# ESCORT MAINTENANCE SHIPS

BY

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Escort maintenance ships were first planned to work as units of the Fleet Train, being completed in 1945 as conversions from Canadian victory ships. They were, and are, important links in the logistic support chain, their function being the provision of facilities which enable frigates and similar ships to remain operationally available between prescribed refits. The number of older escorts is now much reduced and, as new types of advanced design take their place in the Fleet, the maintenance requirements need to be reassessed. The existing escort maintenance ships are, therefore, being modernized and, in order that a sufficient number of these supporting vessels are available, a few L.C. and L.C.T. maintenance ships are also being adapted for escort maintenance duties.

All departments are affected by the great changes which have taken place in escort design and equipment. New weapons of attack and defence, increased radar, sonar, and electrical commitments, and modern main and auxiliary machinery requirements, together with heavier demands from ships alongside for supplies of air, water, and power, form a total maintenance load of such a character that it can be met only by a comprehensive revision of the original arrangements. Some of the facilities formerly provided have been eliminated, and others have been reduced to accommodate the modernized services. The purpose of this article is to describe, in general terms, the more important differences between the original layout and the modernized arrangements in the escort maintenance ships, as they affect the Engineering Department workshops and associated spaces.

In the first place modernization does not necessarily mean that all the existing machines and equipment are scrapped. The basic features of many machines show little change over very extended periods and some, if properly cared for, should have a useful life at least as long as that of the ship in which they are fitted. Furthermore, the greatest economy must, as always, be exercised so that the best additional equipment can be obtained. The new machines and equipment are, therefore, limited to those which are essential to meet the additional requirements, or to replace worn-out machines of the type needed during the further service of the ship.

H.M.S. 'HARTLAND POINT'

## THE NEW ARRANGEMENTS

Over-the-side requirements excepted, changes in the type and scale of the maintenance facilities fall chiefly under three heads :—

(*a*) Workshops and workshops stores
(*b*) Stores (spare gear for attached ships)
(*c*) Offices.

### Workshops and Workshop Stores

Excluding the arrangements for the specialized work of the Electrical, Gunnery, and Torpedo Departments, the workshops concerned with the engineering maintenance of escorts originally numbered about fourteen and these were accommodated in six main compartments. In the modernized ship, there will be a greater number of workshops, stores and offices in the maintenance organization. Room for the new services could be found only by :—

(i) reducing the original facilities in some respects
(ii) making greater use of the available space (area and volume).

With regard to (i), this has been done by reducing the number of machines without reducing the range of types (except where items are redundant). The scope of the original facilities is thus maintained. To meet (ii), many of the workshops have been replanned and the machines and equipment re-sited to greater advantage, while maximum accessibility of the machines and adjacent hull structure has been obtained.

Included in the new spaces are shops for :—

(*a*) Degreasing
(*b*) Preservation, identification and packaging (P.I.P.)

(*c*) Light plate work
(*d*) Refrigerator plant dehydration
(*e*) I.C. engine fuel injection equipment testing.

The former motor-boat engine workshop has been replaced by an I.C. engine maintenance shop, with revised duties and equipment.

In order to make room for the important new requirements of another department the area of the combined smithery, plate, coppersmiths and plumbers shop and foundry has been considerably reduced. Items excluded under the rearrangement are :—

(*a*) Motor driven pneumatic hammer
(*b*) Motor driven plate punching and shearing machine
(*c*) Motor driven pipe bending machine
(*d*) Large metal melting furnace
(*e*) Lead melting furnace
(*f*) Core drying oven
(*g*) Small bending slab
(*h*) Motor driven sand mixing machine
(*j*) Motor driven 3 ft 6 in radial drilling machine

The foundry sand pit has been made smaller.

New items include a grit-blasting chamber with air exhausting and filtering plant, metal spraying equipment, and a hand-hydraulic portable pipe bending machine (4 in). Metal, sand, coal, coke, plate, and bar stowages are provided, and space for a new store for spare gear for attached ships has also been found. In general, the essential basic facilities have been retained although necessarily on a smaller scale.

