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# A novel multi-layer coil for a large and thick-walled component by electromagnetic forming

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**Abstract**: A driving coil is one significant tool for transferring electrical energy to plastic energy during electromagnetic forming, and the coil structure plays a crucial role on the distribution of magnetic field and electromagnetic force acting on the workpiece and determines the forming characteristics and magnitude. Due to the limitation of the conventional coil on forming a large and thick-walled component, this paper proposes a novel multi-layer flat spiral coil for large and thick sheets based on theoretical analysis of the relations of coil inductance, skin depth of sheets and energy efficiency. Taking electromagnetic flanging forming of a large and thick-walled sheet for example, a 3D numerical model is developed to investigate the effects of coil structure on magnetic field and sheet forming. Finally, several electromagnetic flanging experiments with 5 mm 5056 aluminum alloy sheets by a three-layer coil are carried out to validate the simulation results and a comparison of the thickness distribution and the fittability degree between the die and the sheet after one-time and two-time forming is performed. The results show that the magnetic force loading on the workpiece increases obviously with the increase of the coil layer owing to the additive effect of each layer of the multi-layer coils, and further enlarges the deformation, while the pressure acting on the coils can be controlled effectively due to the share of each layer of the multi-layer coils. The energy efficiency of the multi-layer coils increases with the increase of the skin depth and peaks at 19.6% when the skin depth is equal to the sheet thickness. The experimental results of electromagnetic flanging based on a three-layer coil coincide with the simulation results.

**Keywords**: Multi-layer coil, Electromagnetic forming, Large and thick-walled