RESTRICTED

A.P. 3225C

(ALS 1 - 3 incorporated)

ROYAL AIR FORCE

FLYING INSTRUCTOR'S HANDBOOK

CHIPMUNK T.10

AIR MINISTRY

JANUARY, 1959

Reprinted JUNE, 1963

RESTRICTED

RESTRICTED

A.P. 3225C

ROYAL AIR FORCE

FLYING INSTRUCTOR'S HANDBOOK

CHIPMUNK T.10

Promulgated by Command of the Air Council.

Tn. J. Dean.

AIR MINISTRY
December, 1958

RESTRICTED

RESTRICTED

AMENDMENT LIST RECORD

AMENDMENT LIST NO.	AMENDMENT LIST DATE	AMENDED BY	DATE
1			
2		INCORPORATED	
3			
4	Jul 1964	[signature]	May 1967.
5	July 1965		
6	Jan. 1966		
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			

RESTRICTED

TEMPORARY AMENDMENT LIST RECORD

T.A.L.		AMENDED BY	DATE
NO.	DATE		
1		incorporated	
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

(A.L. 5, July, '65)

CONTENTS

(A.L. 4, *July*, 64)

Amendment Procedure

Temporary amendment lists (TALs) to this handbook are issued by Headquarters Flying Training Command and should be inserted as appropriate. Subsequently permanent amendment lists are issued in page form and should be inserted in the appropriate place. New or amended passages are indicated thus ◀.....▶ to show the extent of amended text and thus ▶◀ to show where text has been deleted.

Flying Instructor's Handbook

CHIPMUNK T.10

INTRODUCTION

1. This publication is an authoritative guide to basic flying instruction. The recommended sequence of the air exercises is the result of extensive experience, but this book cannot be a substitute for individual instructional experience and in no way removes from the instructor the right to use his own initiative. It is, therefore, not essential for each lesson to take the precise form given so long as the student becomes proficient.

2 The book provides:—

(*a*) A progressive series of Air Exercises which fulfil the requirements of basic training.

(*b*) Useful advice to instructors in the form of an Instructional Guide.

(*c*) The important points of each exercise that should be made clear to the student.

(*d*) References to those parts of A.P. 129 on which detailed briefings and discussions can be based.

Instructional Guide

3. The handbook is separated into a series of Air Exercises, each of which has an Introduction (Instructional Guide) which consists of:—

(*a*) General advice on the stage at which the exercise should be taught and on features of the exercise.

(*b*) Considerations applicable to the Air Exercise on which instructors can base their lesson to give the student the necessary background knowledge. These considerations may have been covered in ground school but they should in any case be revised with the student.

(*c*) Advice to the instructor on the best method of teaching certain sequences of the Air Exercises and, where necessary, amplifying remarks which apply to certain of the observations in the Air Exercises.

(*d*) A list of the more common faults made by students and advice on how to correct them.

Air Exercise

4. The Air Exercise proper is arranged into:—

(*a*) A series of sequences which detail the appropriate demonstrations. The power settings and speeds to be used are

given whenever they have a bearing on the success of the demonstration.

(*b*) A list of observations which apply to each sequence. The observations should be made to the student at suitable moments during the demonstration.

5. In the initial demonstration of an exercise it may be unwise to attempt to cover all the observations. The intensity of the instruction given should be tailored to the ability of the student, the aim being eventually to cover all the points in a reasonable time. Note that the order in which the observations are given is not a reflection of their importance—all are equally important—but their order is logical if all the comments are made in a single demonstration.

6. **Preparatory Instruction.** Preparatory instruction is a detailed discussion and briefing, and should be given before each new exercise is taught in the air. This briefing should cover the subject thoroughly and may take up to an hour to deliver. The opportunity should be taken to link the instruction given in ground school to the practical aspects of flying. The briefing should be practical and aimed directly at what is to be taught in the air.

7. **Pre-Flight Briefing.** The pre-flight briefing, which is given just before each flight, should cover such details as the effect of the weather on the course of the flight, any unusual obstacles or restrictions in the circuit and on the airfield, and similar information. *A résumé of the main points of the lesson about to be taught must be included*; these points can be based on the relevant "Observations" in the Air Exercise.

8. **Post-Flight Discussion.** The post-flight discussion is used to review the exercise and amplify or explain any special point of interest or difficulty that has arisen. This discussion is invaluable for consolidating what the student has just learned.

Notes on Basic Instruction

9. The attitude of the instructor towards his student can have a significant effect on the rate of progress. The instructor should spare no effort to stimulate the student's interest and enthusiasm by teaching in a way that holds the interest. The rate of progress varies between students, but the successful accomplishment of each new exercise serves as a useful spur to further effort. If any feeling of antipathy or incompatibility is sensed in the instructor/student relationship, the student should be put in the hands of another instructor; if this is not done the students progress may be affected to the extent of complete failure to progress.

10. The student's active participation in the lesson is all-important. He should be allowed to take control of the aircraft as soon as

possible when learning a new exercise, and to this end, the essentials should be taught first and refinements dealt with after the student has practised the exercise. The habit of critical self-analysis of his flying should be encouraged, particularly during solo flying. To keep the student mentally alert and usefully occupied the instructor should, whenever advantageous, ask questions which necessitate the use of critical reasoning; more is achieved in this way than by a series of bald statements by the instructor.

11. At all times the instructor's flying should be both accurate and polished, thus setting a clear-cut example on which the student can pattern his own flying. The flight should be planned to give the student the maximum benefit without overtaxing him by excessive demands on his concentration and limited experience. Each lesson should follow as a logical development of the preceding lessons. The instructor should ensure that the conditions under which each new exercise is introduced are such that the student is not distracted by irrelevant matters or subjected to extra difficulty. For example, the first flights should be planned so that the student has a reasonably well defined horizon to assist his attempts to fly straight and level.

12. Manœuvres involving high *g* and extremes of attitude should be avoided unless they are essential to the demonstration or the student obviously enjoys the experience. If a student is uneasy in his early training, an excess of aerobatics and exaggerated attitudes may undermine his confidence completely; however, after several hours of flying any nervousness should have disappeared; if it has not it may be an indication of his unsuitability for further training. ◀It cannot be over-emphasized that if this particular aircraft is the first one on which a student has received flying instruction, every effort must be made to ensure that the student's self-confidence is progressively built up during the early sorties. Air sickness caused by aerobatics or harsh manœuvres could be disastrous as far as self-confidence is concerned because air sickness can be self-perpetuating. If a student is air sick or apprehensive, aerobatics should not be demonstrated until after the circuit consolidation period; by then the student will have settled down in his new environment. Even a mild attack of air sickness without nausea can reduce the student's ability to absorb flying instruction and thus delay his progress; just as important, it can spoil the student's enjoyment of flying. By the end of flying training a student will have proved that he can accept all the physical stresses that a modern aircraft can impose. At the *ab initio* stage the student must be ushered gently into an entirely new environment.▶

13. Basic flying instruction should be confined to the simple facts and full use made of available aids to instruction, *e.g.* blackboard, models, diagrams, *etc.* The student learns through the use of all his senses and the instructor should draw attention to all the sensations involved in an exercise; for example, the student can see the changing attitude, hear the changing engine note and airflow noise, and feel the response of the aircraft to control movements.

14. Airmanship is the ability to choose the most effective and safest course of action for a particular set of circumstances. It is important that the student's sense of airmanship, apart from his individual skill, should be developed so that he is able to recognize the approach of a potentially dangerous situation in good time. The student should be made aware of the fact that common sense and airmanship are synonymous and that their use implies careful planning and continuous anticipation. The teaching of airmanship is, above all, a matter of the example set by the flying instructor.

EXERCISE 1

FAMILIARIZATION WITH THE AIRCRAFT

AIM: TO FAMILIARIZE THE STUDENT WITH THE AIRCRAFT'S CONTROLS AND SYSTEMS AND TEACH HIM THE DRILLS AND CHECK LISTS USED FOR NORMAL FLYING.

INSTRUCTIONAL GUIDE

1. The impressions formed by the student at this stage largely determine his attitude towards instruction and his confidence in himself and the aircraft. The instructor must aim to develop the confidence and co-operation of his student from the outset. The student should not be swamped with a mass of detail at this stage.

2. All the instruction in this exercise involving the external features of the aircraft, the cockpit layout, and the checks and drills should be given at the aircraft. The instructor should first show the student the external features, pointing out constructional and technical items such as the control surfaces, undercarriage details, refuelling points, and so on.

3. Having dealt with the external points of primary interest, the cockpit can be entered and its layout explained. A good method of teaching the disposition of the controls and instruments is to work through the check lists and drills in Pilot's Notes; in this way the student also learns to associate Pilot's Notes with aircraft familiarization. The vital importance of systematic checking should be emphasized and the student should realize that the checking of every item on the check list or in a drill is essential to safe flying. Any questions should be answered within the limitations of the student's background knowledge, but discussions on engine and aircraft handling are premature and should be avoided at this early stage.

4. **Aircraft Systems.** By the time the student is ready for solo he should be familiar with the following:—

(*a*) Fuel system.

(*b*) Brake system.

(*c*) Electrical system.

(*d*) Handling and use of radio equipment.

5. **Check Lists, Drills, and Controls.** The student must learn all check lists and drills thoroughly so that the actions become instinctive. He should be able to locate all controls and switches without looking for them; to this end the student should seat himself in the aircraft and practise with the aid of Pilot's Notes.

EXERCISE 1A

EMERGENCY DRILLS

AIM: TO FAMILIARIZE THE STUDENT THOROUGHLY WITH THE DRILLS TO BE USED IN EMERGENCY.

1. When teaching the emergency drills emphasize that seconds will count if an emergency arises. Do not give the impression that such emergencies are commonplace, and stress the fact that since emergencies are rare the unexpected nature of the occurrence demands an instinctive drill which needs to be practised at intervals to ensure that no time is lost through momentary confusion and indecision. The following drills must be learned thoroughly and recorded in the student's flying log book after each practice:—

(*a*) Action in the event of fire in the air and on the ground.

(*b*) Canopy side-panel jettisoning.

(*c*) Abandoning the aircraft.

(*d*) Emergency communication procedures.

EXERCISE 2

PREPARATION FOR FLIGHT AND ACTION AFTER FLIGHT

AIM: TO TEACH THOROUGH PREPARATION FOR FLIGHT AND ACTION AFTER FLIGHT.

INSTRUCTIONAL GUIDE

1. **Flying Clothing.** The importance of wearing the appropriate flying clothing must be impressed on the student. Check his clothing to see that it fits correctly, otherwise any discomfort may effect his flying. This applies particularly to the fit and functioning of the helmet and oxygen mask. Flying boots are seldom required in the Chipmunk and tend to impede easy movement of the rudder. The instructor should make certain that the student knows the procedure for checking his parachute and how to adjust and operate it.

2. **Flight Authorization and Aircraft Acceptance.** The use of Form 700 and the authorization sheet should be explained and the student should be shown how to complete the documents before and after flight. At this early stage the student should not be overburdened with pre-flight planning details, and only the more important points such as the weather, aerodrome control requirements and the airfield state should be mentioned.

3. **External Checks.** The instructor should point out the following:—

(*a*) Siting of the aircraft for starting—state of ground, direction of slipstream, etc.

(*b*) Precautionary presence of fire extinguishers.

(*c*) Importance of checking the immediate taxying path for obstructions which cannot be seen from the cockpit.

Next, the detailed external check of the aircraft is carried out, as detailed in Pilot's Notes. (See also A.P. 129, Vol. 2, Part 2, Sect. 1, Chaps. 1 to 7.)

4. **Internal Checks.** On entering the cockpit, check that the student knows how to fasten and adjust his safety harness and see that the rudder pedals are suitably adjusted. After these preliminaries the internal checks (as listed in Pilot's Notes) should be made. During these checks the student should be kept actively engaged; this not only helps him to learn the checks but makes him more familiar with the cockpit.

5. **Starting and Warming Up.** When demonstrating the starting procedures the signals between the pilot and the ground crew should be explained and the various safety precautions emphasized. The

student should be allowed to start the engine for his first flight, as this small achievement can make him more receptive to further instruction. During the warm-up period the student should be kept aware of the engine instrument readings and alert to the general nature of things going on in the immediate vicinity of his aircraft.

6. **Power Checks.** The Chipmunk should be headed into wind and the control column held fully back to ensure that there is no risk of nosing over.

7. **Running Down and Switching Off.** It should be pointed out that the handling of aircraft engines necessitates a correct running down and stopping procedure in order to prolong the life of the engine and ensure reliability. Carry out the running down and stopping procedure as given in Pilot's Notes. Tell the student of the dangers of leaving the ignition switches on.

8. **Leaving the Aircraft.** Explain the use of the flying controls locking bar and point out the advisability of leaving the canopy closed in wet weather. After vacating the cockpit carry out the final brief external check of the aircraft and explain that this is done to check for any signs of leaking fluid or other indications of unserviceability.

9. **Completion of Authorization Sheet and Form 700.** Make certain that the student knows how to record his flying times on the authorization sheet and the method of reporting defects and completing Form 700.

10. The student cannot be expected to remember all the detail involved in this lesson until he has had frequent practice. He should be supervised and checked as unobtrusively as possible, until he becomes proficient.

EXERCISE 3

AIR EXPERIENCE

AIM: TO INTRODUCE THE STUDENT TO THE SENSATIONS OF FLYING AND THE TOTALLY NEW ASPECT OF THE GROUND WHEN SEEN FROM THE AIR.

INSTRUCTIONAL GUIDE

1. No flying instruction should be given during the exercise, but this does not detract from its usefulness. During the flight the instructor can make his initial assessment of the student's in-flight temperament and decide on a tentative manner of approach for subsequent instruction. The student becomes still more familiar with the aircraft and its operation by watching the instructor, and also becomes accustomed to the new environment and the novel sensations associated with flight.

2. The flight should be made in the vicinity of the aerodrome and local flying area so that local landmarks can be pointed out. After the student has settled down and is taking an active interest, his attention can be drawn to items such as the altitude and air-speed and the importance of the horizon as a visual aid to flying. Any reasonable request for aerobatics or cloud flying should be agreed; if this cannot be done, the reason should be explained to prevent the student forming the opinion that the request has involved something difficult or dangerous. Aerobatics should be limited to those involving positive loadings. If the student shows signs of becoming airsick the flight should be discontinued, and if he is sick do not reveal any annoyance, or show undue concern, but make light of the incident and assure him that his behaviour is not uncommon in the early stages.

3. The flight is for the benefit of the student and not a pleasure trip for the instructor. The impressions of the first flight can have a definite bearing on the student's subsequent interest, enthusiasm, and ability to learn.

EXERCISE 4

EFFECTS OF CONTROLS

AIM: TO TEACH THE EFFECTS OF THE CONTROLS ON THE AIRCRAFT IN FLIGHT.

INSTRUCTIONAL GUIDE

1. **General.** Since this is to be the student's first lesson in the air the instruction should be unhurried. Points which are obvious to the experienced pilot are not so to the student and should not be glossed over or omitted; examples are the direction of movement of the trimmer control and rudder bar to obtain a required movement from the aircraft. The student's clear understanding of the principles of this lesson is an essential foundation for later exercises. Usually more than one lesson is required to cover the scope of the exercise adequately.

Before Flight

2. **Preparatory Instruction.** (See para. 6 of Introduction.) The following points should be discussed before the lesson. The subject matter should be confined to that of immediate interest:—

(*a*) Function of the flying controls.

(*b*) Effects of airspeed and slipstream.

(*c*) Effect of bank.

(*d*) Effect of yaw.

(*e*) Effect of inertia.

(*f*) Trimming control.

(*g*) Flaps.

(*h*) Effects of power.

Reference—A.P. 129, Vol. 1, Part 1, Sect. 1.

3. **Pre-Flight Briefing.** (See para. 7 of Introduction.)

During Flight

4. Make certain that the student can hear clearly and is relaxed and comfortable. Check that he holds the controls correctly. Show how the horizon is used as a reference for interpreting the aircraft attitude. Point out that the position on the nose or windscreen frame at which the horizon intersects, changes when the attitude changes.

5. Avoid harsh control movements which may startle or cause discomfort to the student.

6. Allow the student to attempt all the effects demonstrated and give sufficient time for him to become used to the feel of the controls and to appreciate their effects. Be sure that the aircraft is correctly trimmed before handing over control.

7. **Airmanship.**

(*a*) Since the student cannot be expected to keep a good look-out at this stage, the instructor should explain the reason for any actions that he takes for reasons of good airmanship.

(*b*) Ensure that the student knows the correct method of handing over and taking over control.

8. **Primary Effects.**

(*a*) When showing the primary effects of the rudder, remind the student that the prime function of the rudder is not to control the direction but to balance the flight of the aircraft.

(*b*) Show that the response of the aircraft to control movements depends on the I.A.S. and the amount of slipstream, as well as on the quickness and magnitude of the control movements.

9. **Further Effects.** It must be quite evident to the student that only the one control is being used. This can be done by allowing the student to rest his hands and feet on the controls.

10. **Effect of Airspeed.** Although the effectiveness of the controls is reduced and the aircraft response becomes poor when the speed is reduced, a measure of positive control is still available.

11. **Effects of Trim.** Briefly remind the student of the purpose of the trimming control. Demonstrate that the initial adjustment to the aircraft attitude should be made by the elevators and that the trimmer should then be adjusted until no force is required on the control column to maintain the attitude. During this demonstration ensure that the student has his hands resting only lightly on the control column, otherwise he may fail to identify the zero-force trim setting.

EXERCISE 4

EFFECTS OF CONTROLS

AIM: TO TEACH THE EFFECTS OF THE CONTROLS ON THE AIRCRAFT DURING FLIGHT.

