

# A Flexible and Economic Method to Improve the Ability of Electromagnetic Flanging for Tubes

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## Research Article

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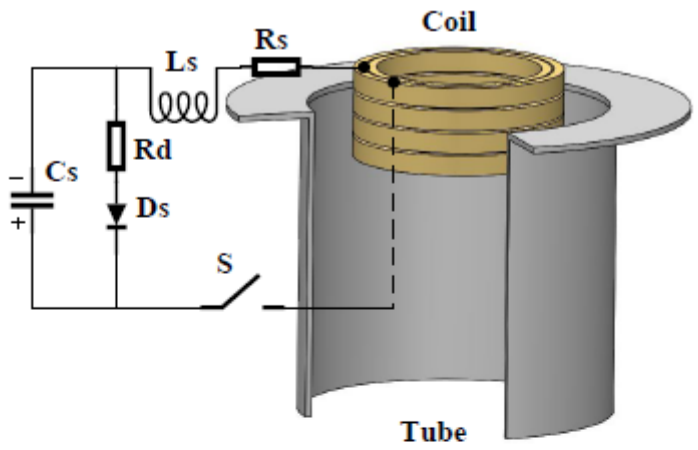
# Abstract

In recent years we have seen the rapid development of electromagnetic flanging of tubes, which uses coils to generate electromagnetic forces to achieve the deformation with high speed but without contact. However, the electromagnetic force decays rapidly with the increase of distance, resulting in strict requirements of geometrical matching between the coils and the tubes. Usually, new coils should be fabricated for tubes with new sizes, which is inconvenient and uneconomical. Therefore, a more flexible and economical method is proposed in this article, which introduces a solenoid field shaper into the existing electromagnetic flanging system. By adjusting the structure and the position of the field shaper, the distribution of electromagnetic forces can be reshaped to form tubes with various sizes, without changing the coil, whose cost is much higher than a field shaper. The principle of this method is introduced in detail. Then an electromagnetic-structure coupled finite element simulation model is established to calculate the forming process. The results show that when forming an A1060-O aluminum alloy tube with an inner diameter of 110mm, the discharge voltage can be tuned down from 8.5kV, without field shaper, to 7.11kV, with field shaper. That means the energy consumption of the system can be saved by 30%, and the manufacturing process of the field shaper is simpler than that of the forming coil. What's more, when forming tubes with different sizes, the new method shows higher effectiveness, greater flexibility, and lower cost than the traditional way.

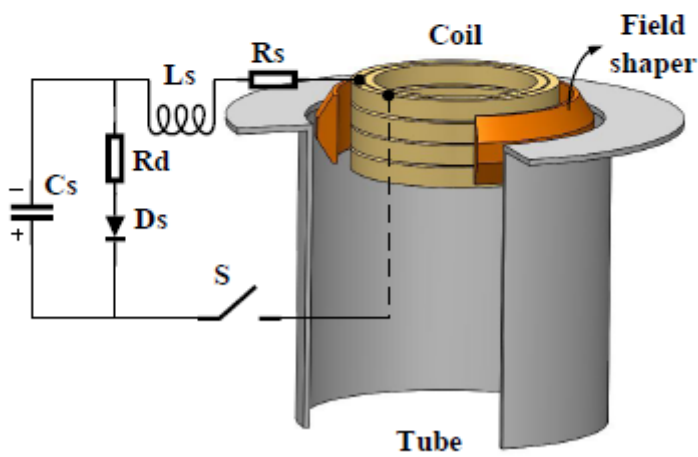
# Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the manuscript can be downloaded and accessed as a PDF.

# Figures



(a)



(b)

Figure 1

Schematic diagram of electromagnetic flanging system: (a) without field shaper; (b) with field shaper

