GUNNERY RADAR

TYPE 282/3/4/5.

AMPLIFIER M56.

A suggestion for using two Amplifiers M56 in cascade has been received from C.R.T. after experiments carried out at Eastney Fort East. Using a Receiver P.20, an increase of 6 db. in Signal/Noise ratio is claimed for this arrangement.

A.S.E. Comment.

P.20's are shortly to be replaced by P.24's. As one Amplifier M56 gives little gain in Signal/Noise ratio with Receiver P.24 in any case, the suggestion will not then apply.

The increase of 6 db. with the P.20 must have been obtained at the expense of bandwidth and stability; degrading of the pulse shape and instability are obvious undesirables.

Another suggestion for M56 from C.R.T. reads as follows:-

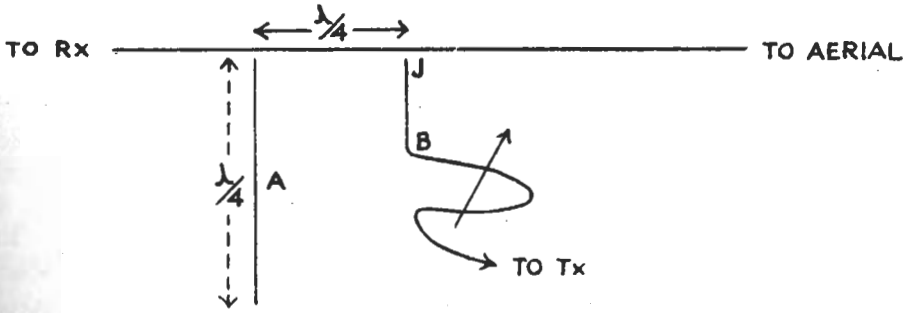
"Since certain M56 failures may be attributable to failure of H.T. supply or fuses, it is suggested that an H.T. indicator circuit should be incorporated, consisting of a small osglim neon in series with 100,000 ohms across the H.T. supply with a hole bored in the front panel to make the neon visible."

A.S.E. recommend neon lamp Patt. W4251 with a hole $\frac{3}{8}$" in diameter.

SWITCH UNIT, COMMON AERIAL.

The following suggestion has been received from C.R.T. for tuning the Common Aerial Switch. The use of a lamp, the impedance of which is not matched to the system, is frowned upon, but the method can be recommended when no echoes are available and provided a final check with the neon is made on the output of the Amplifier M56, where matching will not affect the tuning of the Switch.

Adjustment of Line A to $\lambda/2$.



A very accurate method of adjusting line A is afforded by the use of a neon lamp W1188 (as issued in Officers' tool kit).

Procedure.

(a) Close spark gap.
(b) Disconnect feeder to receiver at R and hang lamp on centre pin of socket at R.
(c) Adjust A and observe the points at which the neon strikes and extinguishes, taking readings on scale S.2 at the lower end of line A.

Typical Readings (taken at Eastney Fort East).

Type 285P(4).

(The position in which the neon did not glow was first determined).

(a) Increasing S.2 reading, the lamp struck at 5·3
(b) Decreasing S.2 reading, the lamp extinguished at 4·8
(c) Decreasing S.2 further, the lamp struck at 4·2
(d) Increasing S.2 again, the lamp extinguished at 4·7
By taking the mean of (a) and (c) a value of 4·75 was obtained.
By taking the mean of (b) and (d) a value of 4·75 was obtained.

Later, after the tube had been fully struck by altering A very much from its normal value of $\lambda/2$, on returning to the minimum position given above, the lamp did not actually extinguish and the position of minimum brilliance was clearly observed to be 4·75. The adjustment was VERY critical, and the whole procedure appears to be very much better than using Lampholder unit 2145a.

It is suggested that the above method be used when strong echoes are absent. When strong echoes are available the "minimum echo method" would be employed as the Switch Unit Common Aerial would then be set up under actual working conditions."

The following suggestions have been extracted from a very comprehensive report to Admiralty made by H.M.S. BLACK PRINCE:-

"

Calibration of C.R. and R. Units.

