

# ENGINEERING IN THE GHANA NAVY

BY

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## History

In September, 1959, two I.M.S.s arrived at Takoradi, Ghana, to become the first ships of the Ghana Navy. They were ex-H.M.S. *Ottringham* (renamed G.N.S. *Yogaga*) and ex-H.M.S. *Mallingham* (renamed G.N.A. *Afadzato*) and were brought out by an R.N. passage crew, together with a handful of Ghana Navy ratings.

No Base maintenance organization awaited them and for their repair facilities they had to rely upon Ghana Railways and Harbours. For the next 2½ years these ships formed the sole operational and training arm of the Ghana Navy. R.N. personnel were initially seconded on loan to Ghana for an 18-month tour and on 1st May, 1962, the British Joint Services Training Team was formed.

Technical ratings were in short supply until the first two E.R.A.s arrived in November, 1961, and by then three P.O.M.(E)s, an E.A., P.O. (R.E.L.) and C.P.O. (Elec.) formed the technical expatriate complement. Each ship carried a Sub-Lt. (E) contract officer and the Base Technical Officer, a Lt. Cdr.(E) had a Sub-Lt.(L) as Base Electrical Officer.

In January, 1963, two Seaward Defence boats, G.N.S. *Komenda* and G.N.S. *Elmina* left the U.K. and arrived at Takoradi in February. These ships were built for Ghana by Messrs. Yarrow to the normal R.N. design.

In March, 1963, a Diesel yacht S.S. *Kantemanto* which had been used for training by the Ghana Nautical College, was commissioned G.N.S. *Achimota*. She is primarily meant to act as a support ship and to provide accommodation for the I.M.S.s and S.D.B.s when operating at Tema.

