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BR 2132

C.B. 4423 LCAFO 34/56.

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HANDBOOK

FOR

TYPE 147B

SHORE TRAINER

C.B. 4423 R Handbook for Type 147B Shore Trainer having been approved by
My Lords Commissioners of the Admiralty, is hereby promulgated for information
and guidance.

By Command of Their Lordships,

J. V. Markham

S Material Department,
Admiralty.

July, 1945.

S.M. 2505/45.

TYPE 147B SHORE TRAINER

CHAPTER I.—INTRODUCTION

1. General

01. The Type 147B Shore Trainer has been developed to provide a means whereby a pupil may be given instruction in the operation and use of the Type 147B Asdic Set without the necessity of using an asdic fitted ship with a submarine or other target.

2. Use of the Handbook

01. The handbook is intended to assist the instructor in using the Shore Trainer and also as a manual for the maintenance of the equipment.

02. The personnel operating and maintaining the trainer should make themselves familiar with this book and also C.B. 4312 (Temporary Handbook for Asdic Set, Type 147B) as a whole; it is not sufficient to read merely small sections.

03. Asdic handbooks are being constantly amended and should therefore be re-read at frequent intervals. It is only by following these instructions that the Shore Trainer may be maintained in a state of efficiency essential for successful operation and instruction.

3. Stores

01. A list of the permanent and consumable stores which form the various parts of the Shore Trainer will be found in the Establishment List of Stores A/S 145, a copy of which is kept by the Officer-in-Charge of Stores.

This publication contains information regarding the pattern number, full name and quantity of each article fitted, together with details of the spares allowed.

02. When demanding stores it is most important that the proper Establishment List description of the article is given as well as the correct pattern number. A/S numbers appearing on the tally plates of certain components are *not* to be quoted when ordering stores.

03. Establishment Lists are obtainable from the Superintending Naval Store Officer, R.N. Store Depôt, Copenacre, Hawthorn, Wilts.

CHAPTER II.—DESCRIPTION

4. General

01. The pupil sits at a standard operator's panel, and operates the controls as at sea. Reverberations and echoes are produced by suitable electronic units mounted on a wheeled trolley, which also carries a mechanism which is, in effect, a scale model showing the position of the "submarine" in relation to the tilting "sword". This mechanism controls the electronic components so that echoes are produced at the correct range, but are only heard when the sword is tilted to the correct angle. The angle of depression and also the vertical extent of target vary in a realistic manner as the "submarine" is moved in relation to the "ship".

02. Controls mounted on the trolley enable the instructor to set :—

Depth of submarine between 0 and 1,200 ft.
Closing speed 0 to 30 knots.
Strength of reverberations.
Strength and pitch of echoes.

Three dials indicate :—

Depth of submarine.
Slant range of submarine.
Relative speed of approach.

03. It should be noted that the Shore Trainer reproduces conditions in deep water, no provision is made at present for the reception of echoes from the sea bottom. Further, although a mark is made on the recorder paper at the moment of transmission, the corresponding "crash" is not heard in the phones.

04. The power supplies necessary for operation of the equipment are :—

110 volts D.C.	220 watts.
22 volts D.C.	65 watts.
230 volts A.C.	50 cycles/sec. 230 V.A.

and are taken from wall sockets and plugs through flexible leads to the instructor's trolley on which a switch, fuseboard and voltmeter are provided for each supply. It is essential that the supplies have the correct voltage and polarity.

05. The apparatus mounted on the instructor's trolley consists of :—

Transmitter, Pattern A. 2748.
Mechanism range depth, Pattern A. 2655.
Signal injector, Pattern A. 2707.
Signal injector, Pattern A. 2363.
Amplifier, Pattern A. 121.
Box relay, Pattern A. 3009.
Panel supply, Pattern A. 519.

06. The functions of these various instruments are described in detail in the following paragraphs.

5. Mechanism Range-Depth

01. This unit reproduces, to a scale of 1 in. = 100 yards, the relative positions of 147B sword and submarine, and changes these relative positions in such a way as to simulate an attack by a ship on a centre bearing).

02. For convenience in manufacture, the "submarine" is moved towards the "ship," and also the arrangement is inverted, *i.e.*, increase of depth is measured upward, not downward.

03. The sword and sound beam are represented by a lamphouse projecting a light beam which can be suitably focussed. The light beam can be tilted from 0° (horizontal) to 45° (upward) by a small electric motor controlled by the control tilting. Limit switches and mechanical stops are provided, fulfilling the same functions as those on the Type 147B directing gear. In addition, a spring-loaded clutch in the motor drive prevents damage if the gear should over-ride the limit switches and foul the stops.

04. An M type transmitter geared to the "sword," repeats the angle of depression to the depth recorder.

05. The "submarine" consists of two photo-electric cells mounted in a suitable mask assembly. The assembly can be raised and lowered by a handle on the front of the trolley, enabling the instructor to set any desired depth of submarine from 0 to 1,200 ft., and to alter the setting as required, during an attack. In addition, the assembly is attached to a carriage which can be driven along a pair of guide rails, by an electric motor, the distance from one end representing the horizontal range from ship to submarine.

