SUPPRESSION OF INTERFERENCE TO W/T

PULSE LIMITER FOR RECEIVER B28.

With a view to simplifying the present methods of suppressing interference to W/T receivers caused by radar transmitters, and at the same time to overcome one of the major limitations of present RIS equipment - that it only operates on interference with which it is synchronised - work has been going on in A.S.E. for some time with various schemes.

Out of these investigations has come a simple Diode limiter for Receiver B28, consisting of a small metal bracket on which is mounted a valve holder (containing a valve of course!), one resistance, and a switch. This unit is fitted inside the receiver being bolted to the mounting of the heater link in the B28; the holes exist in the majority of models. There are five wires to connect up and the unit's effect on interference savours of black magic.

The unit is most effective on P.R.F.'s in the order of 50 per second but is still effective up to over 500 per second, and, apart from radar interference, the effect on normal static and electric motor interference is excellent. Wren radio mechanics are fitting these units in less than 20 minutes after the first one or two.

The unit is inserted in the B28 between the second detector and the first stage of L.F. amplification and to put it briefly it limits the amplitude of the pulse interference to approximately that of the wanted signal and as the former is of so much shorter duration than the latter it is then barely noticeable. To get the best result keep the H/F gain at its maximum and the L/F gain as low as possible to obtain the required volume. Pass band should be set at 6000.

Bulk production of this item will be available by the time this article is published and an A.F.O. will have formally introduced it and also explained in detail how to fit. It is confidently expected to become a best seller in all ships as it is effective on all types of pulse, static and electric motor interference. It is being introduced as standard into new production B28's as soon as this can be worked into Marconi's production lines.

It will probably be found in most ships so fitted, that RIS(1) and RIS(3) are no longer required on B28's as this unit is equally effective besides being infinitely more simple. Where this is so, please return your RIS units as requested in the A.F.O.

Steps are being taken to apply a similar unit to other receivers, notably the P38. Further applications will be published in a later issue.

AERIAL SYSTEM

Field trials are now taking place of an aerial equipment comprising an H/F D/F aerial on top of a lattice mast with a V.H/F D/F aerial (for outfit FV4) superimposed.

If the principle proves successful, it will be adopted for Escort Carriers and possibly in other instances, provided the weight is kept reasonably low.

As at present designed, the V.H/F D/F will probably be of normal performance but sensefinding on H/F may present considerable difficulty, although the bearings may be up to standard.

It is expected that some of these aerial systems will, if successful, be put into service in 1945.

SOUND RECORDING EQUIPMENT

Requirements are now arising for a suitable type of sound recording equipment for fitting in H.M. Ships for Y purposes, the object being to record principally enemy transmissions of various descriptions for later analysis either on board or at the base.

Although there is a large variety of recording apparatus on the commercial market and although some have extremely accurate characteristics, it has been found that there is only one equipment at present in production which is at all suitable for general use in H.M. Ships.

Briefly, recording equipments fall into 3 categories :-

(a) Disc recording (such as the ordinary gramophone type).
(b) Film recording.
(c) Recording on wire.

Disc recording, although suitable for special Shore Stations, etc. would not be suitable for use in ships due to the use of a recording needle, which may come unstuck through vibration or shock, and the records would be liable to buckle in hot or humid climates.

Film recording equipment, although essential for highly accurate analysis work, is normally too complex and bulky for use in ships, although A.S.E. is now designing an outfit which can be fitted temporarily in ships for special operations. It requires experience and skill in operation.

The magnetic wire recording system which has been adopted is an American development and has the advantage of small size, simple operation, capability of withstanding severe tropical conditions, and ease of handling and despatch of the actual records, which are on small drums.

The principle of the wire recorder is that the wire in question, which is very small gauge cylindrincal wire of about the size used on I/F coils is wound by a motor from one drum to another - on the way passing through a magnetising head which is subject to impulses either from a microphone or from a radio receiver.

The impulses cause the molecules in the wire to be affected in such a manner that when replayed on the instrument, the sounds recorded are reproduced through a loudspeaker incorporated in the instrument.

The instrument can be run at 2 speeds, giving either 33 minutes or 66 minutes continuous running.

By manipulation of appropriate switches, the whole or part of a record can be erased from the wire and it can be used as many times as may be found convenient.

