SHIPS THAT SERVE SHIPS

BY

T. Clark, Esq., M.I.Mar.E.

Surveyor of Shipping and Marine Engineer, Trinity House

The author relates in some detail the special features incorporated in the design of light vessels and lighthouse tenders, which are maintained for the service of the mariner by the Corporation of Trinity House as the General Lighthouse Authority for England and Wales. Some details of the pilot cutters maintained by the Corporation of Trinity House are also described. Opportunity has been taken to include a short history of Trinity House as a Corporation since the grant of the first Charter.

INTRODUCTION

In 1514 Henry VIII granted its first Charter to a Guild of mariners or " Pilots " of the Trinity which had already been in existence for some time with functions of a semi-religious and charitable nature. The petition for the grant had pointed out that many unqualified young men and foreigners were setting up as pilots or lodesmen in the River Thames and the Charter, among other things, gave power and authority to the Guild of the Trinity to make ordinances for the relief, increase and augmentation of shipping and to enforce these ordinances by penalties.

This Charter was renewed by each Sovereign in succession, with or without variations, that of James I (1604) laying it down specifically that no persons should take upon them to be Pilots in the Thames unless they were so appointed by the Corporation.

The amplified Charter of James II was granted in 1685, thanks largely to the influence of Samuel Pepys, that indefatigable Secretary to the Navy, who twice served as Master of the Corporation, and, so far as pilotage in the Thames was concerned, laid down that pilotage of foreign ships was compulsory and gave to the Corporation the exclusive right to license pilots.

The whole question of pilotage was made the subject of an enquiry early in this century and the Pilotage Act of 1913 provided for the reorganization of this important service with a view to securing uniformity of administration so far as practicable.

Today, Trinity House is the Pilotage Authority for the London District, an area which extends from London and Rochester Bridges to the Sunk Sand off Felixstowe in the north and to Dungeness in the south, as well as for some forty ports in various parts of England and Wales, including Southampton (these Out-ports having been created in 1808). Its duties comprise :—

(*a*) the examination and licensing of pilots

(*b*) the granting of pilotage certificates to masters and mates of British ships ; and

(*c*) the provision of a sufficient supply of licensed pilots for the ports concerned.

There are nearly six hundred pilots licensed by Trinity House but it must be understood that they are not the servants of the Corporation. The Pilotage Service is administered through the London Pilotage Committee on which the ship owners and pilots have a representative, so far as concerns the London District, and through sub-commissioners at the other ports. Certain ports, including Liverpool, have pilotage authorities independent of Trinity House.

PILOT CUTTERS

The term " Pilot Cutter " is, of course, a heritage from the days of sail. Many of the vessels which today bear the name are over 140 feet in length and a few are over 150 feet in length.

The duty of a modern pilot cutter is simply to act as a floating base at the approaches to ports and estuaries from which a pilot may be " picked up " or to which a pilot may be " dropped " as required.

Where there is a considerable volume of traffic provision must be made for a large number of pilots and up to thirty can be accommodated on the larger pilot cutters. A dining saloon and comfortable lounge are also provided entirely separate from the accommodation for the master, officers and crew. With modern facilities in the way of bathrooms, and washplaces and galley, it will be appreciated that the vessel, except for navigating bridge, machinery spaces and boat deck, is almost entirely sub-divided into accommodation.

Pilots generally take their turns in rotation to board incoming vessels requiring their services. Pilots of outward bound vessels are also landed by the pilot cutter. Radio-telephone communication between the pilot cutter and the shore is maintained to ensure, among other things, that pilots are available in adequate numbers for incoming vessels.

Two boarding motor boats are carried, each 18 ft. long but designed for use in heavy weather to transport the pilots between the cutter and the vessels

FIG. 1.—A MODERN LIGHT VESSEL

awaiting or finished with their services. These boats have to be launched in any weather and shock absorbing gear is fitted on the davits or arranged in the lead of the falls. As an additional precaution, the boat winch is of ample power to give a rapid speed of hoist.

PROPELLING MACHINERY

The variety of propelling machinery installed on the vessels ranges from a single-screw triple expansion steam reciprocating engine to twin-screw Diesel machinery of 800 collective brake horse power. One of the smaller pilot cutters, 101 feet in length overall, has a Diesel-electric installation in which power is obtained from three London 'bus type engines running at 1,650 revolutions per minute to give 225 collective shaft horse power at a single propulsion motor which is controlled from the bridge.

LIGHTHOUSE SERVICE

A lighthouse is usually pictured as a lofty tower erected on a headland or isolated rock at sea. It acts as a seamark by day and displays by night a powerful light. Add to this the ability to produce the most efficient sound and wireless signals that can be devised and the result is a lighthouse of modern times in its most perfect form.

