EVOLUTION OF THE MODERN GUN MOUNTING

—— Part I ——

A hundred years ago naval guns were similar to those carried in *H.M.S. Victory*. These guns were elevated by means of a ' quoin ' or wooden wedge which was inserted under the breech of the gun. Recoil was taken by the overrunning of a six or eight fold purchase secured to a wooden carriage which slid to the rear on small solid wooden wheels. The gun was muzzle-loaded by hand and ' run out ' through the gun ports by means of hand-spikes, assisted, if the ship was rolling, by the recoil purchases. No training gear was fitted, and thus the Master was responsible for putting his broadside on the enemy.

During the same era Carronades, which could be trained by means of a central swivel and a rail on the deck, were fitted at the extreme ends of the ship for use during chasing actions.

The solid cast iron muzzle-loading piece held the field until about 1850 when it began to be ousted first by the wrought iron and then by the mild

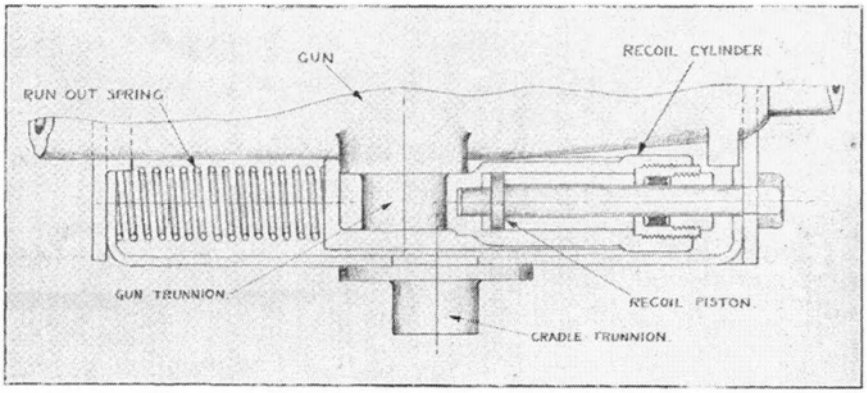

FIG. 1.—AN EARLY APPLICATION OF RECUPERATOR SPRINGS

steel gun, both of which could withstand higher chamber pressures without bursting. More improvements in the quality of steel soon made it possible to incorporate a breech opening at the rear of the chamber. As soon as breech loading became possible, it was no longer necessary for the gun to ' run in ' on recoil, in fact it was seen that it would be an advantage for the breech to return to the same position immediately after the gun had fired.

This led designers to introduce hydraulic brakes and ' run out ' or recuperator springs which were at first applied to the solid trunnions of the gun (see Fig. 1). At the same time, the advent of high velocity steel guns was making the recoil forces too large to be absorbed by rope purchases and ' breechings ' secured to the hull by ring bolts.

Early elevation gears

In the days of the *Victory*, broadside guns were generally fired at almost point blank range and accurate elevation was therefore relatively unimportant. The introduction of steel had made greatly increased gun ranges possible, but elevation had still to be applied to the guns by means of quoins or screw-jacks under the breech. It was clear that the problem would be solved if

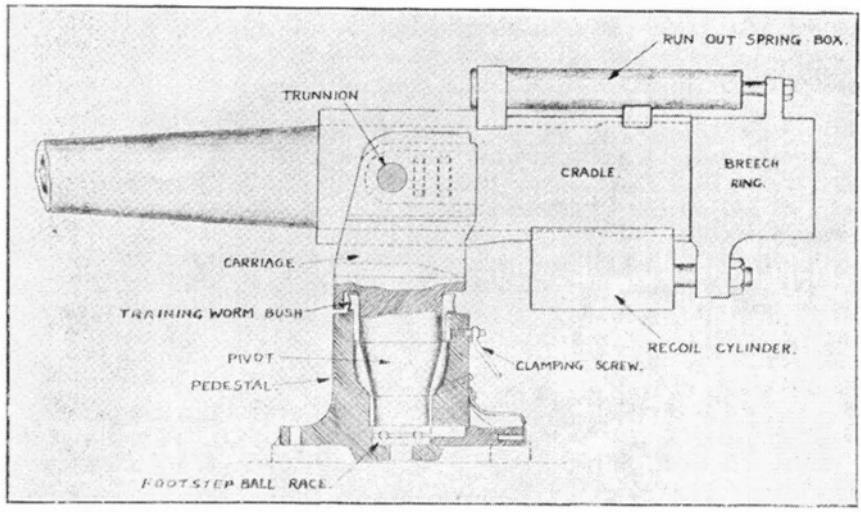

FIG. 2.—PEDESTAL MOUNTING

elevation could be applied by means of a rack and pinion to something which carried the gun but did not itself recoil.