On the other hand, a record which it is desired to analyse or to send back to the base can either be cut off and removed from the drum or if the whole drum is required for analysis it can be returned.

Spare drums will be allowed for each ship concerned.

It is foreseen that such an equipment may also be of use for recording battle events, recording morse transmissions of somewhat high speed for replaying at the lower of the 2 recording speeds for easier reading, R/T recording to check doubtful transmissions, etc. etc. etc.

However, the outfit will be intended in the first instance primarily for Y uses and other uses of the equipment and provision for them have not yet been decided.

The equipment is about the size of a portable typewriter.

BANTAM D/F AND COMMUNICATIONS RECEIVERS

It has often been said in the past that the requirement of a naval communication receiver is continuous frequency cover from "D.C. to light on one knob". Modern conditions have introduced a further requirement, namely, that all W/T equipment shall be as small and as light as possible.

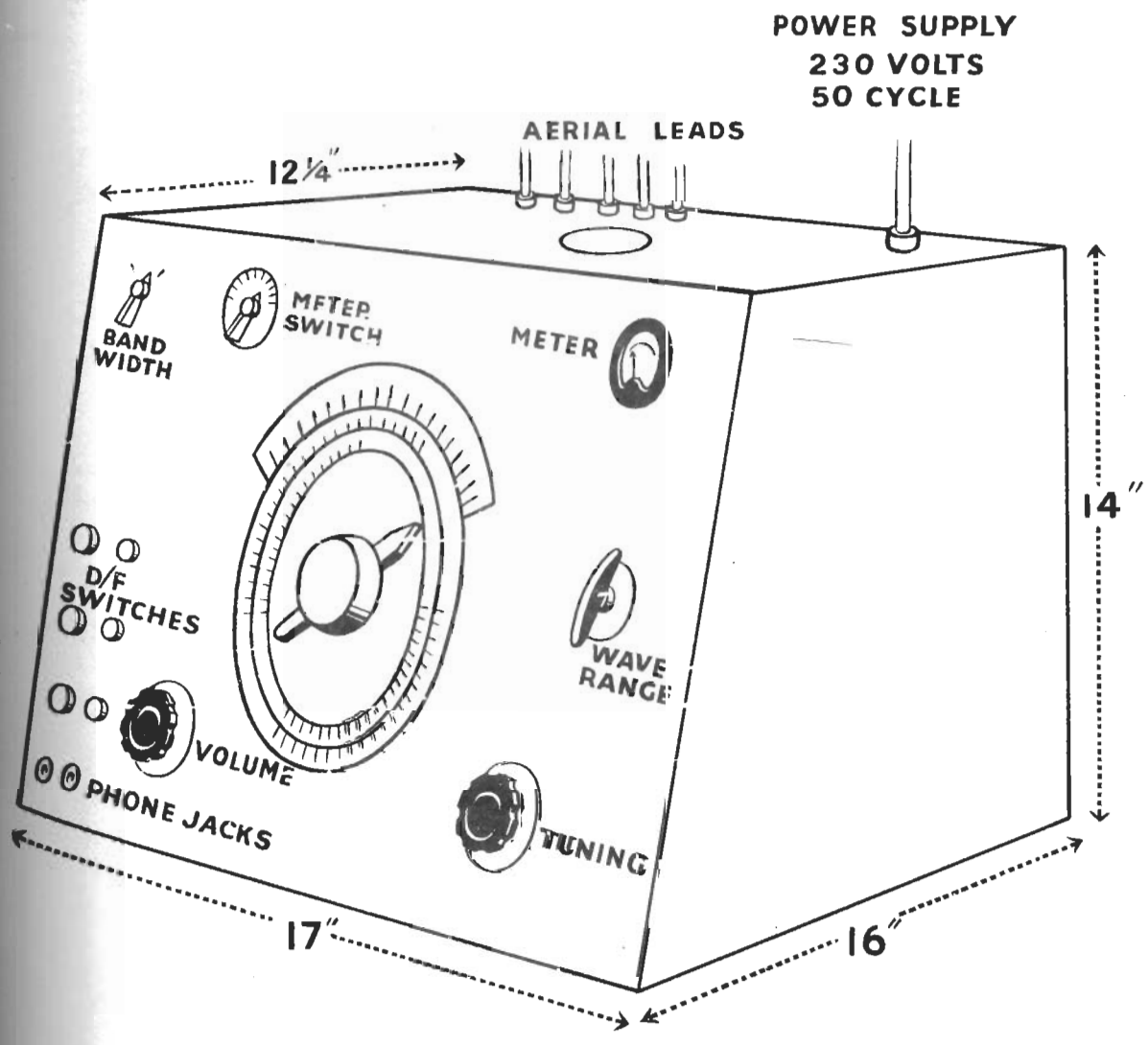
In the case of Naval Search and Communication Receivers, a wide frequency cover must also be obtained, whilst at the same time the highest possible performance must be maintained. The receiver must remain simple to operate and be easy to keep in good working order and yet be robust enough to stand rough treatment. The developments of the last few years have introduced so many radio devices for use in H.M. ships that economy in space is a more essential consideration than it used to be. This applies particularly to small ships and to submarines. A range of receivers is therefore being developed which will be as small as possible but in which the performance level has not been lowered - but rather has been raised.

