H.M. UNDERWATER WEAPONS LAUNCHING ESTABLISHMENT

BY

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It must be said at the outset, that this is a purely non-technical article, for the technical details of the majority of the work under development are still classified as secret. Its object is to bring to wider notice the existence of this small establishment and the work undertaken. Frequently, it is brought home to us who work here, how little is known of the Underwater Weapons Launching Establishment outside the circle of directly interested authorities and departments, and it is felt that a wider knowledge of its existence might well be of benefit, not only to the Establishment, but also to the users of our equipment in the Fleet.

The torpedo tube, the primary reason for the U.L.E.'s existence, has for many years been accepted as a standard fitting throughout the Navy, yet it is doubtful whether many people have ever wondered how and where these necessary items were first conceived and subsequently saw the light of day.

The establishment is small, spread over about five acres at West Howe, on the northern outskirts of Bournemouth. The original buildings, which have since been added to considerably, were used as a N.A.A.F.I. store, but were taken over and subsequently named the Engineering Workshops, West Howe, in 1941, as a result of the bombing of Portsmouth Dockyard.

Before going further into the details and history of the U.L.E., it would perhaps be appropriate here to state the nature of the work undertaken today. This can be summarized under the following headings :—

(*a*) The design of all above-water and submarine torpedo tubes and associated discharge equipment.

(*b*) The design of all power minelaying equipment fitted in H.M. ships.

(*c*) The design of power-operated torpedo loading equipment. (The design of hand-loading gear is undertaken by the Director of Naval Construction).

(*d*) The design and development of cordite charges for the discharge of torpedoes from above-water tubes.

(*e*) The development and design of submerged signal ejectors for submarines.

(*f*) Research into new methods of torpedo and mine discharge, and subsequent development.

(*g*) Research and development in certain other fields regarding the discharge of future improved underwater weapons.

The requirement from which the U.L.E. originally evolved was, of course, item (*a*). In the old days, torpedo tube design was a military commitment and was undertaken at the Royal Carriage Department, Woolwich. At the end of the last century, however, the responsibility for this work was taken over by the Admiralty, and until the end of the first World War, was carried out by a section of the Manager, Engineering Department, Portsmouth's main drawing

office. Later a separate drawing office was established and named the Torpedo Tube Design Office, with a Commander (E) and a Technical Officer in charge, the Commander (E) being directly responsible to M.E.D. for the work carried out in the T.T.D.O. While this ' set-up ' lasted, all prototype and other shop work was carried out in the main factory of M.E.D., Portsmouth. On Saturday, 24th August, 1940, during an air raid, the T.T.D.O. received a direct hit, which caused very severe damage. Fortunately, at the time, no work was in progress and there were no casualties. Much of the drawing work in hand was saved, as was the complete record room, not to mention the Commander (E)'s overflowing ' in '-basket, which is reputed to have been found reeling drunkenly on top of a very large pile of rubble. It was now necessary to find alternative accommodation, and the T.T.D.O. was moved temporarily to requisitioned offices in Commercial Chambers, Portsmouth.

