TWO-PDR. MULTIPLE MARK VII GUN MOUNTING CRADLES

Replacement of Castings by Steel Fabrication

This paper was prepared by the Naval Ordnance Department, having been condensed from an original article by ENGINEER CAPTAIN J. P. JOHNS, R.N., *Gunnery Engineer Overseer, North-Eastern Area.*

In 1940 there was a pressing need for economy in non-ferrous materials and their replacement by steel for various gun mounting components was considered. At that time the great advance in welding technique made during the war had scarcely begun and many engineers still regarded welding with suspicion and disfavour. There were, however, certain British firms who had studied and practised its application with marked success.

The substitution of a fabricated article for one designed as a casting is seldom satisfactory. It was decided, however, to attempt the change on the cradle of the 2-pounder " M " Mark VII Mounting. This is a complicated structure, in which are mounted four 2-pounder Mark VIII guns. As these fire automatically there is a constant racking of the cradle. Two large diameter trunnions, disposed one on either side of the cradle, transmit the firing loads to the carriage through roller bearings, the trunnions themselves forming the inner races of the bearing.

These cradles were originally cast in 28-ton U.T.S. high-strength brass, requiring a four-ton melt. A 2½-ton casting was the result and the final machined weight was 25 cwt. The material selected for the fabricated cradle was B.S.S. 32 Grade 2, 28-ton U.T.S. mild steel, and, in considering the change to fabrication, the following principles were decided upon :—

(*a*) The firing shock must not subject welds to tension stresses. All such welds were to be arranged so as to be in compression, or the parts were to be spigotted together, before final welding.

(*b*) The machining of weld metal must be avoided wherever possible, but, when unavoidable, the welds were to be so made as to allow for all tolerances required in fabrication and machining and to leave enough weld metal to give the required strength.

(*c*) Facings and pads on large plain surfaces were to be avoided because of the danger of removing the greater part of the facing during machining, thus leaving a thin piece of metal attached only at its edges. Low facings were to be built up solid with weld metal ; others were to be made from blocks recessed into the plate.

(*d*) Sharp corners were to be avoided, as they are difficult to make and involve recessed welds.

The various stages of the actual construction are shown in the accompanying photographs. All items were cut to size and formed to shape in accordance with detailed drawings which showed the finished part. Facings and bases were welded to plating as sub-assemblies before being assembled in their turn in the main fabrication. In accordance with general practice certain parts were pre-set to compensate for the distortion which would take place during welding. All welds were double runs and, at each stage, the fabrication was checked for distortion.

Referring to the plates, Figs. 1 and 2 show some of the flame-cut parts.

