REPAIRS.

H.M.S. "Vancouver."

Repairs to Port Shafting carried out after Collision.

During exercises off Gibraltar in February, 1922, H.M.S. "Vancouver" collided with an "H" Class submarine, the Port Propeller of the Destroyer striking the Submarine. "Vancouver" was docked at Gibraltar Dockyard for examination and it was found that all blades of Port Propeller were badly damaged and propeller shaft bent at propeller cone to an angle of approximately 20°.

It being decided that repair of the shafting, etc., should be carried out at Portsmouth, the damaged propeller was removed while in Dock at Gibraltar, the vessel steaming to England with the Starboard Main engines only in use.

When docked at Portsmouth, Micrometer clock gauges were placed in positions A, B, C, and D, with the result shown in figure 1. This gauging showed both shafts to be bent—the intermediate shaft being 0·084″ out of centre, and the thrust shaft 0·023″ and 0·024″ out of centre respectively at the forward and after journals. Both these shafts together with the propeller shaft were then removed from the ship for straightening.

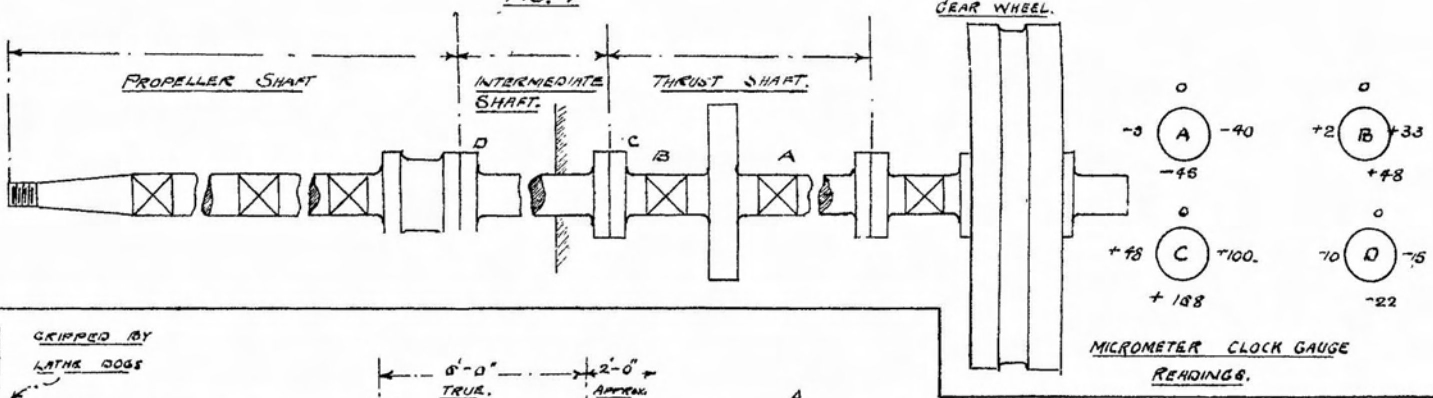
The next forward length of shaft, viz., that carrying the main gear-wheel, was also carefully checked by similar micrometer gauges. These gauges were applied at the after journal, at the periphery of distance piece between gear wheel rims and also at the face and bore of recess on coupling for spigot of the thrust shaft. These gaugings showed that the gear wheel shaft was true.

When the bent shafting was removed a wire was stretched from the aft end of gear-wheel shaft through stern tube to aft end of "A" bracket. This wire was set central at forward and aft ends of the Shipbuilders' stern tube and found to be central with bore of recess for spigot at aft coupling of the gear-wheel shaft.

From this wire, the "A" bracket was found to be slightly twisted in both the vertical and horizontal plane—the maximum amount of eccentricity being $\frac{3}{32}$″. It was decided not to reset the "A" bracket, but to correct the error by boring the "A" bracket bush to thickness gauges made from place when the shaft was placed in position after straightening.

