

GUNNERY NOTES

INTERIM "TEACHER" FOR PANEL L22.

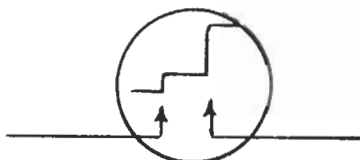
The following suggestion, due to S/Lt. J. Worker, R.N.V.R., has been received from H.M.S. PELICAN for a "teacher" for Panel L22 where Panel L24 is fitted with the same set. Reports from sea as to the success of this method of training ABU Operators are urgently required.

"After carrying out, in H.M.S. "WOODPECKER", the modification suggested in C.A.F.O. 2227/43, for the interconnection of the display panels of Type 285, so that the Panel L22 might provide a training "echo", the result was of such high value that an attempt was made to make Panel L24 provide a similar training "echo" on the L22 trace, where training in accurate following of echoes is of even greater importance.

The "Remote A.R. Sweep" output plug on the L24 gives a rapid drop in volts at an instant determined by the range setting of the L24. The "Strobe" output plug gives a positive pulse of short duration, at the same instant, but insufficiently short to resemble an echo.

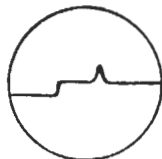
Initially the "Remote A.R. Sweep" pulse was superimposed on the M53 output, and passed on, via the Board Distributing, to the L22 video-amplifier, the resulting picture on the C.R.T. being:-

Ordinary step
positioned by
the A.B.U.
range setting



Amplified L24 A.R.
Sweep output, positioned
by the L24 range
setting.

With a differentiating circuit between the video-amplifier and the C.R.T. (say 50 pfd. coupling and 20,000 ohms to earth) this provides a pulse of short duration:-



This is fairly satisfactory, but the bias conditions of the video-amplifier are upset, resulting in very little grass before the "echo" and none after.

It was then decided to have a separate amplifier for the A.R. Sweep output, which would enable differentiation to be undertaken without upsetting the passage of normal grass and echoes to the L22. For this purpose the G76 calibrating oscillator seemed capable of rapid conversion. The following changes were made:-

- (a) The tag connections to the crystals were removed.
- (b) The A.R. Sweep pulse was fed via a breeze plug and telecothene cable to the grid of the first amplifying valve.
- (c) The existing resonant anode load was disconnected, and replaced by a resistive load of 20,000 ohms.
- (d) The existing coupling, C3 (formed by wiring) was reinforced by a 0.01 mfd. condenser.
- (e) C5, R.F. bypass condenser was disconnected.
- (f) A 10 pfd. condenser was joined to the anode of the second amplifying valve, and to the loop of wire forming C4. This enabled the old "Line" input socket to be utilised as an output plug.
- (g) The output pulse is fed via the lead supplied for linking the L12 calibrating oscillator with the G.76 wavemeter, to the breeze plug connected to the output of the M53 amplifier (needed in the C.A.F.O. modification).

This arrangement produces a realistic "echo" on the L22 panel and can be superimposed upon a full trace of genuine groundwave, grass, and echoes, giving practice in following a moving echo through stationary ones.

The echo amplitude can be easily varied by a potentiometer in the grid input circuit, or even by switching the amplifier on and off. However, as the majority of echoes are large at A.B.U. ranges the chasing of variable "echoes" is of less importance than the "getting the feel" of the rate aiding mechanism, for which a steady "echo" is as good as any.

Two D.P.D.T. switches would enable the unit to be used as either calibrating oscillator or "echo" producer, but with the L24 its use in the former category is obsolete".

HAVE YOU BROUGHT YOUR GUNNERY SETS UP TO DATE?