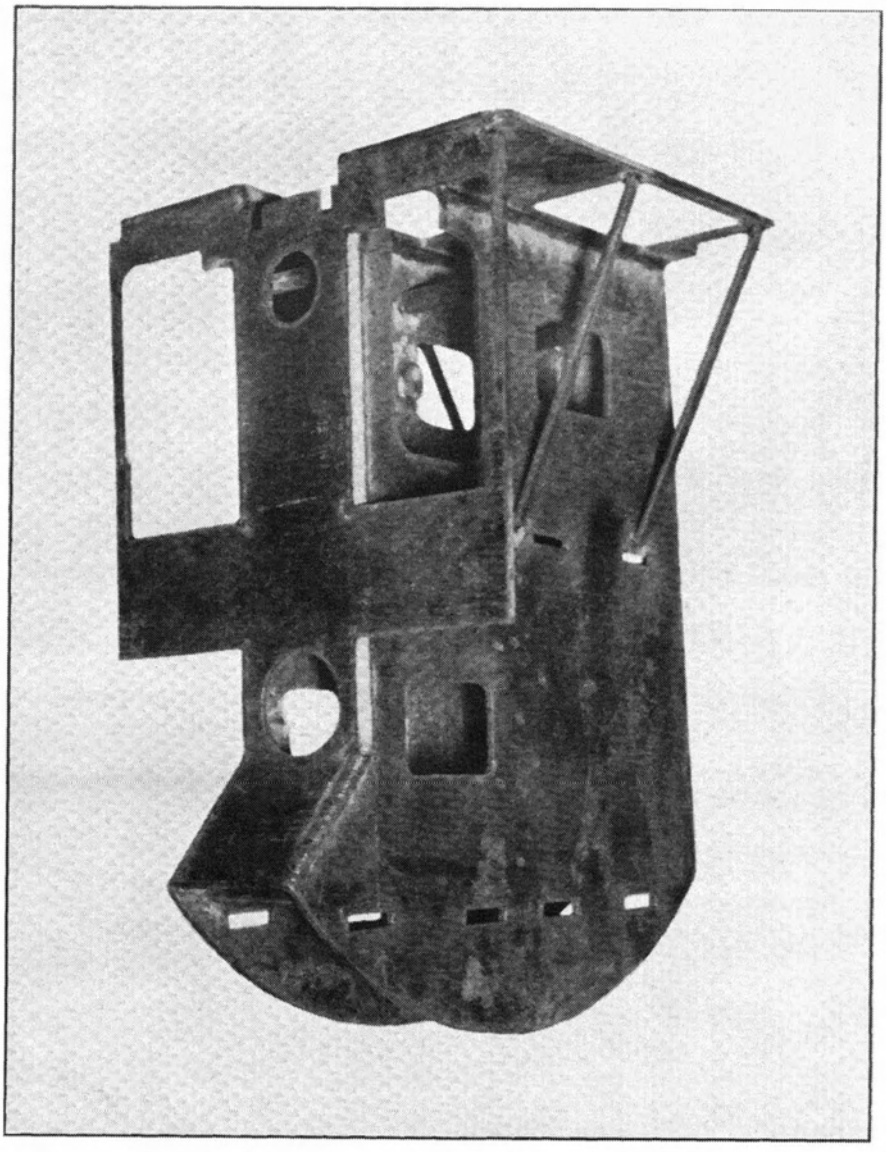

FIG. 4.—CENTRE PORTION SHOWING TEMPORARY STAYS

Fig. 3 shows two views of a pre-fabricated trunnion ring. The temporary centre is added to accommodate a spindle for the purpose of locating the trunnion rings accurately on the centre line of the cradle. A hole is bored through the box centre piece on the centre line of the trunnions, through which a spindle is passed to locate the trunnion rings and elevating arcs. These two figures show how the hinge-lugs of the ammunition trays are spigotted into the side plates of the trunnion ring and welded at the back.

Fig. 4 shows the centre, box-like, formation. It has flat, parallel side walls, enclosed front, top and back, and is sufficiently rigid to form a base for the

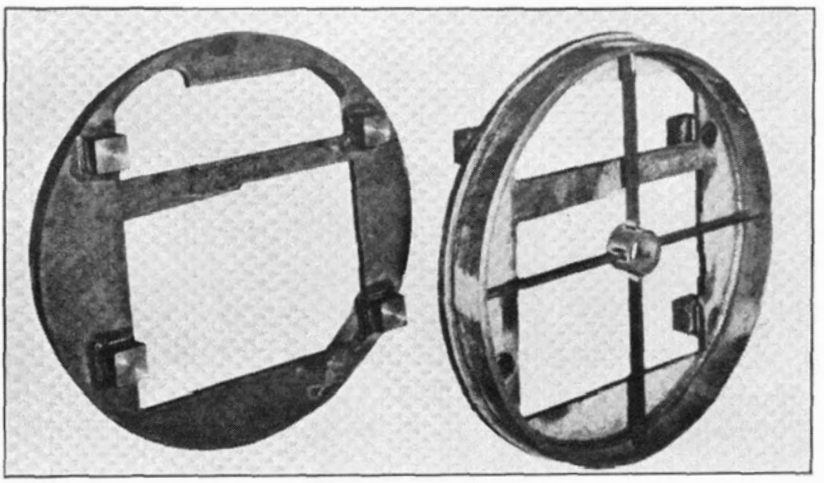

FIG. 3.—PRE-FABRICATED TRUNNION RING

subsequent addition of the remainder of the structure. In this and subsequent stages, liberal use was made of temporary stays to stiffen any insufficiently supported surfaces until the addition of the final parts rendered the stays superfluous ; they were, however, left in place until the fabrication had been completed and had been stress-relieved.

Fig. 5 shows the above after assembly of the side plates and gun shelves, and shows how the gun shelves have been spigotted into the side plates. Tongues on the shelves fit into slots in the side plates and are heavily welded. The arrangement of temporary stays can be seen in these two views.