The ship had reported that the port thrust block moved on its seating when trying engines after the collision, and the alignment of block was therefore checked. It was ascertained that the thrust block was lying outboard $\frac{1}{32}$″ (full) from the centre line shown by the wire. The thrust seating was carefully examined but no signs of distortion could be found. As it was necessary to remetal the thrust shaft plummer bearings and

FIG. 1



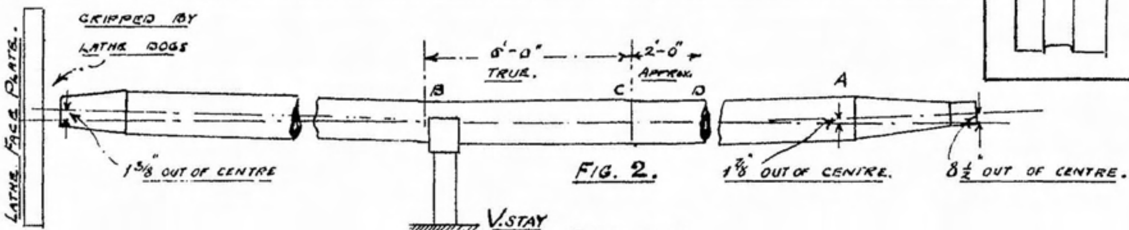
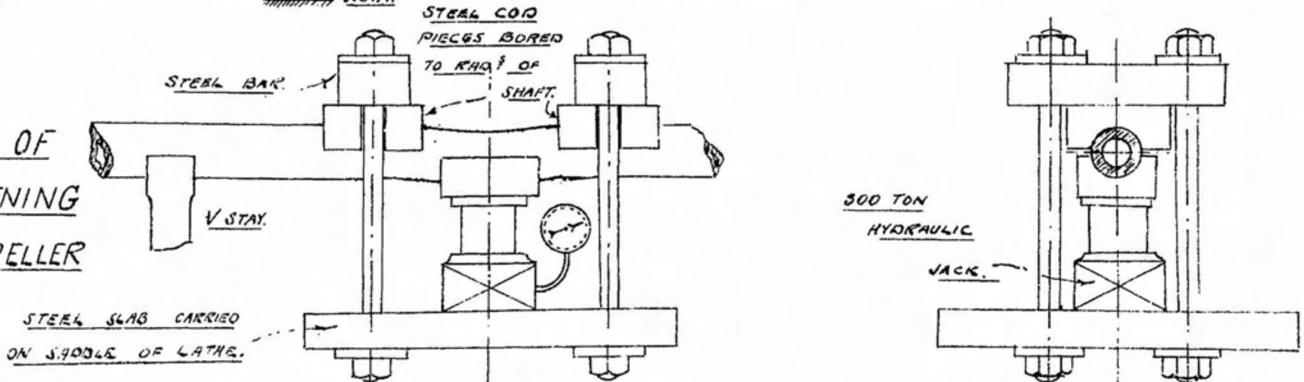


FIG. 2.

METHOD OF STRAIGHTENING A BENT PROPELLER SHAFT



pivot bearings of the Michel thrust owing to skimming of the journals after straightening, it was decided (as an alternative to broaching bolt holes and fitting new thrust block holding down bolts), to fit eccentric bearings to accommodate the error in athwartship position of the thrust block.

The shafts were sent to the shop for straightening. An examination there with straight edges showed that the tail shaft was bent through practically the whole length with the exception of about 6 ft. near the middle of shaft which was true, the portion immediately forward of propeller cone having the greatest angle (about 20°). The shaft was placed in the lathe, the forward end being gripped central in dogs and the forward end of straight portion placed in a " V " stay; the shaft was then revolved and it was found that the after end of straight portion was running out of truth; the portion gripped in lathe dogs was then moved out of centre until the 6 ft. straight portion was running true and it was found that the shaft was then lying in the lathe as shown in Figure 2.

Straightening of tail shaft.—The points " B " and " C " on Figure 2 are respectively the forward and after ends of the 6 ft. straight portion, and " D " is a position immediately aft of the 10½-in. steel cross beam.

The hydraulic jack was placed directly beneath " C " and shaft was revolved until bend at " D " was pointing away from jack. The top nuts were screwed down hand tight and the load put on by jack; this in the first instance raised shaft off stay and then commenced to bend shaft at " C "; the amount of set put on shaft was noted by means of scribing blocks and when slightly less than required amount, reading of pressure gauge was noted; the load was released; the top nuts eased back and cod pieces lifted clear of the shaft; shaft was then turned in lathe and amount of bend remaining at " D " was noted. An increased load indicated by the reading on pressure gauge, was then put on shaft and a further check made; this process being continued until portion " C," " D " was running true.

