PART 2: SECTION 3

CHAPTER 4

SELF-CONTAINED MAGNETIC COMPASSES

Purpose

1. The purpose of a magnetic compass is to show in which direction the magnetic north or magnetic meridian lies and to show the heading of an aircraft relative to that meridian. In aircraft fitted with remote indicating compasses, the Pilot (P) Type Compass is normally regarded as a checking or stand-by instrument; but where lack of space precludes the installation of a stand-by compass of the P-type, an E-type compass is fitted.

Implementation

2. Both types of compass utilize the property of the poles of a magnet to attract and be attracted by the pole of opposite kind of another magnet. The earth being magnetized, a freely suspended magnet takes up a position with each of its poles pointing towards one of the magnetic poles of the earth.

Construction

3. The constructional details of P-type and E-type compasses are fully covered in A.P. 1275B, Instrument Manual (Navigation Instruments).

P-TYPE COMPASSES

Errors

4. P-type compasses are subject to the following errors *in addition to the local compass error* (*i.e.* the algebraic sum of variation and deviation) :—

(*a*) Turning and acceleration errors.

(*b*) Tilt error.

(*c*) Parallax error.

(*d*) Random deviations.

5. A detailed description of the causes and effects of these errors is given in A.P. 1234B, Air Navigation (Allied Subjects).

Accuracy

6. P-type compasses can be read accurately to within $\pm 2°$.

Pilot's Serviceability Checks

7. Before flight the following checks should be made to ensure that the compass is serviceable :—

(*a*) The compass should be inspected for traces of oil or petrol. These substances affect the luminosity of the grid ring and wires, obliterate graduations, and attack rubber components.

(*b*) The compass liquid should be inspected for discolouration. This normally appears as a darkening of the damping-wire luminizing compound and may be caused by the presence of sediment formed by corrosion. This sediment may settle when the aircraft is stationary and appear only in flight. If discolouration is sufficient to affect accurate reading of the compass by day or night, the instrument is unserviceable.

(*c*) The compass liquid should be inspected for bubbles. If any are present the instrument is unserviceable.

(*d*) The compass bowl should be moved gently in all directions (except in azimuth) to ensure that no metallic contact occurs between the bowl and the aircraft or container. The spring vibration insulators should be checked for serviceability.

(*e*) The grid ring should be tested for freedom of rotation. If the movement is too slack, making accurate setting difficult, or if the movement is too stiff, the instrument is unserviceable.

(*f*) The bowl glass should be inspected for cracks, and the clamp tested for efficient operation. The clamp should be slightly past the vertical position when the grid ring is properly clamped.

(*g*) If the aircraft's approximate magnetic heading is known, a check should be made to ensure that the compass heading roughly agrees with the magnetic heading.

Operation

8. **Checking Heading.** The compass heading of an aircraft is determined by setting the grid ring so that the E-W luminized tubes on the magnetic system are parallel with the E-W grid wires, with the north pointer on the magnetic system between the two north luminized grid wires. The compass heading is then shown on the scale by the lubber line. This reading must be corrected by reference to the deviation card to obtain the magnetic heading.

9. **Setting Heading.** Before setting a heading against the lubber line, the deviation shown on the deviation card should be applied to the desired magnetic heading. The grid ring is then rotated and clamped, with the resultant heading set against the lubber line. The aircraft is then turned until the E-W luminized tubes of the magnet system are parallel to the E-W luminized grid wires.

10. **Compass Readings.** Compass readings should if possible only be taken during steady flight, to avoid turning and acceleration error effects. When the aircraft is tilted the grid ring may no longer be parallel to the magnetic system, therefore special care should be taken at these times to avoid errors in setting and reading the compass. Readings should not be taken when the tilt is more than 20°, as the magnetic system is not free to rotate when it is in contact with the verge glass.

Swinging Procedure

11. The swinging procedure for P-type compasses is fully detailed in A.P. 1234B, Air Navigation (Allied Subjects).

E-TYPE COMPASSES

12. The E2 magnetic compass (Fig. 1) is a miniature instrument developed for use as an emergency or stand-by compass. It does, however, provide a rough check on the functioning of the main compass. It is a vertical reading compass with built-in correctors for coefficients B and C, and component R.

13. The E2A model is almost identical to the E2, the sole difference being that the E2A has no built-in correctors for component R, *i.e.* the vertical component of the aircraft's permanent magnetism.

Errors

14. E-type compasses are subject to the same errors as the P-type described in para. 4.

Accuracy

15. As this type of compass was designed solely for emergency use its required degree of accuracy, $\pm 10°$, is not high. The compass behaves well under normal flight conditions, however, and by careful reading and interpolation a fairly accurate indication of heading is obtainable.

Pilot's Serviceability Checks

16. Before flight the following checks should be carried out to ensure that the compass is serviceable :—

(*a*) The compass should be inspected for traces of oil or petrol. These affect the luminosity of the lubber line and graduations.

(*b*) The compass liquid should be inspected for discolouration. If discolouration is sufficient to affect the accurate reading of the compass by day or night, the instrument is unserviceable.

(*c*) The compass should be inspected for bubbles. If any are present, the instrument is unserviceable.

(*d*) The bowl glass should be inspected for cracks.

(*e*) If the aircraft's approximate magnetic heading is known, a check should be made to ensure that the compass heading roughly agrees with the magnetic heading.

