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UNCONVENTIONAL AND HYBRID UNCONVENTIONAL PROCESSES AND PRODUCTION TECHNOLOGIES – INTEGRATION OF THE STUDY AND RESEARCH IN THE UNIVERSITIES OF EASTERN AND CENTRAL EUROPE

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ADVANCED MATERIALS AND OPERATIONS

EDITOR : Aleksandar MAKEDONSKI

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A.I.Makedonski

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Съдържание / Table of Contents

Том I / Vol I

Том II / Vol II

Презентации / Presentations

Том III / Vol III

Aspects Regarding the Wear of Ball-Nose End Mills

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Abstract: *There have been studies over the tool life and wear of the ball-nose end mills, depending on the cutting data, cutting strategy, tool tilting angle, tool coating and so on. The current paper presents the monitoring process of the wear phenomena of this type of tools throughout a finishing operation, under the cutting data recommended by the tool's manufacturer, the tool being positioned vertically while machining a flat surface, in order to get a reference basis needed for further research. In the same time the surface roughness, surface profile and acoustic emissions during the cutting process, as well as the energy consumptions of the machine-tool are being monitored. All these lead to the proper estimation of the tool life with respect to the surface quality as well as to the establishment of a diagnosis methodology for the onset/progress of the tool wear during the cutting process.*

Key words: *ball-nose end mill, wear, tool life, milling*

Aknowledgements

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1. Introduction

There have been many studies carried out concerning the wear of the ball-nose end mill, tilted at different angles to the machined surface, yet there are no studies over the tool wear occurring while being used in vertical position.

Using offset, raster and one way raster strategies (climb milling and conventional milling) [12], [4], [5] have conducted experiments on different quality steels (X40CrMoV5 1, St37-3 and C45), concluding that the best roughness value of the machined surface is obtained when applying the one way raster strategy and climb milling.

On the grounds of the above mentioned hypothesis, an experiment has been set up, involving the milling of a flat surface using ball-nose end mills vertically positioned to evaluate the tool wear and the impact it has upon the quality of the surface, the acoustic emissions and the amount of electric power consumption.

A flat surface has been chosen to be processed, aiming at obtaining reference data to be compared in further research for the case when the tool is tilted at a certain angle with respect to the surface. Another reason for the choice of a flat surface is the fact that cutting operations on complex surfaces are also carried out using 3-axis machines, lacking the possibility of tool tilting or workpiece inclination, except for the case when special a device is being used. Moreover, when cutting complex surfaces, regardless the profile configuration, the tool intermittently comes into a perpendicular position to the surfaced to be machined, provided that there is no option for a constant angle to the surface involved.

The experiments are conducted on the grounds of the experimental directions described in ISO 8688-2/1989 regarding tool life testing for end mill cutters and they come in addition. The above mentioned experiments have been conducted in the RAMIRA S.A. Research Center in Baia Mare, Romania, in an industrial environment.

The target of the current study is to assess the possibility of tool wear detection using acoustic emissions, to find a possible influence of tool wear over the power consumption, as well as to monitor the wear phenomenon while milling flat surfaces with this type of tool in a vertical position.

Cross Section Study of the Uncut Chip in 5 Axes Ball Nose End Milling for the First Geometrical Quadrant of the Tool Inclination

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Abstract: *The current paper looks into and assesses some aspects regarding the geometric simulation of the chip generating mechanism in 5 axis ball nose end milling. The cross section variation of the uncut chip produced by a ball nose cutter is very complicated. The influence of tool inclination, however, was not considered in the machining strategy, starting with the tool path program in CAM software which allows the management of various ways of tool path generation, but cannot decide which one is the best. The present study advances, with minimal approximation, a geometrical method to establish the volume of the uncut chip and area variation of the cross section, obtained in 3D-CAD by four surfaces intersection. Both rotations in 5 axes are considered for the tool, in positive sense (A+ & B+) for 0 to 30 degree range (first geometrical quadrant).*

Key words: *ball nose end mill, uncut chip, cutting edge, cross section area, milling.*

1. Introduction

Complex surface machining by milling is characterized by high production rates, high dimensional and geometrical shape accuracy and roughness of surface and the development of cutting tools provides a competitive alternative to grinding and electrical discharge machining (EDM) [1].

A ball nose end mill, also known as spherical end mill or ball end mill, has a semi-sphere at the tool end. Ball nose end mills are used extensively in the machining of complex surfaces of dies, molds for metal and for plastic injection molding in electronic industry, automotive work pieces, aircraft components (especially frame sections and gas turbine with spline like profile) and in the defense industry.

This modern milling is a universal machining method and during the past few years, along with machine tool developments, milling has evolved into a method that machines a wide range of configurations. Tooling developments have also contributed to the new possibilities along with the gains in productivity, reliability and quality.

More and more complex machining environment and complicated freeform surface challenge users to define more accurate and appropriate tool path and tool postures. By changing from 3-axes to 5-axes milling, cutting efficiency and machining quality could be enhanced a lot. The two more rotary axes (A around X and B around Y) make cutting flexible and efficient, but they also bring some troubles in controlling.

The ball nose end milling has a very complex machining mechanism, as the cutting edge is determined on a spherical surface. When a cutter with a non-flat end, such as a ball nose end mill, is used to cut a target surface with spindle speed ***n***, in bidirectional tool path going from one side to the other and back with feed ***f***, an uncut strip, called cusp, is created between the two cutting passes with radial depth $\mathbf{a_e}$ (Fig. 1).

Interrupted Machining and Its Usability for Ceramic Material More Accurately for Ceramic Inserts DISAL 100

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Abstract:

***In** this article called Interrupted Machining and Its Usability for Ceramic Material is solving suitability of ceramic cutting tools during interrupted machining in the concrete ceramic DISAL 100 from the Czech producer Saint Gobain Advanced Ceramic Turnov. All tests have been performed on a special fixture that has been constructed at Department of Machining and Assembly. As testing material on which were those inserts tested was steel 12050.*

The outcomes were statically processed and evaluated by the help of tables, graphs and their description. The main parameter was number of shocks to total destruction which the tool could withstand. The other parameter which was monitored was surface roughness, due to this parameter it is also important for deciding of optimum cutting conditions.