The slab was then moved along lathe bed by means of saddle, until jack was immediately below commencement of next bend; the foregoing process repeated and so on to the end of the shaft, new cod pieces being provided for the cone portion as necessary.

On completion of the straightening of the after end, the shaft was reversed in lathe, and straightened end being gripped in dogs and set true and position " B " resting in " V " stay. The straightening operation was then repeated on the forward end of shaft.

On completion of this, shaft was centred at each end true to the cones and then run on these centres while supported at " B " by a stay; a complete check was taken of variations from truth, the greatest error being found to be $\frac{1}{32}''$ approx. on the " A " bracket bearing section, partly caused by shaft being out of round due to initial bend.

The inner bush end " A " bracket bearing journals were skimmed to remove these slight errors, while the outer bush bearing journal was polished only.

It was found that a load of 230–250 tons was sufficient to straighten shaft cold with the exception of portion " A " at the forward end of propeller cone. This part was beyond capacity of hydraulic jack to deal with when cold, owing to the large angle of bend, and it was therefore heated to a dull red by paraffin blow lamps and could then be straightened with a pressure load of 280–290 tons. The diameter of shaft was $12\frac{1}{4}$ in.

After straightening in the lathe the shafting was machined as follows :—

(*a*) Propeller shaft—Journals for Inner stern bush and " A " bracket bush skimmed.

(*b*) Intermediate shaft—There are no supporting bearings to this shaft—0·016 in. was machined from face of forward coupling and 0·004 in. from face of aft coupling.

(*c*) Thrust shaft—Journals reduced forward 0·025 in. and aft 0·034 in. on diameter. Thrust collar reduced 0·011 in. in width, forward coupling 0·008 in., aft coupling 0·016 in.

After replacing in the ship, the shafting was aligned by the couplings and it was noted that thrust block was considerably low—a check was also made by coupling up shafts and allowing the line of shafting to sag. Shafting was then lifted in centre of length until it just left the bearings at after end of gear case and forward end of stern tube. The thrust block was set up one-half the amount shafting was lifted and a taper steel liner fitted under each of the two fore and aft bottom feet of thrust block. Dimensions of these liners were—length, 5 feet, thickness 0·140 in. at aft end, and 0·060 in. at forward end.

At this stage the gauges for use in the shop in preparing the eccentric bearing of the plummer and spherical bearings previously referred to, were made.

In view of the extensive damage to the port propeller and shafting from the collision the starboard line of shafting was also tested while vessel was in dock and found to be true.

On completion of the repairs a two hours' full power trial of machinery was run during which no undue vibration was observed.

Repairs to Michell Thrust Block.

The following repair affords an excellent example of what can be achieved with elementary means on board, and, in

