The theory of equilibrium figure and gravitational field of the giant planets' satellites. The second approximation.

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The theory of the equilibrium figure and gravitational field of the giant planets'satellites, which is synchronously rotating in the gravitational field of Jupiter, is developed within terms of second orders in the small parameter α. It is shown, that the equation for the figure of the satellite must contain both the components of the second spherical function and the components of the third and the fourth spherical functions to describe all effects of the second approximation. The contribution of the components of the third spherical functions is determined by Love number of the third order h_3 . The theory is important for satellites with the high values of small parameters α: Io (1.7137×10^{-3}), Mimas (1.48×10^{-2}), Enceladus (0.84×10^{-2}), Tethys (about 0.44×10^{-2}), Dione (about 1.77×10^{-3}). The measurement of the gravitational moments of the third order will reveal the detail scale of the hydrostatic equilibrium condition. This condition is: $J_3 = C_{32} = 0$; $C_{31}/C_{33} = -6$. The corrections of second approximation for the gravitational moments J_2 and C_{22} for Io are calculated. We came to the conclusion that at modeling the inner structure of Io it is better to use the Love number k_2, which is determined from observations, than the moment of inertia of Io, derived from k_2. The corrections of second approximation to the length of semi-axes of the equilibrium figure of Io are equal to about 64.5 m, 26 m, and 14 m for axis a, b, c correspondingly. The theory presented in the paper allows one to calculate the parameters of figure and the gravitational moments of fourth order which differ from zero. For the uniform model their values are following: $s_4 = \frac{885}{224}\alpha^2$, $s_{42} = -\frac{75}{224}\alpha^2$, $s_{44} = \frac{15}{896}\alpha^2$, $J_4 = \frac{885}{224}\alpha^2$, $C_{42} = -\frac{75}{224}\alpha^2$, $C_4 4 = \frac{15}{896}\alpha^2$.