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ABOUT THE IMPLICATION OF THE REGENERATIVE ENERGY IN THE OPTIMIZATION OF THE LINEAR ACTUATORS

Vasile NASUI[1], Radu COTETIU[2], Mircea LOBONTIU[3],
Miorita UNGUREANU[4],Gabor PAY[5],
[1,2,3]Professor PhD. Eng. [4]Lecturer PhD. Eng., [5]Assoc. Prof. Phd. Eng.
[1,2,3,4]North University of Baia Mare, Str: V. Babes no. 62/A, Ro-430083, [5]Nyiregyhazi Foiskola,
e-mail: nasuiv@ubm.ro

Abstract

The paper approaches a major problem in the functioning of the electro mechanic linear actuator son which depend this capacity in the transitory regime that is the effect of the regenerative energy. This is essential taking into account the technical and technological importance of the actuators in the intelligent flexible industrial systems of refinement. In the future the researches can continue for the development of new applications on other types of mechanical transmission using this method and different modular control laboratory. This research offers a new concept concerning the development of new systems of linear actuation and simulation using adding numerical programs and virtual instrumentation

Key words: *the electro mechanic linear actuator, the intelligent flexible industrial systems, regenerative energy.*

1. INTRODUCTION

The technical and technological evolution towards the integration in mechatronic included the stages of development of the module of linear acting of the actuator type marked by the integration of the microprocessors. The development of the mechatronic technology within this context contributed to the development of the actuators as elements of execution capable with this which have besides the cinematic chain, energetic and informational material. In the dynamic study of the actuators we have to consider the the whole actuators – mechanism, in spite of the effects the transitory functional regime [9]. These results the necessity of the analysis of the influence of the the energy regenerated in the system as a consequence of the periods of deceleration in the functioning on all the mechanic, electrical land electronically components [5].

The paper is structured in three parts; this initially o we treat the functioning regimes of the actuators followed by the way of control of the regenerative energy and the best solutions of the actuators [5], [6].

2. THE ECONOMIC REGIME OF WORK OF THE ACTUATORS

The correct definition of the economic functioning regime of an electro mechanic linear actuator must take into account, on the o none hand, the clues that characterizes the economic regime. The main component parts of an actuator are represented in figure 1, including the electric engine of acting, the transmission itself, the filling and the control devices. Shown below are two diagrams depicting the basic elements of the two most common electric motion control systems: stepping motor-based and servo motor-based? Each has advantages over the other, some of which are highlighted in the diagram.

The parameters which characterize the economic regime are the training electric power and the efficiency of all the structural components. In the transitory dynamic regime, on order to maintain a constant of the efficiency at the nominal power of the power dissipations supposes the knowledge of a weight graphic as exact as possible. The appreciation of the functioning economic regime should be done separately for each type of action engine as well as for every nominal parameter which changes, that is for each artificial characteristic.

Saving the electric energy can be done by important measures in the whole chain of the actuator system starting from the filling point, passing to the control one or the regulating one and going on with the acting engine and the cinematic transmission. Shown below are two diagrams (fig.2), depicting the basic elements of the two most common electric motion control systems: stepping motor-based and servo motor–based [9].

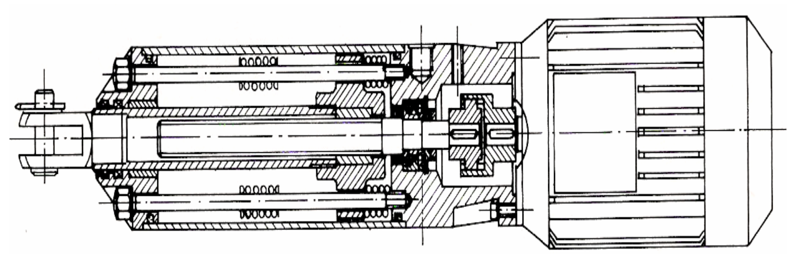
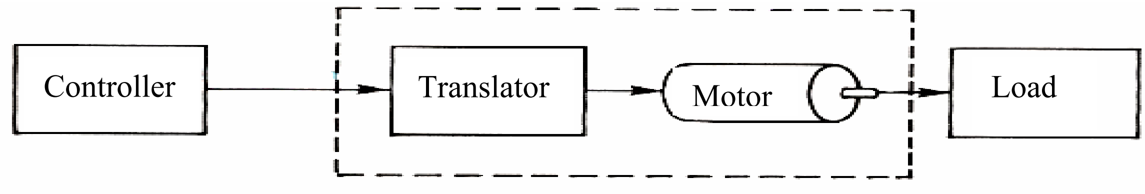