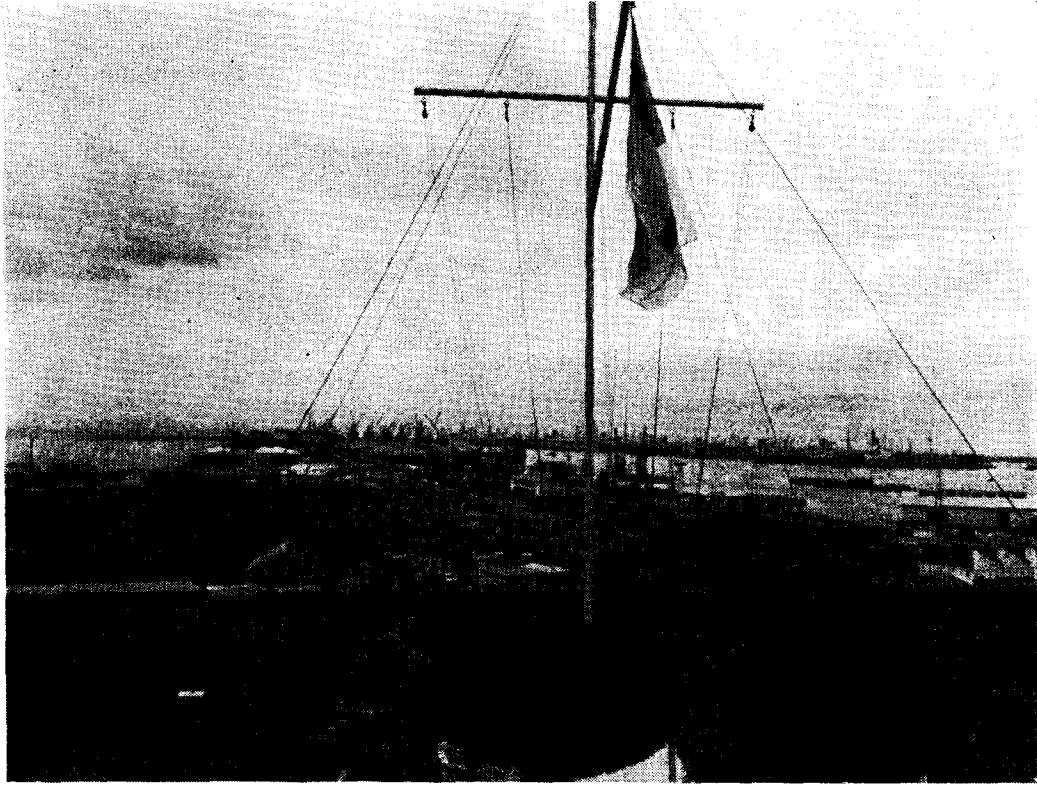


FIG. 1—VIEW OF TAKORADI HARBOUR FROM GHANA NAVAL BASE

### Organization

The Headquarters of the Ghana Navy is at Accra in Burma Camp together with the Ministry of Defence, Army H.Q. and Ghana Air Force H.Q. The Staff consists of a Commodore, Chief Staff Officer, Staff Officer Administration, Staff Officer Plans and Staff Officer Developments. The duties of Staff Officer Technical are carried out by the Base Technical Officer at Takoradi. This naturally leads to difficulties and attempts are being made to obtain an additional engineer officer to act as S.O.(T).

Eighteen miles from G.N.H.Q. is the new harbour of Tema where G.N.S. *Achimota* is berthed. A dry dock is available there and technical repair assistance is provided by Ghana Railways and Harbours. Ships usually spend a week at Tema using this port as a base, for patrols extending to the eastern borders of Ghana.

One hundred and forty miles to the west from Accra is Takoradi where the Naval Base is situated some  $1\frac{1}{2}$  miles from the harbour. The Naval Base, though small in size, has now been developed into a typical R.N. training establishment, complete with parade ground. The ships berth on one side of a small jetty adjacent to the slipway, on the other side of which is the naval workshop.

The technical organization and strength is shown in FIG. 2 and the entire expatriate complement at Takoradi consists of 15 officers and 19 C.P.O.s and P.O.s. Each ship has a R.N. officer in command with the two S.D.B.s also having an expatriate First Lieutenant.

Ghana Navy ratings are accommodated within the Naval Base and after one year in the Navy are allowed to be victualled out and live ashore. Married quarters are provided in the town, and quite a high percentage of the ratings are married.

## BASE TECHNICAL OFFICER

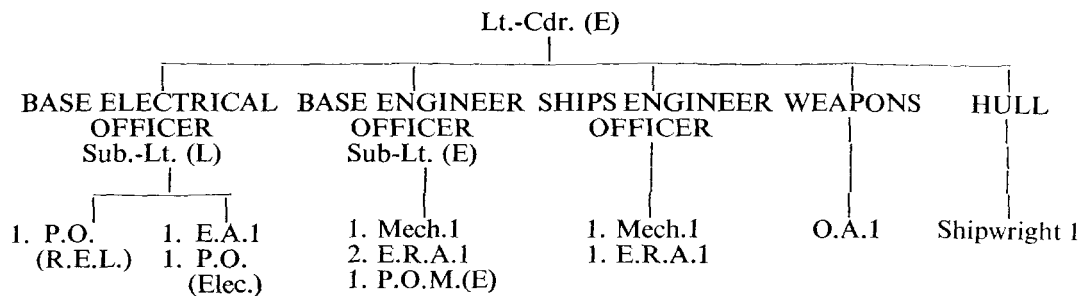


FIG. 2—TECHNICAL ORGANIZATION AND STRENGTH OF THE B.J.S.T.T. AT TAKORADI

**Operations**

The ships carry out a dual training and operational role. The former consists of forenoons at sea with Basic Training Classes and Specialist Training Classes. The latter comprises patrols along the coast line to prevent smuggling and for fishery protection. Recent success in both of these operational fields has led to useful Press publicity and a realization by the public of the Navy's role.

Joint training is carried out with the Army on amphibious training and with the Ghana Air Force on air-sea-rescue operations.