In this new range of receivers, a reduction in size has been achieved by careful attention to design but not by the use of miniature components. The first of the range will be the F.M.C., a D/F receiver to replace F.M.A. in submarines. The size of F.M.C. has been reduced to about half that of F.M.A. and the weight to less than half. It is hoped to effect a similar reduction in the physical dimensions of replacement receivers for F.M.B., B28, B29 and possibly B21.

The new series replacing B28, B29, F.M.A., F.M.B., are all superheterodyne receivers which will incorporate new features such as crystal calibrators, facility for crystal control of the B28 replacement, and particular attention has been paid to the ease with which the sets can be serviced. They are intended to work from existing power supplies and the same aerial systems as the existing receivers.

D/F ASSEMBLY FMC

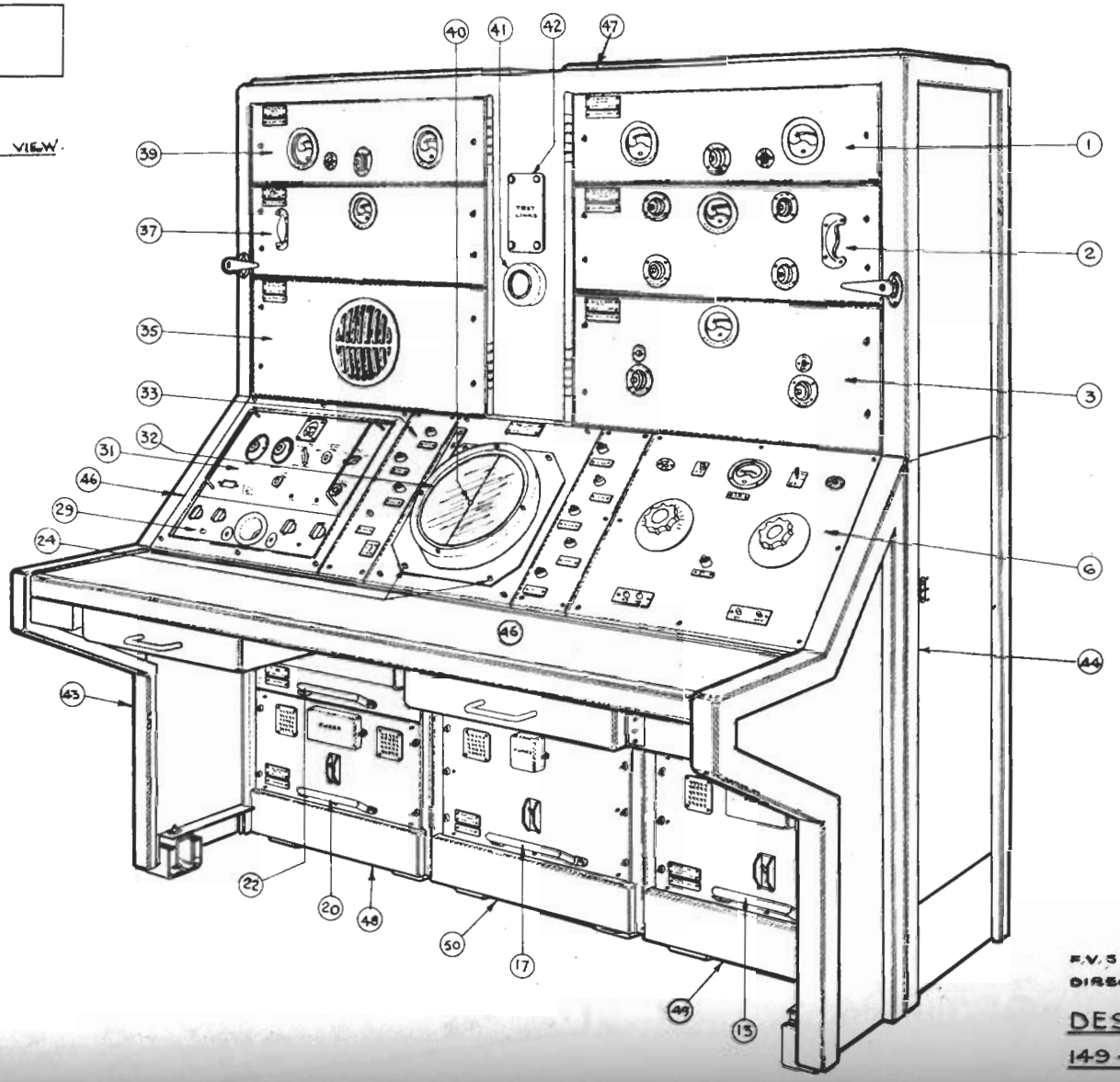
(PRELIMINARY SKETCH)