Major changes have been made in the machine shop. This space used to comprise :—

(*a*) Machine shop
(*b*) Fitting space
(*c*) Tool room
(*d*) Issue room.

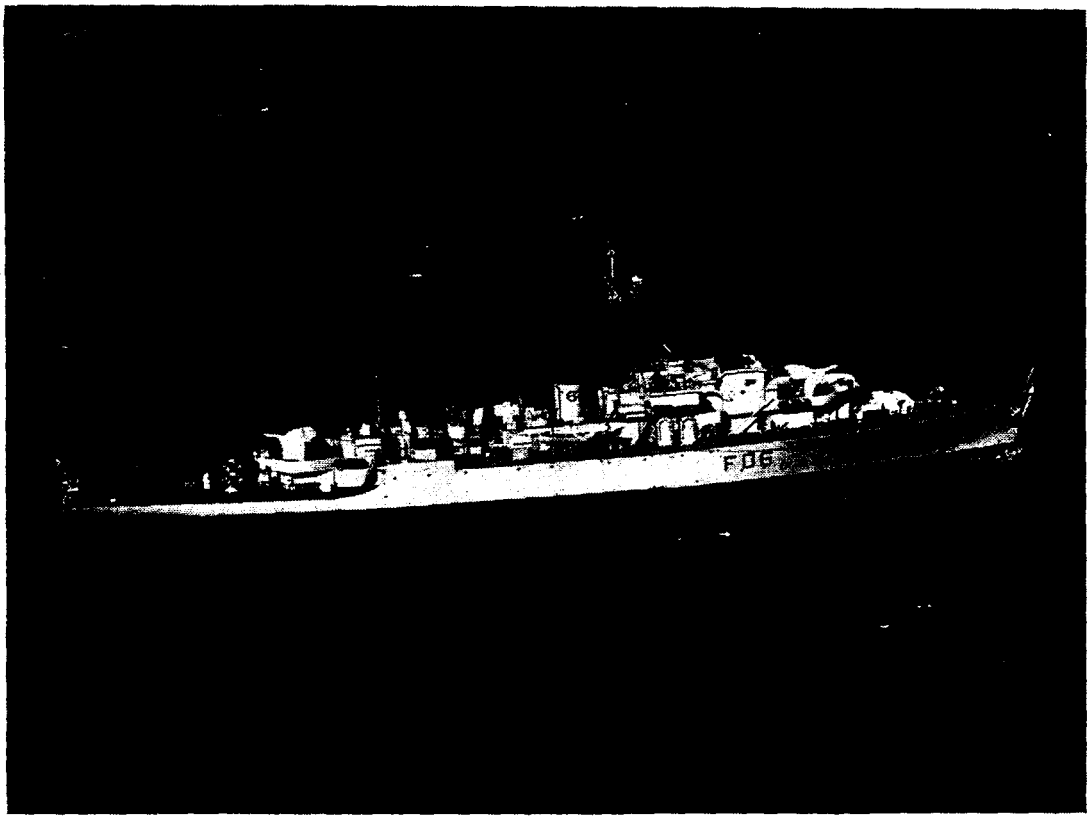
The modernized arrangement of the same area contains the following :—

(*a*) Machine shop
(*b*) Fitting space
(*c*) I.C. engine maintenance shop
(*d*) Degreasing shop
(*e*) Portable repair plant bay
(*f*) Workshop office and tool store
(*g*) Spare gear office
(*h*) Engineers workshop R.U. store
(*j*) Spare motor boat engines stowage
(*k*) Spare gear stowage (part).

It will be noted that several additional functions are located in this main compartment in the space made available by the general rearrangement and the removal of :—

1 in no. 24 in swing (12 in centres) S.S. and S.C. lathe
2 in no. 13 in swing (6½ in centres) S.S. and S.C. lathes
1 in no. universal miller
1 in no. screwing machine (6 in–3 in).