Range scales of Kodatrace, graduated in thousands of yards have been fitted on all units, in T.S., Directors and Offices, and these are found most valuable for target indication purposes; frequently it is necessary to refer to an echo before the Panel L.24 has ranged on it, and when consequently there is no strobe to act as a guide. Before affixing the scales, the green celluloid screens were removed in all cases to make the graduations more legible; as the Director tubes are not operated by a man who requires his eyes to be correctly "night adapted", there is no disadvantage in this.

The tubes are calibrated by the G41 oscillator. (See next paragraph).

Calibration of Type 284 C.R. and R. Units.

As no G41 Oscillator is fitted with Type 284, in order to calibrate the tubes (as mentioned in the preceding paragraph) it is necessary to "borrow" calibration pips from the G41 of a Type 285 set. Two leads have been made up, using half-inch Uniradio cable terminated by a Plug Patt. 4335 at one end, and a Socket Patt. 10H/160 at the other. These are then connected from the Picture Output and Sync. of the G41 Oscillator to the Picture Input and Sync. Input of the Type 284 Board Distributing.

Shades Over Panel L.24 Long Range Tubes.

In ships were the L.24 Panel is fitted in the T.S. or H.A.C.P. where the illumination is of necessity kept fairly high it may be convenient to fit small metal shades over the tubes to reduce direct light on the face of the tube.

Tallying of Cables.

Tallies easily legible have been fitted to the numerous leads to and from the Board Distributing.

Removal of Spark Gap.

After removal of the top horizontal contact carrier of the Switch Common Aerial for cleaning, it is found difficult to effect replacement. A polythene "keyway", situated on the aerial feeder side of the spark gap makes this operation much easier."

P.P.I. NEWS

DO YOU SET UP YOUR RANGES CORRECTLY?

Do you, when working with Type 277 etc., (i.e. at 500 cycles p.r.f.), turn the Range Control on the front panel slowly clockwise from zero, or anti-clockwise from full, to get the right number of pips on the long range? You should do the former, to avoid the "counting down" (i.e. firing on alternate sync. pulses), which may occur if ranges of more than about 80 miles are attempted at 500 cycles p.r.f.

Do you, when adjusting the Linearity Control, always make sure that there are no pips "piled up" at the start of the scan? It is a good idea to "stretch" the start of the scan right out first of all (by turning the Linearity Control fully clockwise), and then draw the pips back slowly to their correct spacing.

Do you, when trying for that last half millimeter of lining-up accuracy, make use of the fact that the Linearity Control affects the first half of the scan a good deal more than it affects the outside? and conversely, that the Scan Amplitude Control will "stretch" or "squeeze" those outside pips while leaving the inner ones almost untouched?

COMING SHORTLY!

Here are some notes on certain modifications to Outfit JE likely to be promulgated by A.F.O. in the near future.

Calibrator Monitor Point Modification.

At present the Calibrator Monitor Point (orange pye plug) gives a sinewave output, or, if the modification described in C.A.F.O.622/44 Section 3 (b) has been carried out, negative pips. By connecting the orange pye plug (via a condenser) to the cathode of V11 instead, and inserting a 100 ohm resistance in the lead to C33, an output of positive pips of about 5 volts amplitude can be obtained. This output is a low impedance one so that calibrator pips can be piped away via a terminated line to any other display. This may prove a useful way of checking the calibrator frequency of one P.P.I. against that of another. This output can also be used for calibrating the scans of the Type 281B Warning Tube or Panels L37, L43. (As part of this modification a spot of white paint will be put on the front panel immediately below the pye plug in question. This will save trouble later).

High Impedance Sync. Input.

The Sync. Pulse is fed at present via a 50 ohm potentiometer (VR1) into the cathode circuit of V1. Unfortunately it is not possible to get over this cathode feed by any simple change, so that the input impedance cannot be made really high, but it can be put up to about 250 ohms simply by removing VR1 and connecting the Sync. Input (brown pye plug) directly to C1. This will enable several P.P.I.'s situated close together to be fired in parallel from any 40 ohm line where only one could be fired before.