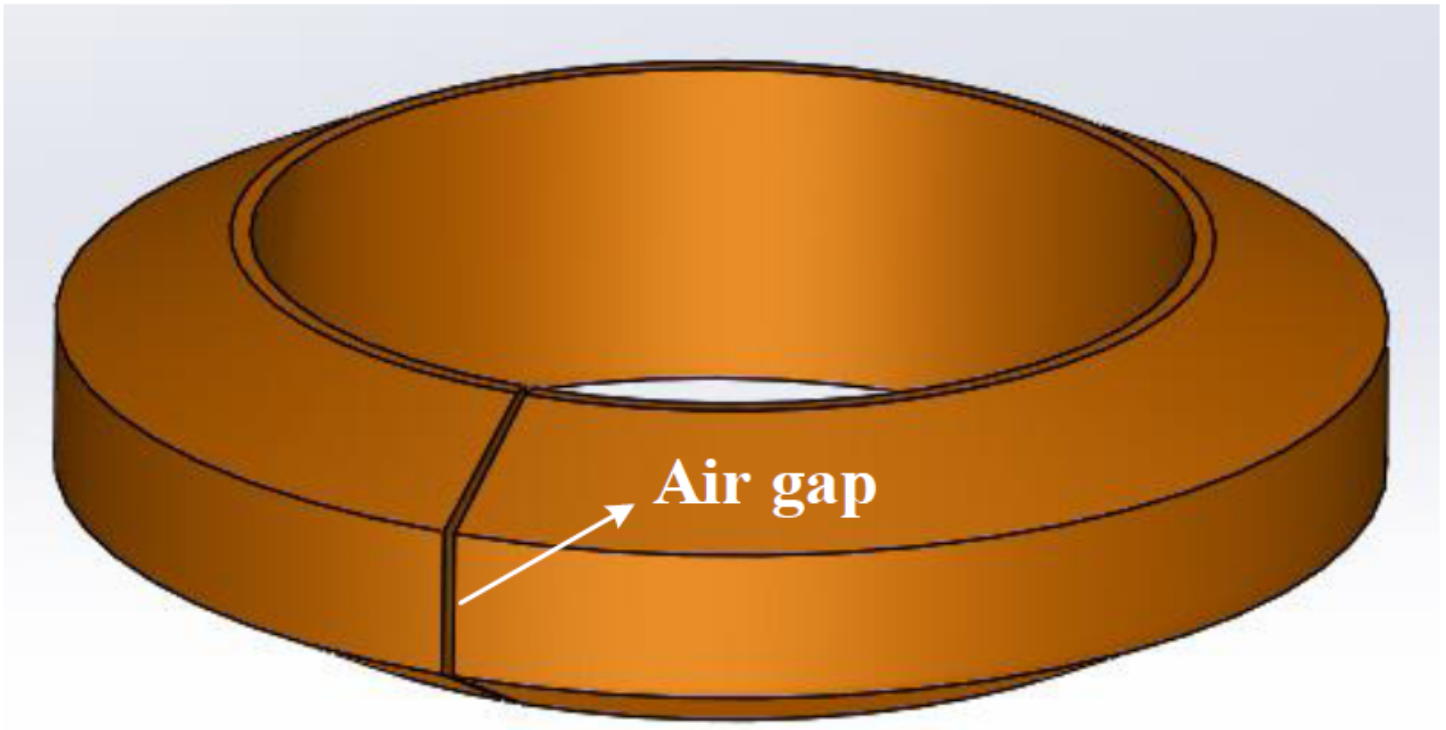


Figure 2

Structure diagram of solenoid field shaper

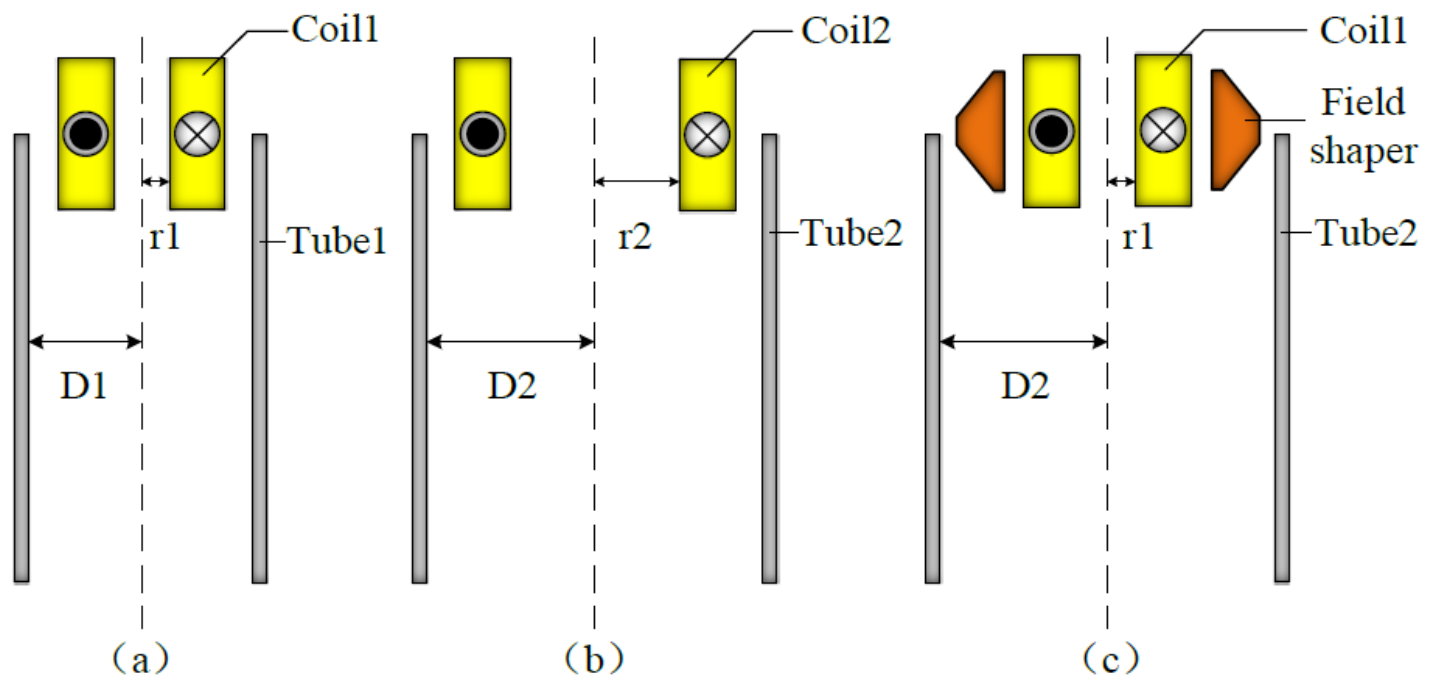


