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DIAGNOSTIC SYSTEM MAINTENANCE THE ABILITY OF MACHINES

This work presents the main descriptors of the diagnostic system machines exploitation. Determine the measure of the technical state, the boundary value and the periodicity of diagnostics. Problems and the tasks of the system of the exploitation of machines with utilization of computer techniques were distinguished on this background.

Keyword*s: diagnostics of machines, symptoms of the state, boundary value, periodicity of diagnostic.*

1. Introduction

The command of the technical condition of the machine results from the need of making rational decisions about "quality" and the more far conduct with machine. It can be the decision about the more far use, about the undertaking of preventive interventions or the introduction of changes in construction, technology or the exploitation of machines.

Talk over in these work chosen problems diagnoses the condition of machines, stress the problems of the new strategy of the exploitation of machines, and in this the symptoms of the state, determine the boundary value measure symptoms and the spanking of deadlines the next term of diagnosis.

The initiation of diagnostic systems makes possible the improvement of organization and management of using of machines in industrial institutions with utilization of computer techniques.

2. Main problems in diagnostics of machines

Growing up the level of complexity of machines and criticality of their function from the safety of considerations and constructors and the users of these objects to the acquaintance economic of the technical state and be well-versed in the use prognosis. This is possible, if on stage of constructing integrated were with the object equipment and diagnostic procedures.

Generation of vibration signals in the description of the changes condition the machine

Opinion of the dynamic condition of machines with generate by not he physical processes requires the association of functional parameters the estimated object with the gathering of measures and the opinions of processes howl exit.

While functioning the machines, in the consequence of the existence of the row of external factors (the extortion environment, from different machines) and internal (aging, wastes, the co-operation of elements) in the machine sequence the disorder the states the equilibrium, which propagate oneself in about springy medium - the material of which the machine is built.

The disorder has dynamic character and maintains the conditions of equilibrium among the condition inertia, elasticity, the suppression and extortion.

The disorder propagate oneself from source in the figure of waves in the dependent way from properties physical and the borders configurations, dimensions and the shapes of the machine. This results in the consequence. He existence the causes source and spreading the disorders occurrence of the vibration of the elements of the machine and surround them environment. Processes these are base of the building of the model of the generation of signals, determinate the way of the building, functioning and the changes of the conditions of the object.

One can introduce the sequence of foundations guidance to the model of the generation of signals in the figure, of the cybernetic model, as on fig. 1.

Introduced way of the interpretation of the signal $y(\theta,r)$ there is about the periodical working true in the general case of machines, but not always as simple as on fig. 2.
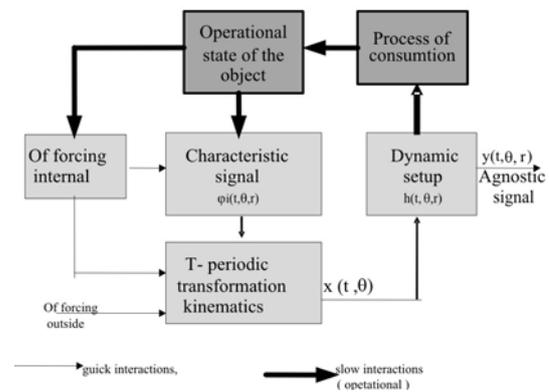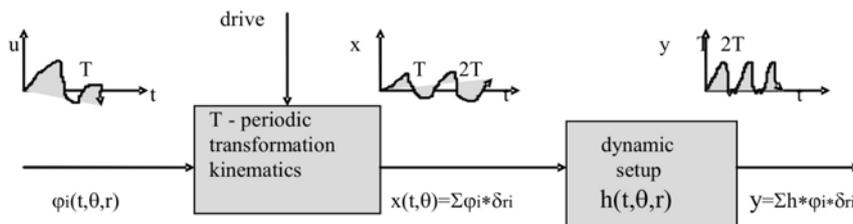