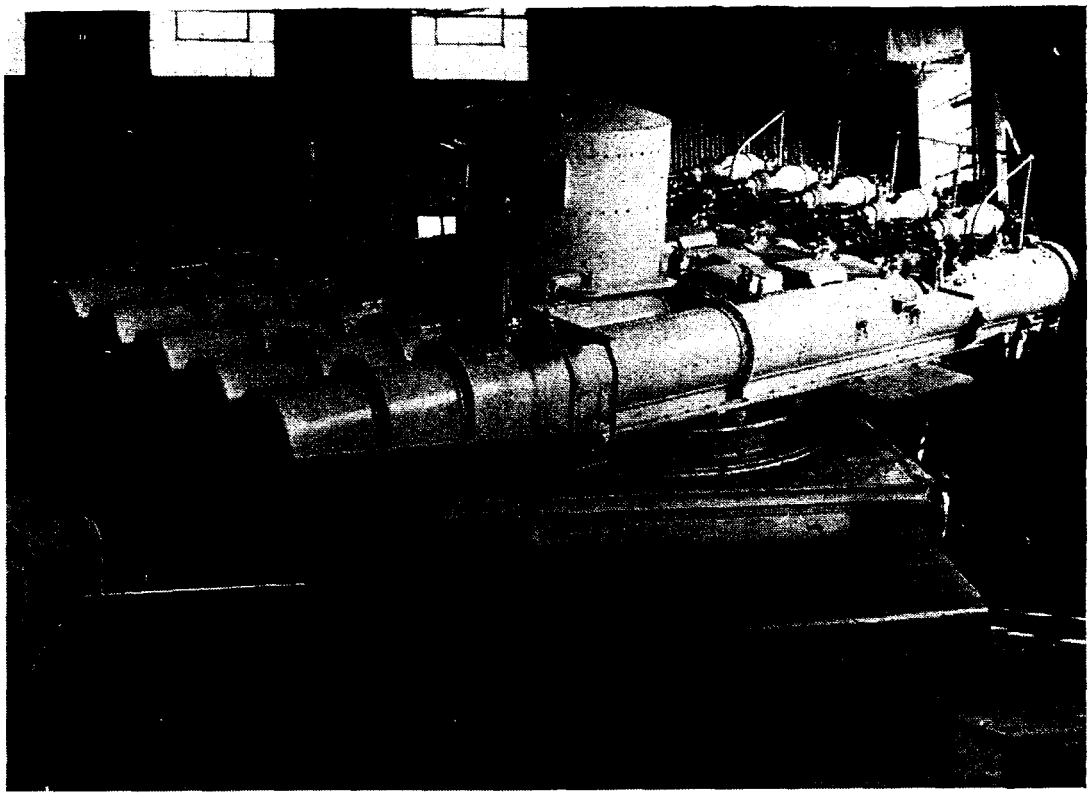
Early in 1941, as a result of further heavy air attacks, the team moved to West Howe. Here, reasonable factory premises were available, as well as some drawing office accommodation. All necessary equipment and machine tools, which had hitherto been used to meet Portsmouth Dockyard's share of the torpedo tube production, were transferred to West Howe. The whole drawing office staff could not, however, be accommodated, and it was therefore necessary to requisition part of a large block of flats in Boscombe to house some fifty per cent of them.

The production of submarine and destroyer torpedo tubes and the supply of production drawings to all manufacturers was continued in this way until the end of the war. West Howe then became a Research and Development Establishment manned by R.N.S.S. personnel under the control of the then D.T.M. In 1946, as a result of the completion of additional drawing offices, it became possible to house the entire staff in the present buildings, and in 1947, the establishment was re-christened H.M. Underwater Weapons Launching Establishment.

As it is today, the staff of the U.L.E. consists of the Superintendent, a commander, who is an engineer officer with submarine experience, and a total of one hundred and fifty scientific, drawing office, workshop, clerical and other staff.

The primary duty of the establishment is to provide manufacturing drawings for the Director of Underwater Weapon Material, to enable him to place contracts with industry for the supply of the equipment in question in sufficient quantities to meet the needs of the Fleet. Normally, a project starts with the receipt of a staff requirement. This is then worked on by the scientific staff, who, in due course, provide the drawing office with sufficient data to prepare a sketch design. In some cases, of course, it is possible for design work to be started in the drawing office. The normal procedure thereafter is for the shop to manufacture an experimental model to the sketch design. Trials, etc., with this model frequently lead to modifications to the original design, and after further drawing office work, drawings are prepared enabling a prototype to be manufactured. Extensive tests, including sea trials when required, are then carried out, and subsequently further modifications to the design may be necessary. It should then be possible to go ahead with the manufacturing drawings.

The majority of the projects undertaken are, of course, required to meet ship completion dates, and in this respect the U.L.E. differs considerably from some other research and development establishments, for example, developing Vote 9 stores, where completion dates of vessels do not put a limit on the time available for the completion of any particular project. A development schedule has been laid down for the establishment, and it is this programme which it



A P.R.4 MOUNTING ON THE TILTING PLATFORM

endeavours to follow in the development of all projects, except of course, for research items from their first inception to the completion of the manufacturing drawings.