**Maintenance and Repair**

The maintenance of the I.M.S.s was seriously neglected in the early days due to shortage of skilled technicians, workshop facilities and spare gear. A new workshop was opened in May, 1963, comprising a machine shop, dismantling bay, electrical and electronics workshop, battery shop and a shipwrights' shop. The whole floor space is only 80 ft × 20 ft but this is a vast increase on the original workshop space which was part of a store and only measured 15 ft × 8 ft. Above the new workshop are the technical offices and a classroom.

A planned maintenance system was commenced in March, 1962, based broadly on R.N. lines. After some adjustments the present system allows the following days for maintenance: 3 days per month, 14 days per quarter, 4 weeks per year and 8 weeks per two years. The I.M.S.s either slip or dock at Takoradi and the S.D.B.s dock at Tema once a year. Ships staff are responsible for routines up to one month and Base Staff for larger routines.

**Usage and Availability**

From each quarter's running return the following percentages are calculated. They are based on the number of days which include any periods at sea:

$$\text{Sea running percentage} = \frac{\text{No. of days at sea}}{\text{Total No. of days}}$$

$$\text{Sea availability percentage} = \frac{\text{Days at 4 hours' notice or below}}{\text{Total No. of days}}$$

$$\text{Sea usage percentage} = \frac{\text{No. of days at sea}}{\text{Days at 4 hours' notice or below}}$$

The figures shown in TABLE I were returned for the period 30th June, 1962 to 30th June, 1963, for the two I.M.S.s.



FIG. 3—THE NAVAL WORKSHOPS

TABLE I

	<i>G.N.S. Yogaga</i>	<i>G.N.S. Afadzato</i>
Distance run (miles)	6,514	5,263
Sea running (per cent)	30	34
Sea availability (per cent)	65	73
Sea usage (per cent)	45	47
Main engine hours	650 (average)	600 (average)
Generator hours	750 (average)	850 (average)