Fig.1. Model of generation the diagnostic

Fig. 2. Transformation of the characteristic signal φ_i and howl in the signal exit as the model of the generation of the signal in machines [2]

The example of such formulation of the question the main transmission of the bridge of the vehicle the whose model of the generation was introduced on fig.3. Howl the received signal exit is important sum of the answer on all events in the any place of the casing of the transmission elementary $U_n(t, \theta, r)$, is present always in this alone sequence in individual arrangements dynamic partial about the pulse function transition $h_n(t, \theta, r)$. These influences after transition by characteristic arrangements dynamic sum oneself and become additional transformation on the trunk of the transmission, near what the change of the place of the receipt of the signal "r" tie is also from change transmittance. By $n(t, \theta)$ was the here accidental influence is present marked from the title presence these micro of dynamic phenomena such as the friction, inequality.

Signal initial one can express of the any point the receipt in the approximation the example:

$$y_k(\theta, r) = \sum_{i=1}^{k} a(k) h_i(t, \theta, r) * \left[u_i(t, \theta, r) + n(t, \theta, r) \right] \qquad (1)$$

where: the pulse function transition $h(*)$ properties also captures you the trunk, $a(k)$ gives the various weights of adding up tie with the place of the receipt "r".

Problems the main diagnostics of machines include:
- the logging and processing of diagnostic information;
- the building of models and diagnostic reports;
- the diagnostic inference and boundary value;
- the classification of the conditions of the machine;
- the expectation of the time of next diagnosing;
- the presentation decision information.

Measuring system for the aims of the present diagnostics of machines consists of two basic elements:
- the equipment in which distinguishes oneself modules: subsystem conditioning and processing of signals, the subsystem of processing of the signals of the gauge of phases,

the subsystem of the industrial computer, the subsystem of the power supply,
- the software, in whose composition are modules: operating system (VxWorks), the software of the modules of processing and the analysis of signals, software guarantee transport among the layers of the system, software to filings and processing given measuring, software manage work of the system (configuration of the system, testing the system, the initialization of measuring sessions).

The introduced structure of the measuring system uses the newest solution both equipment, how and the program. Applied solution helps easier the extension of the system, and possibility these closure him to any diagnostic systems.

The problems next the practice of applying the methods of diagnosing (fig. 4):
1. The time of forming the diagnostic symptom.
2. The change the boundary symptom - preventive workings (PSOTia).
3. The complex opinion of the state: the measurements of symptoms, the reference to boundary value, prognoses of the state, it is proper the delimitation of the deadline next diagnosing, the geneses of the cause of changes the measure symptom.
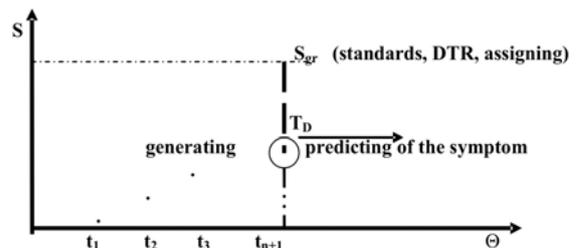

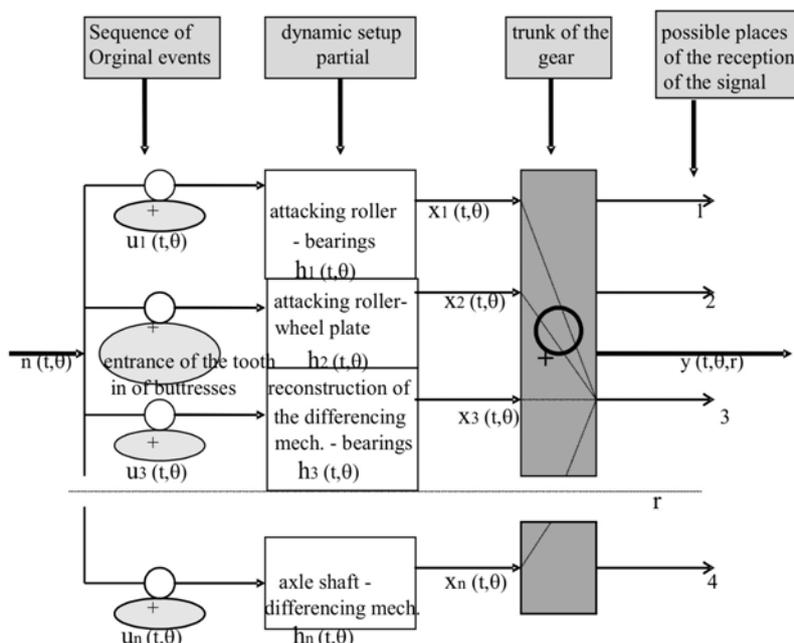Fig. 4. Modern system diagnostic on exploitation