AIR EXERCISE

SEQUENCE	OBSERVATIONS
1. Effects of Flying Controls.	
(*a*) Demonstrate primary effects of controls from straight and level flight at 90 knots.	(*a*) Elevators:— (i) Fore and aft movement of control column. (ii) Nose up and down (pitching). (iii) Airspeed changes.
	(*b*) Ailerons:— (i) Lateral movement of control column. (ii) Wing up and down (rolling).
	(*c*) Rudder:— (i) Rudder bar movement. (ii) Nose left and right (yawing).
	◀(*d*) Aircraft response continues until control is returned to the neutral position.
	(*e*) Response of aircraft related to amount of control deflection.
	(*f*) Smooth progressive control movements desired.▶
(*b*) Demonstrate primary effects in banked attitudes.	Effects are in relation to aircraft axes and not to the horizon.
(*c*) Demonstrate further effects from straight and level flight at 90 knots.	(*a*) Elevators—no further effects.
	(*b*) Ailerons:— (i) Primary effect (roll). (ii) Further effect is yaw, leading to increase in bank and spiral descent.
	(*c*) Rudder:— (i) Primary effect (yaw). (ii) Further effect is bank, leading to increase in bank and spiral descent.
2. Effect of Airspeed.	
Demonstrate effect on controls of low (60 knots) and high (100 knots) airspeed, at constant low-power setting.	(*a*) Low airspeed:— (i) Reduced feel. (ii) Reduced control effectiveness and aircraft response.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
	(*b*) High airspeed:— (i) Firm feel. (ii) Increased effectiveness and response.
3. Effect of Slipstream. Demonstrate effect on controls of a strong (full throttle) and a reduced (throttle closed) slipstream. Use of a constant airspeed of 70 knots.	(*a*) Reduced slipstream:— (i) All controls relatively ineffective. (ii) Feel of controls. (*b*) Strong slipstream:— (i) Rudder and elevators more effective and firmer feel. (ii) Aileron feel and effectiveness unaltered.
4. Effect of Trim. The student maintains a constant attitude while trimmer is moved by the instructor. The student then adjusts trimmer until control force is removed. Use 90 knots.	(*a*) Increasing load on elevators. (*b*) Sense of trim control movements. (*c*) Adjustment to relieve control force. (*d*) Aircraft remains in selected attitude when accurately trimmed.
5. Effect of Throttle.	(*a*) Effect of throttle:— (i) Sense of throttle movement. (ii) r.p.m. changes. (iii) Maximum weak mixture position. (*b*) Effect of airspeed on r.p.m.
6. ◀Use of Mixture Control.	Sense of movements.▶
◀7.▶Effect of Power. Demonstrate effects of power changes:— (*a*) At 1,600 r.p.m., trim aircraft to fly with hands off, then increase power to full throttle. (*b*) At full throttle, trim aircraft to fly with hands, off, then close throttle.	(*a*) Increasing power:— (i) Yaw to starboard. (ii) Nose rises. (*b*) Decreasing power:— (i) Yaw to port. (ii) Nose drops.
◀8.▶Effect of Flap. Trim hands off straight and level before each demonstration. Retrim level after initial observations of flap effect:—	

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
(*a*) Lower half flap.	(*a*) Attitude and airspeed in level flight before lowering flap. (*b*) Flap selected (maximum speed 93 knots) note nose-down attitude change. (*c*) When counteracted by elevators:— (i) Trim change. (ii) Lower airspeed.
(*b*) Lower full flap.	(*a*) Maximum speed 71 knots. (*b*) Observations as for half flap but trim change more marked.
(*c*) Raise flap to "half" setting.	(*a*) Attitude and airspeed in level flight before raising flap. (*b*) Flap raised:— (i) Slight sink. (ii) Nose-up change of attitude. (*c*) When counteracted by elevators:— (i) Slight trim change. (ii) Increasing airspeed.
(*d*) Raise flap completely.	Observations as for raising flap to half position.

POST-FLIGHT DISCUSSION

EXERCISE 5

TAXYING

AIM: TO TEACH HOW TO MANOEUVRE THE AIRCRAFT ON THE GROUND.

INSTRUCTIONAL GUIDE

General

1. The elements of taxying should be introduced as early as possible. The student should be given progressively more responsibility as his proficiency increases. The temptation to take over control in order to save time must be resisted so that the student accumulates the maximum amount of taxying under supervision.

2. The sequence in which the items of this exercise are taught depends on variables such as wind velocity, airfield layout, and local regulations, as well as on the student's ability. The lesson should therefore be adapted to the prevailing circumstances. Whenever permissible the initial taxying lessons are best done in an open space on the airfield where there is plenty of room to manoeuvre.

Before the Exercise

3. **Preparatory Instruction.** (See para. 6 of the Introduction.) The following subjects should be discussed with the students:—

(*a*) Effect of inertia.

(*b*) Use of controls.

(*c*) Use of power.

(*d*) Effect of wind.

(*e*) Use of brakes.

(*f*) Engine handling.

(*g*) Marshalling signals.

Reference—A.P. 129, Vol. 2, Part 2, Sect. 3, Chap. 1.

4. **Pre-Flight Briefing.** (See para. 7 of Introduction.)

During the Exercise

5. Emphasize the constant need for a careful lookout and the inherent lack of manoeuvreability of aircraft on the ground. Mention the following points:—

(*a*) Flying controls have only indirect effects on the steering.

(*b*) Distribution of the keel surface tends to make the aircraft weathercock into wind.

(*c*) There is a time lag between opening the throttle and the aircraft responding.

(*d*) Tail-wheel undercarriage limits the ground manoeuvre ability owing to the effect of inertia acting through the high position of the C.G.

6. **Airmanship.** The student should be told that the captain is ultimately responsible for the safety of the aircraft and that, although marshallers' signals should be obeyed, the captain is at liberty to disregard them if he considers that the safety of his aircraft is endangered by following the marshaller's instructions.

7. **Brake Failure.** The main considerations affecting the action to be taken if the brakes fail are:—

(*a*) Proximity of obstacles and other aircraft.

(*b*) Wind strength and direction.

(*c*) Nature and gradient of the surface.

(*d*) Lack of ground manoeuvreability when only the slipstream over the rudder is available to turn the aircraft.

All these points should be discussed with the student but it should be made clear that usually the safest course of action is to switch off the engine.

8. **Lookout.** The forward view from the Chipmunk is quite good but a blind spot exists straight ahead. To clear the blind area the aircraft should be turned sufficiently at short intervals to obtain the full coverage that is essential for safe taxying under all conditions. The great importance of a continuous watch for obstacles and other aircraft should be emphasized. When taxying, pilots must be prepared to give way to aircraft approaching to land and taking off.

9. **Starting and Stopping.** More power is required to start the aircraft moving than to keep it moving because of the higher initial power needed to overcome the inertia of the stationary aircraft. Throttle movements and brake applications should always be smoothly executed and the control column held back while doing so. Harsh braking, excessive use of power, and failure to keep the control column back can, separately or together, cause the aircraft to nose over. (See also para. 14.)

10. **Control of Speed.** When demonstrating the correct taxying speed, point out that the most accurate assessment is obtained from the movement of the ground close to the aircraft. The student must be shown the correct method of setting the brake lever for the specific wind and airfield conditions, and how to combine the use of power to obtain the desired taxying speed.

11. **Directional Control and Turning.** The method of controlling direction is through the use of the rudder and the differential

application of the brake. Power is used only to increase the slipstream over the rudder (the rudder effectiveness) in cases when the extra power will not result in an excessive taxying speed. The direction and amount of control movement and brake application required to enter and leave a turn must be anticipated. These are affected by the wind velocity and whether the turn is made into wind or downwind.

12. **Turning in a Confined Space.** When turning in a confined space the tail can be made to swing quite sharply through a large angle. The necessity to ensure that there are no obstacles in the path of the tail must be emphasized. The student should be told that turning about a locked wheel must be avoided unless the safety of the aircraft is involved.

13. **Leaving Dispersal.** Immediately the aircraft moves forward the throttle should be closed and the brakes applied to test their effectiveness. The aircraft should only be allowed to move slowly before applying the brakes in case they are unserviceable. ◀When the aircraft is stationary full rudder should be applied and the number of notches required for minimum differential brake should be counted.▶

14. **Taxying in Strong Winds.** Normally the control column is held fully back while taxying. If the wind is strong and is blowing from astern the control column should be held central to prevent the wind from blowing against the underside of the elevators and tending to lift the tail. Explain that the fully forward position of the control column is not used because the central position makes it easier to prevent the ailerons from being blown violently against their stops by the following wind.

Common Faults

15. As the student gains experience and confidence there is a distinct tendency to taxi too fast—particularly when solo. Point out the dangers and penalties involved.

EXERCISE 5

TAXYING

AIM: TO TEACH HOW TO MANOEUVRE THE AIRCRAFT ON THE GROUND.

AIR EXERCISE

Airmanship

1. **Before Taxying.**
   (*a*) Check brakes on.
   (*b*) Adjust throttle friction nut.
   (*c*) R/T clearance.
   (*d*) Note wind velocity.

2. **During Taxying.**
   (*a*) Dog-leg taxi path.
   (*b*) Check engine and gyro instruments.
   (*c*) Lookout.

SEQUENCE	OBSERVATIONS
3. **Starting and Stopping.** When clear of dispersal demonstrate starting and stopping in a straight line.	(*a*) Starting:— (i) Throttle closed. (ii) Brakes released. (iii) Control column back. (iv) Open throttle. (v) Throttle back slightly—effect of inertia. (vi) Dangers of misuse of power and elevator. (*b*) Stopping:— (i) Close throttle. (ii) Rudder bar central. (iii) Control column back. (iv) Apply brakes. (v) Danger of braking harshly.
4. **Control of Direction and Turning.** (*a*) Demonstrate use of rudder and brake both upwind and downwind.	(*a*) Power off, brakes off—small effect. (*b*) Power on, brakes off—improved effect. (*c*) Power on, brakes set—large effect. (*d*) To control direction and turn:— (i) Brakes set. (ii) Rudder and power as required. (*e*) Anticipation.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
(*b*) Demonstrate across wind.	(*a*) Weathercock tendency. (*b*) Turns into wind tend to tighten up. (*c*) Aircraft is less willing to turn downwind.
5. **Control of Speed.**	(*a*) Smooth use of throttle. (*b*) Control of speed with:— (i) Power. (ii) Brake. (*c*) Factors affecting speed:— (i) Surface gradient. (ii) Nature of surface. (iii) Wind. (*d*) Judging speed. (*e*) Avoid taxying fast.
6. **Turning in Confined Spaces.**	(*a*) Low speed. (*b*) Use of rudder, power, and brakes. (*c*) Avoid turning on a locked wheel. (*d*) Check that the tail is clear of obstacles.
7. **Leaving Dispersal.**	(*a*) Checks. (*b*) Throttle closed before chocks away. (*c*) Brakes tested.▶◀ ◀(*d*) Check minimum differential brake. (*e*) Set taxying brake.▶ ◀(*f*)▶ Marshaller's signals—captain's responsibility. ◀(*g*)▶ Dismissing marshaller.

POST-FLIGHT DISCUSSION

EXERCISE 6

STRAIGHT AND LEVEL FLIGHT

AIM: TO TEACH HOW TO FLY THE AIRCRAFT ACCURATELY STRAIGHT AND LEVEL.

INSTRUCTIONAL GUIDE

General

1. Accurate straight and level flight is required for certain types of operation; therefore the student should ultimately be required to attain a high standard.

Before Flight

2. **Preparatory Instruction.** (*See* para. 6 of Introduction.)

3. **Pre-Flight Briefing.** (*See* para. 7 of Introduction.)

During Flight

4. **Airmanship.** Again stress the importance of a good lookout. Introduce the clock system of reporting aircraft and ask the student to report the position of other aircraft by using this system.

5. **Straight and Level Flight at Cruising Power.** Pay attention to the following points:—

(*a*) The student should concentrate initially on judging the aircraft attitude by the position of the nose in relation to the horizon and then use that attitude to fly straight and level.

(*b*) The student should be shown how to choose a reference point on which to keep straight and how to bring the aircraft back to that point if the direction alters.

(*c*) Errors in the altitude and airspeed should be corrected by a number of small adjustments to the attitude. This is to avoid the common error of "chasing the needles".

▶◀(*d*)▶ The inherent stability of the aircraft in straight and level flight is demonstrated by trimming the aircraft accurately and then releasing the controls.

◀(*e*)▶ After the student has become fairly proficient at maintaining straight and level flight the instructor should introduce disturbances by upsetting the attitude and trim and then asking the student to restore the aircraft to the original conditions.

◀(*f*) Marked slip can be readily detected by the sensations experienced and by the yaw present if the wings are level. Slight slip, however, is more difficult to detect and the slip indicator must be used. Demonstrate unbalanced flight by applying considerable rudder, showing the yaw with the wings level and the indication of the slip indicator. Bank the aircraft

in the opposite direction to prevent the yaw. Point out that straight and level flight can be maintained, but the feeling of slipping and loss of airspeed (or loss of height if airspeed is maintained) indicates inefficient flight. Recover by levelling the wings and correcting the yaw with rudder using outside references. Point out that reliance upon external references for yaw correction may result in slight residual unbalance. Show that the slip indicator *must* be used to attain completely balanced flight. The lesson to be learned therefore is that for accurate balanced flight the lateral level is controlled with the ailerons and the rudder *co-ordinated* with this to centralize the slip indicator.▶

6. **Straight and Level Flight at Various Power Settings.**
(*a*) While flying at the constant attitude, an increase in power causes the aircraft to accelerate and climb and a decrease in power causes it to slow down and descend. The correct technique therefore is to readjust the attitude while the speed is changing, thus maintaining a constant altitude.
(*b*) It must be stressed that the elevators and power must be co-ordinated to control attitude, airspeed, and also to maintain level flight. Any movement of one of these controls necessitates movement of the other in order to maintain a constant flight path.
(*c*) The speed range of the aircraft with variations of power should be shown.
(*d*) The correction for the yaw which occurs during the power change is a point that requires careful instruction to bring it home to most students.

7. **Straight and Level Flight at Selected Airspeeds.**
(*a*) The student should be made to change the airspeed of the aircraft from one pre-determined figure to another. Special emphasis should be placed on the co-ordination of the power and the elevators to give the required airspeed in level flight.
(*b*) Although only two airspeeds are mentioned in the sequence, the student should be made to fly at any airspeed within the range of the aircraft.

Common Faults

8. Difficulties encountered in eliminating yaw are usually due to the following two causes:—
(*a*) Aircraft is not laterally level.
(*b*) Lateral level is allowed to change while eliminating yaw.

9. Despite careful instruction and warnings to the contrary some students tend to develop the habit of using the trimmer to change the attitude. This fault is not always easy to detect and should be watched for very carefully.

EXERCISE 6

STRAIGHT AND LEVEL FLIGHT

AIM: TO TEACH HOW TO FLY THE AIRCRAFT ACCURATELY STRAIGHT AND LEVEL.

AIR EXERCISE

SEQUENCE	OBSERVATIONS
◀1. **Straight and Level Flight.**	
(*a*) Demonstrate straight and level flight at cruising speed (90 knots).	(*a*) Lookout. (*b*) Point out speed and R.P.M. setting. (*c*) Constant Altitude:— (i) Pitch attitude selected—elevators. (ii) Trim elevator. (iii) Check instruments. (iv) Adjust attitude if necessary and re-trim. (*d*) Constant direction and balance:— (i) Wings level—aileron. (ii) Correct any yaw with rudder. (iii) Check direction by external reference point. (*e*) Adjust direction by making small applications of bank in the required direction—aileron. (*f*) Stability.
(*b*) Show exaggerated and slight degrees of slip by the co-ordinated application of rudder and aileron. Maintain height.	(*a*) Note airspeed in balanced flight. (*b*) Exaggerated slip:— (i) Physical sensation. (ii) Slip indicator. (ii) Reduction of airspeed inefficient flight. (*c*) Recovery:— (i) Level wings. (ii) Correct yaw with rudder. (*d*) Slight slip difficult to feel—value of slip indicator.▶
2. **Straight and Level Flight at Various Power Settings.**	
(*a*) Demonstrate effect of increasing power to full throttle from straight and level flight at cruising power.	(*a*) Lookout. (*b*) Attitude and airspeed at cruising power. (*c*) Increase power while still maintaining attitude and direction—aircraft climbs—importance of

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
	adjusting attitude as power is increased. (*d*) Adjust attitude and trim for straight and level flight:— (i) More nose-down attitude. (ii) Increased airspeed. (*e*) Instrument indications.
(*b*) Demonstrate effect of decreasing power to 1,650 r.p.m., from straight and level flight at cruising power.	(*a*) Lookout. (*b*) Attitude and airspeed at cruising power. (*c*) Decrease power while maintaining attitude and direction—aircraft descends—importance of adjusting attitude as the power is decreased. (*d*) Adjust attitude and trim for straight and level flight:— (i) Higher position of nose. (ii) Decreased airspeed. (*e*) Instrument indications. (*f*) Further decreases in power:— (i) Still higher position of nose. (ii) Further decreases in airspeed. (*g*) Eventually aircraft cannot maintain height if power is reduced further.
3. Straight and Level Flight at Selected Airspeeds.	
(*a*) Demonstrate how to change airspeed of aircraft from approximately 90 knots to exactly 110 knots.	(*a*) Lookout. (*b*) Note airspeed. (*c*) Increase power to approximate setting for required speed—prevent yaw. (*d*) Aircraft accelerates—inertia. (*e*) Maintain level flight—gradual lowering of nose as speed increases. (*f*) Allow speed to settle. (*g*) Adjust power and attitude to give exactly 110 knots. (*h*) Trim.
(*b*) Demonstrate how to reduce speed from 110 knots to 70 knots.	(*a*) Lookout. (*b*) Reduce power to approximate setting for required speed—prevent yaw. (*c*) Aircraft decelerates—inertia. (*d*) Maintain level flight—gradual raising of the nose as the speed decreases. (*e*) Allow speed to settle. (*f*) Adjust power to give exact speed. (*g*) Trim.

POST-FLIGHT DISCUSSION

EXERCISE 7

CLIMBING

AIM: TO TEACH HOW TO CLIMB THE AIRCRAFT AT A GIVEN AIRSPEED.

INSTRUCTIONAL GUIDE

General

1. Usually an aircraft is climbed at the airspeed recommended in Pilot's Notes; this speed gives the best compromise between maximum rate of climb and optimum engine performance at the high-power and low-forward speed. Although flaps are not normally used during the climb, the considerations for raising flap during the climb after a mislanding are included under Exercise 13.

Before Flight

2. **Preparatory Instruction.** (*See* para. 6 of Introduction.)

   (*a*) Effect of changing power.

   (*b*) Recommended airspeeds.

   (*c*) Effect of flap.

   (*d*) Engine limitations.

   (*e*) Effect of altitudes.

Reference—A.P. 129.

3. **Pre-Flight Briefing.** (*See* para. 7 of Introduction.)

During Flight

4. **Airmanship.** A good lookout should cover the whole area around the aircraft, but during the climb the area into which the aircraft is moving is especially important. In order to clear the area in the blind spot beneath the nose, the heading should be changed at intervals. ◀The standard pressure setting (1013 M.B.) should be set on the altimeter at the transition altitude.▶

5. **Normal Climb.**

   (*a*) The climbing speed should be set by first placing the aircraft in a climbing attitude, referring to the airspeed indicator and ajusting the attitude as necessary. Unless this method is used the student tends to chase the airspeed.

   (*b*) The oil temperature and pressure should be frequently checked.

6. **Levelling Off.** Until the student is proficient at levelling off from the climb he should not be expected to level off at a precise

altitude. In the early stages students encounter difficulty in levelling off correctly and maintaining a constant altitude at the same time; the difficulty is caused through the progressive attitude change required as the speed increases.

7. **Maximum Rate of Climb.**

(*a*) The best rate of climb is achieved at the airspeed which realizes the greatest excess of power over that required for straight and level flight. The recommended climbing speed takes into account the engine cooling characteristics and ease of handling. The recommended climbing speed for the Chipmunk is higher than that for maximum rate of climb.

(*b*) At maximum power the rate of climb will decrease during the climb.

