'WITHDRAW BEARING USING TAPPED HOLES PROVIDED'

BY

LIEUTENANT V. HENSON, R.N.

Introduction

Initial loading of the large dynamometer at the Admiralty Reactor Test Establishment caused overheating of the forward bearing. The bearing was opened up and cleaned under the supervision of the manufacturer and pronounced satisfactory for service. Fresh grease was introduced and the machine prepared for running.

Operation

During the subsequent period of running the dynamometer bearings were carefully watched. Low-load conditions produced no significant rise in temperature. High powers soon produced overheating of the forward bearing which was estimated to be settling out at a running temperature, under heavy and continuous load, of about 130 to 135 degrees F.

No other unusual conditions were observed and it was therefore decided to continue the trials of the prototype machinery. The dynamometer was therefore under load for several hours during which the after journal bearing temperature was about 90 degrees F. and the forward combined roller journal and ball thrust bearing temperature continued at 130 degrees F.

There was a pause between the above trial and the commencement of the next series of tests. Bearings cooled down to the ambient temperature of 60 degrees F. Further trials were conducted at various powers and it was evident from the ominous 'rattle' of the forward dynamometer bearing that some damage had been caused during the earlier runs.

Defects

The machine was withdrawn from service and the defects investigated.

Removal of the bearing cover revealed severe damage to the ball thrust bearing. The race had split radially and allowed the balls to crunch together. This bearing failure was considered to have affected the adjacent journal bearing. Spare roller and thrust bearings were available and preparations to remove the old ones were therefore commenced.

Remedial Action

Examination of the relevant dynamometer and propeller shaft drawings revealed an unexpected difficulty. The stub shaft between the thrust block and the dynamometer coupling was seen to be spigotted at each end. Male spigots, $\frac{3}{8}$in. at one end and $\frac{1}{4}$in. at the other, meant that $\frac{3}{4}$in. play had to be found in the shaft assembly before this shaft could be removed and the bearing drawn off the dynamometer shaft. The general arrangement is shown in FIG. 1.

From examination of the dynamometer drawings it was evident that the axial clearance required would have to be found elsewhere. In the most favourable position only $\frac{1}{2}$in. could be obtained by moving the dynamometer.

The main thrust block was opened up and the pads removed.

The shaft torsionmeter cover was removed and the assembly stripped down to the slip rings, which were protected by temporary covers during shaft removal operations.

The next item for attention was the main motor. Here the brushes were lifted, the exact axial position noted and closely observed during subsequent shaft removal operations.

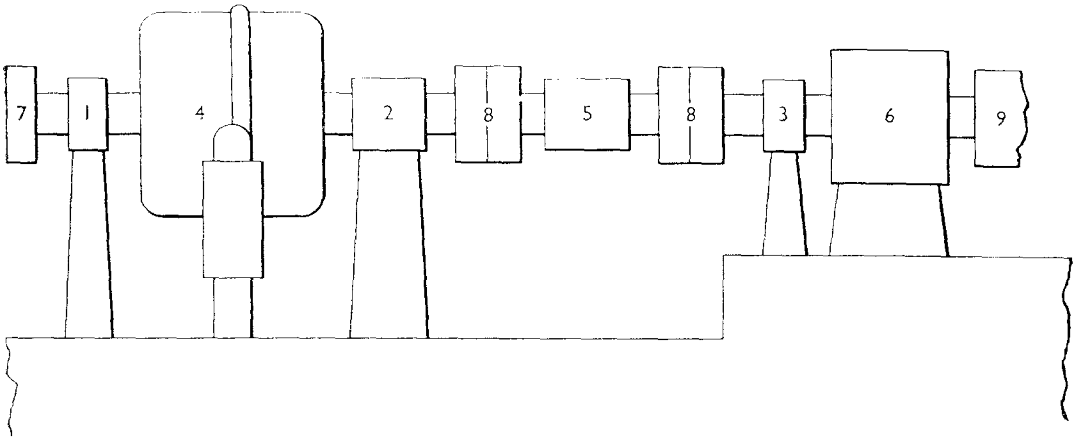

FIG. 1—THE GENERAL ARRANGEMENT

1. Roller journal bearing
2. Journal and thrust bearing
3. Thrust block
4. Dynamometer casing
5. Stub shaft and torsionmeter
6. Main motor
7. Half coupling
8. Coupling
9. Clutch housing

The main clutch tachogenerator drive assembly was withdrawn complete.

A careful check of all available information confirmed that the above procedures should result in the necessary $\frac{3}{4}$in. axial movement being available.

The coupling bolts were then removed, except for one at the thrust block end of the stub shaft, and final preparations made to remove this shaft.

Hydraulic jacking gear was made ready, the final coupling bolt removed and the weight of the shaft taken by the overhead traveller.

Various observers took up their positions and the shaft was slowly eased forward exactly $\frac{3}{4}$in., using the hydraulic jacks. Despite some anxieties the movement was well controlled and, as a result, the stub shaft was then lifted clear.

The damaged bearing was drawn off the shaft end and, slight damage to the adjacent journal bearing being confirmed, this was also removed.

The two new bearings were carefully fitted and the dynamometer alignment re-checked. The stub shaft spigots were machined back to facilitate replacement work and the coupling bolts checked for size and soundness. The dynamometer position was as recommended by the makers, the axial clearance being divided equally fore and aft and the bearing heights correct.

The stub shaft was replaced, coupling bolts inserted and the forward part of the shaft drawn aft. The coupling nuts were then hardened up and the shaft and dynamometer alignment verified. All shaft units were re-assembled and made ready for the next shaft load trial. This work was progressed under the surveillance of the mechanical and electrical engineers and in reverse order from the stripping operation.

The dynamometer handbook contained the following reference to bearing replacement:

'Withdraw bearing using tapped holes provided.'

In fairness to the makers it must also be stated that their instructions contained the injunction:

'Shaft spigots should be kept to a minimum.'

No valid reason has so far been found for the bearing failure. The manufacturers have been kept fully informed of events and complete maintenance and operational histories made available.

Conclusion

Subsequent loading of this machine has proved the effectiveness of the remedial action described. All bearings were in fact quite cool at each power. The work described was spread over two weeks and occupied the mechanical and electrical fitters for 110 man-hours.