Fig. 3. Model of the generation the diagnostic signal of the toothed transmission

3. Diagnostic system of the exploitation of machines

Present machines determine are such features as: functional, reliability, availability, safety, mobility and flexibility operating. Formation and maintenance of these features is possible the methods of the technical diagnostics which makes possible: diagnostic constructing and production of new machines and maintenance of machines in the condition ability functional.

The use of the machines characteristic:

- gatherings of at random changing times of the correct work;
- at random changing moments of the beginning and changing long the times of duration of the tasks;
- people and machines in at random changing compartment of the time of the use intensive work;
- the influence of at random changing conditions of exploitation;
- the various kinds of tasks executed in the short periods of the time.

Need and the condition of the economy market prove necessity loading the modern authorized strategy of the production and the exploitation of machines. He does not get lost the hitherto existing accomplishments of the newest strategy of exploitation according to the state in the proposal of this strategy, but it is create modernizes. The proposed strategy of exploitation- ASEM - shows on creator and responsible for the product by name. The manufacturer interested as quality and after that the sale responsible for the product from the intention, through construction, production and exploitation, until to utilization after the liquidation of the object. The same manufacturer constructs and he produces his products in the support about the newest achievement technical idea, his product protects the own service during exploitation, and also he provides objects in diagnostic means (the best automatic).

Effectiveness of solution in applying this strategy requires the improvement: the models of diagnostic machines, the methods of diagnosing and prognoses of the conditions of machines, economic, exact and unfailing diagnostic equipment, the principles of the formation of flexibility diagnostic, the algorithms of steering the maintenance of the machines in the condition ability, the methods of the opinion efficiency you diagnostics and the system of the exploitation of machines. Specified questions enclose safely of the problems and unambiguously establish the directions of the development of the technical diagnostics of machines.

The users of machines are interested particularly their ability task, for determine sluggard which belong:

- to mark the symptoms of the condition ability you;
- to determinate the boundary value symptoms of the condition ability,
- to establish the class ability you the object.
- to mark the periodically of diagnosing.

Distinguished tasks diagnostic will be talked over below selectively, near what detailed can their description found in the author works [6, 7].

4. Boundary value symptoms of the condition

Ability task in the formulation symptom is unambiguously it is proper boundary value of the measure symptoms of the state. It is proper the crossing marks you the boundary value of the machine in the state near the quickly of the waste, characteristic oneself the large probability of the sudden breakdown.

Realized often in the industrial practice passive and passive-active experiments diagnostic gives symptoms the state, which compared during infers from it is proper boundary value accessible in many national, foreign, trade norms or with the data from own to experiment. When however lack of such norms from help here push for the studied machine maybe the statistical description of the random process of exploitation for help densely schedule or often the occurrence observed symptom.

It is proper estimation one can realize the border symptom for the safe close of the machine before damaging you for the help of statistical methods.

The formula on delimitation of **Sgr** minimize the probability of the breakdown near set, the admissible probability of the superfluous repair **A** can write down in the figure [1]:

$$Pg \int_{S_{gr}}^{\infty} \left(\frac{S}{X_g} \right) dS = A \qquad (2)$$

where: Pg - the probability ability.

