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PART 2: SECTION 2

CHAPTER 1

AIRSPPEED INDICATORS

Purpose

1. The airspeed indicator shows the speed at which the aircraft is moving through the air.

Implementation

2. In flight an aircraft experiences a pressure on its leading edges owing to the impact of the airstream. This pressure is proportional to the density of the air and the forward speed of the aircraft, and is known as total pressure. At any altitude the difference between total pressure and the still air, or static pressure, at the same altitude is known as the dynamic pressure. The airspeed indicator implements its purpose by measuring dynamic pressure and registering it on a scale graduated in units of speed.

3. Fig. 1 is a schematic diagram of a simple A.S.I., and illustrates the principle on which all A.S.I.s function. From this it is seen that a pressure head, consisting of a pitot tube and a static tube, supplies the instrument with the necessary dynamic plus static, and static pressures respectively. The pitot tube is open-ended and points into the airstream. The static tube has a closed end and also points into the airstream, but has small holes drilled radially in the wall of the tube near the closed end.

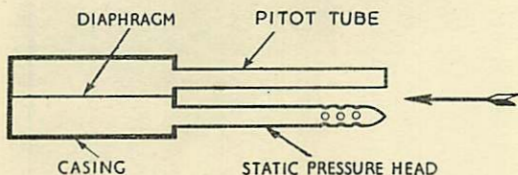


Fig. 1. Principle of the Airspeed Indicator.

4. The pressures from the pitot and static tubes are led to opposite sides of a diaphragm in an airtight case, as shown. When the aircraft is moving through the air, the pressure (dynamic plus static) from the pitot tube is greater than the pressure (static) from the static tube and the diaphragm becomes distended. The amount of this distension is in proportion to the dynamic pressure and is thus a measure of the speed of the aircraft. The diaphragm movement is transmitted by suitable mechanism to a pointer

moving over a graduated dial calibrated in knots. It is essential that the instrument casing, the tubing leading to it from the pitot head and static source, and all connections are completely airtight so that the correct pressure difference is recorded and measured accurately by the instrument.

5. The construction of airspeed indicators varies in detail, but they can be classified into two types, namely, diaphragm-operated and capsule-operated. Constructional detail is dealt with in A.P. 1275B, Instrument Manual (Navigation Instruments).

Dynamic and Static Sources

6. **Dynamic Tube.** As stated, the dynamic tube is essentially an open-ended tube. It is usually placed well in front of the wing or nose, or underneath the wing or fuselage, so that it is as far away as possible from the disturbed airflow near the surface of the aircraft. One end of the dynamic tube leads to the airspeed indicator, while the other faces into the airflow. An electric heater is almost invariably incorporated in the tube to prevent icing at the open end.

7. **Static Tube.** On many installations the static tube is situated near or around the dynamic tube. It has a closed end, but the small holes pierced radially in the wall of the tube near the closed end ensure that its internal air pressure remains equal to the outside atmospheric pressure.

8. **Pressure Head.** When the dynamic and static tubes are mounted as one unit the assembly is known as a pressure head and a single heating system keeps both tubes free from ice. A water trap in each pipeline prevents rain from blocking the system.

9. **Static Vents.** As the main source of pressure error (para. 11) is due to the difficulty in obtaining a true atmospheric pressure, the static side of the pressure head may be divorced from the dynamic side and sited at another position on the aircraft where the truest indication of the atmospheric pressure can be obtained. This location is found by trial and error, and its position varies from one type of aircraft to

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another. The position where the static line terminates under these circumstances is known as the static vent.

Calibration

10. Since dynamic pressure varies with airspeed and air density, and since air density, in turn, varies with temperature and pressure, it follows that a standard density must be used in the calibration of airspeed indicators. The standard adopted is the I.C.A.N. sea-level atmosphere.

Errors

11. The airspeed indicator is subject to errors known as pressure, instrument, density, and compressibility errors, as described under "Speed Measurement". Blockages and leaks also cause erroneous indications.

12. **Errors Caused by Blockages and Leaks.** If the pitot tube becomes blocked, *e.g.* through icing up, the needle of the A.S.I. does not react to changes of airspeed. Blocking of the static tube at altitude causes the instrument to over-read during descent, which is dangerous, since it is then possible for the aircraft to be stalled at a higher *indicated* airspeed than that at which the stall normally occurs. In emergency this condition may be relieved by breaking the glass cover of the machmeter (or, on piston-engined aircraft, the rate of climb and descent indicator) which work off a common static supply circuit

with the A.S.I. Since this action enables cockpit pressure, which is normally lower than the local static pressure, to function as an alternative static source, the A.S.I. will continue to over-read, but not to such a great extent as it would do with a completely blocked static tube. Leaks in the pitot tube cause the instrument to under-read, which is undesirable, but not necessarily dangerous. Leaks in the static line normally result in an over-reading of the A.S.I.

Lag

13. There is no lag in the instrument indications, but there is an *apparent* lag after a change of attitude in the pitching plane, or an alteration in throttle setting, owing to the inertia of the aircraft.

Pilot's Serviceability Checks

14. The pilot can do nothing to check the A.S.I. serviceability before flight, beyond noting that the pointer has not stuck above the stop. Naturally he must ensure that the pressure-head cover is removed before flight, and that the heater is switched on if required. In flight some indication of the instrument's accuracy may be obtained by observation of the speed indicated at the stall in level flight.

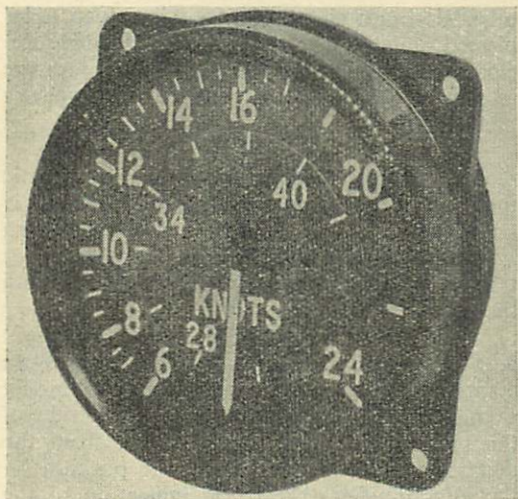


Fig. 1. The Airspeed Indicator Mk. 9, 60-420 Knots.

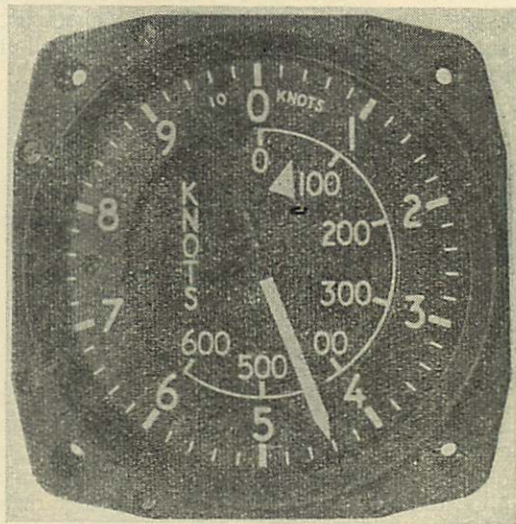


Fig. 2. The Airspeed Indicator Mk. 13C, with Two Pointers, 50-600 Knots.

The smaller hand indicates hundreds of knots while the larger shows the detailed figures. The instrument is shown as it appears on a stationary aircraft.

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