Figure 3

Symmetry axis

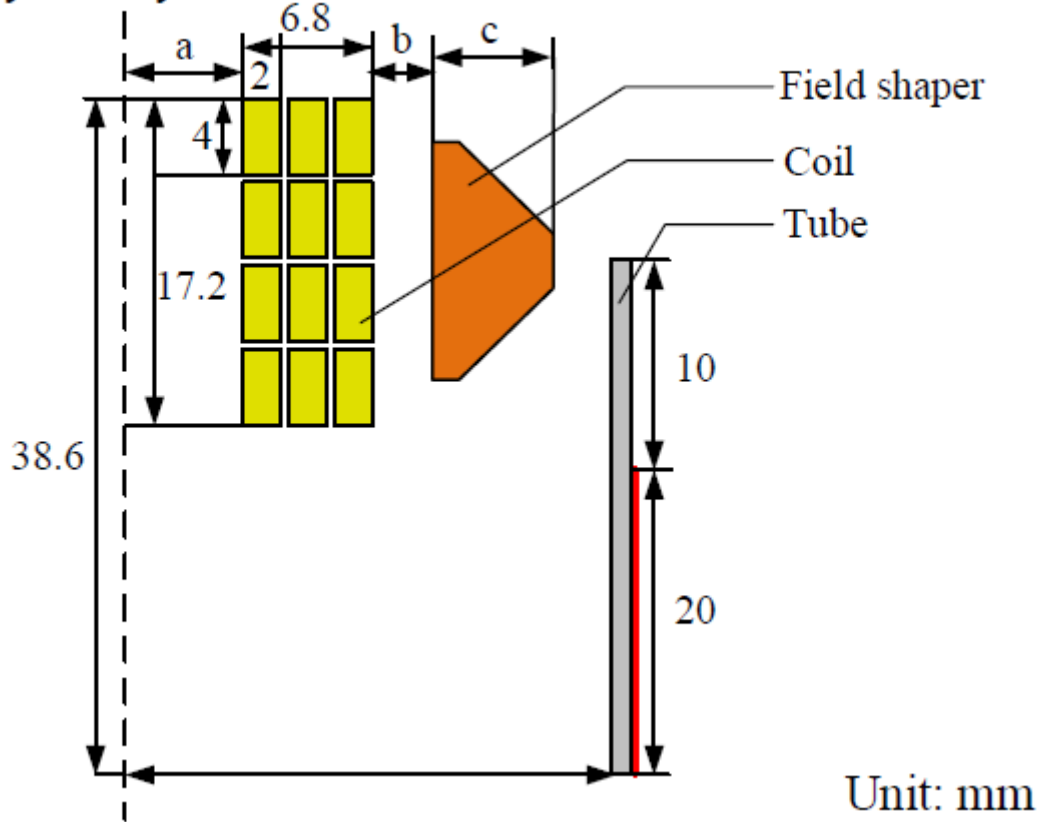


Figure 4

The geometry of numerical simulation