According to Birger [1]: $A = k\,(1-Pg)$, where: k - the coefficient of the store ($k = 1$-3 for usual damages, $k = 3$-10 for dangerous damages), Pg - availability the machines marked from dependence: $Pg = Nz\,/\,Nz + Nn$, where: Nz - the number of machines of fit, Nn-number of machines of unfit.

The row of simple transformations leads in the effect to dependence:

$$S_{gr} = s + \sigma_s \sqrt{\frac{P_g}{2A}} \qquad (3)$$

Received the estimation boundary value symptom leaning on it is proper middle value, he creates good bases to simple marking to dispersal and repair politics it is proper ? you the border studied measures of the state in the industrial practice.

5. Periodically diagnoses

Growth intensity he extorts you occurrence of damages in the measure of wearing away the using potential of the machine the need of the optimization periodically diagnosing. From the course intensity he results the damages of the machine that in the period of the growth intensity should enlarge frequency of diagnosing. This helps the lowering of expenditures on the exploitation of the machine (the decrease: intensive to use up you, the waste of the fuel, equipment exchangeable, materials use) and growing up the costs and hard working of diagnosing, the time turn off the machine as also increases from the use.

The optimization periodically of diagnostic does he move you diagnose to the answer on two basic questions: as to lead diagnosing often? to conduct next diagnosing in what range?.

Several possibility determine the delimitation periodically diagnosing (the method of boundary value the symptoms, the method of the smallest sum costs of exploitation), near what for their realization indispensable numerous are given statistical, inconvenient often (in the sense amount and true to gaining over.

In this work the question periodically of diagnostic were considered diagnosing in formulation symptom, use boundary value of the symptom. The of n-measurements chosen in the separate procedure the measure of the signal (symptom) and the delimitation it is proper on their basis boundary value according to dependence you (2), he exists one need determine the sluggard

of the deadline of next diagnosing td. The essence of the method introduced in works [6, 7] does he show that one marks the deadline of next diagnosing from dependence these (fig. 5):

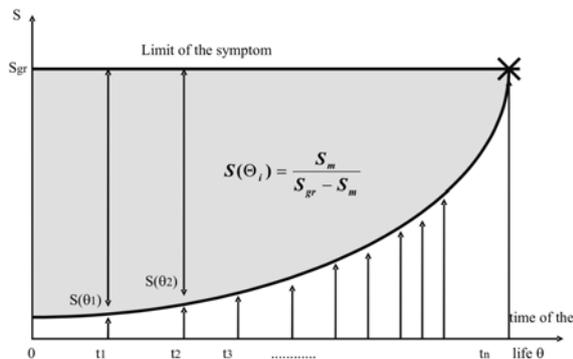$$t_d = \frac{(1 - P_r)(S_{gr} - S_m)}{S_m} \theta m \qquad (4)$$

Fig. 5. Periodically of diagnosing in the formulation symptom

6. Manage the system of exploitation

Every of economic organizations has the determined system of management which he is fulfilling for her of requiring of the strategy accepted in the field of the realization. This particularly essential is for these from they, which have essential influence on the course of the productive process (logistics, exploitation, tools and equipment) or control it is proper durable means about essential, from the point of the sight of the firm, value (maintenance the movement, repairs, survey) [4].

Functions subsystem:
- he leads classification and the record of all durable assets,
- proposes basic index technical-economic,
- he supervises exploitation of durable assets ,
- he analyses given from monitoring and makes decisions,
- he infers liquidation of durable assets,
- he plans, supervises and realizes all kinds review , preservation and repairs,
- he establishes basic norms, records and for led works,
- the supply plans in spare parts and necessary materials to repairs,
- he infers and motivates the leasing, infers and motivates outsourcing,
- organizes storing spare parts you exchangeable, their publication and account for,
- he plans investment tasks, organizes and realizes the purchase of machines and equipment,
- he realizes indispensable building and assembly works,
- organizes the receipt of durable assets,
- he prepares the technologies of repairs.

