PART 3 : SECTION 1

CHAPTER 2

GROUND MONITORED APPROACH SYSTEMS

Introduction

1. Ground controlled approach systems may be regarded as belonging to either a system of limited accuracy, based on the use of C.R. D/F or V.H.F. D/F equipment, or one giving precise control by radar (G.C.A.).

C.R. D/F and V.H.F. D/F Controlled Descent (QGH)

2. This system uses C.R. D/F ground equipment to indicate aircraft bearing from base. Older systems use V.H.F. D/F for this purpose. No indication of height or exact distance from the airfield is given by the equipment. The procedure involves a descent in which the aircraft, after being homed to the airfield by a ground controller, is directed out on a safety lane from which it returns after a timed interval and is let down. This system enables a descent to be made through cloud, after which a *visual* approach and landing can be made. The advantages of this system are that no additional airborne equipment other than normal R/T is required, and the pilot needs no previous knowledge of the procedure, although practice in it is advocated. This system is known variously as controlled descent through cloud, controlled descent, and QGH.

Function of G.C.A.

3. Ground Controlled Approach (G.C.A.) is a ground radar system providing precision tracking of aircraft, enabling the operating crew to bring it safely to a position from which the pilot can make a visual landing (Fig. 1).

Method of Operation

4. G.C.A. is a method of assisting pilots to approach for a landing in conditions of low cloud and restricted visibility. The actual landing of the aircraft is made visually. Flying at a safe height and using R/T, the pilot is given headings to fly which take him round the G.C.A. circuit and place him on the line of approach. From this position he is handed over to the G.C.A. controller and "talked down" to a position from which he can make a visual landing. This position varies according to the instrument rating of the pilot, but half-mile visibility and 200-ft. cloud ceiling may be taken as the minima for a non-rated pilot without special permission and in cases of emergency. G.C.A. is a primary radar equipment employing two separate systems ; a search system and a precision system.

5. Some direction-finding system is essential for use with the search system of G.C.A. Not only does it materially help in the identification of aircraft within the coverage of the plan position indicator (P.P.I.) tube, but it can home aircraft from ranges in excess of the radar coverage.

Search System

6. The search system operates on a wave-length of 10 centimetres, and scans through 360° at 30 r.p.m. The beam radiated from the aerial is approximately 7° wide in azimuth and can be moved through 8° in elevation. The maximum range is 30 miles at 4,000 ft. Through the centre of the beam is the line of maximum intensity, which determines heights at various distances at which aircraft must fly to give maximum signal strength. The echoes received by the search system are displayed on two identical P.P.I. tubes employed by the directors.

7. **Traffic Director.** One of the two P.P.I. tubes is monitored by a traffic director, whose duty it is to identify the blips of approaching aircraft (by supplementary D/F bearings, turn procedures, or from aircraft position reports), marshal them in proper spacing with other traffic, and subsequently deliver each aircraft at a predetermined point to the feed director.

8. **Feed Director.** At the agreed point, the feed director guides the aircraft onto and along the final approach until the aircraft is detected by the precision system, usually at a distance of 7 to 10 miles from the touchdown point.

Precision System

9. **Azimuth Tracking.** The azimuth beam is 0·85° wide and 2° deep, and sweeps through 20° (15° to the left and 5° to the right) looking towards the point of touchdown. Echoes from the approaching aircraft appear on two cathode ray tube displays which magnify by three times the triangular sector swept by the beam ; one display covers a range of 10 miles, and the other (which is a further amplification of the scan) up to 3 miles. The aircraft blip first appears towards the

base of the 10-mile display and gradually moves to the top. When the aircraft approaches within 3 miles a blip appears at the base of the 3-mile display. Movement of the blip is followed by an operator, known as the Azimuth Tracker, who keeps a transparent cursor centred over the blip by means of a handwheel. The cursor is electrically linked to a meter on the controller's panel to indicate the aircraft's position relative to the correct line of approach.

10. **Elevation Tracking.** The elevation beam is 3·6° wide and 0·6° deep, and scans up and down through 7° (1° below horizontal and 6° above).

