PART 3 : SECTION 2

▶ CHAPTER 5

TACAN

Function

1. Tacan (A.R.I. X1354) is an airborne radio navigation aid which operates in conjunction with a ground beacon and provides a continuous indication of bearing and distance up to 195 nautical miles from the beacon on a single dial in the pilot's cockpit. The ground station can broadcast bearing information simultaneously to any number of aircraft but the maximum number of aircraft able to obtain distance information is limited to 100 from any one beacon. Both bearing and distance functions normally operate during most manoeuvres, but unlocking may occur when the aerial is shielded from the beacon. The equipment will relock almost immediately after the aircraft regains level flight.

GENERAL PRINCIPLES

Heading Indication

2. The azimuth circuits of the airborne equipment detect the signals from the ground beacon and compute the relative bearing. The information is indicated by the bearing pointer on the combined indicator so that the "tail" of the pointer shows the magnetic bearing of the aircraft from the beacon and the "arrow head" indicates the magnetic bearing to home to the beacon (Fig. 1).

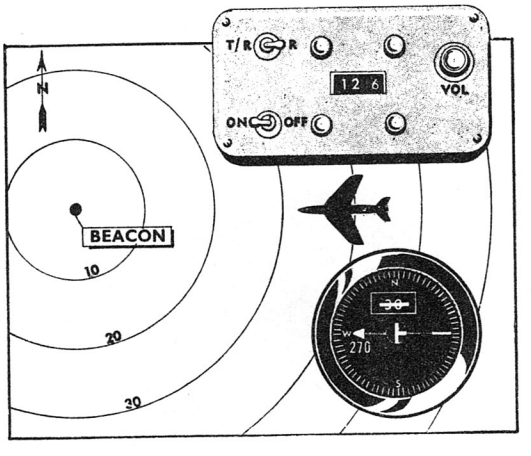

Fig. 1. Switch Positions and Heading Indication

3. An incorrect bearing indication is prevented by the bearing pointer rotating until the proper signal is received when it will remain quite steady on the correct bearing.

Distance Indication

4. Signals from the aircraft transmitter are picked up by the ground receiver and retransmitted to the aircraft. The time interval between the transmission and reception of the signal by the aircraft equipment is measured, converted into a distance and indicated in nautical miles on the veeder dial of the combined indicator (Fig. 2).

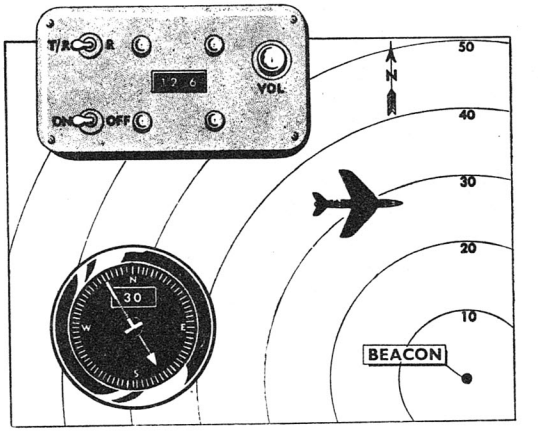

Fig. 2.
Switch Positions and Bearing/Distance Indication

5. The range indicator also searches until it can provide the proper range indication. Whilst it is searching, the distance indicator is covered by a bar which partially hides the numbers. The distance indicator may stop momentarily when spurious signals are received and the bar will rise and return almost immediately. When a correct bearing is indicated the bar will rise and remain hidden as long as the equipment is tuned to the beacon signal.

Beacon Identification

6. Each beacon transmits an identifying code every 30 seconds in morse. The volume can be controlled by a knurled knob on the control box.

Memory Circuits

7. Memory circuits are incorporated in the equipment to permit loss of signal for a limited period before the distance and bearing circuits unlock and begin searching.

