CONTROL ROOM SIMULATOR

TYPE 21/42 MAIN PROPULSION MACHINERY

BY

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On the 24th May 1973, a combined machinery control room simulator of a Type 21 frigate and Type 42 destroyer was accepted into service at H.M.S. *Sultan*. The value of simulator training has been firmly established over the past five years as a result of experience gained with the County Class destroyer machinery control room simulator. The latter has proved to be an invaluable training aid, both for pre-joining training courses for officers and ratings of the marine engineering branch and also for continuation training of DLG watchkeeping teams. The DLG simulator, however, arrived some years after the first of the class put to sea, and was, therefore, not available to those who would encounter the operating problems associated with a new class of ship.

By contrast, the Type 21/42 simulator was used to train the marine engineering personnel of H.M.S. *Amazon* before she went to sea. In this way, not only will the first crews be given early operator training but also their ship experience can quickly be incorporated into the training programme for the benefit of those joining ships later. Getting the simulator before the first of the class put to sea presented major problems, mainly associated with lack of ship operating experience and the need to incorporate late modifications as they were approved for the ships.

Designed and manufactured by Redifon Flight Simulation, the simulator consists of four main items:

The Machinery Control Console.
The Bridge Control Console.
The Instructor's Console.
The Computing Equipment.

Machinery Control Console

The machinery control console is an exact replica of the console fitted in the ships. The engine control panels and the ship control panel on the console are virtually identical in both types of ship. However, the fuel and auxiliary control panels do differ in content and layout. Fortunately, in the Type 21, they are situated on the right of the machinery control console, and in the

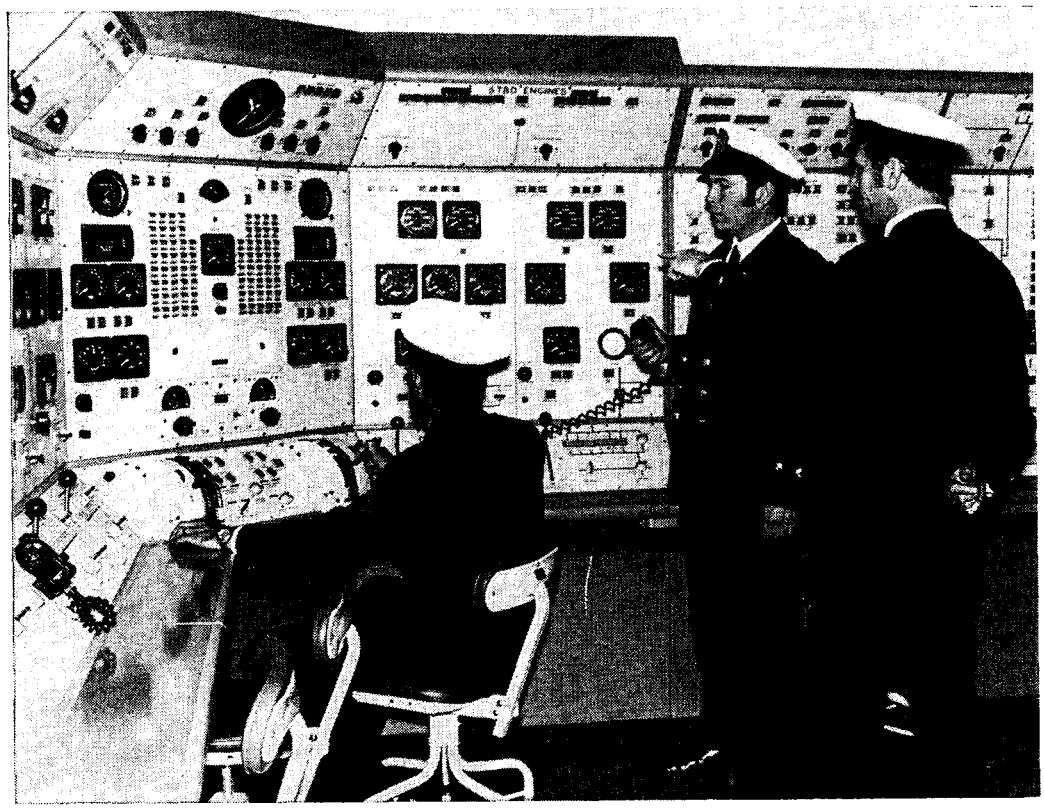

FIG. 1—TYPE 21/42 SIMULATOR

Type 42, on the left. The Type 21 panels are covered when operating in the Type 42 mode and vice versa. The simulator is capable of reproducing all the normal reactions of the ship fitted control systems. The trainee can, for example, start, stop and change over engines, or reply to bridge orders with the appropriate engine response and propeller pitch changes. Auxiliary machinery can be started and stopped, or set to cut in automatically. The effects of all such actions are realistically reproduced in the simulator. Fuel boost and transfer pumps may be started and the effects of fuel transfer, filling and emptying of service tanks, are simulated.

Bridge Control Console

The bridge control console contains all the bridge control facilities and indicators fitted in the Type 42; this enables the instructor to take the part of the bridge watchkeeping officer when the simulator is in the bridge control mode.

Instructors Console

The instructors console provides the instructor with extensive facilities to inject out-of-tolerance conditions and machinery failure/faults into the simulated control system. The effects of such faults, e.g. warning and alarm indications, automatic cut-in of stand-by machinery, etc., is realistically produced at the trainee's machinery control console.

Computing Equipment

For reasons of compatibility with the DLG simulator, the Type 21/42 simulator uses the same electronic hardware and fairly well-known techniques. In an analogue computer, the parameter concerned is scaled to a voltage. Thus if a

ship's maximum speed is 25 knots and the analogue computer uses a 100 volts, then 4 volts represents 1 knot. By applying this voltage to a voltmeter of range 0–100, but scaled 0–25 knots, intermediate speeds can be read. Other parameters are treated in a similar manner. The heart of the analogue computer is the operational amplifier, and it is from these amplifiers that the voltages are derived to operate the various indicators. Using these amplifiers it is possible to add, subtract, integrate, and differentiate. Multiplication and division are accomplished by means of electromechanical multipliers. Ship and machinery operating characteristics were based on a computer simulation of the main propulsion systems of the ships carried out by Y-ARD. From their report, the ship and machinery performance was analysed and a set of mathematical equations derived. These equations were then solved using operational amplifiers, and any logic, such as fuel availability, was achieved by using miniature relays and transistor circuitry.

A post-design services contract has already been drawn up to cover modifications which will occur as a result of operating experience at sea. This contract covers a two year period in the first instance and will be extended if the need arises.

The primary aim of having this simulator operational before the first ship went to sea was only just achieved, but nevertheless reflects great credit on all those concerned with the project.