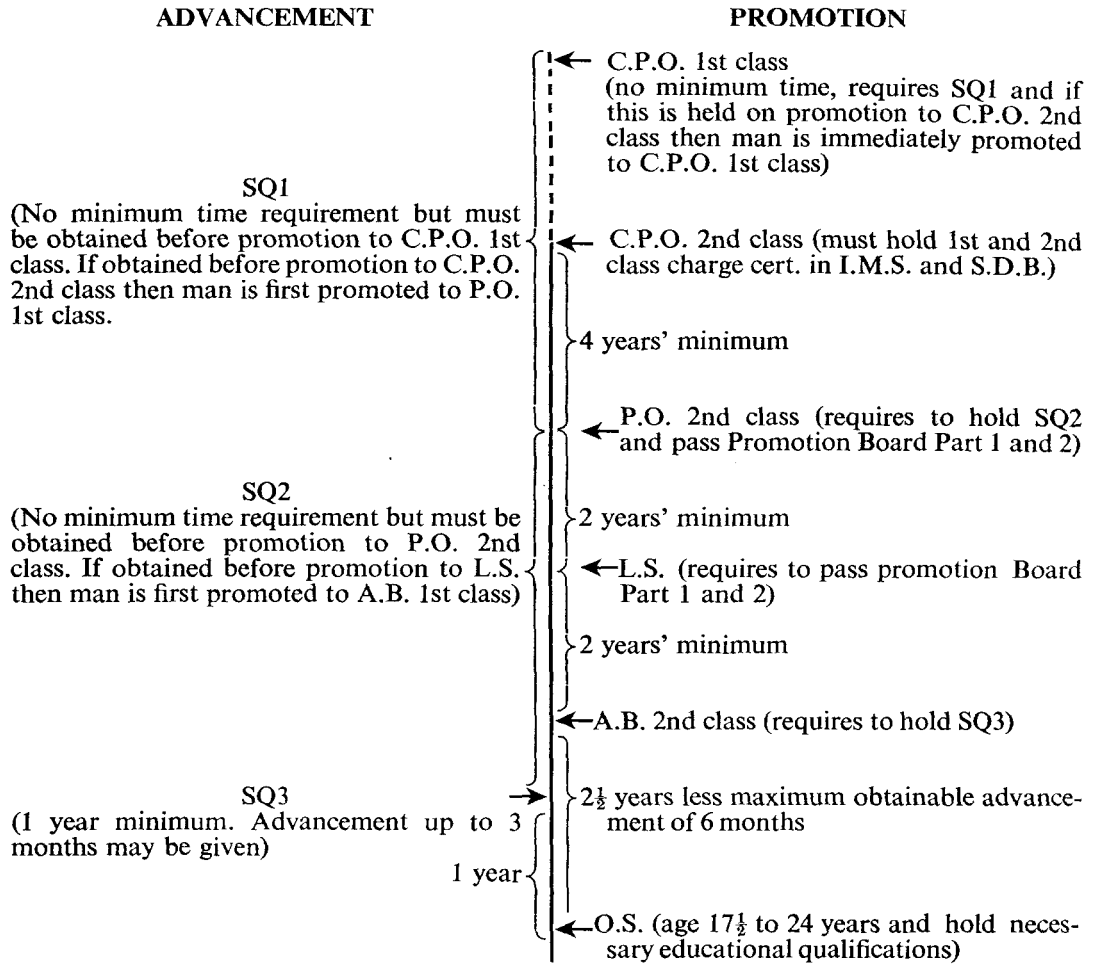
### Recruitment and Training

Every rating signs on for six years except on promotion to artificer in which case a 12-year engagement is necessary.

Initial training is carried out at the Ghana Armed Forces Training Centre at Kumasi where recruits for all three Services receive basic training for 10 weeks.

For the past 18 months a new class of 25 men has joined every three months and an increase is planned for the immediate future. Up to 1,000 letters of application may be received for each entry and the resulting educational level tends to be higher than for other Services. A few men join with quite high technical qualifications such as Intermediate City and Guilds in Mechanical Engineering Craft Practice.

On completion of training at Kumasi a 5-week basic seamanship course is carried out in the Naval Base. Men are then selected for their trades and commence specialist training. Engineering mechanics do a basic engineering course

