Stresses Determination Method in Moving Parts of the Marine Engines

Moroianu Corneliu

Abstract— **The moving parts of internal-combustion engines endures the highest and the most complex stresses. The tensile compression, bending and twisting stresses appear under the action of gas pressure forces and inertic forces in the elements of the crankshaft. One to the bending stresses, the crankshaft is the strained compromising the coaxiality of necks and bearing bushes. Taking into account these points (considering the points), the determination of the stresses to witch it is put, becomes a defining element for designing and testing to strength. This work presents a numerical modelling (MathCad program) for determining the stresses to which the moving parts is put for the marine two-stroke engines.**

Key words: **Numerical modeling, marine, internal-combustion engine, moving parts, stresses.**

I. INTRODUCTION

One to the installing clearances, high speed of the rise of pressure during the combustion and change of application direction of forces, the stress of the crankshaft of the internal combustion engine is like a shock. The variable forces induce the fatigue phenomenon

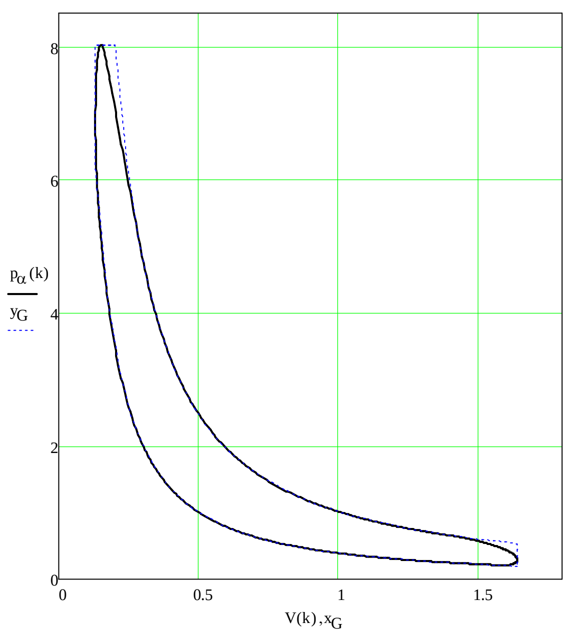

Fig. 1. The characteristically points of the duty-cycle.

Manuscript received September 20, 2015.
Corneliu Moroianu, Associate Prof., PhD, Department of Marine Engineering and Naval Weapons, Naval Academy "Mircea cel Bătrân", Constanta, Romania, 0766464120, (e-mail: cmoroianu2000@yahoo.com).

dangerous especially to the passing from the arm to the necks and the torsional vibration stress is also dangerous. Knowing the state values of the motive fluid in the characteristically points of the duty cycle, we can determine the values of the show and effective parameters of the duty cycle as well as the values of the main building dimensions of the engine. We obtain the duty cycle diagram based on the data obtained for the real volumes of the motive fluid in the characteristically points of the duty cycle (Alexandru C,1991).

II. THE DETERMINATION OF KINEMATIC VALUES OF PISTON AND CONNECTING ROD

Having established the type of crank and connecting rod assembly, determined the crank star and chosen the firing sequence we shall develop the kinematic calculation of driving mechanism taking into account the characteristically values of piston and connecting rod (shift, speed, acceleration), (Grunwald B , 1980).

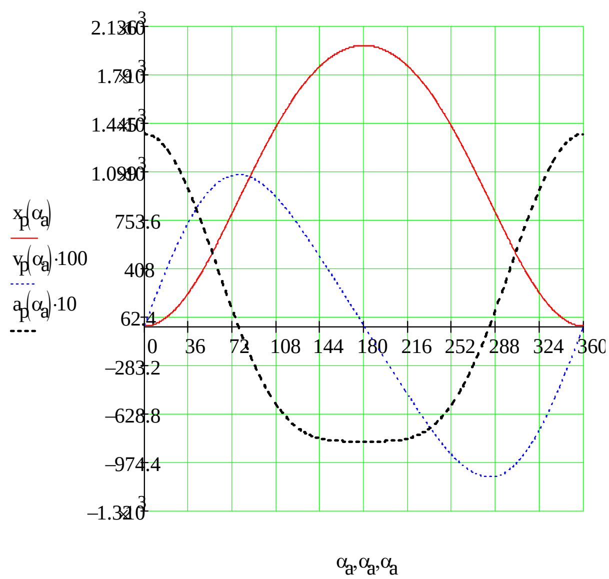

Fig 2. The characteristically values for piston resulted from the kinematic calculation.

