I.F.F.

PART II - MK. IIIG.

(Continued from Page 41 Bulletin No. 1)

MK. IIIG TRANSPONDER

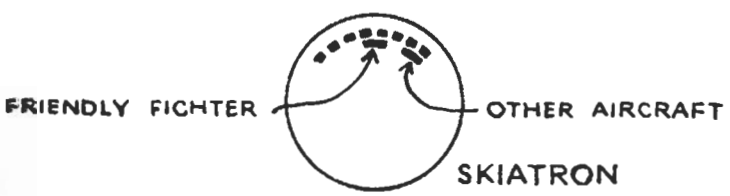
The Mk. IIIG Transponder fulfils the normal function of a Mk. III set and in addition has a 'G' band unit, originally intended to give identification direct to G.C.I. Stations. The 'G' band unit operates on a pre-set fixed frequency in the 'G' band. It is brought into position for a period of about 15 seconds by means of a push button switch controlled by the pilot. To permit normal Mk. III and 'G' band facilities to be available simultaneously, the bands are automatically switched on and off alternately 5 times a second. This has the secondary effect of 'chopping' the 'G' band response.

R.A.F. USE OF MK. IIIG.

There are occasions when an F.D.O. must be able readily to distinguish his own fighter formation on the interception plot. At a G.C.I. station it is necessary merely to tell the pilot by R/T to press the G band button and the 'G' response will then appear on the G.C.I. plan display symetrically about the echo of the aircraft concerned.

NAVAL USE OF MK. IIIG.

To make this facility available to ships fitted with Type 281 and skiatrons, it is proposed to fit such ships with a 'G' band interrogator, to be known as Type 941. The aerial for Type 941 will be similar to, and will replace, the existing Type 243 aerial. A remote control box at each interception skiatron will give choice of "Radar only" or "Radar and G band", the combination chosen at one skiatron being independent of that on the other displays.



MK. III INTERROGATION

Type 941 will enable the F.D.O. to pick out his own fighter formation on the skiatron. Type 243 will still be necessary for normal identification of Type 281 echoes. An independently controlled Mk. III aerial, Aerial outfit AQF similar to ASS, will be fitted for use with Type 243. In ships without an R.D.R. the Type 243 responses will be displayed on the Type 281 A scan and the Type 243 aerial will be controlled by a hand wheel to be fitted adjacent to the Type 281 Aerial Control Unit. In ships with an R.D.R. the Type 243 response will be displayed on a panel L43 in the R.D.R. alongside the Type 277/L43 and worked by the same operator, the Type 243 aerial being remotely controlled from the same position.

I.F.F. SUMMARY.

In a ship fitted with Type 281 and skiatrons in the A.D.R., the following interrogation facilities will be available.

(a) R.D.R. Central interrogation position, equipped with two panels L43 worked by an Interrogator Operator aided by the Remote filtered plot and the plan displays in the R.D.R. Information from central interrogation position will be directly available to A.D.R. (for air) and O.R. (for surface) and thence to remote filtered plots, A.D.P. etc.

(b) A.D.R. Presentation of G band responses on skiatrons under direct control of F.D.O. enabling him to pick out his own fighter formation. Main Display Plot fed with I.F.F. information direct from R.D.R.

(c) T.I.R. The T.I.O. will have a panel L43, displaying Type 293/242, for his own use, making possible rapid identification of targets inside the 'artillary zone'.

W/T TRANSMITTERS

THE 600 SERIES.

The term '600 Series Transmitters' has been given to the medium and low power, high and medium frequency transmitters at present being developed in A.S.E. and referred to in the last number of the A.S.E. Bulletin.

In this issue it is intended to give a brief general description of these transmitters together with an outline of their application to ships. Table A contains a description of the transmitters, Table B shows their application to various classes of ships.

As certain details of design of the series are still incomplete, it is not yet possible to provide a technical description of each transmitter. It is hoped to include such a description in the next issue of the Bulletin.