So that sync. pulses of any amplitude can still be catered for, a potentiometer of 10,000 ohms should be substituted for R8 (to "pot" down the pulses reaching the first grid of V2 from the anode of V1, if this is found necessary for stable firing). R4 should at the same time be changed to 10K 1W and R5 to 470 ohms $\frac{1}{2}$W.

When these changes have been made it should not be found necessary (with any normal type of sync. pulse) to vary the new Sync. Preset potentiometer at all. Stable operation of the time base should always be obtained with this potentiometer set to maximum. (As is usual with Sync. Presets this control should, if not set to maximum, be turned up as fully as possible, since if the time base is "only just" firing it is quite likely to be starting a little late).

A spot of white paint will be added to the front panel immediately to the left of the brown pye plug when this modification is carried out.

High Impedance Signal Input.

This modification consists simply in removing R85 (100 ohms) from the circuit and so putting up the input impedance to 5,000 ohms. Several P.P.I.'s may then (under certain circumstances) be fed from a 70 ohm cable. In this connection the article "Remote Displays" (particularly the section "Alternative Suggestions") in the September issue of the Bulletin should be consulted.

This modification may have been carried out already to your Outfit JE. If so, put a spot of white paint on the front panel immediately to the left of the blue pye plug.

Coupled Pair of P.P.I.'s (For use with Type 281B etc.)

If a resistance of 100 ohms is inserted between the condenser C24 and earth, a positive pulse is developed across this resistance at a precise moment that the brightening pulse ends. (If R40 is decreased to 100K this pulse is more pronounced). It can be used to fire a 2nd P.P.I. (if the latter has a high impedance sync. input - see above), which therefore "starts where the first leaves off" so far as the range of the display is concerned. This is the principle of operation of a "Coupled pair" of Outfits JE. The "Inner" P.P.I. displays 0 to 80 miles while the "Outer" displays 80 to 160 miles. Care must be taken to see that the scan of the inner P.P.I. really does stop at the 80 mile calibration pip or a constant error will be introduced on the outer P.P.I. The scan on the "Inner" P.P.I. is lined up against the first 80 miles of either the 100 mile range on Perspex Mask W8060 or the Spider-web Mask A.P. 56754. The scan on the "Outer" P.P.I. can be lined up similarly (add 80 miles to the scale reading), or better, the 50/500 cycle switch on the side of the unit can be put to the 500 cycle ("down") position and an "Open Centre" display obtained, i.e. one in which the scan starts on a circle of approximately 3 cm. diameter. This reduces the distortion of the picture near the centre and avoids the considerable bearing inaccuracies that might otherwise occur at ranges just over 80 miles. A new Spider-web Mask (A.P. 58246) to fit this Open Centre display will be ready shortly.

10 Mile Calibrator Pips.

This is a modification to simplify the setting up of the time base on long ranges. (A spot of white paint will be put immediately below the Calibrator ON/OFF Switch).

Spider-web Mask A.P. 56754.

This mask has range rings every 10 miles from 0 to 100 miles and bearing lines every 10°. It is for use mainly in aircraft plotting with Type 281B.

Strobe Input

A strobe from RTA or RTC (late RTU52) can be displayed as a range ring on the Outfit JE, if a resistance is inserted between the condenser C43 and earth and the low voltage side of this condenser connected to a new pye plug on the side panel. This new pye plug should be marked "Strobe Input" and have a black ring painted round it. The intensity of the strobe ring must be controlled from the "Positive Amplitude" preset on the Strobe Generator Unit.

8000 Yard Scan with Open Centre.

By disconnecting the lead from Tag A of S2 to the potentiometer VR5, decreasing the resistance R91 to 470 ohms 2w. and turning the Range A control well down, a scan of less than 10,000 yards can be obtained (at 500 p.r.f.) on Range A. If the Range A control is reduced still further, an open centre appears and a 8000 yard scan between this open centre and the edge of the tube can be obtained. This may be a useful display with Types 267W, 277, 293 etc.

