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Analytic analysis of a cam mechanism

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Abstract

Cam mechanisms are integral parts of many products. They are used in many applications from combustion engines through milling machines to fitness machines. As suggested by their range of applications, it is an important issue. In this article the configuration of a mechanism, comprising a flat faced follower, which is pressed to the surface of a radial cam by the coil spring, is studied. On the basis of the known lifting function (the results of previous work) a new cam profile will be proposed. Lifting functions are of a polynomial character. Particularly, a cubic polynomial, the fifth degree polynomial and the seventh degree polynomial will be studied. Subsequently, there will be proposed a methodology for the calculation of torque according to the desired angular velocity of the cam. This methodology will be used for choosing a suitable electric motor and for a proper selection of coil springs. The spring preload will be determined with intention to avoid the rebound of the follower from the cam surface. Based on the analytical analysis a new measuring stand will be proposed. In future, the analytical results will be complemented by experiment.

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Keywords: cam; cam mechanism; flat faced follower; force analysis;

1. Introduction

The paper deals with a configuration of a cam mechanism with a flat follower that is pressed to the profile of a radial disc cam by means of a coil spring. Geometric profiles of the cam are evident from Fig. 1. These imaginary elements have their specific terminology [1, 2].

- The cam profile is a functional surface that is in contact with the follower.
- The base circle is such a circle to which the action profile of the cam is connected.

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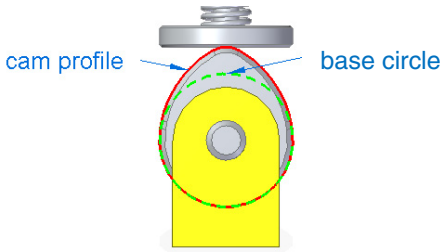

Fig. 1. Cam mechanism geometry.

The position of the follower is determined by the cam lift $s = s(\varphi)$, where φ is the angle of rotation of the cam. Lift dependencies were proposed in [3, 4], and we will arise from this solution. Boundary conditions for the determination of polynomial dependencies were defined in points A and B (see Fig. 2). Polynomials were defined from the boundary conditions at the point of connection of the polynomial to the base circle (point B) and at the furthermost point of the cam from its rotation axis (point A).

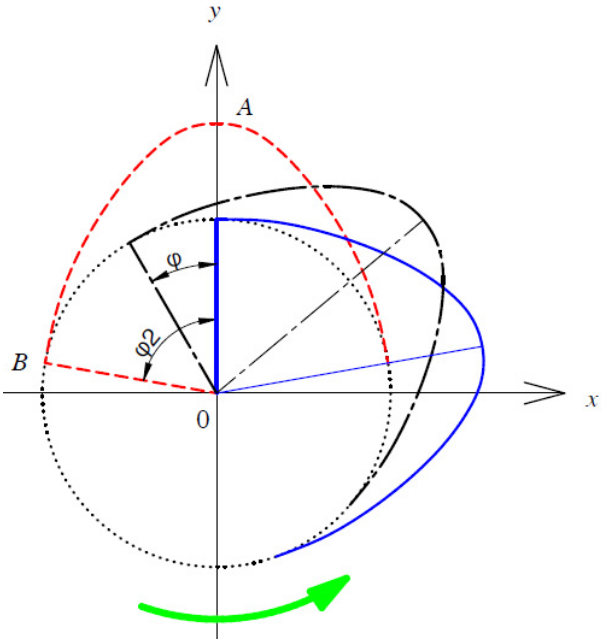

Fig. 2. Cam geometry.

The angle φ_2 is indicated in Fig. 2 (the angle between axis y and the normal leading to the cam profile at point B for the position of the cam where point A lies on axis y). The angle φ_2 is selected as $\frac{\pi}{2}$. Seventh-degree (marked with index 7), fifth-degree (marked with index 5) and third-degree (marked with index 3) polynomial lift dependencies were proposed. For a lift of 10 mm and the angle of connection of the cam profile to the base circle $\varphi_2 = \frac{\pi}{2}$, the lift dependencies take the following forms [3, 4]:

$$s_7 = 57{,}4895\varphi^4 - 87{,}8375\varphi^5 + 46{,}59923\varphi^6 - 8{,}476\varphi^7 \tag{1}$$

$$s_5 = 25{,}80123\varphi^3 - 24{,}6384\varphi^4 + 6{,}274106\varphi^5 \tag{2}$$