The method of testing was chosen as slide turning. This decision was determined on the basis of knowledge and accessible possibilities.

Key words: *Interrupted Machining, Statically Processed, Number of Shocks, Roughness,*

1. Introduction

If it is wanted to achieve the best machining result so the most influencing factor is option of cutting tool. That means choice of tool material and its geometry. Another very important factor is choice of cutting parameters. The most influencing parameter is cutting rate then cutting feed and last is choice of cutting depth. But also if everything is adjusted and selected correctly there is always some external influence that can negatively affect the final dimensional accuracy and surface quality. In regime of interrupted machining occurrence of vibration is ordinary which negatively affects the final machined surface.

On this reason it has to be during proposing of all conditions of machining take into consideration not only proposal of tool and cutting parameters but also stiffness of tool and general stiffness of all machine.

The quality of ceramic materials has done a big progress in order to support the ceramic material to use more often even at interrupted machining [3].

2. Chosen Tested Ceramic Material

The division and notation for ceramic material is not so far clearly normed. But generally it is respected accepted following division [1, 4]:

- Aluminum – Oxide based (Al_2O_3)
  Pure
  Mixed
  Reinforced

- Silicon – Nitride based (Si_3N_4)

For entire test was chosen as representative of ceramic which is on base of Al_2O_3, from the Czech producer Saint Gobain Advanced Ceramics Turnov. This ceramic material excels with its high hardness and high wearability even at high cutting temperature (up to 1200°C). This ceramic can be applied at cutting speed up to 1000 $m.min^{-1}$.

Influence of growing feed speed to machined surface quality

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Abstract:

This *paper is called Influence of growing feed speed to machined surface quality. In consequence of competition increasing on our and worlds market shoot up also need loading of modern technology into our companies. Part of these new technologies stool in the area belongs to e.g. electroeroerosion machining, machining by laser and by water jet, but also HSC (high speed cutting). In mentioned experiment we are tested surface after milling by milling cutter with three edges with diameter 18 mm at raising of feed speed we are and evaluated of surface roughness and residual stress below the machined surface. Our results gained at determination of residual stress can be tell, that on the surface negatively functions low feed speed. The best results was achieved at* $v_f = 10$ *m.min*$^{-1}$*. After that value gently grew again. Test data of roughness was not so unambiguous and it is need make next investigation in this direction.*

Key words *– HSC, HFC, surface roughness, residual tension*

1. Introduction

Continuous pressure of competition urges constructors and technologists work on fresh solvings and fumble with a new problems like are e.g.: shortening operations time, improving of surface qualities, quick change of production programmers and so on. Solve these and other aspects used to be their daily chores. Solving of some problems can also be usage of high speed machinig. [4]

2. Conception of HSC and its definition

Single conception of high speed cutting is very relative. It is impossible exactly tell, that the conventional machining press to areas of high speed cutting from definite cutting speed without we would hereat consider to other conditions creative this process. From among these conditions belongs to e.g.: type of machining, but primarily sort of mechanided material. Some of specialists incline to the opinion, that is concerned HSC than, when mean temperature of cutting achieving values near of melting temperature of mechanided material. In practice undertook opinion, that the cutting of high cutting speed proceeds in the area from 600 to the 1800 m.min^{-1}. [2]

2.1 Cutting process at HSC

The cutting velocity increase, up to the area of high-seed cutting, will induce the occurrence of significantly different processes – in comparison with the conventional machining. Under conditions typical for HSC, the chip temperature will increase, close to the melting temperature of the machined material. The excess of a certain value of the cutting velocity will bring about a sudden change in a number of metallurgical and mechanical properties of the removed chip. The chip colour will turn red and even a hardened steel chip will soften and reduce its adherence pressure applied on the cutting edge front face (regarding the prevailing force conditions). The friction force and total value of cutting resistance will decrease, while the shear plane angle will increase, the chip cross section areas will decrease, while its velocity of removal from the contact zone will increase. [1]

Investigations On The Dynamic Characteristics Of The Air Gauges

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Abstract: *In the paper, the investigations on the dynamic properties of air gauges were presented. The measurement of the amplitudes of back-pressure p_k dependent on the input signal circular frequency ω for the group of air gauges with various parameters has been performed. From the obtained results, the time constant was calculated. To evaluate the influence of the measuring chamber volume on the dynamical properties, the set of the model chambers have been prepared with different dimensions. The gained results underwent comparative analysis with the results of investigation of the step response revealing the differences between the setting time values obtained experimentally from different methods. Clear dependence of the dynamical characteristics on the geometric parameters of the air gauge was proved.*

Keywords: air *gage, dimensional measurement, dynamical measurement*

INTRODUCTION

The air gauges have been used as a length measuring devices for decades. They are widely applied in many branches of Mechanical Engineering, especially in in-process control. The main merits of the air gauges are: possibility of non-contact measurement, high accuracy, high sensitivity, high resistance to the external conditions influence and adaptability for the wide range of different measuring applications [1], [2]. When measuring is performed during technological operation (in-process control), or continual data on the profile is to be collected (like in non-contact pneumatic devices for roundness and cylindricity measurement), dynamical properties of the air gauge are of high importance. The examples of the measurement influenced by dynamical characteristics of the air gauges are presented in the Fig. 1 [3]. During the measurement of runout, roundness or profile straightness, the measuring signal continuously changes, and the measurement results are affected by the dynamic error.

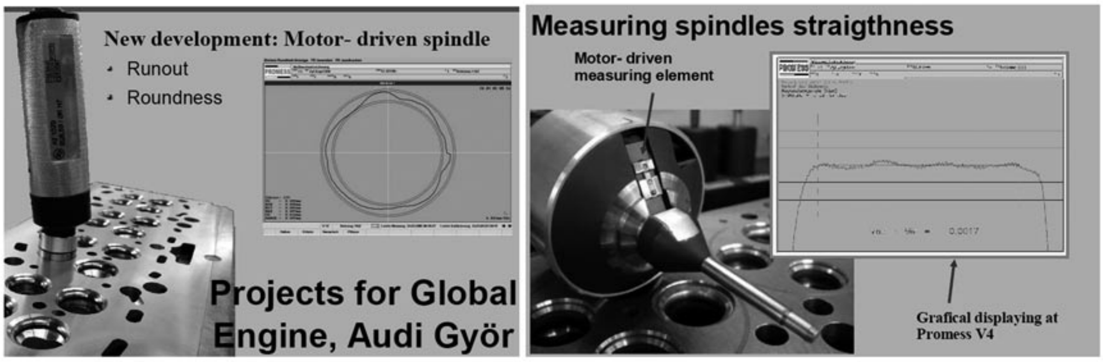

Fig. 1. Examples of the dynamic measurements with the air gauges [3]

The dynamic error *δ(ω)* of a system is defined in literature [4] through the magnitude ratio *M(ω)*:

$$\delta(\omega) = M(\omega) - 1 \qquad (1)$$

where:

$M(\omega) = \dfrac{B}{KA} = \dfrac{1}{\sqrt{1+\omega T}}$ – magnitude ratio,
B – amplitude of the steady response,
K – static sensitivity,
A – input signal amplitude
ω – circular frequency,
T – time constant.