06. The driving motor is controlled by a contactor unit working in conjunction with a pair of toroidal potentiometers mounted on a spindle which carries a pointer moving over a dial calibrated from 0 to 30 knots.

07. A momentary closure of the instructor's push button causes the contactor to operate and to lock in. The motor then rotates in such a direction as to move the "submarine" towards the "ship," the closing speed being determined by the setting on the speed dial.

08. When the run is completed—*i.e.*, the horizontal range reduced to approximately 100 yards—a pin on the carriage operates a limit switch, which de-energises the contactor, thus reversing the direction of rotation of the motor and driving the cells away from the lamp at approximately 25 knots, independent of the setting of the speed control. The range increases until the outer limit switch is operated by the pin on the carriage, when the motor stops. In addition, by releasing a small locking lever on the carriage the range can be reset quickly.

09. A spring-loaded clutch between the motor and worm prevents damage to the mechanism in case the limit switches should fail to operate.

10. One of the contacts on the contactor suppresses all echoes during the run out.

11. A small chain, anchored on the "submarine," passes over a pulley close to the centre of rotation of the lamp system, and by way of a guide pulley, to a grooved drum which is spring-loaded to keep the chain taut. The amount of chain which is wrapped round the drum, and therefore the rotation of the drum, is thus an inverse measure of the slant or true asdic range from ship to submarine. The drum is suitably geared to a dial calibrated 100–2,500 yards enabling direct reading of the true range, and also operating a potentiometer (100,000 ohms) controlling the range transmitter (see paragraph 7).

12. The electrical circuits can be divided into four parts, tilting motor circuit, driving motor circuit, projector lamp circuit, and photo-cell circuit.

Tilting Motor Circuit

13. This is similar to that of Type 147B as fitted in ships (see C.B. 4312). The motor armature and field circuits are energised by the board control, the direction of rotation depending on the direction of current flow through the armature.

14. A resistance, Pattern 7623 (300 ohms), is used in place of Pattern W.7315 (25 ohms) in the board control, to reduce the speed of tilting.

15. Limit switches are provided at the 0° and 45° positions of the sword. These take the form of relay spring-set assemblies, operated by an insulated pin on the sector.

16. At the 45° position the contact breaks the circuit to the S2 coil of the magnetic switch, preventing further depression of the beam.

17. At the 0 position, two changeover contacts operate. One contact breaks the circuit to the S1 coil of the magnetic switch, while the other contact, connected as a "make" contact, lights the "dome vertical" lamp on the operator's panel and energises the coil of the magnetic lock in the raise-lower unit.

Driving Motor Circuit

18. The operation of the driving motor circuit is as follows:—

19. The instructor presses the push button S4. This completes the circuit—A.C. line, contactor coil, push button, short-range limit switch, A.C. line.

20. The contactor operates and locks in through b3.

21. Power is applied to the motor field potentiometer P1 through contact b4, and a voltage depending on the position of the regulator is applied to the motor field through contact b1.

22. Power is also applied to the potentiometer P2, and a voltage is tapped off by the slider and applied to the armature through contact b2. The motor, therefore, runs at a speed depending on the position of the regulator, the rotation being in such a direction as to move the cells towards the lamp.

23. The motor continues to run until the short-range limit switch S2 is opened by the pin on the carriage. The contactor coil is then de-energised, the "b" contacts break and the "a" contacts make. Since S3 is closed the field circuit is completed through a 1,500 ohm resistance and contact a1, while the armature is connected directly to the mains through contacts a2 and a3. It will be seen that the current flows through the armature in the opposite direction from the current flow when the contact was energised, and therefore the motor runs in the opposite direction, *i.e.*, the cells move away from the lamp. The speed of the motor during the run out is not controlled by the regulator, and corresponds to about 25 knots.

24. The range increases until the long-range limit switch S3 (adjustable to the desired starting range) opens, when the motor stops.

25. The regulator potentiometers are only in circuit during a run in, thus reducing the amount of heat generated. A steel housing with a vent hole in the lid is a further measure to prevent excessive heating, inside the main cover of the mechanism.

Lamp Circuits

26. The projector lamp, Pattern 7637, and dial indicator lamps, Pattern 16120, are fed from the 8-volt secondary winding of the transformer.

Photo-Cell Circuit

27. Two photo-cells are used, one providing "primary" echoes, the other providing weak subsidiary echoes.

28. The terminal marked P.C.+ is made positive with respect to earth, the voltage depending on the setting of a potentiometer in the amplifier.

29. A resistance and condenser are provided to prevent noise due to electrical pick-up, and the voltage is applied through another potentiometer P3 to the "primary" cell. The cathode of the cell is connected to P.C.— ve, *i.e.*, to the grid circuit of the control valve in the amplifier.

30. A high resistance potentiometer P5, connected from the slider of P3 to earth, supplies the "subsidiary echo" cell, the cathode of which is also connected to P.C.— ve.

31. The amplifier is arranged to pass echoes only when current flows through the photo-cells, *i.e.*, when the cells are illuminated. No echoes will be received until the voltage has been increased to a sufficiently high voltage by rotation of P3. Rotation of this potentiometer is effected by a pin on the carriage, which engages with a forked lever on the potentiometer shaft. The range of first contact can be altered by moving the position of P3, a number of locating studs being provided for this purpose. After the voltage has been increased by the forked lever, echoes will only be heard when the cells are made conducting by being illuminated. Further, it will be seen that contact a4, which is closed during the run out, short-circuits P3 and prevents echoes being received except during the "attacking" run.