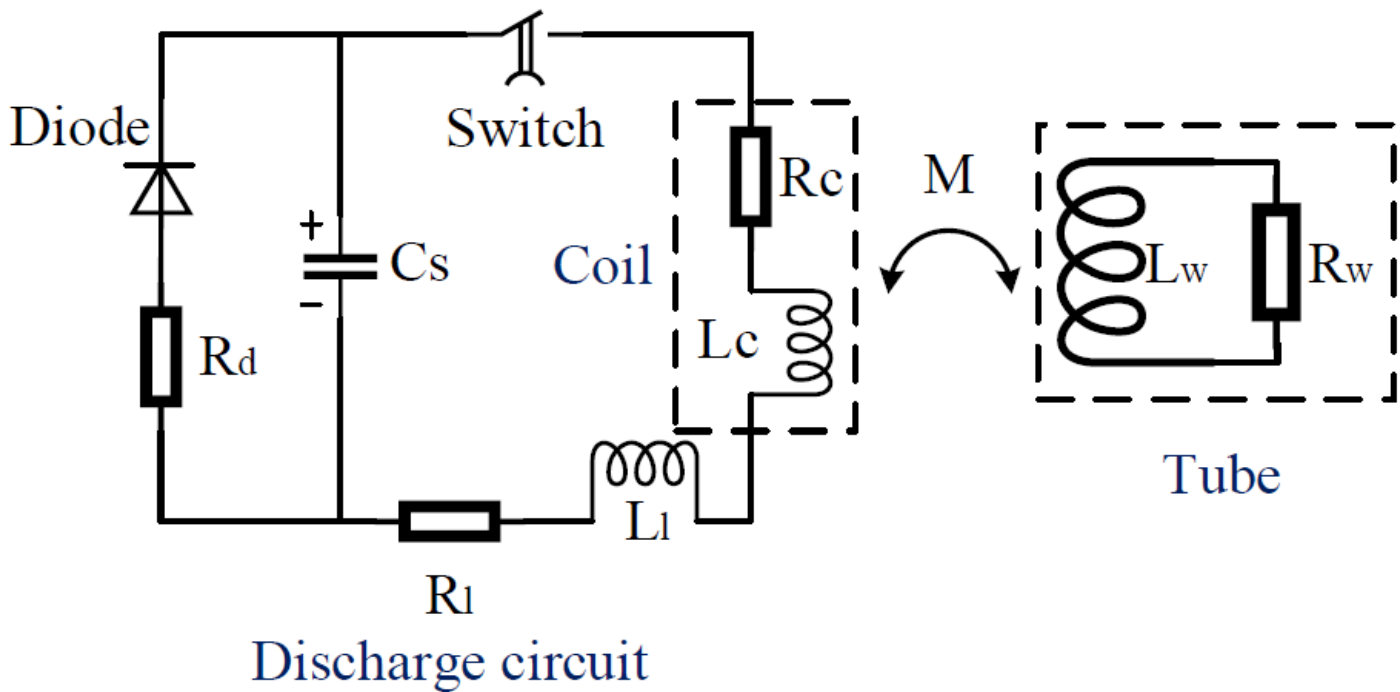


Figure 5

Equivalent schematic diagram without field shaper

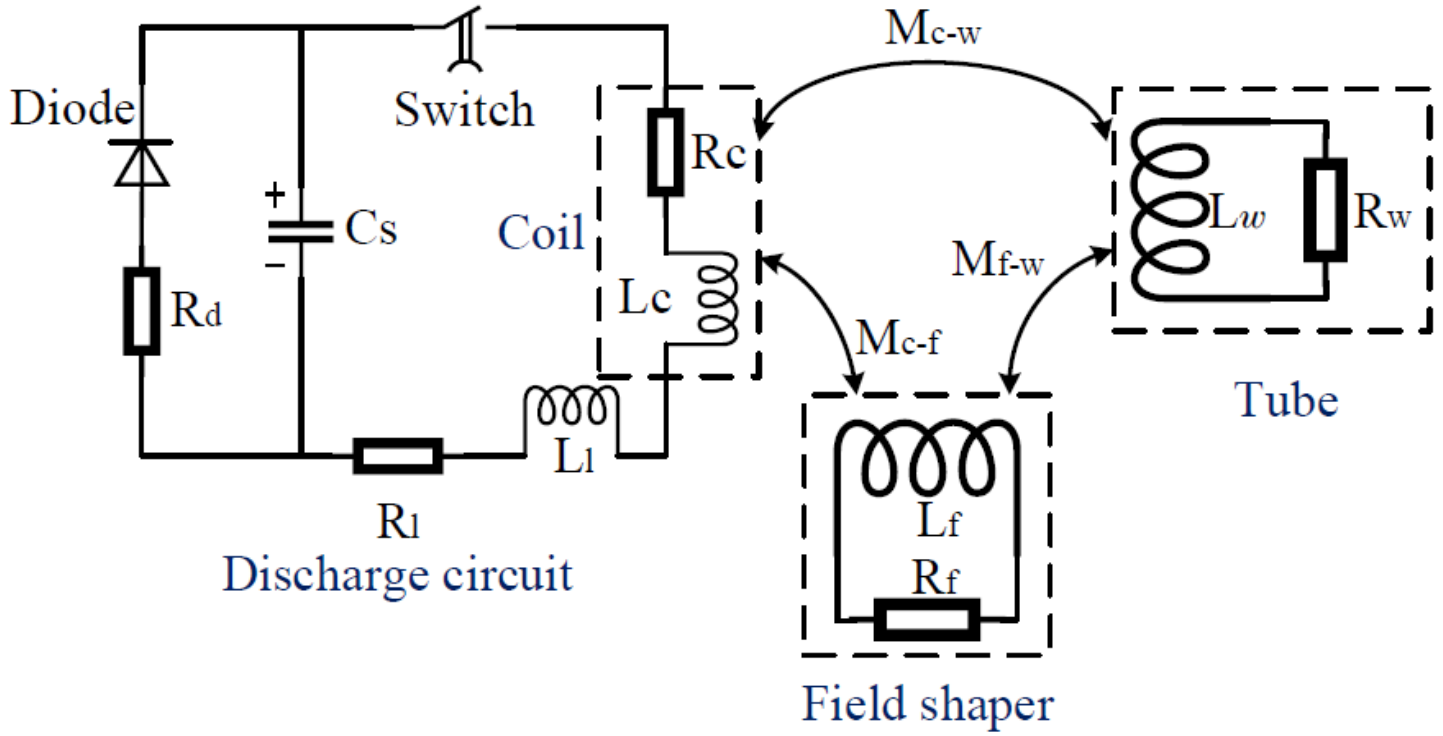