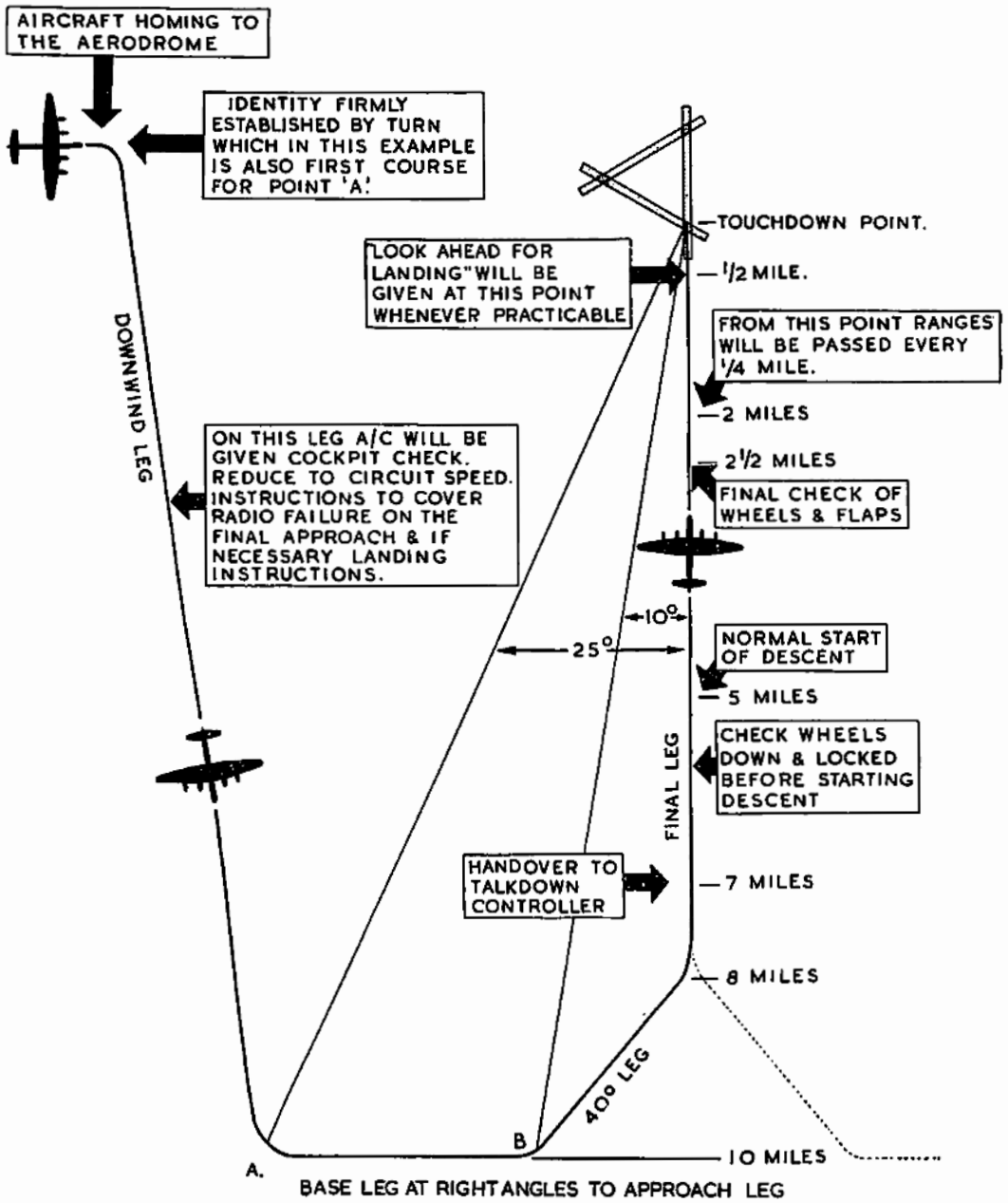

Fig. 1. Typical Flight Pattern During a Ground Controlled Approach.

Echoes are similarly presented on two displays (10-mile and 3-mile) which magnify the area of scan nine times; the blips are followed with a cursor controlled by the elevation tracker. This gives an indication of the position of the aircraft relative to the predetermined glide path on a second meter on the controller's panel, the meter being calibrated to read 200 ft. above and 300 ft. below the desired glide path.

11. Distance from the touchdown point is called aloud by the tracker to the controller. The controller therefore has a complete picture of the aircraft's approach, and is able to direct the pilot to a position from which a visual landing can be made.

Operational Limitations

12. **Range.** The range limit for the search system is 30 miles for an aircraft at 4,000 ft. The limit for the precision system is 10 miles.

13. **Accuracy.** Accuracy depends on the proficiency of the G.C.A. operating crew. Errors attributable to the equipment are negligible.

14. **Weather.** Heavy precipitation produces clutter, which can be severe, on the displays. Experienced operators may be able to track large aircraft in spite of this, but the weak signals reflected from jet aircraft usually make the task impossible.