Some Major Effects of the Quality of the Advanced Materials on the Performances of the Worm-Driving Gears

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Abstract: *The researches were done comparatively on different materials starting from a tested reference model whose characteristics achieved a high level of performance. This paper normally reflects on the research regarding the preoccupations and results of the research activities and the production experience which the authors have been working in, in the area of series production of the reduction gears. This paper meets the optimization necessities of the mechanic transmissions and first of all of making products of superior performances and a technical, consumption of materials and energy. In this direction we aimed at a great change of a hint in their construction axial washer which plays a great functional part linked to tribological aspects. The choice of the material as the precision of execution is the principal problems caring the quality as it optimal functions. The research is justified showing some the principal influences maximizing the performances involving the appropriate compositions.*

Key words*: electromechanic actuator, e-creative design, virtual simulation, planetary reductor, efficancy*

1. Introduction

The performances of mechanic transmission with worm-driving gear depend to a great extent on the material of the wormed crowns which have to ensure a resistance to weariness at the lowest contact and gripping stress as well as to the high antifriction characteristics [1]. The optimum solution depends on several factors such as the quality of the material, the sliding speed, the exploitation conditions, the cost price, the weight of the transmission, the kinematic and dynamic performances etc. The most frequently used material at the manufacture of the worm wheels is chosen according to a series of factors such as the physic mechanic characteristics (stressing resistance, braking limit, pitting resistance correlated with the sliding speed between the teeth flanks wearing resistance etc).

This paper emphasis the technological influence of manufacturing materials, in the thermal reaction regarding the resistance at high speed in high working speed published in specialized studies, resulting real possibilities of minimizing the cost of the material and of improving the weariness resistance. The researches aim at the theoretical fundamental objectives, such as the research trials with materials composite with all moulds or copper mould by simple procedures which don't require systems of high performance. The existent achievements as well as the practical vast experience in this field offer many choices according to the different working conditions, which are from certain points of view optimum for that particular goal. Some preoccupations and achievements in this field consisted of the assimilation of some materials and alloys replacing the copper and the tin used at high sliding speeds which should have antifriction properties [2]. There have been made special alloys that don't contain tin but only some linking elements easier accessible established on the basis of some strictly specialized elements, such as: lead, aluminum, copper, silicon, iron, zinc. There are also many researches which recommend the choice of material of the worm-driving wheel according to different parameters such as the sliding speed. [3]

Their importance is great conversing the functionality and the energetic consumption as well as the weight done with the purpose of optimizing this type of axial washer in designing the planetary reduction gears is necessary due to the large series of production as well as their effects on the efficiency and the fiability. The behavior under loading of different synthesis materials proves the decrease of the portent capacity at more reduced values than the initial one in time at the mould of portent capacity and oiled classical washers increases. The applicative and experimental researches viewed the practical checking and the making up of the theoretical patterns used in the output and also convergences to the ways of approaching the problems to reality. The work integrates itself into the present day researches in the field of the development of the modern mechanic transmissions making contributions in their optimal design.

These researches have focused mainly on establishing the best material for the worm-driving wheel. (Fig.1). Compared to the size and the character of the evolution of the weight as well as according to other functional conditions which reflects directly on the quality of the material of bearing, this should be closing to ensure an exploitation with maximum of fiability we especially have to take into consideration aspects such as resistance

Self-propelled rotary tool and wood turning

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Abstract: Self-propelled rotary tool and wood turning. *Machining with self-propelled rotary tools is one of the most dynamical machining processes suitable for machining which poses claims on high surface quality and small cutting forces and which is accompanied by high production of heat. The basic information about principles of this type turning and preliminary results are presented in this article.*

***Key-Words: self-rotating** tool, geometry, design, forces, beech, spruce*

1 INTRODUCTION

Woodpieces made by turning, like plates, bowls or glasses as well as various pieces of art have their place in our everyday life.

Turning or the working method similar to the one which we call turning today has been mentioned already around the year 700 BC. The invention of this „technology" is closely connected with the invention of the wheel itself (app. 3500-3000 BC) as well as with the development of kick wheel and the production of artistic objects.

Only later, the Industrial revolution (the beginning of the 18th century) has brought greater development of technologies in the field of rotating-tool machining. However, the development has already taken place both in the woodworking industry and mechanical engineering. In Fig. 1 is Great Wheel Lathe This example is of interest because of the dual wheels, providing two different turning speeds.

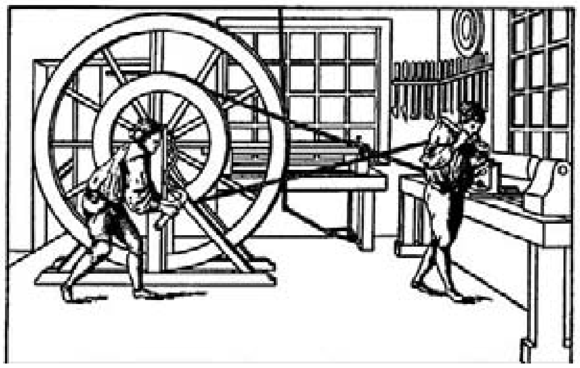

Fig. 1 „Turning" in 18th century
[Scanned from Daumas' A History of Technology & Invention Vol. I.]

2.1 Tools and technology

In this process the component geometry is generated by systematically removing the excess material from a workpiece by means of a cutting tool which interferes with, and moves relative to the workpiece in a predetermined and controlled manner.