At sea it is not always possible to secure a firm foundation where, for the safety of shipping, a seamark is essential. The seabed may consist of unstable drifting sands, or the depth of water over isolated rocks may rule out any practical hope of building a permanent structure, and it is necessary to use some form of floating mark instead. Buoys of various types are used as floating marks, but the provision of a major light accompanied by a powerful fog signal is essential, in many instances, for adequate protection and this need can be met only by mooring a light vessel in the required position.

LIGHT VESSELS

Britain led the way in the use of lightships to mark sandbanks where lighthouses could not be built, the first being placed at the entrance to the Thames in 1732 to mark the Nore Sand. By 1795 four other dangerous shoals, including the Goodwin Sands, had been marked by lightships. These early vessels exhibited fixed lights from simple lanterns containing four to six candles. One, two or three lights in various combinations on separate masts enabled the particular station to be identified. Although they were strongly built, these early vessels had to ride out the winter gales on hemp cables and it was not unusual for them to break adrift. They were rigged with sails for use in emergency but an attendant vessel in the nearest port had to be maintained to supply new cables and restore the lightship to its position when necessary.

The introduction of chain cables in 1820, important as it was for shipping in general, had even greater significance for light vessels which depend so much on a safe mooring. Longer vessels were built, in which greater comfort for the crew became possible, and space was made available for the development of the navigation light and fog signal equipment concurrently with the development of ship construction.

Wooden hulls gave way to composite construction, to iron and, in due course, to steel hulls. It is, however, worth pointing out that three of the later-built wooden hull vessels and seven composite vessels are still in service, improved where possible to meet modern standards for accommodation.

MODERN LIGHT VESSELS

Figure 1 shows in profile a modern light vessel of which the principal particulars are as follows :—

Length overall	137 ft. 3 in.
Breadth, moulded	25 ft. 0 in.
Depth, moulded	15 ft. 0 in.
Mean draught	10 ft. 11 in.
Displacement	515 tons

It will be seen that the lantern is carried on a steel lattice tower amidships. Forward of the lantern tower a look-out shelter with all round vision is provided and on top of this shelter the diaphone fog signal is erected above all obstructions which could possibly blank the sound. The foremast and mainmast carry the radio telephone and radio-beacon aerials, and they have also been used to display daymarks, large conical or globular shapes, to assist identification in daylight. The station name is exhibited each side of the vessel in letters 6 ft. high and, as the topsides and lantern tower are painted Post Office red, the vessel can readily be identified from a distance in clear weather.

Light vessels are not self-propelling but are moored at their stations and the windlass is of necessity robust in construction. A rotary engine of 35 h.p. driven by compressed air, supplies the power required for working the windlass but hand gear is also fitted for emergency use. In addition to the main riding cable, two anchors are carried at main deck level in recesses built in the forward bulwarks (Fig. 2). These anchors are arranged with special releasing gear so that one or both of them can be instantly be let go in the event of the permanent mooring carrying away in a gale. It should be said, however, that very few instances have occurred when the standby anchors have had to be brought into use.

