PART 2: SECTION 4

CHAPTER 2

THE I.L.S. METER, EQUIPMENT, AND SYSTEM

Purpose

1. The I.L.S. meter and airborne equipment are installed for use in conjunction with their associated ground equipment, and together comprise a pilot-interpreted runway approach aid known as the Instrument Landing System.

Implementation

2. The system consists of radio transmitting and receiving equipment providing the pilot with visual indications for lateral and vertical guidance to a runway. Marker indications are given at fixed distances from the touchdown point.

Ground Equipment

3. **Runway Localizer.** A transmitter situated at the upwind end of the runway radiates two overlapping field patterns, one on each side of the runway, on a frequency selected from the 108 to 112 megacycles band. The carrier wave transmitted in the field pattern to the left of the runway heading is modulated with a 90-cycles note, and the other with a 150-cycles note. The line of equal signal intensity, known as the beam, coincides with the centre line of the runway and continues beyond the downwind end of it. It should be noted that in the I.L.S. system *there is no back beam.* The relative amplitude of the two signals received in the aircraft is used to actuate a vertical ammeter needle (Fig. 1) calibrated to show position in azimuth relative to the centre line of the runway.

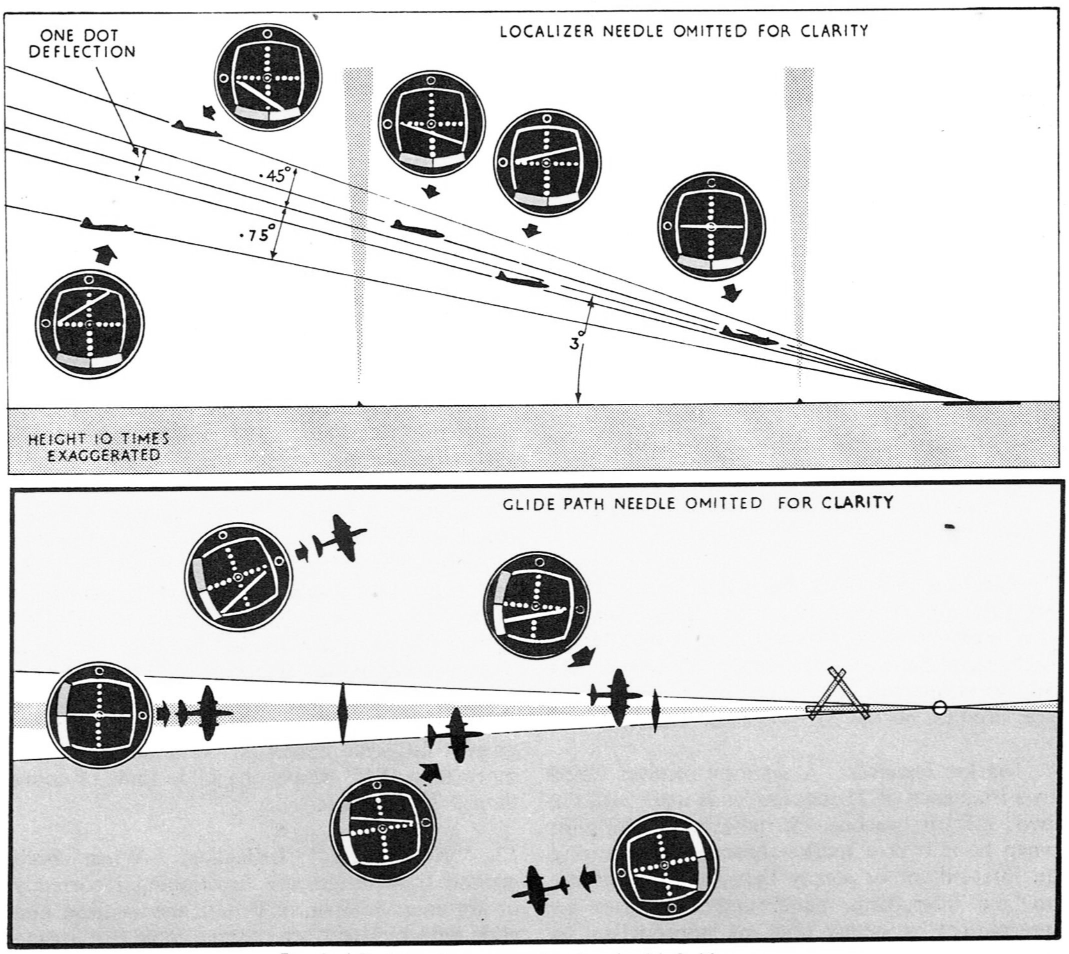

Fig. 1. Position Interpretation by the I.L.S. Meter.

central and warning flags appear from the sides of the meter dial, covering the ends of the needles. This is known as "no signal" indication and it persists until normal signal transmission and reception is resumed, at which instant electro-magnets are actuated, causing the flags to be withdrawn from sight. Should only one channel become unserviceable for any reason, the warning flags will cover the ends of the appropriate needle, leaving the remaining needle to function alone.