Cutting edge of cutting tool with defined cutting edge may be in line, in circle (or only part of circle), or it may be a combination of the previous modifications. Tools with cutting edge in line (fig.2a) are well-know and they are widely spread.

Measurement residual stress for precision milling hardened steel with cubic boron nitride cutting tools.

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Abstract: *Residual stresses resulting from machining operations have important aspects in assessing surface integrity. Even though such residual stresses are limited to a thin surface layer they have a direct influence on performance of the machined component. In general, compressive residual stresses are to be preferred since they improve the fatigue life of parts and increase stress-corrosion cracking resistance, where as tensile residual stresses are usually detrimental to these properties.*

Key Words: *residual stress, precision milling, hardened steel, cubic boron nitride,*

Introduction:

The method of the removed surface layer was used to determine the effect of cutting parameters on the residual stress distribution during the milling process. Electro-chemical or chemical method was selected for removing layers without forces since this method induced practically no additional stresses on the work-piece. The removal of layers of material from the machined surface relieves a portion of the residual stresses and disturbs the existing conditions of equilibrium. This causes the remaining stresses to redistribute themselves and attain a new equilibrium by producing a change of the deflection as the work-piece. Measurements of the changes in deflection can then be used to compute the residual stresses.

The deflection theorem was used to determine the residual stress distribution in the work-piece as a function of the depth beneath the machined surface. The experimental used the deflection-electrochemical etching technique to investigate the relief of residual stress in a given layer (n) of thickness (dt) occurred through the removal of that layer by etching ($\sigma_{1,n}$) and the removal of previous layers by etching ($\sigma_{2,n}$). Therefore, the actual residual stress was the sum of these two components.

Figure. 1 shows the machined work-piece containing residual stress. One end of the beam is fixed in a rigid support and the other end is free. F is an imaginary force in the direction of deflection. If a layer of thickness dt was removed from the machined surface, then the free end will deflect because of the partial relief of the residual stress. The deflection (or displacement) sensed by the linear voltage displacement transducer had a magnitude and direction that depends on the characteristics of the stress in the layer removed.

Figure 1 The layer of machined work-piece containing residual stress

If a layer of the material was removed from the machined surface, then a deflection (δ) was caused because of the partial relief of the residual stress in that layer. Now, the stress in the (n-th) layer due to the removal of this layer can be given by

$$\sigma_{1,n} = \frac{E[2t_0 - (2n-1)dt]^2}{2dt.L^2}(\delta_n - \delta_{n-1})$$

where, E is the modulus of elasticity of the work material, t_0 is the original thickness of the specimen, and L is the length of the specimen.

When a layer of the material was removed from the machined surface, a change in the stress distribution occurred

New possibilities of improving the EDM process

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Abstract: *Researches in the domain of unconventional technologies have been developed in the last 20 years in the Faculty of Machine Building from the Technical University of Cluj-Napoca. The team has focused within some national research projects on micro machining and special applications. Even if it will never be able to compete with the metal cutting manufacturing process in terms of material removal rate, today it is the main manufacturing process of complex die and mould due to the major advantages presented in this paper. The article will present the main parameters of the process that influence the quality of the surface and the possibilities of improving the quality of the surface that is obtained by this process.*

Key words: *EDM, process, machining, surface quality.*

1. Introduction

In 1942 the Lazarenko couple discovered the EDM process. At the beginning it was used only in the military industry. EDM performed a long way till to its present high performances. EDM has appeared as a necessity to manufacture materials with better mechanic and thermal characteristics. The major advantage of EDM in comparison with other manufacturing processes is represented by the fact that the hardness of material is not important, the only condition being that the processed material must be electro conductive [1].

Today, the world is participating at an extraordinary growth of electronic and automatic, aeronautic and special industry, nuclear or micro technologies. All this domains have made the unconventional technologies to arrive in the top of manufacturing processes. This was possible by discovering new materials that are hard and sometimes impossible to be processed with other technologies. The new dimensions in the electronic and automation opened also, the gates for the unconventional technologies to take position in the research departments.

Even if the unconventional technologies are for long time studied, some aspects are not yet perfectly known. For the industry that is using those technologies (for example EDM) is important to know every detail that could influent the quality of the workpiece that is wanted to be manufactured.

One of the most known and studied unconventional process is EDM (Electrical Discharge Machining). The main principle of processing the material, is to copy the form of the work tool into the work piece. Apparently it is a very simple process but it involves many phenomena during the process.

Electric discharge machining process is complex and stochastic in nature. The process involves a combination of several disciplines such as electrodynamics, electromagnetic, thermodynamic, and hydrodynamic making it difficult to present the process in a comprehensive model [2].

In EDM, conductive work piece materials are removed for the purpose of machining in a dielectric by electrical discharge. The material removal results from the erosive effect of subsequent, time wise separated, no stationary or quasistationary discharges between electrodes, i.e., between tool and work piece. Each discharge generates a microscopic removal on the two electrode surface. In principle, the process is based on thermal erosion. Hence, an efficient EDM process can only be realized by a purposefully uneven material removal on the two electrodes. Wire – EDM as kinematical variant of EDM allows hereby the machining or respectively, production of complex geometrical contours.

The properties of diatomic plasma were taken as a constant and the fluid dynamic equation was included in the model. Eubank [3] reported variable mass cylindrical plasma which expands with time. For an EDM process with a current of 2,34 A, the temperature and pressure of the plasma channel were approximated to be 11,210K and 54 bar after 6 µs. Another approximation of plasma channel for micro-EDM process was reported by Dhanik and Joshi (2005) where the temperature and pressure were found to be in the range of 8100±1750K and 6–8 bar, respectively [2,3,4].

One of the parameters that depend on these phenomena is the roughness of the surface obtained by processing a work piece with EDM process [5].

