Extreme machines as part of robotics

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Abstract:: Gravity is the main physical phenomenon that produces enormous forces acting on matter. These forces vary in very wide limits, from absolutely insignificant values to values that can destroy other cosmic bodies, so in the presented material special attention is paid to these forces. The approach to the design of extraterrestrial industry on other space bodies outside the Earth has to be tailored to the specific features of the region. The region can be solid ground and atmosphere, solid ground and hydraulic surroundings, only atmosphere or only liquid, or just outer space in the vicinity of a space body. The article explains the circumstances surrounding Extreme Machines and their differences with ordinary machines. In this material, the main directions for the design of industry outside the Earth, for the use of the natural resources of outer space and space bodies, are indicated.

Keywords: transportation, robotics, astronautics, gravity, mining, extreme machines

I. IINTRODUCTION

Extreme machines are a separate part of mechanical engineering where the loads are particularly high and the environment in which they work is highly aggressive in all possible aspects. Extreme machines are the result of human genius in the struggle to conquer natural elements and givens where it cannot exist, and derive benefit from it.

When it comes to extreme machines, huge career escalators, career dump trucks, nuclear aircraft carriers, submarines or simply intercontinental nuclear missiles immediately come to mind. This is undoubtedly the case, but in the present material another point of view will be shown, which will show that extreme machines are not necessarily huge colossi driven by huge power systems, they can be small machines (for example, the size of car) and still be extreme.

Extreme technique is usually applied in places where the region is harmful to man. These are the deep sea, outer space, radioactively contaminated regions, etc. Given that, for objective reasons, the presence of people in these regions is absent, this technique can be referred to as a section of robots and robotic complexes.

Unfortunately, Earth has experienced major industrial accidents at nuclear power plants and the resulting destruction and heavy radiation contamination of the region. To control the situation, in the beginning, ordinary equipment was sent to these regions to carry out certain activities. This technique quickly failed and was left in place.

In recent years, the beginning of the design of specific extreme equipment for use in critical situations has been noticed.

When it comes to the extraction of minerals from space bodies [7], a number of circumstances must be taken into account that arise and complicate the extraction process compared to that on Earth.

Outer space is partially mastered only in close orbits around the Earth. In this space, there is no industry, no need (yet) for service robotics, no transfer of bodies of terrestrial origin to bodies of extraterrestrial origin, etc. In space, man's sojourn is in a state of extremity, and his labor cannot be relied upon in a future space industry. Moreover, the machines themselves must be adapted to the unusual conditions of the region, which differ from those on Earth.

II. WHAT EXTREME MACHINE MEANS

There are different types of constructions for the realization of one or another movement or physical phenomenon [2,3,8,10]. Usually the parameters of the movement or physical phenomenon are taken as input for the construction of a given machine. Of course, various parameters characterizing the impact of the environment, the parameters of the materials from which the future machine will be created and many others are also taken as input data.

During the actual construction of the future machine, the output parameters that it must cover are set. These output parameters, or as they are also called - capabilities of the machine, are characterized by some range (for clarity, we can denote the range of a given parameter P with the closed interval [a,b]). The specified interval is closed, because outside of it the machine should not work. The values $\boldsymbol{c_1, c_2, \dots, c_k, \dots, c_n}$ of P in the closed interval [a,b] , can be represented as a graph in the two-dimensional space.

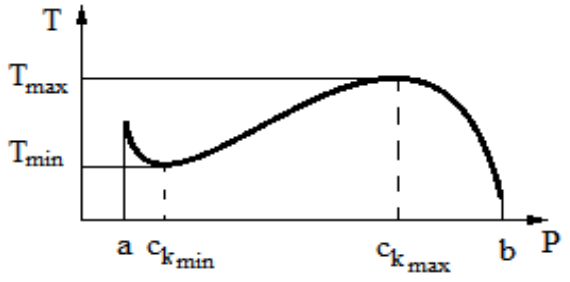

Fig. 1. Example curve of durability T of a given machine from one of its output parameters P

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As can be seen from Fig. 1. the durability T of a machine depends on the type of its operation. The curve shown is conditional, it may contain more than two extremes. If all output parameters (n in number) of one machine are taken into account, then the two-dimensional coordinate system in fig.1. will become an n + 1 dimensional coordinate system describing multiple minima and maxima.

