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Intellectual Control of Flexible Manufacture Module with Throw-over Manipulator and Step Conveyer

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Abstract
The paper deals with provision of throw-over manipulator and step conveyer with intellectual sensor control. A lower quality tuned circuit satisfying all the requirements for normal functioning of the system and robotics complex control is obtained on the base of lower magnetic permeability entire magnetic circuit.

1. Introduction

One of the stages of flexible manufacture systems (FMS) creation at theirs system technical design level is definition of its creation productivity on the base of doing simulation and computer experiments of technical systems, specialty new automation units (industrial and intellectual robots, different types mechatron equipments - special manipulator, automatic conveyer). That problem is actuality as elements of FMS work at 3D area with one working zone contrary connected and at real objects application of dynamic systems are accompanied with some difficulty.

By investigation of the problems of computing design of flexible manufacture system, specialty on the beginning stages, it is necessary to do purpose-directly option of elements, informing data and parameters FMS. Computing option of FMS, as complex iteration process, is performed with many level organization of design procedures from design demands at first level to design solution of the demanded degree of detailing at the next levels. At computing option of FMS, for creation its informing, mathematical, program supports, the levels of logical and parametric designing application are demanded. In this connection, for designing process advancement of efficiency and accuracy, in the paper the problem of computing option and definition of FMS elements parameters on parametric designing level are demanded.

The last time for investigation with using simulation and computer experiment of technical systems as mathematical apparat [1, 2] is very popular. With using mathematical apparat investigation of simulation of technical system allows to do analyz of characteristics of this system. As FMS has complex structure its representation with simulation model like iteration process is doing difficult, practical not real.

The areas for transmitting the cards from the tube furnace outlets to card doubling process inlet are used in manufacture technology of evaporators of household refrigerators. In this area a throw-over manipulator and a step conveyer are applied (fig. 1).

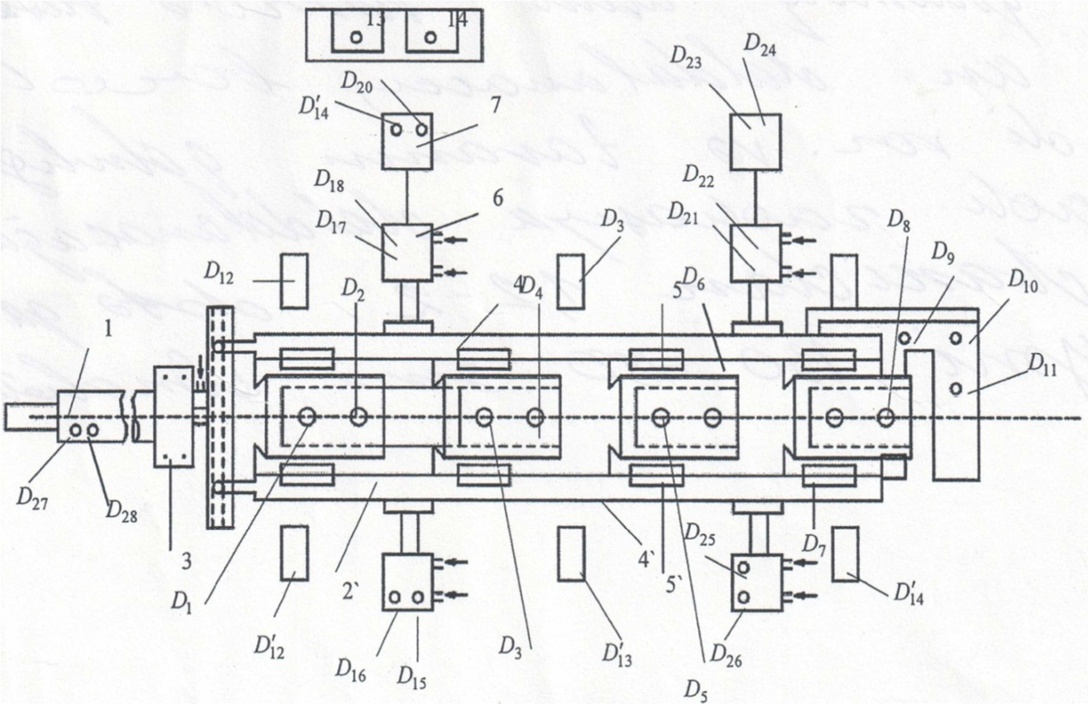

Fig. 1. *Composes structure of the step conveyer*

For organization of informing support, computing search and option of the researched FMS technological equipment and composes structure the following algorithm is proffered:

