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CONTRIBUTIONS TO THE RESEARCH OF THE DEGRADATION COMPONENTS FROM AUTOMATION SYSTEM TOOL-MACHINE

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Abstract: In the work is tackle the problem of components degradation of the automation systems from tools-machine, for which the experimentally researches has been made on two lots of 12 lathes with digital commanding. To these the elements of automation ware predominated hydraulic (the variant 1) or electric-electronic (the variant 2). The study of these in exploitation has been made on a period of 5 years (the precinct 20000 working hours), which permitted the obtained of a sufficient date of precise in bind with the way, the periodicity and the causes of components degradation. Through the statistical analyze of collected dates they established the weights of different types of equipments and automation equipments innards. Between two types of automation equipments are manifested sensitive differences below the appearance of brake downs frequency, this being much littler at the electric - electronic components comparative with the hydraulic one. The hydraulic brake downs represent 66.6 % to the variant 1, and electric-electronic brake downs represent just 5.81 % to the variant 2, while to the components mechanical the structure and break down frequency its kipped constant. To the mechanic components the brake downs are caused by the surfaces usage (51.7 %), the degradation of the innards deeply (32.8 %), functional brake downs (11.6 %), etc.

Keywords: tool-machine, degradation, wears

1. Introduction

The automation of tool-machines commands has multiple economic advantages (the reducing of auxiliary times, the diminishing of the rejects) but and disadvantage of reliability decrease for the equipment considered, pursuant to the increase of components number. In figure 1 is presented the functional scheme of operating mechanism to *X* axis to a lathe with digital commanding (SPT 32), in which the digital commending with the computer (CNC) receive the instructions from the operating panel and transmits them to a variable shifter. This operate the electromotor M, which transmits the movement to the axis *X* sled, being checked up through the position transcriber TP and taho-generator for the shift TH. Permanently the results are posted on a display [1, 2].

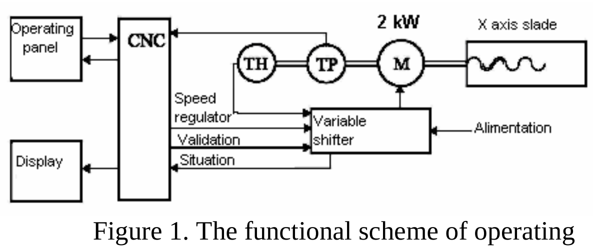

Figure 1. The functional scheme of operating mechanism to *X*-axis

From reliability point of view the scheme from the figure 1 is transposed in a system series as the in the figure 2.

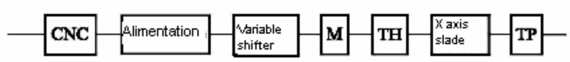

Figure 2. The reliability scheme of operating mechanism to *X*-axis

It's noticed that the damage of an element from the reliability scheme will challenge the work cessation of whole the mechanism [3].

In case the considered tool-machine does the part from the flow-sheet for big serial innards, an accidental breakdown to a machine provokes the shut down of whole technological lines and default important economic loss.

The better knowledge of different components behaved (hydraulic, electric, electronic, mechanics) will permit preventively interventions in the place of corrective ones, the rational with spare part and the avoiding of technological breakdown [4, 5, 6].

2. Material and Method

The study was made on tow groups of 12 lathes itch with digital commanding SPT 32 (the variant 1 and 2), whereat the differences appear to a part from the system of automation of statement of the advances.

To first variant the respective equipment were of hydraulic type, and to another of electric type. The lathes were followed on period of approximately 20000 hours of work. For each among one 24 lathes it was drew up a broke down evidential card, corresponding to the model from the figure 3.

Tool-machine name: lathe with digital command type SPT 32 Identification number: 1, variant 1				
No. crt.	**Broke down name**	**Affected innards**	**The broke down type**	**Work hours**
1.	The broke down of advance system	Servo-valve for advance command	hydraulic	200
2.	The broke down of advance system	Servo-valve for advance command	hydraulic	350
3.	The broke down of advance system	Servo-valve for advance command	hydraulic	570
4.	The broke down of advance system	Servo-valve for advance command	hydraulic	800
5.	NC broke down	Action advance block of NC	electric-electronic	905

Figure 3. Broke down evidential card (the lathe 1, the variant 1)

3. Results and Discussions

The evaluation of parts material degradation level and the study of laws which describe these processes are imported for the calculus method elaboration and for the prognosis of reliability for mechanical, hydraulically and electrical systems.

Abaft systematization and procession of the dates from the experimental research are obtained the results which are presented in the table 1. Must specify that the divide duration of running times on analyzes aisles was made with the relation:

$$\Delta t = \frac{t_{\max} - t_{\min}}{1 + 3.3 \lg \sum n_i} \qquad (1)$$

in which: t_{max} and t_{min} represent the times whereat they registered the last and respectively the first broke down of the lathes; n_i – total number of broke-downs.

Table 1. The medium number of broke downs on aisles

Time aisles, *h*	**Broke downs number**			
	variant 1		variant 2	
	Total no. /lot	Media	Total no. /lot	Media
0-2300	228	19	12	1
2300-4600	276	23	12	1
4600-6900	312	26	12	1
6900-9200	312	26	24	2
9200-11500	288	24	24	2
11500-13800	300	25	12	1
13800-16100	336	28	24	2
16100-18400	300	25	48	4
18400-20700	336	27	72	6

It's funded that the broke downs number on each aisle is drastic decreased in the variant 2 comparative with the variant 1. The broke down rate λ presented in the table 2 is very big in the case of hydraulic components and much more decrease in the case of electric and electronic components.