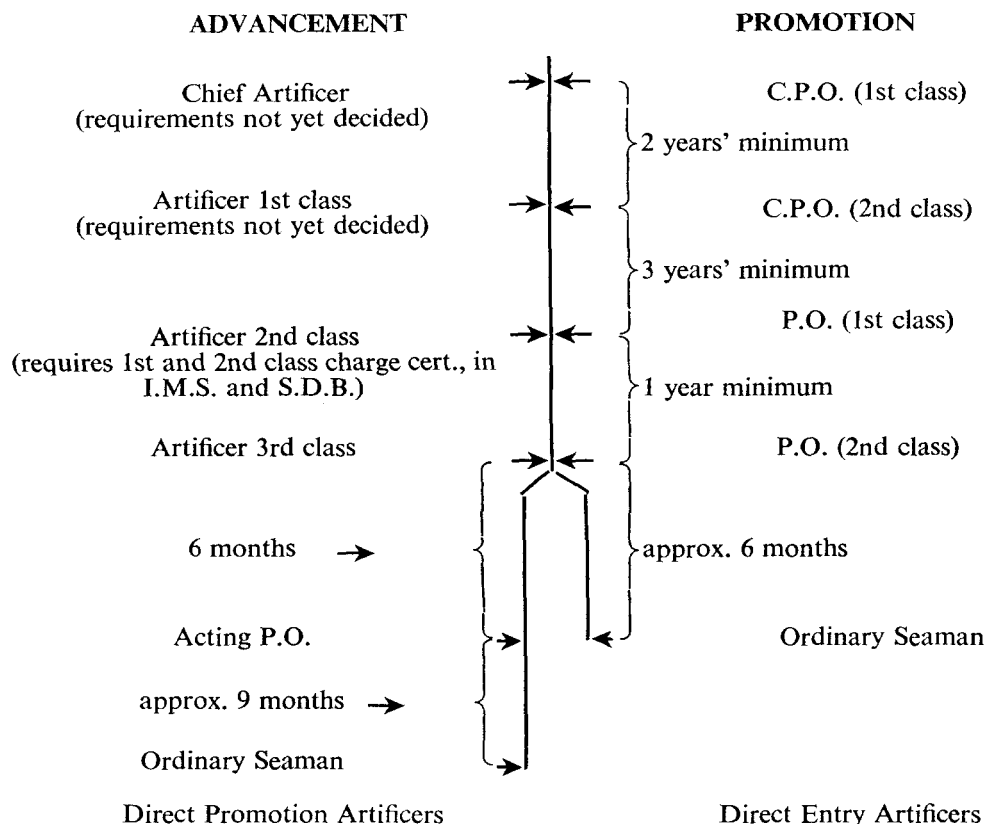


<i>Mechanic</i>	<i>Specialist Abbreviation</i>
Engineering	E.M.
Electrical	L.M.
Radio	R.M.
Shipwright	S.M.

FIG. 4—PROMOTION AND ADVANCEMENT FOR MECHANICS

of three weeks followed by 3-4 months at sea and a consolidation course of six weeks. Success in this course qualifies ratings for S.Q.3, to which he is advanced at the end of one year in the Navy. Electrical mechanics do a similar proportion of formal and sea training. Shipwright mechanics receive on-the-job training and are quite skilled on entry into the Navy.

The method of advancement for mechanics and artificers is shown in FIGS. 4 and 5. It will be noted that in addition to requiring a particular S.Q. for promotion there is in addition a promotion board. This is split into two parts and each part has a short course before the final examination. Part I is common to all Branches and consists of boat handling, organization, parade ground and damage control and fire fighting. Part II is purely technical and a man must be



<i>Artificer</i>	<i>Specialist Abbreviation</i>
Engineering	E.A.
Electrical	L.A.
Shipwright	S.A.
Weapons	W.A.

FIG. 5—PROMOTION AND ADVANCEMENT FOR ARTIFICERS

successful in this before taking Part I. It has always been emphasized that all ratings are seamen first and all reference to ratings is made by rank. This policy was based on the smallness of Ghana Navy ships where necessity demands that every man is able to act as a seaman.

The two fields of progress have been clearly defined as promotion in rank and advancement in trade and specifications have been laid down for all rank and trade levels in each branch.

These specifications or standards of knowledge show the level of ability in skill or knowledge which a man must achieve in each aspect of his Promotion Board Part I and in operation, maintenance, administration, clerical and instruction for any particular S.Q. and Promotion Board Part II.

Trade pay is awarded for each level of S.Q. and the amount depends on the particular S.Q. level and branch. Artificers receive the highest trade pay at the 'X' level and all mechanic branches receive 'A' trade pay, this being the next highest, e.g., an artificer 3rd Class receives 'X3' trade pay, this being equal to the 'A2' trade pay given to a mechanic holding an S.Q.2.

