

WARTIME MODIFICATIONS TO STEERING GEAR.

The steering gear of *Vanguard*, incorporating many new features of control, has now completed shop trials and is likely to form the basis of design for future 'big ship' installations. As lessons learnt from failures of steering gears under war service conditions have been incorporated in *Vanguard's* gear, it is perhaps interesting to review some of the alterations found necessary. Needless to say, the faults brought to light in existing ships were rectified as As and As if construction was too far advanced for re-design.

The necessity for more than one source of power supply, remote from the after steering compartments in capital ships, was brought to light by the failure of the engine room ventilation in *Prince of Wales*. This necessitated evacuation of the engine room steering position. The opposite engine room to that containing the steam steering engine received damage early in the action, as did the electric circuits to the motor-driven pumps aft. Had the engine room containing the steering engine received this early damage, steering would have been lost earlier in the action. Remote telemotor control in addition to local control for all power-operated steering gear was obviously indicated by the foregoing conditions.

In *Vanguard*, two steam steering pumps in diagonally opposite engine rooms, will be fitted, each controlled from the primary steering position by separate duplex telemotor leads. These will be additional to an electrically driven pump in the steering gear compartment aft. This pump is also controlled by duplex telemotors from the primary steering position. Both the steam and the electric pump can also be controlled locally.

Electrical Damage.

Failure of solenoid valves after damage to *Illustrious* showed the necessity of providing means of shutting solenoid-operated valves of electrically driven pumps and of by-passing solenoid-operated shut-off valves from the steam-driven pump in battleships and aircraft carriers. Similar failure to *Kent* necessitated the fitting of means for closing the pump shut-off valves by extension shafting from above the tiller flat. These measures were necessary in order to allow steering by the steam pump (or other electric pump in cruisers) to be continued in the event of electrical damage and damage preventing access to the steering compartment.

Solenoid-operated valves have been dispensed with in *Vanguard* in favour of spring returned shut-off and by-pass valves held in the working position by pressure from an auxiliary hydraulic pump driven by the steam steering gear pump in use. This feature also allows an automatic steering change from steam to electric pump by the springs operating the valves on failure of pump pressure.

Destroyer actions at Narvik revealed the need for duplex systems of telemotor steering control with well-separated leads in order to reduce vulnerability. This has been rectified in all ships from frigates upwards, which are fitted with hydraulic steering gear, by the provision of duplex telemotors. Telemotor leads are now fitted under protection, either below W.L., in trunks, or under protective plating. Exposed parts of telemotor systems above the waterline are made of heavy gauge steel pipe.

As a result of the loss of *Imperial*, all ships fitted with hydraulic steering gear are now provided with locking plates to hold the rudder in mid-position in order to allow the vessel to be steered by engines in the event of complete breakdown of the gear. These take the form of plates hung on the ram guides

between the ram crosshead and the fixed structure. Certain vessels, however, fitted with Brown Bros. steering gear have trunk pistons and no ram guides. Rudder locking in this case is assured by hinged plates bearing on the rudder crosshead.

When the design of *Vanguard's* steering gear was contemplated, it was suggested that to provide a quick change over, the electric steering pump (or pumps) should be fitted for starting automatically by failure of pressure from an auxiliary oil pump driven from the steam pump shaft. A sufficiently reliable type of automatic starter was not available however and it was decided that in the action condition the electric pump should run continuously on bypass as immediate standby.

After discussion on the pros and cons of one or two electric motors situated in a single W.T. compartment near the rudder, it was decided that where two separate steam pumps are fitted, one electric motor driven pump with duplicate supplies would meet requirements. Consideration was given to the recommendation of the Bucknill Committee that electric steering motors should be suitable for running when the compartment is flooded. Owing to the great complications in the motor design including very considerable additions to weight and space, it was finally decided not to apply this recommendation to *Vanguard*.

In common with all other important turbo auxiliaries the turbine driven steering pumps of *Vanguard* are designed to work with the engine room flooded.
