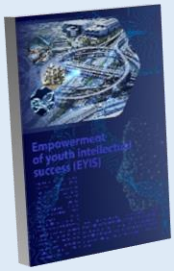

Methods of designing machine mechanisms

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Annotatsiya

Examines the basic principles of machine mechanism design methods and techniques. The concept of the project, its structure, and how to provide the necessary actions of the mechanism to perform various tasks are discussed. In the design of mechanisms, theories, and methods are presented for the transformation of motion in various forms, for example, turning rotary motion into rectilinear motion or vice versa, as well as the synthesis of mechanisms. Also, detailed information is given on how to satisfy and optimize various structural conditions, taking into account the synthesis, kinematic, and dynamic characteristics of mechanisms. The advantages and disadvantages of higher and lower pair mechanisms in providing the necessary types of movement for technological processes are also considered.

Kalit so'zlar: Project, Mechanism ,Motion transmission, Kinematic synthesis, Dynamic synthesis, Theory of mechanisms, Technological process, Krivoship, Grasgoff's rule, Theory of machines and mechanisms, Cars, Synthesis of mechanisms

The project comes from the Latin verb procedure, "before action, " which in turn comes from pro-, which means priority (something that precedes something else in time (Greek prō), and sincere, "to do"). Thus, the word "project" originally meant "before action."

Project — 1) a set of documents (calculations, drawings, models) prepared for building a building, or structure or creating a specific item. L. of a certain building or structure can be individually or in the same order. Currently, L. of various organizations. There are special and design institutes, departments, and other creative associations that fulfill orders (see Design); 2) prepared text of a document; 3) plan, goal, and idea.

A project is any carefully planned undertaking, either individually or collaboratively, involving research or design, to achieve a specific goal.

An alternative view of a project from a management perspective is based on a sequence of events: "a set of interrelated tasks that must be completed within a specified time and specified costs and other constraints."

It should be a temporary social system (work system), perhaps staffed to perform specific tasks under time constraints.

A project can form part of program management or can work as a dedicated system.

Mechanism (Greek: mechane - weapon, structure) is a device that converts the movement of one or more bodies into known movements of other bodies. It is the basis of most machines and is used in many tools, equipment, and technical devices. Depending on the task, M. is the transmitter of the action; executor (executor); manager, supervisor, and adjuster; provider, sorter, and carrier; there will be M.s. who counts, weighs, and places products.

Motion-converting machines convert energy into mechanical work or mechanical work into another form of energy (machine, motor, pump, compressor, etc.). Each transmission M. transmits the movement received from the engine (reducing the rotation speed of the shaft) to technological machines or executive M. Actuator M. directly affects the environment or object being processed (for example, the pressing mechanism of the press, the spindles of the cotton picking machine, etc.). Controlling, monitoring and adjusting devices include devices that control the technological process, regulators, fluid level and pressure control devices. Feeder, sorter and carrier machines include augers, bucket elevators, mechanical sieves, and others. Machines that automatically count, pack, and place finished products are mainly intended for grain products that are produced in large numbers. Such M. can be executive M. in special machines (for example, tea measuring and placing part of a tea packing machine).

In today's technology, the main issue of mechanism design is the conversion of movement from one type to another, which mainly includes the following: 1) rotational movement around one axis into another axis put into action; 2) turning circular motion around one axis into straight line motion; 3) turning a straight hara kat into a circular motion; 4) converting a straight line movement into another straight line movement; 5) moving one of the points in the mechanism to the required trajectory in the technological process. To implement the above, the laws of motion of two joints that transmit motion to each other should be given concerning time. To lower a point in the mechanism to the trajectory required in the technological process, this trajectory must be given analytically (with the help of an equation) or through the points lying on this trajectory, i.e. graphically. Often, the problem of performing a given action is better solved by mechanisms with lower and higher pairs than by a mechanism with lower pairs. This is because, in a plane, the lower pairs consist of only two pairs - the rotation and the forward pairs, while the higher pairs have many types. For this reason, in modern technology, mechanisms with upper and lower pairs are used for the exact implementation of the types of movement required for technological processes, and only using mechanisms with lower pairs, the required type of movement is created approximately. Therefore, it is up to the designer to choose a mechanism depending on the importance of the movement in the technological process. An objective function or optimization criterion is an expression in the form of a functional relation whose extremum determines the desired values of the output parameters. Constant value parameters defining the kinematic scheme of the mechanism include lengths, masses,

