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CHARACTERISTICS OF THE GENERATOR KINEMATICS CHAINS

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Abstract

The present paper focuses on the main characteristics of the generator kinematics chains, their mechaism and transfer and regulation equation by which they function. The input and output measures are referred to in the second part of the present study the variation ratio of these being rendered in their corresponding expression. The case of the kinematics chains set in action with electric engines of alternative current is presented in detail in the previous instance whereas the case of the main kin

1.1. The transfer equation

The kinematics chains of the machine –tools are consisted of a certain number *n* of mechanisms linked in series, their transfer (sending) equation being

$$y_e = y_i \cdot i_T ; i_T = i_1 \cdot i_2 \cdot \ldots \cdot i_j \cdot \ldots \cdot i_n = \prod_{j=1}^{n} i_j \qquad (1.1)$$

where X is the output measure of the kinematics chains; X – the input measure; X – the total transfer ratio of the kinematics chains

The total transfer ratio of the kinematics chain has the following expression

$$i_T = i_C \cdot i_R \cdot i_D \qquad (1.2.)$$

where X is the product of all constant transfer ratios; X – variable transfer ratio obtained by the regulation mechanism RM; X – the dimensional transfer ratio of the last mechanism.

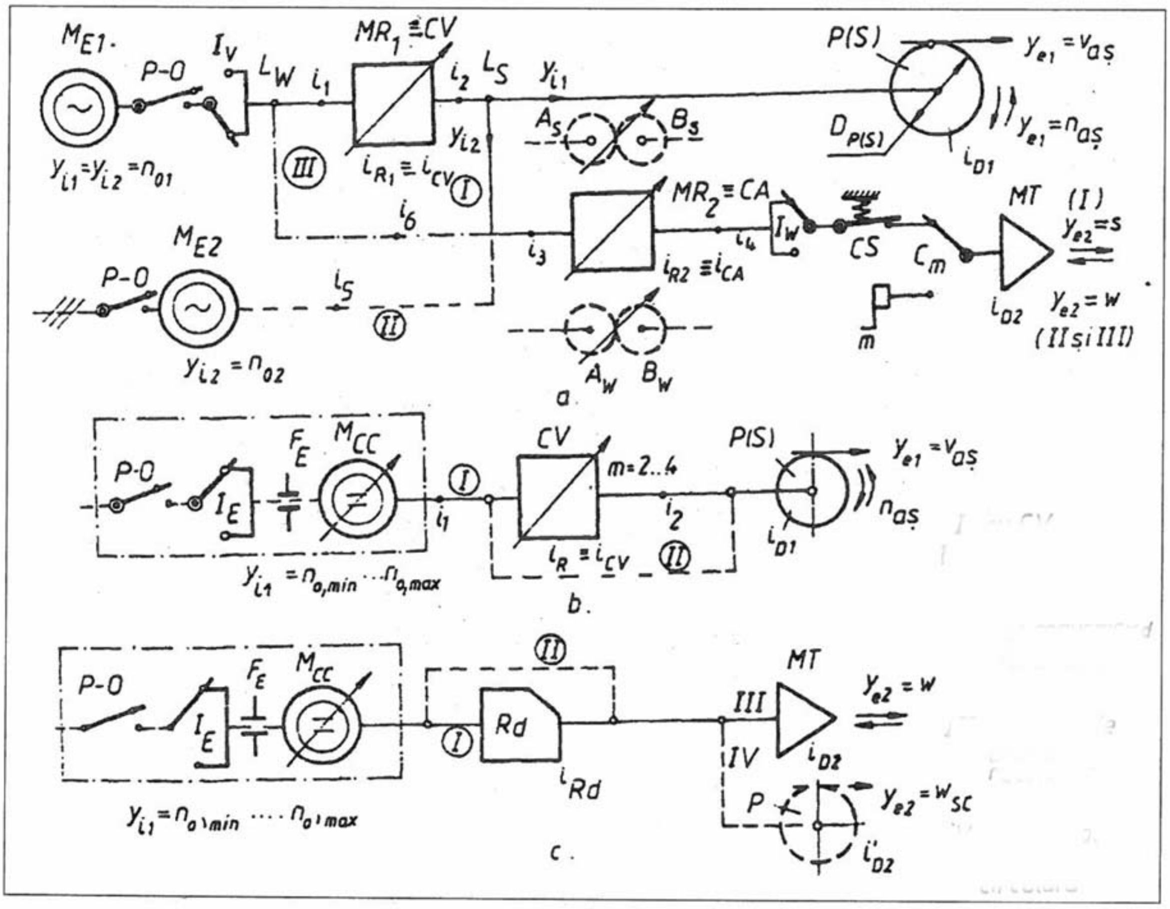
The dimensional transfer ratio depends on the type of mechanism, i.e.:

- $i_D = \frac{v_{aş}}{n_{aş}} = \frac{\pi \cdot D_{P(S)}}{1000}$ in m – mechanism – spare part or mechanism – device;

  in mm – mechanism – screw – nut

- $i_D = \frac{w}{n} = \frac{\pi \cdot m \cdot z \cdot n}{n} = \pi \cdot m \cdot z$, in mm-mecanism pinion –rack
- $i_D = \frac{w}{n} = \frac{n \cdot p_k}{n} = p_k$ in mm –mecanism cam-lug
- $i_D = \frac{w}{n} = \frac{\pi \cdot m_a \cdot k \cdot n}{n} = \pi \cdot m_a \cdot k$ in mm –mechanism worm (creeper)

where D is the diameter of the of the circle described by the point of the generator element in the circular ….(advance) movement, with the circular …. speed



- iD = ….. in mm – mechanism worm gear (creeper) -rack with tilted

Where D P(S) is the diameter of the spare part or device; in mm; pSC - the …. (pas) of the driving screw, in mm; m – the module of rack with straight … (dinti), in mm; m… - the front module of the rack with tilted teeth, in mm; ma the axial module of the creeper, in mm; pk – the pace of the cam-disc or cylindrical cam, in mm; **k**- the number of starting points; vas – the splintering speed, in m/min; **w**- the advance speed, in mm/min; n-the revolution of the element with rotation movement of the last mechanism, in rot/min; - the radius of the crank, in mm; **l**- the length of the connecting rod, in mm; xxxx….. w the angular speed of the crank in rad/s.

The transfer equation depends on the type of kinematics chain and on its structure:

- main kinematics chain with main circular movement **(fig.1.1.)**

$$i_R = i_{CV} \cdot K_{LP} \frac{v_{aş}}{D_{S(P)}}$$

imain kinematics chain with alternative rectilinear movement **(fig.1.2, 1.3)**

$$K_{LP} = \frac{1000}{\pi \cdot i_1 \cdot i_2 \cdot n_0}$$

$$\frac{A_V}{B_V} = K_{LP} \frac{v_{aş}}{D_{S(P)}}$$
$$A_V + B_V = \Sigma z$$

- main kinematics chain with main rectilinear movement **(fig.1.4.)**

$$i_{R2} = i_{CA} = K_{LS} \cdot s$$
$$K_{LS} = \frac{1}{i_3 \cdot i_4 \cdot i_{D2}}$$

- advance kinematics chain set in action by its own electric engine **(fig.1.6, II)**

$$i'_{C2} = i_3 \cdot i_4$$

- advance kinematics chain associated with the main kinematics chain in a point Ls, situated after the gear box **(fig.1.6, I)**

$$i'_{C2} = i_3 \cdot i_4$$

.

- circular advance kinematics chain **(fig.1.5, f)**

where D is the diameter of the of the circle described by the point of the generator element in the circular ….(advance) movement, with the circular …. speed wsc

Fig. 1.6. a,b,c – The possibilities of association of the main (advance) kinematics chains

1.2. The regulation equation

The regulation equation (function) is determined from the transfer equation of the kinematics chain, by explaining the transfer ratio X of the regulation mechanism.

For the main kinematics chain **(fig. 1.1.)**, the regulation function is:

$$i_R = i_{CV} \cdot K_{LP} \frac{v_{aş}}{D_{S(P)}} \qquad \textbf{(1.3.)}$$

Where $K_{LP} = \frac{1000}{\pi \cdot i_1 \cdot i_2 \cdot n_0}$ is the constant value of the main kinematics chain

If the regulation of the main kinematics chain is made by exchange wheels (Av, Bv), then the regulation function becomes

$$\frac{A_V}{B_V} = K_{LP} \frac{v_{aş}}{D_{S(P)}}$$
$$A_V + B_V = \Sigma z \qquad \textbf{(1.4.)}$$

where X represents the sum of the number of wheels of the exchange wheels that are fixed between two … (arbori), when the distance between the axes is constant.