ADMIRALTY SIGNAL ESTABLISHMENT.	D/F OUTFIT F.V.S.
DRAWING Nº 40345 C	DESK EQUIPMENT.
SCALE:-	

ISSUES & CHANGES.			
①	ORIGINAL DRAWING.		STR.C.LTD.
2.	ITEM LIST ADDED	15.7.44	A.G.W

ASSEMBLED VIEW.



F.V.S AUTOMATIC V.H.F.
DIRECTION FINDER.

DESK EQUIPMENT.

149-LE-11A (COMPLETE).

TYPE 93 IN AIRCRAFT CARRIERS

Type 93 has been developed as a modulated C.W. blind approach transmitter for use in conjunction with the YE homing beacon system, and the ZB/ARA or ZBX receivers in aircraft. Aircraft under bad weather conditions, especially single seaters, up to the present time have been able to use either the YE beacon or the fighter direction organisation to home to the immediate vicinity of the Carrier, but unless equipped with radar, have been left to their own resources to get on to the deck. Type 93 now fills this gap, enabling the aircraft to position itself for final control by the deck landing control officer.

In azimuth the conventional "dot and dash" blind approach signals are given. There are no glide path facilities, the aircraft making a low approach to the round down with the aid of the radio altimeter. It is also impossible to provide marker beacons at sea for range indication, although a very useful fade from the vertical polar diagram is evident in the last few hundred yards. This fade after practice is a useful last minute indicator.

During sea trials the coding was very clear and distinct, and both maximum and minimum range results very good. No difficulty in picking up the transmitter is encountered in the aircraft. The same carrier frequency as that of YE is used, and only a slight alteration in modulation frequency has to be made when shifting from YE to 93.

AVC has to be used in the ZB/ARA or ZBX and the receivers will be modified very shortly. It is worth noting in this connection that it is also most helpful for close range working with YE.

The 93 system is also going to be used at Naval Air Stations with the addition of marker beacons. The marker beacons, which give range indication, are on a much higher frequency than the main beam and also need a special horizontal dipole for reception. With these additions we then have the same system ashore and afloat.

Although no date can be given for general fitting, we hope very soon to make Naval airmen even more independent of weather conditions.

D/F OUTFIT FV5

This is a V.H/F D/F outfit which has been developed in parallel with D/F outfit FV4, primarily for homing of fighters on V.H/F. Whereas D/F outfit FV4 utilises the normal receiver and goniometer method, D/F outfit FV5 employs visual presentation on a cathode ray tube, with automatic sensefinding. In order to achieve this simple result, it is necessary to go to considerable complexity in circuits and a rather more complicated aerial system than is employed with D/F outfit FV4.

An outline diagram of the receiving equipment is given on page 74.