Влияние на комбинираната електрофизична обработка на основните зависими променливи при фрезоване

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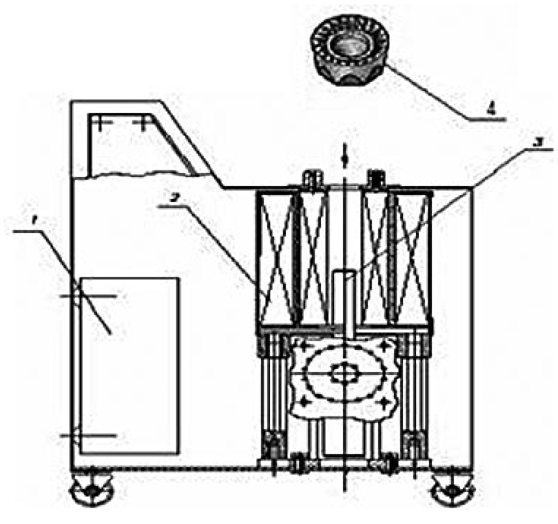
Резюме: *Изследван е ефекта от комбинирана електрофизична обработка върху зависимите променливи-сили на рязане,износване на инструмента и грапавост на обработените повърхнини при фрезоване. Регистрираните резултати се обясняват с настъпилите изменения в условията на триене в процеса на рязане.*
За да се изключи всякакво съмнение, че работата с инструменти предварително подложени на магнитно-ултразвукова обработка води до промяна в условията на рязане и контактното взаимодейдтвие "инструмент-стружка", бяха проведени продължителни и независими сравнителни изследвания за процеса фрезоване в условията на катедра "Производствени технологии"в ТУ-Прага,Р. Чехия.

Ключови думи: *магнитно-ултразвукова обработка ,зависими променливи , самоорганизация.*

1. Въведение

Комбинираната електрофизична обработка на инструментите с цел тяхното уякчаване се свежда до следното. Инструментите се подвеждат в работната зона на устройство (фиг.1) като се подлагат на краткотрайно и едновременно въздействие от постоянно магнитно поле със зададена напрегнатост и ултразвукови колебания с постоянна честота и амплитуда. След обработката инструментите предназначени за обработване на феромагнитни материали се размагнитват[1].

а)



б)

Фиг.1.Устройство "МУЗ-1"а) общ вид б)разрез:-1-ултразвуков генератор, 2-бобини, 3-пиезоелектрическипреобразувател с концентратор и вибраторен прът, 4-пластина

В процеса на рязане действат едновременно редица зависими и независими променливи. Основните независими променливи са материала на инструмента и детайла с неговите физико-химични и механични свойства, геометрията на инструмента, режима на рязане, МОТ, характеристиките на машината-мощност, виброустойчивост и др. Зависимите променливи са тези, повлияни от смяната на независимите променливи, а това са: ъгъл на приплъзване(срязване), форма на стружката, сили и разход на енергия при рязане, износване на инструмента, грапавост и точност на обработваните повърхнини и др.

Мониторинг и диагностика на съгласувани движения за фрезови операции в реконфигурираща се производствена система на базата на iec 61499

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Резюме: *The Reconfigurable Manufacturing Systems (RMS) are the new generation of production equipment. Therefore the development of reconfigurable control system and means for monitoring and diagnosis are very important tasks. The paper outlines a systematic approach for extending the developed control system with monitoring and diagnostic subsystems using IEC61499 based Function Blocks (FB). The approach is illustrated with a case study for distributed motion control of coordinated milling operations on a reconfigurable workstation. Some conclusions and directions of future work are made and discussed.*

Ключови думи: *IEC61499, motion control, coordinate motions, RMS, monitoring and diagnostic.*

1. Въведение

Една от основните задачи за осигуряване на надеждна и сигурна работа на реконфигуриращи се производствени системи (РПС) е разработването на отворена разпределена система за управление, както и системи за мониторинг и диагностика.

Основните изисквания към съвременните методи за мониторинг и диагностика са [5]:
- ранно откриване на неизправности и
- диагностика на неизправности в изпълнителните механизми, и отклонения в процесите.

Най-общо методите за диагностика могат да бъдат класифицирани в две основни групи: количествени и качествени. По-голямо приложение в диагностиката са намерили количествените методи, или така наречените моделно-базирани методи, развиващи се в две основни изследователски направления – методи, базирани на теория на управлението и методи, базирани на логика.

Методите, базирани на теорията на управлението са по-успешни при откриване на неизправности и се делят на методи с наблюдатели на състоянието [6, 7], методи, базирани на оценката на параметри [8] и методи на паритетните пространства [9].

Методите, базирани на логика, са компонентно-ориентирани [10], като са приложими за диагностика на множество от неизправности и не изискват предварителното им дефиниране, като допускат диагностика при много на брой и различни режими. Едни от най-известните представители на този клас методи са методът на логическото съгласуване [11], различни методи базирани на автомати, мрежи на Петри [12] и др.

Основните изисквания към диагностичните системи в машиностроенето са систематизирани от [13]: модулност, реконфигурираща се структура, възможност за измерване и преработване на голям брой аналогови/цифрови сигнали, способност за взимане на сложни, многопараметрични решения.

В последните години в областта на разпределеното управление на базата на стандарта IEC-61499 [1] са осъществени много научни разработки. В [14, 15 и 16] са докладвани различни разработки за проектиране на разпределени системи за управление на базата на IEC-61499, но не и в областта на диагностиката.

Стандартът IEC-61499 се явява продължение на съществуващите вече стандарти IEC-61131-3 [2] за програмиране на програмируеми логически контролери (PLC) и IEC-61804 [3] в областта на разпределените системи за управление на непрекъснати производства (DCS).

Тук се предлага подход за изграждане на разпределена система за мониторинг и диагностика на коорди-

Possibilities Of Wood Gas Application In Combustion Engines

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Abstract: *Wood matter gasification represents one of the ways of alternative exploitation of wood matter in power engineering. The article deals with possibilities of wood gas application in combustion engines. Wood gas should be purified for this kind of utilization. The paper deals with filter efficiency and effectiveness evaluation by means of adsorption cartridge filters. The evaluation was carried out on a basis of determination of the ingoing and outgoing change of solid particles concentration in wood gas during a continuous 4 – hours loading. The evaluating criterion was an acceptable value of contaminants in wood gas for its utilization in combustion engines.*

Key words: *wood gas, combustion engine, contaminants, adsorption cartridge filter, filter efficiency*

Introduction

One of the possibilities of solution of the increasing deficit of classic fossil fuels is searching for alternative energy sources and also improving the existing energy sources. Today it already participates in worldwide consumption of primary energy sources with a share of 14 %. Replacement of fossil fuels by biomass has apart from a relatively easy availability also a positive environmental impact. Significant amount of suplhur as well as CO_2 is released into the air by burning of fossil fuels. Other important aspects of Slovakia's orientation on energy from wood is the insufficiency of its own fossil fuels, tendency for energy independence on import of fossil energy resources and fuels, lowering of transport costs and the above mentioned positive environmental influence of biomass burning. The foremost is however the lower price of wood as a fuel in comparison with other types of fuels. Forests cover up to 40 % of the area of Slovakia, whereby they represent a huge potential also from the viewpoint of accumulated energy. Currently gasifiers of outputs starting from a few tens of kW up to a few hundred MW units start to appear in developed countries in experimental as well as commercial operations.

