THE RUSTON PAXMAN RP 200 VALENTA

BY

M. F. GRIFFEY, C.ENG., M.I.MECH.E., M.R.I.N.A., A.M.I.MAR.E., A.M.B.I.M.

Introduction

The majority of naval personnel are now familiar with the Ruston Paxman Ventura range of Diesel engines which are fitted in survey vessels and most of our frigates and destroyers; this familiarity will increase as the Type 21 and 22 frigates and the Type 42 destroyers come into service.*

For powers from 0.375 to 1.0 MW, the Ventura YJCA range is considered to be completely adequate; after a large number of improvements (leading to over 200 modifications to date) it is expected that it should give reliable service throughout the 70's and 80's at which time it is anticipated that well over 250 engines will be in R.N. service (cf. 132 at present). However, when feasibility studies of the through-deck cruiser (CAH) were carried out, it became evident that a more powerful Diesel generator having an initial power output of 1·5 MW with potential uprating to 1·75 MW would be required. Various alternative commercially designed prime movers were considered and finally the Ruston Paxman Valenta 16 RP 200 was selected.

History

Design work on an uprated Ventura (later re-christened Valenta) was initiated at Paxmans in 1964 and the first prototype was run in 1967; the aim was to produce 50 per cent more power from the same size power unit. Development

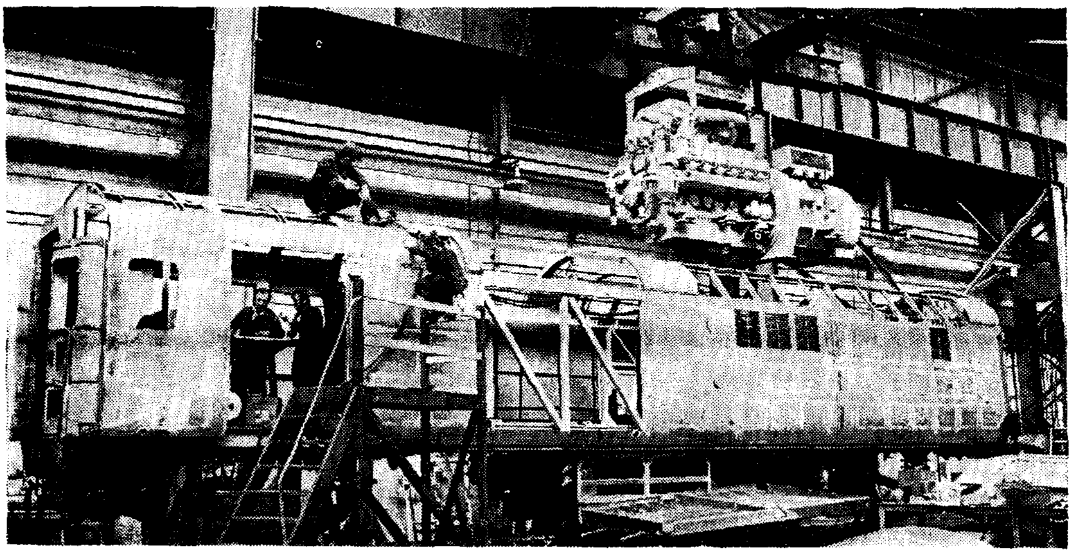


FIG. 1—VALENTA 2250 H.P. ENGINE BEING LIFTED INTO THE HIGH SPEED TRAIN POWER CAR

*It is of interest to note in passing that in R.N. surface ships the emergence of the Diesel engine from the shadows where it has sat somewhat neglected and sulking for about 50 years is a direct derivative of our present gas turbine propulsion policy; with no superheated steam in ships and no economical simple cycle gas turbine as an alternative, our new generation ships are entirely dependent on Diesel engines for the generation of electrical power.

