AUTO – ALIGNING

The 'M' Type, or step by step, system is used to drive the scan coils of P.P.I.s and other remote displays. This system is not ideal for the purpose as it is not self aligning, but it was the only system which had been sufficiently developed and for which equipment could be produced for the P.P.I. programme. When the requirement for inter-switching of displays between Radar sets whose aerials were not driven in synchronism arose, it became very desirable to develop a system of auto-lining-up which would enable a display to be switched between sets without stopping the aerials to re-align the display to the new set. If the system could also be made to automatically bring the display back into line if it got out of line due to any failure of the drive from the control table to the display or to the aerials this would be an important additional advantage. It may be mentioned that in Types 277 and 293, considerable trouble has been experienced with the drive from the control table to the aerials and steps are being taken to overcome these troubles.

A system of auto lining-up was developed which it was hoped would meet the above requirements. The system is described in the new P.P.I. handbook C.B. 4298/44. Briefly it provided, by means of relays and a break mechanism, that the trace stopped rotating as it passed through the 12 o'clock position if the aerials were not then pointing to true north (as indicated by a special aerial and gyro repeater in the Radar Office). The display remained locked with the trace in the 12 o'clock position until the aerials passed through true north when the display started in synchronism with the aerials.

Unfortunately certain difficulties have been experienced with the system during tests. Very accurate adjustment of the relays is required to insure that the display lines up at the correct position. Allowance must be made for the inertia of the rotating mechanism in the P.P.I. which cannot be started and stopped instantaneously. Adjustment which is suitable for aerials rotating at say 7 r.p.m. may be wrong for 2 r.p.m. or 15 r.p.m. Settings for correct alignment with aerials rotating in one direction may give incorrect alignment when the aerials are rotating in the opposite direction. Variations in the Low Power supply also present difficulties as the correct adjustment of the relays will vary with the voltage available. A further difficulty which is now expected, is very short life for some of the relays when handling a number of displays simultaneously.

The matter is still under investigation, but it has been decided for the present that ships should not attempt to operate the system. Further instructions will be promulgated shortly.

The importance of being able to switch a display from one set to another without stopping the aerials is fully realised and the suggestion described later in this note may be tried by ship's Radar Officers.

In order to make it easier to check that a display is in alignment, a ship's head marker which is a line of light on the face of the P.P.I. in the ship's head position is being substituted for the ship's head lamp. Details of the modification to the P.P.I. to provide this are being promulgated. It is regretted that the official version is more complicated than the method employed by at least one ship to achieve apparently the same result. Unfortunately the simple method introduced a large range distortion as well as a sector at the ship's head in which echoes did not appear on the scan.

Unfortunately no ship's head marker transmission is available from Types 281/B/BP/BQ.

With this modification it is possible to line up a display by breaking the aerial bearing switch on the supply board, a few degrees off the ship's head position and making the switch again when the ship's head marker appears. The number of degrees of aim off required depends on the aerial speed, but with practice the system will be found to be reasonably satisfactory.

It should be particularly noted that the ship's head marker is about 4° broad, the mid point corresponding to ship's head. The front edge of the marker appears much more clearly than the rest. This edge must not be taken for the mid point.

The following modification to the P.P.I., which is easily within the capabilities of ships' staffs provides accurate manual lining up of a P.P.I., displaying Types 277, 293 or other sets with true bearing transmission to the P.P.I., without stopping the rotation of the aerials of the set concerned.

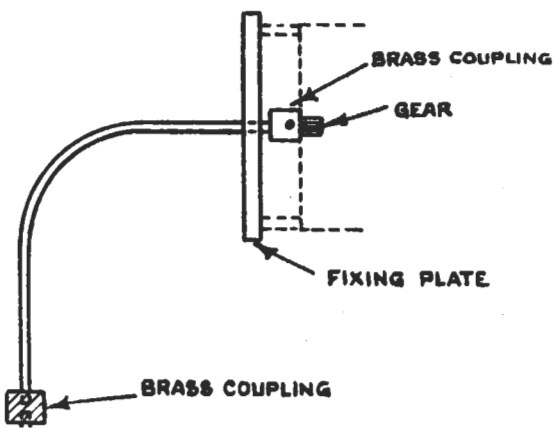
1. Remove fixing plate from the side of the differential. This plate has a small gear-wheel attached to it. Remove the gear wheel, from the plate and cut the gear as shown :- i.e. $\frac{3}{8}$" from flat end.

