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RESEARCH OF METHODS TO INCREASE THE HYDRAULIC SYSTEM AGGREGATES RESOURCE OF AVIATION GROUND EQUIPMENT

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Article describes the methods of the friction surfaces wearproofness improvement at the use of influence of magnetic field on oils for the units of aviation ground equipment hydraulic systems in order to increase their resource and diminish of cost on aviation ground equipment maintenance in their operation.

Keywords: aviation ground equipment, hydraulic systems resourse, friction surfaces wearproofness, influence of magnetic field on oils.

Описано методи підвищення зносостійкості робочих поверхонь вузлів тертя гідравлічної системи авіаційної наземної техніки за умов впливу магнітного поля на оливу, що дозволяє збільшити ресурс деталей гідравлічної систиеми авіаційної наземної техніки, а також знизити вартість її технічного обслуговування в період експлуатації.

Ключові слова: авіаційна наземна техніка, ресурс гідравлічної системи, зносостійкість поверхні тертя, вплив магнітного поля на оливи.

Introduction

The increase of level of air traffic dictates new requirements to organization of work of aviation ground equipment (AGE) as the aerodrome technical flight service of aircraft in airports is one of the most essential constituents of the aircraft reliability. The majority of the ground technological processes require the use of wide spectrum of the ground equipment samples during aircraft maintenance. As known, AGE — is a set of the special ground technical units for aircraft maintenance, air transportation and maintenance of air fields [1].

To AGE belong: aircraft refuellers, machines for fuelling the aircraft with technical liquids and charging the aircraft systems with gases; the machines for control of hydraulic, pneumatic and other aircraft systems: service of runways, taxiways, aprons, parking lots; passengers and baggage handling: aggregates and machines for aircraft towing, ground starting of aviation engines. More than 250 types of AGE are being exploited in airports.

The problem formulation

Permanent intensification of air transportation requires a perfection of question about supporting of the set resource of AGE knots and aggregates.

Practice of AGE exploitation shows that its greater part loses a capacity not because of breakages, but as a result of separate details wear, pairs of friction. Thus, increasing of wearproofness of their workings surfaces is an actual task and the decision of which will give a possibility of increasing the AGE reliability and manage its resource, as decreasing of resource of the details of mechanisms is related to the changes of operating parameters of their friction surfaces, that is a result of different types of wear.

Publications and researches analysis

Nowadays, a row of classifications has been accepted on the types of wear at friction, built mainly on the base of external terms and features of the process. In the basis of this classification is the mechanism of separation of wear products from the surface. The basic types of wear are adhesion or transfer, cutting, corrosion, plastic deformation and fatigue failure, and to the specific types of wear belong cracking, surface reactions, tear, melting and electrochemical reactions. It is possible to add to the last also fretting-corrosion [2].

Researches of wear and attendant processes, realized at friction, are shown up in forming of discrete contacts — spots with ridges and the tapes covering them, and also adjoining to these ridges the areas of the material. It is considered that the forces, attached to the different areas of spots of the contact, which appear at a relative motion of adjoining surfaces, are different, and the temperature of materials, even within the limits of the contact area, is different. It leads to a different reaction of local micro-volumes of the materials at wear during friction. A technical progress constantly extends the

nomenclature of the pumps' use in oil- and hydraulic systems of AGE, which require a substantial increase of reliability and at the same time the increase of the capacity resource. The terms of extension of the resource of oil- and hydraulic systems of modern AGE becomes a timely task.

The state of pumping units is tied up with reliable work of a tribology pair "piston - cylinder" or "cog-wheel — a body of a bearing" (a body of a pump), due to which they are able to save parameters, set by the requirements of technical documents (pressure, consumption). At the manufacture and exploitation of the machines, along with a quantitative growth, the condition of increase of high-quality and economic indexes of the units is needed.

A management of the wearproof level, a correct choice of tribologically compatible materials and wearproof pairs, rational design of mobile couplings and optimization of service conditions, the level of wearproofness can substantially prolong the AGE resource. At the manufacture and exploitation of the machines, along with a quantitative growth, the tendency of increasing the reliability and economy of its indexes will prevail.