The weight of the causes of degradations and broke downs types to the systems of automation it's presented in the table 3.

Most frequently broke downs are caused by the usage process (49.4%), as much to the ensemble of the automation system, as much too each individual components in part (with the exception of the electric and electronic equipment), while the deterioration and deformation of innards are seldom broke downs. It's funded out that the weight of broke downs on components, in function of their nature, isn't evenly.

In the table 4 is presented the weight of advances mechanism broke downs on the damages type and components of the equipment, in both variants of execution. Must underlined that from number viewpoint, to the variant 1 are produced a 250 either else many damages than to the variant 2.

Table 2. The broke down rates of the components from the advances mechanism

Component	**Component part**	**Broke down rate, $\lambda \cdot 10^{-6}$/h**	
		Variant 1	**Variant 2**
Hydraulic	pump	14	-
	filter	0.3	-
	pressure regulator	2.14	-
	battery	6.2	-
	gaskets	0.0012	-
	servo valve	30	-
	hydraulic engine	4.3	-
Mechanic	ball screw	0.05	0.05
	tooth wheels	0.2025	0.2025
	guides	0.22	0.22
	transcriber coupling	0.04	0.04
Electric-electronics	command CN	5	5
	engine c.c.	-	1.5
	variable shifter c.c.	-	9.3

Table 3. The causes of systems of automation degradation

The broke downs type	Manifestation modes of the broke downs	Weight, %
The degradation of innards in profoundness	Deteriorations	5.8
	Fissures	11.3
	Forficate or pull up of the threads	1.2
	Perforations	0.7
	Burnings	5.7
	Rubbings	0.3
	Total	**32.8**
The degradation of surfaces	Usage	49.4
	Scratches	1.9
	Crushes	0.4
	Total	**51.7**
Disrespect of innards position	Loosening of fixed organs	1.6
	Settlement (loosing the elasticity)	0.8
	Blockades	0.4
	Stretches	0.4
	Deformations	0.4
	Total	**3.6**
Functional broke downs	Impurities sediment	7.2
	Blocking (electric equipment)	4.4
	Total	**11.6**
The environment influence	Corrosion	**0.3**
TOTAL		**100**

In the table 4 is presented the weight of advances mechanism broke downs on the damages type and components of the equipment, in both variants of execution. Must underlined that from number viewpoint, to the variant 1 are produced a 250 either else many damages than to the variant 2.

In both constructive variants the weight hold by the broke downs of the advance train system (74.48% for the first variant, respectively 94.19% for second variant), comparative with the broke downs of the digital commanding equipment (25.52 % - variant 1, respectively 5.81% -variant 2). Else consisted that in first constructive variant the weight of broke downs is registered to the hydraulic components. To the second variant total number of broke downs is much more little, because the hydraulic train of advances mechanism were replaced with electric and electronic train. Evan in this situation the weight of electric and electronic broke downs is only 5.81%, comparative with the weight of 25.52% of the electric components to the variant 1.

The broke downs which reflected an individual change in automation system components of tool-machine and which have there origin exactly in there functional process, are classified after there appearance frequency in systematic and accidental broke downs.

Are considered systematic the broke downs which can be manifest with an exact frequency at a system component.

Table 4. The broke down weight of advances mechanism system

	variant 1			variant 2		
▪ Advances system broke down	74.48			94,19		
o hydraulic broke down		66.60				
- servo valve for advances command			4478			
- filter			7.16			
- battery			3.02			
- gaskets			4.48			
- advances system pump			3.58			
- pressure regulator			1.57			
- hydraulic engine			1.34			
- pipes			0.67			
o mechanic broke down		7.87			87.55	
- transcriber coupling			5.63			62.66
- system wedges			0.90			9.96
- guides			0.45			4.98
- intermediate tooth wheels			0.45			4.98
- ball screw			0.45			4.98
o electric-electronic broke down					6.64	
- engine c.c.						2.49
- variable shifter c.c.						4.15
▪ Digital command system broke down (electric-electronic)	25.52	25.52		5.81	5.81	
- advances training bloc from NC			8.96			0.33
- measurement bloc NC			8.96			
- incremental transcriber			4.48			0.33
- measurement system cable			0.22			0.50
- electric command for pump engine			1.79			
- pump engine			1.12			
TOTAL	100			100		

4. Conclusions

- The work in complete safety of digital commanding equipments of tool-machine is necessary for the avoiding of the technological fluxes in which these are included. Through the automation of the commands are reduced the auxiliary times, but he diminishes the general reliability of the equipment.
- The automation systems comprise hydraulic electric, mechanics and electronic components, which have specific reliability in specific working conditions.
- On the strength of the supervision on a period of approximately 20000 working hours of two lots of same lathes, but with different structures of the automation equipments, it's consisted that the most little reliability they have it the hydraulic components, while the electric and electronic components are brooking down much more rare.
- Through the settlement of the broking down weight of different innards and equipments types it can shorten the immobilization time of tools-machine for the maintenance works, is make a rational supply with spare parts and are transferred the corrective activities in the preventively activities zone.

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