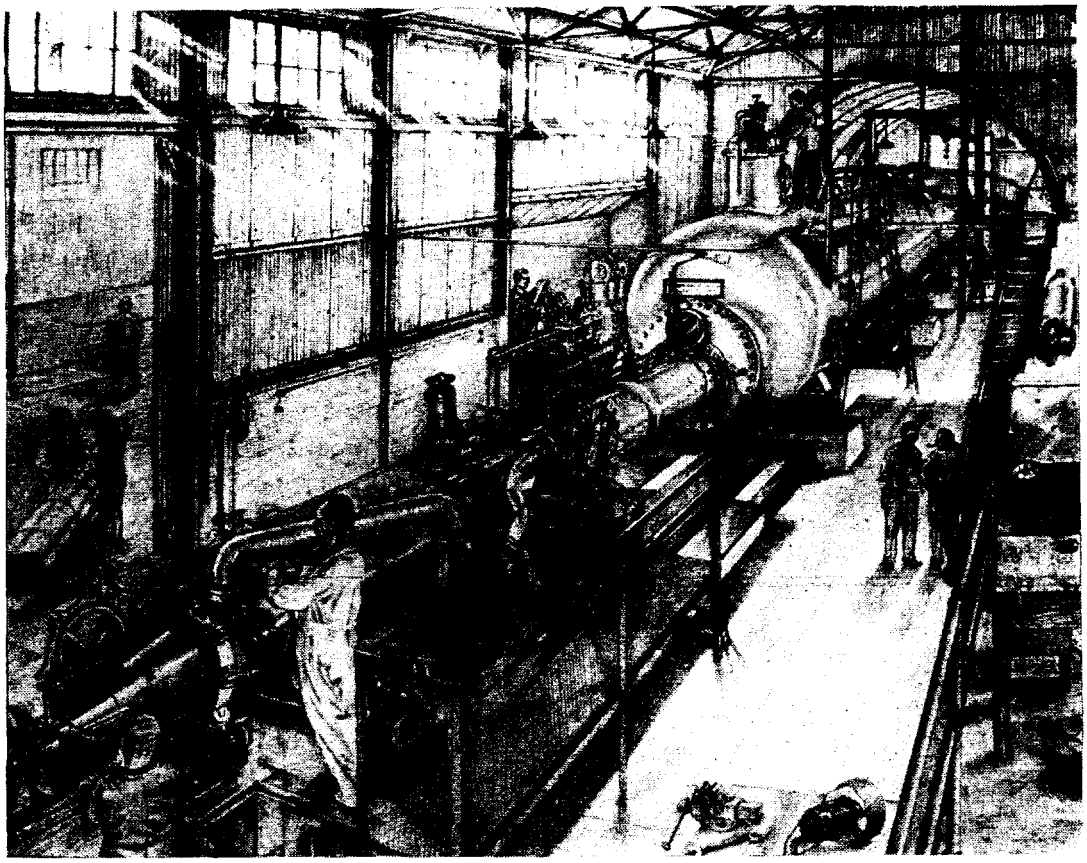
Broadly, the programme consists of an initial study of the Staff Requirements, research and development by the scientific staff to produce a sketch design, the manufacture and proving of prototypes, and finally, when the prototype design is satisfactory, the provision of production drawings and specifications to the Director of Underwater Weapon Material to enable contracts for ships equipment to be placed with industry.

THE ESTABLISHMENT

The establishment is conveniently compact. Much of the workshop and store accommodation is still comprised of Nissen type huts and other forms of temporary structure, but it is hoped that, in time, these will be replaced by buildings of more solid and lasting quality. The office block, which is at the front of the main building, also accommodates the four drawing offices. Immediately behind and attached to this block is a modern well-equipped machine shop. A small part of this shop has now been enclosed to form a ' standards room ', of which the establishment is justly proud, and which proves invaluable.