Endeavour has been made to render the operation of the equipment as simple as possible for the operator and normally having tuned the receiver to the frequency in use for homing, it merely remains to watch the tube and pass in the bearing to the ADR. As an experiment, the first outfit (which is being fitted in H.M.S. COLOSSUS) will have a remote indicator unit in the ADR which will repeat the information shown on the screen in the V.H/F D/F office, and if this is found useful it will be standarised.

Spares will be supplied in a generous proportion, including complete spare aerial units. The latter are exposed when fitted and may receive damage, particularly as they will be on a hinged mast and will have to stand up to a good deal of weather.

RADIO EQUIPMENT IN COASTAL CRAFT

The history of Radio equipment in Coastal Craft during the war has followed a similar course to that in major war vessels; as each fresh operational requirement has arisen, more and more equipment has been installed.

When war broke out, Coastal Craft were fitted with one W/T set, the TW12 with one receiver 394, and no radar. Medium frequencies only were covered so that communication was restricted to the port wave band. The telegraphist was in a fortunate situation; he had only one set to operate and look after, and by Coastal Craft standards, plenty of living room; owing to the comparatively light armament of the craft and the absence of explosive projectiles, he had a good aerial rig; he suffered from no interference from Radar and it was only after some months in service, when bonding and earthing had deteriorated, that he experienced electrical interference. That within a comparatively short time he knew as much about flags and flashing and V/S procedure as an average signalman was inevitable. As no officers steward was borne, it was also inevitable that he came to know the inside of the wardroom galley as well as his own W/T office.

The next step was the introduction of an H/F attachment to the TW12. This meant that coastal craft, which were now being called upon to undertake ocean passages - in West Africa a passage of 400 miles was normal and 800 miles as escort to a convoy by no means rare - were able to communicate with their bases on the lower ship-shore frequencies.

Meanwhile in December 1940 experiments were being carried out with Type 286 MY (later Type 286 MU) in M.T.B. 28, and in the spring of the following year general fitting started. This radar set was fitted in the W/T office and the ubiquitous W/T operator had another job to perform.

The next step forward was the rotatable aerial - Aerial outfit ATS (Type 286 PU) and the fitting of Type 252 for indentification purposes.

The receiver CR300 was developed on the lines of the B28 with the additional facilities of a built in L/S and a crystal check oscillator.

It was not the original intention that the equipment was to be rack mounted, but in course of development it was decided that in order to save space and simplify installation, a light tubular rack should be provided.

Following Type 286 PU came Type 291U and a transmitter receiver Type TCS for interboat communication, fitting of these commenced in the latter half of 1942. About the same time the specialised Radar operator began to make his appearance amongst Coastal Craft personnel.

By early 1943 the large increase in the amount of gear to be fitted had brought in its train an increasing number of problems, especially as the Mark III I.F.F. programme has just started which necessitated fitting Types 242 and 253.

First of all the W/T office was obviously too small to accomodate all this gear plus two operators, and secondly, the problem of radar interference to W/T reception, coupled with electrical interference from the increasing amount of electrical apparatus being fitted, began to assume serious proportions.

The effect of this interference was to prevent in many cases the simultaneous operation of Radar and W/T.

At first these two problems were tackled separately; to overcome space considerations a scheme was evolved to put the Radar operator in the plot, with a remote cathode ray tube together with remote controls

and the ATS training gear; while to overcome interference the earths of transmitting and radar equipment were separated from receiving equipment and split bonding was introduced.

The logical outcome of these two problems was the introduction of separate W/T and Radar Offices, together with increased measures to eliminate mutual interference, with the object of allowing simultaneous and efficient operation of all radar and W/T equipment.

The following is a summary of the steps which have been and are being taken to implement this policy:-

(i) Siting of radar and W/T equipment in separate screened offices, the object being to provide each office with a complete electrical screen; the screen of each office to be kept electrically separate from the other and each screen to be earthed to its own earthplate situated on the outside of the hull; the earths of each office to be kept separate from the ships earth. The object is attained by lining each office with metal or metal mesh; providing a metal trunk or feeder for W/T transmitters and receivers; breaking the lead sheathing of all cables entering the office; providing filters for all conductors entering the office.