<informing supports of computing option > : : =

<Data base of the principal parameters of FMS active elements and composes structure >&

<The data base of principal standard characteristics and composes structure of FMS >&

<Informing search and option >

<The data base of principal computed parameters > : : = < the results of mathematical calculation by definition of positioning error, working zone of active elements, structural and functional analyze, productivity of FMS >

< The data base of principal standard characteristics > : : =

< Technical characteristics of principal equipment of FMS >

< Informing search and option > : : = < search conditions >

<search conditions > : : = < purpose limiting for FMS active elements option >

<purpose limiting for FMS active elements option > : : =

< lift-loading → FMS demands >&

<speediness→ max >&

<movement degree → FMS demands >&

<positioning error → min >&

<working zone → max >&

< FMS productivity → max >.

As see from the above presented model of computing option of FMS active elements and composes structure the important dynamical informing model is data base for computing documenting the project and description of the project's documents and their interaction with another documents. Search conditions shorten search area, what heighten search efficiency.

In the figure 1, the standard and non-standard transducers are shown. The transducers D_1, D_2, D_3, D_4, D_5, D_6, D_7, D_8, D_9, D_{10},D_{11}, are non-standard. The transducers (D_{12}, D'_{12}), (D_{13}, D'_{13}), (D_{14}, D'_{14}), ($D_{15}D_{16}$), ($D_{17}D_{18}$), ($D_{19}D_{20}$), ($D_{21}D_{22}$), ($D_{23}D_{24}$), D_{25},D_{26},D_{27},D_{28}, are freed contacts and define the state of pneumatic. These transducers are standard ones produced in industry. The transducers 13, 14, control the state of the tube furnace conveyer. The throw-over manipulator and step conveyer system functions as follows. In the presence of the card with picture in the position 13 and 14, the tube furnace conveyer stops and the throw-over manipulator consisting of the pneumatic actuator 6 and the arm 7 takes this position.

2. Solution

The moving and fixed parts of the manipulator are symmetrically arranged on the arm 7. The moving parts are rigidly fastened to the arm of the pneumatic actuator 6. The fixed parts are rigidly fastened on the shoulders of the manipulator's arm [4]. In the operation process of the manipulator, the cards are accepted from the sides by the sheets D_5, D_6 and D_7, D_8. In the absence of the cards with pictures, in the position D_5, D_6 the manipulator works and throws over the cards from the position 3 and 4, the cards appear in the position D_1, D_2, the step conveyer works at the position $D_1, D_2$and by means of the pneumatic actuator that transfer the cards along the conveyer and carries the cards from the position D_1 and D_2 and position D_5, D_6 and farther, the cards are doubled and handed over to the working table for further operation.

In the place of non-standard transducers, the inductive transducers with entire magnetic-circuit with frequency outputs [3, 5] are used.The principal block circuit of such a transducer is given in fig. 2.

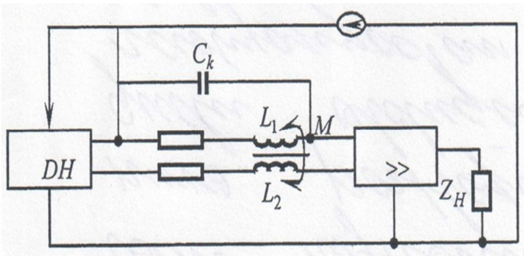

Fig. 2. *Principal block circuit of the self-excited oscillator*

The oscillation frequency of the self-excited oscillator is written in the form:

$$\omega=\omega_0\sqrt{\frac{L_1(r_3+(r_2+r_\delta)(1-\alpha))}{L_1(r_3+(r_2+r_\delta)(1-\alpha))+L_2r_k(1-\alpha)}} \quad (1)$$

where L_1, L_2 are inductances of the tuned circuit coil r_3, r_δ are emitter and base contact resistance of the collector transition of the current gain factor of the transistor: ω_0 is an Eigen frequency of the tuned circuit of the self-excited oscillator.

Here constant current operational amplifier with very great stress gain factor is used as an amplifier. It is always used with external, strong negative feed-back that defines its resulting characteristics. In the ideal operational amplifier we take $R_{Bx}=\infty$, outlet stress gain factor $R_{\text{вых}}=0$. Furthermore, it is assumed that the common-mode rejection ratio equals infinity. In real operational amplifiers, we try increase maximally the inlet resistance and minimize the outlet resistance.