Increase of the AGE reliability, being set in the forefront, which is limited mainly of a long service life of the knots and the elements of friction, is equivalent not only to the proportional increase of the productivity but also to the economy of resources of materials, finances. The task of increasing the long service life of the knots of friction is becoming strictly complicated, the development of equipment and the maintenance techniques is inexorably resulted in toughening of the operation modes of AGE, and therefore the operation modes of knots of friction.

Nowadays some repair methods of increasing the wearproofness of details are widely used: with plastic deformation, making the details up to a repair size, setting an additional detail, welding and fusing, metallization, galvanic coatings, baking a lot of powders, polymeric materials.

A wide use is found by new methods and technologies of increasing the level of wearproofness, introduction of non-disassembling technologies of repair allows considerable reducing of the expenses and the cost of extension of the machines resource.

Magnetic treatment is used for the improvement of construction materials' properties, water, solutions, dispersible systems, and also in engineering. Under the action of a magnetic influence a solution changes its physical and mechanical characteristics. The improvement of properties at ferromagnetic details, which had been treated by a magnetic field, is reached due to the directed orientation of free electrons of the solution by the external field, and as a result increased thermal conductivity and electric conductivity of the material is being increased [3].

It is necessary to notice that the reliability of details to a great extent depends on a working environment which they work in. The intensity of wear of the details and the size of a friction force depend on the descriptions of lubricating properties of a lubricating environment.

Consequently, the better the lubricating properties of a lubricating environment are, the lower is the level of wear, the less losses on friction ,the more reliable defence of surfaces of friction from grasping and jamming of the details. The major influence on a lubricating capacity of the environment is carried out by physical and chemical properties of additives, which are added to the composition of the working environment.

Anti-wear and anti-burr characteristics of the lubricating environment can be changed at the change of the material's properties of friction surfaces and characteristics of the working environment, as a velocity of chemical processes, sizes and properties of the formed protective films, depend on chemical properties of the material of friction surfaces, and also on the properties of the environment [4].

Lubricating capacity of the working environment are discovered by two positive qualities: an ability to react towards greater loadings, speeds of sliding and higher temperatures, in the moment of break of the extreme film of the lubricating environment and properties of metals, and also posessing of anti-burr characteristics and an ability to prevent the wear of friction surfaces at the terms of a proof extreme film of the lubricating environment in the area of oxydative wear, so to say, the oil must have anti-wear properties [5].

Optimization of operating properties of engine oils is carried out at introduction to their composition some additives in the process of burn-in, and exploitation.

The presence of additives in the composition of engine oil enables to attain such functional properties of the friction surfaces, as anti-wear, anti-burr, antifriction, anticorrosion etc. The presented properties of the details' surfaces can provide engine oil with additives due to the formation of surface films.

Thus, it is possible to make a conclusion, that the terms of the surface wear of friction areas to a great extent are put in the lubricating material, namely in its anti-wear properties.

At the extreme lubricating the friction surfaces are divided with a thin oil layer. An extreme layer or

an extreme film reduce the friction forces in comparison with friction without lubricating in 2–10 times and reduces the level of the surfaces wear hundreds times [6; 7].

One of the ways of prolongation of the service life of mechanisms and increase of wearproofness of their friction surfaces is the tribomodification of the working surfaces by forming of metal consuming films, by the use of the lubricating materials, treated with a magnetic field as a working environment.

As the lubricating materials, treated by a magnetic field, have high antifriction and wearproof characteristics [8], that is why they are used for lubrication of the magnetic bearings, gearings, with the magnetic system of oil feeding.

It is known [9; 10], that magnetic liquids are used both in the knots of friction of mechanical transmissions and at tooling of metals. Magnetic liquids, under the action of a magnetic field, are concentrated in the area of its greatest tension, creating a lubricating layer of 3.4 mkm. Thus, the presented property of magnetic liquids can be used for lubrication of different friction knots and supports of mobile joints. The strength layer of some magnetic liquid takes the external loading, and the coefficient of friction in this case is very small and it is determined only by viscosity of working liquid, the level of wear of the friction surfaces is insignificant.