The 10 foot by 6 foot hatch over the compartment is ideal for shipping and unshipping the larger and heavier items. For this reason the portable repair



H.M.S. 'BIGBURY BAY'

plant stowage bay, stowage for spare motor boat engines, and one of the spare gear stores have been sited here. New items to be installed include :—

*Main Machine Shop*

Valve grinding machine (for spherical seated valves)
Double wheel carbide tool grinding and lapping machine
Spring testing machine (2 tons)

*I.C. Engine Maintenance Shop*

Injection valve needle lapping machine
Engine service kit

There are better facilities for degreasing and decarbonizing ; a separate space with two degreasant tanks, a water rinsing tank, and generous bench and floor space being included. It is hoped, thereby, to prevent contamination of the machine shop and I.C. engine maintenance shop by carbon dust and dirty oil. The cleaning agents will be used cold, i.e. at room temperature, and be capable of removing hard carbon deposits, engine gums, and oil. No atmospheric contamination should be experienced with the type of degreasant it is intended to use.

In the welding shop the motor generators which gave D.C. current for welding have been replaced by fixed transformer units, together with capacitors and reactors, giving A.C. The fixed L.P. acetylene generator has been removed.

Few alterations have been made in the woodworking and pattern shop. Siting of the circular and bandsaw sharpening and setting machine in this shop has been made possible by removing the 26 inch sensitive drilling machine and re-siting the motor driven grindstone. The 26 inch sensitive drill has been replaced by a high-speed bench drilling machine (not to be confused with the A.P. machine supplied under the Establishment of Stores). Additional storage

space for timber and patterns has been provided by extending the flat on the port side of the shop.

In a part of the area once occupied by the H.P. acetylene producing and charging plant, the new I.C. engine fuel injection equipment test shop has been sited. This shop is air-conditioned and fitted with special benches, the bench tops and deck being covered with non-sparking materials. The equipment will allow the setting and testing to be done accurately and quickly and it includes :—

(*a*) Motor driven I.C.E. fuel pump calibrating and testing units (heavy and medium duty)
(*b*) Pressure gauge tester
(*c*) Nozzle valve setter and tester
(*d*) Nozzle magnifier unit
(*e*) Nozzle pressure-cleaning cabinet
(*f*) Plastic dip pot (electric).

A dieso supply, with drainage, re-circulating, and filtering system, for bench tests is also provided in this shop.

The preservation, identification, and packaging (P.I.P.) shop is a new space and is situated aft on the upper deck. The installation consists of tanks for initial and final cleaning of work, for hot and cold preservatives, and tables for receipt, wrapping, and despatching. The hot tank is fitted with a thermostat to prevent over-heating the preservative. A small electrically heated ' hot sealer ' is included in the equipment for use with polythene film and lay-flat tubing. Facilities are also provided for draining and drying work, draining the tanks, and the stowage of wrapping materials. There is, of course, a limit to the size of item which can be dealt with and it might be well to add here, also, that strict fire precautions must be rigidly observed at all times.

The refrigerator dehydration workshop is another space not included under the old arrangements. Experience has shown that most of the failures occurring in refrigerating plants in service are caused by chemical changes which, in turn, have been started by moisture in the system. The new shop will provide the essential facilities for refitting and dehydrating this type of plant. The equipment comprises a thermostatically controlled electrically heated insulated oven (of a size sufficient to accommodate large components), headers, a fixed motor driven vacuum pump, and gas charging bottles. A portable motor driven vacuum pump has also been provided so that the dehydration of plants can also be carried out in place.

The former acid store (starboard) has been converted into a light-plate workshop and fitted out with :—