2. Make up a coupling from a suitable piece of brass rod. At one end drill a hole sufficient to take the small gear wheel (i.e. 3/16" diameter) and 3/16" long. The length of the coupling being 3/8". At the other end drill a hole of sufficient size to permit entry of the flexible cable. Sweat the cable in and hold the gear wheel in the other end by a grub screw (6BA).

3. Drill a hole in the fixing plate itself at its centre sufficient in diameter to allow flexible cable to pass through it. Slip the plate over the cable.

4. The free end of the cable is now sweated into another brass coupling, the other end of which is connected to a suitable handle which is in front of the P.P.I., and is held to the spindle of the handle by a grub screw. This necessitates drilling a hole in the front of the P.P.I.

5. It will be found that one complete rotation of the handle corresponds to $\frac{1}{2}^{\circ}$ of bearing.



GUNNERY NOTES

TYPES 282/3/4/5.

Valve Circuit Unit Design C. - CV970.

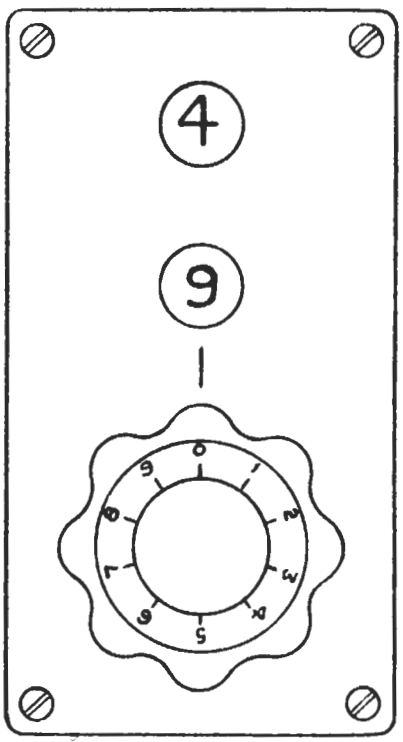
In a recent Radar Routine Report it was suggested that the M56 Valve Circuit Unit should have the frequency to which it is constructed stamped on it.

It is pointed out that these valves pass test at 600 Mc/s and that any further adjustment can be made in accordance with instructions given in the Amplifier M56 section of the C.B.4221 series of handbooks.

RECEIVER P24.

A suggestion has been received from CRT for marking and numbering the eight corners of the turning knob of the P24 in order to improve the accuracy of reading off the correct tuning position.

A.S.E. prefers the knob to be subdivided into ten parts and a reference mark to be painted under the lower window as shown here.



FAILURE OF SYNC PULSE TO REMOTE PANELS.

In the Type 285 series of Gunnery sets, sync pulses and video signals have to be distributed to various remote panels. Distribution is made by Cathode followers in two or more Boards Distributing and by means of Pattern 13831 cable between the boards and the various panels. It often happens that a sync or signal pulse disappears from one or more panels due to faulty cathode follower valve, a broken lead, or more likely a faulty connection in one of the terminating plugs. These faults can quickly be traced by using an ordinary pair of W/T telephones as a monitor; tests at any point where sync or signal pulses exist should produce an audible 500 cycle note in the telephones.

ACCURACY OF MODIFIED L24 RANGING PANEL

Every month Devonport Gunnery School send us a copy of their Type 285 Range Accuracy Report. On the 7th December last, we received one of particular interest in that both the Panels L24 used for compiling the report had been modified in accordance with C.A.F.O. 1767/44. By comparing the results with the average of those obtained in the previous five months, it is seen that no change in accuracy has occurred due to the modification.

Type of Set	Ranging Mark	True Range	Ranging Panel	Index Errors	Mean Variation.	Consistency
285 P(4)	Eddystone	20520 yds.	Modified L24	+ 153 yds.	23 yds.	17 yds.
			Average for unmodified L24	+ 150 yds.	26 yds.	19 yds.
285 P(3)	Eddystone	20520 yds.	Modified L24	+ 166 yds.	28 yds	15 yds.
			Average for Unmodified L24	+ 151 yds.	24 yds.	20 yds.

"EXCELLENT" have been carrying out trials to determine this same accuracy and consistence, using photographic recording. The following is taken from their official report :-

Range Accuracy Results.

Run	Course	Bias in yds.	Average Residual in yds.	Number of Readings
Overall	Total	-12	12	1508
Overall	Opening	- 6	10	. 712
Overall	Closing	-18	14	796

Conclusions.

From the results obtained the performance of the modified L24 panel is considered satisfactory.