(ii) Development of equipment to prevent high frequency interference from radar reaching the communication receivers. R.I.S.5. was developed for this purpose; its function being to act as an aerial rejector to prevent entry of the radar carrier frequency via the aerials and to shut down the receiver during radar pulses.

(iii) Re-arrangement of aerials so that the main W/T aerial is lead forward from the mast and the intercraft R/T set aerial is lead aft. This re-arrangement, which is referred to in a later paragraph, has the effect of separating the two aerials as much as possible and keeping the main aerial, used principally for W/T and therefore more susceptible to electrical interference, clear of the vicinity of the main engines.

(iv) Development of equipment which will prevent the radiation of spurious frequencies from Type 291. This development is still in the experimental stage but results so far are promising.

Meanwhile in the summer of 1943 development of a successor to transmitter Type TW12 and receiver 394 was put in hand by the Marconi W/T Company. Details of this equipment, which was named Type 607 and receiver CR300, have been published by A.F.O. It was decided that the design of the transmitter should follow as far as practicable the lines of the TW12 transmitter so that the drawbacks of the introduction of a set of entirely new design, operated as this set normally is by inexperienced telegraphists, could be avoided. The frequency range to be covered was approximately the same. The ship-shore range of frequencies up to 8290 kcs. was also to be covered. Crystal or M.O. control was to be provided.

While the problems of space and interference were being tackled, fresh commitments continued to arise and fresh radar and communication staff requirements were being formulated. An example of the former was the fitting of a number of 'B' M.L's with Radar Type 970 for combined operations.

It has long been obvious that the advantages of P.P.I. display, and greater definition achieved by X band equipment would be of immense value in Coastal Craft. Type 268U has been developed for this purpose and fitting will shortly commence. (An article on Type 268 will appear in the next issue of this Bulletin).

As a result of the fitting of radar the increase in armament and use of explosive projectiles, together with the increase in the number

of communication sets fitted, the W/T aerial efficiency suffered and the problem became more and more involved.

With a view to effecting an improvement in aerial efficiency, approval has been sought to fit a light metal mast on the foremost gun, or where this is not possible, immediately abaft the gun. The main set aerial is lead from the main mast forward to the mast on the gun, the inter-boat R/T set aerial is lead from the main mast aft to the depression rail of the mid-ship gun and the aerial of the 2nd channel receiver is lead to the mast.

Trials have shown that a very great increase in performance of both transmitters and receivers is obtained with this new rig. Its principle disadvantage is that the forward mast constitutes a "wooding" of vision forward from the bridge, but it is felt that if the continually increasing communication requirements are effectively met, some sacrifice is inevitable.

In order to allow coastal craft to communicate with aircraft fitted with V.H/F, a requirement has arisen for the fitting of Type 86M in certain craft. The problems of prevention of interference, siting of the aerial and provision of power are being investigated now.

To improve the communications of Coastal Craft proceeding to the Far East, ability to employ the higher ship-shore frequencies has became a requirement. This has necessitated the fitting of Type 608 which is similar to Type 607 with the addition of a transmitter TNS2, covering the band 8-20 Mc/s. More space and weight became necessary but fortunately no additional power supplies as transmission on the TNS2 is alternative to transmission on the main transmitter TGY2. Reception on this band is already allowed for by the CR300 which covers 15 Kc/s to 25 Mc/s.

While provision of power supplies is not in A.S.E's province, it is a matter of very vital concern where communication and radar staff requirements have to be met. When fresh communication or radar requirements arise, more equipment is necessary; this means more weight and where the new equipment must be run from 24 volt batteries (e.g. type 86M), this means batteries of greater capacity and therefore more weight still; more weight means less speed. In general large craft are provided with 220 volt mains with an auxiliary battery supply of 24 volts; smaller craft are in general provided with 24 volt battery mains. It is under consideration - but as a long term policy - to provide a common A.C. supply for all communication and radar equipment with emergency batteries.