After the introduction of hydraulic brakes, it was but another step to mount the gun in a cradle and connect the two together by means of the hydraulic brake and 'run-out' springs. Once this had been achieved the

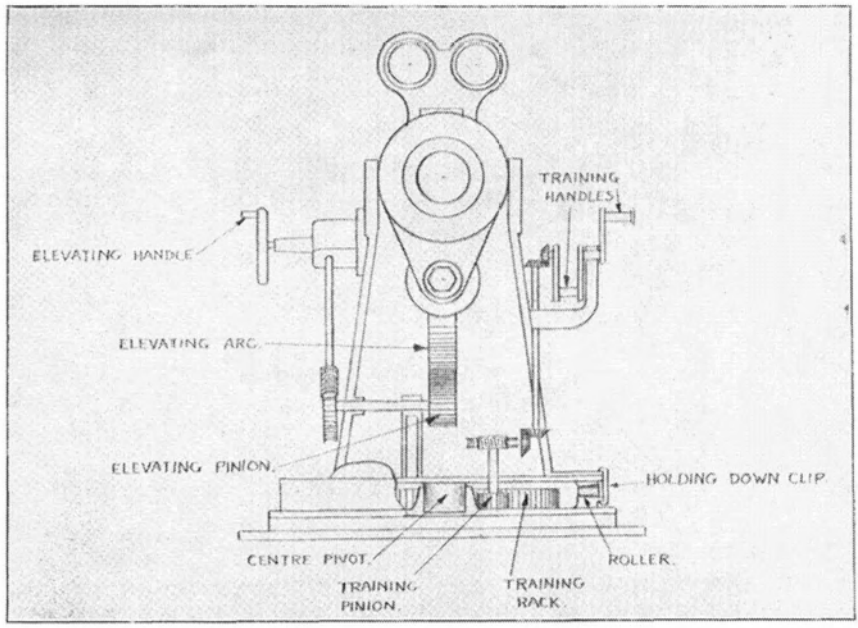

FIG. 3.—CENTRE PIVOT MOUNTING

trunnions were fitted on the cradle and not on the gun, and the whole assembly was accurately controlled in elevation by means of a rack and pinion or a hydraulic cylinder.

Early training gears

Another effect of longer gun ranges was that guns had to be aimed ahead of the enemy to allow for his forward movement during the projectile's time of flight. It was obviously inconvenient and inaccurate to swing the ship off its course each time the guns were fired and it began to dawn on naval designers that some sort of training gear ought to be fitted. Heavy guns were therefore mounted on a rotating turn-table and the essence of this idea is still modern practice. Heavy gun mountings such as these came to be known as the non-transferable type because a special structure had to be built into the ship to house them. Lighter guns tended to follow the Carronade principle, i.e., they were slewed or trained about a swivel.

As soon as the cradle was introduced, it became possible to house its trunnions in a stout " Y " piece which rotated on a footstep bearing and was supported in a pedestal mounting. The upper part of the " Y " piece was supported in a vertical bearing and a training worm wheel was either made integral with the upper part of the pedestal or could be clamped to it (Fig. 2). Training was effected by clamping the worm wheel and revolving a worm housed in part of the " Y " piece. It is of interest to note that " Transferable " naval gun mountings up to 6 in. were still of the pedestal or " P " type until the 1914-1918 war.

Centre pivot type mountings

During the European War, the heavy demand on forgemasters for guns, breech mechanisms and breech rings resulted in a serious bottleneck. It was therefore decided to change over the design of transferable mountings to the C.P. (centre pivot) type which made use of steel castings instead of forgings. The C.P. type was an adaptation of the heavy turret principle which used *cast* steel upper and lower roller paths with a central pivot incorporating vertical rollers to take the rolling stresses and part of the recoil forces.

The upward blow resulting from the recoil forces was taken by clips at the front and the downward blow by the training rollers (Fig. 3). The trunnion bearings were held in " carriage cheeks."* These carriage cheeks consisted of plate and angle structures riveted and keyed to the cast steel upper roller path.

High angle gun mountings

The need for H.A. mountings was not felt until about 1916, when the C.P. mounting then being evolved was seen to be more suitable for H.A. purposes. With this type, the gun and cradle could be elevated to 90° if necessary (see Fig. 4), whereas with the " P " type mounting, elevation was limited by the cradle fouling the fork of the " Y " piece. This is clearly shown in Fig. 2.

Since 1918 the tendency has been for the H.A. gun mounting to become a dual purpose H.A./L.A. weapon which could deal with submarines and light surface craft as well as aircraft.

Director firing

The earliest director was essentially a dummy gun mounting fitted with a gun sight capable of being trained and elevated. The movements of this sight were transmitted electrically to control the movements of pointers at

* The nomenclature was taken from the *Victory* type of gun mounting.

various groups of guns. Thus, the individual gun layers and trainers instead of using their own sights followed the movement of these so-called red pointers.