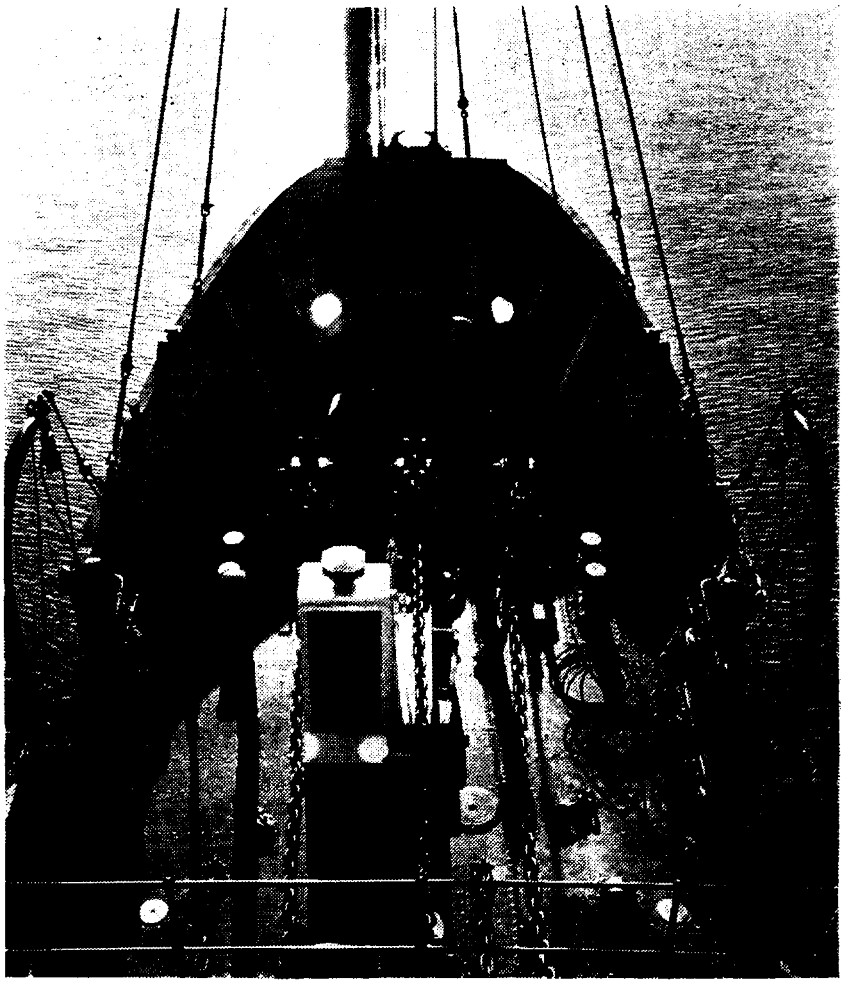

FIG. 2.—FOREDECK OF A MODERN LIGHT VESSEL LOOKING FROM STEERING SHELTER

The machinery for current supply to the main navigation lantern and for ship's lighting is housed in the engine room amidships (Fig. 3). For lighting purposes four single cylinder Diesel engines directly coupled to $5\frac{1}{2}$-kW. 100-volt D.C. generators are installed ; each engine develops $9\frac{1}{2}$ b.h.p. at 1,000 revolutions per minute and, under normal conditions, one set is sufficient to supply the load requirements. A second set may be necessary in certain circumstances, leaving one machine available as standby, should one be dismantled for servicing.

Two fog signal sets are fitted to provide compressed air supply for the diaphone. These sets consist of a Diesel engine developing 38 b.h.p. at 1,000 revolutions per minute with a drive through flexible couplings to a $5\frac{1}{2}$-kW. generator and through a multi-groove Vee pulley and belt drive with clutch to a quadruplex air compressor. The Diesels are fresh water cooled in conjunction with a sea water circulated heat exchanger.

The quadruplex single stage air compressors have four cylinders arranged radially in a circular casing. Each cylinder is fitted with a trunk piston driven by connecting rods from a common crank pin. An annular space forming a water jacket is contained in the casing through which the cylinders pass. In effect each cylinder forms a separate single acting compressor delivering into a common passage so that at high speed a steady stream of air is discharged.