Fig.1. The electromechanic linear actuators

Stepping Controller System Block Diagram



Servo Controller System Block Diagram

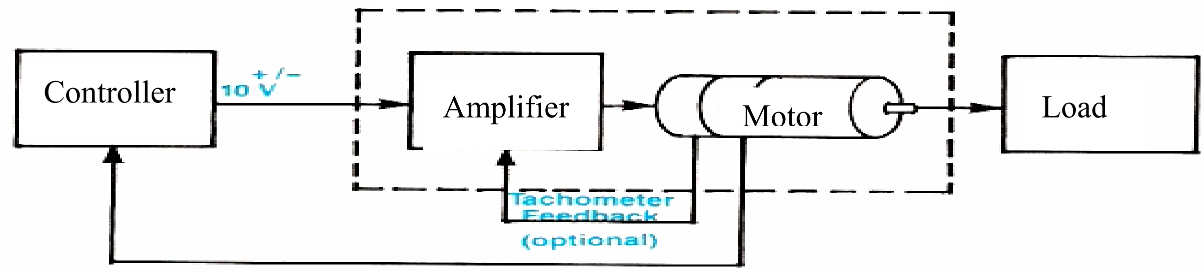


Fig. 2. Controller System Block Diagram

The basis problem in order to obtain a profitable regime is to correctly establish the nominal power according to the efficiency, the transmission report, the increase or decrease in the speed and the cinematic moment with the relation:

$$M = M_r \cdot \frac{1}{i} \cdot \frac{1}{n} + \frac{G \cdot D^2}{375 \cdot i^2 \cdot \eta} \cdot \frac{dn}{dt} \qquad (1)$$

Where:

M_r it the resistant moment,

i - the transmission report;

n – the turation on the engine;

η - the efficiency of the transmission;

GD- gyration moment.

At the majority of the electric engines, the efficiency has small variations about its nominal value in changes of power between the nominal value and aprox 50 % out of the nominal value. However [9]. in the situation of the actuators, to establish acting power is very important owing to the conditions of transitory regime of work.

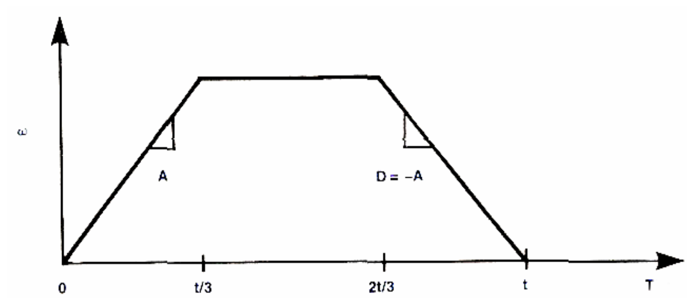


Fig. 3. Motion profile

2. THE REGENERATED ENERGY IN THE ACTUATOR AND ITS EFFETS

This regenerated energy in the system results from the weight by amplifications from the energy supplier. At the actuators, in order to reduce the stopping time of the acting system, it this frequently applied the dynamic braking or recuperative braking in continuous power regime.

The electric machine in this case functions as a generator transforming the rotation kinetic energy or the potential energy of the working machine into electric energy debit ate dons the braking resistance. The whole of the kinetic energy of the weights in movement is transformed in electric which in its turn is dissipated on the circuit, being controlled in this way.

The catching up braking is similar to the dynamic braking with the difference that the electric engine generate son the continuous power flux. The potential energy is transformed by the engine in electric energy recuperating by it self and being used by other consumers. The pattern of dynamic control is shower in figure 4 and figure 5.

