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# MODELLING OF ACTIVE MAGNETIC BEARING



***In this appearance the problems of modelling of control system of active magnetic bearing of natural gas centrifugal compressor is considered***

## 1. Preamble

In gas-transport system of Ukraine a nagging problem appears in change-out of out of date equipment of compressor units , which equipped with oil seals and oil rotors bearings, which has become out of date for and do not corresponding with technical and environmental challenges, for modern, namely for compressor equipment with active magnetic bearings. Using of magnetic bearings, in which lifting capacity realized by no hydrodynamic forces in oily tape, but contactless magnetic field forces to provide raise of specific speed of compressor. Natural gas centrifugal compressors that is made in Ukraine to this days are slow-speed and this circumstance restrains the increase of technical level of technique.

Introduction of magnetic bearings gives substantial reduction of equipment and expansion of workshop apartments due to liquidation of oil system which occupies considerable area. Fire safety of unit is improved at the same time, possibility of creation of explosive oil and gas mixtures is liquidated. This is important especially for compressors which are set on marine platforms on the shelves of seas.

The indicated prospects are tested as by domestic producers so, especially, foreign. However the last indicated do not report about structural features of bearings and seals , restraining development of such prospects.
It in the turn results in the problem of creation of the system control of active magnetic bearing for compressor units. That is why above all things it is necessary to conduct the computer design of rotor related to stator ( basic constituent of active magnetic bearing) to use the received results (data ) for subsequent development of the automated system control.

## 2. Task statement

To investigate the algorithm of analog control of rotor of compressor unit of natural gas centrifugal compressor; to conduct the computer design of work of rotor related to stator and find out what factors influence on the increase of efficiency of its work (rotors); to prepare the collected information for its subsequent application in creation of systems control and to development of digital algorithm of control.

**Synthesis of algorithm of control active magnetic bearing .**

To probe the algorithm of analog control of rotor. Bring of task to the scheme of application of regular regulators.

In technique there are general principle of design prevails, which consists in the bringing of aktual task to already known calculation scheme, to the algorithm, etc.

Mostly, try to find simple models, to feel the role of basic determining parameters of task in influence on quality of decision of technical task.

One of practical ideas of construction of algorithms of control of the linear system is expounded in the lectures of professor P. D. Krutko devoted to application of reverse tasks of dynamics of system or point particle– classic task of theoretical mechanics.

Let motion of the system be determined buy differential equalization:

$$m\ddot{y} + f(y, \dot{y}) = F(t), \text{ where} \qquad (1)$$

m – system mass

*y(t),* $\dot{y}(t)$ - coordinate and velocity current situation

*F(t)* – active force

Within the framework of direct task of dynamics of point sets initial position and velocity, and also force F(t)

$$y(0)=y_0;\ \dot{y}(0)=\dot{y}_0;\ F(t) \qquad (2)$$

Task – to define a mechanical trajectory *y*(t)* and velocity $\dot{y}^*(t)$ at all time interval of moving from the beginning of initial position

Within the framework of reverse a task looks this way. The already known trajectory of moving is *y*(t)* and $\dot{y}^*(t)$, specified initial value $y^*(0)=y_0^*$ та $\dot{y}^*(0)=\dot{y}_0^*$. It is nasessary to define active force F(t)=F*(t) (right part of equalization of motion), thus such which exactly moves a point on the set trajectory of y*(t) with velocity $\dot{y}^*(t)$. It is a reverse task of dynamics of point. From the point of view of control tasks this is search of law ( the algorithm) of control at which the system owns set

trajectory and velocity ( standard motion or programmatic).

Proving, forming in terms of feed-backs, power interpretation expounded in resulted before lectures []. Not going into a detail these features will require, for motion of the system a rotor - magnetic support according to equalization:

$$m\ddot{y}-C_y y=h_i i,\ Q=0, \qquad (3)$$

horizontal motion of mass of m was analogical to motion of the mechanical system

$$m\ddot{y}+b\dot{y}+Cy=0 \qquad (4)$$

what symbolizes motion of load of m on a spring inflexibility of C and viscid resistance of b. This motion and will

accept for programmatic ( standard).

Designating

$$\omega_0=\sqrt{\frac{c}{m}};\qquad \zeta=\frac{b}{2m\omega_0}$$

will write down equalization (4) in a standard form

$$\ddot{y}+2\zeta\omega_0\dot{y}+\omega_0^2 y=0 \qquad (5)$$

if in a puttee to accept the size of current by law

$$i=-(k_1 y+k_2\dot{y})$$

where

$$k_1=\frac{m\omega_0^2+C_y}{h_i};\qquad k_2=2\zeta\omega_0 \,{}^{m}\!/_{h_i}$$

Then (3) and (5) coincide

It means that regulator which gives a current

$$i=-\left(\frac{m\omega_0^2+C_y}{h_i}y+\frac{2\zeta\omega_0 m}{h_i}\dot{y}\right) \qquad (6)$$

a rotor-support will realize programmatic motion of the system. In the technique of him name a proportionally differential (By a PD-regulator) a flow diagram is shown on a picture (1)

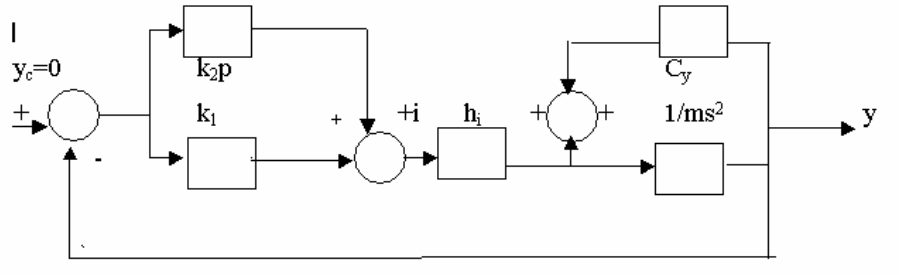


*Fig. 1*. Flow diagram of the adjusting system

Changing к1 and к2 we obsessed the proper quality of management.

**Results are got**

By the system of komputering design MathLab was design analog algorithm of management of active magnetic support. What it was discovered as a result of, that changing К1 and К2 ( sizes factor of current are in a puttee) we got the proper quality of management

## 3. Conclusion

By the system of komputering design of MathLab it is possible to probe different models and algorithms of management active magnetic supports, define their areas of stable work and influencing of coefficients of inflexibility and viscid resistance, that in the turn allows to conduct the synthesis of optimum algorithm of management and create the digital system of management active magnetic support.

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