Throughout the trial the zero setting was constantly checked and no shift was detected.

Recommendations.

During the course of these trials investigations were made into the best way of setting up with the modified ranging mark. The three methods investigated were :-

(i) Ranging on the leading edge of the echo.
(ii) Ranging half way up the leading edge.
(iii) Ranging on the leading edge of the echo with a "threshold" between the ranging mark and the leading edge (as recommended for L22 panel).

Using method (i) operators experienced difficulty in determining when they were in fact on the leading edge and this caused unsteady following.

With method (ii) it was difficult to gauge the mid position on the leading edge due to the shape of the echo, and in the case of very weak echoes the ranging marked completely swamped the echo.

Each operator then set up the panel using method (iii) and found this to be the most satisfactory. The trials reported on above were carried out using this method.

LINING UP PANEL L22 WITHOUT G41.

(By Lieutenant S.T.P. Allsopp, on the staff of C.R.T.).

This method can only be used with "P" versions of Type 284 or Type 285, since Panel L24 is used in place of G41 to produce thousand yard markers on the L22 scan. It will be found most useful if G41 is out of action, or is not available for any other reason. The accuracy of calibration obtained will be as great as if G41 were being used.

The method of connecting up Boards Distributing according to specification is shown in Figure 1, output point No.14 on Board B being taken to the picture input socket on L24.

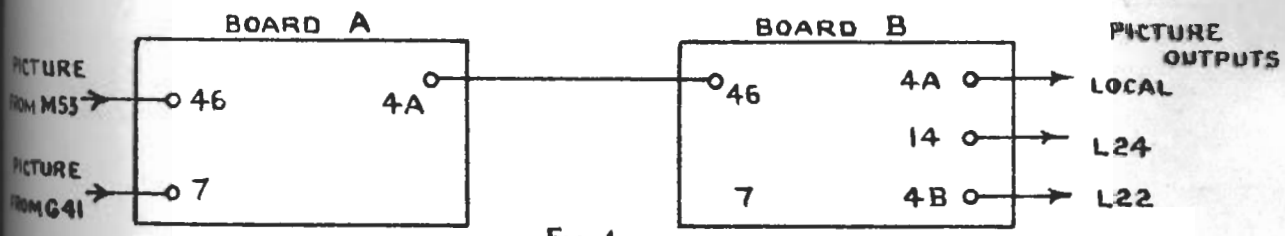


FIG. 1.

To use L24 as a calibrator for L22, the following changes should be made :-

(i) Remove the plug from L24 Picture Input (14) and place it in the socket marked Index (21).

(ii) Remove the lead from socket "Picture in" (46) in Board B.

(iii) Remove the lead from Picture Remote (14) in Board B and replace it in socket 46 (Picture in).

The connections will now be as in Figure 2, and the L24 index

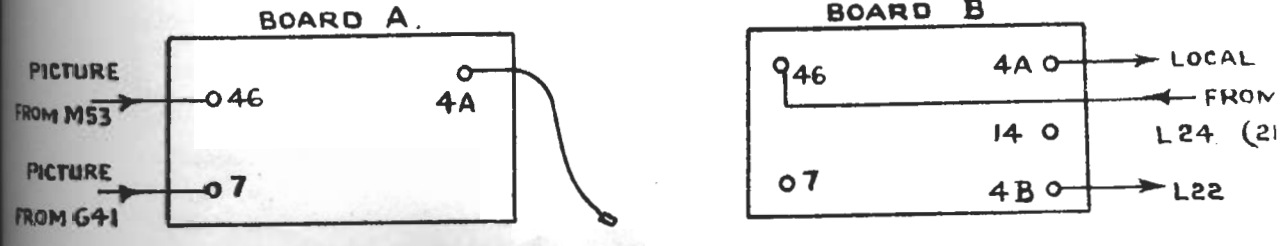


FIG. 2.

marks will be transferred to the L22. The calibration switch should of course, be left in the up position.

To obtain "sync" for the L22 is a simple matter, since the 3AH or 3AD sync pulse can be used, and it is only necessary to switch on the modulation generator or Initiator (firing from L24) when the sync pulse will arrive at the L22, providing both switches on the Boards Distributing are in the up position.

The display on L22 will be as in Figure 3, where the step is shown positioned for calibrating. The tail could be removed if it was found to be objectionable by temporarily short-circuiting the compensating inductance in the anode of the final video stage in L22. The ranging gonio of L24 should be used as the "R/F phase control".

FIG. 3.

This system can be used with the modified version of L24 in which case the calibration marks will be of the shape shown in Figure 4.