Typically, the range between $c_{k_{max}}$ and P is the range of extreme machine activity. It should immediately be clarified that if no such extremum exists, then the extreme activity of the machine is taken for the last quarter of the range [a,b].

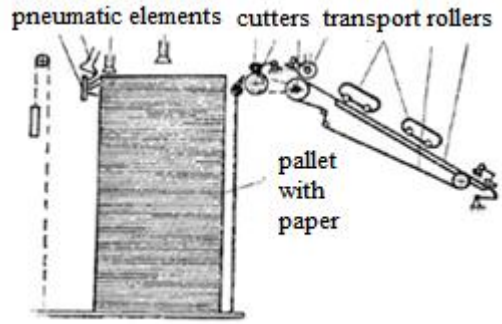
It can be seen from Fig. 1. that the increase in the values of the parameter P leads to a sharp decrease in the durability of the machine - this is an extreme operation of the machine. There are machines that are designed to work in exactly this range - these machines are called EXTREME MACHINES.

III. KINEMATIC EXTREME OF MACHINES.

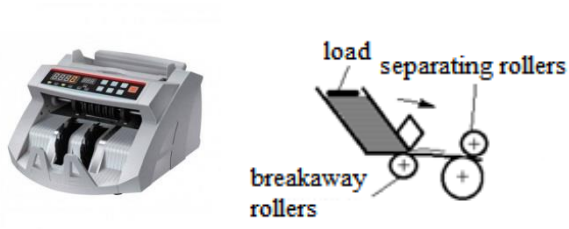
The realization of a movement or a physical phenomenon can be realized through different types of machine constructions, that is, through different types of kinematic schemes of machines. This gives rise to the creation of a whole class of machines for the realization of a movement or physical phenomenon. The selection of a kinematic scheme for the implementation of a given machine is based on a kinematic and force analysis, where the movement of speeds, accelerations and loads of the individual elements during the full cycle of the future machine is clearly visible. In this sense, a kinematic scheme is usually chosen to realize the set movement or physical phenomenon in an average loaded state of the machine elements.

This construction scheme is not always realized in this form. Life makes it necessary to create ever faster, ever larger, ever busier, etc. machines. Realized machines according to a given kinematic scheme have certain limits of the output parameters, and when their load approaches the limits of the set parameters, we already say that the machine is working in an extreme state. To increase a certain type of output parameters, it is necessary to choose another type of kinematic scheme for the realization of the set movement or physical phenomenon.

As the first example in Fig. 2.a) shows a photo of a sheet-fed printing machine of the KBA company from the RAPID 205 series and its schematic diagram of the sheet-feeding mechanism.



a)

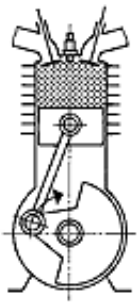


b)

Fig 2.a). Photo of a printing press for offset printing "KBA RAPIDA 205" and a schematic diagram of the sheet feeding module. b) Photo of a banknote counting machine and its basic kinematic diagram

In this example, the output parameter of the machines operation is the operation speed. In the case of the offset machine, due to the huge presence of pneumatic elements working in planar movement mode with multiple horn points along their trajectory and pneumatic cycles, the feeding mechanism cannot feed the printing sections with more than 3-4 sheets per second.

At the banknote counting machine, Fig. 2. b). the chosen kinematic scheme is very simplified and fully rotational and the possible movement speed reaches 12-15 cycles per second.



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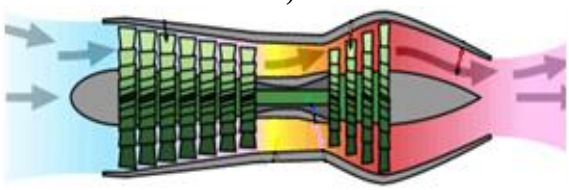

b)

Fig. 3. a) Schematic diagram of an internal combustion engine .b)Schematic diagram of a turbojet engine.