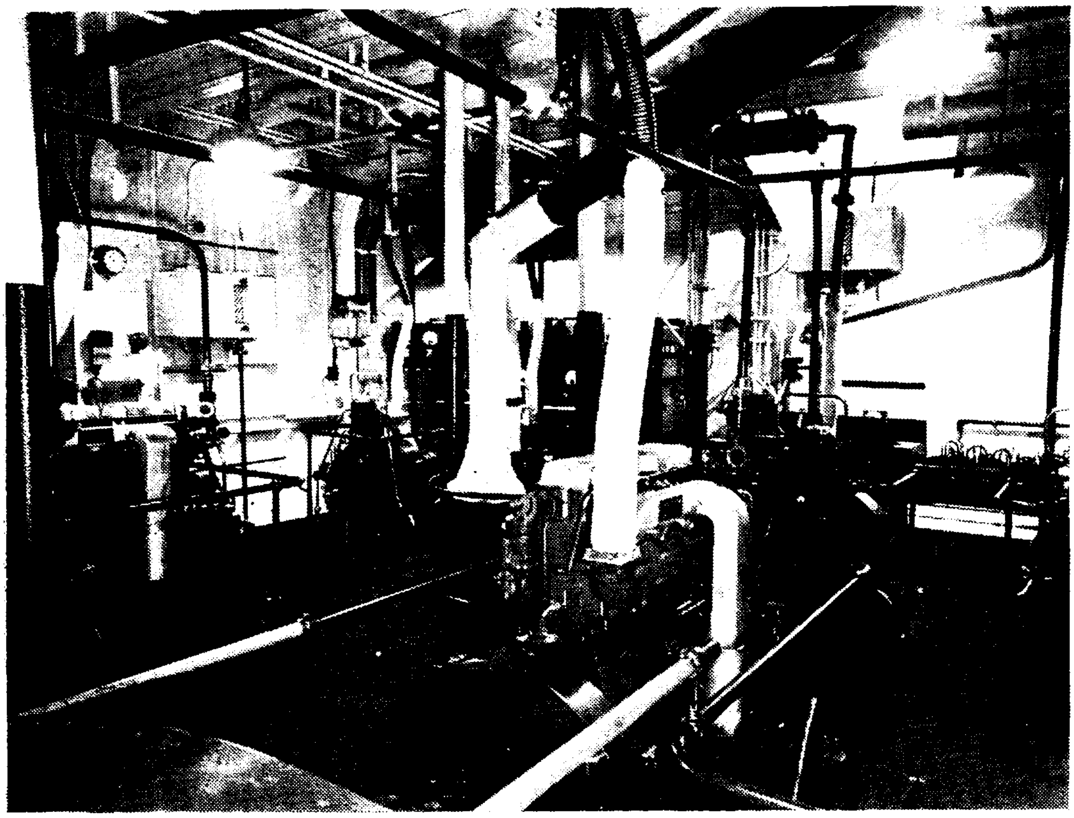

FIG. 3.—LIGHTING AND FOG SIGNAL MACHINERY COMPARTMENT

The compressor has no suction valves, air being admitted to the cylinders through ports in the piston which coincide with similar ports in the top of the connecting rod during the suction stroke and at the end of the suction stroke, the piston uncovers ports cut through the cylinder wall so making direct communication between the cylinders and the suction chamber formed in the casing. Delivery valves are fitted at the outer end of each cylinder and they open during the compressing stroke when the air has reached the required pressure.

Three air receivers each of 220 cu. ft. capacity are arranged in the engine room for the storage of air at a maximum pressure of 120 lb. per sq. in. This air supply is reduced in pressure to 35 lb. per sq. in. for use in the fog signal diaphone and the windlass engine, the low pressure air being stored in two small receivers on the main deck.

LANTERN

The lantern, carried on a lattice tower, is a fixed structure which houses an optical system of the catoptric or mirror type. The arrangement consists of a pendulum supported on gimbals, balanced and designed so that it will have a rate of oscillation just out of step with the natural period of the ships' roll. By this means the light beams are kept horizontal although the light vessel may be riding and pitching heavily in a seaway. Above the pendulum pivot point, four groups of two focus mirrors are arranged each with its own 500-watt lamp. The mirrors can be set in various positions so that the beams from any pair are disposed in the desired relationship to the beams from the other pairs. By this means the light can be given differing characteristics and single, double, triple or quadruple flashing combinations can be produced. The advantages of this system are obvious as a lightship may have to be used first on one station and later on another station.

The optical system is revolved by a small electric motor through a shaft mounted on journal and thrust bearings and by means of change gears the speed of revolution can be made one in fifteen seconds, one in thirty seconds, one in sixty seconds, one in ninety seconds or one in 120 seconds. The current is conveyed to the lamps by slip rings. The lantern focal plane is forty feet above sea level at normal load draught and the light is visible in clear weather for a distance of approximately twelve miles.

DIAPHONE

The fog signal diaphone is operated by compressed air. A gunmetal piston is made to oscillate in a cylinder by introducing compressed air at a pressure of 35 lb. per sq. in. to the rear chamber of the diaphone casing through an operating valve. The piston and cylinder contain a series of annular slots cut over the larger part of their length and the outer end of the piston is open to a resonator which is a trumpet mounted vertically and fitted with a large mushroom head to give all round distribution of sound. Air at the same pressure, 35 lb. per sq. in., is introduced through a sounding valve to the front chamber of the casing and as the piston oscillates the annular slots on the piston and cylinder coincide, so releasing pulses of compressed air into the resonator. A large volume of sound at approximately 180 cycles per second is produced. A timing mechanism controls the sequence of the operating and sounding air valves, and the mechanism can be set to give any desired character and length of blasts.

GENERAL FEATURES AND WIRELESS AIDS

Light vessels, lying moored as they are at the converging points on busy shipping lanes, quite frequently sustain damage by collision. The point of impact in many cases is on the bow, and for this reason particularly heavy construction in this area is essential. The sloping bow and high bow bulwark, which is a feature of modern light vessels, is capable of absorbing heavy damage, thus preventing so far as possible, injury to the underwater bow plating. In case of serious damage, however, the inboard ends of the riding and anchor cables are secured on the main deck by slips which can readily be released if it is essential to let go the cables to lighten the vessel. An efficient alarm bell system is provided to warn the crew of approaching danger.