Directly behind the main machine shop is the Erecting and Heavy Machine Shop. This is fitted with two overhead travelling gantries with maximum lifts of 5 to 10 tons, to facilitate, among other things, the handling of the larger torpedo tube mountings.

One of the more interesting pieces of equipment in the erecting shop is the tilting platform. This is used primarily for testing the training gear of new mountings under varying conditions of heel.



THE TEST LABORATORY: AN ARTIST'S IMPRESSION

Accommodated in Nissen huts on the east side of the establishment are the tool room, coppersmiths shop, photoprinting room and joiners shops, and in the south-east corner is the test laboratory.

The Photoprinting Room is of interest in that it is an exceptionally well-equipped unit for so small an establishment, and, in addition to the normal Dyeline printing equipment, is fitted with a reflex copier and Ordoverax true-to-scale printing table. The section is manned by four photoprinters, and in a normal year, something in the order of 80,000 reproductions of tracings and drawings are made for issue to D.U.W.M., dockyards, refitting yards and other authorities. There is also a small but extremely well-equipped photographic laboratory where much work is done in the photographic recording of trials and in illustrating trial reports and other publications.

The Test Laboratory, a building of some 130 feet by 40 feet, contains, in addition to offices for the scientific and experimental staff, most of the test equipment needed for the everyday work of the establishment. The main item is the ' deep firing tank '. This cylindrical tank, about 53 feet long and 8 feet in diameter, is used for testing submarine torpedo tubes and firing gear, and to study the discharge characteristics of submarine-launched mines and torpedoes under laboratory conditions. Prototype submarine torpedo tubes and firing gear can be completely tested down to the maximum simulated depth permitted by the working pressure of the tank. In this way, the characteristics of the production tubes are known before sea trials are started,

A proposal has recently been approved for a new tank capable of withstanding pressures down to greater simulated depths. When installed, it will enable all submarine torpedo tubes and associated equipment to be tested under realistic conditions over their full range of operating depths, before installation in a submarine.

In addition to the deep firing tank, other important test equipment includes a large vertical pressure tank for use in trials of submerged signal ejectors, and a one-fifth scale perspex model of a submarine torpedo tube coupled to a small firing tank. This latter is used for research on firing and venting equipment for submarine tubes. A cylindrical water tank, 30 inches diameter and 30 feet high, which can be pressurized to a figure equivalent to the full diving depth of a submarine, is also available for testing valves and cocks of various descriptions under full-flow conditions similar to those which might be encountered when in service.

For testing above-water torpedo tubes and impulse cartridges, a sand range is used. This is as simple as it sounds, being virtually a sand pit into which torpedoes are fired from above-water tubes mounted on a concrete firing point. This simple range is, of course, a necessity in the development of new impulse cartridges. More advanced trials with above-water tubes and torpedo impulse cartridges are carried out from a firing point at Horsea Island lake, where the U.L.E. also undertakes trials for the Ordnance Board. This firing point, together with other trial facilities at Horsea, is the responsibility of the U.L.E., and is in the charge of a Senior Scientific Assistant. Much valuable work is done here.

The Establishment's most important customer is Flag Officer, Submarines, torpedoes being the submarine's main armament, and the greater part of the work undertaken in the past has been in his interest. In addition, The Captain, H.M.S. *Vernon*, who accepts all torpedo tubes and equipment, has to be satisfied, and the Ordnance Board, so far as torpedo impulse cartridges are concerned. For obvious reasons the establishment works, too, in close touch with the Director of Naval Construction ; the Director of Electrical Engineering is also brought into the picture on the electrical aspects of any particular project to ensure that equipment designed at the U.L.E. will fall into line with Admiralty requirements.