6. Panel Supply

01. This unit is a standard component of the Mass Procedure Teacher A/S 406. It comprises a normal mains transformer and rectifying valve circuit with associated smoothing choke and condensers. The unit provides supplies of—

- 4 volts A.C.,
- 6.3 volts A.C.,
- 200 volts D.C.,
- 80 volts D.C.,

which are used to energise the range transmitter, amplifier, and signal injector, Pattern A.2363.

7. Range Transmitter

01. The unit, Pattern A.2748, is a slightly modified form of the transmitter, Pattern A.2364, used in the Mass Procedure Teacher A/S 406. It consists of two thyatron circuits, together with a thermal delay valve which prevents the application of H.T. voltage to the thyatrons until time has been allowed for warming up.

02. The operation of the unit is as follows: the 4-volt supply from panel supply heats the filaments of all valves, and the contacts of the thermal delay valve close after a short time interval.

03. Bridging of terminals 5 and 6 in the depth recorder by the relay contacts of the recorder, operates relay A. Contacts on A close, charging up the condenser in the grid circuit of the valve, to a voltage of approximately 70 volts, the grid being negative with respect to cathode. At the same time, the condenser connected to the anode of the valve is charged through another pair of contacts on A relay, to a voltage of approximately 40 volts, anode being made positive with respect to cathode.

04. In this condition, although the valve is supplied with H.T. voltage, its grid is very negative and no current passes through the valve.

05. When relay A releases, both anode and grid condensers are left charged, but the charge on the grid condenser leaks away through the resistance connected across the "Range" terminals, and the negative voltage applied to the grid falls at a rate depending on the value of the resistance, until a critical value is reached, at which the valve suddenly passes current. The current is drawn from the anode condenser through relay B, which operates, but releases shortly afterwards when the condenser has lost its charge.

06. The contacts on B relay energise E relay, one pair of contacts of which is connected to the signal injector, Pattern A.2363, in such a way as to produce an echo. It will be evident that the length of echo depends on the charge stored in the anode condenser of the thyatron circuit, and that the time from transmission to echo depends on the value of resistance connected across the "Range" terminals, *i.e.*, on the position of the submarine in the mechanism range depth.

07. Contacts on E relay charge up the condensers of the second thyatron circuit in the same way that the A contacts operated the first thyatron. The resistance across the grid circuit, however, is fixed, so the second thyatron always flashes a fixed time (0.3 sec.) after echo, this corresponding to the time from echo to flyback. D relay operates at flyback, and the contacts of D relay operate the master relay box.

08. A break contact on A relay is connected to the amplifier to give a mark on the recorder at transmission, and a make contact on A relay initiates the reverberations received from the signal injector, Pattern A. 2707.

09. In order to allow for the differences in the characteristics of thyratron valves, four 0.5 mfd. condensers controlled by a rotary switch enable one or more condensers to be switched in to the grid circuit as required.

10. The external toggle switch should always be set to Automatic, *i.e.*, switch down.

It is essential that the polarity of the D.C. supply shall be correct.

8. Master Relay

01. This unit consists of a simple relay, which is energised by the make contact on D relay of the range transmitter, that is, 0.3 seconds after echo. The relay operates without any appreciable time delay, and the contacts open, breaking the circuit energising the clutch of the depth recorder, causing the stylus to fly back.

02. The contact in the range transmitter breaks after a short time, but the master relay is held by the large condensers connected across its coil, and does not release for approximately 0.6 seconds, when the recorder clutch circuit is re-energised, the stylus moves forward again, and a new transmission is initiated. This delay allows for the flyback time of the stylus.

9. Signal Injector, Pattern A. 2363

01. This unit is a standard component of the Mass Procedure Teacher A/S 406. Provision is made for generating both echo and reverberation signals, but only the echo portion is used in this trainer.

02. The echo generator consists of an electron-coupled 16 kc/s. oscillator. When the terminals 5 and 6 are not connected, the cathode is made positive with respect to earth, and the valve does not oscillate. When 5 is connected to 6, the bias is removed, and the valve generates a signal which is applied through the volume control R3 to the output terminals.

03. The frequency of the echo can be varied by any of three small condensers:—

- (a) A small trimmer for setting the nominal frequency.
- (b) The doppler control; and
- (c) The pitch control (*see* notes in paragraph 12 on the use of the doppler control).

04. The pitch control has exactly the same effect as the doppler control, and should be left in the mid-position.

05. The three knobs marked "Reverberation Strength," "Reverberation Quality" and "Reverberation Range" have no effect on the signals received by the pupil.

10. Amplifier

01. The amplifier chassis is identical with the lower chassis of the Pattern A. 108 amplifier used in the Attack Teacher A/S 345. It consists of two photo-cell controlled valves, a triode hexode frequency changer, a telephone output stage, and a power output stage to the recorder stylus.

02. The 6.3-volt supply for valve heaters, 200-volt supply for H.T. and the 80-volt supply for the photo-cells, are drawn from the panel supply.