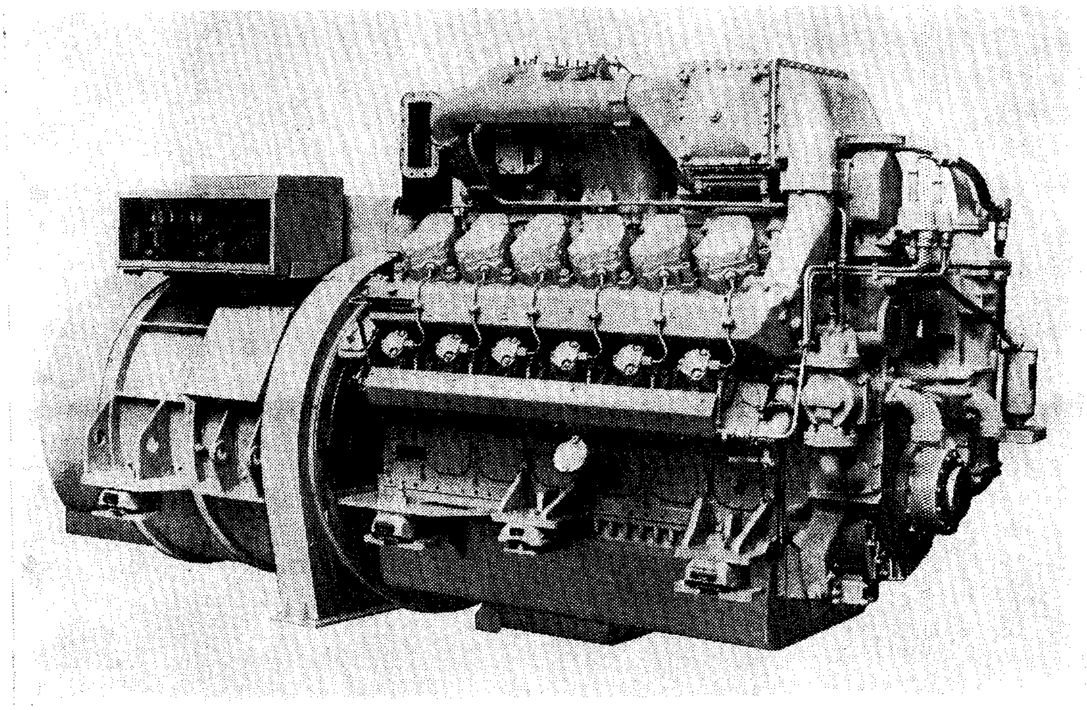


FIG. 2—BRITISH RAIL VALENTA 12 RP 200

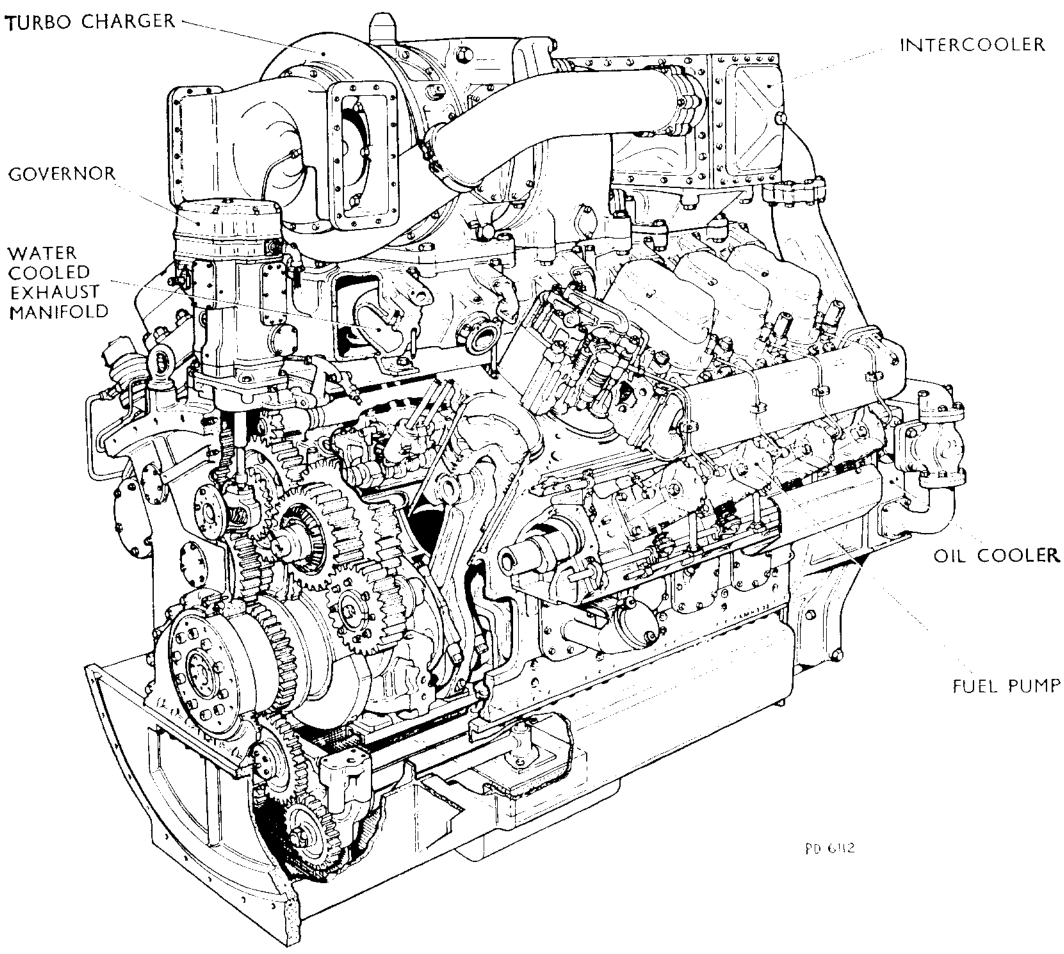


FIG. 3—12-CYLINDER VALENTA

proceeded fairly slowly in those early days because Ruston Paxman's two principal customers—the railways and the Royal Navy—had no immediate need for an uprated engine, and were concentrating on achieving higher reliability from the Ventura Mk 2. However, more or less at the same time, the development programme received two powerful impetuses; British Rail decided to build a prototype 125 m.p.h. High Speed Inter-City Train (HST) having two power cars, each engined with a Valenta 12 RP 200 Diesel generator rated at 2250 b.h.p. (FIGS. 1 and 2); the Royal Navy decided to specify eight Valenta 16RP 200 Diesel generators for its first CAH, each initially rated at 1·5 MW, but with the potential of uprating to 1.75 MW. TABLE I illustrates that in 1974 it will be quicker by Valenta!

TABLE I

London to:	*Current best time (mins)*	*HST time (mins)*
Newcastle	215	180
Leeds	156	127
Cardiff	127	104
Bristol	100	83

Principal Characteristics of Valenta

FIG. 3 shows a part-sectioned isometric view of a 12-cylinder Valenta. Although its construction and design philosophy are similar to those of the Ventura, the only physical characteristics which are identical are length of stroke (8.5 in.) and diameter of bore (7.75 in.).

TABLE II lists some of the important design features of the Valenta and TABLE III compares engine data.

TABLE II—*General Comparison of Valenta with Ventura*

Components	*Design Features*
