THE USE OF NON – CONVENTIONAL TECHNOLOGIES IN THE REPAIR OF HYDRAULIC BRAKE SYSTEM OF THE AIRCRAFT

Peter Mrva --Martin Hančák

The aim of the diploma thesis is to describe the options for repair of hydraulic brake system. Brake system of the aircraft is one the most important systems of every aircraft. Technical requirements for this system are on high level. The thesis deals with possibilities of applying thin layers of the valves of the hydraulic brake system of the aircraft. Thin layers are applied using unconventional technology that can increase durability, technical characteristics and reliability of aggregates of aviation technology. The essence of the thin layers is to apply a thin layer of metal or of ceramic with extraordinary features in the part which are constructed from commonly available and inexpensive materials. Economic aspect of coating is not negligible, since expensive material which the coating is created by is applied in a thin layer, but the component itself is made of cheap and available materials.

K e y w o r d s: Hydraulic brake system, PVD, CVD, PECVD, Repair of parts of hydraulic brake system.

1 INTRODUCTION

Most damage that arise in components, starting at the surface. Therefore, it is necessary to pay attention to just the surface of the material or the method of protection and surface treatment. Such methods include the method of applying thin layers with a thickness of a few micrometers. Aerospace and automotive industries in the long term record growth and development. This study aims to address traffic injury arising in the elements of the hydraulic brake system of the aircraft, respectively prevent such damage and increase technological life as the element itself, as well as the entire system. Thin layers of progressively bring the possibility of repair of hydraulic braking system having undeniable economic

2 PURPOSE AND TYPES OF LANDING GEARS

Landing gear provides a secure, linear movement during take-off and landing, and good maneuverability during movement of the aircraft on runway composition of the solid surface of snow or water level. On each take-off and landing environments They use the following types of chassis : [1]

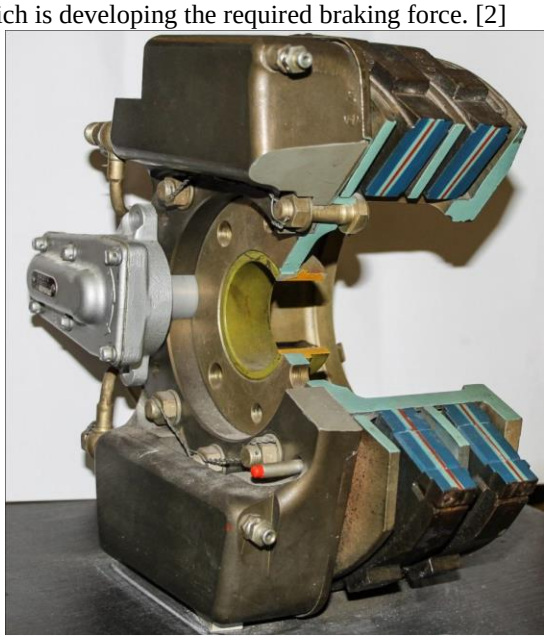
- wheeled chassis
- chassis with Lyta,
- chassis floats - float hull (flying boats)
- combined (amphibole : float hull and chassis). [1]

To make the movement of aircraft ground surface safely, the landing gear to dampen and absorb some of the energy upon landing and running, at the same time must provide sufficient maneuverability movement and stability. The wheeled chassis, excluding shock absorbers dampen and absorb energy and tires. Float float hulls or chassis at the abutment surface absorb hydrodynamic lifting force. [1]

3 BRAKES

In the aerospace industry have meant utilization hydraulic and pneumatic brakes. Due to the fact a performance brake system can not compete with hydraulic brakes, the airline industry is currently the most advanced hydraulic brakes. However indisputable advantage is the absence of pneumatic brakes back flow and pressure medium, which is the compressed air is discharged into the atmosphere. [2]

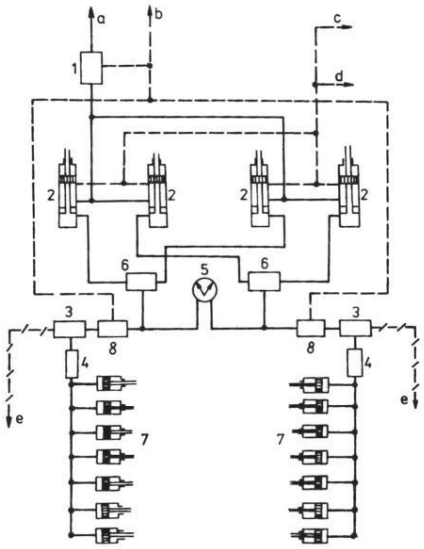
"The brakes consist of a brake pedal, master cylinder power-assisted braking force, the system piping, in some cases, the limiter and braking performance brake system with wheel brake cylinders." [2] The current hydraulic brakes consist of a head and emergency brake circuit. Emergency braking circuit takes an aircraft when the main hydraulic circuit failure occurs. Pilot operating the brake pedal, put pressure, which is amplified in the hydraulic booster. Pressure hydraulic fluid is transferred through the hydraulic system to brake system wheel, which is developing the required braking force. [2]



picture 1 section of disc brake[2]

4 ACTION BRAKE CIRCUIT HEAD AIRCRAFT WHEEL

Main wheel braking circuit serves to main wheel brake control by means of pedals unified management. Most equipment of this circuit is placed on the platform left landing gear and nacelle front of the fuselage. Operating pressure circuit moves 4.9 to 5.4 MPa.