03. The "submarine H.E." input circuit and the associated photo-cell controlled valve are not used.

04. The 16 kc/s. echo signal from the signal injector, Pattern A. 2363, is fed into the input of the "ship" control valve. This valve is a pentode (6J7G) normally biased to cut-off so that no echoes are passed to the mixer. When the photo-cells in the mechanism range depth are illuminated the small current passed through the grid resistance generates a voltage which opposes the excess bias on the 6J7G valve, and the signal is passed to the triode hexode mixer valve.

05. The triode portion of this valve is connected as an oscillator. When used in the Attack Teacher the frequency of oscillation is 17.0 kc/s., but in the Shore Trainer the frequency is set to 14.75 kc/s. by adjustment of the heterodyne trimmers (*see* paragraph 27), so that an output frequency of 1,250 cycles per second is obtained in the output circuit. This signal, together with the 1,250 cycles per second reverberation signal which is also injected into the mixer valve, is passed to the power output stages and on to the phones and recorder.

06. A potentiometer on the left of the terminal block is provided for adjustment of the voltage applied to the cells.

07. An additional circuit is incorporated which makes a mark on the recorder at the time of transmission. This consists of a variable potentiometer in series with a fixed resistance, across the H.T. line, the slider of the potentiometer being connected through 10,000 ohms to the stylus. A break contact on the A relay in the range transmitter which normally connects the slider to H.T. — ve, opens during transmission and allows a mark to appear on the recorder.

08. Although the mark appears on the paper no "transmission crash" is heard in the phones.

11. Signal Injector, Pattern A. 2707

01. This unit is a slightly modified form of the reverberation unit used in Attack Teachers and operates in exactly the same way.

02. The grid voltage of the valve is varied in an irregular manner by the contacts of the motor unit, thus shock exciting the tuned anode coil. Anode voltage is applied by charging the 10-microfarad condenser at transmission; the generated signal gradually dies away as the condenser discharges. A potentiometer controls the strength of reverberations.

03. The modifications are:—

- (a) A reduction in the value of the tuning condenser from $0.81 \mu\text{F}$ to $0.5 \mu\text{F}$, giving a reverberation frequency of approximately 1250 cycles per second.
- (b) A reduction in the value of the resistance across the anode condenser from 500,000 ohms to 100,000 ohms.
- (c) Minor modifications of the wiring to the terminal block. This necessitates a link from terminal 5 to terminal 2 external to the instrument.

NAVY DEPARTMENT
NAVY PICT

Signal Injector, Pattern A.2709

30. General.

Unit Recorder Slaving, Pattern A.2708

31. General.

Control Echo Depth, Pattern A.2706

32. General.

33. To Remove the Slip Ring.

34. To Replace the Slip Ring.

LIST OF FIGURES

1. Wiring Diagram.
2. Circuit Diagram.
3. Control Echo Depth.

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TYPE 147B

PROCEDURE TEACHER

CHAPTER 1. Introduction

1. GENERAL

01. The Type 147B Procedure Teacher has been developed to provide a means whereby a pupil may be given preliminary training in the operation of the Type 147B Asdic Set without the necessity of using an asdic fitted ship with a submarine or other target.

2. USE OF THE HANDBOOK

01. The Handbook is intended to assist the Instructor in using the Procedure Teacher and also as a manual for the maintenance of the equipment.

02. The personnel operating and maintaining the Set should make themselves familiar with this book and C.B.4312 (Temporary Handbook for Asdic Set Type 147B) as a whole; it is not sufficient to read merely small sections.

03. Asdic Handbooks are being constantly amended and should therefore be re-read at frequent intervals. It is only by following these instructions that the set may be maintained in a state of efficiency essential for successful operation and instruction.

3. STORES

01. A list of the permanent and consumable stores which form the various parts of the set will be found in the Establishment List of Stores A/S 140, a copy of which is kept by the officer in charge of stores.

This publication contains information regarding the pattern number, full name and quantity of each article fitted in the set, together with spares.

02. When demanding stores, it is most important that the proper Establishment List description of the article is given as well as the correct pattern number.

03. Establishment Lists are obtainable from the Superintending Naval Store Officer, R.N. Store Depot, Copenacre, Hawthorn, Wilts.

CHAPTER 2. Capabilities, Limitations, and Operation of the Procedure Teacher

4. TYPES OF INSTRUCTION

01. When introducing a new Asdic set it is necessary to give instruction on:-

(a) The various components of the set (mechanical, hydraulic, electrical and electronic) and the adjustments and maintenance required by each component.

(b) Operating Procedure.

(c) Recognition and classification of the various sounds and recorder traces obtained at sea.

5. CAPACITY OF THE PROCEDURE TEACHER

01. This Teacher is primarily designed for giving instruction in 4(b), and will give a realistic reproduction of an attacking run on a submarine at a depth of 200 ft., 400 ft., or 800 ft. in deep water.

02. It is desirable, for obvious reasons, that instruction in 4(a) should not be given on the same apparatus as is used for instruction in operating procedure.

03. If, however, it is impossible for any reason to erect completely independent sets of gear, the directing gear, hydraulic equipment, Panel Tuning and oscillator may be added to the Procedure Teacher, thus providing a complete Type 147B set which may be used for instruction in 4(a) as well as 4(b). (Note:- It is essential that the oscillator be immersed in water).