To give some idea of the technical problems which now confront the various Admiralty departments concerned with the meeting of Staff Requirements for Radar and W/T in Coastal Craft, the equipment fitted in a Coastal Craft in 1939 and the equipment being fitted in 110 ft. M.L's now converting to M.L. Gunboats for service in the Far East is shown below:-

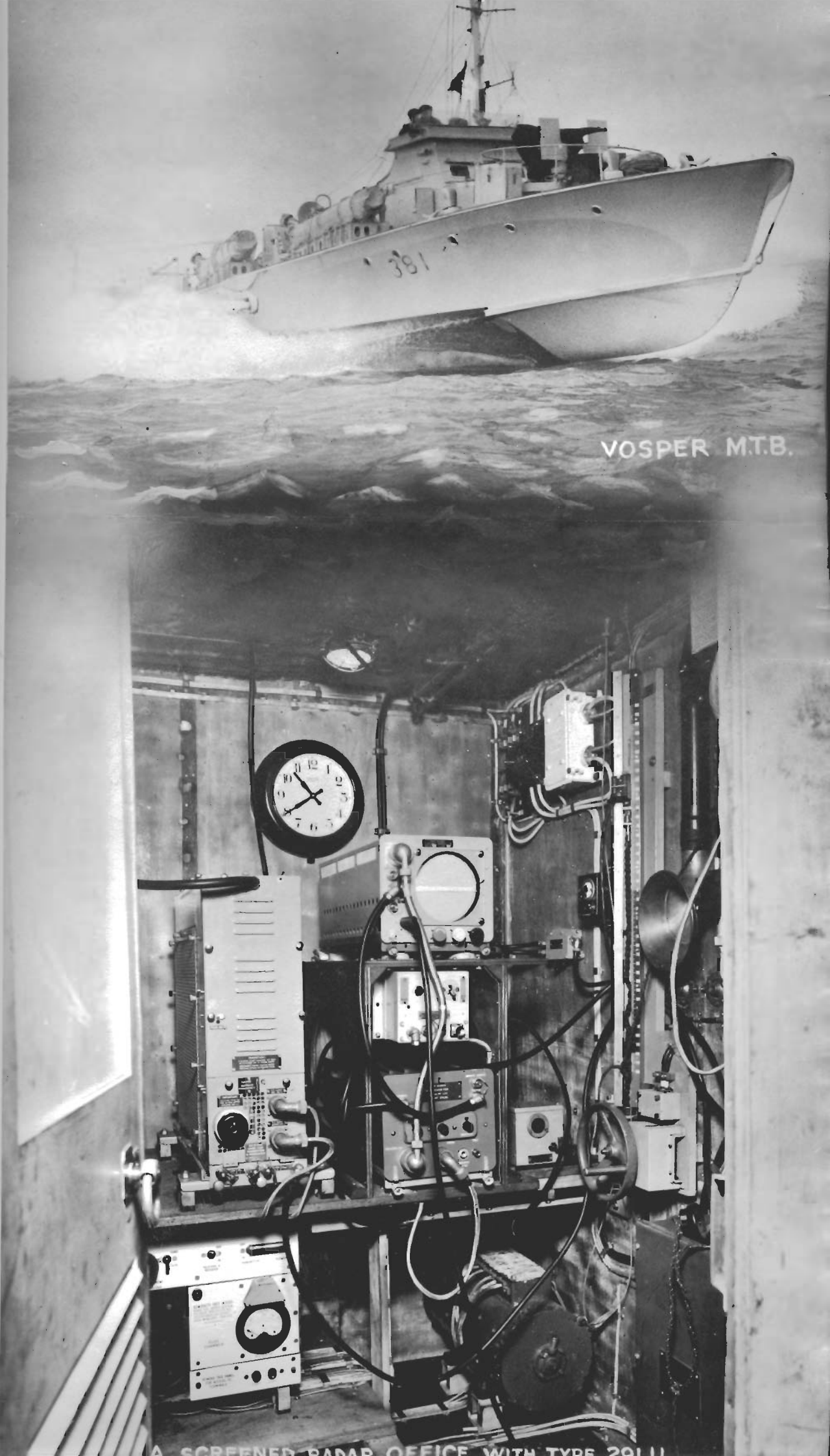
(a) W/T and Radar equipment fitted in Coastal Craft in 1939

Transmitter TW12
Receiver 394.

(b) W/T and Radar equipment being fitted in M.L. Gunboats.

W/T transmitters Type 608 (with two Receivers CR300).
Type 86M. and T.C.S.

Radars Types 268U, 242 and 253/P.



A SCREENED RADAR OFFICE WITH TYPE 291 U