1. Wood gasification and purification of wood gas

Gasification is a process during which the combustible share of solid fuel is transformed to gas fuel. This process takes place by the influence of high temperature and by limited access of oxygen. The result of wood gasification is gas fuel – wood (generator) gas with thermal value of 4,5–6,9 MJ.m-3 and 1,6–1,9 mn3 of generator gas is extracted from 1 kg of dry wood. The forming mix of gases has a high energy value and may be used as other gas fuels, for production of heat and electricity and also in motor vehicles. However this gas leads to a lower engine output in vehicles by about 40 %. The composition of wood gas significantly fluctuates and depends on several factors. The share of combustible gases in wood gas represents roughly 40 %, it is mainly carbon monoxide CO (17 – 22 %), hydrogen H_2 (12 – 20 %) and methane CH_4 (2- 3%). The share of noncombustible gases is 60 % in total, from which the nitrogen N_2 (50 – 54 %) is predominant, furthermore carbon dioxide CO_2 (9 – 15%). Apart from the mentioned components the raw wood gas contains also other – undesirable admixtures, such as water vapour, higher hydrocarbons – tars, acetic acid and also solid contaminating substances. The main obstacle which prevents expansion of gasification technologies is the necessity to comply with requirements on pureness of the produced gas. The produced wood gas contains large amount of dust particles and tars, therefore contaminants which it is necessary to remove from gas. The experience has shown that these contaminants are the main causes of engine damage as well as extreme maintenance costs of engines powered by wood gas. Contaminants content in wood gas is dependent on gasification technology (on type of gasification generator as well as gasification media) and on fuel characteristics. A comparison of parameters of various types of gasification generators with specified concentration of tars is shown in tab 1.

Intelligent Assembly Systems

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Abstract

***In** present time are used new trends in industrial production as are flexibility and intelligence. That means as new generation of intelligent production systems. The flexible manufacturing and assembly system is projected in the flexible production. That means production of typical type and characteristic width of products with frequently modification of production program. The sensor system and control system define the degree of intelligence in the assembly system.*

Key Words: *production system, assembly system, intelligent production system, intelligent assembly system*

Introduction

In the past mass production was dominating. In these days following to the globalization, small or middle series production is dominating. These kinds of manufacture are usually oriented to the individual customer requirements, what is called individual customer strategy. Rising requirements are giving to the production. Competitiveness of some factory on the market has to be ensured by some good business strategy. Basic condition for this is high manufacture flexibility of high quality products in low costs. Product ranges are widened and innovation cycles are shortened. Products are changing its shapes, material, and they receive new functions. With such strategy, traditional known costs are not so important, but really important cost is the manufacturing time. That why production time shortening is very important. Time oriented strategy needs pass over from traditional functional manufacture structure to the manufacture oriented in flexible manufacturing cells. Cell oriented production, in last years, becomes to be one of the most important conceptions of manufacturing system organization. Its manufacturing philosophy is based on the similarity of:

- Manufactured products shape
- Manufacturing process

Products likeness ensures its grouping to the similar groups following to the manufacturing machines. This way economical effect of mass production can be done. Cell structures has bound machines, they save time and also the space. If more machines is integrated in to the one cell, their production is synchronized and material flow is fast.

- Most important effects which are coming from cell production are:
- Manufacturing process time reduction
- Working out manufacture reduction
- Stocks reduction
- Manufacturing costs reduction
- Rigid reaction ability to the market requirements
- Higher machine usage
- Redistributing times reduction
- Quality increase
- Material and manufacturing documentation circulation reduction
- Stock material volume reduction
- Manufacturing space reduction

Clamping Devices for Intelligent Production Systems

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Abstract
*Within solving the project „***Intelligent Assembling Cell***" in UVSM this paper goes into concepts like production system, intelligent production system, clamping system. Further it addresses characteristics, division and requirements of clamping systems used in intelligent production systems. Assembly is a part of production process and that´s why assembly systems are included in production systems.*

Key Words: *production system, intelligent production system, clamping system*

Introduction

Before mentioning clamping device for intelligent production systems it is necessary to clarify the terms: production system, flexible production system and intelligent production system. The mentioned terms are not clearly defined in any standard and this is a reason of their different interpretation in literature.

The paper also addresses the concept of clamping system what is actually one of subsystems of the production system. The clamping system itself consists of main and auxiliary structural elements, driving mechanism, control system including monitoring elements. Clamping systems determined for intelligent production systems have to satisfy special requirements.

1. Term of Production System

Production System

The term of production system is not clearly defined, in available literature there appear even several definitions of the term –production system-.

For example the production system can be understood as units beginning from an individual machine and group of machines up to the whole plant including construction and assembly.

Another interpretation of the term: The production system can be defined as a group of production machines consisting of several subsystems the role of which is to execute a specified production process aimed at processing a semi-product into a required finished product.

Production system can be divided into two main subsystems:
- Subsystem providing for the production process itself,
- Subsystem providing for preparation and control of the production process.

Based on production process it is possible to divide the production system core into individual subsystems:
- Control and information,
- Technological,
- Handling and transport,
- Measurement and checking,
- Storage.