Analysis the range of functions attributed to realize system can determine, what should sail the groups of the data to him, he what given as also generates.

The model manage was built the system of exploitation on basis of analysis of two basic criteria i.e. flow and type given and realized through individual modules functions. Structure manage of the system of exploitation was introduced on fig.6

together with the flow of the data. Make the structure of the system individual modules realize next basic functions:
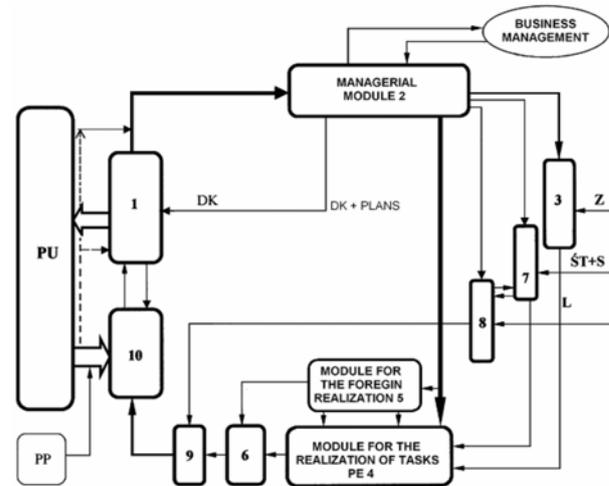

Fig. 6. Model manage the system of exploitation [4]

1. The module of the processing of given responsible too the processing given sent to the system. Just carrier and the media of the broadcast can be considerably diverse.
2. The managerial module, to whose given effect about the various degree of aggregation from the module of the processing of given. One can affirm that he the data is processed according to sets algorithms make the basic gathering for needs manage of SE about 80% these.
3. The logistic module, which delivers indispensable materials, equipment he leads you, the components and standardized machine elements for needs of realized repairs, the stock management and analyses the level of stores, leads the record of given supplies analyses their waste for individual orders, organizes and supervises transportation bought technological equipment, he co-operates from logistics of factory in the range of the economy the scrap-iron.
4. The module of the realization of the tasks which realizes or realization all reviews and lots of supervises of repairs.
5. The module of the strange realization, registration the range of repair works charged the external firm.
6. The module of the control, check quality and range of realized works from the strange realization as also own.
7. The module of the renovation of the technical base, the purchases of machines, renovation and repairs.
8. The module improvement frame, justifications and workers training.
9. The module of accounts, abstract summary compositions as also controls need of the realization of given operations.
10. The module technical realize the functions: planning, constructional, technological, the opinions of the technical state possessed equipment, record and actualization, the emission of records.

PU - the subsystem of the use which exploits machines and equipment.
PP - Remaining subsystem. Reports these subsystem with the system management of using in the smaller degree defined.

The building of the model of the system management of using allows to identify the basic elements of his surroundings, how also modules in the composition subsystem himself.

7. Summary

Accomplishment of the diagnostics of last years, using achieve of many the fields of the science, allow as the tool of formation and opinion of machines, on all stages of their existence. Looking on present trendy developmental machines you should recognize, that present growth their quality is contained you in the sphere their of automating mainly. The guild of measurable becomes automatic accumulating the only objective way it is proper valuation and formation quality of machines.

The range of investigations in the field of the methodology of the diagnostics hugs such questions, how: source of diagnostic information, signals and diagnostic symptoms, the principles of the detailed methods of the diagnostics, modeling in the diagnostics, diagnostic experiments, the aid of the diagnostics modern computer technologies, diagnosing in systems human engineering and social engineering and the organizational and economic aspects of applying the diagnostics. The question these apply in turn to: source of information from the physical side and from the informative side, farther the bases of methods and investigative techniques, simulation and experimenting in the diagnostics and modern inference and visualization of worked out diagnostic-using decisions.

8. References

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