- C.A.F.O. 1194/43. Type 284/5 (modified) - Interconnection of aerials for emergency purposes - A'S and A'S.
- C.A.F.O. 889/44 Panels 3AH Transmitting-Modification to Phase Control.
- C.A.F.O. 929/44 Remote Gain Control.
- C.A.F.O. 1287/44 Replacement of Receivers P14/P16. Patterns X/W1334/X/W2124 by Receivers P24 Pattern W3920.
- C.A.F.O. 1712/44 Modifications to Aerial Outfit ASE on Barrage Directors.
- C.A.F.O. 1523/44 Panel 3AH Transmitting-Changeover Switch for Internal or External Fitting.
- C.A.F.O. 1876/44 Interswitching of Panels L18/L24 with Type 284P(3)/P(4).
- A.F.O. 2174/43 Panel L12 - Fitting of fan ventilating Pattern W5997/8.
- A.F.O. 2283/43 Packing bearings of motor, Pattern W5437 in blower and heater units, Patterns W3510, W3637, W4057 and W4058 with grease, Pattern W8305.
- A.F.O. 2401/43 Panels 3AH transmitting - Modification to valve holder for rectifying valve NU4.
- A.F.O. 1228/44 Amplifier M56, Pattern W3126 - Replacement of selenium rectifier.
- A.F.O. 2499/44 Oscillator G41 - Modification.
- A.F.O. 3165/44 Panels L24/L34 - Modification to C.R.U. Des. K. Patt. W4651.
- A.F.O. 3557/44 Panel L12 - Replacement of Resistors.
- A.F.O. 4138/44 Panel 3AH Transmitting - Transformer Pattern W2663 Modification.

AMPLIFIER M68.

Vague reports have been received in A.S.E. that the new amplifiers M68 do not give as good results as the amplifiers M53 which they replace. There is no foundation in these rumours; a defective M68 is indicated if results do deteriorate when this amplifier is fitted.

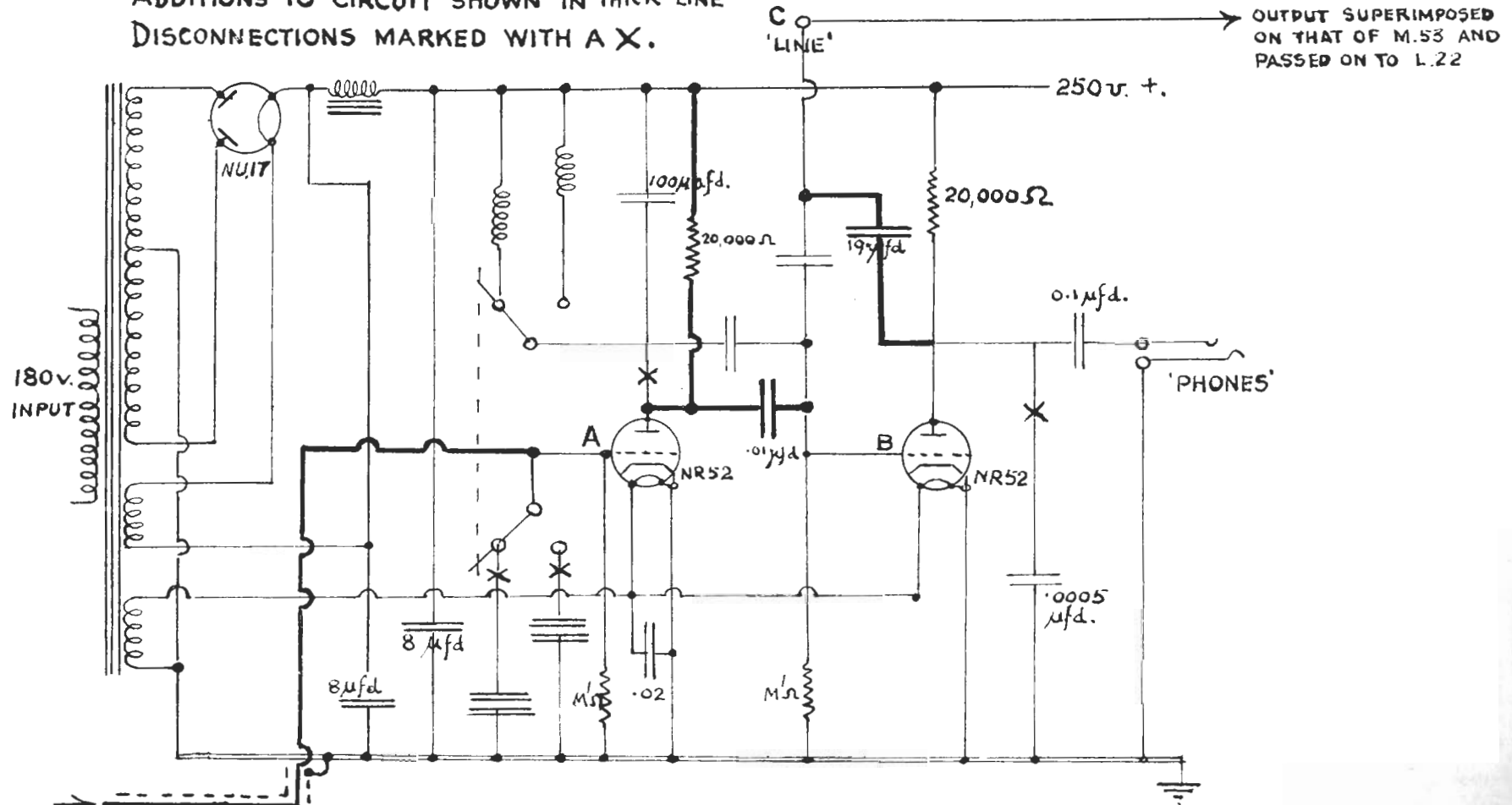
MODIFICATIONS TO PANELS L24/L34.

