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Mathematical Modeling of the Operating Process and a Method to Determine the Design Parameters in an Electromagnetic Hammer Using Solenoid Electromagnets

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Abstract : This study presented a method to determine the optimum design parameters based on a mathematical model of the operating process in a manual electromagnetic hammer using solenoid electromagnets. The operating process of the electromagnetic hammer depends on the circuit scheme of the power controller. Mathematical modeling of the operating process was carried out by considering the energy transfer process in the forward and reverse windings and the electromagnetic force acting on the impact and brake pistons. Using the developed mathematical model, the initial design data of a manual electromagnetic hammer proposed in this paper are encoded and analyzed in Matlab. On the other hand, a measuring experiment was carried out by using a measurement device to check the accuracy of the developed mathematical model. The relative errors of the analytical results for measured stroke distance of the impact piston, peak value of forward stroke current and peak value of reverse stroke current were −4.65%, 9.08% and 9.35%, respectively. Finally, it was shown that the mathematical model of the operating process of an electromagnetic hammer is relatively accurate, and it can be used to determine the design parameters of the electromagnetic hammer. Therefore, the design parameters that can provide the required impact energy in the manual electromagnetic hammer were determined using a mathematical model developed. The proposed method will be used for the further design and development of the various types of percussion rock drills.

Keywords : solenoid electromagnet, electromagnetic hammer, stone processing, mathematical modeling
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