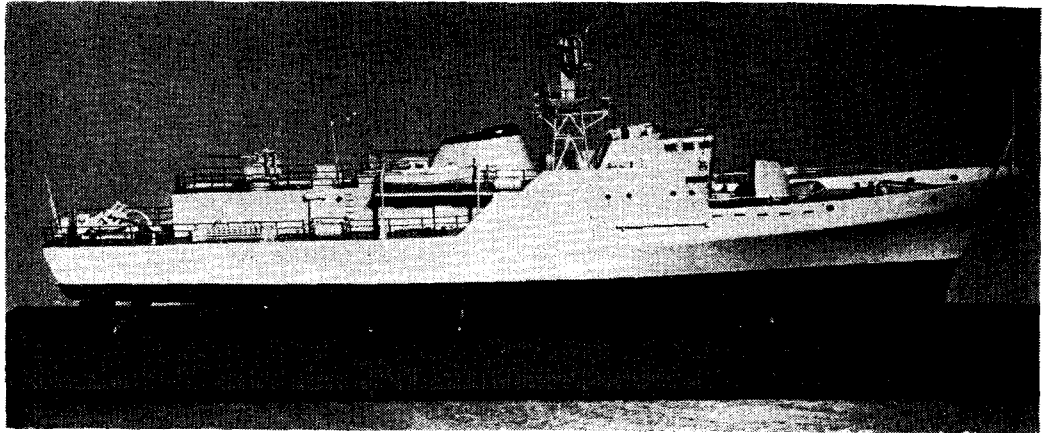


FIG. 6—MODEL OF G.N.S. KRONANTSE

Experience has shown that the highest retention of knowledge is achieved by omitting large gaps of time between courses or examinations. No. S.Q.1 courses have yet been held and this will probably require the R.N. I.C.E. course or L.R.E.M.'s course. Shipwright artificers undergo the R.N. F.A.M. using Ghanaian personnel as instructors as much as possible. S.Q.2 training in the Electrical and Radio Branches is done in the U.K. using the R.N. L.E.M.'s course or L.R.E.M.'s course. Shipwright artificers undergo the R.N. F.A.M. course at H.M.S. *Sultan*.

After becoming a petty officer a man is immediately drafted to a ship and when considered suitable he is examined on his ability to act as senior rating when his ship is day running from Takoradi. Until he is successful he is always double banked with an R.N. E.R.A. At a later stage he sits another board to assess his suitability for taking a ship on patrol away from Takoradi. It is hoped to introduce a watchkeeping and charge certificate to cover both these standards of responsibility and to make this a requirement for promotion to either P.O. (1st class) or C.P.O. (2nd class).

### **Artificers**

The following types of entry have been attempted in order to obtain artificers:

#### *Direct Entry*

Men holding a Government Trade Test I have been entered and although educationally they are not well qualified, their skill as tradesmen is quite good. The required standard is not, however, available in the numbers required and as they are older men their potential for more learning is not high.

#### *Direct Promotion*

There are six technical institutes in Ghana who run City and Guilds courses in machine shop engineering or mechanical engineering craft practice. A number of such qualified men join the Navy as ordinary seamen and the best have been advanced to artificer. The result seems so promising that it is intended to recruit this type of man direct from civilian life and advance him to artificer after about 15 months.

### **Officers**

An entry of six students holding G.C.E. or West African School Certificate was made to H.M.S. *Fisgard* in September 1960, 1961, and a final entry of three in 1962. These ratings are undergoing the normal artificer apprentice course (with a few modifications) as E.R.A., E.A. and R.E.A. On return to Ghana they

will eventually be considered for the position of Officer Technician and suitable ratings will be thus promoted.

A number of General List Technical Officers are at various stages of training at Dartmouth, in the Fleet and at Manadon. Depending on their progress it is intended that they undergo either the Degree course or the one-year or two-year Commonwealth courses at Manadon.

Attempts are also being made to recruit students from the Kumasi University where degree courses are held in both engineering and electrical engineering.

### **The Future—Corvettes**

Two corvettes have been ordered from Vosper, Ltd. the first being built at Vosper's and launched on 5th September, 1963. She is named G.N.S. *Kronantse*, after the first British Port to be built on the Gold Coast in 1651 by the 'Company of London trading into Africa'. It was captured and recaptured during the Dutch wars and is now known by its Dutch name of Fort Amsterdam. The second ship is being built at Vickers-Armstrongs, who collaborated with Vosper's in the design of these ships. They are expected in Ghana about September, 1964, and March, 1965.

#### *Construction*

Length overall of 177 ft, beam 28 ft 6 in., draft over propellers 13 ft. Welded mild steel for main structure of hull; bridge superstructure and internal partition bulkheads to be of aluminium alloy. Displacement 440 tons.

#### *Armament*

One 4-inch Mk S2, one 40 mm Mk 9, One 3-barrelled squid, surface and air warning radar.

#### *Electrical*

High voltage	440 volts, 3-phase 60 c.p.s. A.C.
Medium voltage	115 volts, 3-phase, 60 c.p.s. A.C.
Low voltage	24 volts D.C.