It has been defined [10], that time from the moment of feeding the magnetic liquid to the area of contact depends on the roughness of the contact surface. Microroughnesses on it are created by capillaries on which the magnetic liquid under the magnetic field action quickly gets to the area of contact and covers all the surface. Accordingly, the wear decreases, as a result of it, increases the resource not only of mechanisms but also the equipment on the whole.

The work [11] is one of the first on theoretical description of the magnetic and liquid lubrication, in which the lubrication of the very long cylinder bearing is considered, taking into account its internal field, both for the saturated and for unsaturated magnetic.

The authors [12] have developed, probed and offered the method of numeral design of a magnetic lubricating layer, taking into account the cavitation phenomenon for bearings of a free length. The factor which complicates the theoretical study of the mechanism of the magnetic and liquid lubrication there is a linear curve of magnetizing. Thus, an analysis is possible for a magnetic saturation and maximum cases of a linear law of magnetizing. The researchers developed the simple analytical model of a lubricating layer. According to [13], magnetic and liquid oils are used mainly in gearings, where the magnetic stream are closed by a pair of friction. In the works [14–16] the results of researches, linked with the prevention of asphalt and pitch deposits and paraffins under the action a magnetic field. The magnetic treatment of oil assist the continuous flowing of asociative-disassociative transitions of the lubricating system. It is also known, that the changes of the lubricating and water systems after the magnetic treatment are analogical [15].

It is known [17] that the lubricating systems and composition oils are thermodynamically mobile. There the diamagnetic molecules pass into paramagnetic ones and back, that causes the change of overmolecular structures and determines the behaviour of the system on the whole. At the action of a magnetic field occur the formation and recombination of radicals, and also there is the growth of concentration of paramagnetic centers, namely a maximum increase of paramagnetic activity at a minimum flow speed.

The authors [14–16] developed and offered the method of magnetic treatment of the lubricating materials, which supposes that by a pipeline the oil feeding is carried out and a magnetic field influences it, the force lines of which are directed perpendicularly to the oil stream. Thus, due to the location of the pair of magnets downstream the motion of the oil with a shift and the polarity reversals, the action of th asymmetric magnetic field on the lubricating material is carried out, which changes density and viscosity of the lubricating material, and it improves the oil operating properties. Thus, actual, perspective and unsufficiently studied is the method of increasing of wearproofness of the friction surfaces by the influence of a magnetic field on oil material, the main feature of which is that it is energy-efficient.

Most works in which the magnetic treatment is used examine the matter of of electromagnetic fields' influence on operating properties of steels.

The authors have researched, that an effect from the magnetic treatment appears better for hardened steel [18]. It is explained that the process of austenite decomposition appears in beforehand hardened steels, that is proved experimentally by diminishing of its percentage in hardened samples after electromagnetic treatment. The result of these works' development was the creation of experimental units [19].

This work summarizez the results of the research [20] in relation to the influence of the electromagnetic fields and high-speed one-directed friction on triborechnical properties of surface and deep steel layers. It allowes decreasing the level of wear of the friction surfaces at ordinary conditions with increasing of loads, corrosion proofness and other properties. A magnetic field of high tension results in additional formation of martensite, that can increase hardness and stability of the product's sizes. Treatment in a magnetic field of hardened steels

allows to reduce the amount of austenite to the minimum [21]. The nfluence of a magnetic field at hardenning results in strengthening of the processes of original magnetic delamination of austenite. In a certain temperature range, when austenite becomes overplastic, the formation of martensite is considerably simplified. At growth of martensite crystals, tension as a result of the action of a twisting moment on the edges of each one which is unfavorably oriented in relation to the vector of the field of the crystal.

There are forces which do not exceed ten of grammes for considerable particles. For a group, which consists of a great amount of crystals, at the simultaneous input of energy of magnetostrictional deformations and crystallographic magnetic anisotropy, the processes connected with the inclination of the crystal to turn under the action of a twisting moment, influence the development of their transformation in the conditions of overplastic austenite [22].

Conclusions

In view of the presented scientific works it is actual to carry out the connected with the improvement of wearproofness of the friction surfaces at the use of a magnetic field for the units of AGE hydraulic systems in order to increase their resource and diminish of cost on AGE maintenance in their operation.

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