TABLE A

Type No.	Description and Frequency Range.	Wave-form.	Power Supply and load.	Size.	Replaces
601	50 watts, H/F 1·5 to 24 mc/s.	CW MCW R/T	230 volts 50 cycles 600 V.A.	One rack 3'8" high 29½" wide 15" deep	Types 60F 60D (H/F only)
602E	50 watts H/F M/F. with emergency battery operation. 200 to 500 kc/s. 1·5 to 24 mc/s.	CW MCW R/T CW ICW	230 volts 50 cycles 600 V.A. 24 volt battery.	One rack 5'6" high 29½" wide 15" deep	Type 60E etc.
603	400 watts H/F. 1·5 to 24 mc/s.	CW MCW R/T	230 volts 50 cycles 4 K.V.A.	Two racks each: 6' high 29½" wide 23" deep	Type 89 TBK TBM
604	400 watts M/F. 200 to 500 kc/s.	CW MCW	230 volts 50 cycles 4 K.V.A.	Two racks each: 6' high 29½" wide 23" deep	TAJ
605	400 watts H/F M/F. 200 to 500 kc/s. 1·5 to 24 mc/s.	CW MCW R/T	230 volts 50 cycles 4 K.V.A.	Three racks each: 6' high 29½" wide 23" deep	Type 49 TBL TAJ/TBK

TABLE B.

Type of Ship.	No. 1 T.R. or U.T.R.	No. 2 T.R. or L.T.R.	R/T room	B.R.R.
Battleships and Cruisers.	59 603/2. 602E. 601	604. 603. 601/2		602E
Fleet and Light Fleet Carriers.	59 603/2 602E. 601	604. 603. 601/2	603/3	602E
Flotilla Leaders Tribals Fast Minelayers	605 602E 601	602E		
Fleet Destroyers	605 602E 601			
Escort Destroyers Hunts, Sloops, Frigates, Fleet Minesweepers, Corvettes other than Flower Class.	603 602E			

Note: Limitations of space will, in a large number of cases, preclude the fitting of 603/602E in existing ships of these classes.

AERIAL ROTATION SPEED

RADAR SETS TYPES 276/277/293.

The speeds of rotation chosen for Types 276/277/293 are essentially a compromise between,

(a) The necessity for a slow speed to ensure a 'paint' each rotation of the aerial of weak or fading signals.

(b) the necessity of a fast speed for the set to operate efficiently as a warning or target indicating set of fast closing targets.

2. With highly directional sets such as these and with continuous rotation the beam will only be 'on' the target for a short period, and thus the number of pulses falling on the target during each rotation will be limited. The number will depend on

(a) Speed of rotation of aerial.
(b) Beam width.
(c) Pulse repetition rate.

It is believed that if each individual pulse which leaves the radar set hits the target and returns, is investigated, then behaviour is found to be largely random. Thus with a fading signal it is found that five or six pulses may give no results, followed by one or two giving large signals. The number of pulses returned will depend to a certain extent on such points as the aspect of ship and sea and weather conditions. Thus to ensure a good 'paint' for every rotation of the aerial it would be necessary to have a very slow speed of rotation. These conditions are met with when the set is carrying out WS functions.

3. To give efficient warning, particularly of aircraft, a high speed of rotation is necessary owing to the distance an aircraft can travel during a single rotation of the aerial. Moreover, it becomes more important because it is not certain that an echo will be detected by an operator during its first 'paint' on the P.P.I. Thus with Type 276 which will give low flying cover, but only for short ranges, a slow speed of rotation might mean that an aircraft was very close to, or over, the ship before being detected by the set.

4. Type 293 was designed to work in conjunction with a Target Indication Unit to disseminate range and bearing of targets to the High Angle weapons. Since fast moving close range targets have to be dealt with it is essential that information be kept up-to-date, and this is only possible with a high speed of rotation.

5. Thus if a slow speed of rotation is used it is ensured that all possible signals are received, but operationally the set will not be used to its best advantage, whereas if a fast speed is used weak signals may be missed and targets at long range may not be detected. Speeds have been selected for the aerials which will, it is hoped, give the best results from the sets. A.S.E. will welcome reports from ships as to the correctness of the choice of speeds for Types 276/293.

T.P.I.

TARGET POSITION INDICATOR.

The Target Indicating System for Air Defence is described in C.A.F.O.'s 1633/43 and 123/44. It provides target indication to the long and close range H.A. directors and A.D.O. sights. Type 293, with alternative display of Type 277 if fitted, will display on a T.P.I. (Target Position Indicator) which is fitted in conjunction with the T.I.U. (Target Indication Unit). The range scales of Type "B" P.P.I. of 15,000, 75,000 and 150,000 yards are not suitable for target indication work, so, during development, some T.P.I.'s with range scales of 15,000, 30,000 and 75,000 yards for gunnery target indication were introduced.

