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THE NON-PYROTECHNIC DOOR RELEASE MECHANISM APPLIED TO MULTI-SATELLITES LAUNCHING

Abstract

In order to reduce launch costs and have the fast networking ability of hundreds of satellites, the multi-satellites launching type is paid great attention in recent years. The door release mechanism plays an important part in the process of multi-satellites launching, which directly determines the success or failure of the mission. The explosive style is a mature technology, however it is inconvenient to be tested repeatedly, and worse it has impact force. The reliability issues of the explosive device are more prominent in the multi-satellites launching type. In view of the above drawbacks, the non-pyrotechnic door release mechanism is put forward, which is consisted of an electromagnet and a ball bearing mainly.

A restoring spring is built between the electromagnet body and the core. In powered off stowed configuration, the electromagnet core inserts the ball bearing to lock the door under the built-in compression spring force. In powered on deployed configuration, the electromagnetic force overcomes the built-in compression spring force and the friction from the compression spring force driving satellite, then the core is pulled out, and then the door is released. There is no object else be ejected except for satellite. This is critical for the safety of the launch vehicle and other surrounding satellites.

To analyse the performances of release mechanism, the static characteristic of electromagnet, which is only related to the position of the core, can be inspected whether the electromagnetic suction match the spring back force. The dynamic behaviour is more important, for it reflects the practical operative mode. Then the mechanical-electrical-magnetic coupling mathematical model is established and calculated, and the ground experimental results agree well with the theoretical simulating analysis.

In order to verify the reliability of the non-pyrotechnic door release mechanism, all mechanical environment tests along three axes and the vacuum thermocycling tests are carried out. The proposed door release mechanism has great performance, and the test results show the unlocking time is only less than 20ms with rating 28V power. What's more, the prototype has undergone twice successful on-orbit flight tests, developed by Shaanxi Engineering Laboratory for Microsatellites of NPU. So this technology can be regarded as references for the future multi-satellites non-pyrotechnic door release mechanism standardization.