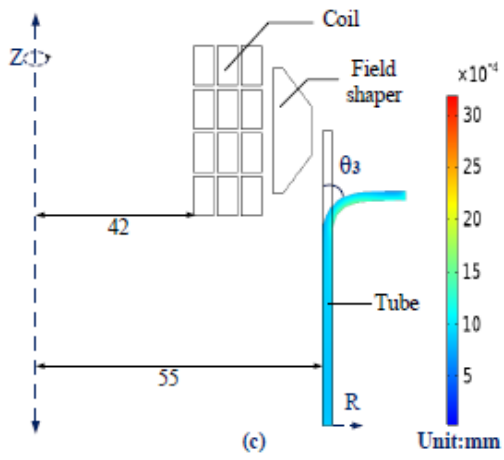
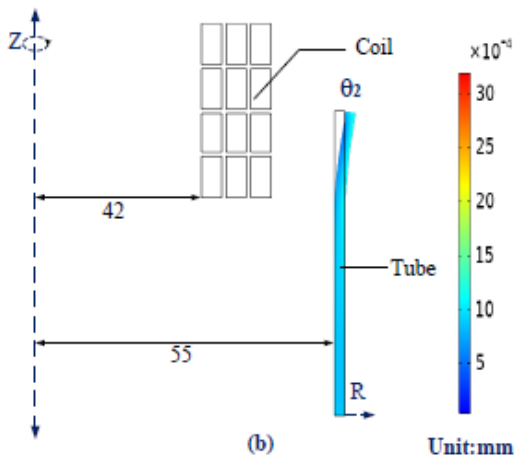
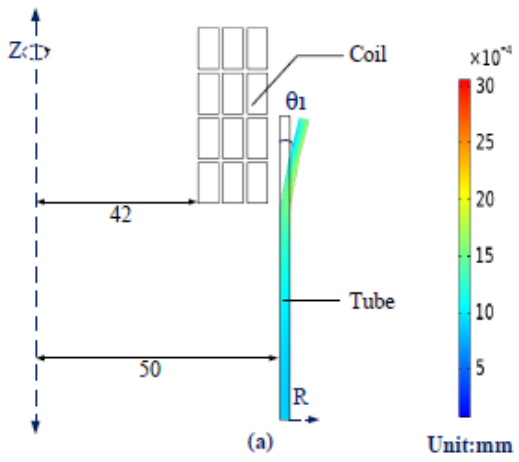