15. **Landing Rate.** Three or four aircraft can usually be dealt with simultaneously on the search system by an experienced director. On the other hand, the precision system can accommodate only one aircraft at a time. With an experienced G.C.A. crew, a landing rate of one aircraft every two to four minutes can be expected, depending on the system of marshalling aircraft onto the final approach and on the amount of traffic on the available R/T channels.

16. **Communications.** The only link between the aircraft and the G.C.A. operators is R/T, therefore the air-to-ground and ground-to-air communications within the G.C.A. trailer are very comprehensive. When operating more than one aircraft at a time, two distinct and uninterrupted channels are necessary; one for the aircraft being controlled by the directors, and one for the aircraft being talked down by the controller who, after initial contact, continues to give a running commentary using an open transmitter until the aircraft has landed. To meet these requirements there are a possible 16 channels of V.H.F.; 15 of these are set up on standard frequencies, leaving one spare.

17. **Mobility.** G.C.A. is completely mobile and, with prepared sites, can be moved from one to another in about 20 minutes.

G.C.A. GENERAL INSTRUCTIONS

Minimum Weather Conditions

18. Except in emergency or when the pilot concerned holds a Green instrument rating, the minimum weather conditions recommended for carrying out ground controlled approach are that the pilot should be able to complete the approach and landing visually from a position 800 yards from the touchdown point and not below 200 ft. in relation to the aerodrome level. In some commands, orders regarding the use of G.C.A. may specify other minimum weather conditions.

Weather Deterioration During an Approach

19. Aerodrome air traffic control is responsible for informing the G.C.A. officer in charge of the watch of any major deterioration in the weather whilst a G.C.A. is in progress. Such information will be passed immediately to the aircraft.

Use in Emergency

20. When, in the opinion of the responsible authority, an alternative course of action would involve a greater risk to the aircraft and crew, G.C.A. may be attempted by pilots not holding Green instrument ratings, irrespective of weather conditions. The responsible authority is the station commander or officer commanding flying.

Guidance Limits

21. To establish confidence in the system, guidance information will, wherever possible be continued until the theoretical touchdown point, even though under normal circumstances the phrase "Look Ahead for Landing" will have been given earlier. If it is essential for the talk-down controller to take over a second aircraft on the approach with the minimum delay, then, at the discretion of the G.C.A. supervisor, guidance information to the first aircraft may be discontinued when it is quite certain that visual contact has been made and can be maintained.

Aircraft Captain's Responsibility

22. Responsibility for requesting and carrying out a G.C.A. rests with the captain of the aircraft. Before making such a request, the captain is to

acquaint himself with the weather prevailing at the particular aerodrome.

Method of Request

23. Advance notice of the requirement to use G.C.A. should be given, if possible; this particularly applies to the use of G.C.A. for practice purposes. The need for G.C.A. for landing may, however, first become apparent in flight. In this case, the request for G.C.A. should be made through an air traffic control centre, if by so doing a time saving in notifying the G.C.A. unit is likely to be achieved. In addition to the request for G.C.A. the following information should be passed :—

(*a*) Type of aircraft.

(*b*) Aircraft R/T callsign.

(*c*) E.T.A. at the aerodrome concerned.

(*d*) R/T frequencies available for use with the G.C.A. unit. The associated selector button letters may also be advised if desired, to simplify subsequent instructions by the G.C.A. unit when a change of frequency is necessary.

24. The A.T.C.C. will notify the aircraft whether G.C.A. is available for use, and if so will instruct the aircraft to contact the appropriate approach control (or tower).

25. Where a request for G.C.A. is not made through an A.T.C.C., the approach control (or tower) is to be contacted directly on the appropriate frequency.

26. The approach control (or tower) will give appropriate flight instructions and, when the G.C.A. unit can accept the aircraft, instructions to contact G.C.A. and the frequency to be used.

Standard R/T Phraseology

27. The standard R/T phraseology is to be used in all normal circumstances. However, there will be occasions when standard phraseologies cannot be applied (*e.g.* certain foreign aircraft), and in these circumstances controllers should use their discretion as to the phrase used. Any desired combination of phraseology may be used.

Landing Instructions

28. Landing instructions will be passed by approach control, or the tower, or, at the discretion of the air traffic control officer on duty, by the G.C.A. controller.

29. With R.A.F. aircraft, the phrase "landing altitude . . . feet" will be used to indicate the altitude above mean sea level of the desired touchdown point. Otherwise "aerodrome elevation . . . feet" will be used.