Two signal guns are carried, fired through gunports in the after main deck bulwarks. Their function is to provide visible and audible warning by the production of a large volume of smoke and sound to warn any craft approaching into danger. Explosives for the signal guns are carried in magazines built at the stern of the vessel.

Wireless aid to the navigator is given by radio-beacon transmitter which performs two functions :

(1) To transmit in clear weather a radio signal having a definite characteristic by which the light vessel can be identified and at the same time to enable a bearing to be taken.

(2) To transmit during fog or haze the radio signal which identifies the light vessel at precisely the same instant as the diaphone fog signal begins to sound. By this means the navigator is enabled to estimate his distance from the light vessel using as a basis for the estimate the known difference between the speed of sound and the speed of wireless waves. The number of seconds elapsing

between the times at which the radio-beacon and sound signals are heard can be readily converted to distance from a suitable table of figures previously prepared. It is pointed out, however, that varying atmospheric conditions can alter the time taken to receive the sound signal and it is not now considered so desirable to synchronize the diaphone with the radio-beacon.

An automatic code-sender governs the Morse characters of the transmitter by operating make and break contacts to form the characteristic of the radio-beacon. The code-sender is itself controlled by a master clock which times the beginning and duration of each group of signals. The master clock and code-sender also govern the timing of the diaphone fog signal. The radio-beacon is in duplicate and in the event of failure the standby unit can be switched into circuit without interruption of transmission.

The accommodation for the Master consists of a day cabin with adjoining sleeping cabin and a separate washplace. The crew of six men is accommodated in two berth cabins with separate messroom and modern facilities are provided, including an electric refrigerator, hot and cold fresh water supplies and central heating by hot water radiator system. Steel light vessels are required to remain on station for a minimum period of three years and for this reason separate accommodation is also provided for two Trinity House workshop mechanics when on board for maintenance work.

Communication with the shore and with other light vessels is maintained by radio-telephone.

UNMANNED LIGHT VESSELS

Unmanned light vessels or light floats vary in length from about 45 feet to 65 feet. They are fully decked and suitably compartmented to give a good chance of survival in the event of being damaged by collision. An automatic acetylene light is carried on a lattice tower. An automatic bell fog signal operated by compressed CO_2 gas acting on the striker is usually fitted, sometimes with the addition of a wave operated bell signal.

Two unmanned light vessels are in service at the present time, both 65 feet long on the load waterline. They have low bulwarks forward but elsewhere the deck is open and rounded at the margin into the shell plating so that any water which has been shipped will escape freely overside.

A watertight hatch is fitted over each compartment and ventilation is arranged by means of watertight gooseneck ventilators. At the outlet end of each gooseneck is arranged a non-return valve consisting of a light composition ball and a brass seating ring. The ball in its normal position leaves the compartment below open to atmosphere but when the ventilator mouth is submerged by a sea the ball is floated up on its seating and effectively seals the ventilator.

The light is of the open flame type in which a small pilot light burns continuously. The dissolved acetylene gas illuminant is fed to the burner by means of a flashing mechanism controlled by a diaphragm chamber into which the gas is fed at a pressure of about 450 lb. per sq. in. The gas distends the diaphragm in a predetermined time and the movement of the diaphragm, magnified by suitable lever and fulcrum, opens the supply valve and admits gas to the burner, where it is at once ignited by the pilot light. The pressure in the diaphragm chamber is reduced by the release of gas to the burner and the diaphragm moving inwards closes the burner supply valve, so restarting the cycle of operations.