Towards the end of development, it was found that the limits of adjustment of range calibration on the P.P.I. were wide enough for the P.P.I. to be calibrated to T.P.I. ranges without any internal difference, except for the cutting out of R90, to cover T.P.I. ranges. T.P.I. was, therefore, dropped as a separate unit and it was decided to supply each P.P.I. with two perspex range scales and two engraved name-plates for the range change switch, so that each unit could be used as either P.P.I. or T.P.I.

In considering the most suitable range scales for P.P.I.'s in different positions in the ship, it was found that frequently T.P.I. scales were more suitable, which led to certain confusion in that target position indicators were being fitted where the use would be plan position indication. There is, therefore, a tendency now to drop the name T.P.I. as it can only apply to the display unit fitted in the target indication unit. This particular unit is, at present, different in the following respects to P.P.I. fitted elsewhere :-

(a) A special true bearing ring will be provided which will have a white back-ground with black lettering so that the H.A. Director identification letters on the ends of the lines projected by T.I.U. can be more easily seen. As soon as production of this bearing scale is in full swing, all P.P.I.'s will be so fitted.

(b) The relative bearing ring will have distinctive colouring such as, white marks to show head and stern, red and green strips on the bows, and red and green spaced markings on the quarters. This is appearing early in the production and so will not be specially supplied for target indication.

(c) Blank perspex dial. As range marks are projected on to the perspex dial, engraved dials are unsuitable and one blank dial is, therefore, supplied for each target indication unit.

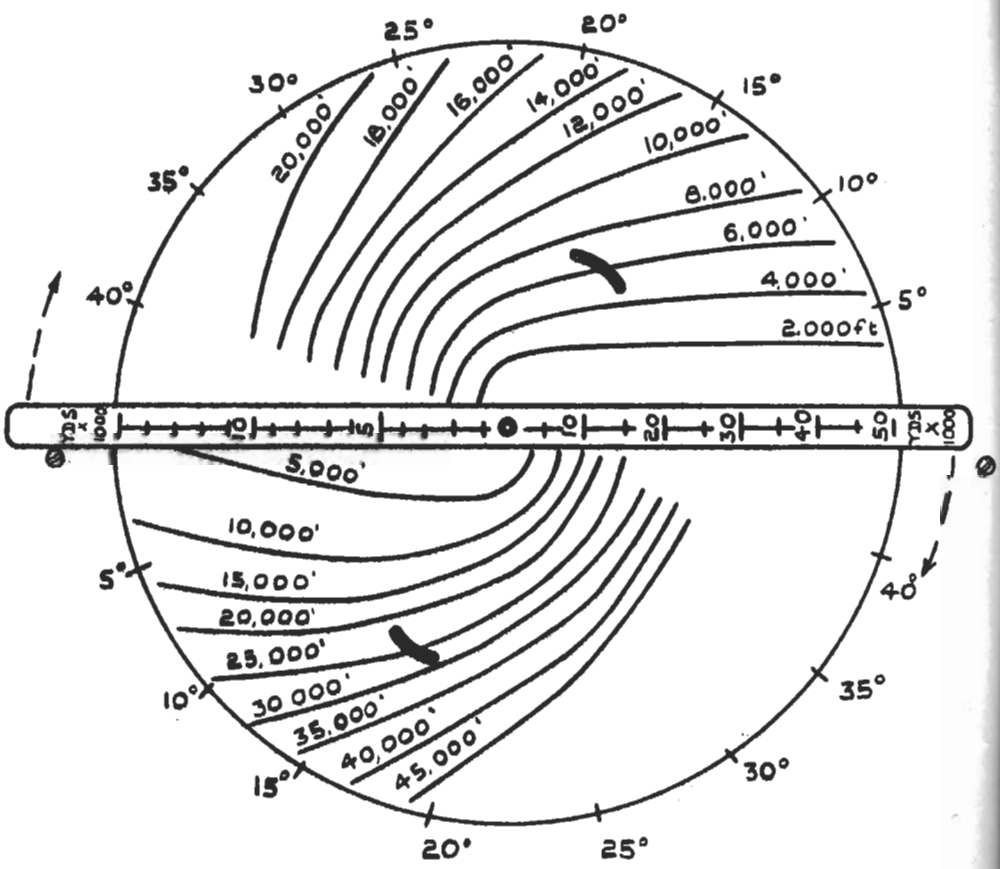
NOTES :

(i) Type 'A' P.P.I., which is used with Type 281, has 50 mile and 100 mile scales, (the third position of 15,000 yards is retained but normally will not be used). Owing to the great difference in range scales from the Type 'B', this could not at one time be included in one unit, but has now been achieved so that the only difference is that Type 'A' will, for the present, have gyro mixing inside the unit, as relative bearing only is available from Type 281. It is hoped shortly to have a suitable differential in production, which will fit into the control unit 20D to give true bearing transmission to the P.P.I. when the gyro motor in the P.P.I. can be blanked off.