04. The Procedure Teacher can give only elementary instruction in 4(c). The sound effects are sufficiently realistic for teaching operating procedure, but can only be considered as an attempt to reproduce natural effects by artificial means. Bottom echoes, secondary echoes, variation of reverberation pitch with speed and angle of tilt, rocks, etc., are not reproduced. In addition, the effect of temperature gradients is ignored and the extent of target is never increased sufficiently to enable drill with the sensitivity control to be exercised. It is therefore essential that instruction in Type 147B at sea must always supplement instruction on the Procedure Teacher.

05. The Procedure Teacher will only give satisfactory reverberations and echoes when the recorder is switched to "Slave".

6. PRINCIPLE OF OPERATION

01. Artificial reverberations are heard on every transmission if the recorder is running in "slave".

02. Artificial echoes are also produced after every transmission, the range being governed by a dial under the control of the instructor. This dial is calibrated up to a maximum of 1,000 yards. These echoes are only received by the pupil when the "sword" is tilted to the correct angle, depending on the depth and range of the submarine. When the "beam" is not directed at the "submarine", the echoes are suppressed by the "Control Echo Depth" which consists of a segmental slip ring, with contact brushes

brushes driven round by an M type motor as the sword is tilted. Echoes are only heard when the sword is tilted to such an angle as will bring the brushes on to the insulated segment of the slipring.

03. For constant depth of submarine, it is necessary to alter the angle of depression of the target as the range is reduced. The slip ring is therefore attached to a dial, which can be set by the instructor to the correct position. For convenience in use, the dial carries three concentric scales; for a submarine 200 feet, 400 feet or 800 feet deep. Each scale has a series of calibrations, marked in yards of range. To produce a trace on the recorder at one of these depths, it is only necessary to choose the appropriate scale, set the dial so that the range indicated under the engraved line corresponds with the range set on the signal injector, and to sweep across the target. Provided the recorder has been correctly lined up, the trace will show a series of strong echoes centred about the nominal depth, with one weak or "fringe" echo on each side.

04. A friction clutch in the Control Echo Depth ensures that the brushes are automatically lined up when the pupil lines up the Depth Recorder.

7. OPERATION OF THE PROCEDURE TEACHER

01. The Procedure Teacher comprises the essential components of Asdic Set Type 147B with an Instructor's Table, on which is mounted the following additional apparatus:-

- (a) Signal Injector, Pattern A.2707.
- (b) Signal Injector, Pattern A.2709.
- (c) Control Echo Depth, Pattern A.2706.
- (d) Unit Recorder Slaving, Pattern A.2708.
- (e) Depth Indicator, Pattern A.2304.

(i) The two Signal Injectors serve to provide the artificial reverberations and echoes.

(ii) The Unit Recorder Slaving, Pattern A.2708, controls the Depth Recorder, Pattern A.2296B, and the Signal Injectors, Patterns A.2707 and A.2709.

(iii) The Control Echo Depth, Pattern A.2706, is the unit which controls the angle of depression at which echoes are received by the pupil.

(iv) The Depth Indicator repeats the depth in feet from the Operator's Panel for guidance of the Instructor.

(v) A full description of the Asdic Set Type 147B will be found in C.B.4312 and of the additional apparatus mentioned above in Chapter 3.

02. In order to simulate an attacking run on a submarine, the instructor must:-

(a) Switch on all supplies, and after about $\frac{1}{2}$ minute, press pear switch once. (Reference should be made to Chapter 4 switching routines).

(b) Decide whether the depth of submarine is to be 200 feet, 400 feet, or 800 feet, and choose the appropriate scale.

(c) Set the two dials (i.e. Control Echo Depth and Signal Injector Range dials) to the required range of first contact on Type 147B. (This is normally not greater than 700-800 yards).

(d)

(d) Turn down the echo strength to zero, using the sensitivity control on the Signal Injector.

The pupil can now carry out the normal sweeping procedure (C.B.4127) without hearing echoes.

When sufficient sweeping has been carried out:-

(e) Increase the echo strength until echoes are heard. The pupil will then report contact and use the appropriate procedure (C.B.4127).

(f) Reduce the range steadily by turning the dial on the Signal Injector, keeping the Echo Depth Control in step. The speed at which the range is reduced determines the "speed of approach"; (Note:- Speed in knots divided by 3 = hundreds of yards per minute).

03. The echo strength should be increased gradually until it is at full strength approximately 200 yards after first contact. The strength should not be increased far enough to overload the amplifier, or a change in quality may be noticed between the "main" and "fringe" echoes. It is convenient to make a mark on the echo strength control in a position where good results are obtained.

04. As the run progresses, the angle of depression will gradually increase until the sword is tilted to 45° and contact is lost by the target passing below the sound beam. This simulates a run in which the attacking ship runs over the submarine. If it is required to lose contact on 147B because the target is left wide on the bow, it will be necessary to reduce the echo strength again at the end of the run, but this is not usually practicable as the manipulation of the two control dials and supervision of the operator require the full attention of the instructor.