IV. TRANSPORT ACTIVITY

When it comes to mining minerals from space bodies, it:

First and foremost is the task of reaching this cosmic body.

Existing missile designs could reach the pre-targeted body. As already noted in [7], chemical rockets would not be able to do the job due to the low efficiency of the fuel. The engines created for the rockets carrying the artificial satellites of the earth are extreme machines, since their activity is expected to be within one or two days. There are developments of atomic engines that would give a much better result than chemical fuel, but the development of these engines is not yet at the necessary height to be used in the means of transportation in creating an industry in outer space.

Fig. 4. Materials, details, assemblies, engines, etc. of rockets are extremely calculated.

In modern mechanical engineering, rocket engineering is the branch with the most extreme units. In modern rocketry, the dimensioning of aggregate modules is long-lasting until the fuel in the rocket's combustion chambers runs out. After the ditch, it falls freely to the surface of the Earth (if it is civilian), or explodes (if it has reached its target, in military production).

It is necessary to create a new type of technology of transport activity in outer space, which will provide the increased needs for the creation of industry beyond the limits of the Earth

Such a technology has already been created and published in [7].

V. FORCE EXTREME

In outer space, and especially on other space bodies outside the Earth, there are forces that have a wide range of action. Gravitational forces are one of them. There are heavenly bodies without gravity (it can be so small that we can practically ignore it). On other celestial bodies, the gravitational forces are so great that photons (light) cannot overcome gravity and fly into outer space (the so-called black holes).

Gravity is not the only parameter that occurs within wide limits in outer space. Temperature is another physical parameter with a large range of action.

All physical parameters exist in outer space in wide ranges. In this way, matter changes its characteristics in the different sectors of the parametric ranges of influence.

The existence of the impact of different parameters on matter in the universe is not a constant quantity. There is one additional parameter - PERIODICITY. Here on Earth we call it time, but in the universe it is considered differently. At a given point in space, all influencing parameters, at that point, periodically change their impact intensity, in different intervals of their range. In places, the intervals can be quite wide compared to those found here on Earth.

This unfavorable situation requires the construction of machines intended for the space industry to be carefully dimensioned. Earth standards of resistance of materials need to be reviewed for each specific case, because the wide intervals of the ranges of periodic influence of the parameters can lead not only to a change in the strength characteristics of the materials, but also to their phase transformation.

Here, as an example, we can point to water on Earth, which is mostly liquid and its manipulation is usually realized through pipes. Even if heated and turned into steam, it can also be transported through pipes. However, if it cools and turns into ice, the method of transportation changes fundamentally. The situation is absolutely the same with other materials, which here on Earth we are used to perceiving in one way, but in other places in the universe their behavior is different.

VI. PHYSICAL AND CHEMICAL EXTREME

The specific conditions of a specific location in space provide the input conditions for constructing the specific technique. When setting up an alien industry, it is normal to build machines for as long a period of operation as possible. This is achieved after the site has already been studied and the working conditions are known. This cannot be said for a technique that is designed for field research, sampling, working in atmospheric conditions or in highly aggressive environments. In these regions, in addition to phase transformations of matter, there are also periodic chemical processes influenced by the periodicity of physical parameters, thus periodically changing the chemical composition of the environment.

In this case, the available equipment needs to work quickly to complete its tasks, because in the next period the chemical composition of the environment will change and this can destroy the machines.

Fig. 5. This is a crater left by a meteorite that fell to Earth a long time ago, about 50 meters in diameter. Now it houses a whole city

There are numerous traces of fallen meteorites on the Earth's surface, most of which are significantly larger than the

dimensions of the crater shown in fig. 5. It is part of the cosmic life of our planet on which we live.

This material is one of a series of publications that heralds the beginning of a new era in which the technical solution to mastering the riches of space is now available. About the need for a connection between cosmonautics and robotics, which will give us the opportunity to penetrate dangerous places for humans, but where the new materials needed by humanity are born.

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