If, in addition, R23 is changed to 2·2K, 5W (use the "old" R91), normal operation can be reverted to instantaneously by putting the 50/500 cycle switch to the "up" position since this makes the cathode circuit of the time base valve virtually what it was (for 500 cycle working) before.

Electrolytic Condensers

An A.F.O. is being issued which tells you how to move C10, C13, C17, C32 and C46 away from the transformer T1 and the valves V4 and V5 and mount them in the blank space available beneath the chassis. (Until such time as you are able to carry out this modification why not slip a piece of 1/16" asbestos card between these condensers and the offending transformer and valves?).

THE "BRIGHTNESS", "LIMITER" AND "INPUT" CONTROLS

It would appear that the respective functions of these three controls are not always as clearly understood as they might be. The following notes should help to clear up any misconceptions that may exist.

The story is quite simple, really. Think for a moment of how the brightness of a spot on an "intensity-modulated" C.R.T. must vary with the voltage applied to its grid. The relationship drawn as a graph, will look (to a first approximation) rather like a valve characteristic of Ia against Vg. When Vg is more than a certain amount negative (with respect to cathode), there will be no spot at all. As Vg becomes less negative the spot will appear faintly at first but increasing steadily in brightness as Vg changes. As the spot increases in brightness, it will unfortunately increase also in size, until a point is reached at which its size becomes unacceptable. The spot is then said to have become "de-focussed". This has nothing to do with the setting of the "Focus" control. The spot will still be in the best possible focus (for that amount of brightness) but what has happened is that the "best" is no longer good enough. The spot must <u>not</u> be allowed to become so bright. Thus the upper limit of swing along the "grid characteristic" is fixed by this occurrence of de-focussing. This point is, by the way, still many volts negative to cathode - it has no counterpart in ordinary valve theory.

Now for practical details. What are we going to take as the bias point for the video signal on this characteristic? The answer is that since the video signal is positive-going, we must bias to the bottom of the characteristic. This is done by taking the video signal away altogether (turn "Input" right down) and setting the "Brightness"

control so that the rotating trace just shows. (A glance at the circuit diagram will show that the "Brightness" control is, in fact, the bias control, i.e. determines the working point on the characteristic). Next, turn up the "Input" control until the ground wave is painting fully, and adjust the "Limiter" until the ground wave (and large echoes, if any) are just not de-focussing (see above). Note. It's simply an accident of the particular circuits used that the "Brightness" and "Limiter" controls have to be adjusted in this order. The "Limiter" does not, in fact, of its own accord, determine the top point of swing along the grid characteristic, but only how many volts above the bottom point this shall be. Hence the bottom point has to be fixed first.

It remains only to adjust the "Input" control correctly. Assuming you want maximum range, i.e. best detection of weak echoes, which is almost always the case, you must turn the "Input" up until the noise shows as a firm speckled background. In other words, to spot small echoes almost hidden in the noise you must have sufficient noise on the screen to begin with. Try this adjustment out when you get the chance, on a barely visible steady echo, making sure first of all that the "Brightness" and "Limiter" controls are correctly set as described above. When you've brought the echo up as well as you can make a mental note of the sort of noise background you have and stick to it in the future. (Remember, this test is only fair if carried out on the smallest possible echo).

The above discussion makes several assumptions and cannot be regarded as a proof that this setting-up procedure is correct, but it does at any rate give a reasonable theoretical explanation of a drill that has been established otherwise, viz. by carefully controlled experiments under true operational conditions.

If it is found impossible to turn the "Limiter" far enough down, reducing R74 (to 4•7K, say) will remedy this.

Since the settings of the "Brightness" and "Limiter" controls depend only on the characteristics of the cathode ray tube and not on the amplitude of the received diode signal, both controls should be regarded as pre-sets. The "Limiter" is a pre-set control already. It is suggested that the "Brightness" control should have its knob removed to indicate that it, too, is not to be altered by the operator. The only important "operator-controlled" knobs will, in fact, be the "Input" and "Focus" controls. It is suggested that these should be painted, white and yellow respectively, to make their identification doubly sure.