Application of artificial intelligence in manufacturing systems

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***The** goal of this work is the application of Artificial intelligence (AI) in the manufacturing process. The manufacturing process consists of the conveyor belt, vision system, SCARA robot and palletizing system. The AI solution was chosen for the advantages that it offers and it is applied in the machine vision system. The main goal of this application is to obtain real time analyses of the product position on the moving conveyor, the position is sent to the SCARA robot controller, which relocate the product from the moving conveyor to the palletizing system. The real time analyses is obtained from the three camera signals in high resolution which means high data flow that causes the time consumption and decrease the time reserved for the robot as the slowest part of the system. To decrease this time delay, there was an AI solution developed, based on the use of artificial neural networks working as a pattern recognition system and offers short time response.*

1. Introduction

Application of artificial intelligence in the manufacturing process offers a wide area of possibilities. It is usually in based on pattern recognition systems. This work describes the use of artificial neural network as the pattern recognition system for product localization on the moving conveyor. It focuses on positive aspects of this solution such as parallel computing that offers time gain even when the system is developed under robust development environment without any need of portage to low level devices.

2. Description of problem

We have a conveyor with a product buffer which corresponds to the product manufacturing process. From this buffer articles are released to the conveyor. On the conveyor the products are captured by the camera to obtain the position, quality and quantity characteristics. The camera signal is preprocessed and processed. Then the program under the analyzed information is generated and sent to the robot controller via the serial link connection so that the SCARA robot can pick up the article and move it to the palletizing system which transport it to the next part of manufacturing system.

3. Machine vision system

The vision system is developed under three signals form industrial cameras. The choice of three cameras was decided because of the complex possibility to analyze three dimensional constitution of the subject, even if for the product localization there is a need of at least one camera signal. For this solution was used the Basler camera with 33fps capture speed, SVGA resolution, 1394b firewire interface. They are connected to Pc via NI measurement card with PCI-e interface. The captured signal is preprocessed as we can see it in Fig.1.

Testing of accuracy of machined parts for transmission gearbox of electric locomotive

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Abstract: *This paper deals with technological aspects and accuracy of transmission gearbox component production for drive of electric locomotive. The accuracy has been analysed after heat treatment of components using cementation process and machining using carbide inserts. The results of measurements of 4 dimensions of hard turned geared surfaces (60 HRC) on both gears in pair. Practical achievements will be applied for improvement of the gearbox production.*

***Keywords: Claw** coupling, accuracy, Student distribution*

Introduction

Company "ĐĐ Montaža" is for many years engaged in the production of electric locomotives couplings. Within this production, processing of materials with chip removal processes has a very great significance. Machined surfaces of these parts are exposed to high loadings during exploatation and therefore the high quality of parts is required, and the minimum thrust and radial deviation allowed. When machining technology for this production is determining, it is necessary to take into account the specific technical requirements and features that were raised before the chip removal process starts. Nowday, when chip removal process has to achieve the required precision, better mechanical properties with the shorter machining time has to be conducted. But the biggest role in defining the technology of chip removal processes has a material that is processed and the tool that has to withstand processing conditions (regimes) that sets the material to this process going as soon as possible. Figure 1 shows one oft he ready to use coupling [1].

Fig. 1 Displaying claw coupling

1 Material for making of gearbox

material for making of gear (claw coupling) is the steel DIN 15 Ni – Cr 6, which according to HRN norms is signed as Č 5420, and is a steel for cementation process. The basic objective of cementation process is the enrichment of carbon content in surface layers of steel (preferred content is 0.8% C), obtain a hard surface layer (min 60 HRC) resistant to wear, and that material in higher depts keep this low carbon content (with < 0,25% C) and stay tough (shock resistant). Depth of cementation layer is 0,7 – 1,1 mm, temperature of cementations process is 800 – 1000 °C.

2 Technology requirements for machining [2]

Figure 2 represents the coupling with its constituent parts. There are different types of technological requirements that occur when processing of material with separation of particles, and in the preparation of claw cou-

Quality Management System With Non-Contact Pneumatic Measurement

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Abstract: *In the paper, the main characteristics of the Quality Management System have been presented. As one of the solutions for the in-process control, the air gauges controlled by PNEUTRONIK devices has been presented. Air gauging could provide a non-contact measurement with high resistance to dirt, wear and tear, vibrations and so on, and of high accuracy and reliability. Also, the pressure signal could be easily converted into electronic one and processed in the way required by the Quality Management System.*

Keywords: air *gage, dimensional measurement, Quality Management, surface topography, thermal diagnostics*

Introduction

According to standards ISO 9000:2001 the supervision of whole manufacturing process should be done. The purpose of the Standard had been creation of better solutions of combined quality systems (PN-EN ISO 9001:2001), environmental management (PN-EN ISO 14001) and work safety (PN-N-18001) [1, 2, 3]. According the Standard PN-EN ISO 9001:2001, Quality Management covers the whole life-cycle of product, from the market investigations up to after-sale service. Various parameter may be pointed out and underwent thorough inspection and analysis. Among others, they are parameters of the roughness and 3D surface topography or dimensions. Also the thermal diagnostics could become a part of the Quality Management System and provide important information on the functional abilities of the machines, their malfunctions and inaccuracy.

The main principles of the quality management

Any process may become a subject of Quality Management. The Standard PN-EN ISO 9001:2001 considers as a process any operation which accepts the input goods and transform them into output ones. Hence, all the actions and operations with products or services are processes. The general process model is shown in the Fig. 1.

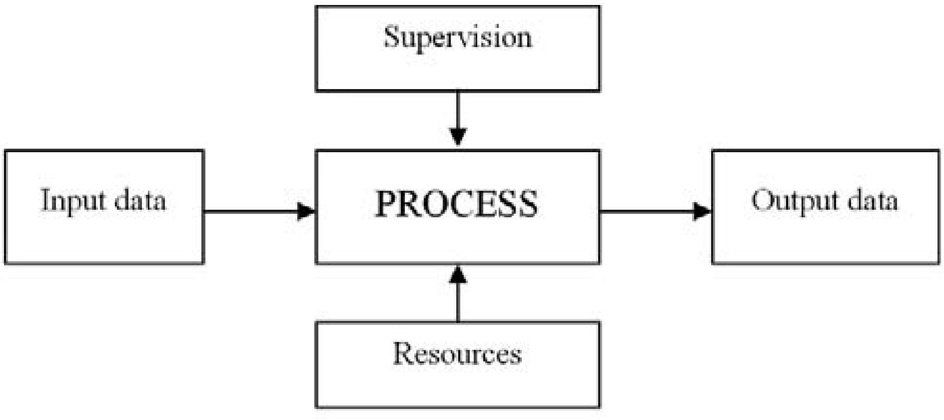

Fig. 1. General model of the process

The process approach of the Standard should help to conduct the enterprise and its processes management. Often the result of one process is the input for the next one. So, the systematical identification and proper management of various processes and their connections is required. Process model ensures the content and logical connection between particular elements of system with emphasize of quality planning. The cycle P → D → C → A is introduced (planning, execution, measurement and analysis, correction and improvement).