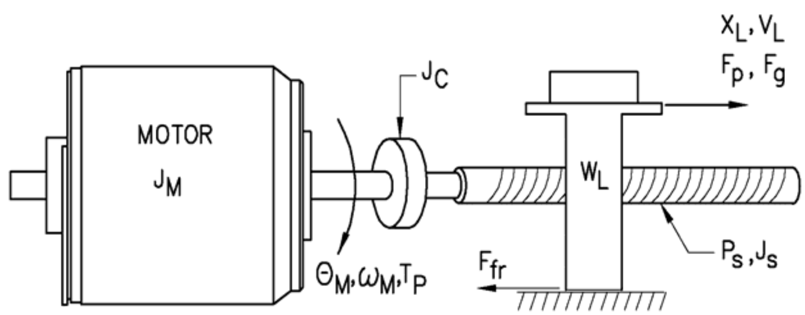


Fig. 4. The actuators for servomechanism

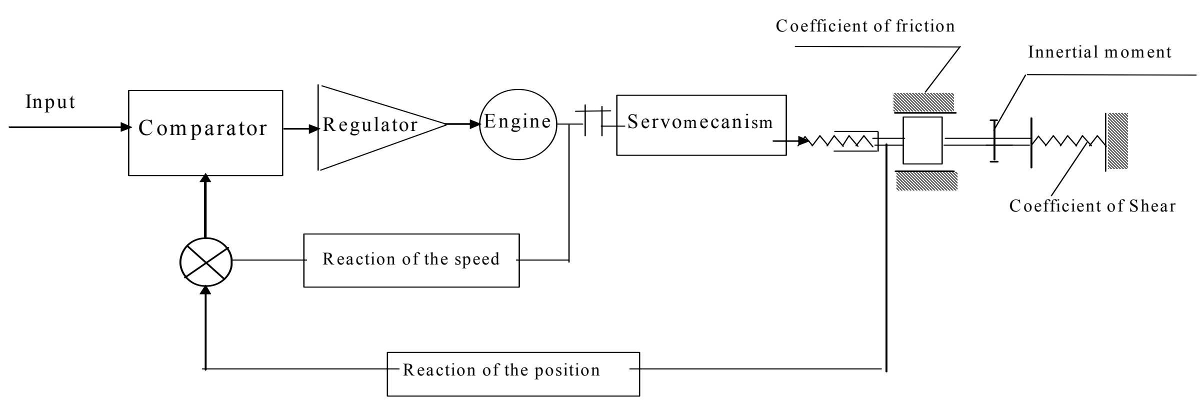


Fig. 5. The dynamic model of programmable servomechanism

At the actuators with asynchrony engines in recuperating energy regime, the braking is obtained for speeds of the superior's rotor, the speed of the rotator field, generating within the net an active power, but continuing to obtain reactive power.

Because the actuators have a significant control, the recuperative energy has a major part which can influence the optimum functioning of the whole system.

Regenerative energy is transferred from the motor load through the amplifier to the power supply during deceleration. If this energy is not managed it will boost the bus voltage which may damage the driver.

Singe the electrical energy stored within the motor is small, it usually can be neglected. However [9], the driver must be able to handle the motor and load mechanical energy ($E = 1/2 \cdot J \cdot \omega^2$), less the energy dissipated by the cable and motor ($E_R = I^2 \cdot R \cdot t$).

$$E = \frac{1}{2} \cdot J \cdot \omega^2 (4,2 \times 10^5) - I^2 \cdot R \cdot t , \qquad (2)$$

and,

$$t = \frac{J \cdot \omega}{M_T \cdot I} \left[\frac{2 \cdot \pi}{60} \right] \qquad (3)$$

where:

E - amplifier regenerative energy capacity;

J -inertia of motor plus load;

ω - velocity load;

I – current limit setting of driver;

R – resistance of cable and motor,

t – deceration time, [sec.];

M_T – motor torque constant.

The energy handling capacity of the driver power supply must beat least the value calculated. Aerotech [9] suggest a 50 % margin on this value. Also, give consideration to simultaneous deceleration in multi-axis systems.

4. CONCLUSION

The control of the movement of the system actuator is the key factor on which depends the capacity and their availability. Owing to the dynamic regime particular to the functioning of the actuators, it this necessary to know the influence of the regenerated energy in the system in order to take the technical measures most appropriate as far as the performances of the control equipment of the actuators are concerned. When designing a linear motion system, is necessary to consider the effect the variables operation will have on performance. In the future the researches can continue for the development of new applications on other types of mechanical transmission using this method and different modular control laboratory.

Reconnaissances

The author makes the best of the researches done within the MEC, CNCSIS grant regarding the development of the actuators within the flexible intelligent systems of reworking in the laboratory for actuators of the North University of Baia Mare.

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