III. THE DYNAMIC CALCULATION OF DRIVING MECHANISM

The dynamic calculation of driving mechanism assumes the determination of gas pressure forces, of inertic forces of masses being in rotating and translation motion as well as of their components. In figure 3, 4 and 5. I presented the diagrams obtained for a marine Sulser RTA84 engine.

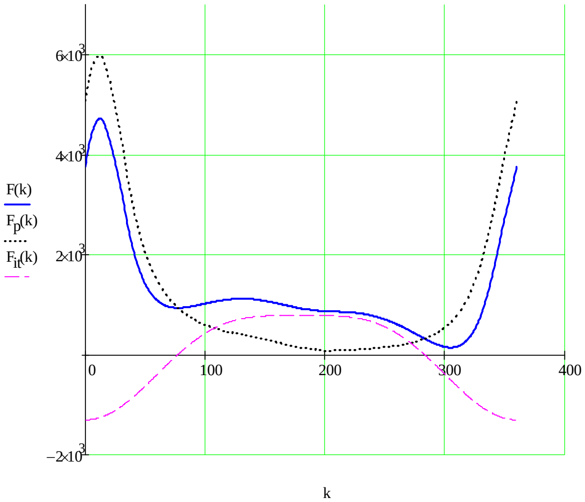

Fig. 3. The inertic forces of masses in rotating and translation motions.

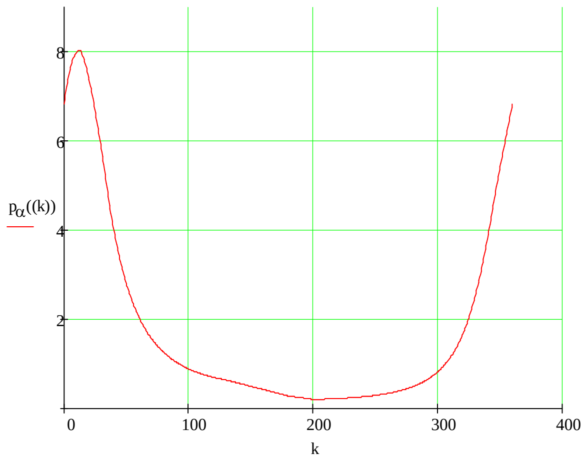

Fig. 4. The gas pressure force.

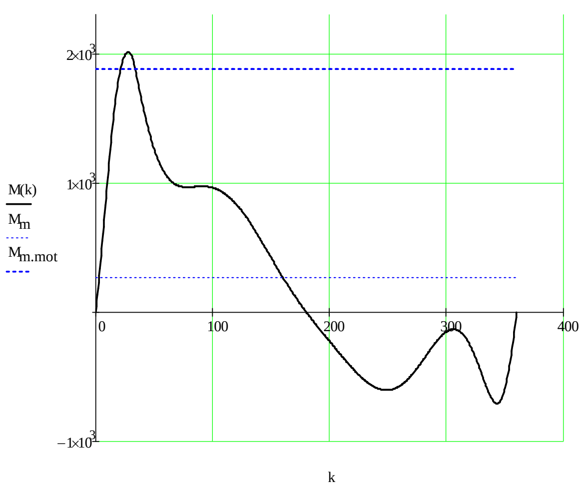

Fig. 5. Instantaneous momentum and resulted momentum.

IV. THE DETERMINATION OF STRESSES OF THE CRANKSHAFT NECKS

The calculation of the direction of resulted force straining the crankpin neck is made according to the positive or negative values of the involved forces and at the values so obtained it was added 180° to achieve the correlation of force variation with the neck surface which takes over those forces. In Figure 6 the polar diagram of stress is presented.

The diagram shores that the highest stresses of crankpin neck are recorded in the scale II for P_M=90°… 180°, while the lowest stresses are in the scale IV for P_M=270°… 360°.