Common Faults

8. The student often fails to correct the yaw after changing power. The student must be taught to anticipate the yaw.

9. Students tend to neglect the engine instruments when concentrating on the flying of the aircraft. The student should be reminded of the vital importance of keeping within the engine limitations.

EXERCISE 7

CLIMBING

AIM: TO TEACH HOW TO CLIMB THE AIRCRAFT AT A GIVEN AIRSPEED.

AIR EXERCISE

SEQUENCE	OBSERVATIONS
1. The Normal Climb.	
Demonstrate climb using full throttle. Climb at 70 knots.	(*a*) Lookout. (*b*) Assuming climb:— (i) Power—prevent yaw. (ii) Attitude selected and held constant. (iii) Trim. (iv) Aircraft settled — check speed. (v) Adjust attitude. (vi) Wings level — slip indicator. (vii) Retrim, hands off. (*c*) In climb:— (i) Instrument indications. (ii) View ahead. ◀(iii) Set standard pressure setting (1013 M.B.) at transition altitude.▶ (iv) Control of oil temperature. (v) I.A.S. reductions. (5 knots per 5,000 feet.) (vi) Use of mixture control. (*d*) Rate of climb decreases as altitude increases.
2. Levelling Off.	
Level off from a normal climb at a predetermined height.	(*a*) Anticipation of height. (*b*) Attitude changing with speed—inertia of aircraft. (*c*) Reduction of power at cruising speed. Use of mixture control. (*d*) Prevent yaw. (*e*) Wings level—slip indicator. (*f*) Trim. (*g*) Check height. (*h*) Adjust attitude. (*j*) Retrim, hands off.

POST-FLIGHT DISCUSSION

EXERCISE 8

DESCENDING

AIM: TO TEACH HOW TO DESCEND AT GIVEN AIRSPEEDS AND RATES OF DESCENT.

INSTRUCTIONAL GUIDE

General

1. An accurately controlled descent involves four variables which must be correctly related to obtain the required conditions for the descent. The variables are:—
   (*a*) Airspeed.
   (*b*) Power.
   (*c*) Flap setting.
   (*d*) Rate of descent.

Since all these variables assume added importance on the landing approach it may be advisable to revise this exercise before teaching landings.

Before Flight

2. **Preparatory Instruction.** (*See* para. 6 of Introduction.)
   (*a*) Effect of power.
   (*b*) Recommended airspeeds.
   (*c*) Effect of flap.
   (*d*) Engine limitations.
   (*e*) Effect of wind.
   (*f*) Wind gradient.

Reference—A.P. 129.

3. **Pre-Flight Briefing.** (*See* para. 7 of Introduction.)

During Flight

4. **Airmanship.** The following two points have particular significance to the exercise:—
   (*a*) During a long descent the heading should be changed at intervals so that a lookout can be maintained in the area into which the aircraft is descending.
   (*b*) At 1,000-foot intervals during a glide descent, the throttle should be fully opened to clear the engine. The student should be taught how to keep the airspeed constant by raising the nose at the same time.
   ◀(*c*) At the transition level the aerodrome QFE or the regional QNH should be set on the altimeter.▶

5. **The Glide.** The following points are important:—
   (*a*) The glide can be established in two ways:—
      (i) Throttle back and immediately assume the gliding attitude, allowing the speed to stabilize in its own time.

(ii) Throttle back and delay assuming the gliding attitude until the speed approaches the desired gliding speed, then lower the nose to the gliding attitude. The glide is established more quickly by using the second method.

(*b*) The student may encounter some difficulty in judging the gliding attitude since the nose is below the horizon. However, the instructor must persevere until the student can determine the correct attitude quickly and clearly. Accurate trimming is important. As early as possible the student should be made to cross refer to the instruments.

6. **Effect of Flap.** When lowering the flaps, the nose-down change of trim should be anticipated and countered to maintain the desired airspeed for the descent.

7. **Effect of Power.** To ensure that the student becomes generally proficient at descending under defined conditions he should be given frequent practice at varying the rate of descent while at a constant airspeed.

8. **Effect of Airspeed.** This exercise is difficult to demonstrate and should be shown only if conditions are favourable and it is certain that the result will be convincing. Start at about 1,500 feet a.g.l. and descend to 200 feet a.g.l. If circumstances permit, the demonstration at the airfield can be continued to the touch-down. The student is not required to practice this particular demonstration.

9. **Slideslipping.** If, owing to poor judgement during the final stages of a forced landing, it is apparent that the aircraft is too high, both the rate and the angle of descent can be increased by sideslipping the aircraft. Sideslipping is an unnatural condition of flight, both the lateral stability and the directional stability tend to prevent it. The former tries to take off the bank, the latter tries to make the aircraft turn into the sideslip; the aileron control must be used to maintain the bank against the lateral stability, and the rudder must be used to overcome the directional stability. The elevators are used for their normal function of controlling the position of the nose in the pitching plane and consequently the airspeed.

10. Sideslipping should be demonstrated and practised at height until the student is proficient at entering the sideslip, maintaining airspeed and direction and then resuming the normal balanced glide. On no account should he be allowed to use this manoeuvre near the ground until such proficiency has been checked. When recovering from the sideslip adequate height must be allowed for resuming the normal glide before rounding out.

Common Faults

11. The student does not allow enough time for the airspeed to stabilize and consequently chases the needle.

EXERCISE 8

DESCENDING

AIM: TO TEACH HOW TO DESCEND AT GIVEN AIRSPEEDS AND RATES OF DESCENT.

AIR EXERCISE

SEQUENCE	OBSERVATIONS
1. The Glide.	
Demonstrate how to enter and maintain a glide at 70 knots from straight and level flight.	(*a*) Lookout. (*b*) Assuming the glide:— (i) Close throttle—prevent yaw. (ii) Allow speed to fall—inertia. (iii) Attitude selected and held constant. (iv) Trim. (v) Aircraft settled — check speed. (vi) Adjust attitude. (vii) Wings level — slip indicator. (viii) Retrim, hands off. (*c*) In the glide:— (i) Instrument indications. (ii) Engine limitations. (iii) Blind spot. ◀(iv) Set aerodrome QFE or regional QNH at the transition level.▶
2. Levelling Off.	
From the glide at 70 knots level off at a predetermined height.	(*a*) Anticipation of height. (*b*) Power—prevent yaw. (*c*) Attitude changing with speed—effect of inertia. (*d*) Speed constant. (*e*) Wings level—slip indicator. (*f*) Trim. (*g*) Check height.
3. Effect of Flap.	
When gliding at 70 knots demonstrate effect of full flap.	(*a*) Attitude and rate of descent for the straight glide. (*b*) Full flap:— (i) Initial decrease in rate of descent. (ii) When settled—lower nose position, slightly higher rate of descent at same airspeed.
4. Effect of Power.	
(*a*) Demonstrate a descent from the glide at 70 knots using intermediate power settings up to 1,600 r.p.m.	(*a*) Attitude and rate of descent in the glide. (*b*) Power increased by stages up to 1,600 r.p.m. At each stage:— (i) Higher nose-up attitude. (ii) Rate of descent decreased.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
(*b*) Demonstrate how rate of descent can be varied at constant speeds (70 and 90 knots).	(*a*) Elevators control airspeed. (*b*) Power controls rate of descent. (*c*) Changes in rate of descent necessitate changes of attitude to keep airspeed constant.
5. Effect of Airspeed.	
Start demonstration with a glide at 70 knots, and compare with glides at 90 knots and 50 knots. Start each glide from same point over ground (gliding into wind) and show distance covered at each speed.	(*a*) Note descent path at 70 knots. (*b*) Steeper descent paths at both 90 and 50 knots. (*c*) At 50 knots—application to stretched glide. (*d*) Best range gliding speed is 70 knots.
6. Sideslipping.	
◀(*a*) Entry. From a straight descent at 65 knots with full flap and the throttle closed sideslip the aircraft whilst maintaining airspeed.	(*a*) Note rate of descent in straight glide. (*b*) Sideslip aircraft:— (i) Rudder to slip. (ii) Bank in opposite sense to control direction. (iii) Maintain IAS with elevator. (*c*) Higher rate of descent with same IAS. (*d*) Danger of stalling is speed is lowered. (*e*) Application to forced landing.▶
(*b*) Recovery.	(*a*) Take off rudder. (*b*) Level wings. (*c*) Move control column forward sufficiently to maintain gliding speed. (*d*) Check balance.

POST-FLIGHT DISCUSSION

EXERCISE 9

MEDIUM TURNS

AIM: TO TEACH HOW TO TURN ONTO A SPECIFIED HEADING USING MEDIUM ANGLES OF BANK.

INSTRUCTIONAL GUIDE

General

1. For the purpose of this exercise the amount of bank used should not exceed about 35 degrees. Turns using higher angles of bank are considered as steep turns.

2. All types of medium turns should be taught before starting circuits.

Before Flight

3. **Preparatory Instruction.** (See para. 6 of Introduction.)
   (*a*) Principles of turning.
   (*b*) Use of controls when turning.
   (*c*) Use of power.
   (*d*) Climbing and descending turns.

Reference—A.P. 129, Vol. 1, Part 1, Sect. 1, Chap. 12.

4. **Pre-Flight Briefing.** (See para. 7 of Introduction.)

During Flight

5. The initial emphasis should be placed on the correct judgment of attitude and angle of bank through the use of the horizon as an external reference. As the student becomes more proficient he should be made to cross refer to the instruments to achieve greater accuracy.

6. The student should be able to enter and leave the turns smoothly before progressing to sustained turns through large changes of heading.

7. The direction of turn should be alternated so that the student obtains practice in turning in both directions.

8. **Airmanship.** The student often forgets to maintain a good lookout while concentrating on flying accurately. He should be told that a good lookout is very important before and during a change of direction, particularly on the side towards which he is turning. During the exercise the student should be required to orientate himself at intervals so as to develop his sense of direction.

9. **Level Turns.** The following points should be remembered while teaching level turns:—

(*a*) The student should be taught to be systematic and apply the following basic checks to all turns:—

(i) Lookout.

(ii) Angle of bank and balance.

(iii) Attitude and height.

(*b*) In an accurate turn the airspeed settles at a slightly lower figure than that realized in level flight at the same power. When the aircraft is in a steady turn the airspeed should not fluctuate.

10. **Climbing Turns.** The handling technique is the same as for level turns but the speed is adjusted and maintained by use of the elevator. The angle of bank should be kept comparatively moderate to avoid a substantial fall in the rate of climb.

11. **Descending Turns.**

(*a*) Handling technique for entry and recovery is the same as for climbing turns.

(*b*) Effects of power and flap settings are the same as for a straight descent.

(*c*) Although the considerations of steep descending turns are covered in Exercise 15, the student should be told at this stage that high angles of bank have the effect of increasing the rate of descent and stalling speed, and that more power, a higher airspeed or a combination of both, is required to counter these effects.

12. **Practise Emergency Call and Homing.** At the end of the turning exercise it is opportune to demonstrate how to make an emergency call and then how to home to base. First, however, the student should show that he is able to read the compass correctly and synchronize the D.I. with the compass.

Common Faults

13. Most faults stem from the lack of co-ordination of the controls. It should be made clear to the student that a correction to any one of the variables involved in the turn will necessitate adjustment of the others. Co-ordination can be improved by getting the student to maintain height and balance while banking alternately to port and starboard.

14. Faulty turns often result from inaccurate flying and trimming just before entering the turns.

15. Some students become confused over the function of the controls when the aircraft is banked. It should be made clear that the controls still retain their basic functions when the aircraft is banked, *viz.*:—

(*a*) Ailerons control the angle of bank.

(*b*) Elevators control the pitch attitude.

(*c*) Rudder controls the yawing plane—slip or skid.

EXERCISE 9

MEDIUM TURNS

AIM: TO TEACH HOW TO TURN ONTO A SPECIFIED HEADING USING MEDIUM ANGLES OF BANK.

AIR EXERCISE

SEQUENCE	OBSERVATIONS
1. Level Turns.	
(*a*) Turn at a medium angle of bank using cruising power.	(*a*) Airspeed before entry. (*b*) Lookout. (*c*) Entry:— (i) Control co-ordination. (ii) Aileron and rudder together. (iii) Pitch attitude controlled with elevator. (*d*) In the turn:— ◀(i) Maintain correct bank with aileron. (ii) Adjust pitch attitude to maintain height. (iii) Balance with rudder-slip indicator. (iv) Instrument indications. (v) Note slightly lower airspeed. (vi) Lookout.▶ (*e*) Recovery:— (i) Control co-ordination. (ii) Aileron and rudder together. (iii) Pitch attitude controlled with elevator. (iv) Check straight and level.
(*b*) Turn in opposite direction.	
(*c*) Carry out turns onto preselected points and headings.	Anticipation of recovery.
2. Climbing Turns.	
(*a*) Climbing turn (15-degrees bank) using full throttle commencing from a straight climb.	(*a*) Rate of climb before entry. (*b*) Lookout. (*c*) Entry and recovery is similar to level turn but elevators are used to maintain airspeed. (*d*) In the turn:— (i) Maintain a constant angle of bank and speed. Slip indicator. (ii) Attitude ◀ —lower nose position.▶ (iii) Lower rate of climb. (iv) Instrument indications. (*e*) Check straight climb after recovery.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
(*b*) Increase bank to higher angle using same power.	(*a*) Marked lower nose attitude—still lower rate of climb. (*b*) Need for moderate angles of bank.
3. Descending Turns.	
(*a*) From a straight glide enter a medium gliding turn at 70 knots. Increase angle of bank to show higher rate of descent.	(*a*) Attitude and rate of descent before entry. (*b*) Lookout. (*c*) Entry and recovery similar to that for climbing turn. (*d*) In the turn:— (i) Maintain a constant angle of bank and speed. Slip indicator. (ii) Steeper attitude. (iii) Increased rate of descent. (iv) Instrument indications. (*e*) Larger angles of bank cause increased rates of descent. (*f*) Check straight descent after recovery.
(*b*) Demonstrate effects of power and flap on medium descending turns.	(*a*) Observations as for effect of power and flap on straight descent. (*b*) At a constant power setting:— (i) Nose is lowered to maintain set speed. (ii) Increased rate of descent. (*c*) Power may be used to maintain a constant rate of descent. (*d*) Amount of power required to maintain a constant rate of descent increases as angle of bank is increased.
4. Practise Emergency Call and Homing.	
(*a*) Practise emergency call.	(*a*) Securité, (Pan or Mayday) three times, followed by the aircraft's call sign◀(three times for Mayday).▶ (*b*) Estimated position and time of position. (*c*) Heading (true) and airspeed (indicator). (*d*) Altitude of aircraft. (*e*) Type of aircraft. (*f*) Nature of distress, and assistance required. (*g*) Intention of captain. (*h*) Endurance remaining (see Flight Information Publications for full details).
(*b*) Homing.	(*a*) Check D.I. with compass. (*b*) Request steer and emphasize difference between a true bearing and a steer.

POST-FLIGHT DISCUSSION

EXERCISE 10

STALLING

AIM: TO TEACH HOW TO RECOGNIZE THE SYMPTOMS OF A STALL AND HOW TO RECOVER: FINALLY, HOW TO RECOVER WITH THE MINIMUM LOSS OF HEIGHT.

INSTRUCTIONAL GUIDE

General

1. The ultimate aim of this exercise is to teach the student how to recover with the minimum loss of height; however, this aspect should not be over-emphasized in the early stages of the exercise. The student should first be able to identify the symptoms of a stall and know the correct method of recovery under all circumstances.

2. The first lesson should be taken no further than the fourth sequence of the Air Exercise but the whole exercise must have been taught by the time the student first flies solo.

Before Flight

3. **Preparatory Instruction.** (See para. 6 of Introduction.)

(*a*) Lift, the stalling angle and the stalling speed.

(*b*) Characteristics of the stall.

(*c*) Factors affecting the stalling speed.

(*d*) Attitude and the stall.

(*e*) Recovery from the stall—use of power.

Reference—A.P. 129, Vol. 1, Part 1, Sect. 1, Chap. 5.

4. **Pre-Flight Briefing.** (See para. 7 of Introduction.)

During Flight

5. The student may be a little nervous at first; this is understandable, but he will gain confidence as he himself becomes able to identify and recover from the stall. As soon as possible the student should be allowed to stall the aircraft and recover. He should be given plenty of practice until he becomes thoroughly proficient and confident.

6. In the early stages the student should be watched for symptoms of airsickness and the exercise discontinued if necessary.

7. Principal emphasis must be placed on the recognition of the stall warnings and the recovery. Although a practical method of entry must be taught, it is of less importance. If the particular aircraft drops a wing at the stall, the observations dealing with this additional consideration should be brought in from the start.

8. Stalling in turns and during aerobatics are considered under steep turns and aerobatics.

9. **First Stall.** The student's first experience of a stall should show him that it is not in any way a frightening experience and should rid him of any false ideas of danger and violent sensations. The first stall is best done at the end of the lesson preceding that on which stalling is to be dealt with in detail. No instruction should be given during the first demonstration but the point of stall and the commencement of recovery should be indicated. During the subsequent post-flight discussion, the stall, as demonstrated, should be discussed and the student's questions answered; in this way the student is better prepared for the detailed lesson on stalling.

10. **Symptoms of Stall.**

(*a*) A high nose-up attitude is not always a fundamental symptom of an approaching stall. The nose-up attitude should only be pointed out when it is a valid indication that a stall is imminent.

(*b*) The student must be given plenty of practice at approaching the stall and detecting the symptoms for himself—he should become thoroughly familiar with the stall warning symptoms.

11. **Effect of Power on Recovery.**

(*a*) The smaller amount of height lost by using power in the recovery should be emphasized.

(*b*) It should be shown that a larger amount of height may be lost if power is used when the nose is already well below the horizon.

12. **Recovery when the Wing Drops.**

(*a*) The student should be told that the use of aileron will not always raise a dropped wing and may aggravate the situation under certain conditions. Therefore, because of this possibility, ailerons are not used in the standard recovery.

(*b*) When demonstrating how the use of aileron can worsen the wing drop, it may be found on certain Chipmunk aircraft that a clear-cut demonstration cannot be made, *i.e.* the dropped wing can be raised by aileron movement. In such cases the demonstration should be made with the flaps fully down. The difference serves to emphasize the original point that the use of aileron is not always successful in raising a dropped wing at the stall.

13. **Recovery from the Incipient Stall.** An unintentional stall should always be stopped at the incipient stage, therefore the emphasis should be placed on quick recovery action as soon as any stall

warning symptoms are recognized. The student should be given ample practice in recovering from the incipient stage of all types of stalls.

14. **Stall under Approach Conditions.** The demonstration should be made as realistic as possible. Show how lack of attention to accurate flying can lead to a stall when concentrating on the approach to land.

15. **Stall at Higher Speeds.** The student should be under no doubt that the aircraft can be stalled at any speed and power. He should understand that the more extreme cases cannot be demonstrated because of the possibility of over-stressing the aircraft.