05. It will be noticed that, while the markings on the Range Dial of the Signal Injector are equally spaced, those on the Control Echo Depth are further apart at short ranges than at long ranges. This means that the Control Echo Depth dial has to be moved more quickly in the later stages of an attack.

06. The dials should be moved steadily and continuously throughout the run, when a steady zig-zag trace on the recorder will be obtained. The echoes obtained on each sweep across the target should form a straight line, and the number of echoes in each sweep should be fairly consistent, though each upward sweep may give fewer echoes than each downward sweep. The three most common faults are:-

(i) Turning the dials jerkily while the operator is stepping across the target. This results in the echoes forming irregular patterns instead of regular "zig-zags", irregular numbers of echoes in each sweep, or in an extreme case, loss of contact through failure to obtain any echoes when stepping across the target.

(ii) Keeping the dial still while echoes are being heard, and moving in steps while the "beam" is tilted off the target. This results in irregular intervals between successive sweeps, even when the pupil has correctly followed the procedure of reversing his switch after two transmissions without an echo.

(iii).....

(iii) Failure to keep the two dials in step. This will result in the recorder trace being centred about an incorrect depth. It is possible to make use of this to obtain a gradual change of depth, but a considerable amount of practice is required before this can be done satisfactorily.

8. REVERBERATION FREQUENCY

01. The reverberations heard in the 147B set at sea have a frequency of 1,000 cycles per second with the ship stopped. The frequency increases with increase of ship's speed, and also varies with the angle of tilt, being highest when the sound beam is horizontal.

02. The reverberations used in the Procedure Teacher have a fixed frequency of 1250 cycles per second, corresponding to a ship's speed of approximately 7 knots.

03. A control on the Reverberation Unit governs the strength of reverberations. Care should be taken to avoid increasing the strength of reverberations beyond a realistic level.

04. Reverberations are only heard when the recorder is running.

9. DOPPLER

01. The second dial on the Signal Injector controls the pitch of echo, or doppler.

02. The actual pitch of the echo heard in the 147B set at sea varies considerably with submarine's speed, but doppler is not usually noticed by the operator, firstly because of the short, sharp echo, and secondly because the echo is not generally heard until after the reverberations have died away, and there is therefore no musical background with which the echo can be compared.

03. With the slightly different character of the synthetic echo, a small change in pitch can be distinguished quite easily, and in order to avoid undue emphasis on Doppler, it is recommended that the echo pitch should always be matched to the reverberations.

10. BOTTOM ECHOES

01. Bottom echoes are not reproduced in the Procedure Teacher; the pupil's attention should be drawn to the characteristic differences between echoes from the submarine and from the sea bed. The submarine echo is short and sharp, and has a definite range whatever the angle of tilt, resulting in the characteristic zig-zag trace as the stylus speed is varied.

02. The bottom echo is more drawn-out, always comes in at about the same depth, the range increases as the beam is elevated, and bottom echoes are not heard when the beam is horizontal unless the ship is facing a bank or there is a temperature gradient in the water.

03. A submarine lying on the bottom (or a wreck or rock) gives a combination of the zig-zag pattern and the straight bottom pattern (see also OTM 10 - Type 147B Recorder Traces).

11. OPERATION IN AUTO

01. The instructor should emphasise the need for switching the recorder to "Slave", so that the stylus flies back as soon as possible after the echo has been received.

02. When the switch is set to Auto, the stylus must travel right across the paper before flying back. When the beam is nearly horizontal, this takes a very long time, and seriously reduces the efficiency of sweeping. In addition, as the transmissions of the 147B set are not synchronised with those of the main set, mutual interference may be heard in the phones and seen on the depth recorder trace.

03. The Procedure Teacher may be used to demonstrate the slowing up of the procedure when in "Auto" as follows:- Switch off reverberations, and reduce echo strength to zero. It is then possible to see the greatly increased time between transmission marks when sweeping. It is necessary to eliminate the echoes and reverberations as they occur at intervals dependent on the operation of the relay system, and if the recorder is set to operate independently of the relays, the echoes and reverberations will appear as an irregular pattern on the paper, more than one reverberation mark occurring during a single traverse of the stylus.

12. SUBSIDIARY USES

01. Use with an A.T.H. If the Instructor's instruments are mounted in the close vicinity of an Attack Table and an Automatic Range Repeat is fitted to enable the instructor to keep the Type 147B range tuned to the main set, this Procedure Teacher will enable Type 147B training to be co-ordinated with an attack in the A.T.H. It is as well to note, however, that a certain degree of skill is required to compete successfully with a fast closing rate.

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CHAPTER 3. The Electrical Apparatus of the
Procedure Teacher

ASDIC SET TYPE 147B

13. GENERAL

01. The various instruments and mechanical gear of the Asdic Set Type 147B are described in the Handbook of the Set, C.B.4312. Three Units of the Set:-

- (a) Tilting Unit, Pattern A.2533.
- (b) Panel Transmitting, Pattern A.506.
- (c) Receiver, Pattern A.2704.

however, are incorporated in a slightly different manner than in a ship's set, details being given in the following paragraphs.

14. TILTING UNIT, PATTERN A.2533:

01. This unit may be used by itself on the stand provided or mounted on the Lifting Tube of the Directing Gear when it is desirable to demonstrate the tilting action of the sword.

