WARSHIP '88

INTERNATIONAL SYMPOSIUM ON CONVENTIONAL NAVAL SUBMARINES

BY

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(*See Systems Controllerate*)

The Royal Institute of Naval Architects holds an annual symposium on a warship-related subject. This year's symposium, Warship '88, was entitled 'Conventional Naval Submarines' and was held between 3 and 5 May in London. Like all RINA warship symposia Warship '88 was well supported, with 198 delegates and 42 authors from 17 countries and a wide variety of organizations. A previous RINA symposium on submarines was held in 1983.

Papers were presented on a wide range of subjects covering all aspects of submarine design and construction, including design criteria and tools; computer aided design; latest shipyard developments; propulsion; manoeuvring and control; torpedoes and weapon discharge systems; and the teaching of submarine design. The word 'conventional' in the title of the symposium was given a very wide interpretation as some of the ideas presented were anything but conventional. Limits on space prevent me from giving details of all the papers but I have summarized some of the more thought-provoking ideas below.

A Canadian team presented a paper on a very small, low-cost nuclear power plant to provide auxiliary power and propulsion for a diesel electric submarine in order to increase the vessel's endurance. An idea for a low technology nuclear powered coastal submarine was presented by a French author. Both these ideas rely on recent developments of relatively simple, small, and cheap nuclear reactors. The French reactor uses natural convection for circulating the primary coolant water, thus avoiding the need for main circulating pumps, and it does not have a pressurizer. Superheated steam is generated in the secondary circuit which drives a 1 MW d.c. generator. The Canadian system also has water as the primary coolant but uses circulating pumps and a pressurizer for forced convection. The fluid in the secondary circuit of this plant is freon, driving two Rankine cycle turbines which in turn drive alternators of up to 0.4 MWe combined output. Two sizes of plant are envisaged, of 0.1 and 0.4 MWe, and the larger incorporates a recuperator with each of the freon turbines.

Nearer the common perception of 'unconventional' power plant were a German paper on a closed cycle Diesel propulsion system and a Swedish Stirling submarine power system. The designs for incorporating these systems involve stretching the pressure hull and adding the system as a modular unit within the increased length. The Swedish Stirling system has been incorporated into a submarine during a refit and, at the time of the symposium, sea trials were due within 'a few weeks'.

An Italian team presented a novel submarine design which incorporated an unconventional pressure hull structure. For the design of a commercial submersible, the necessity for a greater energy density than that of a lead acid battery drove the team to develope a Stored Chemical Energy Propulsion System. This needs a very large capacity for stored fluids and the best way of providing this storage with a limited size of pressure hull is around the periphery of the pressure hull. The storage was incorporated by making the

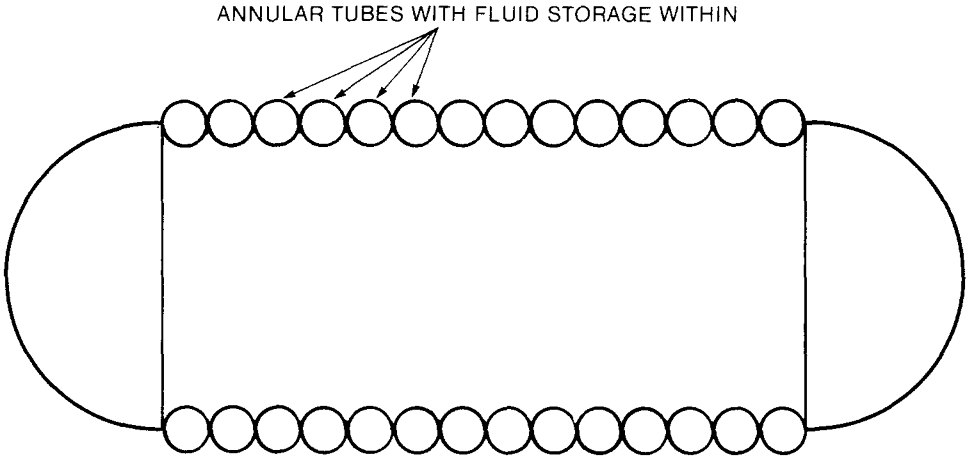

FIG. 1—ITALIAN CONCEPT FOR A SUBMARINE PRESSURE HULL INCORPORATING FLUID STORAGE

pressure hull of annular tubes, as shown in FIG. 1. A small submersible swimmer delivery vehicle has been built and operated using these principles, and the ideas have been extended to a study of a full-scale submarine. The strength of the pressure hull was calculated and a trial section tested to collapse. However, the experimental results of collapse of externally pressurized vessels is subject to wide scatter and so the statistical significance of one experiment is somewhat questionable. Unfortunately, pursuit of this aspect fell victim to the guillotine necessarily imposed on the discussion. The annular tubes for the submersible were made from commercially available pipes of scantlings dictated by the high pressure of the stored fluid. It was not clear if this would be the case for a full scale military submarine. If it is not, it may be more cost-effective to produce a double skinned pressure hull with planar diaphragms between the skins, as shown in FIG. 2. This would utilize space better and enable the scantlings of the inner and outer skins and the diaphragms to be optimized for strength, and so weight could be reduced. An additional benefit is that fabrication of the hull would be simplified. Using uniform tubes constrains the scantlings to those of the weakest part (either of the skins or the diaphragms) and limits flexibility of the design in other ways. Therefore the pressure hull weight is greater than necessary. Discussion among some MOD delegates concluded that the concept would be cost-effective only if it is necessary to carry a very large volume of fluid stores.

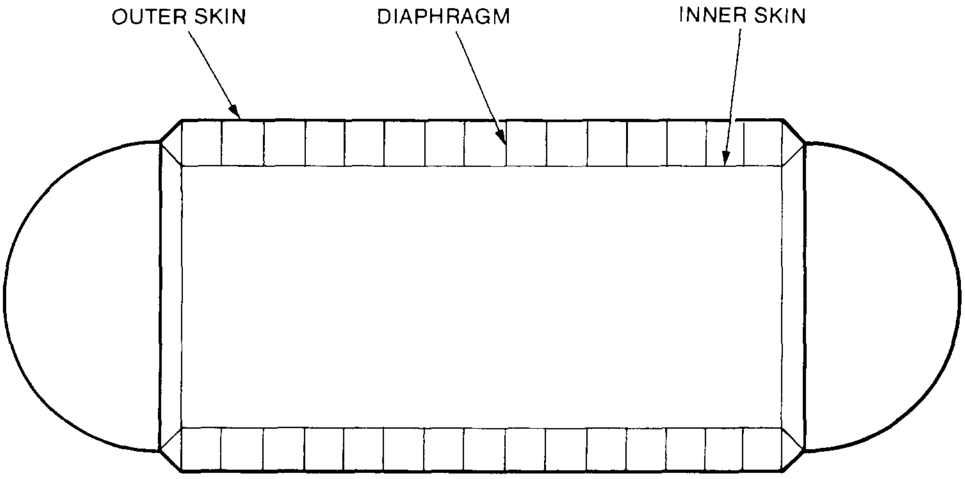

FIG. 2—MODIFICATION OF ITALIAN CONCEPT

The discussion provoked by the papers means that there is greater benefit in attending a symposium than reading the proceedings. Therefore, since the second day was divided into two parallel sessions, delegates had difficult decisions to make choosing which to attend, although there was time between papers to change from one session to the other.

Complete proceedings of the symposium can be obtained from the Royal Insitution of Naval Architects, 10 Upper Belgrave Street, London SW1X 8BQ.