The main principles of the Quality Management may be specified as following [4]:
Principle 1: Customer focus.

Calibration Of Measures As A Basis For Product Quality Assurance

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Abstract *: This article explains the method of calculation of the random error and uncertainty of a calliper, a procedure which must be performed every time a measuring tool is being calibrated. Callipers are used in all branches and types of industry. Each measurement and every measured value are influenced by various mistakes, errors and deviations. These are due to several factors – imprecision of measuring tools and methods, environment as well as the human factor. It is therefore imperative that the standard deviation accompany the measured result and thus compensate for the random error with a range of probable values. Measuring procedures are to be considered as a special means of sustaining the high quality of a company's produce and calibration plays an important role in the quality maintenance.*

Key words *: calibration, measuring tool error, standard deviation, calliper, quality.*

Introduction

each system of management comprises a subsystem – the system of measurement management. In general, it can be defined as an ensemble of mutually interacting or interconnected elements which are necessary in order to metrologically confirm the quality of the performed measurements and to maintain the control of the measuring process. This subsystem is closely described in the international norm ISO10012:2003 – Systems of Measurement Management, Measuring tools and instruments requirements [3]. The norm ISO 9001:2008, Systems of Quality Management, Requirements contains the requirement no. 8 "Measurement, analysis and improvement" which also helps to monitor and improve the measuring process [4]. The outcome of a production process is manufactured goods that ought to be reliably controlled. In order to maintain such control, calibrated measuring tools must be implemented. The use of calibrated measuring tools is highly recommended in any organisation which insists on the product quality, whatever is the field of industry. Poor quality leads to decrease in clientele, loss of market position, increase of waste and customer complaints.

1. Definition of the total error of a calliper

Calibration is understood as a system of procedures which create a relation between the values indicated by the measuring tools and the corresponding values of the measured object.

Each measuring process is subject to mistakes which are caused by the imperfection of our senses, the imprecision of measuring tools and the impossibility to assure identical measuring conditions such as stability of temperature, atmospheric pressure and humidity, etc. The measured value can be subsequently influenced by other external forces which cannot be completely eliminated. Even if we try to diminish all the disturbing elements, we must be aware of the fact that perfectly accurate measurements do not exist, especially as the very process of measurement changes the measured object. That is why the measured value can never be totally identical with the physical value. Measuring tool error can be defined as a measuring tool indication minus measured object value. Errors can be divided into gross errors (not a part of the total error), systematic errors, random errors. To define the total measuring error of a calliper, various fixed length end gauges have been used. The results are shown in the table no.1 below.

Tested length (mm)	Maximum acceptable error (μm)	Upper limit of the measurement range (mm)	
		150	200
0,0	± 20	X	X
23,4	± 21	X	X
64,5	± 23	X	X
124,5	± 26	X	X
141,9	± 27	X	
171,9	± 29		X

Table no.1 Tested values and the maximum errors for callipers with a scale segment of 0,01 mm

Analysis Of Intermittent Motion Mechanisms Adjustment

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Abstract: *In order to design a new manipulative system with intermittent motion, an analysis of purely mechanical solutions is performed. Attention is payed specually on possibilities for adjustment of output displacement. Design solutions are chosen based on simple lever and cam mechanisms combined with one-way clutch. Regulation parameter which is most convenient from the design point of view is picked up and regulation equations are developed. Calculation of adjustment characteristics for various mechanisms with different output motion interval and different design parameters is performed in order to evaluate it for the proposed task .*

Key Words: *Mechanisms, intermittent motion, regulation*

1. Introduction

A great number of mechanical systems in various machines and devices have such a motion characteristics that, for continuous input motion, output motion achieve intervals of dwell as well as intervals of motion. This kind of mechanisms is known as intermittent mechanisms.

In order to design a new mechanical system for adjustable intermittent motion [4], a feasibility study was conducted [1]. It was observed that specialized intermittent mechanisms such as Geneva mechanism, ratchet mechanism and others, due to its structure, can not provide continuous regulation, but a discrete one with relatively great steps, and are therefore not suitable for the proposed task. Instead, a solution is found in combination of a mechanism that gives oscillating output motion with a one-way clutch which is placed after it. After the evaluation, we proposed several design solutions: inverted slider-crank, fourbar linkage and two types of simple cam mechanisms, for a main part of an assembly. General appearance of combined mechanism-one way clutch assembly can be seen in [1].

All of previously mentioned mechanisms can be easily adjusted in order to precisely regulate output motion interval. Detailed analysis of regulation properties of those mechanisms is the topic of this paper.

2. General considerations

2.1 Regulation of intermittent motion

Two important parameters of intermittent motion are: displacement interval (angle or length) that is achieved in the motion period and working coefficient that presents ratio of working and idle time. The main issue in design of intermittent motion mechanical system is assuring that those parameters can be regulated. From the design point of view, an important problem is the amount of regulation. Higher amount is used to change working parameters system. In this case, regulation can be discrete and can be accom-plished by exchange of some system element (taking a new rod of different length, new cam plate etc.). Smaller amount of regulation - adjustment is used to correct errors occurring in machining, assembly or production. Adjustment must be continuous and must be accomplished by variation of some design parameter (location of joints, element lengths etc.). The choice of adjustable design parameter is as much a matter of design as a matter of kinematic-dynamic analysis of the system. The later analysis has to state influence of regulation parameter variation to functional, kinematic and dynamic behavior of the system.

In this analysis we will discuss only an adjustment problem. In the calculation we will assume that required amount of adjustment will be 2 percents of an output interval. The working coefficient problem will not be addressed because of two reasons: first, a small adjustment of design parameter will mean also small change of working coefficient and second, in our particular design, it is not the working coefficient that is important but rather the actual idle time whose small change will not endangered the system functioning

Индекс / Index

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