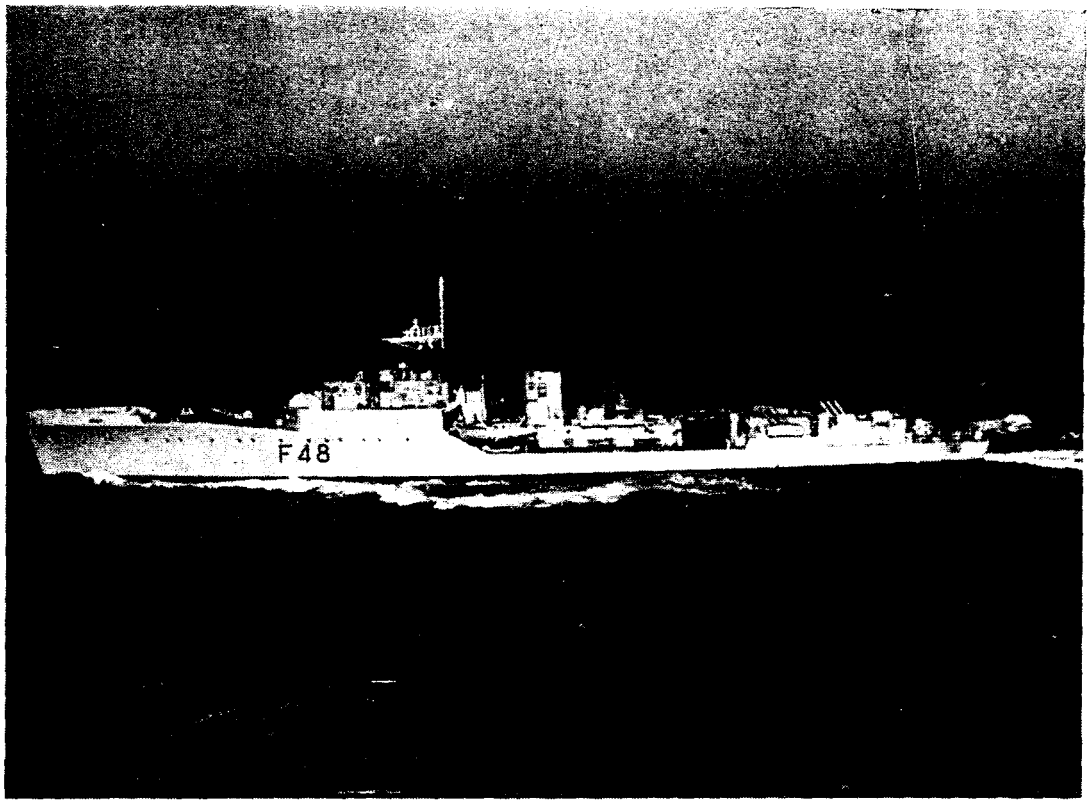
(*a*) Small bending rolls
(*b*) Metal folding machine
(*c*) Guillotine shears
(*d*) Beading machine
(*e*) Bench drilling machine.

This equipment is suitable for working light gauge sheet-metals, for example, the manufacture or repair of ducting and trunking.

As all the other gases required in the ship will be supplied and carried in charged cylinders, the H.P. acetylene producing and charging plant has been discarded. Plenty of bulk stowage for charged cylinders of oxygen, acetylene, H.P. air, hydrogen, and argon is included in the revised arrangements.

**Stores for Spare Gear**

A wide range of spare gear has to be catered for, particularly in connection




THE 'BLACKWOOD' CLASS FRIGATE, H.M.S. 'DUNDAS'

with the new type frigates where the principle of 'repair by replacement' has been widely used in the design. Adequate storage space has, however, been found and a considerable amount has, therefore, been allocated for the purpose. In order to make the best possible use of the volumetric capacity of each store, racking and binning of proprietary brands have been specified, together with shelves and cupboards as appropriate. Where practicable, and headroom permits, the stores and offices have been decked over at a convenient height to give additional stowage space.

The various spare gear stores are, of necessity, located in different parts of the ship ; some of these compartments have better access than others and care will be needed in determining the items to be kept in a particular store.

**Offices**

The main machine shop now includes :—

(*a*) *Workshop Office :* this was the old Receipt and Issue Room and from it will be controlled the day-to-day work in the shops

(*b*) *Spare Gear Office :* in which will be handled the spare gear records relating to the attached frigates.

The maintenance ship's own engineering routine, including its own spare gear records, will be administered from the ship's Engineers Office sited elsewhere. Lack of space precluded the provision of a central Technical Administrative Office for overall planning and co-ordination of the maintenance of ships being supported, and a compromise had to be accepted. The engineering aspects of this planning and co-ordination are, therefore, accommodated in part of the ship's Engineers Office, which adjoins a similar dual role Electrical Office, and is adjacent to other technical departmental offices.