Airborne Equipment

8. (*a*) *Transmitter/Receiver* (*Fig. 3*). This unit is capable of transmitting or receiving on any of the 126 channels spaced 1 Mc. apart. The transmitter frequencies occupy the bands 1025 to 1150 Mc/s inclusive and the receiver frequencies occupy the bands 962 to 1024 Mc/s.

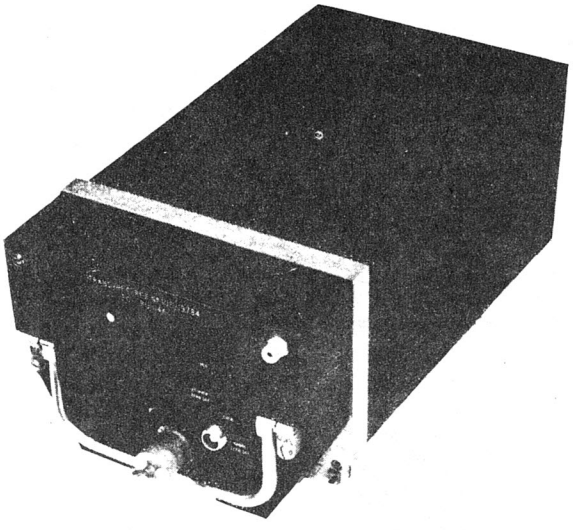

Fig. 3. Transmitter/Receiver Unit

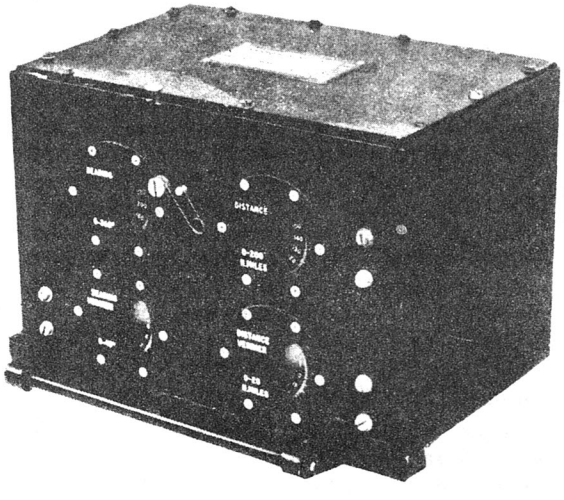

Fig. 4. Coupling Unit

(*b*) *Coupling Unit* (*Fig. 4*). This unit contains the distance and bearing servo motors, resolver and repeater circuit. The front panel of the unit displays both bearing and distance on main and vernier scales. The main scales indicate bearing in two-degree divisions from zero to 360 degrees and distance in one nautical mile divisions from zero to 200 nautical miles. The verniers show bearing in $\frac{1}{4}$-degree divisions from zero to 40 degrees and distance in $\frac{1}{10}$ nautical mile divisions from zero to 20 nautical miles. The unit is capable of operating up to two pilot indicators.

(*c*) *The Pilot's Indicator* (*Fig. 5*). Distance from a beacon is shown by the figures in the rectangular slot; a horizontal bar descends over the figures to indicate signal strength failure or equipment failure. Bearing is shown on a normal 360-degree scale marked off in 5-degree divisions having a centrally pivoted arrow with a luminous "T" over the pivot.

Fig. 5.

Pilot's Indicator

(*d*) *Control Unit*. The early type (Fig. 6) contains two selector knobs; 126 channels can be selected, the tens figures being moved by the left and the digits by the right-hand knob. The channel selected is shown in a window between the two selector knobs. A volume control for the aural identification signal and a three-position switch complete the controls. In the central "Rec" position only bearing information is available; in the T/R position both bearing and distance functions operate.