SOME RECENT PROJECTS

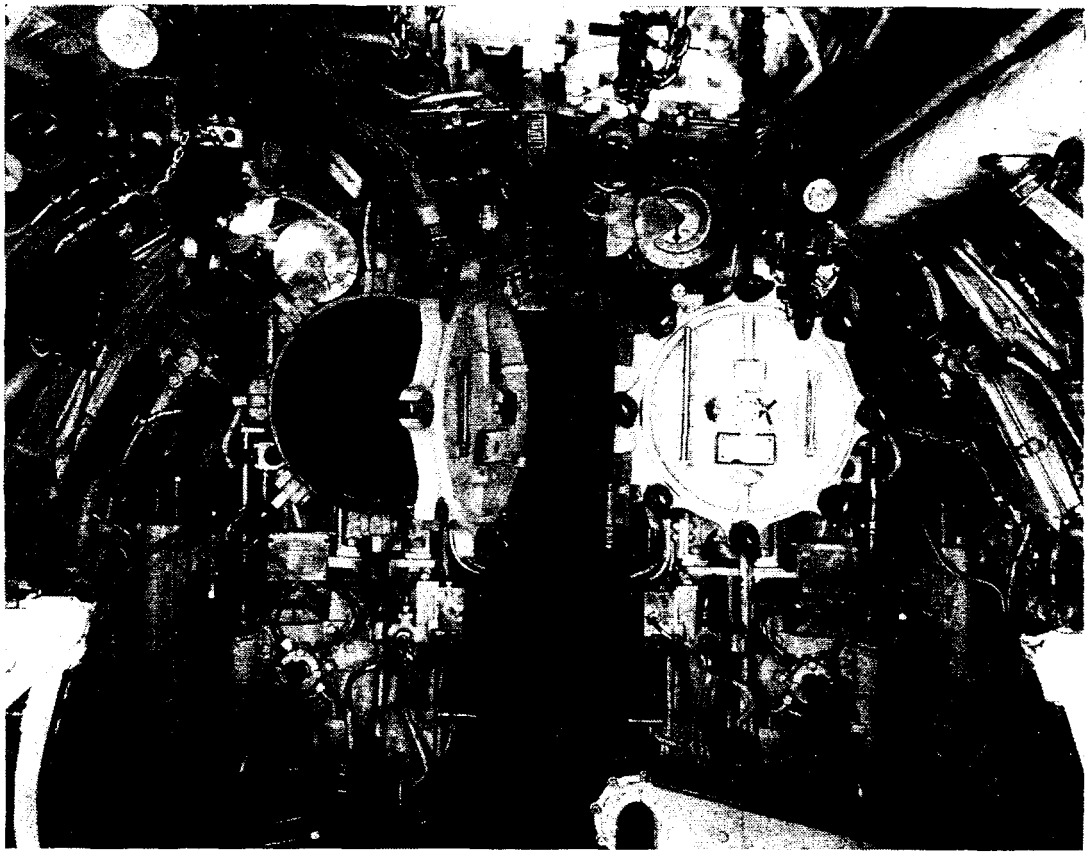
Of work recently completed, the more important projects are as follows :—

Torpedo Tubes and Firing Gear for ' Porpoise ' Class Submarines

It may be of interest to those readers who are not conversant with submarines to say a few words here about submarine torpedo discharge equipment in general, as the equipment is both complex and ingenious. Torpedoes are, of course, discharged from submarines by means of compressed air, but in addition to expelling the weapon, it is necessary to ensure that no air leaves the torpedo tube to produce a tell-tale splash on the surface. In addition, the trim of the submarine must be maintained throughout the operation, and it is therefore necessary to provide a means whereby compensation is effected for the negative buoyancy of the weapon fired. These requirements are met by the firing and venting gear.

The standard firing and venting gear now in service has been considerably modified and improved for these submarines. In these vessels it will be possible to fire at any depth from the surface, down to the maximum firing depth, without any special adjustments, such as alterations to firing reservoir pressure, being made. Each tube is provided with its own air reservoir, and firing and venting equipment. The sequence of events when a torpedo is fired can be very broadly described.