Boxes of Parts Pattern 56391 will soon be available. As soon as they come off the production lines they will be despatched to "first-comers". Demands should be made in the usual way on S.N.S.O. (H) repeated S.S.E.

MODIFICATION TO WAVEMETER G.76.

INTERIM TEACHER FOR PANEL L22. (SEE PAGE 10.)

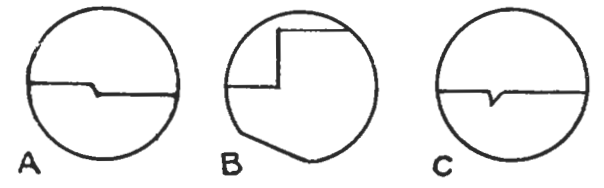
ADDITIONS TO CIRCUIT SHOWN IN THICK LINE
DISCONNECTIONS MARKED WITH A X.



OUTPUT SUPERIMPOSED ON THAT OF M.53 AND PASSED ON TO L.22

PULSE FROM 'A.R. SWEEP' PLUG ON PANEL L.24.

WAVEFORMS



SIMPLE LAWS FOR CURIOUS

SAILORS

SURFACE

Maximum Range is proportional to:-

$$(\text{Power})^{\frac{1}{8}}$$

$$(\text{Area of Reflector Aperture})^{\frac{1}{4}}$$

$$(\text{Height of Aerial above L.W.L.})^{\frac{1}{2}}$$

$$(\text{Pulse length})^{\frac{1}{8}}$$

Range Discrimination is proportional to Pulselength.

$$1 \text{ microsecond} = \text{approx. } 200 \text{ yards.}$$

Bearing Discrimination is proportional to

$$\frac{1}{\text{horizontal aperture of reflector in wavelengths}} = \frac{\text{Wavelength}}{D}$$

where D = width of aperture.

With lobe switching, Bearing discrimination is approximately equal to:-

$$\frac{72 \text{ wavelength}}{D} \text{ degrees}$$

Angular Accuracy increases proportionally with D/wavelength.

AIR

Maximum Range for angles of sight above the first interference maximum is proportional to:-

$$(\text{Power})^{\frac{1}{4}}$$

$$(\text{Area of Reflector})^{\frac{1}{2}}$$

$$(\text{Pulse length})^{\frac{1}{4}}$$

independent of height of aerial.

Range and Bearing Discrimination as for surface.

Elevation Discrimination as for Bearing but for horizontal width D read vertical height d.

Angular Accuracies as for surface.

The minimum angle of sight for which accurate elevation can be obtained using normal lobe switching or conical scanning method is proportional to wavelength/d

This angle is approximately equal to $\frac{50 \text{ wavelength}}{d}$ degrees

The above relationships are approximate only.

The following amplifies, and should be read in conjunction with the article on Page 19 of the June, 1944 Bulletin. (R.H.600 (2))

SIGNAL DISTRIBUTION SYSTEM FOR USE WITH
"CATHODE FOLLOWER UNIT, DESIGN 5" AND
"CATHODE FOLLOWER UNIT, 6-WAY EXTENSION"

NOTE: The following method of obtaining extra signal channels is intended for use only in an emergency. The normal method of increasing the number of signal channels is to fit additional 6-way extension units.