16. **Effect of Power on the Stall.** Show the pupil that, when the aircraft is stalled with power on, recovery from the incipient stage can be made by simply releasing the backward pressure on the control column. It should be made quite clear that this applies only at the incipient stage and not when the full stall has occurred.

Common Faults

17. Students often have difficulty in estimating the amount of control column movement required to recover from the stall. Frequent practise and advice from the instructor is needed until the student becomes proficient. When the instructor is demonstrating the recovery, the student should be allowed to rest his hands and feet on the controls.

18. When a wing drops at the stall, the student tends to correct by instinctive use of the ailerons. Only by practice and experience can the proper method be learned.

19. When power is applied during recovery, the throttle movement is often hesitant or slow. If this is so, the student should be told that the amount of height lost and the rapidity with which control is regained both depend on the prompt use of high power.

EXERCISE 10

STALLING

AIM: TO TEACH HOW TO RECOGNIZE AN APPROACHING STALL AND HOW TO RECOVER FROM A STALL: FINALLY, HOW TO RECOVER WITH THE MINIMUM LOSS OF HEIGHT.

AIR EXERCISE

Airmanship

1. **Checks.**

H—HEIGHT	Sufficient to recover by transition level plus height of ground plus 1,000 feet solo, and transition level plus height of ground dual.
A—AIRFRAME	FLAPS—As required. BRAKES—Fully OFF. D.I.—Caged.
S—SECURITY	No loose articles in the cockpit. HOOD—Closed. HARNESS—TIGHT.
E—ENGINE	Mixture—Fully Rich. OIL temperature and pressure within limits. FUEL—Sufficient.
L—LOCATION	Clear of built-up areas, aerodromes and restricted airspaces.
L—LOOKOUT	Well clear of all other aircraft and cloud, vertically and horizontally.

2. **Check position frequently during the exercise.**

SEQUENCE	OBSERVATIONS
3. **Student's First Stall.**	
Stall and recover from straight and level flight.	(*a*) Not violent or unpleasant. (*b*) Control easily regained.
4. **Symptoms of the Stall.**	
Demonstrate a stall from straight and level flight, and detail symptoms.	(*a*) Entry:— (i) Close throttle and prevent yaw. (ii) Progressive backward movement of control column to maintain height. ◀(*b*) Symptoms prior to the stall:— (i) Decreasing airspeed. (ii) Decreasing effectiveness of controls. (iii) High nose attitude. (iv) Buffet.▶ ◀(*c*) Symptoms at the stall:— (i) Sink. (ii) Slight nose drop. (iii) Heavy buffet.▶

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
5. Effect of Power on Reovery.	
(*a*) Demonstrate a stall from straight and level flight. Recover using no power.	(*a*) Entry:— (i) Close throttle, prevent yaw, and maintain height. (*b*) Note stalling height and speed. (*c*) Recovery:— ◀(i) Ailerons neutral.▶ ◀(ii)▶ Control column forward. ◀(iii)▶ Gain speed to regain control. ◀(iv)▶ East out of dive. ◀(v)▶ Level off and apply power. (*d*) Note amount of height lost.
(*b*) Demonstrate a stall from straight and level flight and recover with minimum loss of height, using power.	(*a*) Entry:— Close throttle, prevent yaw and maintain height for as long as possible. (*b*) Recovery:— (i)◀With ailerons neutral simultaneous▶ use of full power and movement of control column sufficiently far forward to unstall aircraft. (ii) Control regained. (iii) Level off. (*c*) Smaller movement of control column to regain control. (*d*) Less height lost.
◀6.▶ Recovery when the Wing Drops.	
(*a*) Demonstrate a stall using a low-power setting. Use standard recovery.	(*a*) Standard recovery:— Simultaneous use of full power and movement of control column sufficiently far forward to unstall aircraft. (*b*) Rudder to prevent further yaw. (*c*) Control regained—level wings with aileron and ease out of dive.
(*b*) Demonstrate using a small amount of power up to the stall. Attempt to level wings with aileron at the stall.	Incorrect recovery:— (*a*) Aggravates wing drop. (*b*) Importance of using rudder.
◀7. Recovery from Incipient Stall.	
Demonstrate recovery from buffet stage.	(*a*) Note stalling altitude. (*b*) Standard recovery. (*c*) Small control column movement to regain control. (*d*) Small height loss.▶

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
◀8.▶ Effect of Power on the Stall.	
Demonstrate using half throttle up to the stall.	(*a*) Speed falls slowly. (*b*) Control effectiveness. (*c*) Shorter duration of stall warning. (*d*) Lower stalling speed. (*e*) Stall more marked. (*f*) Tendency to drop a wing. (*g*) Standard recovery.
◀9.▶ Effect of Flap on the Stall.	
Demonstrate stalls with full flap using no power. During recovery take care not to exceed maximum speed for amount of flap used.	(*a*) Speed falls rapidly. (*b*) Shorter duration of stall warning. (*c*) Lower stalling speed. (*d*) Stall more marked. (*e*) Tendency to drop a wing. (*f*) Standard recovery.
10. Stall Under Approach Conditions.	
Demonstrate using approach power and full flap ◀from a descent at 65 knots.▶	(*a*) Large nose-up attitude. (*b*) Control effectiveness. (*c*) Low stalling speed. (*d*) Standard recovery. (*e*) Importance of recovery in incipient stage—danger of stalling on approach.
11. Stall at Higher Speeds.	
Demonstrate this sequence as a badly executed recovery from a normal stall, by moving control column back harshly at 60 knots when recovering from dive.	(*a*) Stalling speed higher. (*b*) Standard recovery. (*c*) Small control column movement to regain control.

POST-FLIGHT DISCUSSION

EXERCISE 11

SPINNING

AIM: TO ACCUSTOM THE STUDENT TO SPINNING AND TO TEACH HOW TO RECOVER FROM INCIPIENT AND ADVANCED SPINS WITH THE MINIMUM LOSS OF HEIGHT.

INSTRUCTIONAL GUIDE

General

1. Although it is not unusual for the student to be somewhat nervous during the first spins, there may be some doubt as to his suitability for further training if he continues to be apprehensive. ▶◀

◀2.▶ Practice spins, dual and solo, should be done at intervals throughout the student's training.

◀3.▶ The Chipmunk spin characteristics are abnormal insofar as there is a marked tendency for a spiral to develop instead of a spin, especially when flown solo. There are two stages to the spin, *viz.*:—

(*a*) The first stage when the aircraft autorotates rapidly at an indicated airspeed, about 50 to 60 knots, with slight pitching. Recovery from this stage is fairly rapid, turns being from one to two after recovery action is taken.

(*b*) The second stage, or true spin, is reached after two to five turns of the first stage and is recognized by the rate of rotation being slower and the indicated airspeed dropping to 35 knots or lower when spinning to the left and 50 knots or lower when spinning to the right. The pitching decreases and the nose level drops. Recovery from this stage takes longer and stick force is appreciably heavier. The propeller may stop on aircraft which spin at 20 knots or less—usually to the left—but will restart in the dive which follows from the spin. However, in some cases the dive may have to be extended to provide sufficient airflow to start the propeller and this will involve greater loss of height.

◀4.▶ If a spin is entered hesitantly with only half control movements, a spiral may develop. The act of moving the stick back fully at this stage results in a manoeuvre similar to a spin with the airspeed steady at around 70 knots to the left and 80 knots to the right. All other indications of a spin are present although the noise level is higher and the rate of rotation faster. To a student a check of the airspeed is the only proof of the manoeuvre achieved. Normal spin recovery action is immediately effective.

◀5.▶ Spinning is the most frequent cause of airsickness and the lesson should be discontinued if any signs of illness appear.

Before Flight

◀6.▶ **Preparatory Instruction.** (*See* para. 6 of Introduction.)

(*a*) Causes, stages and characteristics of the spin.

(*b*) Recovery action.

(*c*) Engine handling.

(*d*) Emergency recovery; the student should be briefed on the emergency recovery actions before carrying out solo spinning practices.

(*e*) Inverted spinning (inverted spinning is not demonstrated but the student should be briefed on the recovery action before starting solo aerobatics).

Reference—A.P. 129, Vol. 2, Part 2, Sect. 3, Chap. 3.

◀7.▶ **Pre-Flight Briefing.** (*See* para. 7 of Introduction.)

During Flight

◀8.▶ The points of difference between a spin and a spiral dive should be made clear; the spiral dive is recognized by a steadily increasing airspeed and, usually, little or no slip or skid. The standard recovery action is effective in both cases but the recovery from a spiral is quicker. It is therefore important in later stages of training to ensure that true spins are practiced to familiarize the student with the longer time taken in the recovery. The application of full out-spin aileron upon entry will ensure the development of a true spin.▶◀

◀9.▶ When the student is proficient he should be authorized to practice spins solo using the normal spin entry technique. If a true spin is not achieved and a spiral develops he should re-enter the spin using out-spin aileron. He should be de-briefed on the results obtained.

◀10.▶ In later stages of training, spins should be demonstrated off the more extreme attitudes such as those encountered in poorly executed aerobatics. These spins should have been practised before the student's first solo attempt at aerobatics.

Airmanship

◀11.▶ To avoid the chance of a misunderstanding during recovery, the words "Recover now" should always be used when telling the student when to recover. The student should acknowledge with "Recovering now" when he starts the recovery.

The Student's First Spin

◀12.▶ The considerations are the same as those for the student's first stall (Exercise 10) and the first spin should therefore be done at the end of the lesson before that on which spinning is to be taught. The spin should consist of not more than two or three turns.

◀13.▶ **Spin from Level Flight.**

(*a*) The student should be told to locate the horizon and use it for a datum when levelling the wings after recovery, especially after a prolonged spin.

(*b*) Prolonged spins should not be done until the student has some experience at spins of short duration. He should be warned that higher control forces may be required to recover and that the aircraft may take a little longer to stop spinning. If he experiences any dizziness the student should be told that it is not unusual.

Recovery at the Incipient Stage

◀14.▶ When the student has mastered the recovery from the fully developed spin, the emphasis should be placed on early recognition of the various conditions that can lead to a spin and the quick and clean recovery from the incipient stage. An unintentional spin is usually the result of an uncorrected or undetected stall, but in most cases the warning symptoms are so clear that the impending spin can be recognized and corrected before it reaches an advanced stage.

Emergency Recovery

◀15.▶ Before being authorized to practice spinning solo the student is to be briefed on the action to be taken in the event of the aircraft failing to recover from the spin within four or five turns after application of the normal recovery action.

◀16.▶ The following emergency recovery actions should be applied in turn until the aircraft recovers:—

(*a*) Use the ailerons by moving the control column into the forward corner opposite to the rudder.

(*b*) Move the control column fully back and hold it there for five seconds then move it fully forward.

(*c*) Move the control column sharply forward, pause a second; fully back, pause a second; fully forward. This is to induce a rocking motion and may be aided by opening the throttle as the column is moved forward and closing it as the column is moved backward.

(*d*) Lower the flaps. This action may produce a decisive change for the better, or it may have a bad effect. Therefore it should not be used until all other methods have failed.

◀17.▶ If the emergency action has not taken effect by the time the aircraft has descended to a height of 3,000 feet A.G.L. the aircraft should be abandoned.

Inverted Spinning

◀18.▶ Intentional inverted spinning is prohibited.

◀19.▶ The Chipmunk T.10 is reluctant to spin inverted, in fact no cases have been reported of inverted spins developing without the previous intention of the pilot. Inverted spins are usually caused by excessive forward movement of the control column when the airspeed is low and when the aircraft is at or near the inverted attitude.

◀20.▶ The direction of a spin is dictated by the direction of yaw, and whilst in a normal spin this is in the same direction as the roll; in an inverted spin the yaw is in the opposite direction to the roll. The instructor should use a model aircraft to demonstrate this. He should also explain that the pilot will normally be far more conscious of the direction of rotation or roll than of the direction of yaw and therefore the correct rudder for recovery will prove most unnatural *when related to normal spin recovery action.* For this reason the correct rudder to use should always be decided after reference to the turn needle of the turn and slip indicator, *i.e.* apply rudder opposite to the indication shown by the turn needle.

◀21.▶ The standard recovery action for the inverted spin is:—

(*a*) Full rudder in the direction of rotation, *i.e.* in the opposite direction to the yaw.

(*b*) Control column progressively moved back until the spin stops.

(*c*) Immediately the spin stops centralize all controls and recover from the ensuing dive.

Common Faults

◀22.▶ Many students forget to throttle back after entering a spin from a flight condition in which power was being used. The instructor should demonstrate the greater amount of height lost by spinning with power on.

◀23.▶ The student often attempts to identify the behaviour of the aircraft from the position of the controls. It should be impressed on him that the position of the controls is not a reliable indication of whether a spin has occurred or the nature of the spin. The spin should be identified from:—

(*a*) Flight conditions obtaining immediately before the suspected spin, *i.e.* proximity to the stall, amount of yaw, nose-down pitching movement, spiral descent. Some or all of these characteristics will be evident.

(*b*) Attitude of the aircraft and the characteristic spinning motion.

(*c*) A high rate of descent with the airspeed remaining at a low figure.

EXERCISE 11

SPINNING

AIM: TO ACCUSTOM THE STUDENT TO SPINNING AND TO TEACH HOW TO RECOVER FROM INCIPIENT AND ADVANCED SPINS WITH THE MINIMUM LOSS OF HEIGHT.

AIR EXERCISE

Airmanship

1. **Checks.**

H—HEIGHT	Sufficient to recover by transition level plus height of ground plus 1,000 feet solo, and transition level plus height of ground dual.
A—AIRFRAME	FLAPS—As required. BRAKES—Fully OFF. D.I.—Caged.
S—SECURITY	No loose articles in the cockpit. HOOD—Closed. HARNESS—TIGHT.
E—ENGINE	Mixture—Fully Rich. OIL temperature and pressure within limits. FUEL—Sufficient.
L—LOCATION	Clear of built-up areas, aerodromes and restricted airspaces.
L—LOOKOUT	Well clear of all other aircraft and cloud, vertically and horizontally.

2. **Check position frequently during exercise.**

SEQUENCE	OBSERVATIONS
3. **Student's First Spin.**	
Demonstrate a 2 to 3 turn spin and recover without detailed instruction.	Ease of recovery.
4. **Spin from Level Flight.**	
Demonstrate spins in both directions with engine idling.	(*a*) Checks before spinning. (*b*) Entry, normal:— At 50 knots apply full rudder and move control column fully back. (*c*) Entry, advanced:— At 50 knots apply full rudder, move control column fully back and fully in opposite direction to applied rudder. (*d*) In the spin:— (i) Ailerons held neutral or fully on as applicable. (ii) Full rudder held on. (iii) Control column held fully back.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
	(iv) Steady low air-speed. (v) High rate of descent. ◀(vi) Turn needle indication. (vii) Number of turns.▶ (*e*) Standard recovery:— ◀(i) Close the throttle.▶ (ii) Ailerons neutral. (iii) ◀Check direction of yaw—turn needle. Apply and maintain full rudder to oppose this yaw.▶ (iv) Brief pause. (v) Control column steadily forward until the spin stops. (vi) Centralize controls. (vii) Level wings and ease out of dive. (viii) Apply power as nose approaches horizon. (*f*) Large height loss.
5. **Recovery at the Incipient Stage.** See para. 14 of Instructional Guide.	
6. **Spin from Descending Turns.**	
(*a*) From a gliding turn at a low speed, misuse rudder in direction of turn, prevent any increase in bank, and move control column back ▶◀ until aircraft spins.	(*a*) Checks before spinning. (*b*) Danger of misusing controls and allowing speed to fall in gliding turns. ▶◀ (*c*) Aircraft spins in direction of turn. (*d*) Standard spin recovery.
(*b*) From a slipping turn without power, increase bank to maintain rate of turn and move control column back ▶◀ until aircraft spins.	(*a*) Checks before spinning. (*b*) Aircraft spins in opposite direction to turn. (*c*) Standard spin recovery. (*d*) Importance of correct handling of controls during slipping turns near ground.

POST-FLIGHT DISCUSSION

EXERCISE 12

TAKE-OFF AND CLIMB

AIM: TO TEACH THE TECHNIQUE OF TAKING-OFF, HOW TO ENTER THE CLIMB AND THEN POSITION THE AIRCRAFT ON THE DOWN-WIND LEG OF THE CIRCUIT.

INSTRUCTIONAL GUIDE

General

1. Before first solo, the student should be able to take off in both into-wind and cross-wind conditions and should have practised the procedure to be used after engine failure during take-off. Short take-offs should not be taught at this stage.

Before Flight

2. **Preparatory Instruction.** (See para. 6 of Introduction.)

   (*a*) Use of elevators and rudder.

   (*b*) Effect of crosswind.

   (*c*) Use of power.

   (*d*) Engine failure.

   (*e*) Drills and circuit procedure.

   (*f*) Factors affecting length of ground run.

   (*g*) Airfield control and R/T procedure.

Reference—A.P. 129, Vol. 2, Part 2, Sect. 3, Chap. 2.

3. **Pre-Flight Briefing.** (See para. 7 of Introduction.)

During Flight

4. **Airmanship.**

   (*a*) The paramount importance of a good lookout must be stressed and a high standard demanded.

   (*b*) The student should be taught to make a thorough check of the vital actions, in the correct sequence; the instructor must insist on accuracy and attention to detail in this matter; the student must be fully aware of the importance of these checks.

   (*c*) The student should be completely familiar with the circuit R/T procedure before first solo. Few students are able to maintain a good listening watch during the early stages of circuit practice because of the high degree of concentration needed.

5. **Take-off into Wind.**

   (*a*) If the student has difficulty when attempting to take off unassisted, it may be necessary to let him use each control in

turn, the instructor handling the others. As the student gains proficiency he should be allowed to take over other controls until he can complete the take-off unassisted.

(*b*) Whenever possible the first demonstration and practices should be made into wind.

(*c*) A point off the upwind boundary, *i.e.* a tree or house should be chosen and used to maintain direction.

(*d*) When the wind is strong the downwind leg tends to become too short for the student to do a thorough check of the vital actions and at the same time concentrate on correct positioning in the circuit. When this is so, the turn onto the crosswind leg should be delayed until the full circuit height has been reached.

6. **Crosswind Take-off.**

(*a*) If the crosswind is not strong enough for a convincing demonstration, the lesson should be postponed until better conditions are available.

(*b*) In strong crosswinds the use of differential brake may be necessary.

(*c*) After leaving the ground, the student should be required to counteract drift so as to make good a track parallel to the take-off heading.

7. **Engine Failure after Take-off.**

(*a*) This demonstration should be made from a height and position which allows time for the instructor to make his observations and give full effect to the lesson. Make certain no other aircraft are below.

(*b*) No attempt should be made to turn back to the airfield since a gliding turn through 180 degrees involves the Chipmunk in a loss of about 300 feet of height. Only under ideal and exceptional circumstances should this be attempted. A convincing demonstration of the risks in attempting to turn back can be made in the low-flying area.

