

## 6 - 25 Magnetic Lifting Prototype

Lü Mingbang, Zhao Lixia, Yao Qinggao and Xu Xiaowei

The lifting device is developed to realize the transportation of tungsten alloy balls. The tungsten alloy balls are new targets used in the ADS. The major components of prototype are the solenoids(Fig. 1) and their power system. The interactions of magnetic field force and tungsten alloy balls drive the balls and then fulfill the lifting. There exist two different ways of power supply, namely square-wave and traveling-wave.

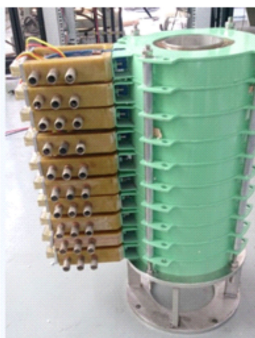


Fig. 1 (color online) a set of solenoids.

### Square-wave prototype

As shown in Fig. 2, the square-wave power supply control the power-on and power-off time of a group of solenoids to achieve the movement of magnetic field. The flow chat of controller of square-wave power is shown in Fig. 3. The magnetic field acts on the targets to complete the transportation of alloy balls. Ansys Maxwell is used to analyze the distribution of magnetic field for solenoid to design the structure of the solenoid. Ansys Maxwell is also used to accomplish simulation at different pulse width for each solenoid. We regulate power-on and power-off time of each solenoid and the number of working simultaneously solenoids to simulate the force of alloy ball. Based on the numerical analysis, the fabrication and test of the device prototype have been finished. The results show the device prototype has achieved the desired effect, but the efficienc of the device is low.



Fig. 2 (color online) Square-wave power supply.

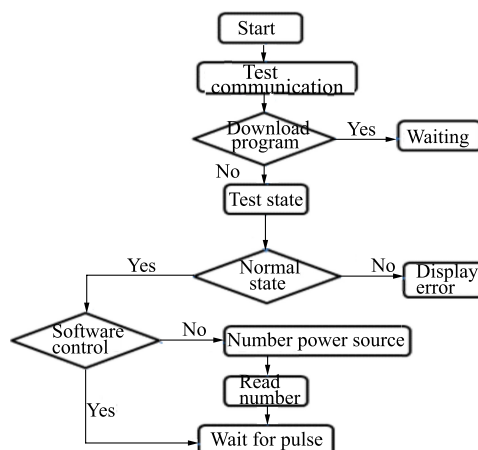


Fig. 3 Flow chat of controller of square-wave power.

### Traveling-wave prototype

We also use another solution to complete the magnetic lifting. A set of solenoids as the main components of the device remain unchanged. Traveling magnetic, as shown in Fig. 4, field act on the targets and then the targets are

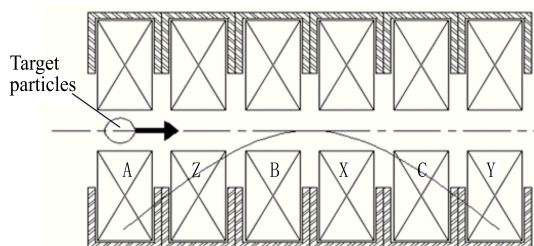


Fig. 4 Diagram of travelingwave magnetic field.

driven by the magnetic field force. In order to get the traveling-wave magnetic field, the solenoids are powered by variable frequency sine-wave current. The lifting velocity depends on the frequency. The solution is similar to the common cylindrical linear motor, but with a completely new way to use. The ways have advantages of low cost and high efficiency, but ejection of the targets seems difficult.

The final scheme should combine squarewave prototype with traveling wave prototype. The device will be divided into two different areas, including main lifting area and ejection area, and their power supplies are traveling wave and squarewave, respectively.