(ii) With Type 'B' P.P.I. the additional perspex dial and range scale tally plate are packed inside the P.P.I. packing case.

(iii) The engraving of perspex covers has been one of the difficulties in production of P.P.I. and was for some time the holding item. It has now been found possible, however, to engrave a suitable "Spidersweb", but the difficulty will be to arrange for the different range scales, as these scales do not have the same degree of non-linearity. A solution will be sought when the first "Spiders-web" perspex cover is received and when the amount of error that will be introduced, and that can be accepted, has been considered.

H.P.I.



HEIGHT POSITION INDICATOR,

AS EMPLOYED WITH TYPE 277.

The Height Position Indicator is a normal-type P.P.I., modified so that the switch to long range also reverses the scan coil connections, and arranges to feed the aerial elevation, multiplied by four, to the P.P.I. rotation.

The upper half of the scan is used with a scan length (radius) of 15,000 yds., and the lower half with a 50,000-yd. scan.

Angles of elevation up to 45° are marked round the circumference of each half, and a double-ended cursor, rotatable in one direction, through 180° only, and graduated in "slant range", is fitted to assist in reading the elevation.

"Constant Height Lines" are engraved on the tube face mask as shown in the diagram.

In operation, the aerial is trained on the target bearing and swept up and down. As the strongest signal is received at the correct angle of elevation, the echo "paints" a bright arc on the screen. The height of the target is given by the height line that coincides with the centre of the arc (positions between height lines being interpolated) and the "slant range" and angle of elevation can be read by the help of the cursor.

The examples shown are :-

(i)	On upper half	Elevation 16°	Figures purely illustrative - not consistent among themselves.
		Slant range 7000 yds.	
		Height 6000 ft.	
(ii)	On lower half	Elevation 17°	
		Slant range 30000 yds.	
		Height 25000 ft.	

The H.P.I. will be fitted in the height filter position in most ships and the Type 277 operators will be given the correct bearing of an aircraft from the air warning P.P.I. (from Types 279 or 281). The Type 277 aerial is then trained on this bearing to allow the H.P.I. operator to height-find in the manner outlined above.

It should be noted that height finding on aircraft below angles of elevation of 4° is unreliable.

TUNING H/F W/T TRANSMITTERS

The importance of ensuring that the maximum amount of energy produced by an H/F transmitter is transferred to its aerial is obvious, but it is apparent that the best indication that an efficient transfer is taking place, the anode feed meter, in the final stage, is not so widely known and too much stress has, in the past, been laid on the reading of the aerial ammeter.

2. Some general notes on the tuning of the final stage and aerial circuit of H/F transmitters are given below. These notes have already been promulgated in A.F.O. 1969/44.

(i) The method of tuning the early stages of a transmitter varies, according to the type of drive employed, but the method of tuning the final stage and aerial circuit is, in general, similar in all transmitters, and should be carried out as follows :-

(ii) (a) Set the aerial coupling to minimum.

(b) Set the tuning controls of the final stage to the positions indicated in the calibration charts for the frequency required.

(c) Tune the final stage to anode current dip or oscillatory current peak or such other indication of resonance as may be fitted.

(d) Adjust the aerial circuit tuning control until an increase in anode current to the final stage is shown.

(e) As adjustment of the aerial circuit will affect the tuning of the final stage, the tuning of this stage should be checked and brought to a position of minimum anode feed.

(f) The aerial coupling should now be increased until the anode feed to the final stage reaches a maximum or the maximum permissible figure for the particular transmitter.

(g) As the increase in aerial coupling will probably affect the tuning of the final stage, the tuning of this stage should again be checked and brought to a position of minimum feed and, if necessary, the aerial coupling increased to bring this minimum up to the maximum or permissible figure for the particular transmitter.

(iii) It is of particular importance that the tuning of the final stage should be checked after every alteration to the aerial coupling circuit.

INSPECTION OF RADIO EQUIPMENT

(EDITOR'S NOTE :
We occasionally receive criticisms concerning defective apparatus which, to quote the critics, "Should never have passed test." We thought the Bulletin a good place to present the other side and accordingly, asked a member of our harassed civilian inspection staff to state a case. We present his unvarnished account.)