(*c*) If the engine fails during the take-off run or when the aircraft is just airborne, the procedure is governed by the overall situation. Since the Chipmunk has a fixed undercarriage, the three-point attitude must be resumed as quickly as possible before the brakes are used. It may also be necessary to turn sharply while on the ground to avoid striking obstacles.

(*d*) Until the student has been shown the forced landing technique he should be told to take the following action if the engine fails while he is in the circuit:—

(i) Emergency R/T call.

(ii) Land on the airfield, as near as possible into wind.

8. **Short Take-off.**

(*a*) Although the aircraft is flown off in the shortest possible distance, the subsequent climb is as for a normal take-off.

(*b*) The sequence can be made more realistic by first explaining the practical applications, *e.g.*:—

(i) Flying from a light landing area which has a limited length of run.

(ii) Flying from an airfield of marginal size in light or zero wind conditions.

(*c*) In general, the power should be increased to the maximum that can be held on the brakes; this is normally full power on the Chipmunk.

Common Faults

9. Over-controlling and lack of co-ordination are usually caused by muscular tenseness on the controls brought about by the high amount of concentration required in the initial attempts. The student can be helped to relax if his responsibility is at first limited as described in para. 5(*a*).

EXERCISE 12

TAKE-OFF AND CLIMB

AIM: TO TEACH THE TECHNIQUE OF TAKING OFF, HOW TO ENTER THE CLIMB AND THEN POSITION THE AIRCRAFT ON THE DOWN-WIND LEG OF THE CIRCUIT.

AIR EXERCISE

Airmanship

1. Impress the following points on the student:—
   (*a*) Note direction of take-off and circuit.
   (*b*) Run-up into wind.
   (*c*) At marshalling point:—
      (i) Choose a position in relation to other aircraft so that slipstream is not directed at them and there is no danger of running forward into them.
      (ii) Parking brake applied.
      (iii) Idling r.p.m. (~~1,000 to 1,200~~). 1,100
      (iv) Vital actions.
   (*d*) Check that approach is clear and for any signals from runway controller, then take off with minimum delay.

SEQUENCE	OBSERVATIONS
2. Take-off into Wind.	
(*a*) Lining up and take-off run.	(*a*) Lining up:— (i) Tail wheel straight. (ii) Reference point. (*b*) Take-off run:— (i) Control column held back. (ii) Open throttle smoothly to full power. (iii) Control column central, flying attitude. (iv) Control direction by rudder. (v) Note increasing rudder effectiveness and firmer feel.
(*b*) Becoming airborne and climbing away.	(*a*) Becoming airborne:— (i) Feel. (ii) Gentle back pressure on control column. (iii) Wings level. (iv) Gradually assume climbing attitude. (*b*) Climbing away:— (i) Allow speed to increase to 70 knots. (ii) Climbing attitude. (iii) Trim.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
	(iv) Turn not below 500 feet. (v) Allowance for drift. (vi) Levelling off. (vii) Trim. (viii) Position to turn downwind.
3. Crosswind Take-off.	Observations as for take-off into wind, except:— (*a*) Use of differential brake. (*b*) Prevent weathercock tendency. (*c*) Hold aircraft on ground. (*d*) Clean fly-off at 50 knots. (*e*) Allowance for drift when airborne. (*f*) Release brake when safely airborne.
4. Engine Failure after Take-off.	
Demonstrate simulated engine failure after take-off from about 400 feet.	(*a*) Gliding attitude and speed. (*b*) Choose landing area—alteration of heading of more than 30 degrees is not advisable. (*c*) Flap as required. (*d*) Fuel and ignition off, side panels jettisoned. (*e*) "Mayday" call on frequency in use if time permits.
5. Short Take-off.	(*a*) Vital actions include setting flap to "Half". (*b*) Use maximum take-off run available. (*c*) Control column hard back. (*d*) Maximum power against brakes. (*e*) Brakes off—full throttle. (*f*) Control column forward—flying attitude gained quickly. (*g*) Check increased tendency to swing. (*h*) Gentle backward pressure on control column so that aircraft becomes airborne as early as possible about 35 to 40 knots. (*j*) Short take-off run. (*k*) When airborne:— (i) Climb and allow speed to increase to 65 knots. (ii) At a safe height raise flaps. (iii) Increase speed to 70 knots and trim.

POST-FLIGHT DISCUSSION

EXERCISE 13

APPROACH AND LANDING

AIM: TO TEACH THE VARIOUS TECHNIQUES OF APPROACHING AND LANDING.

INSTRUCTIONAL GUIDE

General

1. Before the first solo flight the student should be able to make competent engine-assisted approaches and landing and also be able to go round again safely. Glide approaches and landings should also have been practised sufficiently for the student to be able to attempt a landing in the event of engine failure. The remaining sequences of the Air Exercise should be covered at a later stage of training.

Before Flight

2. **Preparatory Instruction.** (See para. 6 of Introduction.)

(*a*) Circuit, approach, and landing.

(*b*) Use of brakes.

(*c*) Effect of crosswind.

(*d*) Going round again.

(*e*) Airfield control and R/T procedure.

(*f*) Consideration for short landings.

Reference—A.P. 129, Vol. 2, Part 2, Sect. 3, Chap. 2.

3. **Pre-Flight Briefing.** (See para. 7 of Introduction.)

During Flight

4. Many students have difficulty in mastering the landing, and, although the instructor's advice and guidance is of help, proficiency is attained mainly through practice. In the early stages the emphasis should be placed on safe flying and the fostering of the student's confidence rather than on a polished performance.

5. Although some students may have no difficulty with the landing, it is important to ensure, before the first solo, that they can recognize and correct any errors that may occur.

6. **Airmanship.**

(*a*) The large number of aircraft that may be in the circuit requires a particularly careful lookout and a high standard should be demanded.

(*b*) The student must learn and understand the significance of all the visual signals that are used by aerodrome control for the control of aircraft.

(*c*) Turns in the circuit should be limited to medium angles of bank unless an emergency arises.

7. **Downwind Leg.** The student should be shown how to judge the correct distance from the landing path.

8. **Engine-Assisted Approach and Landing.**

(*a*) Engine-assisted approach and landing is the basic technique and all others are variations of it.

(*b*) When on the base leg, the student should be told to look for aircraft that are making their final approach, especially for those making a long final approach.

(*c*) It should be emphasized that a good landing is most easily made from a good approach which requires being at the correct speed and approach angle. Any deviation from a good approach, *i.e.* speed or height too high or low, will result in a tendency to overshoot or undershoot.

9. **Going Round Again.** A safe height should be attained before raising the flap. Stress the importance of a specially good lookout during the initial stages of going round again.

10. **Short Landings.**

(*a*) The best round-out speed for short landing a Chipmunk is 45 knots. A student may initially be apprehensive at this low speed and find difficulty in controlling the aircraft accurately, he should therefore aim to round out at 50 knots for his first few attempts, reducing to 45 knots when he gains confidence.

(*b*) The landing run should be shortened by the application of as much brake as possible, but the student should be warned of the dangers of excessive braking on a tail-wheel aircraft.

11. **Bad Visibility Circuits.** Assistance to find the landing path at aerodromes can be obtained from air traffic control by the use of approach lighting, sodium flares, and the firing of pyrotechnics.

Common Faults

12. The usual causes of bad landings are:—

(*a*) Failure to round out sufficiently due to too steep an approach—probably caused by an initial tendency to overshoot.

(*b*) Starting to round out correctly and then ceasing the rearward movement of the control column. This is caused by the student looking over the nose of the aircraft which then obscures his forward view after the attitude has changed sufficiently.

(*c*) Holding off too high. This is sometimes caused by fear of getting too near the ground; the fault can often be cured by a clear demonstration of the hold-off height done by flying the aircraft across the airfields in the appropriate attitude and at the hold-off height.

(*d*) Erratic bad judgment of the hold-off height and poor control of direction during the hold off; this is usually caused by looking at the ground too close to the aircraft and becoming tense on the controls.

(*e*) Not keeping the wings level. This is often caused by looking at the ground too close to the aircraft and then leaning over to improve the view ahead when the nose starts to rise.

(*f*) General difficulty with all stages of the landing up to the touchdown. This trouble can often be traced to:—

(i) Faulty approaches at too high or too low a speed.

(ii) Fluctuating approach speed and over-correcting with the throttle.

(*g*) Poor control of direction during the landing run. Possible causes are:—

(i) Relaxing concentration after touchdown.

(ii) Overcontrolling with the rudder and brakes due to tenseness on the controls.

(iii) Too many consecutive roller landings have been practised so that the student lacks practice of controlling the landing run.

13. Do not attempt to analyse the student's difficulties until he has had a fair amount of practice at landing. Until he has had this practice the errors are likely to be of a random nature while he is becoming accustomed to the appearance and feeling of a good landing. After the student has grasped the basic requirements, any errors will normally form a consistent pattern which can easily be recognized and analysed. During the initial period when the student is feeling his way, the instructor should help by demonstrating landings when necessary and then guiding and advising the student during his own attempts.

EXERCISE 13

APPROACH AND LANDING

AIM: TO TEACH THE VARIOUS TECHNIQUES OF APPROACHING AND LANDING.

AIR EXERCISE

Airmanship

1. (*a*) Basic procedure for joining circuit:—
   - ◀(i) Fuel—contents sufficient.
   - (ii) Radio—correct frequency selected, unmuted, call for joining instructions.
   - (iii) Engine—oil temperature and pressure, mixture fully rich.
   - (iv) D.I.—synchronized.
   - (v) Altimeter—QFE set, descend to 1,000 feet above circuit height.▶
   - (vi) Check signals square and windsock.
   - (vii) Curved letdown on dead side of circuit.
   - (viii) Cross upwind end of runway at circuit height.

   (*b*) Alternative joining procedure:—
   - ◀(i) Rejoining checks as above (sub-paras. (i) to (v)) but rejoin at circuit height.▶
   - ◀(ii)▶ Join circuit pattern before beginning of downwind leg.

SEQUENCE	OBSERVATIONS
2. **Downwind leg.**	(*a*) Distance from landing path. (*b*) Trim for straight and level flight. (*c*) Pre-landing checks. (*d*) Keep track parallel to landing path, use of D.I. (*e*) Correct height. (*f*) Position at which to turn onto base leg for type of approach intended.
3. **Engine-Assisted Approach and Landing.**	
(*a*) Base leg.	(*a*) Allow for drift. (*b*) Reduce power. (*c*) Half flap. (*d*) 70 knots, trim. (*e*) Importance of lookout on finals. (*f*) Position and height (about 600 feet) when starting to turn onto final approach—ensure a straight approach from 400 feet.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
(*b*) Finals.	(*a*) Commence from at least 400 a.g.l. at 70 knots. (*b*) Lower flap to the amount required. (*c*) Appearance of landing path when on correct approach. (*d*) Maintain correct approach path and gradually reduce airspeed to 55 knots at threshold by adjusting attitude with elevators and rate of descent with power.
(*c*) Landing.	(*a*) Judging roundout. (*b*) When level, close throttle. (*c*) Phasing control column movement with rate of sink,
(*d*) Landing run.	(*a*) Reference point. (*b*) Control column hard back. (*c*) Decreasing rudder effectiveness. (*d*) Use of brakes. (*e*) When clear of landing path, checks before taxying.

4. **Going Round Again.**

Demonstrate and practice at altitude before practising on circuit.	(*a*) Open throttle fully, prevent yaw. (*b*) Adjust attitude to give 60 knots with full flap or 65 knots with half flap. (*c*) Trim. (*d*) Lookout. (*e*) Turn towards dead side of runway if necessary. (*f*) Flaps raised in stages at a safe height:— (i) Sink. (ii) Trim change. (*g*) Climb at 70 knots.

5. **Glide Approach and Landing.**

Demonstrate and compare with engine-assisted approach.	(*a*) Position at which to close throttle—wind strength. (*b*) Adjusting base leg to regulate approach. (*c*) Use of flap. (*d*) Steeper angle of approach and higher rate of descent. (*e*) Speed reduced progressively to 60 knots at roundout. (*f*) Roundout started higher because of larger attitude change. (*g*) Application to forced landings.

6. **Short Landing.**

Demonstrate and compare with engine-assisted approach.	(*a*) Base leg as for engine-assisted approach. (*b*) Full flap on finals. (*c*) Descent regulated with power.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
	(*d*) Preselected touchdown point. (*e*) Speed reduced progressively to 45 knots at roundout. (*f*) Immediate touchdown when throttle is closed. (*g*) Use of brake. (*h*) Short landing run. (*j*) Application to restricted landing areas.
7. **Flapless Landing.** Demonstrate and compare with engine-assisted approach with flaps.	(*a*) Position at which to turn onto base leg. (*b*) Speed falls slowly. (*c*) Flatter approach path, higher nose attitude. (*d*) Speed at roundout:— (i) Power on—60 knots. (ii) Glide—65 knots. (*e*) Longer period of float and landing run, therefore touchdown near boundary. (*f*) Application to flap failure and gusty, strong wind conditions.
8. **Crosswind Landing.**	(*a*) Set minimum differential brake in strong crosswind conditions. (*b*) Drift allowance on downwind leg. (*c*) Wind effect on turn onto finals. (*d*) Avoidance of full flap in gusty or very strong wind conditions. (*e*) Drift allowance on final approach path. (*f*) Use of rudder to align aircraft with landing path just before touchdown. (*g*) Weather-cock tendency on landing run.
9. **Wheel Landing.**	(*a*) Normal approach and roundout. (*b*) Reduce power to allow aircraft to touch down in a slight tail-down attitude. (*c*) Prevent bouncing with a slight forward pressure on control column —danger of large movement of control column.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
10. Bad Visibility Circuit.	
Demonstrate at 65 knots with half flap.	(*a*) Circuit height according to cloud base and visibility. (*b*) Fly along intended landing path and note heading on D.I. (*c*) Note any useful landmarks especially on circuit side of landing path. (*d*) Turn through 180 degrees onto downwind leg, use D.I. to check heading. (*e*) Aim to keep landing path or transient landmarks in view, adjust downwind leg heading as necessary. (*f*) At a suitable position begin a continuous turn onto final approach. (*g*) If too close to threshold on final approach overshoot and use knowledge so gained to adjust next circuit.
◀11. Low Level Circuit.	
	(*a*) Downwind leg:— (i) Height 500 feet a.g.l. for initial practice. (ii) Normal vital actions. (iii) Normal downwind position, but wing tip appears further from the landing path. (iv) Position to turn onto base leg. (*b*) Base leg:— (i) Speed reduced to 70 knots and half flap selected. (ii) Maintain height. (*c*) Speed (70 knots) and height maintained until aircraft reaches a position from which a normal approach can be made.
2. Timed Circuit.	
Demonstrate using configuration for bad weather low flying.	(*a*) Circuit designed for landing in poor visibility below a low cloud base. (*b*) Circuit height dictated by cloud base and visibility. (*c*) Fly upwind, tracking parallel to the runway, just on dead side. (i) Assess drift. (ii) Vital actions. (*d*) At end of take-off path turn downwind:— (i) Constant bank to achieve an accurate Rate 1 turn. (ii) Accurate airspeed.

SEQUENCE (*contd.*)

OBSERVATIONS (*contd.*)

(*e*) Downwind leg:—
(i) Steer runway reciprocal plus or minus three times the drift.
(ii) Time to fly is 35 seconds for first 1,000 yards plus one second for each 100 yds. of runway length thereafter.
(iii) Accurate heading and airspeed.

(*f*) Turn onto finals:—
(i) Constant bank to achieve Rate 1 turn.
(ii) Constant airspeed (65 knots).
(iii) Descend to a minimum height of 400 feet a.g.l.

(*g*) Finals:—
(i) Straighten on runway heading plus or minus drift.
(ii) Maintain height (400 feet a.g.l.) until runway approach lighting is sighted. ▶

POST-FLIGHT DISCUSSION

EXERCISE 14

FIRST SOLO

INSTRUCTIONAL GUIDE

1. A successful first solo flight, free from incident, gives the student added confidence which is often apparent as an improvement in his flying ability. The first solo flight is an important occasion for the student and the instructor must do all he can to ensure that the student starts the flight with the knowledge that he is fully competent to do so.

2. One of the main problems of basic instruction is the recognition or selection of the right moment to send the student on his first solo flight. On the one extreme, if he is sent solo before he is sufficiently confident and competent the result may be a poor flight and a loss of confidence; on the other extreme, if the first solo is delayed until after the appropriate moment the result is usually a deterioration in his flying and a loss of interest.

3. The main requirement is not for polished flying but general competence and safety and the ability to correct faults. The instructor must be sure that the student can take the appropriate measures promptly in an emergency; to this end the student's reactions should have been watched at times when anything in the nature of an emergency had occured in training flights.

4. A guide to what constitutes an acceptable standard of flying for the first solo flight is given below:—

(*a*) *Take-off and Climb.* The student should be able to safely correct incipient swings on take-off. He should fly the aircraft off at a safe speed and not hold it on the ground until too high a speed is reached. He should be able to keep a good lookout during the climb from the airfield.

(*b*) *The Circuit.* Although his circuit need not be precise in all respects, the student should be consistent in maintaining the approximate length for each leg and a satisfactory heading. Variations in altitudes are acceptable provided that the student is aware of and corrects for them; however, the variations should not be large enough to cause marked difficulty on the approach.

(*c*) *The Approach.* The student should have good control of the speed, particularly during the final turn and in the last stages of the approach. He should be able to anticipate the need for corrections to the power setting and the necessity for going round again, *i.e.* these decisions should not be left until the last moment.

(*d*) *The Landing*. The main consideration is whether his landings are safe. There should be no consistent faults such as holding-off high. A series of good landings is not necessarily proof of readiness for solo unless the student has shown that he is also able to go round again safely and is able to correct a mislanding.

(*e*) *Airmanship*. The student should be capable of maintaining a good lookout without reminders from the instructor. All flight checks and drills should be faultless. There should be no doubt of his ability to avoid other aircraft and choose a safe landing path.

(*f*) *Emergencies*. The student must have had practice at handling engine failures after take-off. He should be tested for knowledge of all the emergency drills outlined in Exercise 1A.

5. Only a short briefing is necessary and this can be given while taxying to the take-off point. The student should be reminded of points such as any special air traffic requirements and crosswind conditions. No detailed instructions should be given other than that he is to take off, complete the circuit, and land. If possible traffic density should be low; aerodrome control should be told that the flight is a first solo.

6. The instructor can often gain useful information by watching the flight from the edge of the airfield.

EXERCISE 15

ADVANCED TURNING

AIM: TO TEACH TURNING AT HIGH RATES OF TURN AND CONTROL OF THE AIRSPEED AND RATE OF DESCENT IN DESCENDING TURNS.

INSTRUCTIONAL GUIDE

General

1. Since the steep turn, particularly at maximum rate, has important operational uses, the student should be given enough practice to reach a high standard. Steep turns give valuable practice in co-ordination of control movements and, when done at maximum rate, give the student confidence in handling the aircraft at its limits.

Before Flight

2. **Preparatory Instruction.** (See para. 6 of Introduction.)