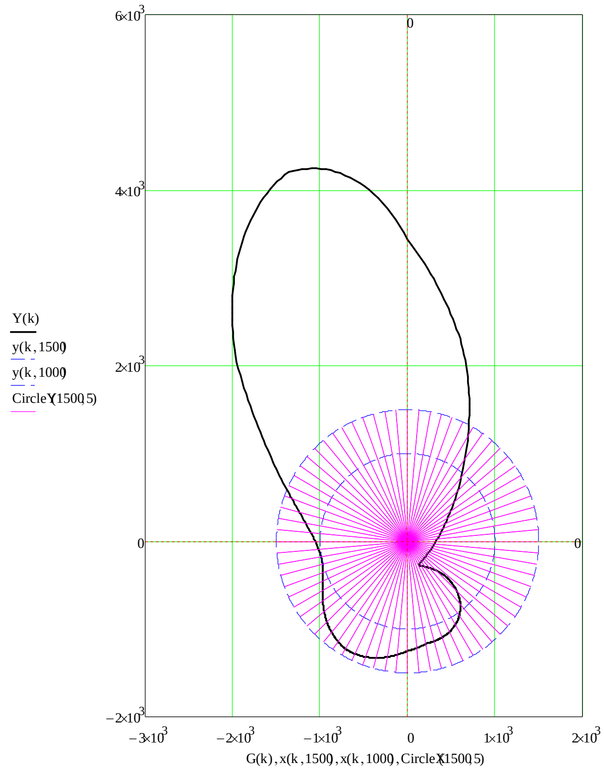

Fig. 6. The diagram of forces loading the bearing neck of the crankshaft.

To determine the stresses of crankshaft bearing, it is necessary to specify the planes on which the forces determining these stresses act.

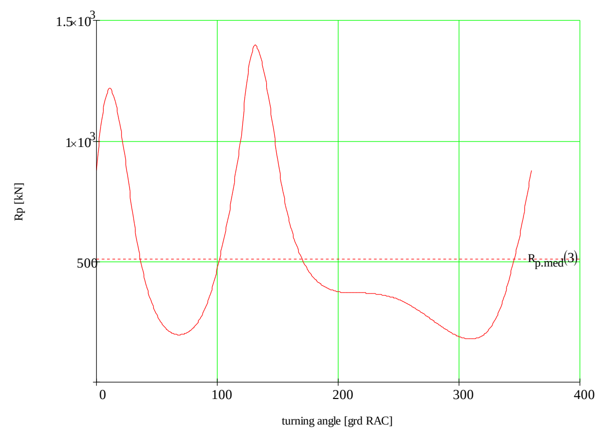

Fig. 7. The polar diagram of forces loading the base bearing.

The total loads of forces acting on a crankshaft bearing are determined taking into account the arrangement of cylinders, the position of contiguous cranks round about the axis of rotation and the firing sequence (Dragalina A, 1993).

The determination is made based on the moment equations of pressure forces and inertia forces of masses with rotating and translation motions being also included the forces generated by counterweights. In Figure 7 and 8 there are the diagrams of forces loading the bearing neck as well as the polar diagram of force loading the base bearing (Bobescu G, 1997).

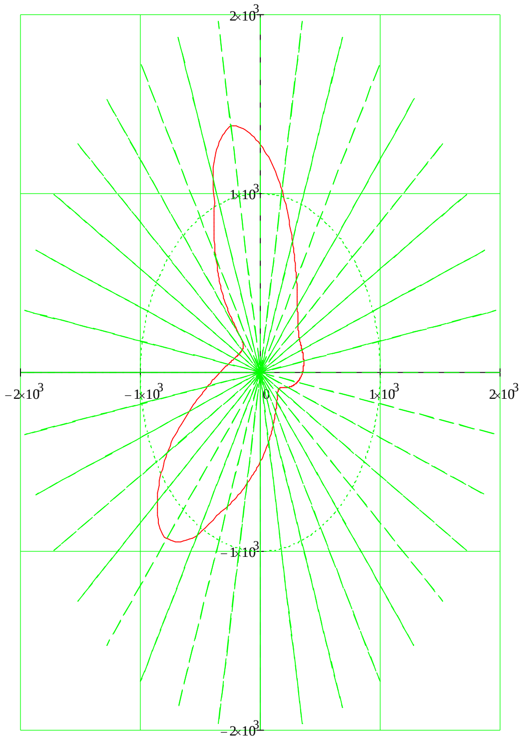

Fig. 8. The polar diagram of forces loading the base bearing.

V. CONCLUSION

The paper presents a type of numerical modeling represented by a program written in ”MathCad program” for determining the stressed at which the moving parts neck of marine engines are loaded, but not only. Such a program is useful for designing the engines as well as for testing the strength of the crankshafts.

VI. REFERENCES

[1] C. Alexandru, “Marine propulsion machinery and equipment”, Ed. Technical Publishing House, Bucharest, 1991, pp. 57-59.
[2] B. Grunwald, “Theory, calculation and construction of engines for motor vehicles“, Ed.Technical Publishing House, Bucharest, 1980, pp. 124-126.
[3] Al. Dragalina, “Applications calculation of marine diesel engines“, Ed. Publisher of Naval Academy "Mircea cel Bătrân", Constanța, 1993, pp. 20-65.
[4] G. Bobescu, “Engines for automobiles - design guide“, Ed. University "Transilvania", Braşov, 1997,pp. 65.
[5] C. Moroianu , “Marine Engines “,Ed. Technical Publishing House, Bucharest, 1996, pp. 305.