moments of inertia of joints, states of points that draw the desired trajectory or have given speeds and accelerations, etc. Among these parameters, functionally independent ones are called synthesis parameters. Some of the synthesis parameters, which are called input parameters, are given as initial data. Another part determined as a result of the synthesis is the output parameters. For example, when synthesizing a four-link planar mechanism m (Fig. VIII.1), which must draw a curve according to the given equation y = y (x), point B on the ABC rod, up to eight parameters (a, b, c, d, k, b, x A, y A) can participate as output parameters of this equation. As mentioned above, in the design of the scheme of the mechanism that provides the required characteristics, it is necessary to satisfy several and often conflicting conditions. Usually, one of these conditions, which must be fully and precisely fulfilled, is accepted as the main condition. All the conditions obtained by Q are called additional conditions, and if they are valuable quantities, then restrictions on these values (for example, limit the length of joints, limit the overall dimensions of the mechanism, must have one or two elbows in the mechanism, etc.) is determined.

The nature of the main condition determines the type of synthesis (kinematic or dynamic), and additional conditions can be both kinematic and dynamic. If it is difficult to distinguish the main one among the set conditions, then several objective functions are created and a compromise solution that satisfies all of them is sought. Additional conditions are usually expressed in the form of inequalities that define the fields of existence of synthesis parameters. Therefore, when calculating the objective function, only solutions that satisfy these areas are determined. VIII.1 - form In today's technology, mechanisms with a pair of sheep are used a lot. Various mechanisms, tools, and machine parts (joints) are often connected through hinges or other means. Most mechanisms consist of a set of joints connected by pairs. The advantages of kinematic pairs are that their element consists of a plane or surface, and the specific pressure per unit surface of such elements is smaller than that of other kinematic pairs, so such pairs are resistant and die. Will work for a while. On the other hand, the technology of processing the elements of small kinematic pairs is also easy. The elements of the kinematic pairs are planar, cylindrical, and consist of a surface. The preparation of such surfaces is well established in the current engineering technology. Thirdly, kinematic locking of sheep pairs without additional means (spring or other means) is very convenient. The disadvantage of mechanisms made up of kinematic pairs is that it is not always possible to obtain the desired law of motion of the leading (working) joint using them. Doing this kind of work causes the number of links in the mechanism to increase. An increase in the number of joints increases the kinematic and dynamic sensitivity of mechanisms. This means that if the number of joints in the mechanism increases, the elements of the kinematic pair in them will wear out due to friction, due to the presence of a gap in the elements of the kinematic pair, some errors will be allowed in the transmission of motion, as a result of which the leading the law of motion of the hinge point will be different from the law we want. Behind this, the forces also change and destroy the normal progress of the technological process. Let's get acquainted with the main essence of the design of mechanisms consisting of kinematic pairs. It is known that any mechanism serves to ensure the necessary and predetermined movement of the driving link included in its composition for a technological process.

This movement of the driving joint depends on many factors. These factors include kinematic parameters, such as the law of motion of the driving joint, the lengths of the joints in the mechanism, and the linear dimensions that determine the states of the kinematic couple moving forward. Therefore, based on the kinematic parameters, a kinematic diagram of the mechanism is created.

According to the conditions of movement of this driving joint, determining the parameters of the kinematic scheme of the mechanism is the basic issue of mechanism design. If we create a kinematic diagram of the mechanism that provides the movement of the leading joint intended for technological work and know the lengths of the joints in it, we will solve the main part of the problem, because the rest of the problems are part of this mechanism It is concerned with testing the movement of gears, ensuring their stability and determining how economically useful or other aspects of this mechanism are, which are related to other disciplines - mathematics, the resistance of materials, machinery details, the theory of vibrations, engineering economics and the like will be solved with the participation of others. In general, the creation of a machine or mechanism begins with the creation of a rational kinematic scheme of this mechanism or machine. The remaining issues are solved by various branches of mechanical engineering. The condition of the existence of the kinship. When synthesizing the mechanism, their flexibility (the presence of one or two curves), which depends on the ratio of the lengths of the joints, is its important kinematic feature. First, let's consider the hinged, four-joint flat ABCD mechanism (VIII.2 - figure, a) with the length of the joints equal to a, b, c, and d. For the joint AB to become a curve, it must pass through the left (AB 1) and right (AB 3) states during rotation. Assuming that a is the length of the shortest joint, and d is the length of the longest joint, and using the known relationship between the lengths of the sides of a triangle (the length of any side of a triangle is less than the sum of the lengths of its other sides) let's write the equal traces in the following: d+a b+c <from triangle B1C1D, (VIII .1) d - a <b+c from triangle B3C3D, (VIII .2) regardless of the relation of lengths b and c, inequality (IX .1) always ensures that inequality (IX .2) is fulfilled. If the joint BC or CD is the longest joint (b >c>d or c >b>d) then the inequality (VIII .1) is only strengthened. States AB2 and AB4 represent the edge states of CD harmonics. VIII .2 - figure, according to a, the joint BC cannot fully rotate concerning the fixed AD, and therefore it is a connecting rod. Inequality (VIII . 1) allows us to generalize the condition of turning a hinged, four-joint planar mechanism as follows: the shortest and the longest link in the hinged four-joint mechanism is the sum of the gins. If the sum of the remaining links is less than the sum, then the shortest link can be a curvilinear one. This rule is called Grasgoff's rule. According to this rule, articulated, four-joint mechanisms can be divided into three categories: - if the dimensions of the joints meet the requirements of the rule and the joint located next to the shortest joint is fixed, such a mechanism will be a rivalship-coronal mechanism (VIII.1 - figure, a); - if the sum of the lengths of the shortest and longest joints is less than the sum of the lengths of the remaining joints and the shortest joint is immovable (fixed joint in), this mechanism is two-curved, this rule follows from the following condition: if, following Grasgoff's rule, the curved vessel is fixed and can fully rotate concerning the connecting rod, then these links are also can turn full circle concerning the curve;