Crankcase	Fabricated from steel castings. Reduction in the number of components to be welded: 70 components for the 16 RP 200 compared with 219 components for the 16 YJCAZ.
Crankshaft	Nitrided with increased journal and pin size
Cylinder head	Improved cooling by using drilled water-passages between the valves.
Exhaust manifold	Water-cooled.
Fuel pumps	Individual pumps for each cylinder.
Turbo charger	Pressure ratio increased from 2:1 for Ventura to 2.7:1 for Valenta.
Valve gear	Strengthened

TABLE III—*Comparison of Engine Data for 16-Cylinder Engines*

	Ventura	*Valenta*
b.h.p. (kW) at 1200 r.p.m. (continuous)	1600 (1200)	2280 (1700)
b.m.e.p.—p.s.i. (kg/cm²)	166 (11.7)	235 (16.5)
Weight Wet—lb (kg)	17000 (7750)	23600 (10700)
Spec: Wt—lb/b.h.p. (kg/kW)	10·6 (6·45)	10·35 (6·3)
Length—inches (mm)	121 (3070)	133 (3381)
Width to remove pistons inches (mm)	60 (1520)	60 (1520)
Height—inches (mm)	94.25 (2393)	96.25 (2443)
S.F.C.—lb/b.h.p.-hr (kg/kW-hr)	0.365 (0.222)	0.35 (0.213)

Valenta Engine Development Programme

FIG. 4 shows the Valenta development programme, past, present, and yet to come. So far this has been most reassuring; on the 12-cylinder engine a large-end bearing failed after 700 hours, but this was due to the use of virtually unfiltered oil (an element was found to be missing from a duplex oil filter) and one or two liners showed fairly high random wear. This defect has not shown up on the 16-cylinder engine, the naval version of which will probably be fitted additionally with oil-cushioned pistons (Ref. 1) which should give even better wear rates.