It might be a good idea to post an instruction card near any P.P.I. operated by non-Radar personnel, as follows:-

(1) CHECK THAT WITH "INPUT" RIGHT DOWN, ROTATING TRACE JUST SHOWS.
(2) TURN "INPUT" UP UNTIL FIRM SPECKLED BACKGROUND APPEARS.
(3) ADJUST FOCUS.

A SUGGESTION

If you have a spare RTU52 and this is used to fire an Outfit JE at some predetermined time after the transmitter pulse, you can get an enlarged picture of any selected "ring", say 40 to 50 miles, of the normal Type 277 etc. display. This should give improved discrimination on distant targets or groups of targets. (Note that 2 microsecond pulses displayed on an Outfit JE require a scan of 10 miles or less if best discrimination is to be obtained. At slower scan speeds the spot size becomes comparable with the pulse length).

RADAR FITTING AND MAINTENANCE NOTES

TYPE 79B.

A recent report indicates that some trouble is experienced with nuts attached to the rotatable support arms X469 of the aerial array. These loosen and drop off. This is an old fault, oft-reported. It is suggested, in the case of ships having similar difficulty, that at the next quarterly cleaning period, the arms and nuts should be drilled and a split pin fitted.

TYPE 242

It is a common fault of these units that the I.F.F. video signals appearing at "Output to Indicator" "bifurcate" (i.e. appear as two short pulses instead of one) when the "Separation" control is turned to maximum. This is not important if the bifurcation does not appear at normal settings of the separation.

When, however, the bifurcation appears at normal settings, the condition is more serious, and can be improved by a minor circuit change, and if necessary by changing the valve V7 (VR65).

The circuit change is to disconnect the bottom end of R19 (4700 ohms) from earth, and to connect it to the junction of R22 (220 ohms) and R23 (5000 ohms potentiometer).

TYPE 244

An error has occurred in the setting up instructions in the handbook. Para 7(a) Page 2 of RH616 reads "Sync. Switch to External Sync.". This should be Sync. Switch to Internal Sync.

TYPE 271Q

AMPLIFIER M.59

Several failures of the I.F. amplifier M.59 in Type 271Q have occurred because vibration has caused the resistance R.25 (Fig. 13A in C.B. 4231B) to bend over and touch the frame of the amplifier, resulting in an H.T. short circuit and the overheating of the transformer pattern W3975 (T1 in fig. 20 in C.B. 4231B).

Ships should ensure that this resistance is securely mounted and should mount a thin sheet of insulating material to cover the frame of the amplifier opposite this resistor. In later serial numbers of the amplifier this modification has been carried out by the manufacturer.

TYPES 271/2/3P

INTERFERENCE WITH W/T SETS

Complaints have been received in A.S.E. to the effect that a ship's Type 271P is causing interference with one or more W/T receivers. This effect is almost invariably due to faulty bonding of R.F. feeders and pulse cables.

(a) The outer sheath of the pulse cable should be carefully bonded to earth at the point where it enters the transmitter box.

(b) The pulse lead should be bonded where it leaves the modulator panel.

(c) The R.F. feeder should be bonded at the back of the mirror.

(d) The R.F. feeder should be bonded at the point where it leaves the transmitter box.

If the above measures are carefully carried out interference should be eliminated.

TYPE 272 - AERIAL LEADS

Fitting out Specification B147/42 Addendum D and C.A.F.O.781/44 give instructions for fitting a plug board (supplied in box patt.55575) in the Type 272 aerial lantern so that the moving parts of the leads between Radar office and aerial lantern can easily be repaired if damaged.

It has been observed in some ships that this plug board has been fitted beside the aerial pedestal near the training stop. This means that the leads have to cover a rotation of up to 360 degrees. If the plug board is fitted on the opposite side of the pedestal to the training stop the maximum rotation required for the leads is only 180 degrees in any one direction, with consequently greatly reduced strain and number of failures.