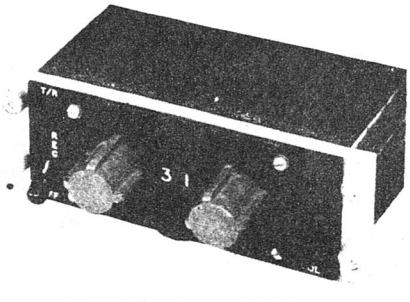

Fig. 6. Control Unit

(*e*) *Later Type Control Units.* Fig. 1 shows how later type control units will appear. With the ON/OFF switch in the ON position and the top switch in the "R" position, only bearing information is provided; in the "TR" position both bearing and distance functions operate. Four push buttons control channel selection; depressing the top buttons increases the figures and depressing the buttom buttons decreases the figures, the left buttons move the tens and the right the digits.

(*f*) *Aerial Type 100 (Fig. 7).* This is a normal small "sharks fin" antenna.

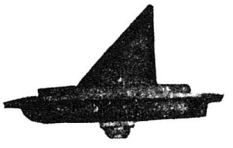

Fig. 7.
Aerial

OPERATION

General

9. The following operating checks and adjustments include both pre-flight and flight checks. No adjustments can be made to the equipment in the air other than control box selections. The pre-flight checks explain how adjustments can be made.

Pre-Flight Checks and Adjustments

10. The aircraft should be positioned at a known distance and bearing from a beacon. The distance should be at least one-half mile. Make the checks and adjustments as follows:—

(*a*) Select a channel other than the one chosen for the check and set the VOL control halfway between its extreme settings.

(*b*) Set the OFF—T/R switch to REC (on later control boxes set the T/R—R switch to R and the ON/OFF switch to ON). After 90 seconds the bearing needle should be spinning.

(*c*) Select the chosen beacon channel. The pointer should stop in a position which indicates the direction of the beacon relative to the aircraft.

(*d*) If the indicator reading differs from the known bearing the Azimuth Zero Set control should be adjusted but it should first be determined that the error is not due to local siting or reflection effects.

(*e*) Set the T/R—OFF switch to T/R (or the T/R—R switch to T/R). After a short period of searching, the bar on the distance indicator should move up disclosing the distance between the aircraft and the beacon. The bearing indication should not change.

(*f*) If the reading differs from the known distance adjust the Range Zero Set control.

(*g*) The beacon identification signal should be heard on the pilot's head-set.

(*h*) Select a different channel. The identification signal should cease, the bearing needle should begin searching and the bar should descend across the distance figures. If the check is satisfactory, switch the equipment OFF.

Flight Checks

11. Although no adjustments can be made the checks outlined in para. 10 can be carried out in the air and the readings obtained should be compared with known readings from a chosen beacon.

12. It is possible for the instrument to have a 40-degree error although the presentation appears normal. If such an error is suspected bearings should be confirmed by another aid. If satisfactory distance and bearing indications are not available on a particular channel, select another channel known to be operating within 195 miles range. If satisfactory indications are obtained from the alternate channel it may be assumed that the original beacon is inoperative. A faulty transmitter or range unit may prevent satisfactory range indications in which case REC. or R should be selected. In this manner bearing information on a particular beacon is available when distance information is not.

Let-Down Procedure

13. In the United Kingdom the beacons are sited to give area cover primarily, but suitable procedures can be evolved to position aircraft for a precision radar approach. Each airfield may present a unique local situation requiring a special procedure, the following is an example and assumes the beacon is on the airfield (Fig. 8). Initial approach points X.Y. and Z. are established 55 nautical miles from the beacon on TACAN radials 220°, 240°, and 260°. Aircraft are assigned one of these points when departing on a mission which requires their return to that aerodrome. When returning to the aerodrome the aircraft proceed, singly or in formation to their assigned approach point using TACAN. On arrival they perform a holding if necessary at 40,000 feet or above.