Figure 6

Equivalent schematic diagram with field shaper



**Figure 7**

Comparison diagram of tube flanging: (a) and (b) without field shaper; (c) with field shaper

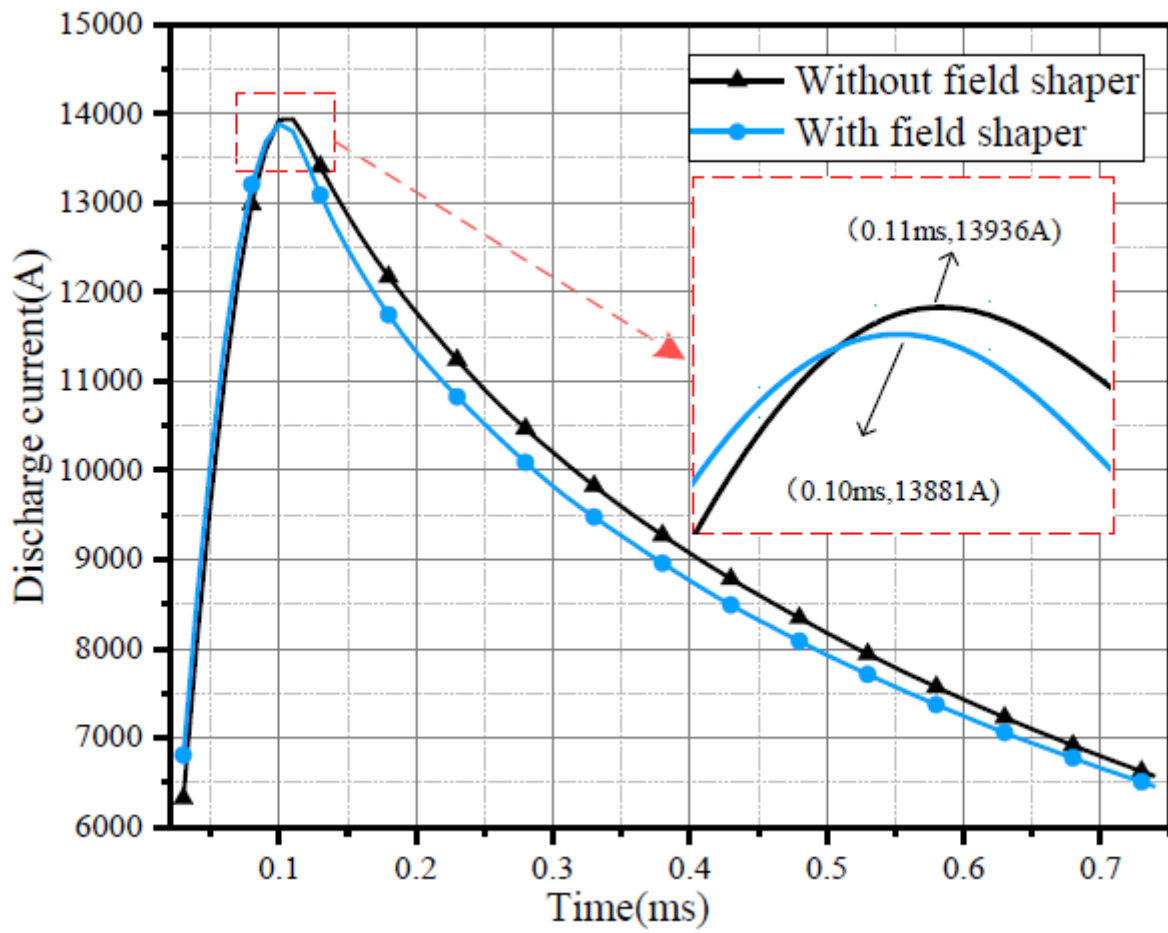
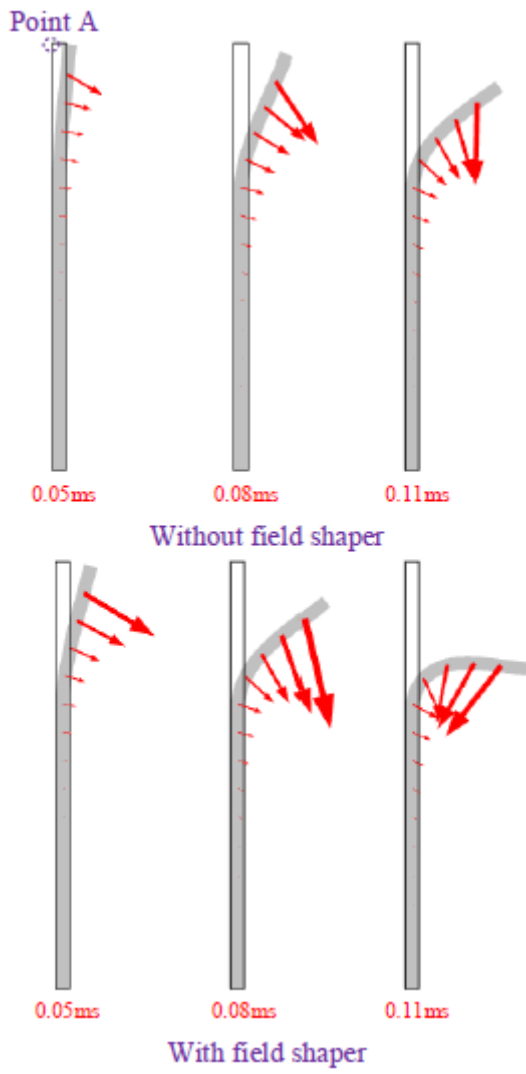