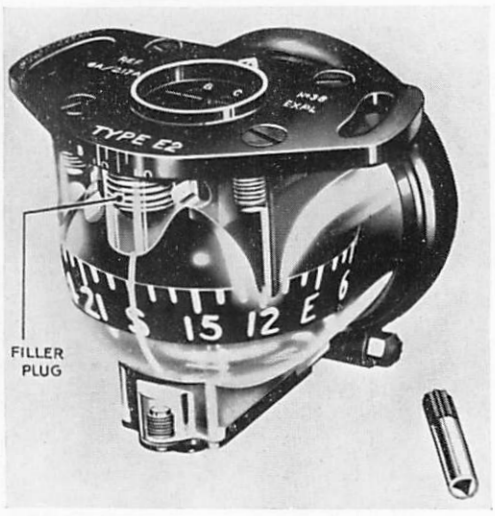

Fig. 1. Compass, Type E2, and Corrector Key.

Operation

17. **Checking Heading.** The compass heading is determined by reading the compass card against the lubber line and estimating the heading in relation to the nearest 10° graduation on the card. Deviation must be applied to correct this reading.

18. **Setting Heading.** Should it be necessary to use this emergency compass for setting a heading, deviation should first be applied to the desired magnetic heading. The aircraft should then be turned until the resultant compass heading can be read off against the lubber line.

19. **Compass Readings.** Compass readings should if possible only be taken during steady flight, to avoid turning and acceleration error effects. Readings should not be taken during steep dives or climbs as the magnetic system may not then be free to rotate.

Swinging Procedure

20. E-type compasses are swung in the same manner as P-type compasses, but on initial installation in an aircraft it is advisable to swing for component R to ensure that the magnets for the correction of this component are in fact neutralized.

21. **Correction for Coefficients B and C.** In both the E2 and E2A compasses two pairs of adjustable correctors are built into a metal plate fitted to the top of the compass bowl. The neutral position for the corrector magnets is denoted by alignment of the index lines (Fig. 2) engraved on the rotatable corrector plates with the fixed lines on the main plate. Fig. 2 shows the correctors in the neutral position. The letters B and C indicate the coefficients being corrected, adjustment being made by a corrector key engaged in the appropriate *correcting head.* The correcting heads for coefficients B and C are on either side of the filler plug (Fig. 1) and are identified by the letters B and C marked on the rim of the top plate.

22. **Correction for Component R.** An adjustable corrector for deviation caused by component R (Type E2 only) is fitted to the base of the compass bowl (Fig. 3). On one side of the corrector casing are index lines to denote the neutral position of the corrector magnets. Adjustment for component R is made by inserting the key in the correcting head at the bottom of the corrector casing and turning as required.

23. **Correction for Coefficient A.** Coefficient A is corrected by loosening the two screws which secure the compass to the aircraft. The two radial slots in the compass mounting plate (Fig. 2) permit limited movement of the compass in azimuth. It is important that the securing screws are retightened after adjustment has been made.

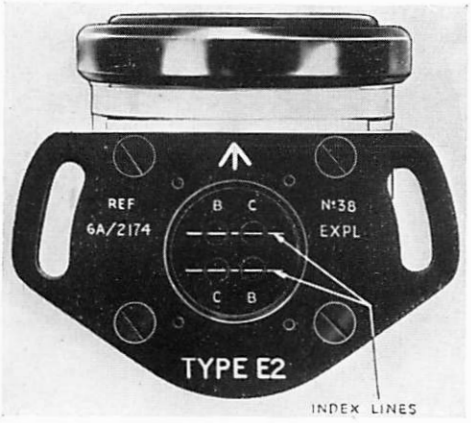

Fig. 2.
Index Lines for Correction of Coefficients B and C.

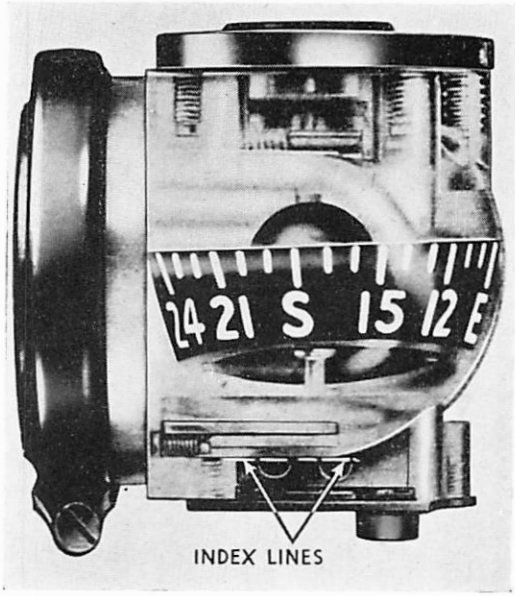

Fig. 3.
Index Lines for Correction of Component R.

Effect of Gunsight, Gunsight Recorder, and Movable Canopies on E2 Compasses

24. When swinging an E2 or other magnetic compass the gunsight must be in the retracted position, the gunsight recorder in its stowage, and the canopy fully closed. The same precautions must be observed in flight whenever the magnetic compass has to be used. Failure to carry out these actions can make the compass useless through the presence of deviations of up to 50° or more.