Air is admitted to the rear end of the torpedo tube through the large firing valve, from a firing reservoir previously charged from the ship's H.P. air system. The volume of air used to discharge the torpedo is regulated by the



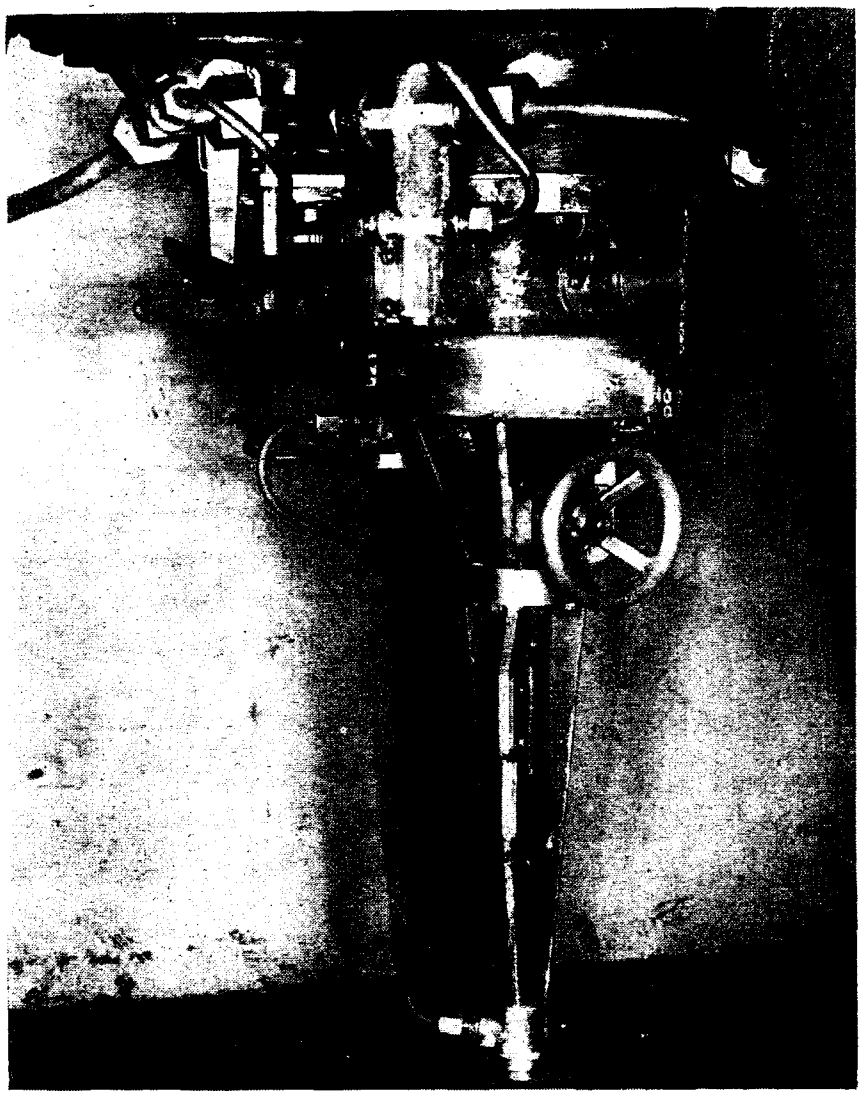
'A' Class Stern Tubes

length of time that the firing valve remains open : this is controlled hydrostatically. The torpedo can thus be discharged at any depth, down to the maximum firing depth, without previous adjustment of the firing pressure. When the torpedo has travelled approximately one-third the length of the tube, the large firing valve shuts. The remainder of the discharge is then effected by the expansion of the H.P. air admitted to the tube. Before this charge of air can escape from the lip end of the tube, the Automatic Inboard Vent Valve (connecting the after end of the torpedo tube to an internal tank in the submarine) opens and allows sea pressure to force back, into the submarine, the air used to expel the torpedo. The operation of the A.I.V. valve is controlled by a delay unit, automatically triggered at the moment of firing. The A.I.V. valve remains open for sufficient time to allow sea water to flow inboard until the weight of water embarked is equivalent to the negative buoyancy of the torpedo fired. The time that an A.I.V. valve must remain open at any given firing depth is regulated by a hydrostatically controlled timing unit.