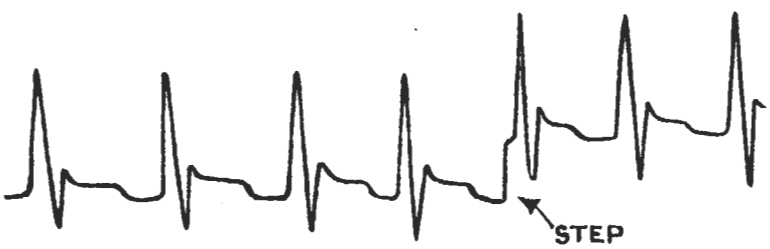


FIG. 4.

The short damped oscillation can be removed by short-circuiting the anode load inductance of the final L22 video amplifier.

SHELL SPLASHES.

The information in this article was obtained during the course of experiments carried out by an Army research unit. It was intended for Coastal Gunnery spotting but will be found of general interest.

If detection range is plotted against height of radar set for (1) Shell Splashes and (2) Ships, the two curves will be found to differ considerably. This is due to the very different nature of a shell splash.

For a 6" shell the splash consists of a "boil" of water about 12' in height and a "plume" of spray rising to about 150' above the sea. The reflecting power of the spray is much less than that of the "boil" and it diminishes rapidly with height. To the eye a shell splash appears as in figure 1. To an "S" band radar set the splash is "seen" as in figure 2.

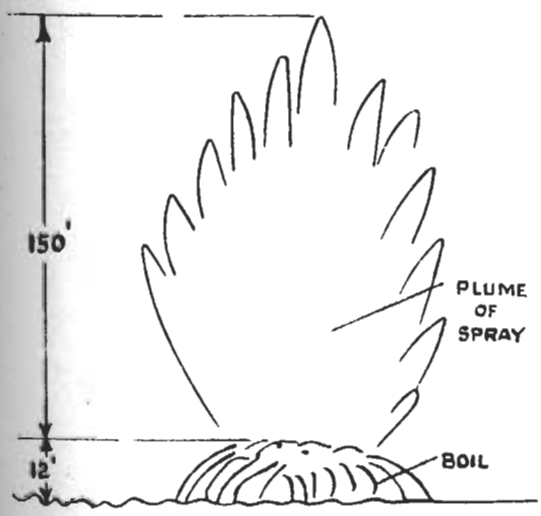


FIG. 1.

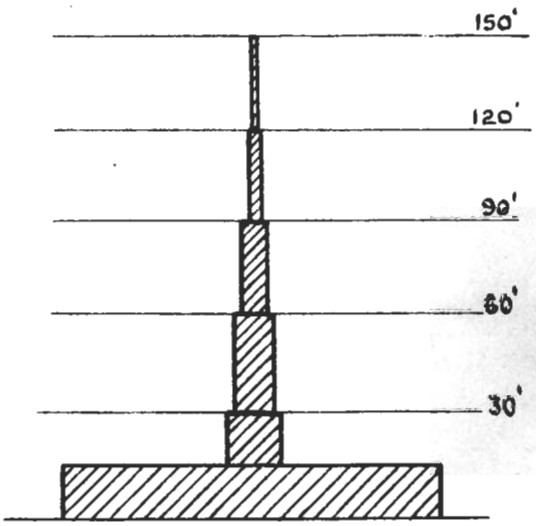


FIG. 2.

It will be seen that the "boil" presents to the radar set an area eight times as big as the lowest section of spray. Unfortunately for Naval users, a radar set cannot be sited at sufficient height to take advantage of reflection from the "boil" so that the reflecting power of the "plume" assumes great importance.

In figure 3, 6" shell splashes are shown at ranges of 10,000 yards, 20,000 yards, and 30,000 yards. Lobes are shown for "S" band radar sets at heights of 50' and 350'. For the high sited sets the "boil" extends into the "lobe" at 10,000 yards and 20,000 yards, and is only just below it at 30,000 yards. For the lower sited set, the "plume" only extends into the lobe at 10,000 yards and 20,000 yards.