02. If the Tilting Unit is used without the other parts of the Directing Gear, the "Dome Lowered" lamp should be illuminated by connecting L.R. to 20V positive and the tilting circuit should be completed by connecting together the two terminals in the Tilting Unit which are normally connected to the Lower Indicating switch.

15. PANEL TRANSMITTING, PATTERN A.506

01. The Panel Transmitting is energised from the A.C. supply in the usual way, the relay being operated from terminals 5 and 6 of the Operator's Panel (5 and 6 Range Recorder). The power output of the Panel Transmitting, instead of passing through the Tuning Panel, Pattern A.514, to the Oscillator as in the normal Asdic Set, is dissipated in a resistance. The frequency of the master oscillator is not important.

16. RECEIVER, PATTERN A.2704

01. The Receiver is connected in the usual way to the Panel Transmitting, Pattern A.506. It is the standard pattern used in the Type 147B Asdic Set, except that the connection from resistance R.15 to earth is removed.

02. This is done to allow reverberation and echo signals to be injected between R.15 and earth into the grid circuit of the mixer valve V.3 by way of an additional screened lead. Signals thus injected can be heard in the telephones and the markings seen on the recorder paper.

03. The Receiver is tuned as in the normal Type 147B Asdic Set. Incorrect or bad tuning will not affect either the artificial reverberations or echoes, but will reduce the noise made at transmission.

INSTRUCTOR'S TABLE

17. GENERAL

The instruments mounted on the Instructor's Table are:-

(a)

B

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C L A S S I F I C A T I O N T R A I N E R

(A/S 1072)

By Command of the Defence Council

L. T. Dunnett

April 1966

MINISTRY OF DEFENCE

Director General, Weapons (Naval)
N/S 1771/65

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CHAPTER 2

TECHNICAL DESCRIPTION

DESIGN FACTORS

1. The Type 177 I.D.C.T. has been designed to train Sonar Type 177 operators under conditions as similar as possible to those occurring in normal use of the sonar set. Signals from the sonar set have been recorded on magnetic tapes, for a variety of sonar events under different sea conditions. These tapes are replayed by the I.D.C.T. and the recorded signals are injected into the sonar set at the points from which they were recorded, so that the replayed signals appear as realistic as possible. The injection points have been chosen so that the amplitudes and frequencies of the signals can easily be handled by the I.D.C.T.
2. The most critical design requirement is that the tape shall be replayed at precisely the same speed as that at which it was recorded.
3. Another design requirement is that the sonar set must be accurately synchronised with the recorded signals during replay. This has been achieved by recording on Channel 8 of the tape synchronising pulses, which control the range recorder stylus carriage, so that the start of each left-to-right traverse of this carriage corresponds with the start of each recorded sonar transmission interval.

Preparation of I.D.C.T. Tapes

4. In the preparation of initial detection and classification tapes, the number of successive transfers of information from tape to tape is kept to a minimum, as degradation of the signals may occur with each transfer. The aim has been to limit these transfers to two, one from the original recording to a master tape, and one from the master tape to a copy tape.
5. Original tapes have been prepared during sea trials on a recorder-replay unit, similar to the Replay Unit used in the I.D.C.T. but with the addition of recording facilities. Ten channels are recorded on a half-inch wide magnetic tape. These channels are listed in Chapter 1, Paragraph 3. Spoken commentaries are added on channels 9 and 10 to give details of the recorded information and instructions to the Sonar Control Room crew, irrespective of whether the equipment is being operated in the 'Doppler Audio' or 'HE Audio' mode.
6. The original recordings are then edited to produce master tapes. During this editing phase, unwanted information is removed so that only the events required for training are transferred to the master tapes. In the editing process, two tape recorders are used, a "master recorder" and a "slave recorder". The original tape is replayed on the master recorder, and signals are transferred via a matching unit to the slave recorder and simultaneously monitored on a Sonar Type 177. When completed, the master tape so produced is transferred from the slave recorder to the master recorder and is played back into the sonar set for final evaluation of the audio and video recordings.
7. In the copy process, two tape recorders are again used, and the signals on the master tapes are transferred to the copy tapes.

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Tape Speed and Alignment

8. If the tapes are not replayed at the same speed as they were recorded, the replayed signals will be at the wrong frequencies and will be processed by the filters in the sonar set. As a result, the Type 177 will give misleading indications. To ensure that all tapes, during editing and replay, are run at the correct speed, within very narrow limits, synchronous motors of the capstans in the recorders and Replay Unit are run from a 115V 60 c/s crystal-controlled supply. Furthermore, a 115V 60 c/s wheel reduces any short-term fluctuations in tape speed. At the same time, the tension is maintained constant during record and replay, by separate capstans associated with the right and left-hand spools.

9. The signals are recorded on, and replayed from, the tapes on five-track heads. Careful alignment of the tape relative to the heads is necessary to ensure that the phase relationship between channels 1 and 2 (Sector Display) is correct. A facility for adjusting this alignment is provided. The procedure, using a special test tape, is described in Chapter 3, Paragraph 80.