Fig. 6 shows the trunnion rings and the elevating arcs in place. The trammels

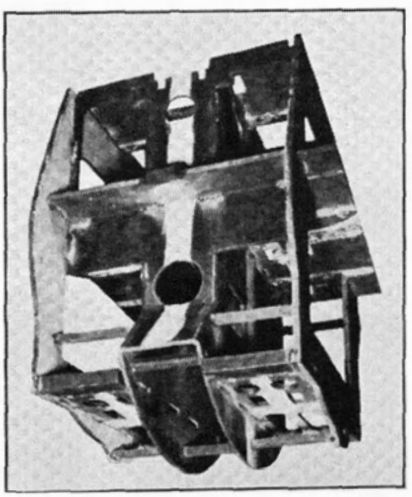

FIG. 5

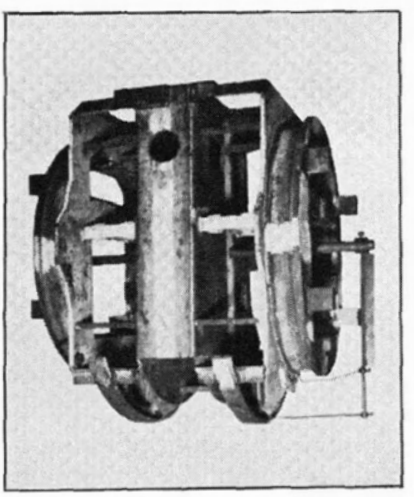

FIG. 6

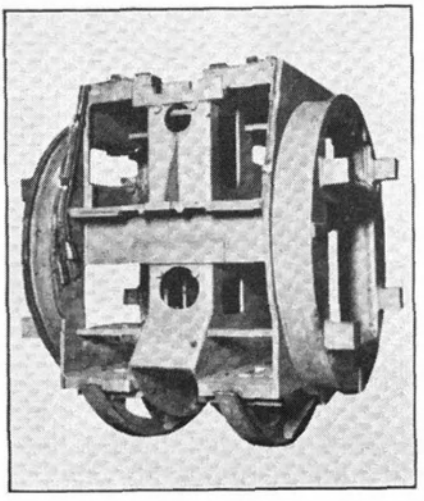

FIG. 7

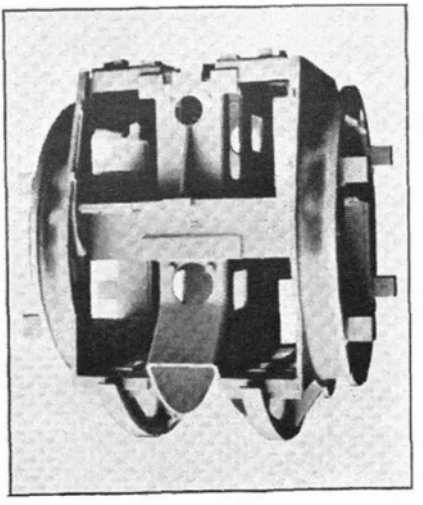

FIG. 8.

used to locate them accurately are also seen in this view. Fig. 7 shows the final fabrication with the temporary stays still in place. In this condition it is stress-relieved, after which the temporary stays are removed and the whole is then zinc sprayed. Fig. 8 shows the completed cradle, stress-relieved, temporary stays removed and the whole sprayed with zinc.

The total weight, including the separate gunmetal firing-cam gear-box, was 18 cwts., *a saving of about 7 cwts.* as compared with the non-ferrous cradles. This saving of weight was very desirable, but the saving of a large quantity of non-ferrous metal was still more valuable, as it came at a time when supplies were difficult. A further and most noteworthy advantage was *a reduction in machining time of nearly* 30%, this in addition to the time saved in making repairs of faulty castings. Moreover, total rejections of castings had frequently been necessary during the final machining process.

As fabrication was an entirely new departure on work of this nature, one cradle was ordered for trial purposes and, as the trials proved entirely successful, the design was adopted. Since then all cradles fitted to 2-pdr. Mark VII (four-barrelled) mountings have been fabricated. The complete success of this experimental cradle justified confidence in adopting the process for other purposes. Many parts of gun mountings, formerly made from castings in steel and non-ferrous metals, are now fabricated in steel with a marked saving in weight and cost.