Technological Process Design for Disassembling the Joint Frame of A Certain Type of Surface-to-air Missile Co-launcher

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Abstract. In order to better standardize the process of disassembly and assembly of a certain type of surface-to-air missile co-launcher assembly frame, improve the efficiency of bomb replacement, and shorten the preparation time for combat, this paper uses Pro/E three-dimensional modeling software to perform three-dimensional modeling of the main structure of this type of co-frame launcher, and carry out the analysis of mechanical interface adaptability.

1. Introduction

Anti-missile, anti-stealth, and anti-saturation attacks have become the main forms of modern air defense operations[1]. Only a single type of missile launcher can no longer meet the increasingly intense air defense and anti-missile combat missions. The major military powers have successively developed and successively equipped a common-frame launch device capable of launching different types of missiles[2]. A certain type of surface-to-air missile weapon system is a typical representative of co-launching. It can mix and assemble A and B missiles[3]. Each of the 4 A missiles is fixed by the pallet as a set of missiles that can be combined with the B missile on the 4th of the launcher. Arbitrarily mixing on the bomb position, which not only greatly enhances the multi-target resistance capability of this type of weapon system, but also expands the interception range. But at the same time, new requirements are also put forward for the compatibility of mechanical interfaces and the problem of loading and unloading in the process of mixing two-type cartridges. In this paper, by modeling the structure of this type of launcher and fully analyzing its mechanical adaptability, this paper designs the process of disassembly and assembly of the A-type missile pallet, which provides a reliable basis for the use of combat units.

2. Launcher Structure Modeling

2.1. Structural modeling of the two launch tubes

Both types of missile launching barrels adopt a cylindrical structure, and the outside of the barrel is welded with reinforcing ribs. The A-type launching barrel is smaller in size, and its diameter is about half of the B-type launching barrel. Four A-type launching tubes are fixed by a joint frame, and the tail is equipped with a disc, which can be connected to the counterweight part by bolts. The body of the B-type barrel is equipped with lifting lugs and grab ears. The structure of the two-type barrel is shown...
2. Modeling the structure of the A-type launch tube assembly clamp and counterweight components

The joint frame is mainly composed of a star-shaped structure and a cup-shaped fixed frame. The frames are fixed by bolts. The outside of the frame is welded with fan-shaped lifting eyes. The model is shown in Figure 3 and Figure 4.

The counterweight component is mainly used to fix and balance the center of mass of the entire vehicle structure with the A-type launch tube. It adopts a tapered structure layout, with a disc structure welded at the front and a fan-shaped lifting lug at the rear. The model is shown in Figure 5.

2.3. Modeling structural of the landing gear

The main structure of the undercarriage is composed of two front and rear supporting devices and a connecting beam in the middle. The model is shown in Figure 6. The front and rear are welded with loading rails for fixing the launch tube, and the model is shown in Figure 7. A hydraulic actuator with
automatic grappling hook is connected to the connecting beam in the middle, and its model is shown in Figure 8.

3. Analysis of the mechanical adaptability of the launching device

Every 4 A-type launching tubes are fixed together by the joint frame, star-shaped structure and counterweight parts. The front part of the launching tube and the star-shaped structure are connected by bolts, as shown in Figure 9, which mainly reduces the vibration of the tube mouth during the launching process. The middle of the launching tube is fixed by the coupling frame, and its radial constraint is imposed by the structure of the coupling frame, and the axial constraint is imposed by the two adjacent reinforcing ribs of the barrel and the coupling frame, as shown in Figure 10. The tail of the launch tube and the counterweight are fixed by bolts, which can balance the center of mass of the vehicle during horizontal transportation. During the launch, the counterweight is connected to the ground to transmit the ejection reaction force, as shown in Figure 11. Both the joint frame and the counterweight parts are equipped with fan-shaped lifting eyes, which can be matched with the two assembly guide rails in front of the undercarriage. A hydraulic actuator with automatic grappling hook is used to grab the ear grab structure on the counterweight component to realize the filling and fixing of the entire set of launching cylinders.
The B-type launcher barrel is equipped with fan-shaped lifting lugs and grab lugs. The structure and size are the same as those mentioned above, which can realize the arbitrary assembly of the two missiles on the 4 bomb positions of the launcher.

4. The design of the disassembly process of the joint rack

4.1. Selection of working platform
The working platform should be selected to facilitate the separation of the launching tube, and the corresponding size of the placement frame should be matched to prevent accidents caused by the launching tube slipping[4]. For the disassembly and separation of the A-type launch tube assembly, the working platform is divided into working platform 1 and working platform 2. The bottoms of the two platforms are equipped with universal wheels with locking function to facilitate the transportation of the separated tail counterweight and other components.

4.2. Disassembly process
In this section, for the convenience of description, the four A-type transport launch tubes and the three parts of the cup-shaped fixed frame are numbered, as shown in Figure 14 and Figure 15.

4.2.1. The separation of the transport launch tube and the counterweight component
The A-type transport launch tube is fixed on the tail counterweight with four bolts. When disassembling, only the hexagonal sleeve is used to remove the corresponding bolts, and the transport launch tube can be separated from the tail counterweight. At this time, turn off the lock switch at the bottom of the universal wheel of the working platform 2 and push the working platform 2 together with the tail counterweight away.

4.2.2. Separation of the transport launch tube and the coupling frame
The separation of the A-type launch tube and the coupling frame can be mainly divided into two processes: the separation of the transport launch tube and the star-shaped structure and the separation of the transport launch tube and the cup-shaped fixed frame. Because the four A-type transport launch tubes are connected in the same way as the joint rack, this article only describes the separation of the
No. 1 transport launch tube from the joint rack:

The first step is the separation of the No. 1 transport launch tube from the star structure. The bolts used to connect the No. 1 transport launch tube and the star structure are fixed inside the star structure, and the working space is relatively narrow, so a ratchet socket wrench is required. By removing the fixing bolts through the ratchet socket wrench, the separation of the No. 1 transport launch tube and the star structure can be realized.

The second step is the separation of the No. 1 transport launch tube and the cup-shaped fixed frame. Fix the wire rope on the No. 1 frame of the cup-shaped fixed frame, use a hexagonal socket to unscrew the nut at the connection between No. 1 frame and No. 2 frame, and rotate the rotatable bolt 90° along the axis to release No. 1 frame and No. 2 frame. We use a hoist to lift the No. 1 frame away from the work area. Fix the wire rope on the No. 1 transport launch tube, and the crane slowly lifts the No. 1 transport launch tube away from the cup-shaped fixed frame. When the No. 1 transport launch tube is separated from the cup-shaped fixed frame, pay attention to an operator who uses a rope to tighten the No. 1 transport launch tube to prevent the No. 1 transport launch tube from being damaged or causing other accidents.

5. Conclusion

In this paper, referring to the technological process of general equipment disassembly and maintenance\(^5\), a certain type of surface-to-air missile launcher is modeled. On the basis of the analysis of the adaptability of the mechanical interface, the disassembly work platform is designed, and the separation process of the A-type launching tube assembly and the tail counterweight, and the separation of the launching tube and the coupling frame are sequentially explained. Studying the disassembly process of the quadruple A-type transport launching tube is an indispensable step for studying the launching device of this type of launch vehicle. This has certain reference value and practical significance for the use and maintenance of combat troops.

References

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