Read Back Procedure

30. Except on the final approach, all data on which executive action has to be taken and which it is essential should be received correctly are to be read back without such action being requested.

Acknowledgments

31. Except on the final approach, the aircraft or ground facility should always acknowledge receipt of a message.

Use of Magnetic Headings

32. Heading information given to an aircraft will always be in magnetic.

Use of Term "Base Leg"

33. To prevent confusion it has been decided to conform to international practice in the designation of the traffic circuit. In consequence, the term "base leg" is to be used instead of "cross wind leg" which the R.A.F. has used up to the present time. The base leg is therefore the leg at right angles to the final approach leg. In G.C.A. approaches carried out at R.A.F. units, the base leg is to be followed by a leg at 40° to the runway approach heading to facilitate turning onto the final approach.

Ground Callsigns

34. Aerodrome control facilities will be identified during communication by the name of the aerodrome concerned followed by the word "Tower". If it is necessary to distinguish the approach control facility from the aerodrome control facility, the aerodrome name followed by the words "Approach Control" will be used.

35. G.C.A. facilities will be identified by the name of the aerodrome concerned, *followed* by the abbreviation "G.C.A.". In addition, when the talkdown controller first establishes communication with the aircraft, the words "Talkdown Controller" will be used after G.C.A.

Aircraft Callsigns

36. When communicating with military facilities, aircraft are to use the normal service callsigns followed by the aircraft identification letter spoken phonetically.

37. When establishing communication with civil facilities, aircraft are to use the code word "RAFAIR" followed by the phonetic version of the W/T callsign, or, if no W/T callsign is available, the last three figures of the aircraft serial number. After communication has been established, the aircraft callsign may be abbreviated to the code word "RAFAIR" followed by the last two letters of the W/T callsign spoken phonetically, provided that there is no possibility of confusion arising.

Call-Up Procedure

38. The initial call-up procedure to be used by an aircraft wishing to establish communication with a ground facility is to be in the following form :—

". . . (callsign of facility called)—THIS IS . . (callsign of aircraft)—OVER".

The ground facility will reply :—

". . . (callsign of aircraft)—THIS IS . . . (callsign of facility)—OVER".

39. If it is reasonably certain that communication can be immediately established, the first message may be included with the initial call.

40. Once communication has been definitely established, it may be continued using abbreviated callsigns if these are unlikely to cause confusion.

"SPEECHLESS" QGH

41. In the event of complete failure of the pilot's microphone (unaccompanied by failure of the headphones), the pilot, although unable to transmit speech, can broadcast a carrier wave by pressing the R/T transmit button. The resultant broadcast can be heard by a V.H.F. homer operator and seen on a C.R. D/F tube. The following pilot-to-ground code, utilizing carrier wave broadcasts, can be used in these circumstances for homing and QGH purposes.

42. **Initial Action.** A pilot finding himself unable to transmit speech but able to receive speech from a ground station should press his transmitter button four times. This indicates to the approach controller that the pilot is "speechless" and requires homing.

43. **Action by Controller.** When the approach controller realizes that the pilot requires assistance he should pass a heading to steer, thus : "Speechless aircraft, steer . . . .".

44. The pilot acknowledges this transmission by sending one dot with his transmitter button. Thereafter, the following suggested code can be used by the pilot :—

(*a*) One dot, to indicate "Yes" or acknowledgment.

(*b*) Two dots, to indicate "No".

(*c*) Three dots, to indicate "Say again".

45. Having passed the initial heading for the pilot, to steer, the controller can ascertain from the pilot, by questions answerable by either "Yes" or "No", the following information :—

(*a*) Whether or not the pilot is in any state of emergency. The degree of emergency (safety, urgency, or distress), if applicable, can be determined by a questioning process of elimination.

(*b*) Type of aircraft, *i.e.* jet or piston-engined.

(*c*) Other vital information, *e.g.* fuel state.

46. Using the "Speechless" callsign, the aircraft can be homed to overhead and a normal controlled descent executed. A two-second transmission should be used by the pilot to indicate :—

(*a*) Overhead turn completed.

(*b*) Steady on inbound heading.

(*c*) Steady at check altitude.

(*d*) Steady at break-off altitude.

(*e*) Aerodrome in sight.

47. Pilots bearing the callsign "Speechless" should maintain R/T silence as far as possible.

48. When a manual V.H.F. homer is used in the above procedures, longer transmissions and an efficient D/F operator are required.