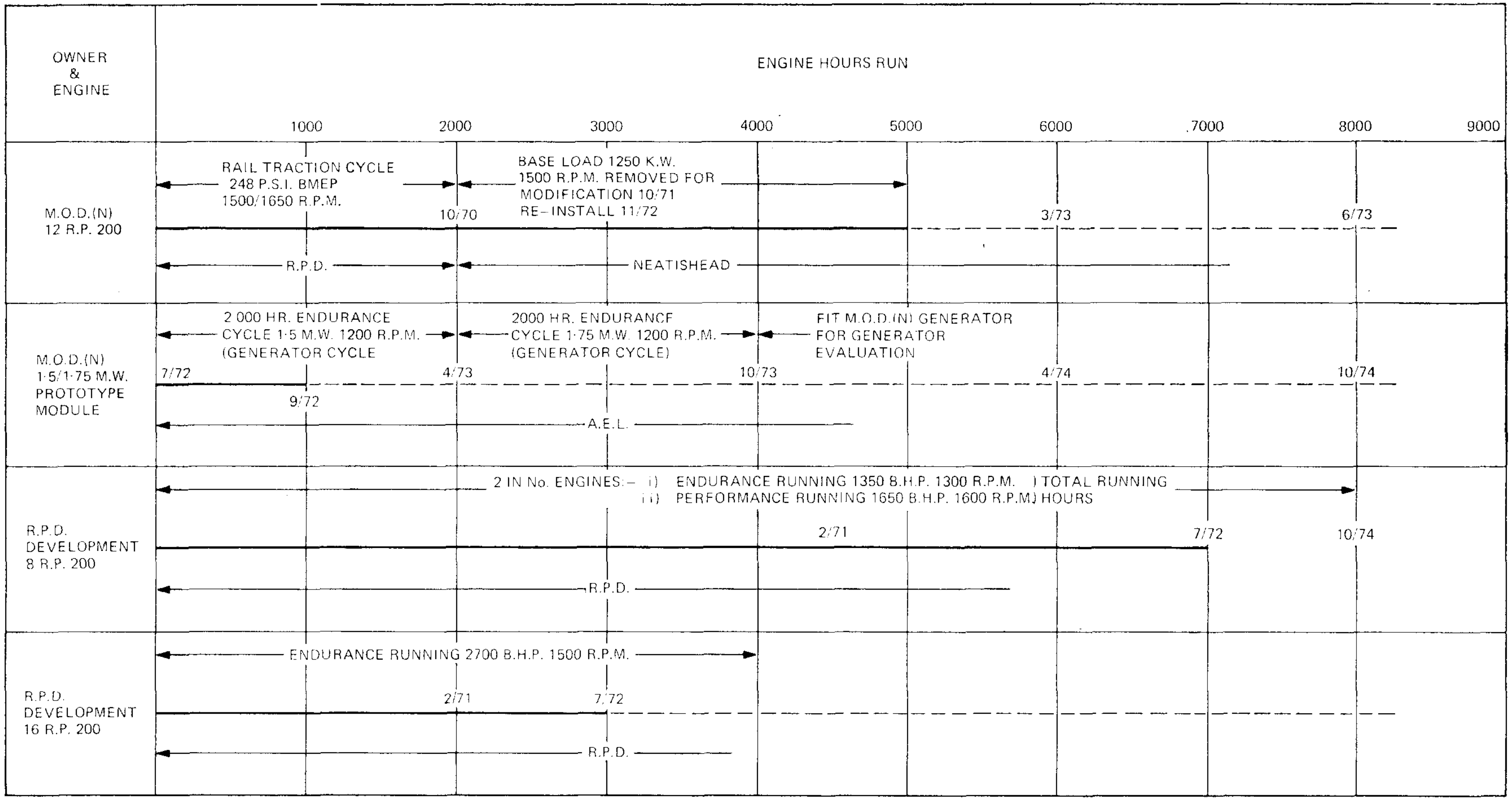
Module Concept and Design

In the CAH, six of the Valentas will be sited in the main machinery spaces below the water-line; these will be fitted in acoustic enclosures to form modules. The other two generators will be situated in separate compartments high up in the ship abreast the hangar and will not be in modules.

Although the Valenta module was conceived with the prime purpose of air-borne noise attenuation, it has the secondary attribute of enabling the Diesel generator installation to be optimized with respect to operation and maintenance very early in the ship design process. Previously, the ancillary equipment and systems layout has been somewhat compromised to suit other equipments and systems in the same compartment. The module size was based on the dimensions of a development test cell and the prototype arrangement is shown in FIGS. 5 and 6. The prototype design work of enclosure, raft, and mounting system was carried out by Y-ARD Ltd. working in very close collaboration with the module design authority, Ruston Paxman Diesels Ltd. (RPD), and it is believed that never before have RPD been associated with detailed installation design so early in a project.

Noise

It is desirable to attenuate Diesel generator noise for both environmental and military reasons. Airborne noise adjacent to high-speed lightweight Diesel generators invariably exceeds Grade E level (that at which aural damage can result if exposure to it exceeds eight hours per day). In addition, and possibly more important, this airborne noise can contribute to radiated and self under-water noise levels. The other main source of Diesel generator radiated and self



