# A COMPARISON BETWEEN BRITISH AND GERMAN HEAVY GUNMOUNTING DESIGN

Among the fundamental problems which face the designers of heavy gunmountings are :—

(i) The rate at which ammunition can be supplied to the gun.
(ii) The absorption of the recoiling forces of the gun after firing.
(iii) The need for keeping the diameter of the roller path—and hence the size of the hole in the ship—to a minimum. The method of carrying the gun in a cradle, so as to reduce the sweep of the gun breech end in elevation, also has a bearing on this.
(iv) The speeds and accelerations of elevating the gun and training the turntable structure.
(v) The remote power control requirement.
(vi) The provision of flashtightness, including arrangement of the flash-tight zones.
(vii) The armour protection of the gunhouse.
(viii) Weight saving.

Most of these questions have exercised the ingenuity of the designers of gunmountings in this and other countries over a period of many years, the problem being aggravated with the advance of time by demands for higher rates of fire, and by the increasing dimensions and weight of projectiles and charges. It is very natural, therefore, that the opportunities which have arisen since the cessation of hostilities in Europe, of studying the methods employed in solving these, and kindred problems, by the Germans, have been welcomed with enthusiasm.

These investigations have been continuing under the direction of D.N.O. by means of a Mission, resident on the continent, known as the British Naval Gunnery Mission. A number of German technicians have been available, and have been questioned by British interrogators.

By far the greatest number of heavy and medium gunmountings for the German Navy were built by Krupps. Krupps also designed and built light mountings, but the firm of Rheinmetall Borsig was the main source of 15 cm. mountings and below. Rheinmetall Borsig's main works is (or was) at Dusseldorf, but their naval gunmounting design office was evacuated to Annaberg, when the bombing of the Ruhr became too heavy.

The interrogations have covered the whole field of ordnance research, and it is felt that the following comparisons between British and German heavy gunmounting design, made possible by these interrogations, and due also to the inspection of innumerable handbooks and drawings, will be of general interest.

The remarks concerning German heavy turrets are based on the main armament of the *Bismarck*, which carried eight 38 cm. (15 in.) guns in four twin turrets, two forward and two aft and are compared with the British equivalent, the 15 in. Mark I/N. The British 15 in. Mark I/N mounting is the Mark I mounting, as originally fitted in the *Queen Elizabeth* class, converted. It has a maximum elevation of 30 degrees, as opposed to the designed 20 degrees, and, although the 14 in. mountings, quadruple and twin, and the 16 in. triple, succeeded it, the converted 15 in. mounting contains several modern features, which, with regard to gun bore and turret size, forms a direct comparison with the *Bismarck* and *Tirpitz* main armament. It is stressed, however, that the 15 in. Mark I mounting was designed in 1912, the modernization,which did not affect the main features of design, taking place during 1935-

1939, whereas the *Bismarck* heavy mountings were designed round about 1938.

## POWER UNITS

### British Practice

Steam-driven hydraulic pumps are fitted in auxiliary machinery rooms on the fixed structure. Distribution of the pressure medium is through hydraulic ring mains with isolating valves enabling any turret to tap off pressure as required. In action, each pump is normally isolated on one turret. Pressure is led on to the turret by means of swivel walking pipes. The system pressure is 1,100 lb. per sq. in.

### German Practice

Two electrically driven, constant speed, fixed swash plate pumps are fitted on the revolving structure. Both pumps are required for operating the machinery at full speed, simultaneously. Each pump discharges to an air-loaded, hydraulic accumulator, from which the pressure system is charged, the pump delivery being put direct to exhaust if, and when, the accumulators are full. The system pressure is 1,100 lb. per sq. in.

## PRESSURE MEDIUM

### British

Distilled water plus 2—2½% Argolene oil, the latter being added as a lubricant. It should be noted that oil was introduced as the pressure medium of the main armament in *Nelson* and *Rodney*, but water was reverted to in the *King George V* class, 14 in. mountings.

### German

Distilled water 50% ; glycerine 47½% and 2½% sulphonized castor oil, as a lubricant. The Germans were against the use of oil from fire risk considerations.

## ELEVATING GEAR

### British

Inverted oscillating elevating cylinder and piston, the end of the piston rod hinging on a pivot fitted under the gun slide.

### German

Elevating arc under the cradle, driven by a pinion, keyed to a cross shaft, revolved by a pinion and rack drive, operated by hydraulic cylinder.

## TRAINING ENGINE

### British

Reversible hydraulic swash plate engines.

### German

Electric motors.

## TRAINING RACES

### British

Roller races.

### German

Ball races.

## HOISTS, OPERATION

**British**

By hydraulic ram and overhauling purchases.

**German**

By rack and pinion—the pinion directly driving a drum on which is wound the hoist wire.