Ships with Type 272 should therefore check the position of the plug board and, if it is on the side of the training stop, have it moved as soon as possible to a more satisfactory position.

TYPE 272

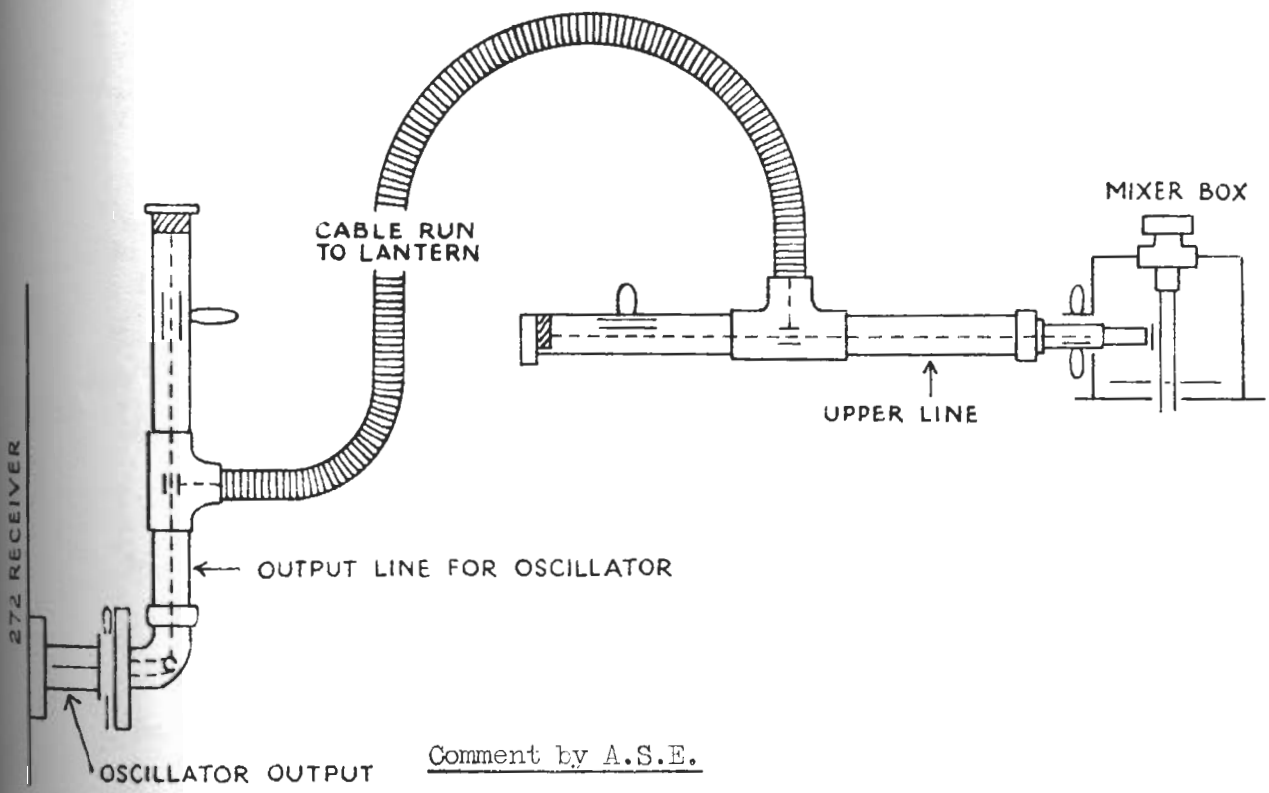
LOCAL OSCILLATOR MATCHING

The following is an extract from a report by the Radar Officer of Escort Group 37 :-

"It was thought that by accurately matching the input and load, to feeder impedance, a considerable reduction in loss in the local oscillator circuit might be obtained. Anode line units (as used in Type 271/2P etc. for magnetron output) were therefore fitted, with suitable mechanical adaptations, at the output of the oscillator line and at the input to the crystal mixer box. In each case the feeder was taken to the output tapping of the transformer (see diagram). With CV 35 kept tuned for maximum echoes, the shorting plungers and tappings were adjusted for maximum crystal current. The results were as follows :-

(1) With one matching transformer only, at the CV 35 output, an increase of 60% in crystal current was obtained, over its original value (CV35 current steady). Stability of CV35 operation was improved, and a slight improvement in echoes also resulted.