Figure 8

Waveforms of discharge currents





**Figure 9**

Distribution of Lorentz force vector at the end of the tube

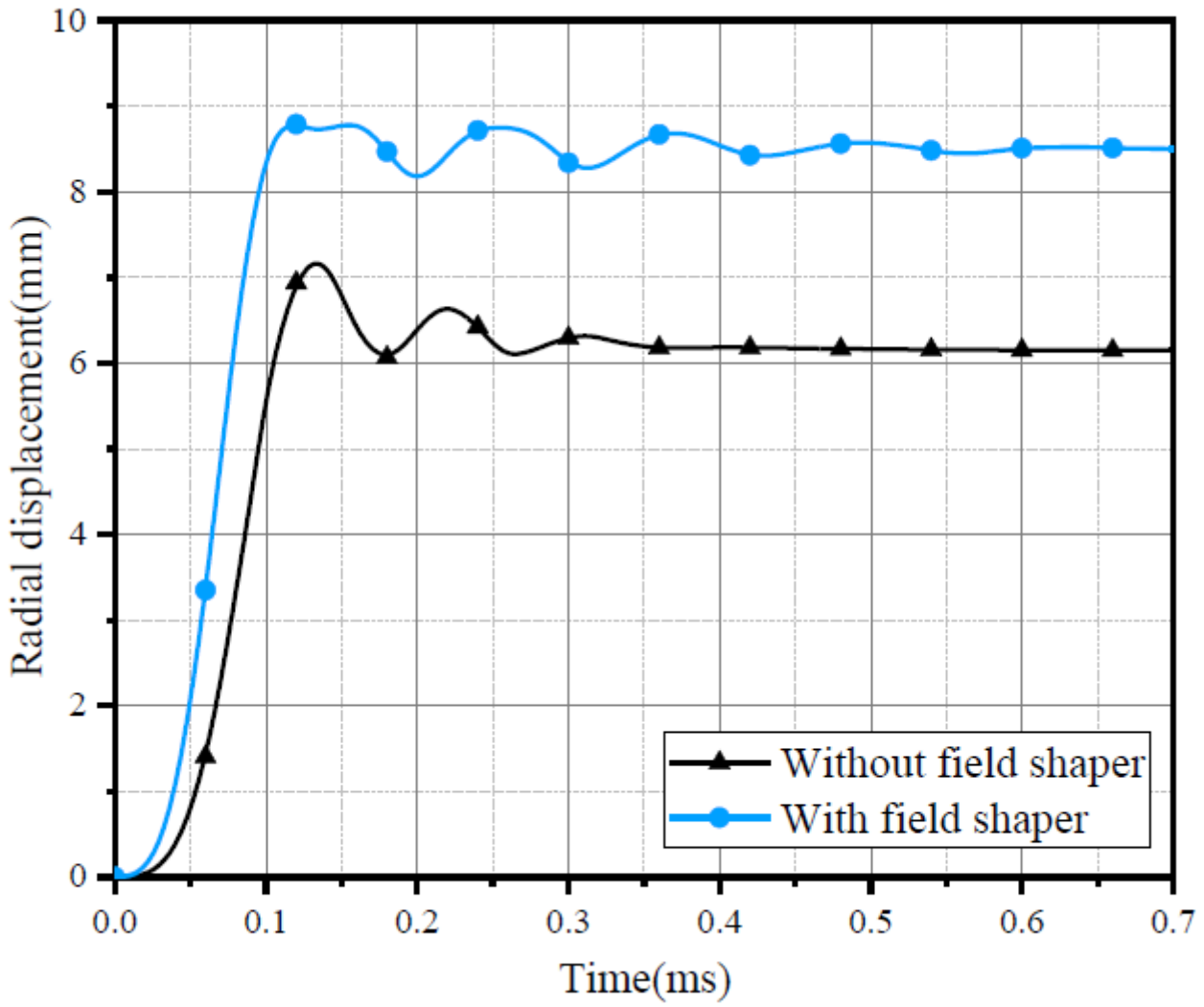
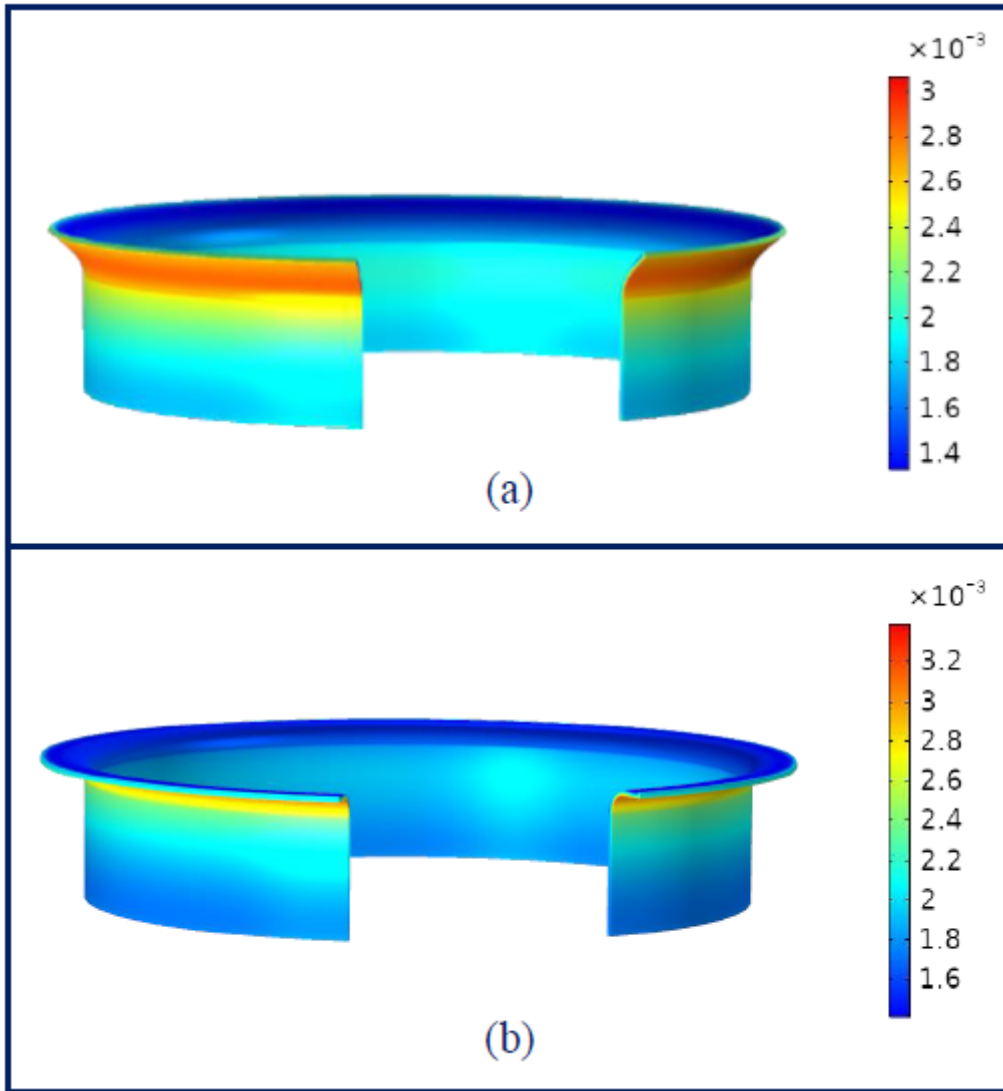


Figure 10

Calculated radial displacements at point A



**Figure 11**

3D simulation deformation diagram: (a) without field shaper; (b) with field shaper