At the commencement of the present war, the Inspection Division of A.S.E. (then H.M. Signal School) comprised a staff of 40 people. The annual expenditure on Radio Equipment has increased to 50 times the pre-war expenditure, but the Inspecting Staff has increased by only 20 times. It is obvious, therefore, that inspection cannot be quite so thorough as it was in pre-war days.

Nevertheless, every effort is made to keep the standard of inspection as high as possible under the present difficult conditions, because it is fully appreciated that the safety and operational efficiency of the Fleet depends ever increasingly on the efficient working of its Radio Equipment.

We have our trials and tribulations, like any other Inspectorate. Just as the Fleet has, we have had to give up expecting "spit and polish" in the equipment and the poor finish of much of it caused many heartburnings amongst us, until it was borne in upon us that, in these days of diluted labour and hasty production, the theory that really matters is to get something that works fitted in the Fleet as early as possible.

On the one hand, the Progress party are continually pressing us to complete the inspection, while the Ship-fitting party are standing by to snatch up the equipment and get it fitted. However, the Ship-fitting party are responsible for final test after installation and, if the equipment we accept satisfies them, we feel that we have not done too badly. So far, the Ship-fitting and Inspection parties have maintained diplomatic relations !

Many of the contractors now making radio equipment for us never aspired, in pre-war days, to anything more intricate than house wiring. We have had to supply them with test equipment and train their personnel to build up their quality of workmanship to the required standard. In the majority of cases, this has been achieved, despite the dilution of labour and the shortage of Inspecting Staff.

We sometimes receive reports that articles are of poor workmanship and ought not to have been accepted by the Inspecting Officer. What is often not known is that the Inspecting Officer originally rejected these articles entirely, and that they have only been finally accepted after much rectification work has been carried out by the contractor. The Inspecting Officer knows that the contractor has done all that possibly can be done with the class of labour available and he accepts the articles if he considers they are up to a standard which will be satisfactory in service. On the following contract, the workpeople are reminded of the previous faults and usually succeed in turning out a superior article with less trouble.

We are at present dealing with some five million articles each month, of which 30,000 are major units requiring radio-frequency tests. We honestly believe that each major unit will have been tested before issue, but an occasional one is bound to slip through accidentally.

Apart from such accidents, Wren couriers have been known to collect from manufacturers and deliver to the ship, apparatus which could not wait to be accepted by the A.S.E. Inspector. Again, the story has been told - and not by us - of loose green "Accepted" labels lying around, being picked up and tied on to the nearest piece of equipment so that it can be issued for service. In fairness to another Department, we must express our incredulity that such a thing could happen in Admiralty circles. In dealing with millions of small components, however, it is obviously economically impossible to examine each one individually.

For certain types of components, the method of "Batch Sampling" is adopted. This is a means of "Quality Control", by which one endeavours to keep a watch on production in order to discover beforehand when a product is about to come outside the prescribed limits. At this stage, the machine is stopped and reset, thus avoiding the production of, perhaps, many hundreds before the fault is discovered.

This method cannot be fully relied upon for such components as resistances, condensers, etc., which need quantitative tests at some stage.

In respect of small resistance rods, it should be noted that their resistance varies with the current and ordinary "Meggers" should not be used for measuring their resistance. A Bridge Megger is, however, suitable.

Talking of meters - do not place too much reliance on your "Avometer" which is not intended to be an instrument of very high accuracy, particularly when used on power supplies of varying frequencies and non-sinusoidal waveforms. Get your Avo checked against a reliable standard and then keep it in cotton wool! But bear in mind that it will be susceptible to changes of frequency and waveform.

In the past radio equipment has suffered a good deal from damage in transit. This aspect is now receiving attention at every stage from that of design to delivery on board. It is confidently hoped that the precautions now being taken will result in much less damage in transit in the future.

Reports of defective equipment are welcomed, because this is one of the main indications of the efficiency of the Inspectorate. Please, however, give the Serial number of the defective component, if there is one, as this is often the only means of tracking down the manufacturer and responsible inspector. The serial number of the receiver or transmitter should also be given.

Much detective work is done on these reports, and it helps tremendously if full information has been given.

In conclusion, all personnel in the Inspection Division have their attention drawn continually to the importance of ensuring that all radio and allied equipment issued to the Fleet is in good working order; and this is their constant aim.