#### *Machinery—General*

Two in No. 200 kVA alternating sets driven by Rolls-Royce C6TFLM Diesel. Each engine drives through a friction clutch a stand-by bilge pump of 10 ton/hour and an air compressor capable of 21.3 cubic feet per min at 450 lb/sq in. In addition a Diesel-driven compressor capable of 6 cubic feet per min at 350 lb/sq in. is fitted.

Fuel capacity is 60 tons with two upper deck filling connection running to a manifold in the engine room. An electrical fuel transfer pump type Megator M16 capable of 5 tons/hour is fitted. Fuel tanks are capable of being flooded to adjust trim.

An electrically-driven hull and fire pump having a capacity to 40 tons/hour can be used for supplying the firemain or can be connected to the main suction line.

Fresh water tanks were originally designed with a total capacity of 15 tons but this has now been increased to 20 tons.

A Clarkson thimble tube oil fired boiler with an output of 1,500,000 B.T.U./hour supplies hot water to the ships' heating system and to two calorifiers. A Freon 12 refrigerating plant is installed for a deep freeze, cold store and vegetable store. Combined heating and cooling units are built into the trunking system supplying the messdecks. Heating is provided from the oil-fired boiler and cooling from the refrigerating plant, both of these units being housed in the engine room.



Vosper roll damping equipment is fitted in the engine room and electro-hydraulic power steering gear is fitted.

For emergency electrical power a Rover 1S/60 kVA 450-volt, 3-phase, 60-cycle gas turbine generator is sited in the funnel together with an emergency switch-board.

#### *Main Engines*

Two in No. Maybach MD872 Diesels capable of the following performance:

Maximum power	3550 h.p. at 1900 r.p.m. for $\frac{1}{4}$ -hour
Overload power	3200 h.p. at 1836 r.p.m. for 1 hour every 6 hours either continuously or intermittently
Continuous load	2970 h.p. at 1790 r.p.m. at 29.5 Hg 60 per cent relative humidity and 68 degrees F. air intake temperature.

Each engine drives an outboard rotating propeller using a flexible coupling as the connecting drive between the engine and reverse gear.

Reverse/reduction gearboxes have a ratio of 5 : 1 giving 358 r.p.m. propeller speed at maximum power. Engines are fresh-water cooled and air start direct into cylinders.

The endurance at maximum continuous power is 1,100 miles and at 16 knots is 2,000 miles. B.h.p. 6,000 = 20 knots.

These engines form part of a range of high-speed Diesel produced by Bristol Siddeley Ltd., covering 360 to 3550 h.p. They are available as 4 or 6 cylinder 'in line' or as 8, 12 or 16 'V' engines utilizing a standard bore (7.28 in.) and stroke (7.88 in.) and compression ratio of 15.5 : 1. A disc-webbed crankshaft is used with large diameter discs and roller bearings instead of ordinary crankwebs and main journals, thus reducing the engine length. This has made possible the use of large connecting rod main bearings with consequent reduction in bearing pressures.

In effect each disc web combines two crankwebs and associated journal in one solid disc. The piston design is standard for the whole range and incorporates pressure oil cooling and a detachable steel crown. The latter allows checking of the compression rings without removing the whole piston from the cylinder bore. The piston cooling oil is fed via a telescopic tube to the underside of the piston crown and cooling is applied to all the ring lands. After circulation the oil flows back through a hole in the centre of the piston, lubricating the gudgeon pin en route.

Cylinder heads have three inlet and three exhaust valves located round an almost spherical centrally located chamber. A combined pump and injector is actuated by the inlet valve camshaft and injectors have only one large nozzle hole.

Valve operation is by means of short rocker arms actuated by direct overhead inlet and exhaust camshafts. Each pair of camshafts is housed in a common valve gear housing which contains the entire control mechanism for its respective bank of cylinders and can be removed as a complete unit. A train of helical gears transmits the camshaft drive from the crankshaft. Each valve rocker has an automatic hydraulic clearance adjuster to reduce noise and wear by avoiding heavy impact of the rocker arm rollers on the cams.