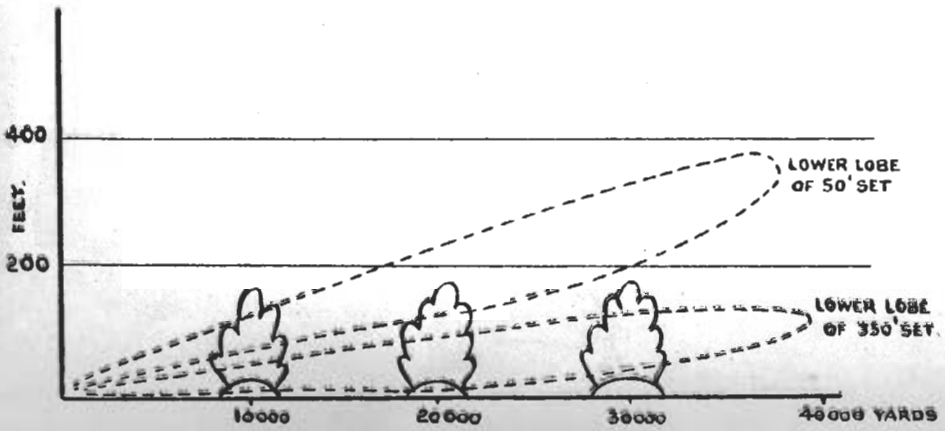


FIG. 3

Some interesting facts which were found during these experiments are set out below :-

(i) It was noticed that the shape of the signal strength/range curves for 6" differed for H.E. and for practice shell. The size of the splash from H.E. is independent of range being produced by the energy of the bursting charge, while that from practice projectiles is dependent on the energy remaining at the moment of impact and the angle of descent. The response from the two types of shell were equal at 10,000 yards, but thereafter that of the practice shell diminished with gun range until at 25,000 yards it was only half that of H.E.

(ii) The "plume" rises to a maximum height in 1 to 2 seconds, but falls more slowly so that the duration of the whole phenomenon may be as much as 10 seconds. During this time the spray may be blown clear of the "boil". This was observed both visually and by radar. An echo from a 15" H.E. splash was observed on a windy day to split into two parts one of which remained stationary while the other drifted 300 yards down wind before fading.

(iii) In a 15" H.E. splash the "boil" is 20' in height and the reflecting area is greater than 6" H.E. by 6 db (4 times the energy is reflected).

(iv) Owing to the greater scattering power of drops of water for the shorter wavelengths the effect of the "plume" of spray will be greater if the wavelength of the radar set is small. This aspect has been considered in the development of the Fall of Shot sets mentioned on page 3 of Bulletin No. 4.

YOU WIV YER 'ANDS IN YER BECKETS LIKE A BLEEDIN' RADAR OFFICER! — GIT CRACKING!

AMPLIFIER M56.

The following has been received from the Squadron Radar Officer, Home Fleet Destroyers:-

"I should appreciate some further amplification of the statement under 'A.S.E. Comment' on Page 50 of RH.600(4).

'As one Amplifier M56 gives little gain in Signal/Noise Ratio with Receiver P24 in any case the suggestion will not then apply.'

On this my comments are:-

(i) If true it seems a pity then to fit M56 with this mixer unit.

(ii) On the general grounds that Mixer stages are inherently more "noisy" than Amplifier stages it seems rather improbable.

(iii) Practical experience indicates that with a good valve circuit unit design "C" (poor specimens are frequent) a worthwhile gain in Signal/Noise Ratio can, in fact be obtained.

My local orders indicate that unless the improvement in Signal/Noise Ratio by the use of M56 exceeds 3 : 1, the gear is to be considered as defective.

A.S.E. comments as above appear to suggest that we are wasting our time trying to achieve the unattainable. Further advice is therefore sought."

Replying to the above points in the same order in which they are raised, A.S.E. comments:-

(i) The improvement in P24 is mainly due to the diode CV58. As the clearance between Cathode and Anode in this valve is less than 1/10 m.m. under operating conditions it is essential that the H/F Voltage from the transmitted pulse applied to the cathode should be limited so that sparking which would destroy the diode does not take place. For this reason although M56 does not give any great improvement it is retained as a "buffer" stage between the aerial and the P24.

(ii) It is not agreed that diode mixers are more "noisy" than amplifying stages.

(iii) A good V.C.U. will show a slight improvement in Signal/Noise ratio, an average one will not.

Only about one V.C.U. in a thousand gives an increase of 3 to 1 (10 dbs.) in Signal/Noise ratio over P24 - or even P20 - when working properly.

With both P24 and P20, the V.C.U. should not be condemned unless the increase in noise as well as signal (not signal to noise ratio) is below 3 : 1, or there is a definite loss in Signal/Noise ratio.

A.S.E. applauds the sentiment which strives for the best but shudders to think of the number of useable V.C.U.s, Design C, Home Fleet Destroyers must be getting through.