(2) With a second line, at the crystal mixer input, only very slight improvement over the above was obtained (10% increase in crystal current) by adjustment of both lines and tappings. It would appear that one line completes the matching of feeder within practical limits, the upper end being equalised by the variable coupling and tuning of resonator box. The results seem to show that mismatching was sufficient in this case to warrant the permanent fitting of the lower adjustable transformer. Also, since the degree of mismatch in the fixed system probably varies considerably, it is possible that in some ships, this addition might make a greater improvement. The improvement in performance would be particularly noticeable in ships where crystal current is normally very low."



Comment by A.S.E.

It should be possible to achieve this result by increasing the coupling at the L/O loop until the cable becomes matched to the L/O. Perhaps the loop here used was abnormally small. Certainly it is advantageous to match the L/O cable to the oscillator output and this method could well be used if orientation of the loop fails to achieve matching. The use of matching section at the mixer and however is not desirable as any increase of coupling here will mean that the local oscillator cable is also tightly coupled to the aerial and will therefore absorb signal energy.

TYPES 276/277/293

SPARKING AT VARIAC BRUSHES

Much trouble can be avoided if the brushes of the Variac in the Modulator Panel are inspected and ascertained to be operating correctly.

A slight flicker of the H.T. meter needle generally indicates sparking at the brushes and this can be cured by insuring that the brushes are able to slide freely in the brush holders. If they are stiff they will have to be removed and the brass carrier carefully filed sufficiently to allow free movement of the brush. Before replacing, carefully scrape away any signs of burning, making certain that the brush has a clean edge.

TYPES 276/277/293

VENTILATION IN OFFICES

These offices are provided with either a $7\frac{1}{2}$" or a 10" exhaust fan, the natural supply inlets being situated at deck level. The reduced pressure in the office resulting from the powerful exhaust causes air to enter not only via the approved natural supplies but through voice pipes. This air is generally foul because it comes from another enclosed position.

A diaphragm consisting of thin paper glued to a cardboard ring can be inserted in the voice pipe and will effectively block the air without stopping the sound.

TYPE 277

STOWAGE FOR GYRO VERTICALS

It is important that spare Gyro Verticals are stored in a place where there is a minimum of vibration; the units should not be removed from the double cardboard container until they are required for use in the stabiliser unit.

Vibration, when the gyro is not rotating, rapidly destroys the bearings, rendering the gyro useless.

PACKING OF GYRO VERTICALS FOR USE WITH AUK AERIAL STABILISERS

Recently certain defective Gyro Verticals returned from ships for survey were so badly damaged in transit that no useful purpose would have been served by taking the matter up with Messrs. Sperry and Co.

The packing case for a Gyro consists of two strong cardboard boxes, the inner one being separated from the outer by a one inch space maintained by cardboard spacers.

All Gyros, not in use, whether defective or not, should be stored in the packing cases in which they are supplied.

RUBBAGLEX SEALS IN AUK AERIALS

One or two ships have complained that this waveguide seal burns out. This may be due to one of two circumstances.

(a) A rough edge of the metal part of the seal may flash over.

(b) The magnetron volts may have been turned up too rapidly while the outside of the seal was wet.

As a precaution the seal should be inspected for any such rough edges which should be carefully removed with a file. The H.T. should be turned up slowly to dry the seal before full power is used.

If the seal is destroyed and no spare available the best substitute is 5/1000" thick mica sheet which has proved quite satisfactory.

TYPE SK

It has been found in A.S.E. that the life of Eimac 327A Oscillator Valves is considerably increased if:

(a) A constant voltage of 10·8 is maintained.

(b) The valve is comfortably fitted with no distortion of points, nor pressure on the glass seal.