(*a*) Use of power.

(*b*) Effect of *g* on the stall.

(*c*) Considerations for maximum rate and minimum radius turns.

(*d*) Use of controls.

Reference—A.P. 129, Vol. 1, Part 1, Sect. 1, Chap. 12, and Vol. 2, Part 2, Sect. 4, Chap. 1.

3. **Pre-Flight Briefing.** (See para. 7 of Introduction.)

During Flight

4. **Airmanship.**

(*a*) Emphasize the vital importance of a good lookout when changing direction rapidly.

(*b*) Students may become disorientated after a number of steep turns. They should be reminded of the importance of keeping a periodic check of their position.

5. **Steep Level Turns.**

(*a*) Steep turns should first be done at an angle of bank of about 45 degrees; as the student becomes proficient the bank should be increased to about 60 degrees.

(*b*) Good practice in co-ordination can be obtained from turning in alternate directions and making the change in a smooth continuous movement.

6. **Stalling in the Turn.**

(*a*) This lesson should have been thoroughly learnt before the student does a solo practice involving steep turns.

(*b*) Before demonstrating stalling in a turn the student should be told what to expect.

(*c*) When recovering from a stall in a turn, full power must be applied unless the nose is well below the horizon.

7. **Maximum Rate Turns.** The demonstrations should be done at the lower altitudes. At high altitude the lack of power does not sufficiently emphasize the difference between the use of full and reduced power to make a convincing demonstration.

8. **Steep Gliding Turns.** The steep nose-down attitude causes difficulty in estimating the gliding attitude; cross reference to the instruments is required to ensure accuracy.

9. **Slipping Turns.** Variations in indicated stalling speed occur with extreme unbalance dependant on the direction of the turn. Students should be made aware of these variations and an adequate speed should be maintained to ensure a safety margin during unbalanced turns.

Common Faults

10. The student often fails to appreciate that, while the aircraft is steeply banked, the use of the elevator to control the height also causes the turn to tighten. To avoid a possible cause of unintentional stalling, the student should be told to reduce the amount of bank before making height corrections.

11. Some students fail to appreciate the large amount of rudder required to keep the aircraft in balance while using large aileron deflections, such as when entering maximum rate turns quickly. A demonstration of the adverse yaw produced by aileron drag at large aileron deflections will show the need for greater rudder application.

EXERCISE 15
ADVANCED TURNING

AIM: TO TEACH TURNING AT HIGH RATES OF TURN, AND CONTROL OF THE AIRSPEED AND RATE OF DESCENT IN DESCENDING TURNS.

AIR EXERCISE

SEQUENCE	OBSERVATIONS
1. Steep Level Turns.	
Demonstrate steep turns in each direction using power as required to maintain speed. Angle of bank should be about 45 degrees initially and increased to about 60 degrees as the student becomes proficient.	(*a*) Lookout. (*b*) Entry as for medium turns, but:— (i) Open throttle progressively as bank increases. (ii) Progressive backward pressure on the control column. (*c*) In the turn:— (i) As for medium turns. (ii) High rate of turn. (iii) Importance of bank adjustments during height corrections. (*d*) Recovery as for medium turns except that power is reduced at the same time as bank.
2. Stalling in the Turn.	
Carry out steep turns from straight and level flight at 70 knots. ◀Do not increase power.▶	
(*a*) Tighten the turn to buffet and demonstrate recovery with elevators only.	(*a*) Usual pre-stall checks. (*b*) Buffet. (*c*) Note airspeed at buffet. (*d*) Relax pressure on control column to recover. (*e*) Small height loss. (*f*) Turn can be continued.
(*b*) Tighten the turn beyond buffet by moving control column fully back to ensure that aircraft is fully stalled.	(*a*) Pre-stall checks. (*b*) Aircraft stalls, note airspeed. (*c*) Recovery:— (i) Relax back pressure on control column and simultaneously apply power if required. (See para. 6(*c*) of Instructional Guide.) (ii) Level aircraft. (iii) If inverted, move control column to minimize height loss, roll out to nearest horizon.
(*c*) Tighten the turn to buffet again and demonstrate normal recovery with minimum loss of height from incipient stage.	(*a*) Pre-stall checks. (*b*) Buffet. (*c*) Recovery—relax back pressure on control column, at the same time apply full power. (*d*) Aircraft recovers with minimum loss of height.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
3. **Maximum Rate Turns.**	
(*a*) Demonstrate a turn from straight and level flight, at power setting for 70 knots, up to threshold of stall and compare with a demonstration using full power.	(*a*) At low power:— (i) Angle of bank. (ii) Rate of turn. (iii) Airspeed when buffet occurs. (*b*) When turn is tightened beyond buffet, rate of turn decreases. (*c*) Maximum rate of turn occurs just before buffet. (*d*) At higher power:— (i) Increased angle of bank. (ii) Increased rate of turn. (iii) Increased stalling speed. (*e*) Amount of power determines:— (i) Maximum rate of turn. (ii) Maximum angle of bank.
(*b*) Demonstrate using maximum power, and show how to reach maximum rate of turn as quickly as possible. Turn through 180 degrees.	(*a*) Aircraft inertia. (*b*) Maximum rate of turn. (*c*) Use in emergency.
4. **Steep Descending Turns.**	
Compare gliding turns at 70 knots with turns at higher speed and power.	(*a*) At 70 knots:— (i) Buffet occurs at about ◀60▶ degrees angle of bank. (ii) Need for increased speed when steepening turn. (*b*) At higher speed:— (i) Higher angles of bank obtainable. (ii) Rate of turn increased. (iii) Higher rate of descent. (*c*) With power:— (i) Rate of descent less. (ii) Pitch attitude flatter. (iii) Rate of descent can be controlled by power adjustments.
5. **Slipping Turns.**	
Demonstrate with and without flap.	(*a*) Rate of descent and angle of bank in a medium gliding turn. (*b*) Apply opposite rudder. (*c*) Increased angle of bank to maintain rate of turn. (*d*) Increased rate of descent. (*e*) Indicated stalling speed increases with unbalance; necessity of increasing speed. (*f*) Need for early recovery when near ground.

POST-FLIGHT DISCUSSION

EXERCISE 16

LOW FLYING

AIM: TO TEACH HOW TO FLY THE AIRCRAFT NEAR THE GROUND WITH CONFIDENCE AND SAFETY.

INSTRUCTIONAL GUIDE

General

1. Although the student should fly confidently and with the requisite amount of dash, the instructor should immediately curb any tendency towards over-confidence or disregard of regulations. Low-flying requires a high standard of both flying ability and self-discipline. The student should be taught to approach this exercise with these points in mind.

Before Flight

2. **Preparatory Instruction.** (See para. 6 of Introduction.)

(*a*) Regulations governing low flying and the circumstances in which it is necessary.

(*b*) Effect of wind.

(*c*) Effect of rough air.

(*d*) Effect of inertia.

(*e*) Flying over contours.

References—A.P. 129, Vol. 2, Part 2, Sect. 4, Chap. 6, and A.M.F.O. No. 406.

3. **Pre-Flight Briefing.** (See para. 7 of Introduction.)

During Flight

4. In the early stages the lessons should not be too long because of the intense concentration required from the student. The length and difficulty of the task should be increased progressively until the student learns his safe limits.

5. **Airmanship.**

(*a*) The student should have marked the low-flying area on his map before starting the first lesson.

(*b*) Although accurate flying is important near the ground, this must not be to the detriment of a good lookout. The student should be warned that the low-flying area is not large and that there may be other aircraft using it at the same time.

6. **Familiarization at Low Level.**

(*a*) The first tasks should be simple and the student should be allowed to handle the controls as much as possible.

(*b*) Point out the danger of relying on the altimeter when close to the ground. The correct height should be demonstrated and the student told to pay particular attention to the appearance of the ground at that height.

(*c*) Point out the necessity of anticipating changes in power when flying over marked changes in contour.

7. The position in the low-flying area should be frequently checked to avoid leaving the area unintentionally. This practice also serves as an introduction to low-level navigation.

8. **Effect of Wind.** The low-flying patterns shown in the accompanying diagrams are valuable for teaching the effect of wind and the allowances required.

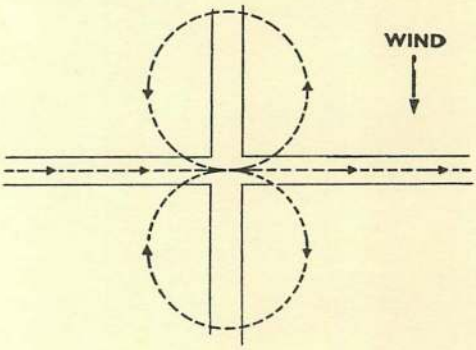
9. **Low Flying in Bad Visibility.**

(*a*) The first demonstration and practice should be done in good visibility. Later lessons can be given in poor visibility.

(*b*) The instructor should ensure that the student uses the correct technique when suitable conditions arise at any time during his flying.

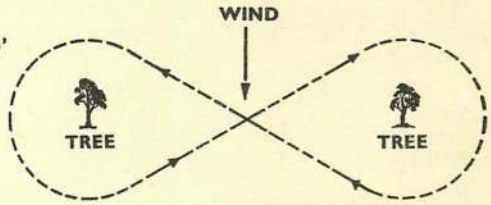
LOW FLYING PATTERN 'A'

The ground target is on the intersection of two straight line features crossing at 90°. Fly along one and complete a figure of eight so that its centre remains over the point of intersection.



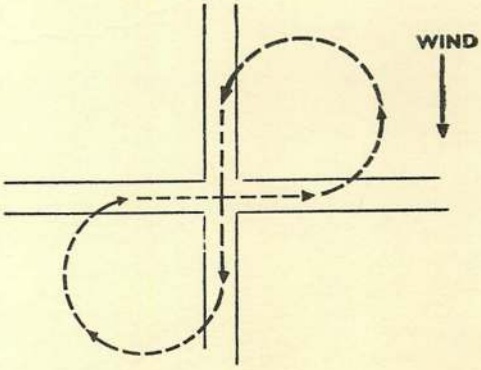
LOW FLYING PATTERN 'B'

The ground target consists of two prominent features (e.g. tall trees) situated sufficiently near to each other for both to be always visible but not so near as to necessitate continuous turns.



LOW FLYING PATTERN 'C'

Use the same ground target as for 'A'. The pattern consists of a figure of eight in which the straight leg of each road follows each turn.



EXERCISE 16

LOW FLYING

AIM: TO TEACH HOW TO FLY THE AIRCRAFT NEAR THE GROUND WITH CONFIDENCE AND SAFETY.

AIR EXERCISE

Airmanship

1. Before descending into the low-flying area:—
   (*a*) Identify low-flying area and boundaries.
   (*b*) Check fuel state.
   (*c*) Harness tight (turbulence near ground).
   (*d*) D.I. synchronized.
   (*e*) Note wind direction.

SEQUENCE	OBSERVATIONS
2. Descending into Low-Flying Area.	
Descend into area and level-off at about 200 feet a.g.l.	(*a*) Cruising speed. (*b*) Moderate rate of descent. (*c*) Gentle turns to clear blind spot. (*d*) Importance of lookout. (*e*) Increasing impression of speed. (*f*) Changing aspect of ground features.
3. Familiarization at Low Level.	
Fly at about 200 feet a.g.l.	(*a*) Lookout. (*b*) Trim for level flight. (*c*) Cruising power. (*d*) Assessment of height—altimeter of little use. (*e*) Increased turbulence. (*f*) Maintain a mean height above ground level over normal contours. (*g*) To maintain height over large contours :— (i) Use power as necessary. (ii) Anticipation of power changes to overcome aircraft inertia and effect of wind. (*h*) Landmarks, obstacles, and hazards (power cables, etc.). (*j*) Boundaries of low-flying area. (*k*) Importance of position check.
4. Effect of Wind.	
(*a*) Fly at right angles to wind along a straight line feature (road or railway). Demonstrate in moderate wind conditions.	(*a*) Wind direction. (*b*) Drift more apparent than at altitude. (*c*) Drift allowance to maintain track. (*d*) Drift allowance to avoid obstacles.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
(*b*) Fly into wind and turn accurately through 180 degrees. Fly downwind then turn accurately through 180 degrees. Maintain a constant airspeed. Demonstrate in moderate wind conditions.	(*a*) Into wind :— (i) Airspeed. (ii) Note low ground speed. (iii) Not necessary to increase power. (*b*) While turning downwind :— (i) Drift gives appearance of slip. (ii) Check for slip or skid. (iii) Danger of drifting into obstacles. (*c*) Downwind:— (i) Airspeed. (ii) Higher ground speed. (iii) Must not decrease power. (*d*) While turning upwind :— (i) Drift gives appearances of skid. (ii) Check for slip or skid. (iii) Danger of drifting into obstacles.
(*c*) Demonstrate low-flying patterns. Student must be proficient at low-level steep turns before practising this exercise.	Adjust bank to compensate for drift to avoid obstacles.
5. Low-Level Steep Turns.	
Power setting as for normal steep turns.	(*a*) Importance of lookout for other aircraft, changing contours and obstacles. (*b*) Aircraft inertia during entry—danger of drifting into obstacles. (*c*) Need for accuracy—constant height over ground.
6. Bad-Visibility Low Flying.	
Demonstration at 65 knots with and without half flap.	(*a*) Need to fly slowly. (*b*) Note pitch attitude at 65 knots without flap. (*c*) With half flap :— (i) Lower nose attitude—better forward view. (ii) Lower safe speed—lower stalling speed—smaller turning radius. (iii) Increased drift apparent owing to low speed. (iv) Increased angle of climb to clear obstacles.

POST-FLIGHT DISCUSSION

EXERCISE 17

FORCED LANDINGS

AIM: (*a*) TO TEACH HOW TO MAKE AN APPROACH AND LANDING AFTER PARTIAL OR COMPLETE ENGINE FAILURE.

(*b*) TO TEACH HOW TO MAKE AN EMERGENCY LANDING IN A FIELD WHEN POWER IS AVAILABLE.

INSTRUCTIONAL GUIDE

General

1. The student should have attempted this exercise before leaving the circuit on solo flights.

Before Flight

2. **Preparatory Instruction.** (See para. 6 of Introduction.)

(*a*) Forced landing procedure.

(*b*) Factors governing the choice of landing area.

(*c*) Actions after landing.

Reference—A.P. 129, Vol. 2, Part 4, Sect. 3, Chaps. 1 and 2.

3. **Pre-Flight Briefing.** (See para. 7 of Introduction.)

During Flight

4. The exercise is best taught in two stages:—

(*a*) The instructor does the various cockpit checks while the student concentrates on planning and judging the descent.

(*b*) The student does the full procedure.

5. The student should be given dual and solo practice at forced landings at intervals throughout the course.

6. When the student reaches a suitable standard at the basic exercise, the practice can be made more realistic by the instructor closing the throttle without warning at various altitudes and under different conditions. The student should say which field he has chosen so that the instructor can assess the procedure.

Airmanship

7. This exercise is practised only in the low-flying area or on special fields which are detailed in Air Ministry Flying Orders. Since several aircraft may be engaged on the practice a good lookout is required at all times during the practice; the student's lookout tends to suffer because he is concentrating on the planning.

8. **Committal Height.** Committal height may be defined as the height at which the pilot commits himself to complete the forced landing; for the Chipmunk this is 1,500 ft. a.g.l. Below this height it is inadvisable to abandon the aircraft and the pilot must make a final decision whether or not to switch off fuel and ignition. The decision as to whether or not to switch off the engine (in the real emergency) is governed largely by the following two considerations:—

(*a*) If the failure is mechanical and the engine has definitely broken down, it should be switched off immediately.

(*b*) If the failure is partial, resulting in reduced power or intermittent running, the engine may be used at the pilots discretion but he should remember that the windmilling engine may pick up temporarily or fail again at a critical stage and so spoil the approach. In such a case it may be best to assume a total failure and not rely on the faulty engine; however, only the pilot can decide which is the best course for a particular set of conditions.

9. **Choice of Field.**

(*a*) From high altitude it is difficult to assess the nature of the ground surface. Therefore until the aircraft is low enough for the pilot to make an accurate assessment, the aircraft should be guided towards an area which seems to be generally suitable.

(*b*) For the demonstration the instructor should choose a field which can be easily identified by the student.

10. **Initial Descent.**

(*a*) The circuit direction should be that which gives best results for the prevailing circumstances.

(*b*) Stress the importance of careful planning, pointing out that the 1,000-feet area is the position from which a normal glide approach is started. When planning the descent it should be remembered that the aircraft should be at about 1,250 feet a.g.l. at the start of the turn onto the base leg; it is seldom possible to make an accurate calculation of the amount of height to be lost since the ground elevation is not always known.

(*c*) The altitude at the time of the emergency greatly influences the plan of action. Broadly, the lower the altitude the more should the plan of action approximate to that for engine failure after take-off. Many factors may affect the course of action and some of these are listed for discussion with the student:—

(i) Altitude above the ground.
(ii) Position of suitable fields.

(iii) Time available.

(iv) Wind strength and direction.

(v) Weather.

(vi) Whether engine has failed partially or completely.

(vii) Pilot experience.

11. **Checks and Vital Actions.** When the student is sufficiently competent at forced landings he should be required to give the forced landing checks and vital actions verbally on every practice.

12. **Final Approach.**

(*a*) It is not necessary to continue the approach to almost ground level, as the success or failure of the practice forced landing can be gauged from a safer height.

(*b*) The amount of field taken up by the roundout and float should be demonstrated on the airfield. Occasional practice forced landings should be made on the airfield.

(*c*) If the speed is still high when holding-off, a wheel landing should be made; in this way speed is lost more quickly. However, if the ground is rough or soft, a three-point landing is essential otherwise the aircraft may nose over.

Forced Landings with Power

13. A forced landing is sometimes necessary for reasons other than engine failure. Such landings are often due to pilot error and poor airmanship, typical causes being:—

(*a*) Poor navigation.

(*b*) Failure to use radio aids when uncertain of position and particularly failure to use emergency R/T procedures.

14. The moral is clear and forced landings of this kind should not occur if good airmanship is used. In other cases the forced landing may be unavoidable for reasons out of the pilot's control, *e.g.* radio failure in poor weather conditions. The following list of factors all have a bearing on this type of forced landing and should be discussed with the student:—

(*a*) If possible locate an airfield for the landing. If the airfield is disused it should be checked for suitability since many disused airfields have obstructed landing runs.

(*b*) Make full use of radio aids, especially the emergency procedures.

(*c*) The landing should be made before the fuel is exhausted. Enough fuel should be kept in reserve to allow for locating, checking, and landing before the tanks have run dry.

(*d*) The field should be selected using the same principles as those used for a forced landing. The approach path and landing run can be inspected at low altitude.

(*e*) If conditions allow, a normal circuit should be made and the short-landing procedure used if the area is small.

(*f*) If it is difficult to keep the selected field in sight, a bad-visibility circuit should be made.