Synchronisation during Replay

10. During replay of the tapes, the start of each transmission interval recorded on the tape must be synchronised with the start of each transmission interval recorded on the tape. Therefore the start of the left-to-right traverse of the Range Recorder stylus carriage must be delayed, until the recorded transmission-interval synchronising pulse has been reproduced.

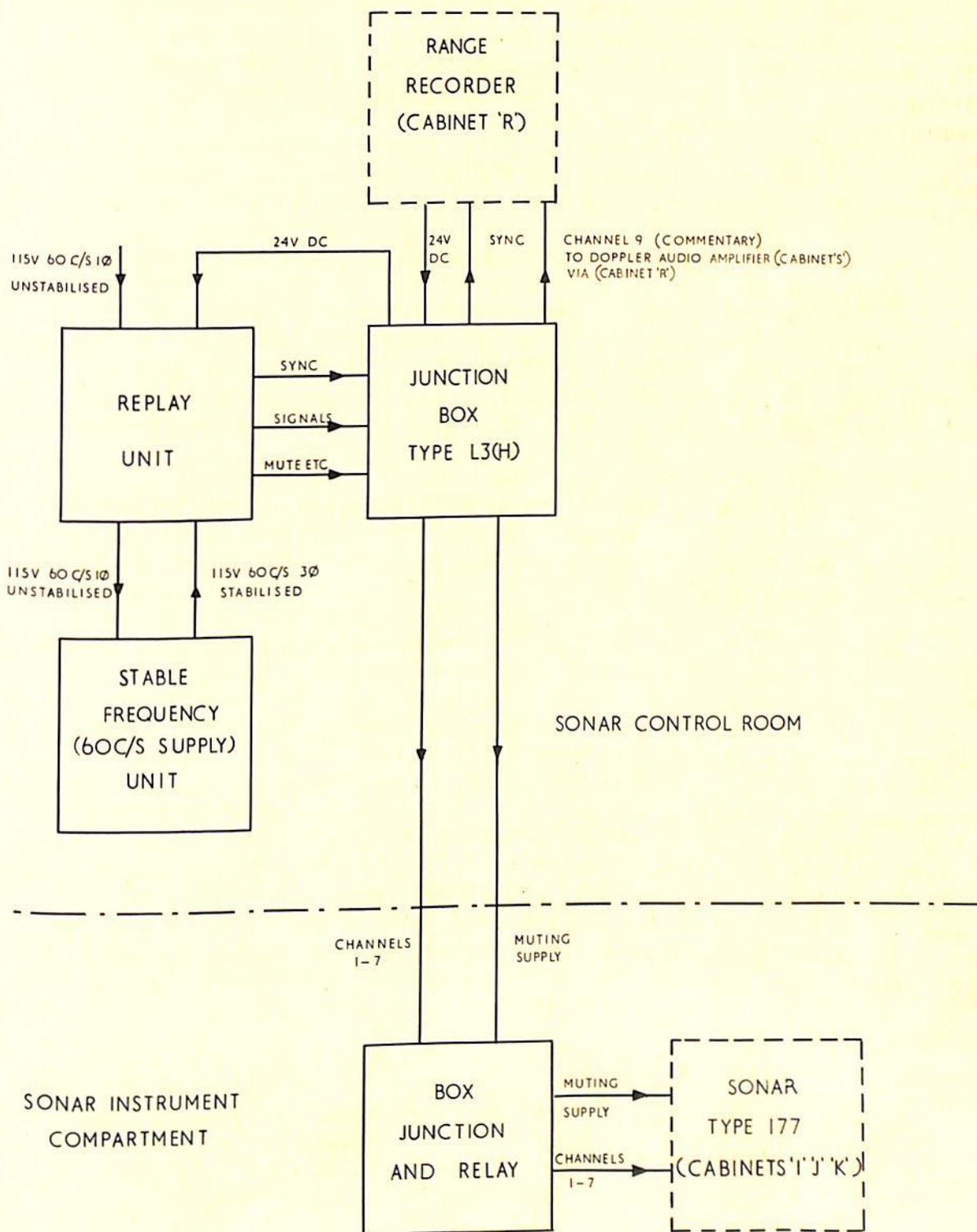
11. At the end of each flyback (right-to-left traverse of the carriage) the Range Recorder start contact is momentarily opened. The start of the next left-to-right traverse of the carriage, which is synchronised with the start of the pulse recorded on channel 8 of the tape, is achieved by a signal pulse recorded on channel 8 of the tape, which is by-passed until the end of the pulse. Details of the synchronisation are described in Chapter 3.

OVERALL TECHNICAL DESCRIPTION (Fig. 2.1)

12. The Type 177 I.D.C.T. equipment comprises four separate units and their interconnections, namely:-
Replay Unit (A.P.192568)
Junction Box Type L3 (H)
Power Supply 115V 60 c/s
Junction and Relay Box (A.P.192973)

13. The first two units are installed in the Sonar Control Room, while the Junction Box and Power Supply are installed in or near this compartment. The I.D.C.T. is installed in the Sonar Instrument Compartment. The I.D.C.T. is connected to the main 115V single-phase 60 c/s and 24V direct-current supplies and is connected in conjunction with the Sonar Type 177.

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I.D.C.T.
FUNCTIONAL DIAGRAM

FIG2.1