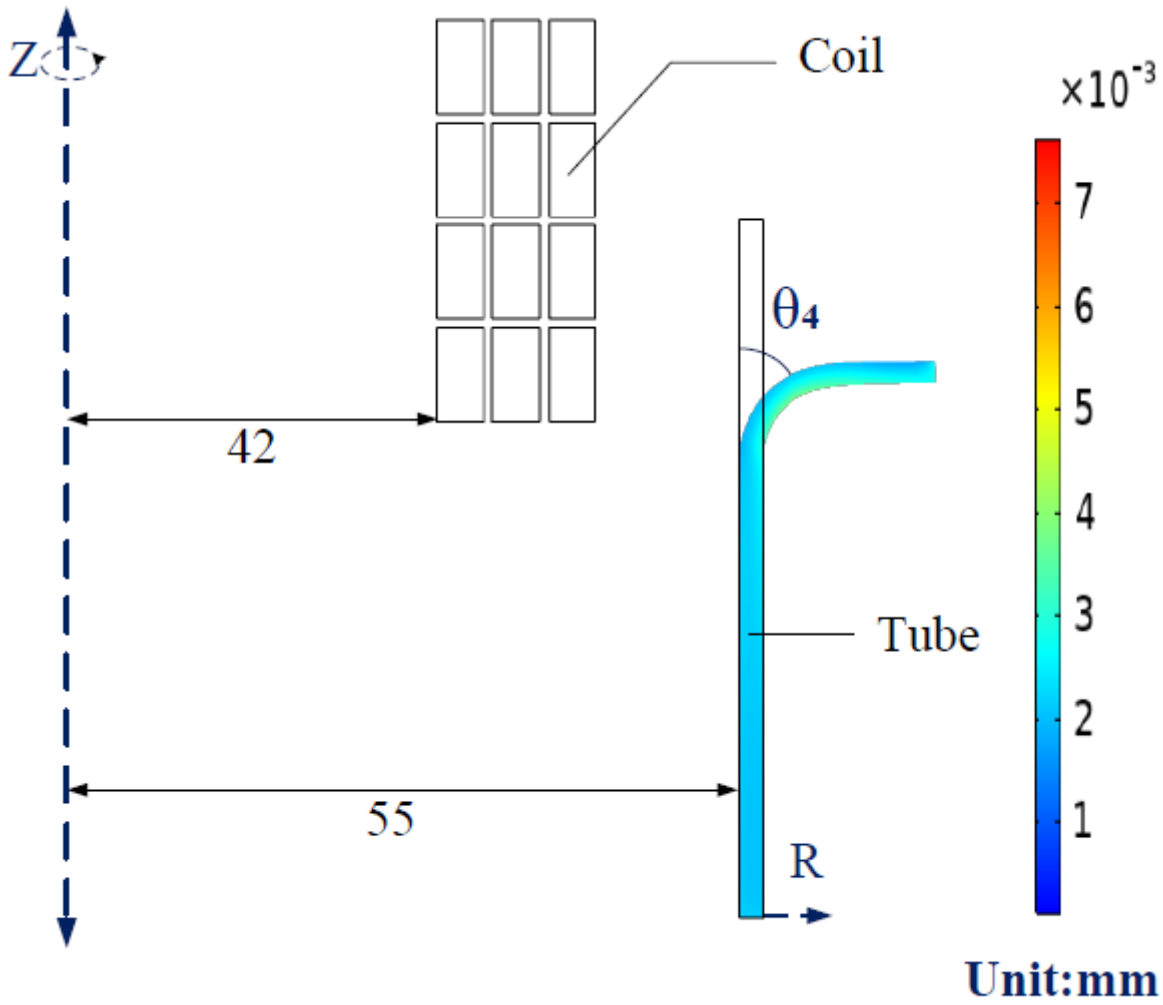


Figure 12

Schematic diagram of 110mm tube flanging without field shaper

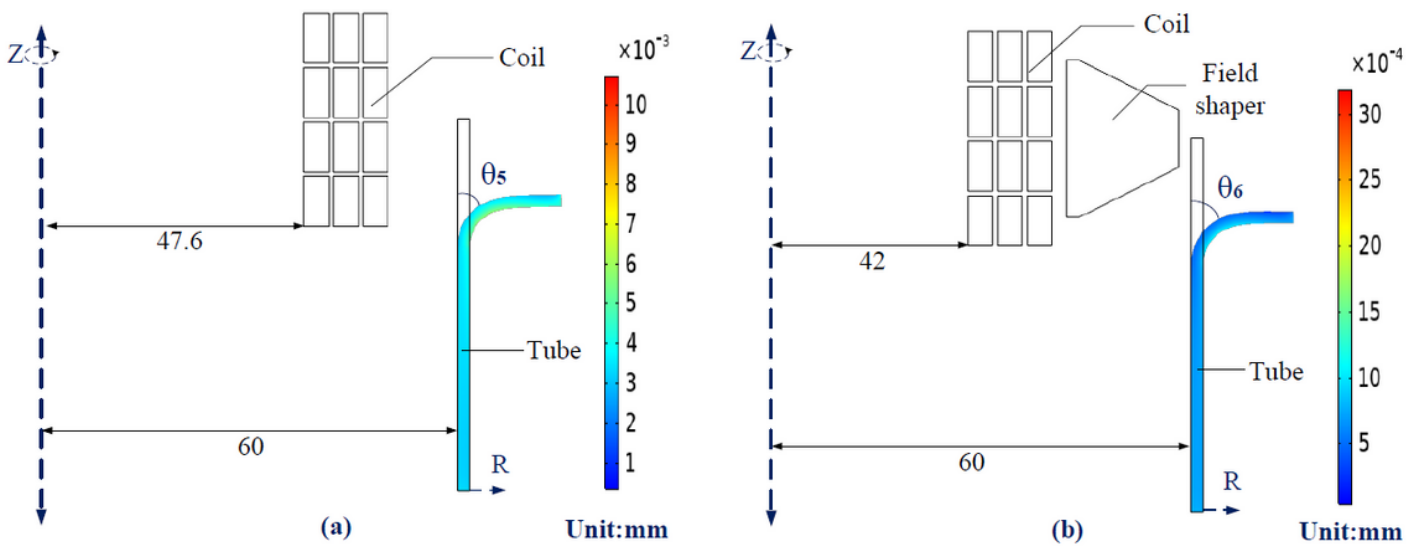


Figure 13

Schematic diagram of 120mm tube flanging: (a) without field shaper; (b) with field shaper