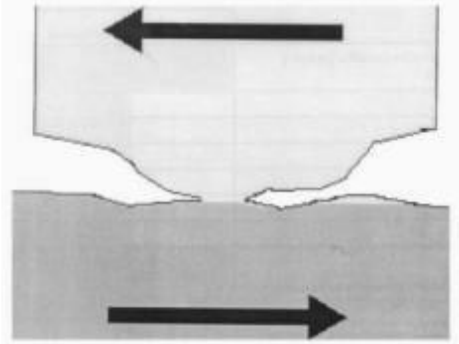


picture 2 circuit scheme of brake system

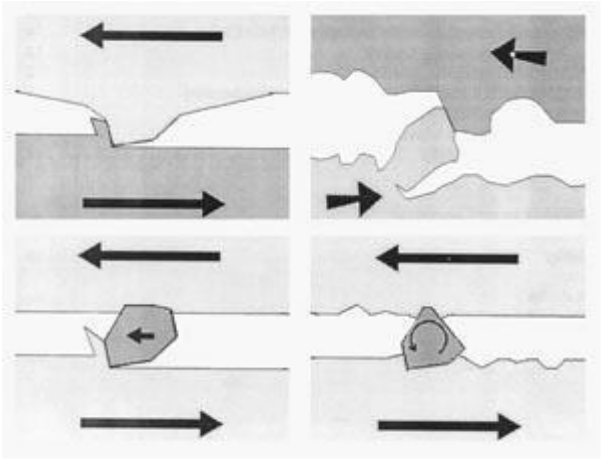
Legend to picture. : 1 - pressure reducing valve ; 2 - brake valve ; 3 - changing valve ; 4 - connection closed by itself ; 5 - manometer ; 6 - Changing brake valve ; 7 - brake rollers; 8 - electro - hydraulic distributor ; and - permanent circuit pressure ; b - reverse circuit ; c - waste of brakes; d - the relief tank ; e - parking tank circuit. [3]

5 ANALYSIS OF WEA MONITRING PARTS IN OPERATION

Surface for the purposes of this article as seen interface between a solid object and its surroundings. Fixed so that the coatings are applied to the surface solid bodies, to protect them against the effects of surrounding solid bodies, liquids or gases, which are in contact, or in order to increase the surface quality of aesthetic point of view. [4]



picture 3 the mechanism of adhesive wear [4]



picture 4 mechanisms of abrasive wear

6 NON-OXYGEN CERAMICS – TITANIUM NITRIDE TiN

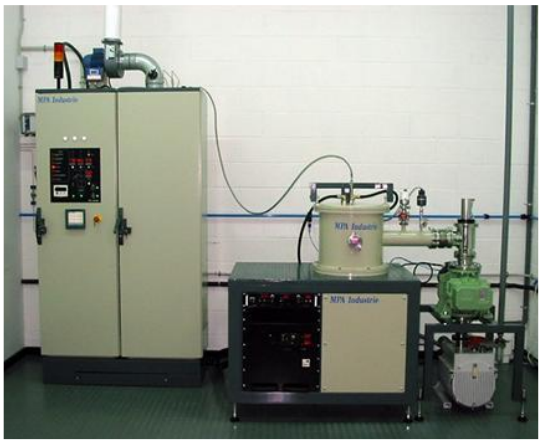
The most commonly used coatings are coatings based on titanium nitride (TiN). They are characterized by low reaction with metal coatings. Is widespread in of coated cutting tools. Titanium at a temperature of 0.39 K becomes a superconductor. After application of the coating are coated materials attractive golden color and a high abrasion resistance. Because of this feature, in addition to cutting tools can also subjects preapplied decorative purposes. TiN coatings have their use in the chemical and food industries for their chemical stability. Titanium nitride has a wide application due to its versatility and quality. [5]

The main features include TiN :
- Coefficient of friction against steel of 0.6,
- Hardness,
- Increase in toughness,
- High hardness,
- Gold,
- Maximum working temperature up to 500 ° C,
- Biocompatibility,
- Excellent adhesion. [5]

7 COATING METHODS

By PVD (Physical Vapor Deposition - Physical Vapour Deposition), which is characterized by low working temperature (below 500 ° C). This method was originally developed for the coating of tools quickly rusting steel (low temperature ensures that there is no heat affected equipment) in the last period there is a very significant development methods PVD and extending their application also includes sintered carbides.