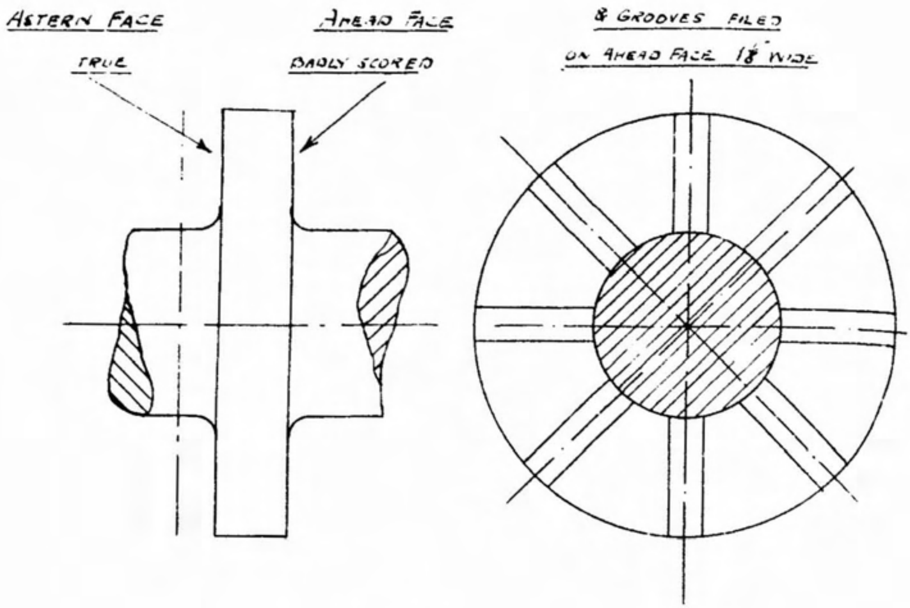


FIG. 1

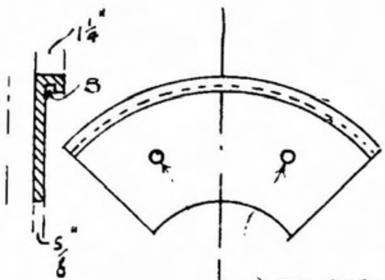
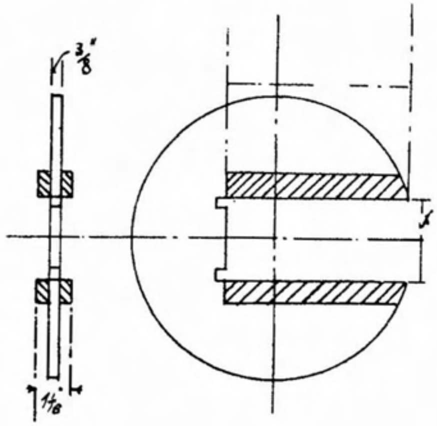


FIG 3.

FIG 2.



X TRUE TO ORIGINAL WIDTH OF COLLAR LESS .02" particular, of a demonstration of the value of expert craftsmanship.

A modern Geared Turbine Destroyer came into port reporting that its Port Main Thrust had become excessively heated and that the whitemetal had run from the pads. On examination it was found that the metal had run from the Thrust Pads on the Ahead Side, choking the lubricating oil pipes, etc. The Ahead face of the collar was deeply grooved over its entire surface but not regularly, one groove extending around nearly the complete circle and reaching a depth of $\frac{30}{1000}$ in. at its maximum.

The Astern face was found undamaged and true, and after consideration it was decided to refit the thrust in position instead of incurring the considerable expense of removing the shaft to the Shop to be dealt with in a lathe. To remove the shaft it would have been necessary to open up the deck and displace many machinery details. The work on board could only be undertaken by a mechanic possessing exceptional skill in using the file, and fortunately such a mechanic was available.

The details of the Thrust Block were removed and the Astern face of the Collar used as a base for trueing the damaged surface.

The damaged surface was first divided into eight sectors as indicated in Figure 1, and grooves $1\frac{1}{8}$ in. wide filed so as to get below the scored surface. By repeated trials it was ascertained that $\frac{30}{1000}$ in. would need to be removed from the entire face in order to obtain an acceptable working surface.

A gauge of horse-shoe type was made as indicated in Figure 2, and used with a feeler to ensure that the filed grooves were true to each other as far as practicable. Truth having thus been obtained, the material between the sectors was removed by rough and smooth files. For final trueing, a special surface plate, shown in Figure 3 was used—the portion " B " working around the edge of the Collar and the surface marked forming the face plate; by constant use of the horse-shoe gauge and feelers, the face was trued, scraped and oil stoned.

All the scores were removed with the exception of the deep one which could not be entirely erased.

The Thrust Pads were remetalled, faced and scraped at both leading and trailing edges to designed dimensions with a final allowance of $\frac{47}{1000}$ in. oil clearance. The Thrust block was completely reassembled, pipes cleared and replaced.

Work afloat was carried out by one fitter and his assistant, in 16 working days of 8 hours each, *i.e.*, 128 working hours at small cost and, if urgently necessary, the work could have been completed by working continuously in one working week presuming that mechanics of equal skill were available.