machines and mechanisms is the science of studying the properties common to machines and mechanisms and the general methods of their design. It is divided into the so-called theory of mechanisms and the theory of machines. In the theory of mechanisms, the properties common to all mechanisms (or groups of mechanisms) of a machine, tool, or apparatus are studied. In the theory of machines, methods common to machines in various fields of technology are studied. These two parts are closely related to each other because mechanisms are the basis of any machine.

M. and M. can be divided into three sections: synthesis of mechanisms, dynamics of machines and mechanisms, and theory of automatic machines. Synthesis of mechanisms deals with the selection of a scheme that ensures the execution of a certain action and finding the parameters of this scheme. In the theory of automatic machines, the methods of creating a scheme of operation of certain mechanisms and achieving optimal productivity, accuracy, and accuracy of machines are developed. The procedure for solving the problems of the synthesis of mechanisms can be divided into three stages. The first stage is the selection of the main criteria and conditions of the synthesis, that is, the formulation of requirements. In this case, technological and constructive issues become mathematical issues. The second step is to determine the analytical expression of the function representing the value of the main criterion of the synthesis. The main criterion is selected depending on the function of the mechanism. For some mechanisms, its analytical expression is very complicated. The third step is to calculate the constant parameters of the mechanism using the optimization conditions of the main criterion, taking into account the constraint conditions. In this case, it is necessary to solve one or more systems of equations and equations. In the theory of automatic machines, methods based on the application of logical algebra have become widespread. These methods are called logical synthesis of control systems. In control systems, together with electric elements, pneumatic elements are used. The development of methods for designing robots has been one of the most recent advances in the theory of automatic machines.

M. and mn are also involved in the mechanics of structures in relative motion. Because the laws of theoretical mechanics are directly applied to machines and mechanisms, M. and mn are called machine mechanics for short.

M. and m, the parts (links) of the mechanism are considered absolute solid bodies. When studying the kinematics of machines and mechanisms, the number of revolutions of the leading link (for example, crank) in the mechanism is assumed to be constant. In M. and m, length (S) is measured in meters, time (t) is measured in seconds, and force (G) is measured in newtons. For example, the unit of measurement of speed (g>): M. and mn apply the principles of mechanics of solid and liquid bodies, mathematics, and drawing geometry to solve concrete problems in technology.

Machines and mechanisms since ancient times. For example, machine details such as lever, lever, and block are associated with Aristotle's name. Information about them can also be found in the works of Archimedes (see Archimedes vin-ti), Geron. Abu Ali ibn Sina in his work "Measure of the Mind" explained in detail the principle of operation of mechanical systems consisting of levers, blocks, screws, and bolts, there is also information about mechanisms in the works of Abu Rayhan Beruni, Ahmad al-Farghani (see also Mechanics).

Requirements for the creation of machines. As we all know, when creating machines or mechanisms, there are requirements for them, and they consist of the following. 1. Technical requirements - it mainly requires high productivity of the machine, accurate movement, and production of quality products. 2. The rationality of the construction - it requires the absence of overweight parts of the machine, the correct selection of materials, and the optimal stress on the details. When it is required to control machines or mechanisms according to their parameters, the following parameters are considered.