## Welding Facilities

To meet general welding requirements (i.e. Grade B), it has hitherto been customary to fit motor driven welding generators giving D.C. for welding and, in special circumstances, to provide portable self-contained I.C. engine driven welding generators, also giving D.C., for use away from the parent ship. Alternating current is now generally acceptable for all normal welding requirements afloat, except in confined spaces. Accordingly, alternating current for fixed welding requirements in the welding shop will be provided by transformers, supplied with primary current from the ship's A.C. power main. These transformers will also supply current to the welding feeder main from which welding points are taken in various positions about the ship.

To avoid the risks attached to A.C. welding in confined spaces, portable A.C. motor driven generator sets giving D.C. for welding will be used. The portable generators will be powered by primary current from the ship's A.C. main. In addition, for use in ships alongside, portable D.C. motor generators and I.C.E. driven generators, all giving D.C. for welding, are being supplied and, for ease of handling and stowage, the portable sets will, if possible, all be of the single operator type. Arrangements also include facilities for stud-welding.

## Carbon Dioxide Foundry Process

Facilities for using the Carbon Dioxide Foundry Process will be provided. This process offers possibilities of considerable savings in connection with foundry operations afloat, the chief advantages being :—

(*a*) Very little equipment is required
(*b*) A core and mould drying oven is not necessary
(*c*) The process is economical and rapid
(*d*) Fewer core and mould irons are needed.

The elimination of the drying oven will result in a big saving of weight and space, and a reduction in wild heat in the compartment. Where the drying of cores and moulds is necessary, the drying time will be reduced from hours to minutes, thus the carbon dioxide process should be of particular value for urgent jobs.

The method of operation is by mixing a special binder with the sand and passing a charge of carbon dioxide through the mould or core. The chemical reaction between the binder and the gas hardens the bonded sand. The introduction and flow of the gas must be carefully arranged and controlled in order to produce the necessary uniform hardening of the mould and core surfaces. Only small proportions of binder and gas are required and the hardening action is very rapid.

It is essential to store the sand under close cover as its temperature and condition at the time of mixing with the binder are important.

There are some disadvantages with the carbon dioxide process, for example, breakdown, stripping, and reclamation of the hardened sand are more difficult than with normal moulds and cores, and the quality of surface finish varies, but these are out-balanced by the savings in weight, space, and time. The operator must be conversant with the special technique required, but training should not present any difficulty.

## I.C. Engine Fuel Pump Testing

Formerly only a bench type hand-operated fuel pump test unit was fitted and this required a skilled operator in order to get good results. Motor driven testing units are now to be installed to satisfy present requirements, and to allow

a reasonable margin for any additional test needs which may arise with the wide range and large numbers of I.C. engine fuel pumps used in naval ships.

There are two machines, one for the heavier pumps with speeds under 700 r.p.m. and another for the lighter pumps with speeds up to 4,000 r.p.m. This arrangement will increase the testing capacity and give greater flexibility in dealing with the large amount of testing which can be expected. The machines are fitted with electronic phasing and can handle all the necessary tests quickly and accurately. Reconditioning of nozzles requires a high standard of inspection and cleaning for the needle and body seatings. The nozzle viewer and nozzle cleaning cabinet have, therefore, been specially included. The viewer will enable a thorough inspection of the nozzle seat and needle valve to be made and, by eliminating a lot of the trial testing formerly necessary, should prove to be a big time-saver. The cleaning cabinet provides an efficient means of removing all particles of abrasive from the nozzle units, after grinding and lapping, and will ensure that the nozzles are returned to service in the best possible condition.

**P.I.P. Routine**

It is essential that items which can be reconditioned and reclaimed in the maintenance ship, or which must be returned to dockyards or bases for repair, should be properly preserved and protected during storage or transit. The P.I.P. routine will prevent deterioration of valuable and important components, whose serviceability would be seriously impaired if the items were left exposed to atmospheric conditions. All the materials are available from naval stores.