R.P.D. – RUSTON PAXMAN DIESELS
A.E.L. – ADMIRALTY ENGINEERING LABORATORY
TOTAL R.P. 200 HRS. NOV 72 15000

FIG. 4—VALENTA DEVELOPMENT PROGRAMME

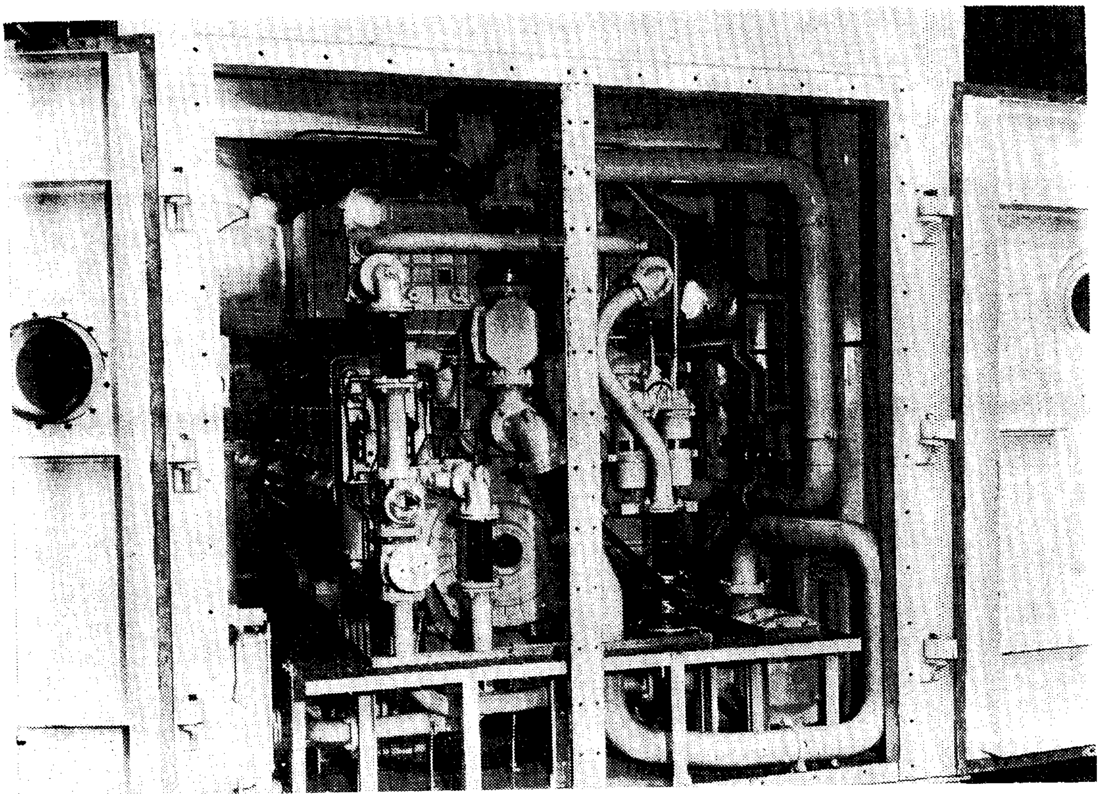


FIG. 5—PROTOTYPE VALENTA 16 RP 200 MODULE WITH REMOVAL DOORS OPEN

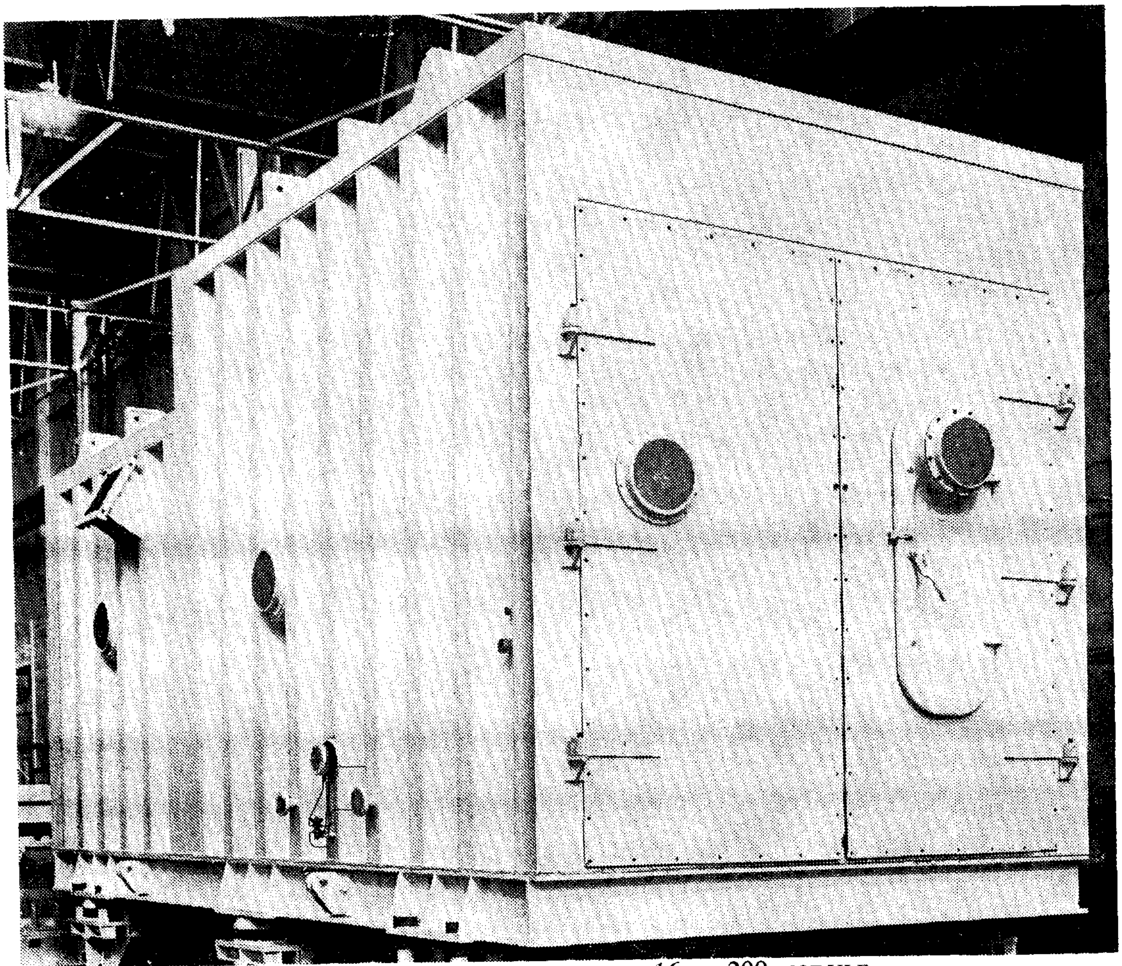


FIG. 6—EXTERIOR OF PROTOTYPE 16 RP 200 MODULE

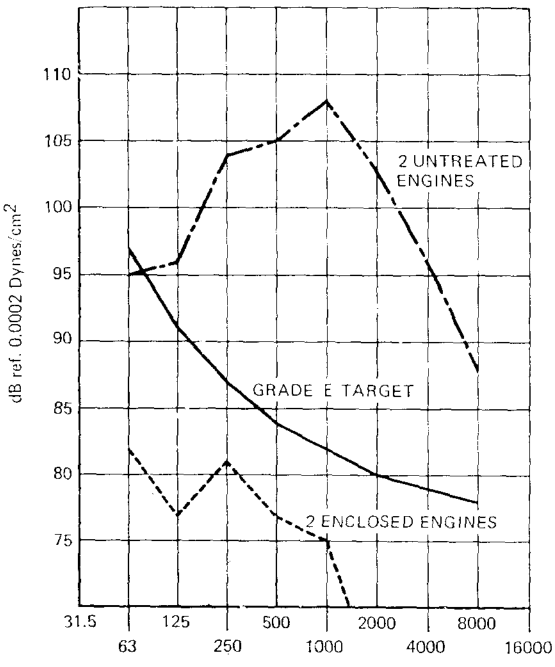


FIG. 7—VALENTA—COMPARISON OF NOISE LEVELS

underwater noise is vibration via the seatings of the machine, particularly if these are adjacent to the ship's outer or inner bottom. Noise from both sources can be reduced by enclosing the Diesel generator in an acoustic box and using a double mounting system, i.e. supporting both the floor of the box and the machine within the box on resilient mounts. FIG. 7 illustrates the estimated attenuation achieved, based on Ventura noise readings taken in H.M.S. *Fife*.

Maintenance

Acoustic enclosures can be made close-fitting but, although this normally saves weight and space, it allows little access for maintenance; in fact, the onboard work-load is increased because parts of the