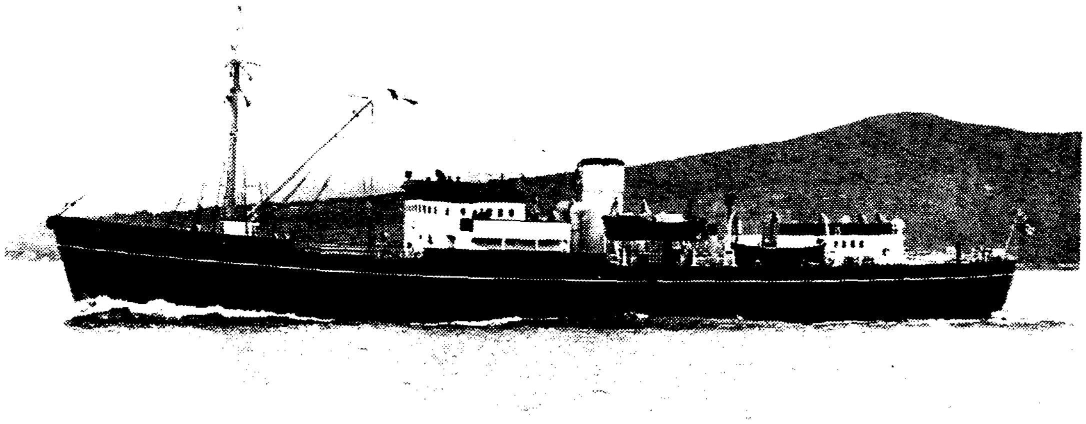

FIG. 4.—TRINITY HOUSE TENDER *ARGUS*

LIGHTHOUSE TENDERS

Nine lighthouse tenders are stationed around the coast at six depots, from which the work of lighthouse maintenance for each of the six districts is supervised by the District Superintendent acting under the overall direction of the Chief Superintendent and the Elder Brethren of Trinity House. The lighthouse tenders are of varying length, ranging from 165 ft. 9 in. to 256 ft. overall, but are generally capable of performing the same manifold duties. T.H.V. *Argus*, a tender of modern type, is shown in Fig. 4. Certain particular duties are more efficiently performed by individual vessels, natural in a fleet of vessels so diversified in type.

The propelling machinery also varies widely in character. Three twin screw tenders are fitted with triple expansion reciprocating engines supplied with steam from two Scotch boilers. Three other twin-screw tenders are fitted with triple expansion reciprocating engines supplied with steam from two oil-fired Scotch boilers. One twin-screw tender is fitted with Diesel-electric propulsion another with reciprocating engines supplied with steam from oil-fired watertube boilers and, lastly, one is single-screw with triple expansion steam engine and one large Scotch boiler of trawler type.

The diversity of propelling machinery is reflected in the auxiliary equipment and the author therefore proposes to describe some particular features of a lighthouse tender rather than attempt to describe one or all vessels in detail. It may be appropriate to digress at this stage so that something may be said of the duties which a lighthouse tender has to perform.

Maintenance work in the Lighthouse Service consists of a wide variety of operations and some of the duties carried out by the lighthouse tenders are as follows :—

(1) The relief of lighthouses and light vessels, which consists of a regular fortnightly trip on which relief crews are transported to and from their stations and supplies of oil, fresh water, coal and general stores are replenished.

(2) Maintenance of the buoyage system which demands that every buoy shall be lifted at regular intervals, cleaned, painted, equipped with fully charged gas cylinders for the light where fitted, and inspected generally

to ensure that the light is efficient and that the mooring chain and sinker anchorage are satisfactory.

(3) Light vessels have also to be relieved from their stations at regular intervals for repair and the lighthouse tenders, after towing the relieving vessel to her station and mooring her there, take the relieved vessel in tow to her depot for de-storing in preparation for drydocking and repair.

(4) Wrecks have to be marked as soon as possible after the occurrence.

(5) Sandbanks, suspected to be extending, must be surveyed to ensure that their limits are adequately marked.

RELIEFS

The day before the relief is due to begin the lights officers' and lightsmen's gear is loaded aboard the tender. The word " gear " in this case covers many items, food for every man to last until the next relief, sea kit of warm clothing, oilskins and seaboots, writing materials, perhaps some books and probably a half-completed mat, wool rug or ship's model on which to work as a hobby during off-duty spells afloat. In the hold of the tender are separate bins for each light vessel and in each bin are stowed personal belongings and food for the men. General stores for the light vessels such as coal and anthracite, paints and cleaning materials, are loaded in the hold. Diesel fuel and lantern illuminant oil in deep tanks and fresh water in the double bottom tanks, to replenish supplies on all the light vessels which are to be visited, complete the stores. The relief crews, comprising twelve lights officers and twenty-four lightsmen, are accommodated in their own separate quarters on board and the relief is ready to begin.

On arrival at the first light vessel the tender draws up and makes fast astern. Oil and water hoses are passed to the light vessel and the electric motor driven pumps on the tender which are controlled from the fore deck are set in operation. At the same time one of the two motor boats has been lowered and the relief crew with their stores are transported to the light vessel. The men who have been relieved are brought back to the tender with their belongings, after which the motor boat transports coal and other stores until all is delivered.

During the course of the relief, which is carried on throughout the day and night, the commanding officer and chief engineer of the tender go aboard each light vessel to carry out an inspection. The hull, deck fittings and life-saving equipment are examined by the commanding officer. The machinery is inspected by the chief engineer and any essential adjustments or repairs are taken in hand.

Emergency repairs and adjustments of this kind are part of the relief work and not to be confused with routine maintenance of the fog signal machinery and electric generating plant, which is carried out by a staff of Trinity House mechanics from workshops at Blackwall, London.