As a temporary measure it is possible to feed several remote P.P.I.'s from each output of the above cathode follower units if the measures described below are adopted. It should first be understood exactly what is involved. The normal High Level output (see Handbook) which is the one to be used in this scheme, of the 3 and 6-way Cathode Follower Units, consists of $\frac{1}{2}$ volt of noise and 5 volts of signal (positive) across 70 ohms, i.e. the signals limit at ten times noise amplitude. This is when the Gain Control on the 3-Way Unit is set for normal operation as described in the Handbook. The Gain Control can, however, be readjusted so that for the same input level to the Cathode Follower Unit, the output has a much greater proportion of noise, say 2 volts of noise out of the total of 5 volts. (This total of 5 volts is almost unaffected).

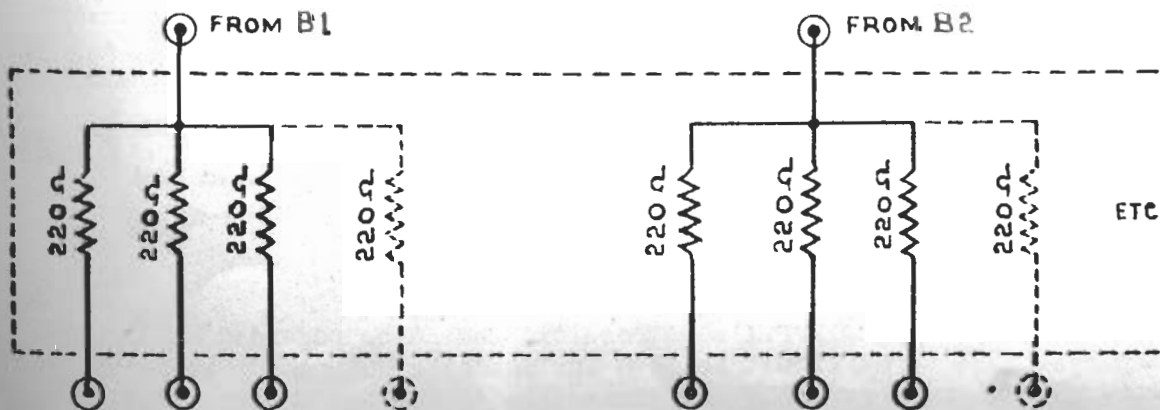
This sort of signal is quite adequate for operating P.P.I.'s since signals greatly in excess of noise are not wanted in any case, and in fact are usually limited inside the P.P.I. at about twice noise or even less. (But see note on station-keeping below).

Hence since we now have as much as 2 volts of noise (for example), at each cathode follower output this can be divided among several correctly terminated 70 ohm cables and still produce a large enough noise signal in each of them.

The resultant signal would, of course, not be satisfactory for any remote A-scan that might be required (since the peak signals would be too small) and it would have to be fed from one of the outputs of the Cathode Follower Unit SE2 in the L26 Panel itself.

Moreover, there would not be complete electrical isolation between the various lines as there is when each line has its own individual cathode follower, but as will appear below, some measure of independence can be achieved by inserting a suitable series resistance in the feed to each cable.

PRACTICAL ARRANGEMENTS.



TO REMOTE P.P.I.'s , VIA 70 OHM CABLES EACH CORRECTLY TERMINATED AT FAR END

A junction box is required, to house series resistors of 220 ohms $20\% \frac{1}{2}W$ connected as shown in the figure. Three (or possibly four) 70 ohm lines can be run from each output to remote P.P.I.'s but only two 70 ohm lines may be run from one output if one (or both) of these goes to a remote skiatron. This is because the Skiatron requires a full $\frac{1}{2}$ volt of noise (slightly more if possible) whereas the P.P.I. will give satisfactory results on rather less.

The outputs should be arranged as evenly as possible, i.e. it is better to feed two lines from each of two outputs rather than three from one and one from the other.

In ships without Skiatrons the above arrangements will enable the 3-Way Unit to feed nine or possibly twelve remote P.P.I.'s and the 6-Way extension to feed an additional eighteen or possibly twenty-four P.P.I.'s.

When one (or two) Skiatrons are fitted, the 3-Way Unit will feed six or possibly eight remote P.P.I.'s from the two outputs not going to a Skiatron and two more lines from the third (either to two Skiatrons or to one Skiatron and one P.P.I.).

The setting of the Cathode Follower gain control should be carried out as follows:-

Disconnect the Signal lead "C" between the Receiver and the Indicator Unit on the L26 Panel and connect instead a lead from "TEST" on the 3-Way Cathode Follower Unit to the Monitor Jack on the Indicator. The picture on the Indicator Unit will then be an enlarged version of the signal being fed to the P.P.I.'s so far as amplitudes are concerned. (The frequency response at the Test Point is not intended to be good).