enclosure have to be removed to permit maintenance. It also makes it difficult to detect and trace oil and water leaks. The CAH Valenta module is designed to allow complete access round the engine and generator for onboard preventive and defect maintenance up to and including that associated with top overhauls. These will be carried out at 6000 hour intervals using kits similar to those provided for the Venturas (i.e. cylinder head and rocker gear assemblies, turbo-chargers, fuel pumps, injectors, air start motors, etc.). Major overhauls at 12000 hours and large repairs will be carried out by engine replacement; the Valenta will be separated from its generator at its flange connection and be removed via large double doors forming the engine-end bulkhead of its enclosure. It will be run out, probably using a pallet on rails, to a point directly beneath a removal trunk (also used for gas turbine change unit removal) and lifted out vertically.

Engine Type Test and Module Evaluation

Further to the engine development running already mentioned, engine type-testing of a 16-cylinder Valenta in a prototype module started at the A.E.L., West Drayton, in July 1972. It is planned to complete 2000 hours running on a generating cycle at 1.5 MW maximum continuous rating by March 1973.

To date 1000 hours has been satisfactorily completed and a top overhaul maintenance evaluation carried out. The second 1000 hours, under identical conditions but with oil-cushioned pistons fitted, is well under way. On completion of this phase of the type test, all major parts of the engine will be examined and gauged. If their condition and wear rates are satisfactory, a further 2000-hour test will be carried out at the higher generator rating of 1.75 MW.

Conclusion

By the time the first CAH goes to sea, it is estimated that its production Valentas will have the backing of over 25,000 hours of development running on various multi-cylinder prototypes. Although there are bound to be some teething troubles as well as random failures, it is felt that it will give good service in this new generation of cruisers.

Reference

1. 'Diesel Engines in the Royal Navy', W. H. Sampson, *Journal of Naval Engineering*, Vol. 19, No. 2.