BUOY WORK

Fine weather is much to be desired for buoy maintenance work and every effort is made to complete a large part of the maintenance programme during the summer months. Over 600 buoys have to be dealt with and on fine days work goes on from dawn to dusk. It is known from the records what buoys are likely to need new moorings or perhaps withdrawal for major repair and the lighthouse tender is loaded accordingly with clean buoys of the correct size and shape, each suitably painted in the colours and pattern by which it is identified in its particular position. New mooring chains are loaded through chain pipes and ranged in the bottom of the hold, ready to be quickly paid out as required, and the auxiliary equipment such as buoy lamps and the wooden superstructures on which they are carried, acetylene gas cylinders, gas mantles and buoy winkers are suitably stowed. These sinkers, which provide anchorage for the buoys, are round or oval cast iron slabs weighing up to three tons and having a heavy steel eyebolt cast solid in the centre to take the mooring chain.

The lifting gear of a modern lighthouse tender consists of a steel derrick, having a safe working load of twenty tons, pivoted on a table aft of the foremast. Two hoisting engines are installed on the lower deck, one for purchase and the other for topping the derrick. Each hoisting engine consists of a 60 h.p. twin cylinder vertical steam engine driving through worm gearing a winch barrel on which 250 feet of 4½ in. circumference flexible steel wire rope is laid and unlaid by automatic spooling gear. A pull of 12¼ tons at 30 ft. per min. can be exerted on the first layer of rope off the barrel and by means of a single sheave purchase block 20 tons can be raised at 15 ft. per min. A volute spring shock absorber is fitted between the purchase block and the hook. The derrick guys are treble purchase blocks rove with manilla falls and operated by a 30-cwt. electric capstan at each side of the hatch.

A capstan suitably positioned on the centre line is used in conjunction with the derrick to handle buoy mooring cables. This capstan has a single head on which cable lifters of various sizes can be fitted and, above the cable lifter, a warping barrel. A 60 h.p. twin cylinder steam engine fitted on the deck below drives the capstan through spur and bevel gearing. Derrick engine and capstan controls are arranged on the upper deck.

When buoy shifting is in progress the fore deck resembles a busy workshop. The tender having run a little way up tide or up wind of the buoy drops an anchor and falls back on the cable until the buoy is riding nicely placed athwart the fore deck working gangways. The derrick is swung overside and, by means of a two-legged sling hooked into the lifting lugs either side, the buoy is raised and swung inboard. The weight of the mooring cable is taken by a stopper secured on the foredeck so that the buoy can be landed.

Thereafter several operations are carried on simultaneously. The position of the buoy is checked to ensure that it has not dragged. The heavy weed and shell growths on the underwater surfaces of the buoy are removed and hosed overboard. The four apertures, each containing a cylinder of dissolved acetylene gas illuminant are opened up, cylinders removed and replaced with fully charged cylinders. Whatever is necessary to fit the buoy for at least one year's service is done, the lamps and flashing mechanism are tested, mooring cable examined and if need be lifted and replaced. Finally, when the buoy has been repainted it is lowered overside.

Buoys which carry a light are as a rule five tons in weight and with the mooring chain and other fittings the load on the derrick is about seven tons. Another class of buoy which carries a more powerful light on a lattice tower is known as a high focal plane buoy and with its fittings and mooring cable it weighs approximately twelve tons. It will be readily appreciated that the movement of a buoy and motion of the tender in even a moderate sea imposes very heavy stresses in the lifting gear.

An interesting feature of some high focal plane buoys is the long cylinder attached to the underwater body. As the buoy rises in a seaway, air is drawn into the cylinder, to be forced out at low pressure through a whistle as the buoy dips again.

LIGHT VESSEL MOORINGS

The modern gear for handling light vessel moorings consists of a triple head capstan mounted on the foredeck. The capstan heads are interchangeable and lifters can be fitted to deal with various sizes of cable. The capstan heads are driven by a 60 h.p. twin-cylinder steam engine installed on the main deck below and each head can be worked independently of the other two. Chain pipes from the lifters lead direct to the bottom of the hold where new cables are ranged and a strongly constructed roller or ramp in the bow of the lighthouse tender takes the lead of the mooring overside.

A suitable mooring for the majority of light vessels is provided by a 5-ton stockless anchor connected to 210 fathoms of $1\frac{5}{8}$-in. diameter stud link cable, but for very exposed stations $1\frac{3}{4}$-in. diameter stud link cable is used. The length of 210 fathoms, which is rather longer than that in use in merchant ships, is required to form a catenary to which the light vessel can ride easily without snatching on its mooring. It is customary to ride with 180 fathoms of cable out in bad weather.