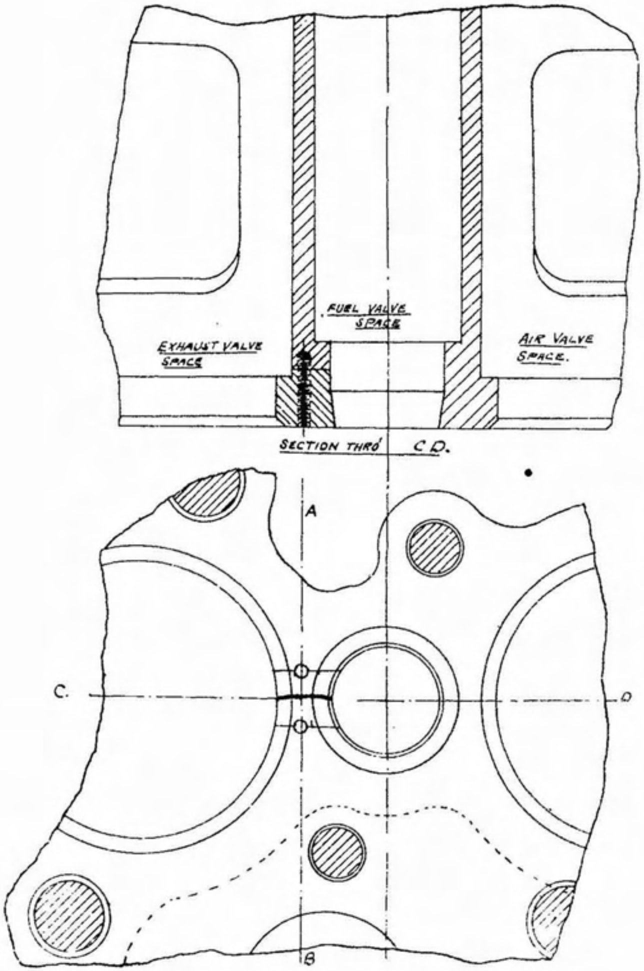
The vessel afterwards carried out a Basin Trial and a Full Power Trial at sea with entirely satisfactory results.

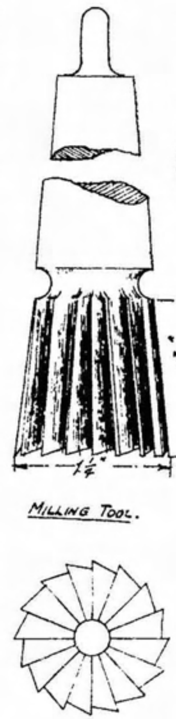
Cracks in Cylinder Heads of Diesel Engines.

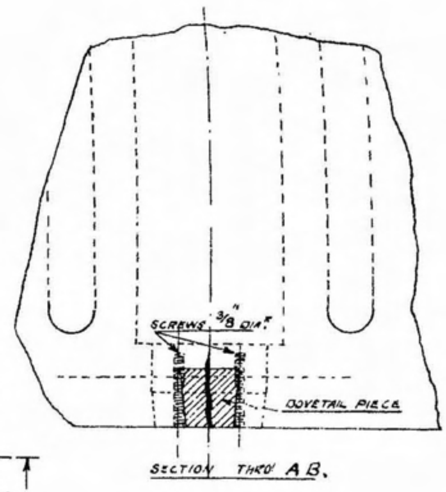
In the Diesel Electric Generating Machinery of a Capital vessel, the frequent development of cracks in the cylinder heads in the metal of the region bounding the exhaust valve spaces on the under side, permitted the exhaust gases to pass through the crack into the space between the exhaust valve cover and the cylinder head, thus leading to erosion of the seating between them, and ultimately to erosion of the exhaust valve itself, and so to loss of compression and misfiring. In some cases cracks also appeared in the metal between the air inlet space and fuel valve space, but this was a development following the growth of the crack in the exhaust space. The circumstances being such that a sufficiency of spares could not be assured, the following method of lengthening the life of the defective heads was followed with success.

As soon as a crack became evident, the head was removed and the material in way of the crack removed for a depth extending to about $\frac{1}{8}$ in. beyond the seating of the exhaust valve cover. The machining was commenced with a 1-in. drill and finished with a bevelled milling tool. A piece of cast iron of dovetailed shape was then fitted carefully in the milled groove, and secured from movement by two in number $\frac{3}{8}$-in. grub screws about $1\frac{3}{8}$ in. in length. The cast iron stop piece was then filed to the circular form of the pocket, and the exhaust valve cover seating was trued up with a morse cutter, which as in the case of the milling cutter was made on board.

The drawing shows the details of the method and the milling tool.







METHOD OF REPAIR OF

FRACTURED DIESEL

CYLINDER HEAD