Make sure that the Receiver Gain Control is at its normal setting for A-Scan working (it must not afterwards be touched) and adjust the Cathode Follower Gain Control until the noise occupies ONE THIRD of the picture. (The full picture height will still be 2 to 3 cm. as described in the Handbook).

Now the normal High Level output across 70 ohms at B1, B2, B3, on the 3-Way Unit and B4, B5, -- B9 on the 6-Way Unit is 5 volts peak + 20% (i.e. 4 to 6 volts). The (peak) outputs into the 70ohm lines connected according to the above scheme will be less than this and will in fact be approximately as follows.

If two lines on one output:	2 volts.
If three lines on one output:	$1\frac{1}{2}$ volts.
If four lines on one output:	1 volt.

but in each case ONE THIRD of this voltage will be noise, i.e. if three lines, $\frac{1}{2}$ volt noise, if four lines, $\frac{1}{3}$ volt. Bearing in mind that the outputs may in fact be 20% less than these nominal values it is seen that with four lines the output may be only $\frac{1}{4}$ volt of noise which is rather low, even for P.P.I.'s.

It is clear that to guarantee at least $\frac{1}{2}$ volt of noise (as for Skiatron) no more than two lines can be fed from one output.

ALTERNATIVE SUGGESTIONS

As many of the P.P.I.'s as possible should be regarded as "local" displays. It is difficult to give any definite ruling but in an emergency it would probably be permissible to run two unterminated lines of up to 50 feet each (or four 25 ft. lengths etc.,) from one cathode follower output, provided that, as laid down in the Handbook,

there is one correctly terminated line already on that output. (See Handbook). The effect of these will be to produce a slight lengthening of the echoes. There will be no loss of amplitude.

Several P.P.I.'s close together and not more than 50 ft. from the Cathode Follower Unit, may be fed from the same line, the latter being terminated only once in the junction box at the far end. The leads between the junction box and the individual P.P.I.'s should not exceed 3 ft. each.

Several P.P.I.'s more than 50 ft. away may also be fed down one cable if they are connected in series provided the cables are of exactly the same impedance throughout. Further there must be no "branch lines" in the circuit, i.e. the cable must run right up to the signal input point on the first P.P.I. and away from the same point (via a Pye T-piece) to the second P.P.I. and so on. The cable will be terminated in 70 ohms at the last P.P.I. only.

MISCELLANEOUS

WARNING

REMEMBER THAT DISPLAY UNITS DESIGNS A & B (THE P.P.I.'s) HAVE AN INTERNAL 100 OHM. RESISTANCE (R85) ACROSS THEIR SIGNAL INPUT CIRCUITS. THIS MUST BE REMOVED BEFORE THE UNITS CAN BE USED AS "LOCAL" DISPLAYS, AND TAKEN INTO ACCOUNT (OR REMOVED) WHEN THE TERMINATION OF THE SIGNAL CABLES AT THE REMOTE DISPLAYS IS BEING ARRANGED.

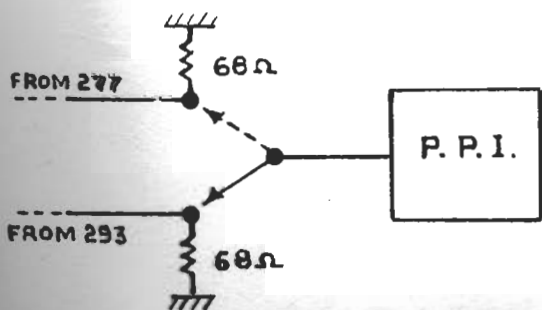
THE HANDBOOK mentioned in these instructions is Chapter 15 of AMENDMENT No. 1 to H546 (type 276 etc), dated June, 1944 which contains full information on CATHODE FOLLOWER UNIT DESIGN 5 and CATHODE FOLLOWER UNIT, 6-WAY EXTENSION

NOTE ON THE SWITCHING OF DISPLAYS

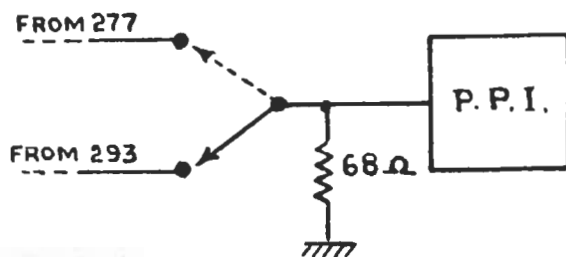
Whenever a remote display (e.g. a P.P.I.) is required to be switchable between two or more Radar sets (e.g. 277 and 293) the signal lines from the various sets must be individually terminated at the input side of the switch as shown in A and not terminated at the P.P.I. side as shown in B.