For the advance kinematics chain **(fig. 1.6, a),** associated in the point Ls with the main kinematics chain, the regulation function of the first kinematics chain is

$$i_{R2} = i_{CA} = K_{LS} \cdot s$$
$$K_{LS} = \frac{1}{i_3 \cdot i_4 \cdot i_{D2}}$$

(1.5)

Where KLS is the constant value of the kinematics chain

The advance kinematics chain propelled by its own electric engine has one of the following regulation functions

$$i_{R2} = i_{CA} = K_{LW} \cdot w$$
$$\frac{A_W}{B_W} = K_{LW} \cdot w; A_W + B_W = \Sigma z$$

(1.6.)

1.3. The variation ratio of the input measures

The input measure of a kinematics chain yi can be constant or variable in a particular domain xxxx

The variation ratio of the input measures in this case is

$$R_{yi} = \frac{y_{i\,max}}{y_{i\,min}}$$

For yi = constant, R yi = 1 – the case of setting the kinematics chains set in action with electric engines of alternative current (asynchronic) with a single revolution

If the electric engines of alternative current has several revolutions(k), the variation ratio has the following expression

$$R_{yi} = \frac{n_{0k}}{n_{01}} = 2^{k-1}; k = 2...4$$

There are frequently used the electric engines with two revolutions, thus Ryi = 2.

The electric engines of alternative current for setting in action the main kinematics chain, produced by the firms SIEMENS or REXROTH, have, for the maximum revolution the following values: 5000, 6000, 6500, 7000, 8000, 9000 rot/min.

1.4. The variation ratio of the output measures

The output measure of the generator kinematics chains varies in a domain xxxxx, the variation ratio of the output measures being

$$R_{ye} = \frac{y_{e\,max}}{y_{e\,min}}$$

In the case of the main kinematics chain with a circular trajectory of the main movement **(fig.1.1)** the output measure ye = nas, the variation ratio resulting

$$R_{ye} = R_{naş} = \frac{n_{aş\_max}}{n_{aş\_min}} = R_{vaş} \cdot R_{iD}$$

When the main movement has the rectilinear-alternative trajectory and it is performed with the mechanism connecting rod = crank **(fig.1.2)** the variation ratio of the output measures is
L – the length of the ….. (cursa) mobile element.

$$R_{ye} = R_{ncd} = \frac{n_{cd\_max}}{n_{cd\_min}} = R_{vaş} \cdot R_{iD};$$

$$n_{cd\_max} = \frac{1000 v_{aş\_max}}{2L_{min}}; n_{cd\_min} = \frac{1000 v_{aş\_min}}{2L_{max}}$$

$$R_{iD} = \frac{L_{max}}{L_{min}};$$

1.5. The regulation capacity

The regulation capacity is the basic characteristic of a generator kinematics chain which refers to the regulation mechanism and is defined with relation to the variation of the variable transfer ratio iR

$$C_{RL} = R_{iR} = \frac{i_{R\,max}}{i_{R\,min}}$$

Rendering the variation ratio Rye by means of the transfer equation of the kinematics chain

$$R_{ye} = \frac{y_{e\,max}}{y_{e\,min}} = \frac{y_{i\,max} \cdot i_C \cdot i_{R\,max} \cdot i_{D\,min}}{y_{i\,min} \cdot i_C \cdot i_{R\,min} \cdot i_{D\,max}}$$

one can obtain the variation ratio RiR, i.e.

$$C_{RL} = R_{iR} = \frac{R_{ye} \cdot R_{iD}}{R_{yi}}.$$

$$C_{RLP} = \frac{R_{vaş} \cdot R_{iD}}{R_{n0}} = \frac{R_{naş}}{R_{n0}}$$

When the electric engine has only one revolution, the regulation capacity becomes

$$C_{RLP} = R_{vaş} \cdot R_{iD} = R_{naş}$$

At the universal machine- tools, the ratios Rv as and RiD having high values and the electric engine being one of alternative current with one or two revolution, for regulation it is necessary a gear box with a relatively high number of stages or a combined regulation mechanism consisted of several simple regulation mechanisms (gear box with a relatively reduced number of stages, mechanism with intermediary, exchange wheels, electric engines with several revolutions, etc.)

In the case of specialised machine-tools, the variation ratios have reduced values, the regulation function being achieved with simple mechanisms or regulation (transmissions by cones in stages, transmissions by driving belts with interchangeable driving belt wheels).

The main kinematics chain of the machine-tools with numerical drive is set in action by electric engines with adjustable revolution (of continuous current **fig.1.6, b**), the variation ratio Rn0 has high values, thus the gear box has a reduced number of stages (2…4).

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