Usually, a differential amplifier is an input cascade of the operational amplifier. The outlet chain of the operational amplifier is represented in the form of outlet equivalent oscillator that develops stress proportional to the internal gain factor and stress difference with non-inverting and inverting inlet [6, 7]. The outlet oscillator possesses the resistance of R_{ext}. The self-excited oscillator of sinusoidal vibrations is constructed on the base of non-converting switching OY with the gain factor$K_u^0=1+\frac{2R}{R}=3$.

On the model of the self-excited oscillator, the chain is represented by the dependent source $k_u^0 u_{bx}=u_0$

The gain factor of this chain is written in the form [1]:

$$k=\frac{R}{(1+j\omega CR)[\frac{R}{1+j\omega CR}+R+j\left(\omega L-\frac{1}{\omega C}\right)]} \quad (2)$$

The calculation model is given in fig. 3.

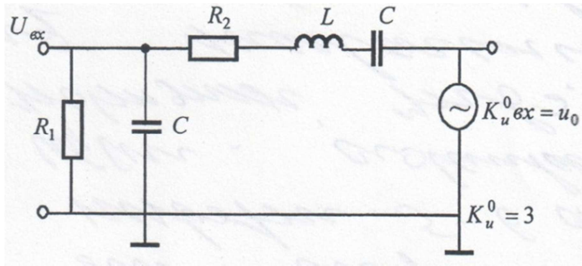

Fig. 3. *Equivalent scheme of the self-excited oscillator using OY.*

While creating a self-excited oscillator, it is convenient to choose variable resistances provided R_1=R_2 =R. When such a condition is satisfied, the asymptotic diagram of chains of the self-excited oscillator is represented in the form of a graph shown in fig. 4.

The asymptotic diagram corresponds to the formula of k.

Performing some transformations in the last formula for the phase shift at resonance we get:

$$\text{tg}\varphi=\frac{\omega^2c^2R^2+\omega^2cL-1}{2\omega cR}=0$$

hence we have:

$$\omega^2c^2R^2+\omega^2cL-1=0 \quad (3)$$

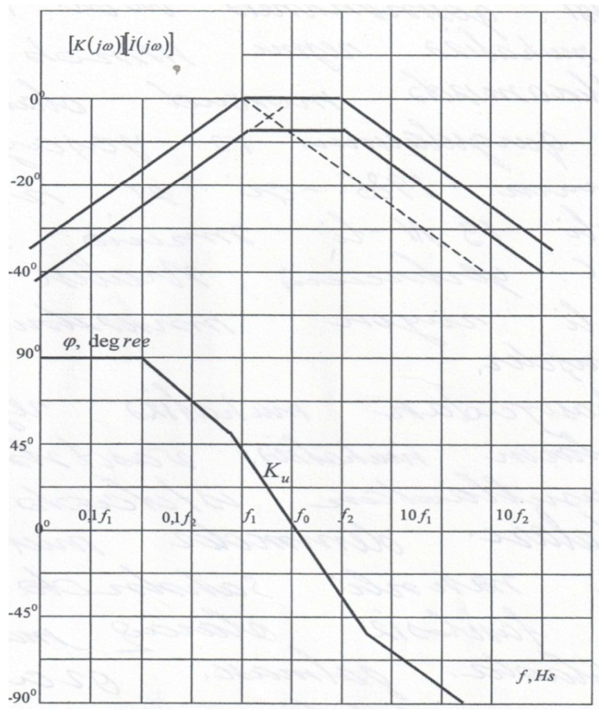

Fig. 4. *Asymptotic diagrams of the chains of a self-excited oscillator.*

Solving equation (3), we find

$$\omega_0 = \pm\sqrt{\frac{1}{C(R^2C + L)}}$$

Or

$$f_0 = \frac{1}{2\pi\sqrt{C(R^2C+L)}} \quad (4)$$

For a real circuit of the self-excited oscillator, the following inequality is always fulfilled:

$$L \gg R^2C$$

Therewith, the frequency of the oscillation of the output stress amplitude of the self-excited oscillator is written as follows [10]:

$$f = \frac{1}{2\pi\sqrt{LC}} = f_0$$

As it seen from (4), the circuit of the self-excited oscillator is more sensitive to the inductance at higher frequency, and under lower frequency it is more sensitive to capacity change.

3. Conclusion

In the considered informational –measuring system and control of robotics complex, a transducer with frequency output was created on the base of entire magnetic circuit with lower magnetic permeability that allows to get a lower quality tuned circuit [8]. Under such situation, the relative small change of the current corresponds to wide range of the relative vibration of frequency that influences on gain factor change in the model of the self-excited oscillator [9].

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