EXAMPLE

A. RIGHT



B. WRONG



This is because the arrangement shown in B would mean an unterminated line on whichever Radar set was not being used by that particular P.P.I. at that particular time, and this is contrary to the fitting instructions given in the Handbook (para. 8 in Chapter 15 of the Amendment quoted above).

In the present scheme it is more than ever important to avoid having an unterminated cable on any cathode follower output since reflections along it would affect the other displays on the parallel output - the 220 ohm. series resistance afford only partial isolation.

STATION KEEPING

It will be appreciated that the usual drill for obtaining greater target discrimination (at the expense of sensitivity) by reducing the "Input" control on the P.P.I., cannot now be applied so successfully, since there is now very little signal in hand. When signals are fed to the P.P.I. at a saturation level of "ten times noise" (see opening paragraph) the "Input" control of the P.P.I. can be reduced considerably below standard level for station-keeping purposes, and the large echoes will still print fully, but if the saturation level is "three times noise" (as in the emergency arrangement described above), the echoes themselves will begin to vanish if the "Input" is reduced too much. This is another reason why the above arrangement must be regarded as temporary only.

FALL OF SHOT

RADAR TYPE 271

REPORT OF FALL OF SHOT DURING TARGET FIRINGS

The Gunnery Firing ship, which normally uses Pattern II targets with dipoles on which Type 271 can only range up to about 5,000 yards, has devised a technique for ranges greater than this to enable fall of shot to be reported during practice firings.

The operators have worked out a system where they range on the towing vessel, but train off sufficiently to pick up the splash of salvos. An arbitrary correction for difference of range is used according to the inclination of the tow.

The technique has apparently worked extremely well for instructional purposes and is promulgated for information in case it is of use to ships carrying out practice firings when targets with adequate dipoles for long and medium ranges are not available.

FALL OF SHOT INDICATION FOR W.S. SETS

In order that the W.S. Radar Office and the T.S. may be informed when to expect fall of shot, when the W.S. Radar is being used for gunnery ranging, ships may find it convenient to inject the sound of the fall of shot hooster into the control group telephones. Distinct clicks will be heard in the telephones which are sufficient to warn the Radar operators when splashes may be expected.

The method of modifying the fall of shot and telephone circuits is shown in C.A.F.O. diagram 9/42. C.A.F.O.'s 198/42 and 1598/44 also refer.