A single stage vertically mounted exhaust turbo charger is employed for pressure charging and intercoolers are fitted. The overall engine dimensions are: length 112 ins., width 64 ins., height 90 ins., dry weight 15,250 lb.

These engines have a number of interesting design features and arrangements have been made for the crew to undergo makers' courses in the U.K. before joining the first of the class. In addition to an R.N. Sub-Lt.(E), C.E.R.A. and P.O. (Elec.) they will carry the following Ghana Navy ratings: 3 E.A.s, 2 L.S.



FIG. 7—AT SEA

(E.M.), 6 A.B.(E.M.), 1 P.O.(L.M.), 1 L.S.(L.M.), 2 A.B.(L.M.), 1 L.S.(R.M.), and 1 L.S.(S.M.). The total complement is for 5 Officers, 11 C.P.O.s/P.O.s and 38 L.S. and below.

### **Coastal Minesweepers**

One big disadvantage with the I.M.S.s and S.D.B.s for sea training has been the limited period for which they can operate at sea or for which the ships' company can live onboard. In order to bridge the gap between the arrival of the S.D.B.s and the first corvette, consideration was given to acquisition of a C.M.S. Negotiations are still under way with the Admiralty and it is hoped that one may be available before the end of 1963 and possibly another during 1964.

### **Frigate**

A frigate with a type 41 hull design fitted with A.S.R.1s has been planned for 1966/67. Consideration was given to employing Maybachs in this ship in order to standardize with the corvette. Admiralty advised against this because a comparison with the A.S.R.1 showed that the Maybach would result in less power, slightly higher specific fuel consumption and require a re-design in gearing.

### **Training**

Given the right type of men to train and the means with which to train them will produce the necessary standard of trained men, only if time is allowed for the accumulation of sufficient experience.

The rate of growth of the Ghana Navy both in the past and that envisaged for the future does not allow such accumulation to take place. Senior Ghanaian technical ratings who have been in the Navy for 3 to 4 years will have to run I.M.S.s and S.D.B.s with considerable less experience than their R.N. counterparts.

There are, however, certain advantages which the Ghana Navy holds. The range of equipment is small and the original decision to adhere to Diesel machinery was a wise one. In addition, the technical problems are considered first when planning ship operations, which are built around the forecast of planned maintenance periods. The ratings are keen to learn and their obedience and respect is above reproach. When one rating was ordered to jump into the sea having been accidentally splashed with acid he did so. On his second reappearance to the surface he politely informed his instructor that he couldn't swim!

The largest problem in training is to achieve the most effective promotion and advancement. Because of the need to expand rapidly, the time requirement to L.S. and P.O. has had to be temporarily waived. If a petty officer must be produced in four years then the choice rests between promoting him P.O. quickly to allow him the maximum time and experience in that rank, or delay his promotion until he is more able and forgo his longer time in rank.

### Conclusions

Whatever the future growth of the Ghana Navy there is no doubt that a tour with the B.J.S.T.T. will always remain an interesting and rewarding experience.

Few officers or ratings on joining the B.J.S.T.T. have a very accurate picture of what to expect. It is hoped that this article will help those who are considering whether to apply under A.F.O. 106/63 for service with the B.J.S.T.T. in Ghana.

*Note:* The foregoing article was received just too late for inclusion in the last issue of the *Journal*. It shows the situation in Ghana in September, 1963, since when a number of events have been overtaken by time; for example, the C.M.S. is now out there.

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O shed a tear for those who may  
 Remain unblessed by S.M.A.  
 To stay like this they never opted,  
 Like some old road, still 'unadopted'.  
 The quarterly returns they render  
 Come back stamped 'Returned to Sender'.  
 Alone with wear and rust they fight  
 No 'S' forms near to put them right  
 No twenty twenty twos and such  
 Which help the E.R.A.s so much.  
 The cry goes up, 'What is the price  
 To schedule us to paradise?'  
 O shed a tear for those who may  
 Remain unblessed by S.M.A.

I.J.L-S.