EXERCISE 17A

FORCED LANDINGS WITHOUT POWER

AIM: TO TEACH HOW TO MAKE AN APPROACH AND LANDING AFTER PARTIAL OR COMPLETE ENGINE FAILURE.

AIR EXERCISE

SEQUENCE	OBSERVATIONS
1. Forced Landings without Power.	
(*a*) Choice of field.	(*a*) Wind strength and direction. (*b*) Size and shape. (*c*) Surface. (*d*) Obstacles—undershoot and overshoot area. (*e*) Approximate elevation of field.
(*b*) Immediate actions.	(*a*) Gliding attitude and speed (70 knots)—use surplus speed to gain height. (*b*) Importance of accurate trimming. (*c*) Choose field and direction of landing. Reset altimeter to Q.N.H. (*d*) Plan descent :— (i) Wind strength. (ii) Amount of height to be lost. (iii) Circuit direction. (iv) 1,000-feet area on base leg. (v) Retain sight of field. (*e*) Check for cause of failure :— (i) Fuel state, fuel cock on, mixture rich. (ii) Ignition. (iii) Air intake icing—ensure hot air is selected.
(*c*) Subsequent actions.	(*a*) R/T distress call. (*b*) Continuous review of descent plan. (*c*) Throttle closed. (*d*) Considerations for switching off fuel and ignition. (*e*) Committal height. (*f*) Crash landing checks :— (i) Fuel and ignition off. (ii) Harness tight. (iii) Hood closed—side panels jettisoned. *Note.*—During practice forced landings the fuel and ignition switches are on and the side panels are not jettisoned. Engine should be cleared periodically.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
(*d*) 1,000-feet area to landing.	(*a*) Normal glide approach aiming to land well into field until sure of getting in without use of flap. (*b*) Methods of adjusting approach:— (i) Turn away from or towards field. (ii) Flap. (iii) Slipping turns. (iv) Longer base leg. (v) Straight sideslip. (*c*) Procedure for going round again. (*d*) Safe height—about 200 feet. *Note.*—Slipping turns and straight sideslips should not be used in the initial demonstrations.

POST-FLIGHT DISCUSSION

EXERCISE 17B

FORCED LANDING WITH POWER

AIM: TO TEACH HOW TO MAKE AN EMERGENCY LANDING IN A FIELD WHEN POWER IS AVAILABLE.

AIR EXERCISE

1. **Airmanship.**

   (*a*) R/T assistance.

   (*b*) Check fuel state and decide on a safe time limit for search and landing.

   (*c*) Fly downwind for maximum ground coverage.

SEQUENCE	OBSERVATIONS
2. **Forced Landings with Power.**	
(*a*) Choice of field.	As for forced landing without power.
(*b*) Inspect field using bad-weather low-flying power settings.	(*a*) Low safe altitude. (*b*) Direction of landing path. (*c*) Best circuit for prevailing conditions. (*d*) Landmarks in circuit. (*e*) Importance of retaining sight of field. Use of bad-visibility circuit technique.
(*c*) Demonstrate a circuit and dummy approach to one side of landing path.	(*a*) Check:— (i) Approach. (ii) Surface. (iii) D.I. heading. (iv) Drift. (v) High ground. (vi) Overshoot area for obstacles. (*b*) Repeat circuit.
(*d*) Final approach.	Short-landing procedure.

POST-FLIGHT DISCUSSION

EXERCISE 18

AEROBATICS

AIM: TO TEACH HOW TO FLY THE AIRCRAFT ACCURATELY TO ITS LIMITS.

INSTRUCTIONAL GUIDE

General

1. Before teaching aerobatics the instructor should have accustomed the student to the sensations involved. If the student shows signs of being airsick the exercise should be stopped; eventually the student should become conditioned to aerobatics and be able to complete a lesson without feeling ill.

2. Regular, brief lessons achieve better results than concentrated lessons at comparatively lengthy intervals. Most instructional flights give the opportunity for a short aerobatic interlude before landing which also serves as a relaxation after any exercise which has required much concentration from the student.

Before Flight

3. **Preparatory Instructions.** (See para. 6 of Introduction.)

(*a*) Effect of *g* on aircraft and pilot.

(*b*) Effects of airspeed on control.

(*c*) Engine limitations.

(*d*) Loop.

(*e*) Barrel roll.

(*f*) Slow roll.

(*g*) Stall turn.

(*h*) Roll off the top of the loop.

(*j*) Half roll.

(*k*) Recovery from stalls including *g* stalls.

(*l*) More advanced aerobatics.

References—A.P. 129, Vol. 2, Part 2, Sect. 4, Chaps. 1 and 5, and A.M.F.O. Nos. 401 to 404.

4. **Pre-Flight Briefing.** (See para. 7 of Introduction.)

During Flight

5. The *g* stall is the most common stall encountered during aerobatics and recovery is effected by releasing the backward pressure on the control column. If the stall occurs at a very low speed the

aircraft will be in a very nose-up attitude and the recovery should be the same as that from the vertical attitude. Demonstrations of both these stalls should be made during instruction on the loop.

6. The student should be taught to fly the aircraft through each aerobatic manoeuvre so that he is aware of the amount of control and response that is available at each stage of a manoeuvre. Automatic control movements, done as a drill, indicate that the student lacks this sense of being part of his aircraft.

7. Students often have difficulty in continuing a control movement when negative *g* is imposed, either when inverted or otherwise. It is essential that the harness (particularly the lap strap) should be well tightened.

8. Aerobatics involve large variations in speed, which cause changes of trim and control effectiveness. Since it is not practicable to trim the aircraft throughout an aerobatic manoeuvre, the changing stick forces must be held by the pilot. The variations in control effectiveness call for care in avoiding overstress through excessive *g* caused by large control movements.

9. Sudden applications of negative *g* are undesirable and are indicative of poor flying. Flick manoeuvres and aerobatics which involve continuous negative *g* (except in level flight) are prohibited.

10. The student should use full power during the dive to gain speed for the manoeuvre in order to minimize the height loss. At speeds in excess of approximately 130 knots the throttle should be closed slightly to prevent exceeding the r.p.m. limitations.

11. **Airmanship.**

(*a*) The airspace around the aircraft, particularly below, must be thoroughly inspected before starting each aerobatic. A lookout should also be maintained throughout the manoeuvre.

(*b*) Wherever possible aerobatics should be done with the sun on the beam, otherwise the blinding effect considerably hampers accurate flying and can be dangerous since it temporarily obscures the lookout.

12. **Slow Roll.** A higher entry speed should be used initially so that better control is obtained. As the student gains proficiency, the speed can be reduced.

13. **Stall Turn.** It is recommended that stall turns to the right are taught first. Stall turns to the left are more difficult due to slipstream effect, the co-ordination required being critical.

14. **Recovery from Vertical Attitudes.**

(*a*) When in a vertical or near-vertical attitude, the exact attitude is best judged by watching the angle that the wing-tip makes with the horizon.

(*b*) Before the first period of solo aerobatics, the student should have shown his ability to recover from vertical attitudes.

15. **Roll off the Top of a Loop.** Two methods of rolling out are given in the Air Exercise; the first method is easier and the student should use it for his first attempts. Ultimately he should be capable of using both methods.

16. **More Advanced Manoeuvres.** When the student is competent in the basic aerobatics, combinations or variations of the basic manoeuvres can be introduced. Most students can be brought to the standard when they are able to complete a sequence of manoeuvres. Particularly able students can be shown the four-point and eight-point rolls and the Derry turn. The instructor should ensure that the standard of lookout does not deteriorate when consecutive aerobatics are practised.

Common Faults

17. Most faults can be traced to under-controlling at low speed and over-controlling at high speed. This is due to failure to appreciate the effect of speed on control effectiveness and change of trim.

18. Students tend to practice their rolls in the direction which comes more easily to them. Make sure that rolls in either direction are equally well done.

EXERCISE 18

AEROBATICS

AIM: TO TEACH HOW TO FLY THE AIRCRAFT ACCURATELY TO ITS LIMITS.

AIR EXERCISE

Airmanship

1. Checks before aerobatics are the same as those before spinning.

SEQUENCE	OBSERVATIONS
2. **Loop.**	(*a*) Use of line feature. (*b*) Lookout. (*c*) Changing rudder and elevator forces as speed increases—trimmer not adjusted. (*d*) Pull-up is started at 130 knots. (*e*) Check wings level as nose cuts horizon and again when vertical. (*f*) Changing rudder forces with decreasing speed—balance. (*g*) Increasing backward movement of control column. (*h*) Second horizon—wings level. (*j*) Gentle control movements at low airspeed. (*k*) Relaxation of back pressure on control column in dive. (*l*) Changing rudder loading—balance. (*n*) Check direction with line feature. (*m*) Climb away.
3 **Barrel Roll.**	(*a*) Lookout. (*b*) Reference point. (*c*) Straight dive to about 110 knots then apply bank away from direction of intended roll, allow speed to increase to 120 knots. (*d*) Pull up to horizon, still to one side of reference point. (*e*) Wings level at horizon. (*f*) Co-ordination of elevator and aileron to circle reference point on horizon. (*g*) Balance with rudder throughout. (*h*) To keep rate of roll constant; aileron deflection varies with speed. (*j*) Use of elevators similar to loop—avoid negative *g*. (*k*) Roll completed at same point on horizon where roll was started,

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
4. Slow Roll.	(*a*) Lookout. (*b*) Reference point. (*c*) Straight dive to about 120 knots. (*d*) Shallow climbing attitude which is checked before rolling. (*e*) Rolling in (up to 90 degrees):— (i) Aileron. (ii) Progressive top rudder. (iii) Elevators to maintain nose position. (*f*) 90 degrees to inverted position:— (i) Control column progressively forward. (ii) Co-ordination with rudder to keep straight. (iii) Attitude for level inverted flight. (iv) Importance of continued application of aileron. (*g*) Rolling out:— (i) Co-ordination of rudder and elevator to keep straight and maintain pitch attitude. (ii) Large amount of top rudder to maintain nose position. (iii) Tendency for rate of roll to increase prevented with opposite aileron. (iv) Slightly higher position of nose when level. (*h*) Residual slip or skid removed smoothly. (*j*) Aim to achieve constant rate of roll.
5. Stall Turn.	
(*a*) To starboard.	(*a*) Line feature reference. (*b*) Lookout. (*c*) Dive to about 120 knots and pull up to vertical attitude. (*d*) Wing-tips used as attitude reference to horizon. (*e*) Forward movement of control column to keep vertical. (*f*) Progressive application of rudder. (*g*) Prevent any slight rolling tendency. (*h*) Throttle closed as nose drops to horizon. (*j*) Anticipation of rudder movement to check yaw. (*k*) Vertical dive—check line feature. (*l*) Ease out of dive.
(*b*) To port.	(*a*) More difficult due to slipstream effect. (*b*) Careful co-ordination required.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
6. Recovery from Vertical Attitudes.	(*a*) When speed is high enough to retain control effectiveness either:— (i) Look for horizon and loop or roll the shortest way to it, or (ii) Stall turn. (*b*) When speed is too low to give adequate control:— (i) Hold controls firmly central until aircraft is in a dive. (ii) Recover from dive.
7. Roll off the Top of a Loop.	(*a*) Begin as for loop—speed 140 knots. (*b*) Rolling out, first method:— (i) Roll started before reaching inverted level flight attitude. (ii) Reference point. (iii) Co-ordinated rudder and elevator movements to bring nose onto reference point. (*c*) Rolling out, second method :— (i) Loop checked in inverted level flight attitude. (ii) Roll completed as for slow roll. (*d*) Gentle handling and large control deflection because of low speed. (*e*) Check accuracy of 180 degrees heading change.
8. Half Roll.	(*a*) Lookout. (*b*) Entry as for slow roll. (*c*) Roll checked when inverted. (*d*) Close throttle. (*e*) Pull through second half of loop. (*f*) Height loss increases with entry speed.
9. More Advanced Manoeuvres. (*a*) Aileron turn.-	(*a*) Lookout. (*b*) Entry from stall turn, half roll or loop. (*c*) Throttle closed. (*d*) Vertical dive—angle of wing-tips to horizon. (*e*) Apply aileron to roll and use rudder as necessary. (*f*) Rapidly increasing airspeed—speed limitation 173 knots. (*g*) Large height loss.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
(*b*) Four- and eight-point rolls. (*c*) Derry turn. (*d*) Horizontal eights. (*e*) Clover leaf.	See A.P. 129, Vol. 2, Part 2, Sect. 4, Chap. 5.

POST-FLIGHT DISCUSSION

EXERCISE 19

INSTRUMENT FLYING

AIM: TO TEACH HOW TO FLY ACCURATELY BY SOLE REFERENCE TO INSTRUMENTS.

INSTRUCTIONAL GUIDE

General

1. Instruction in instrument flying should be started when the student has become reasonably proficient at the greater part of his general flying. As progress is made with general flying, increasing emphasis should be placed on the behaviour of the instruments during the various manoeuvres to provide a connecting link with pure instrument flight. Instrument flying should be regarded as a development of the student's general flying, and care should be taken to ensure that the student regards it in the same way and not as a different method of flying. Accurate instrument flight under all conditions requires constant, automatic cross reference to all the instruments.

Before Flight

2. **Preparatory Instruction.** (See para. 6 of Introduction.)

(*a*) Instruments and their errors—see A.P. 129, Vol. 1, Part 2, Sect. 1, Chaps. 1 to 4; Sect. 2, Chaps. 1 to 3; Sect. 3, Chap. 4.

(*b*) Physiological considerations—see A.P. 129, Vol. 2, Part 1, Sect. 1, Chap. 2.

(*c*) Instrument flying—see A.P. 129, Vol. 2, Part 2, Sect. 4, Chap. 2.

3. **Pre-Flight Briefing.** (See para. 7 of Introduction.)

During Flight

4. While the control movements used in instrument flying are the same as those used in visual flying, the control technique is changed slightly because the instrument presentation does not give the same impression of attitude as visual flight. This applies particularly to the artificial horizon which gives only a miniature, two-dimensional interpretation of a large, three-dimensional effect. When flying on the limited panel the control technique used becomes very important; in these circumstances it is necessary to be able to select and hold an attitude largely by estimating the amount of control movement required, until the instruments stabilize at their respective indications.

5. Each demonstration should be made in visual conditions before it is shown purely on instruments.

6. The student must learn to ignore sensory illusions and have implicit faith in his instruments. Less difficulty will be experienced with this important point if the instructor has placed sufficient emphasis on the instrument indications during visual practices.

7. Consistently accurate instrument flying demands constant practice and concentration. The student should be reminded, as often as necessary, of the importance of a conscious effort to relax; muscular tension on the controls makes it difficult to appreciate and sense the small control movements required.

8. The student must have a good grasp of the fundamental principles of instrument flying before the later exercises are introduced. Practice on the limited panel should be started from the outset as an integral part of each lesson; in this way the student obtains a better appreciation of the value of each instrument and becomes more competent at automatic cross reference, and he also has less difficulty in learning to fly on the limited panel.

9. **Pitch Indications.**

(*a*) The control technique demonstrated in this lesson is a fundamental requirement of accurate instrument flight.

(*b*) Although the artificial horizon gives an immediate indication of attitude, the complete picture requires the use of the other instruments because the relationship between the attitude and the flight path depends also on the airspeed and the power setting.

(*c*) Stress the importance of careful trimming to achieve accurate flying.

10. **Bank and Heading Indications.** Stress that the natural stability of the aircraft is of considerable assistance provided that the aircraft is accurately trimmed. If the aircraft is not trimmed well, instrument flying requires more concentration and becomes more tiring.

11. **Effect of Changing Power.** The yaw which accompanies a change of power must be anticipated and countered immediately, otherwise the aircraft banks and changes heading.

12. **Climbing and Descending.** In the early lessons, whenever corrections are needed for both the airspeed and the rate of descent, the airspeed must be corrected first. As the student gains proficiency he should be able to correct both faults simultaneously.

13. **Medium Turns.**

(*a*) When flying on the full panel two main factors govern the instrument indications during a turn:—

(i) The higher the airspeed the larger the angle of bank required for a given rate of turn.

(ii) The rate of turn indicator is calibrated to read correctly at only one airspeed. To obtain accurate rates of turn it is necessary to time the turn.

(*b*) When no direction indicator is available an accurate turn onto a compass heading requires a timed turn. The reliability of this procedure depends on the accuracy of the rate of turn indicator at the particular speed; the amount of error, if any, of the turn indicator can only be checked by stop-watch, using the direction indicator.

14. **Instrument Take-off.**

(*a*) The turn onto the take-off path should be made as gently as possible to minimize the residual bank error of the artificial horizon.

(*b*) The aircraft must be stationary and correctly aligned with the take-off path before control is handed over to the student.

(*c*) While on the ground the only requirement is to maintain the take-off heading, but the moment the aircraft is airborne good control in all planes becomes essential. The importance of levelling the wings, in addition to setting the correct pitch attitude after leaving the ground, should be pointed out.

(*d*) The acceleration errors in the artificial horizon on the Chipmunk are almost negligible owing to the moderate rate of acceleration, but are marked in high-performance aircraft having a high acceleration on take-off. For this reason the student should be taught to cross refer to both the rate of climb and descent indicator and the airspeed indicator for confirmation of the attitude.

15. **Steep Turns on Limited Panel.**

(*a*) When practising steep turns the technique for correcting a gain or loss of altitude is to move the controls to counter the trend of the R.C.D.I. readings and then wait for the readings to stabilize before making any further corrections.

(*b*) In a correct turn the turn needle gives an indication of the bank angle. It is therefore important for the aircraft to be flown accurately at all times in the turn, maintaining a steady rate of turn and therefore a constant bank angle.

16. **Unusual Attitudes.**

(*a*) During the recovery from a dive a small amount of yaw produces a false indication of a turn on the turn indicator. Such an indication should be ignored since it disappears when the $\dot{g}$ is removed.

(*b*) Demonstrate the technique for locating the horizon (level flight attitude) with the aid of the airspeed indicator and the rate of climb and descent indicator. The airspeed indications are particularly important in the Chipmunk (and on all aircraft having low cruising speed) and emphasis should be placed on this point; however, the vertical speed indications should not be neglected since these become the more important readings in high-performance aircraft.

17. **Spinning.** The recovery should be taught as a definite exercise and not as a novelty or trick manoeuvre. The lesson is valuable for teaching the student the importance of ignoring strong physiological sensation and reliance on the instruments.

18. **Approach Aids.**

(*a*) To simplify the student's task during the first few practices when using an approach aid, the instructor should make R/T calls.

(*b*) Aerodrome control can help the pilot to locate the runway by any or all of the following methods:—

(i) Switching on approach lighting.

(ii) Burning sodium flares.

(iii) Firing white pyrotechnics.

Common Faults

19. Failure to cross refer to all instruments is a frequent weakness; all instrument lessons should include practice with the artificial horizon covered, thus making the student refer to the other instruments. Emphasize the importance of using all the instruments so as to get a comprehensive picture of the overall situation.