14. Descent from the respective points should be made on a heading planned to intercept the 240° TACAN radial at 32 nautical miles from the beacon at 20,000 feet. The aircraft then turns on to the 240° radial continuing the descent inbound. At about 23 nautical miles from the aerodrome, monitoring control is transferred from G.C.I. to Search Radar. Position over the initial approach points and "commencing descent" are the only voice contacts required on G.C.I. On transfer to Search Radar the pilot states his TACAN range and this establishes his position on Search Radar. A slight turn may be required to align the aircraft with the instrument runway, but the inbound radial should not be at a greater divergence than 20° from the runway heading. At about eight miles from touchdown and 1,500 feet A.G.L. control is transferred from Search Radar to Precision Radar for completing the approach. The distances quoted above are for a particular aircraft, but appropriate distances can be determined for other aircraft.◀

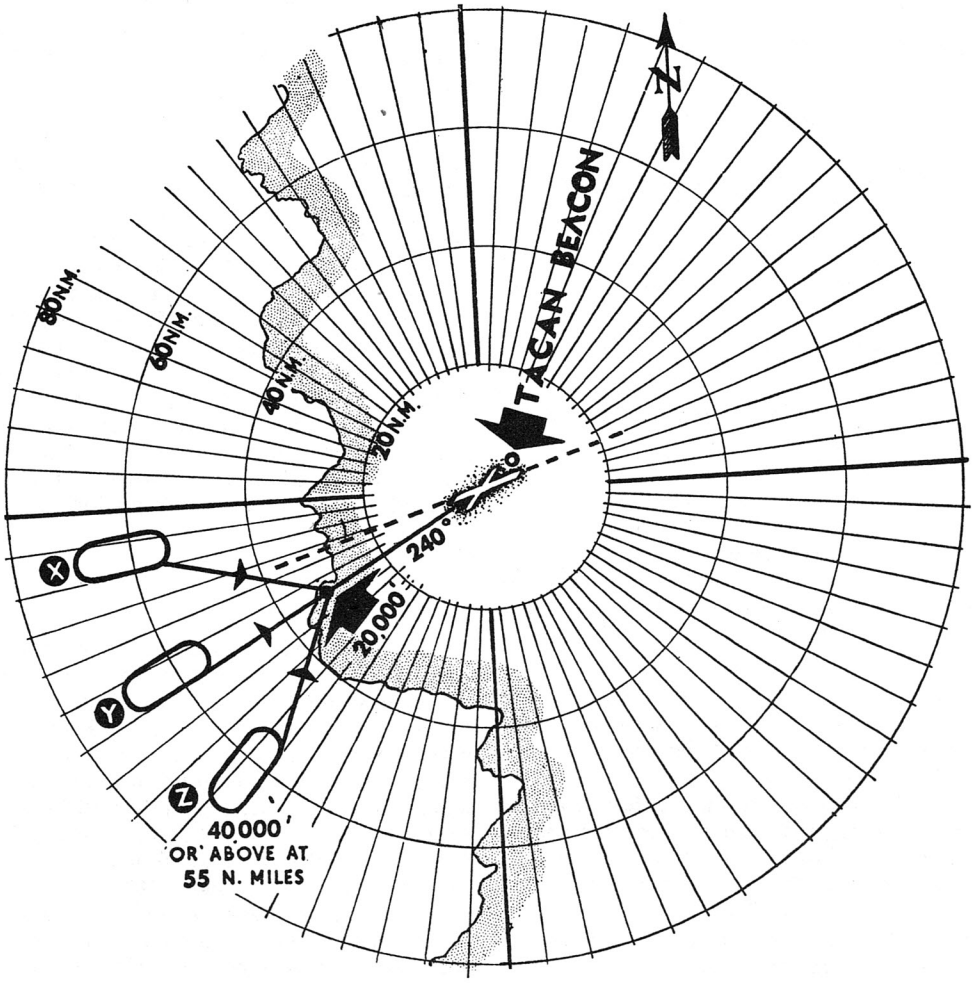

Fig. 8. An Example of a Holding and Approach Procedure