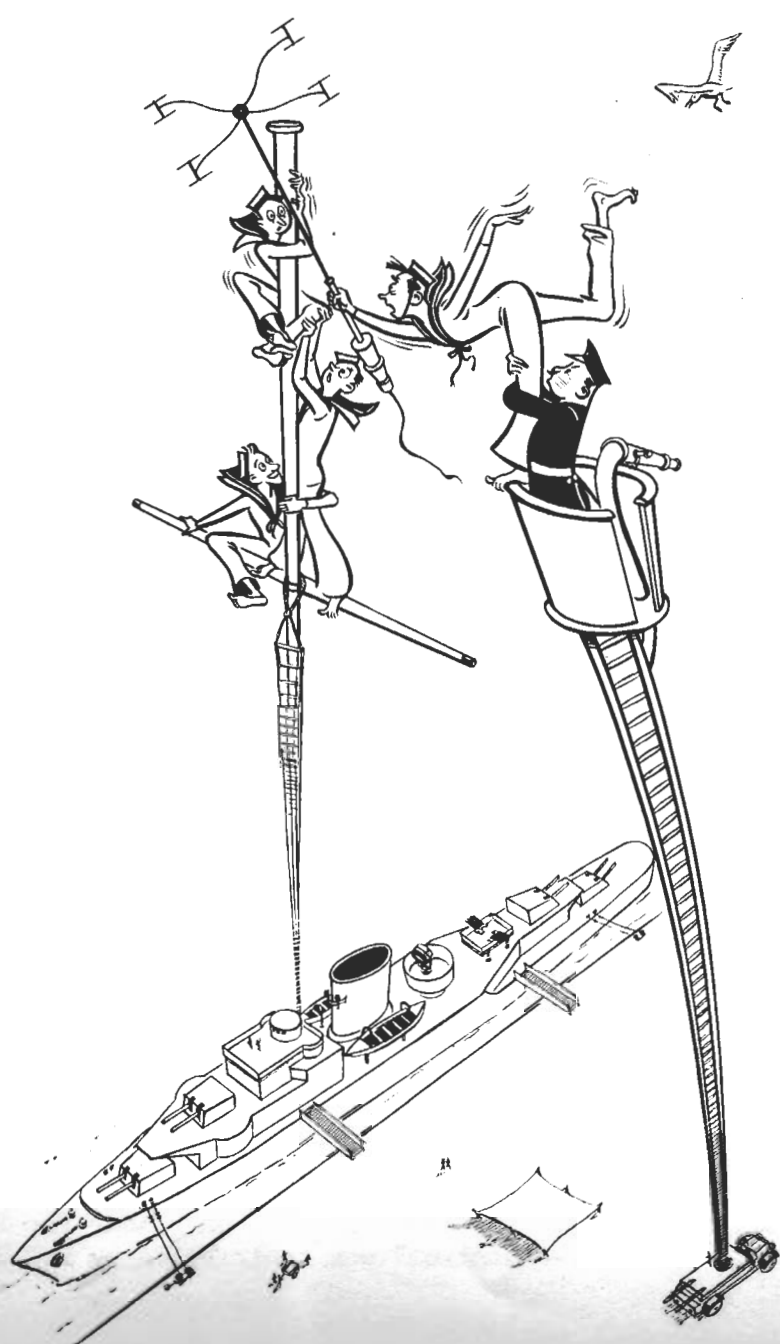
FIRE

The following has been submitted by Lt. G. S. Fowler, R.N.V.R. and - we think - shows considerable ingenuity.

"It occurs to me that you may be interested to hear of the way in which we were able to get over a difficulty in the fitting of an aerial at Leith recently. It so happened that we had several masthead jobs occurring at the same time, in addition to which there was a considerable amount of merchant shipping requiring crane facilities; so on one particular job we were completely unable to obtain a crane to complete the fitting in the time available.

Having arrived at this impasse, the bright suggestion was made that we should request assistance from the Fire Brigade, and they were kind enough to give us a loan of one of their 90 ft. motor-driven turret escapes with which we were able to complete the job.

We are curious to know whether or not this is the first time this method has been used where crane facilities are at a premium. In any case, we feel that the idea may be useful in other ports."



DINK

RADAR FOR TORPEDO

CONTROL

In order that Torpedoes may be fired in Radar control, the Radar Organisation must provide the following :-

- (a) A Radar line of sight with a bearing accuracy of ± 1 degree;
- (b) Information concerning the target's range, course and speed;
- (c) A visual indication as to whether any friendly ships are likely to be endangered by the intended line of torpedo fire.

RADAR LINE OF SIGHT.

This can be obtained from any suitable P.P.I. in the following manner :-

- (a) The selected target is indicated to the P.P.I. "Teller" by the T.C.O., who receives his instructions from the Command;
- (b) The "Teller" keeps his cursor aligned on the target, and "tells" the bearing verbally;
- (c) A torpedo rating applies this bearing to a Torpedo Bearing Transmitter which is situated alongside the P.P.I.
- (d) The bearing transmitter actuates
 - (i) A Binocular sight on the Compass platform by A.R.L. Power Gear.
 - (ii) A pointer in the Torpedo calculating instrument.

At a later stage of development, it will be possible for the "teller" to transmit the bearing automatically by alignment of the cursor on the P.P.I. This will dispense with the verbal link and the Torpedo Bearing Transmitter rating.

INFORMATION CONCERNING TARGET'S RANGE, COURSE AND SPEED.

This can be obtained from the local operational plot, which plots all information received from Radar and other sources.

SAFETY OF FRIENDLY SHIPS.

When firing by Radar it may not be possible to verify visually that no friendly ships are likely to be endangered by the intended zone. A portable transparent disc, upon which is engraved the safe and restricted arcs of torpedo fire, will be supplied for attachment to the face of the P.P.I. in these circumstances. It will have an arrow marking the mean course of the torpedoes, and when this arrow is aligned with the correct course on the gyro bearing ring, the T.C.O. will be able to see at a glance whether or not any friendly ships are inside the dangerous area.