Machines and mechanisms in the production of material wealth are increasing today more than ever. Machines are replacing manual labor in various areas of our industry. Machines and mechanisms are used in heavy industry, forestry, aviation industry, light, textile, food industry, and other sectors. The tasks of the theory of machines and mechanisms can be divided into three sections: synthesis of mechanisms, dynamics of machines and mechanisms, and theory of automatic machines. Synthesis of mechanisms deals with the selection of a scheme that ensures the execution of a certain action and finding the parameters of this scheme. In the theory of automatic machines - the methods of creating an interdependent operation scheme of certain mechanisms and achieving optimal performance, accuracy, and accuracy of machines are developed. In the theory of automatic machines, methods based on the application of logical algebra have become widespread. These methods are called logical synthesis of control systems. Control systems use pneumatic elements along with electrical elements. The development of methods for designing robots has been one of the most recent advances in the theory of automata. In the study of mechanisms, two issues are solved: 1. Analysis of mechanisms, in which existing mechanisms are examined kinematically and dynamically. Analysis of mechanisms is mainly used for technological purposes; For expert technologists, it is of great importance to know the law of motion of some points of the mechanism. 2. Synthesis of mechanisms in which we need, that is, the law of motion of the mechanism links used in the technological process is given, and it is required to create a mechanism that implements this law of motion. Synthesis is extremely important for professional mechanics. Various structures and equipment created to fulfill different purposes can be divided into two main groups; the first includes devices whose parts do not move relative to each other, and the second includes devices whose parts can move relative to each other.

Relationship Between Projects and Mechanisms

The article focuses on the basic concepts of design, which play an important role in the process of creating a mechanism. A project is defined as a set of actions planned to achieve a goal, and a mechanism is a mechanical means of implementing these actions. Thus, mechanism design is the process of planning and optimizing mechanical actions to achieve a defined goal.

2. Mechanism Synthesis

Synthesis of the mechanism is the process of choosing a kinematic scheme and calculating the parameters of the mechanism. At this stage, the synthesis criteria and conditions are selected, that is, it is determined what action the mechanism should perform. The synthesis is divided into three stages:

The first stage is the formation of basic conditions and requirements.

The second step is to analytically determine the function representing the function of the mechanism.

The third step is to calculate the parameters of the mechanism based on constraints and optimization conditions.

And their interconnections to perform a specific action during the mechanism design process.

3. Kinematic and Dynamic Analysis

and dynamic analysis is performed to describe the movement of the mechanism. Kinematic analysis studies the laws of movement of the mechanism, that is, the movement of joints relative to each other. The dynamic analysis calculates forces and moments in the mechanism. These two analyses are closely related because the relationship between the movement of the mechanism and the forces must be determined.

4. Grasgoff's Rule and Curves

Grasgoff's rule is used in the design of crane mechanisms, according to which the relationship between the lengths of the joints in the mechanism plays an important role. If the relationship between the shortest and longest joints does not meet the requirements of the rule, the mechanism may have crookedness. These rules help determine the kinematic characteristics of mechanisms.

5. Main Objectives of the Mechanisms Project

The main purpose of the design of mechanisms is the transmission of motion and the transformation of mechanical energy. This, in turn, ensures the efficient operation of various mechanisms (for example, engine, pump, press). It is very important to choose the right type of movement and adapt it to the technological process.

6. Theory of Machines and Mechanisms

The theory of mechanisms mainly studies the performance properties of mechanical systems and machines. Machine theory studies both kinematic and dynamic issues and develops the techniques necessary to achieve optimal machine performance. These methods are based on the logical synthesis of control systems, which are used in areas such as automated systems and robotics.

7. Provision of technological characteristics of the mechanism

When ensuring the technological characteristics of mechanisms, it is necessary to take into account their efficiency and durability. For this, it is necessary to accurately calculate the kinematic and dynamic parameters of the mechanism. It is also important to control the forces, mechanical stresses, and stiffness that occur during the operation of the mechanism.

8. Basic Terms and Limitations

several conditions and restrictions in the design of the mechanisms, which are determined by certain parameters. The basic conditions must satisfy the functional purpose of the mechanism, while the additional conditions indicate other limitations of the mechanism (eg, dimensions, tension, strength).

9. Industrial Use of Machines and Mechanisms

Mechanisms and machines play an important role in various industries, including heavy industry, forestry, aviation, food industry, and others. They serve to automate human labor, simplify production processes, and increase efficiency.

Summary

The article shows that the design of mechanisms is a complex and multi-step process. This process is primarily focused on the transmission of mechanical motion and energy transformation, and the synthesis and analysis of mechanical systems are necessary to achieve specific technological goals. The study and design of the theory of mechanisms are of great importance in the development of industry and technology.

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