## HOISTS, DESCRIPTION

**British**

Shell and cordite are contained in separate cages. The shell cage is the lower and when, on hoisting, it reaches the cordite handing room level, it picks up the cordite cage, which is not positively lifted. The two cages then proceed up the trunk, together, to the working chamber. A waiting position is here provided where the shell and cordite are transferred to the gun loading cage, which performs the final lift to the gun. This cage is self-aligning to the breech of the gun between the limits of full depression and 20 degrees elevation.

**German**

Similar in principle, but the trunk is continuous from the shell handing room level to the gunhouse, where a transfer position, alongside the gun, is arranged. The loading angle is fixed, in common with modern British practice at 3 degrees elevation.

## GUN LOADING RAMMERS

**British**

Linked chain, extended and withdrawn by reversible fixed swash plate engine.

**German**

Telescopic tubular ram, extended by internal chains.

## RECOIL ARRANGEMENTS

**British**

Recoil piston and cylinder. In moving to the rear in recoil, the liquid in the cylinder passes through a port cut in the piston head. This port is gradually closed as the piston moves over a tapered key, the recoiling forces being thus absorbed. Two cylinders are fitted.

**German**

Similar arrangement, except that liquid passes from one side of the piston to the other, through tapered grooves in the cylinder wall, which gradually cut off the flow. Two cylinders are fitted.

## RUN OUT

**British**

The gun is kept run out by the pneumatic pressure in the recuperator cylinder. On recoil, the recuperator ram further compresses this air, absorbing in so doing about 30% of the energy of the recoil of the gun. At the end of recoil the gun runs out under the action of the increased air pressure, the speed of run out being controlled in the recoil cylinder. One recuperator is fitted.

**German**

The German design of recuperator is hydro-pneumatic and more complex. An outer recuperator ram moves forward under hydraulic pressure, transmitted

through the action of the inner rod, which is drawn to the rear by the recoiling gun. Air, at an initial pressure of 900 lbs. per sq. in., is compressed by the movement of the outer rod. Run out control is arranged in the recoil cylinder. Although this recuperator is more complicated than the British type, it has the advantage that the water side is in contact with the gland of the ram and no sealing arrangements, other than leathers, are required. One recuperator is fitted.

(The 15 in. Mark I/N recuperator gland is intensified to prevent leakage on gun recoil. The intensifier is of simple construction, however, and, under normal conditions of working, no difficulties have been experienced.)

## SHELL ROOM MACHINERY

### British

The shells are held in a grab and are lifted and traversed by hydraulic power.

### German

Shell traverse is similar to the British system, but the drive is electrical. The lifting is arranged by grabs on braided steel tapes, also operated electrically.

## GENERAL

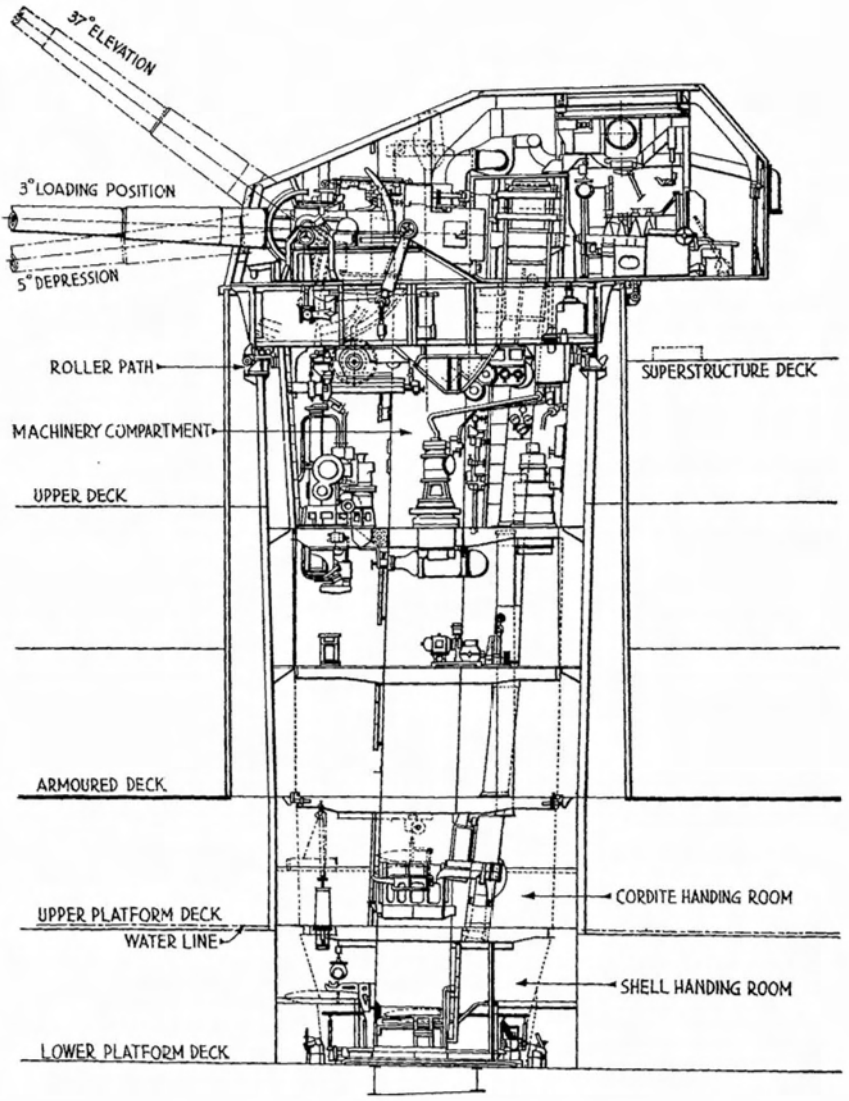
It was of particular interest to discover that German gunmounting designers, according to Krupp's representative, were not greatly concerned about weight saving considerations. Turntable structures were heavily built and, although consideration was apparently about to be given to the adoption of light-plate, welded box-structures, these were to be applied to relatively unimportant parts of the fabric ; steel castings and riveting being retained for highly stressed members. Light alloys are employed for the construction of unstressed parts only, such as indicator plates.

