PROJECT AND CALCULATIONS OF THE MAIN LANDING GEAR BRAKES OF THE STOL AIRPLANE

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Abstract: Nowadays commercial and general aviation airplanes have high requirements for length of distance ran form touchdown to stop. The importance of brake, as a device which significantly decreases the distance, is increasing. Currently development of technology enables designing not only brakes made of conventional materials, but also using achievements of modern technology – for instance carbon-carbon composites – became more popular. In order to make efficiency of braking action even better, systems, which control the face pressure between linings and disks, are applied. Thank to the systems driving speed of wheels as well as slip between tire and ground can be kept close to optimal. In this thesis aims of brake's use are formulated and requirements for it's features are described. Various types of brakes are compared: disk brakes (single-, dual- and multiple disk brakes), drum brakes and pneumatic brakes. Principles of working of brake system used in commercial airplanes (independent-, power boost brake- and power brake control valve systems) as well as four generations of skid control systems were described. The basic problems of heat production and its transfer are characterized. Since selection of appropriate material for brake disk and linings play a key role in brake design, a comparative analysis of materials is carried out. These materials are: steel, beryllium, carbon-carbon (C-C) composite and various types of sintered materials. Mechanical, thermal and related to exploitation characteristics are considered.

For AEROVAN airplane, which is general aviation plane with STOL (Short Take Off and Landing) characteristics, dimensions of brake disk and linings were calculated, maximal permissible pressures and friction coefficients are taken into account. Next, on the basis of analytical Čičinadze method maximal temperatures on friction areas are estimated. The temperatures vary with starting conditions of braking action and applied material. Calculations were made for typical braking after touchdown and braking after interrupted take-off. Weights of conventional, beryllium and carbon brakes are compared. Material, that can be applied on the parts of brake assembly, which do not compose friction pair, is chosen – it is a kind of creep resistant steel. The selection is possible because maximal temperature of lining housing is known – it was estimated by analytical method. Preliminary analysis of brake disk and cylinders strength revealed that thermal conditions decide on the disk dimensions. As a result of the analyses C-C composite is chosen as a material best virtually in every respect. Then numerical simulation of braking action is carried out, using MATLAB program. Changeability of aerodynamic forces and friction coefficient between wheels and ground, as well as thrust's influence are taken into account. The calculations are carried out with assumption that brake assembly's temperature is constant and equal average temperature. The assumption is strong, so it was proven that the average temperature has little influence on length of braking distance. The distance is about 160m. Influence of pressure in braking system and type of skid control system on braking action are studied. Conceptual project of elements of brake assembly (which includes: drawings, description of elements and its principle of operation) is made.