The photograph showing the two stern tubes of an 'A' Class submarine, while being a familiar sight to the submariner, may well be of interest to other readers, as it gives some idea of the complexity of the torpedo tube equipment, and shows clearly how greatly the design is governed by the very limited space available for this gear.

Mark 2 Submerged Signal Ejector for 'Porpoise' Class Submarines

The submerged signal ejector is used in submarines for the discharge of various smoke candles, signal floats, etc., and has in the past consisted simply of a 4-inch bore cylinder bolted at its outboard end to the hull of the submarine and fitted with a hull valve. A simple form of breech is located at the inboard end and the breech mechanism and hull valve are suitably interlocked for



A SUBMERGED SIGNAL EJECTOR, MARK 2, FOR 'PORPOISE' CLASS SUBMARINES

obvious reasons. To date, the method of discharge has been by air pressure, but this has the disadvantage of being visible on the surface. The new ejectors are designed for ram discharge, the $\frac{7}{8}$-inch diameter rammer being operated by an air actuated piston. In the case of the submerged signal ejector Mark 2 for the *Porpoise* Class, however, it has been necessary to incorporate both air and ram discharge, in order to tide over the period during which both air-operated and ram-operated stores will be in service.

Power Loading Gear

This equipment has been primarily designed to meet a requirement rapidly and silently to reload a salvo of torpedoes into the *Porpoise* Class bow tubes with the torpedoes under complete control throughout the entire operation. It would take too long to describe this equipment in detail, but it will suffice to say here that the reload torpedoes are secured on trolleys, which can be traversed to and fro on horizontal beams running athwart the torpedo stowage compartment of the submarine. The beams are arranged in tiers on each side of the compartment, and each tier lines up with one of the torpedo tubes.

The torpedoes are loaded into the tubes by power driven rammers. To load, a torpedo is traversed inboard to its loading position, the rammer is raised to

the required vertical position and the rammer head coupled to the tail of the torpedo. The ramming motor is then started and the torpedo loaded into the tube. The rammer head is then uncoupled from the torpedo tail, retracted, raised or lowered, as necessary, into line with the next tube to be loaded, and the process repeated.

There is, in fact, much more to this gear than has been described. A full scale working mock-up has been constructed which has shown that the equipment can be rapidly and silently operated.

Modified Air Firing Gear for Existing Submarines

New equipment is now being fitted to the ' A ' and ' T ' Class submarines to improve the performance of the torpedo tube firing gear. It involves considerable modification to the existing fittings, and the new arrangement is, in the main, very similar to that to be fitted in the *Porpoise* Class.

Torpedo Tubes and Firing Gear for A/S Frigates

These tubes are of the close-fit type and have been designed with a view to convenience for manufacture in large numbers. They will either be mounted singly or as twin revolving mountings. In these tubes, some changes have been made from the principles employed in the design of earlier above-water tubes, and a considerable saving in weight and space has been effected in the design of the cordite firing gear.

CONCLUSION

The establishment also deals with a limited amount of production work. This is necessary to maintain a steady flow of work in the shops at all times, which would not be possible if only prototype and other research and development work were dealt with. Recent production work has included the manufacture of two new tubes with firing gear for the long and short torpedo ranges at Bincleaves, and a number of firing units for above-water tubes.

In addition to the work actually undertaken at H.M. Underwater Weapons Launching Establishment, much is also accomplished outside the Establishment This includes carrying out all first of class trials where new equipment is involved. The staff are also, if possible, made available on request, to visit ships, establishments and refitting yards, to give assistance or advice.

It is hoped that the foregoing will be of interest to those who have not yet come across this establishment, and that the knowledge of its existence may be of use to those in the Fleet who have queries concerning the equipment designed here. To all those who are interested, a visit to the establishment would be well worthwhile, and we are always pleased to see anyone who may have a problem with which we can help.