Contrary to expectations, the Germans relied to a considerable extent on gun machinery interlocks, the human element being distrusted. In the interests of reliability, however, mechanization was cut to a minimum, one example being found in the magazines where the charges were man-handled, the weight involved being 180 kilos, nearly 400 lb.

The faithful adherence by the Germans to their practice of supporting the revolving turntable structure, even of the heaviest turrets, on ball races, has resulted in protracted discussions between the Naval Ordnance Department and the designers. It can now be fairly definitely stated that the continuation of the German policy was due to their perfection of the necessary manufacturing technique, and the fact that, in practice, the arrangement functioned satisfactorily. No surprise was manifested by Krupp's representatives that rollers were used in British mountings, and that they had been invariably employed by British designers. The conclusion is that the two nations started along different lines and development has proceeded because there appeared to be no reason for either to depart from its precedent.

There is no intention here of stressing the pros and cons of either system. It is mentioned merely to dissipate the element of mystery which has tended to surround the German practice and to explain the diversities in design. It is interesting to note that Krupp's did not heat-treat the large ball races, except for stress relieving, and that the balls themselves were not hardened ; the respective Brinell hardness numbers being of the order of about 220/260 and 260.

The German preference for the twin heavy turret is very marked. In addition to avoiding the " too many eggs in one basket " question, the arrangement of ammunition hoist machinery is simplified, and the continuous trunk




A TYPICAL GERMAN HEAVY TURRET ARRANGEMENT

is easily accommodated in the comparatively wide " throat." The roller or ball path dimension can also be kept to a reasonably low figure, as compared with a triple or quadruple turret.

The complete lack of ventilation in heavy turrets is a marked feature. Reliance is placed entirely on the flow of fresh air induced by the gunhouse

fume extraction fans which are fitted in lieu of air blast arrangements. Turret heating was haphazard and no thought had been given to air cooling, dehumidifying or lagging, which seems to be proof that the Nazi capital ship was expected to operate in comparatively temperate climates, such as the North Sea (or German Ocean !).

In summing up, it should be remembered that, although the design of the German heavy gunmountings, existing and projected, were very conservative and follow the conventional lines of British design of twenty-five years ago, their Naval gunmounting research work was at a standstill for many years, and development has been virtually confined to known and well-tried principles. This apparent inaction, unusual in the German make-up, is accounted for, in the first place, by the ten-year gap—1918 to 1928—due to Allied control, and subsequently to economic and political reasons. There is evidence, however, that some interesting Naval projects were under consideration, on the drawing board at least. In fact, drawings of a 20-in. twin mounting have been inspected. It was not clear, from the remarks of the designers (Krupps) whether this equipment was intended for sea. They thought not, because they considered it inadvisable to jump to a 52.3 cm. mounting from the tried and favoured 38 cm. At all events it seems certain that design work on the 20 in., which started in 1939, was stopped temporarily at an early date, but certain progress was made in spite of interruptions. The German High Command had ambitious ideas for its post-war fleet. The impression gained was that, if time had been available, the politicians would have had their way and their battleships would, in fact, have gone to sea with 20-in. guns.

It is possible that there were other reasons for slowing up Naval heavy gun design, but whatever these may have been, the main armament of the *Bismarck* was reliable and comparatively simple. Althought not incorporating any novel features, its performance was considered very satisfactory by its designers.

Finally, mention must be made of the flashtighting arrangements, which were crude and, by our standards, quite unacceptable. The German flashtight zones were, magazine, handing-room, trunk and gunhouse. It was possible to be open from the gunhouse to the bottom of the trunk, but the designers claim that the cages themselves formed a flash seal. One feature of the German ammunition was the enclosing of the last charge loaded into the gun, and its primer, in a steel case. This enabled the use of sliding breech blocks and allowed a lower degree of flashtight integrity. Even then, certain risks were taken and, in the face of events, they were justified.