**Carbide Tool Grinding**

The introduction and increasing use of tungsten-carbide cutting tools makes the provision of suitable means of servicing necessary, if the best results are to be obtained. For long tool life and high work finish, vitrified wheels are not completely satisfactory. The best results depend upon the use of diamond impregnated wheels which give a fine cutting edge to the tools. A double wheel machine, with a suitable range of diamond wheels, and a silicon-carbide wheel for shank and rough grinding, is being supplied. The 'off-hand' method is used, grinding and lapping being done on right-hand or left-hand tools as desired.

For grinding tungsten-carbide mills, hobs, reamers, etc., it is intended to provide suitable diamond wheels for the universal tool and cutter grinder.

**Grinding Spherical Steam Valves**

To assist in the maintenance of the spherical steam valves and valve seats, fitted to the turbines of modern steam driven frigates, a special valve grinder and valve seat grinder have been included in the equipment. The valve grinder is of new design and an efficient radius setting and operating device is incorporated. The wheelhead and the workhead are driven by individual motors.

The valve seat grinder is of the vibro-centric type. When using this machine, it is important that most of the weight be taken by the hands of the operator, and the grinding done in short periods of about one-third of a minute each. The outfit includes a range of wheels to cover the various sizes of valve seats, and form-gauges for use when reconditioning the wheels. Each wheel is marked with particulars of the valve upon which the wheel is to be used.

**Repair by Replacement**

The introduction of standardization and of a system of acceptable dimensional tolerances in the design and manufacture of machinery, has made possible the implementation of the principle of 'repair by replacement' and the use of spare gear units on an increasing scale. The ultimate effect of this will be to reduce the

load upon the workshop machines and to add to the importance of the fitting-out trades.

### Lighting, Ventilation and Painting

Dull lighting, inefficient ventilation, and shabby surroundings all react most unfavourably upon efficiency and morale. Measures have, therefore, been taken to ensure a good standard of general lighting in the workshops and stores, and to provide the highest possible degree of illumination at the individual working positions. Special attention has also been given to the ventilation of the workshops, particularly the smithery, foundry, and welding spaces where the accumulations of smoke, fumes, and dust are not only incompatible with good health, but considerably reduce the effectiveness of the lighting. Some spaces, depending upon their purpose, will be air-conditioned. To make the workshop surroundings more congenial, the interior of each space will be painted white overhead and on the upper parts of bulkheads, and tan or medium green on the lower parts. This colour scheme will also increase the effectiveness of the lighting.

## DIFFICULTIES

### Dynamic Balancing

Dynamic balancing facilities have not been included. A great deal of consideration was given to this matter, but it was finally decided that the vibrational interference which could be expected afloat, the high cost and the difficulty of siting such a large machine and the consequent reduction of other facilities were overriding disadvantages. From experience with the small dynamic balancers which were installed in repair ships, it is very doubtful whether the readings obtained afloat were of any use from a practical point of view. A portable electronic unit may be the answer, but a suitable machine is not yet available.

### Grade ' A ' Welding

It was decided not to make provision for Grade ' A ' welding in these conversions. Radiographic examination is essential for Grade ' A ' work. This requires an X-ray generating plant, a gamma-ray appliance, and a photographic dark-room and processing equipment. Fully trained personnel are needed to work the plant, read the films and interpret the findings. There would also be great difficulty in finding a space suitable for storing and handling the gamma-ray appliance.

### Welding of Aluminium Alloys

The increasing use of aluminium alloys and light-gauge stainless steel sheet in marine engineering has made proper equipment for manual fusion welding necessary. The best results are obtained by the inert-gas shielded tungsten arc method and the equipment supplied includes a portable type power unit using high-purity argon as the arc shield and A.C. for welding current. Conventional A.C. welding of these materials has grave disadvantages. During tests with these sets some interference with radar and radio signals was experienced, but modifications which have been made to the design show promise of greatly reducing the trouble and of making the sets completely acceptable.

## CONCLUSION

The changes described have been related to engineering maintenance, but the facilities are equally available to meet the needs of all departments. The tendency in future will be for the workshops to be used upon a ' functional ' rather than a ' departmental ' basis, in order to obtain the greatest possible benefit from the machines and equipment provided.