Director firing became universal during the 1914-1918 war because :—

(a) It enabled the spotting officer with the help of his " fall of shot indicator " to recognise and spot his own salvos.

(b) The choice and shifting of target came under the control of one officer who could be near to the Captain or connected to him by an Evershed's bearing indicator.

(c) The layer and trainer could be placed high up in the superstructure with an all-round field of view unobscured by seas or funnel smoke, and it released them from the necessity of controlling the movements of a heavy gun mounting.

(d) Roll could be more easily counteracted, or made use of to obtain a longer range than gun elevation would allow.

It thus became necessary for the training and elevation of the gun to be accurately transmitted back to instruments known as the director receivers by what is called the black pointer drive. The tasks of the gun layer and trainer were thus limited to keeping their black pointers in line with their red pointers.

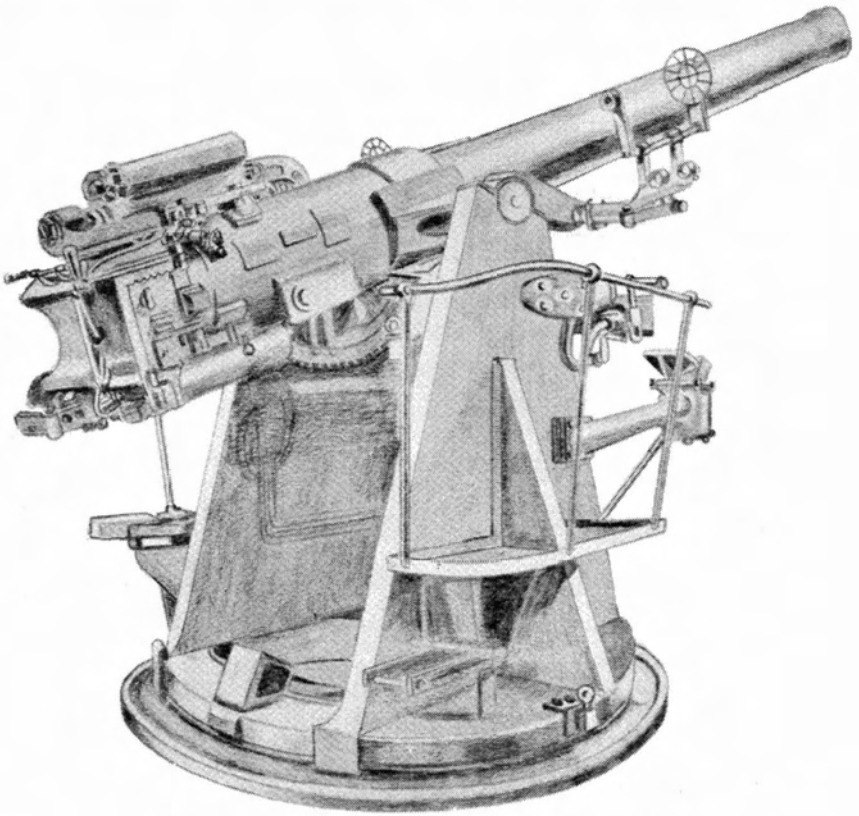

FIG. 4.—C.P. MOUNTING SUITABLE FOR H.A. PURPOSES

As the accuracy of the gun is determined by the correct operation of the black pointers, the drives must be absolutely free from backlash.

Heavy turret gun mountings

At the end of the nineteenth century, anti-ship gunnery was practically the sole requirement and the long drawn out struggle between the defensive power of armour plate and the offensive power of the gun and its projectile resulted in the evolution of the big gun mounted in a heavily armoured revolving turret. Almost from the first it became necessary to use machinery to train the turrets, elevate the guns and handle the heavy projectiles. It was soon discovered that the most convenient means of carrying out the manifold mechanical operations on the revolving structure was by hydraulic power.

The chief advantages of this, over steam, pneumatic or electric motor were found to be :—

(a) High efficiency.

(b) Sweetness of operation and absence of lag.

(c) Ability to creep at very slow speeds under heavy load.

(d) Safety, i.e., there is no explosive or incendiary effect.

The difficulties of designing heavy L.A. mountings lie chiefly in the enormous weights which must be manipulated at high speeds, e.g., a 15 in. gun weighs 100 tons and the shell about a ton. Enormous recoil stresses must be smoothly absorbed and then transmitted from the trunnions through the clips and rollers to the supporting structure provided in the hull of the ship. By 1914 these difficulties had been overcome and the 15 in. gun mounting of those days does not differ in essentials from the heavy L.A. mounting of the present day.

In this article the evolution of the gun mounting has been traced from Trafalgar to Jutland. Subsequent articles will describe the rapid changes which have been dictated by the introduction of the third dimension into naval warfare.