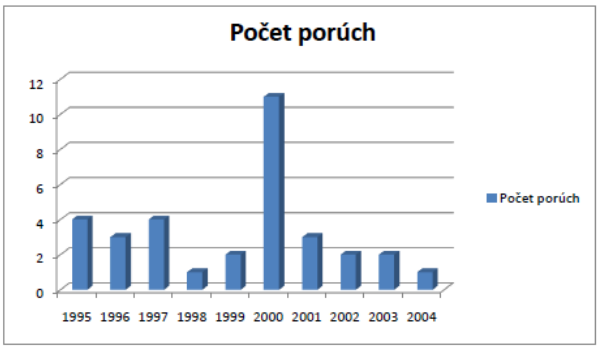
CVD (Chemical Vapor Deposition - chemical vapor deposition from the gas phase), which takes place in high temperature (700 ÷ 1500 ° C) ; This method is a major Carbide coating method.



picture 5 system of coating by CVD [6]

8 EVALUATION FAULT CONDITION AIRCRAFT AGGERAGERS

During the lifetime of air aggregates occurs technological developments in the field of technology and production, may greatly helped to address the issues and lifetime reliability. One of the areas are also tribotechnical properties that offer a wide range of options examination. USE lifetime of materials in air aggregates are on the border usability, to improve following designers have recourse to other materials that would meet the stringent conditions imposed air units. When the complexity of a large air aggregates and small parts unit failure, may in ultimately resulting in malfunctioning of the whole unit, or the entire system, which is part of the unit. Therefore, it is necessary to expend every effort to eliminate the possibility of failure. increasing requirements for reliability and service life of air aggregates working in extreme conditions, a requires increased attention to these aggregates trouble-free fit for their purpose.



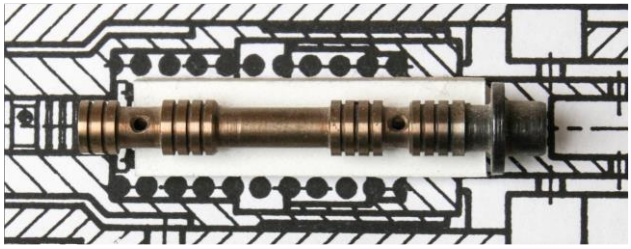
picture 6 The incidence of failures on the hydraulic gate valve during [7]

4.3 ESTABLISHMENT OF PROTECTION ON TOP THE COATING ON THE PORT OF HYDRAULIC COMPONENTS

The following section illustrates demonstrations applying a thin layer of hydraulic gate valve and thereby increase its service life and improve the reliability of the hydraulic brake system of the aircraft. described method is possible in modified form applied to other components of the braking system.

picture 7 differential valve with chrome coating

Removing old layers of fine turning, defat and saved to your device for coating component is ready for depositing thin layers of oxygen-free ceramic TiN. Differential valve is even before applying bombarding ions argon. The thickness of the layer of TiN is 5 to 7 microns, because thicker layers peel off already. The resulting surface has better features than the old chrome finish. Ceramic does not conduct heat and electricity as well as old chrome finish. New ceramic coating is also resistant to aggressive environments hydraulic liquid.



picture 8 differential valve LUN 7364 with a thin
4.4. Diagrams and illustrations

5 CONCLUSION

The application of unconventional technology allows not just repair of hydraulic brake system aircraft to its original state, but also to create and deliver them properties substantially better, thus there is a prolonged technical lifetime if the functionality of the unit. Creating different surfaces we can ensure long service life and trouble-free operation. It is essential reason why they thin coatings utilization not only in the aerospace industry and engineering, but also in other areas. thin coatings changing the default friction pair metal - metal, which over time aggregate corrode and subsequently seized up, the friction pair metal – ceramics. Thanks a thin coating is possible create high quality surfaces with properties that are durable thus ensuring high service life and needed number of spare parts for aviation technology

BIBLIOGRAPHY

[1] DRAXLER, Karel a kol.: Studijní modul 11 aerodynamika, konstrukce a systémy letounů, Brno: Akademické nakladatelství cern, s.r.o.,2005 600 s. ISBN 80-7204-367-6
[2] HANČÁK, Martin, Bakalárska práca: Údržba a opravy prvkov hydraulického brzdového systému lietadla, 2012, 43 s.
[3] TKÁČ, Pavel: Lietadlové systémy L – 410 UVP, Košice: VVLŠ-SNP, 1991 215 s.
[4] HOUDKOVÁ ŠIMŮNKOVÁ, SÁRKA a kol.: Žárové nástřiky, moderní technologie povrchových úprav, 2003 avaible online: http://www.kmm.zcu.cz/CD/content/index.html
[5] ŠVEJKOVSKÁ, Miroslava: Diplomová práca: Hodnotenie vybraných vlastností tenkých povlakov súčastí špeciálne techniky vytvorených na báze wolframu, TUKE LF, 2011, 62s
[6] http://www.mpa.fr/images/img-cvd1.jpg
[7] MRVA, Peter – KOTTFER, Daniel – FERDINANDY, Milan: Možnosti využitia nekonvenčných technológií pri povlakovaní posúvačov lietadlových systémov. In: Funkčné povrchy 2005: Medzinárodná vedecká konferencia, Trenčín: Trenčianska univerzita Alexandra Dubčeka, Fakulta špeciálnej techniky, 2005. ISBN 80 – 8075 – 064 – 5

AUTHORS

Hančák Martin, Bc.
hancak.martin@gmail.com
peter.mrva@tuke.sk