TOWING

For towing light vessels to their stations and bringing them in when necessary for overhaul, the tenders are fitted with a towing winch of which one, an automatic veering and hauling winch, is fitted on a vessel with Diesel-electric propulsion machinery and consequently is operated by compressed air. The winch engine is of 60-h.p. built in conventional steam winch arrangement with two horizontal cylinders driving a barrel through helical gears. On the barrel 120 fathoms of $4\frac{1}{2}$-in. circumference flexible steel wire is laid and unlaid by automatic spooling gear. It is customary to connect the towing hawser to one of the cables on the light vessel so that by paying out cable to suit the weather conditions a catenary is formed to ease the fluctuations of stress in the towing hawser. By this arrangement the anchor cable also takes the nip and chafe at the mooring pipe on the light vessel instead of the hawser, which is less able to sustain prolonged chafe. The lead of the hawser from the tender is taken through a towing roller consisting of one horizontal roller flanked on each side by a vertical roller.

When the tow has been set to the desired length the automatic veering and hauling gear is engaged by a clutch on the towing winch. The operation of this gear is somewhat similar to the hunting gear on a steering engine. When the pull on the towing hawser increases, the winch renders and pays out, so relieving the stress. The movement of the barrel is transmitted through gears to the control valve which is opened to admit more compressed air to the cylinders until a balance of power is reached. As soon as the pull on the hawser eases the winch engine takes charge, winding in the hawser again to the length at which it was originally set.

The remainder of the auxiliary machinery in a lighthouse tender follows generally the same lines as that in vessels of similar size, except for the workshop, wherein lathe, drilling and shaping machines, grinding machine and power saw are provided to facilitate urgent lighthouse or light vessel machinery repairs.

SPECIAL DUTIES

The Trinity House vessel *Patricia* carries out all the normal routine work of a lighthouse tender but has in addition other special duties to perform. Each year an inspection of all lighthouses, light vessels, beacons and buoys is carried out by a visiting committee of the Elder Brethren in *Patricia* which is fitted with accommodation for this purpose.

The Elder Brethren also attend in person on the Sovereign when proceeding on, or returning from, a voyage across the sea and on ceremonial occasions such as a Naval review when the Trinity House vessel *Patricia*, with the Elder Brethren on board, may be seen leading the Royal yacht.

PROPELLING MACHINERY

The propelling machinery of T.H.V. *Patricia* is Diesel-electric and is one of the earlier applications of this type of equipment for marine use, having been built in 1938.

Two six-cylinder four-stroke Diesel engines with mechanical injection, each of 750 b.h.p., are direct coupled to 550 volts direct current separately excited propulsion generators and a 48 kW. overhung generator supplying current, for auxiliary purposes at 220 volts d.c. The main propulsion generators are of the open self ventilated type having rotatable frames carried in cradles to provide for easy removal of the lower poles. Means are provided for measuring the wear down without dismantling the bearings.

The propulsion motors are capable of delivering 665 s.h.p. on each of the two shafts at 200 r.p.m. and are of the single armature type with separate pedestal bearings independent of the thrust shaft. Separate motor driven ventilation fans which start up automatically when current is supplied to the propulsion motors are fitted, to discharge air axially over each commutator.

CONTROL EQUIPMENT

Independent control for each propulsion motor is provided from the navigating bridge from the engine room, and electric tachometers to indicate the propulsion motor revolutions and direction are fitted at each of these control stations.

The bridge controllers are in the form of telegraphs and provide six ahead speeds and four astern speeds. Features are embodied in the control scheme which, without any interruption of power, make it impossible to overload the main generators under any conditions.

Independent control of the two propulsion motors can be maintained with one or both generators in operation. Changeover switches are provided for transferring the control from bridge to engine room and pilot lamps at each station indicate which controller is in service.

The exciter sets are in duplicate, each unit comprising a motor of 30 b.h.p., driving one main generator exciter and two propulsion motor exciters. Control of the propulsion motors is carried out by varying the fields of the generator exciter and the propulsion motor exciters.

It is interesting to note that after thirteen years in service the liner wear on the Diesel engines does not exceed 15/1,000-in., a point which indicates fairly well the advantages to be obtained with constant running Diesels as opposed to those frequently started up by compressed air for manoeuvring.

In conclusion the author realizes that, within the scope of so short a summary, it has been possible to touch only superficially on many aspects of the subject, but it would scarcely be appropriate to conclude without reference to the men who serve in the " Ships that Serve Ships." For the aids to the mariner depend ultimately on the reliability of the men at their stations and we who live by the sea know the value of their work for us and for all who navigate the sea.