of the clutch work of the automatic manual truck transmission and its control mechanism

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Abstract

The paper describes the research conducted at the Nizhny Novgorod State Technical University n.a. R.Y. Alekseev (NNSTU) to design and create the clutch for manual transmission with multi-stage command and automatic control, including 8-, 12- and 16-step modification and having an electro-drive [1-6]. An important problem to be solved in the work is the development and manufacture of the universal clutch – the clutch control mechanism suitable to be used with the clutches of the world's leading manufacturers such as ZF Sachs, Luk, etc.

The paper presents a functional and design model of the clutch control mechanism. The main parameters of the clutch control mechanism are: the cross section of the feeding channels, the diameters of the active elements, the rigidity of the system, the allowed values of the friction components were determined on the basis of the solution of the differential equation:

$$m\ddot{x} + c \cdot x = a \cdot t - b, \quad (1)$$

where x –is displacement of the clutch fork stock, a, b, c - the generalized parameters of the clutch control mechanism, t - time.

Using the obtained values of the parameters we developed the documentation and made details of the clutch control mechanism.

A further objective of the study was to test the operation of the clutch control mechanism. For this at the NNSTU we conducted experimental studies on the specialized stand for testing transmisions with command and automatic control [7, 8], the aim of which was also testing a microprocessor control system in co-operation of the transmission and the clutch, providing a smooth clutch turning (gentle start).

The paper presents a functional diagram of the microprocessor transmission and clutch control, the specialized stand scheme, where experimental studies were carried out, measurung equopment and experimental studies.

In carrying out experimental studies at selected values of frequency and duty cycle on the solenoid valve of the control mechanism to ensure gentle start, we selected parameters of the PID regulator that is a function of the difference between the theoretical and the actual state of a given clutch fork stock. In addition, we controlled variations of the angular speed of rotation of the shaft torque of the drive motor and torque on the output shaft of the multistage transmission, displacement of the clutch fork stock, the pressure in the clutch control mechanism nodes and multi-stage transmission, based on the analysis which determines the time of the vehicle start off on a given transmission, dynamic loads in the transmission and performed a conclusion on the optimality of the algorithm of the clutch and the transmission control.

The paper presents the results of the study of performance of the clutch ZF Sachs MFZ-430 together with a 16-speed transmission "KOM-NAMI" [1-2, 6-8] showing that when the initial values of the pressure in the receiver are 800 ... 850 kPa, and the angular velocity motor shaft is 650 rpm the complete process of starting off the vehicle (gross weight of 20 tons.) in second gear in the transmission was about 1.8 seconds.

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