Ships which will be fitted with Torpedo Control Arrangements conforming with the above principles are :-

1943 and later destroyers
1944 Cruisers.

Older ships will probably be modernised as opportunity offers subject to the gear being available.

(Editor's Note :- The above article on "Radar for Torpedo Control" was contributed by D.T.S.D.)

IN SERVICE

(On information received by Forms S1183; See A.F.O.
4136/43).

Defect forms No. S1183 are now being returned to A.S.E. in considerable numbers, and are providing much valuable information for the improvement of W/T and Radar equipments. Urgent action is being taken by A.S.E. to deal with all defects of which appreciable numbers have been reported.

It is not possible to reply individually to each form S1183 received, but the following list of some of the major and most common defects that are being dealt with should be of interest, particularly to those who have been good enough to send careful and comprehensive reports; it will show that their good work has not been wasted. (The list does not cover valve defects, reports of which have also been received in considerable numbers, and which are being dealt with separately and with equal urgency.)

RADAR.

1. Type 242 Patt. No. 7844. Defective follow-up switch. Improved replacement is now in hand.
2. Type 282/4/5 Condenser Patt. No. W1428. Many general complaints received re this condenser. Manufacture has now been improved.
3. P.P.I. Defective Electrolytic Condensers. New lay-out and design O.K. Oldham Depot is altering all sets in store to give more ventilation. New type of condenser is being looked for to avoid trouble in future designs.
4. Type 251M Bad Planned Packing. Plugs, leads and valves are now packed separately to avoid breakage in transit.
5. Type 276. Misalignment of Blower Motor. Design now modified to clear trouble.
6. Type 291 Transformer Patt. No. W4246. Breakdown of Insulation. Improved type now being issued.
7. Type 291 Transformer Patt. No. W4245. Breakdown of Insulation and secondary winding etc. Production of improved replacement Patt. No. W4245A is now under way.
8. Type 281 Breakage of Valve Leads (NT86 and NT78A). Replacement leads now available and S.N.S.O. Glossop is replacing all defective leads on all sets in store.

W/T.

9. FM7 and FM12. Bad switch contacts. Unsuitable cleaning fluid is being withdrawn and composite cleaning and lubricating fluid being issued as produced.
10. Type 89 Filament Transformer W103. Defective transformers of U.S.A. manufacture are being replaced by new design of home manufacture.

LIST OF "M" PUBLICATIONS PUBLISHED DURING PERIODMARCH - JULY 1944.

<u>"M" No.</u>	<u>Title</u>	<u>Author</u>
M597	The Effect of the Output Circuit on the Frequency and Power of the Magnetron.	C. Domb.
M600	Medium Precision Ranging System.	H. A. Prime.
M601	The Design of Klystron Oscillators and Amplifiers for Maximum Power Output.	A. H. Beck.
M602	Report on Infra Red Progress and Development for Period November 1943 - February 1944.	-
M603	A.G.L.1 Trials.	A. Hamilton.
M604	Electrolytic Condensers. General Information on Design, Production and Application.	M.V. Pirie.
M605	Report on the Photo D/P Plotter.	E.J.W. Underhill. B.R. Fraser.
M609	Review of the Display of I.F.F. with British Naval Radar.	A.G. Bogle.
M613	Pulse Display and Repetition Rate Indicator.	-
M617	Equivalent Circuit of any Lossless Transition Region between Two Uniform Transmission Systems.	S. Kuhn.
M623	Direction Finding on Multiple Ray Morse Signals. Final Report. (Quench Morse Selector).	-

FUTURE OF RADAR OFFICERS

It is sad, but safe, to say that no final decision has yet been reached on this burning question. That there is a future in the Royal Navy for Radar officers is, however, beyond doubt; Radar has come to stay and so, in one form or another, has the Radar officer.

The indications are that Radar equipment will in the future be looked after by an Electrical officer who will also be responsible for all Electric and for W/T equipment. In a Battleship one would expect to find an Electrical Commander and two or three junior electrical officers. Obviously existing Radar officers would form a very suitable nucleus for the Electrical Branch.

The future in the Royal Navy of the less technical and more executive minded officer is not so clear. Proposals have been put forward but they are sub judice and no indication can be given as to whether they are likely to be accepted. It is very much hoped, however, that an executive avenue of some sort or another will be found.

(Editor's Note :- The above was contributed by the staff of C.R.T.)