Limitations

13. **Range.** The maximum operating range is limited by the visual horizon but is further reduced in practice by deliberate restriction of the power output of the individual transmitters. The power output of the localizer, glide path, and marker transmitters is adjusted to give the following *minimum* ranges :—

(*a*) *Localizer Signals.* 17 nautical miles out on the approach side of the airfield over a sector approximately 140° wide centred on the on-course signal, when the receiving aircraft is 2,000 feet above aerodrome level and heading towards the I.L.S. installation. Within a sector 20° wide centred on the on-course signal, however, the minimum range is 25 nautical miles.

(*b*) *Glide Path Signals.* 10 nautical miles.

(*c*) *Marker Signals.* 2,000 feet vertically.

14. **Landing Rate.** The landing rate is limited primarily by the speed at which Air Traffic Control can feed aircraft onto the final approach.

15. **Enemy Jamming.** The system can only be jammed by enemy interference if the enemy is within visual range.

4. **Glide Path Transmitter.** A second transmitter offset from the centre line of the runway and located near the downwind end similarly radiates two transmission fields, one above the other, which overlap to form a glide path in the vertical plane. This transmitter radiates a carrier wave on a frequency selected from the 328·6 to 335·4 megacycles band. The carrier wave in the upper field is modulated with a 90-cycles note and the wave in the lower field with a 150-cycles note. The line of equal signal intensity forms the glide path and its angle relative to the horizontal can be varied between 3° and 4° by adjustment of the aerial system, but 3° is the normal setting. False glide paths are radiated at angles above the normal glide path but their steepness, always greater than 10°, prevents them being flown.

5. **Marker Beacons.** To provide checkpoints two ground transmitters or marker beacons radiate narrow beams *vertically* on a frequency of 75 megacycles. The outer marker is sited 5 nautical miles (± 1,500 feet) from the touchdown point and transmits two low-pitched (400 cycles per second) dashes per second. The middle marker is located 3,250 feet (±250 feet) from the touchdown point and transmits high-pitched (1,300 cycles per second) dots and dashes.

Airborne Equipment

6. The equipment required in an aircraft for use with the I.L.S. consists of :—

(*a*) Localizer receiver.

(*b*) Glide path receiver.

(*c*) Marker beacon receiver.

(*d*) Remote control box.

(*e*) One or more cross-pointer meters as required.

7. **Localizer and Glide Path Receivers.** These are crystal-controlled receivers. Their purpose is to measure the signal intensities received from each aerial field of their respective transmitters and to reveal the information by movement of the needles of the cross-pointer meter.

8. **Marker Receiver.** A separate receiver tuned to a frequency of 75 megacycles is used with the two marker beacons. It indicates to the pilot when he is over a marker beacon by operating an intermittent or steady light, as appropriate, on the instrument panel and/or causes an intermittent or steady note, as appropriate, to be heard in the pilot's headphones.

9. **Control Box.** This is normally located near the pilot's seat and consists of :—

(*a*) An ON/OFF switch.

(*b*) A 12-position stud selector which permits selection of localizer and glide path frequencies according to the frequencies of the crystals installed in the aircraft.

Interpretation of I.L.S. Signals

10. **Azimuth Signals.** The runway localizer receiver compares the signal strengths of the 90- and 150-cycles per second notes (which vary according to the aircraft's position relative to the localizer beam) and shows the result of this comparison by the movement of the vertical needle of the I.L.S. meter. If the aircraft drifts from the localizer beam into the blue sector (Fig. 1) the vertical needle moves proportionately to the left side of the I.L.S. meter, while the opposite direction of needle movement occurs when the aircraft drifts into the yellow sector. When the aircraft is heading towards the runway localizer from the approach side of the airfield, the vertical needle of the I.L.S. meter deflects *towards the beam* and heading correction is therefore made *in the direction indicated by the needle.* When the aircraft is over, or on the approach side of, the airfield and *heading away* from it the sense of the I.L.S. meter indications is changed, and heading corrections must be made *in the opposite direction to the needle deflection.* The localizer needle is very sensitive and gives a full-scale deflection when the aircraft is 2½° or more on either side of the beam centre line. When the pointer is kept within the circle at the centre of the I.L.S. meter the aircraft is aligned sufficiently accurately with the runway for a successful landing.

11. **Glide Path Signals.** The glide path receiving channels function in a similar way and interpret the aircraft's position above or below the glide path beam by movement of the horizontal needle of the I.L.S. meter. This needle is deflected downward when the aircraft is above the glide path, and vice versa. Irrespective of the direction of flight the glide path needle always deflects *in the direction of the glide path.* The needle gives a full-scale deflection when the aircraft is more than 0·45° above the glide path or more than 0·75° below it.

12. **" No Signal " Indication.** When both ground transmitters are functioning incorrectly or are unserviceable, or if both the localizer and glide path receivers are unserviceable (*e.g.* owing to power failure) the I.L.S. meter needles remain