20. The student often fails to realize that a small, sustained control displacement has a large ultimate effect on the attitude. The use of the correct control technique should be stressed and the great importance of continuous cross reference between the instruments again brought home to the student.

EXERCISE 19

INSTRUMENT FLYING

AIM: TO TEACH HOW TO FLY ACCURATELY BY SOLE REFERENCE TO THE INSTRUMENTS.

AIR EXERCISE

SEQUENCE	OBSERVATIONS
1. Pitch Indications.	
(*a*) Demonstrate from straight and level flight at cruising power, showing characteristics and uses of each instrument. Make changes in pitch to give about 20 knots increase or decrease in airspeed, and compare instrument and external indications. Student practises changes of attitude after each demonstration of an instrument. Practise in clear and in simulated conditions.	(*a*) Control technique :— (i) Change. (ii) Check. (iii) Hold. (iv) Adjust. (v) Trim.
(*b*) In simulated conditions, student maintains level flight and also makes changes of pitch attitude to give about 20 knots increase or decrease in airspeed, using artificial horizon, airspeed indicator, altimeter, and rate of climb and descent indicator. Repeat same lesson with artificial horizon covered.	(*b*) Artificial horizon:— (i) Note direct and immediate indication of attitude. (ii) Small presentation of large effect. (*c*) Airspeed indicator:— (i) Direct indication of changing attitude. (ii) Effect of aircraft inertia. (iii) Importance of correct control technique—folly of chasing airspeed. (iv) Indirect indication of attitude when settled. (*d*) Cross reference between artificial horizon and airspeed indicator:— (i) Attitude changed and held with artificial horizon. (ii) Attitude confirmed with airspeed indicator when settled. (*e*) Altimeter:— (i) Indirect indication of attitude. (ii) Effect of aircraft inertia. (iii) Lag during large and rapid height changes. (*f*) Cross reference of artificial horizon, airspeed indicator, and altimeter:— Level flight confirmed when the altimeter settles. (*g*) Rate of climb and descent indicator:— (i) Indirect indication of attitude when settled. (ii) Immediate indication of changing attitude—"trend" of indication.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
	(*h*) Cross reference between artificial horizon, airspeed indicator, altimeter, and rate of climb and descent indicator. (*j*) Cross reference with artificial horizon covered—importance of control technique.
2. Bank and Direction Indications.	
(*a*) Demonstrate from straight and level flights at cruising power. Compare instrument and external indications. Student practises changing attitude on each instrument (in clear and in simulated conditions) after use of each instrument has been demonstrated.	(*a*) Artificial horizon :— (i) Immediate and accurate indication of bank. (ii) Indirect indication of turn; bank and turn inseparable in accurate flight. (*b*) Turn and slip indicator :— (i) Direct indication of rate of turn. (ii) Indirect indication of bank. (iii) Direct indication of slip or skid. (*c*) Direction indicator:— (i) Direct indication of degrees of turn. (ii) Indirect indication of bank. (*d*) Cross reference between artificial horizon, turn and slip indicator, and direction indicator. (*e*) Cross reference with artificial horizon covered.
(*b*) Practice straight and level flight at cruising power in simulated conditions using all instruments.	(*a*) Natural stability of aircraft. (*b*) Importance of accurate trimming. (*c*) Importance of physical and mental relaxation.
3. Effect of Changing Power.	
(*a*) Fly straight and level at cruising power then increase and decrease power maintaining a constant height. Student practises with full and limited panel, in clear and in simulated conditions.	(*a*) Prevention of yaw. (*b*) Yaw indications :— (i) Slip indicator. (ii) Direction indicator. (*c*) Prevention of height change. (*d*) Height indications:— (i) Rate of climb and descent indicator. (ii) Altimeter. (*e*) Need for attitude change when airspeed changes—artificial horizon. (*f*) Instrument indications after settling :— (i) Changed attitude—artificial horizon. (ii) Changed airspeed.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
(*b*) Fly straight and level at cruising power, then increase and decrease power keeping airspeed constant. Student practises with full and limited panel, in clear and in simulated conditions.	(*a*) Preventing yaw. (*b*) Need to change attitude to keep constant airspeed. (*c*) Instrument indication after settling:— (i) Changed attitude—artificial horizon. (ii) Changed altitude—altimeter rate of climb and descent indicator.
4. Climbing.	
(*a*) Enter climb from straight and level flight. Student practises with full and limited panel, in clear and in simulated conditions.	(*a*) Preventing yaw — slip indicator and direction indicator. (*b*) Full panel:— (i) Selection of attitude — artificial horizon and rate of climb and descent indicator. (ii) Confirmation of attitude—air-speed indicator. (*c*) Limited panel:— Selection and confirmation of attitude—airspeed indicator and rate of climb and descent indicator.
(*b*) From a climb revert to straight and level flight at a selected altitude.	(*a*) Anticipation of selected altitude. (*b*) Attitude change as airspeed increases:— (i) Selection of attitude—artificial horizon and rate of climb and descent indicator. (ii) Confirmation of attitude—altimeter and airspeed indicator. (*c*) Reducing power:— (i) Prevent yaw. (ii) Maintain attitude.
5. Descending.	
(*a*) Descend from straight and level flight. Student practises with full and limited panel, in clear and in simulated conditions.	(*a*) Preventing yaw. (*b*) Maintaining height until airspeed settles at descent speed. (*c*) Descent attitude :— (i) Select with artificial horizon and rate of climb and descent indicator. (ii) Confirm with airspeed indicator.
(*b*) From a descent revert to straight and level flight. Student practises with full and limited panel, in clear and in simulated conditions.	(*a*) Anticipation of selected height. (*b*) Power is increased with change of attitude. (*c*) Selection of attitude—artificial horizon and rate of climb and descent indicator. (*d*) Confirmation of attitude—altimeter and rate of climb and descent indicator.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
(*c*) Descend at a constant airspeed and vary rates of descent. Student practises with full and limited panel, in clear and in simulated conditions.	(*a*) Steady descent. (*b*) Power for new rate of descent. (*c*) Attitude adjusted to maintain speed—artificial horizon and airspeed indicator. (*d*) Check rate of descent—rate of climb and descent indicator. Cross check with altimeter and stopwatch.
(*d*) Descend at a constant rate and vary airspeed. Student practises with full and limited panel, in clear and in simulated conditions.	(*a*) Steady descent. (*b*) Adjust altitude to new airspeed —artificial horizon and airspeed indicator. (*c*) Adjust power to maintain rate of descent—rate of climb and descent indicator.
6. Medium Turns.	
After demonstration, Student practises each exercise on full and limited panel in clear and in simulated conditions:—	
(*a*) Medium level turns using a constant angle of bank.	(*a*) Bank—artificial horizon (degrees of bank indicator). (*b*) Attitude—artificial horizon, rate of climb and descent indicator, and altimeter. (*c*) Turn—turn indicator and direction indicator. (*d*) Balance.
(*b*) Climbing turns.	Instrument indications as for level turns, but attitude is :— (*a*) Selected by artificial horizon and rate of climb and descent indicator. (*b*) Confirmed by airspeed indicator.
(*c*) Descending turns.	Instrument indications as for climbing turns.
(*d*) Descending turns at specified rates of descent and turn	(*a*) Instrument indications as for other descending turns. (*b*) Importance of cross reference.
(*e*) Turns onto specified headings.	Anticipation of heading according to rate of turn.
7. Compass Errors and Timed Turns.	
Demonstrate compass errors. Demonstrate observation (*a*) (i) by turning faster than rate one and then continuing at rate one.	(*a*) Turning errors :— (i) Turns faster than rate one are not practical when using compass. (ii) Errors vary between 0 degrees on east or west to 30 degrees on north or south.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
	(iii) Undershoot required heading in northern sector by an amount depending on how near heading is to north. (iv) Overshoot required heading in southern sector by an amount depending on how near heading is to south. (v) Sense of error reversed in southern hemisphere. (*b*) Acceleration errors :— (i) Only apparent on easterly and westerly headings. (ii) Acceleration gives an apparent turn to north. (iii) Deceleration gives an apparent turn to south. (iv) Importance of maintaining steady airspeed. (v) Sense of error reversed in southern hemisphere. (*c*) When direction indicator is not available, timed turns are used in preference to compensating for errors.
Instrument Take-off.	(*a*) Residual bank error on artificial horizon after turning onto take-off path. (*b*) Direction indicator set to nearest 5 degrees when aligning with take-off path. (*c*) Controls central, steady and smooth throttle opening. (*d*) Directional control—direction indicator. (*e*) Unstick at take-off speed—airspeed indicator. (*f*) Airborne, cross reference to all instruments :— (i) Approximate attitude —artificial horizon. (ii) Wing level—artificial horizon and direction indicator. (iii) Adequate climb — rate of climb and descent indicator and altimeter. (*g*) Climb :— (i) Attitude to give correct speed—cross refer airspeed indicator and artificial horizon. (ii) Trim.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
9. Going Round Again.	
Practise in clear and in simulated conditions.	(*a*) Importance of countering yaw and nose-up change of trim. (*b*) Maintain a constant attitude during flap changes. (*c*) Need for trim at each stage.
10. Steep Turns.	
Demonstrate steep level turns, increasing power during entry. Practise in clear and in simulated conditions:—	
(*a*) Full panel.	(*a*) Gentle application of bank. (*b*) Attitude and angle of bank—artificial horizon. (*c*) Height maintenance — rate of climb and descent indicator and altimeter. (*d*) Back pressure on control column more apparant than in visual flight.
(*b*) Limited panel.	(*a*) Gentle application of bank. (*b*) Maintaining height and attitude—rate of climb and descent indicator and altimeter. (*c*) Indication of bank angle by turn indicator. (*d*) Conscious effort required to maintain angle of bank, owing to indirect indication of turn indicator.
11. Recovery from Unusual Attitudes.	
Practise in clear and in simulated conditions:—	
(*a*) Demonstrate recoveries from unusual attitudes in the following sequence:— (i) Straight climbs and dives. (ii) Steep climbing and descending turns. (iii) Extremes of attitude including inverted flight, but prolonged negative *g* should be avoided.	(*a*) Recovery actions:— (i) Power as required (high or low airspeed). (ii) Level wings—turn indicator. (iii) Return to level flight—airspeed indicator and rate of climb and descent indicator. (iv) Uncaged direction indicator. (v) Small adjustments to give accurate straight and level flight. (vi) Reset direction indicator. (*b*) Ultimate aim is to achieve minimum loss of height. (*c*) Momentary false indications of turn needle disregarded during recovery from dive. (*d*) If inverted:— (i) After a control movement, the airspeed indicator, rate of climb and descent indicator and altimeter readings move in opposite sense to those of normal flight. (ii) Roll out for minimum height loss.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
(*b*) Demonstrate stall and recoveries from:— (i) Level flight. (ii) Other attitudes and flight conditions.	(*a*) Instrument indications of approaching stall:— (i) Low airspeed. (ii) Loss of height—rate of climb and descent indicator and altimeter. (*b*) Buffet can be felt. (*c*) Recovery on full panel:— (i) Selection of attitude—artificial horizon. (ii) Control of direction—direction indicator. (*d*) Recovery on limited panel:— (i) Selection of attitude—rate of climb and descent indicator and altimeter. (ii) Control of direction—turn indicator. (iii) As speed increases, attitude is interpreted through airspeed indicator. (*e*) Until control is regained, turn indications must be countered with rudder.
12. **Spinning.** Demonstrate spins and recoveries and show the difference between a spin and a spiral dive. Practise in clear and in simulated conditions.	(*a*) Recognition of spin:— (i) Speed remains low. (ii) Note rate of descent. (iii) Maximum rate of turn. (iv) Usually some degree of skid. (*b*) Recovery:— (i) Normal spin recovery action. (ii) Turn indicator flicks over as rotation stops. (iii) Centralize controls. (iv) Recover from dive as for unusual attitudes. (*c*) Disregard physiological sensations. (*d*) Recognition of spiral dive:— (i) Continuous increase in airspeed. (ii) High rate of descent. (iii) Usually little or no slip or skid.
◀13. **Controlled Descent through Cloud.**	(*a*) Homing:— (i) R/T call, state altitude and flight conditions. (ii) Range speed:—(90 knots). (iii) Quadrantal height on 1013 mbs.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
	(iv) Synchronization of D.I. with compass. (*b*) Overhead:— (i) Fuel state. (ii) Mixture rich. (iii) Set QFE. (*c*) Letdown:— (i) 90 knots, 1500 R.P.M. (giving approximately 1000 feet per minute rate of descent). (ii) Use of RCDI to show trend of attitude change. (iii) Importance of reading altimeter correctly. (*d*) Levelling off:— (i) Anticipation of height. (ii) Gradual attitude change. (iii) Power to maintain 90 knots. (*e*) Platform turn:— (i) Rate 1 turn. (ii) Maintain height. (*f*) Final descent:— (i) 70 knots, half flap, power to give 500 feet per minute rate of descent. (ii) Importance of levelling off at B.O.A.
14. **Ground Controlled Approach.**	(*a*) G.C.A. circuit at 90 knots. (*b*) Prepare to descend:— (i) Reduce to 70 knots and half flap. (ii) Maintain height. (*c*) Glide path:— (i) Use of power to control rate of descent (approximately 300 feet per minute). (ii) Full flap and reduce to threshold speed during final stages of approach when in visual contact with runway. ▶

POST-FLIGHT DISCUSSION

EXERCISE 20

NIGHT FLYING

AIM: TO TEACH HOW TO CONTROL THE AIRCRAFT AT NIGHT, ON THE GROUND AND IN THE AIR.

INSTRUCTIONAL GUIDE

General

1. Before starting night flying the student must be competent at instrument flying and particularly at taking-off and going round again on instruments. Some day-practice at instrument circuits using the night-flying procedure, is desirable before the first lesson.

Before Flight

2. **Preparatory Instructions.** (See para. 6 of Introduction.)

(*a*) Airfield lighting.

(*b*) Procedure for take-off, circuit, landing, and going round again.

(*c*) R/T procedure, lamp signals, and pyrotechnic signals.

(*d*) Marshalling signals.

(*e*) Emergency procedures.

(*f*) Aircraft lighting.

References—A.P. 129, Vol. 2, Part 2, Sect. 2, Chap. 2; Sect. 4, Chap. 3; Sect. 1, Chap. 7; and A.M.F.Os. Nos. 191 to 195.

3. **Pre-Flight Briefing.** This briefing is additional to the night-flying briefing and should cover the considerations of the lesson about to be taught.

During Flight

4. **Airmanship.**

(*a*) Emphasize the need for extra caution when taxying. Tell the student to stop or use the taxi lamp if he is doubtful about the taxi path and his distance from obstructions.

(*b*) The procedure for joining the circuit is the same as the basic procedure used by day but, again, greater caution is required.

(*c*) All R/T calls should be made at the standard positions on the circuit so that the air traffic controller has an indication of the aircraft's position in the circuit.

5. **Familiarization.**

(*a*) This lesson should be used to familiarize the student with night flying. The instructor should avoid giving the impression that night flying is any more difficult than flying by day; it is, in fact, more simple in some respects, since the number of aircraft in the circuit is limited and carefully controlled from the ground. Also the approach path is more easily judged by reason of the approach lighting and the angle of approach indicators. The student should be allowed to fly the aircraft for a short while when the aircraft is clear of the circuit at a safe altitude.

(*b*) Point out to the student that night flying is a combination of visual and instrument flying. According to the clarity of the horizon a greater or lesser degree of instrument flying is required.

Flarepath Demonstration

6. The approach path is judged primarily by the spacing of the lights. The angle of approach indicators should be used only as an aid.

7. **Taxying.** When the student has become accustomed to the lighting and taxying procedure he should do all the taxying.

8. **Take-Off.**

(*a*) When the aircraft is correctly aligned for take-off, the lights appear to converge ahead of the nose. The student should be told to remember the appearance of the flarepath at this point as it is used to assist the judging of the touchdown.

(*b*) When the flarepath ceases to be of assistance the attention should be transferred to the instruments until a safe height is reached.

(*c*) A safe rate of climb must be established from the time of becoming airborne and the airspeed allowed to build up during the climb. It is potentially dangerous to hold the aircraft down to attain climbing speed before starting to climb owing to the possibility of inadvertently losing height.

9. **Downwind Leg.** The student should be taught to adjust his speed to preserve the spacing between aircraft on the circuit. The position of other aircraft can be determined from their R/T calls and by a good lookout.

10. **Approach and Landing.**

(*a*) If no approach lighting is available, the points at which the turns onto the base leg and final approach should be made are judged from the appearance of the flarepath.

(*b*) Whilst a high standard of accuracy should be aimed at, the main requirement is for landings to be consistently safe.

(*c*) It is often difficult to judge the speed when turning off the flarepath after landing. The student should be warned that it is essential to ascertain that the speed is sufficiently low to allow a safe turn.

11. **Going Round Again.** Before the student flies solo he should be competent at going round again both from the approach and from a bad landing.

Common Faults

12. Most faults are due either to over-concentration on the instruments to the detriment of the circuit procedure or to insufficient attention to the instruments which leads to inaccurate flying.

13. The student often has difficulty in keeping the downwind leg parallel to the flarepath. Draw attention to the importance of accurate trimming, keeping the wings level, and using the direction indicator.

14. There is a common tendency for the student to make the circuit wider than necessary probably owing to over-cautiousness in judging the spacing. The circuit should be the same as that used for daylight and the spacing preserved by controlling the speed (use of flap) or by extending the into-wind leg after the take-off.

15. Some students tend to rely too much on the angle of approach indicator. If this fault arises, ask for the indicator to be switched off for the approach ; emphasize that it is an aid to the pilot and that it should be used in company with all the other indications.

16. Many students have trouble with judging the hold-off height. The correct height should be demonstrated clearly and the flarepath indications pointed out. Encourage the student to judge the hold-off height by the appearance of the flarepath rather than attempt to see or feel for the ground.

EXERCISE 20

NIGHT FLYING

AIM : TO TEACH HOW TO CONTROL THE AIRCRAFT AT NIGHT, ON THE GROUND, AND IN THE AIR.

AIR EXERCISE

Airmanship

1. (*a*) Check navigation lights on.
   (*b*) Cockpit lighting and cockpit checks.
   (*c*) Signals to ground crews :—
      (i) Starting up—downward identification light on.
      (ii) Run-up—flash downward identification light.
      (iii) Chocks away—flash navigation lights.
   (*d*) Run-up in dispersal.
   (*e*) Check correct functioning of instruments.
   (*f*) R/T clearance.

SEQUENCE	OBSERVATIONS
2. Familiarization.	
(*a*) On the ground.	(*a*) Marshalling signals. (*b*) Taxiway and airfield lighting.
(*b*) Leave circuit and climb to about 2,000 feet a.g.l.	(*a*) Airfield lighting layout. (*b*) Combined use of natural horizon and instruments. (*c*) Other aircraft. (*d*) Local features.
3. Flarepath Demonstration.	
Demonstrate a normal circuit but flying further downwind than usual; reduce height on base leg to about ~~800~~ feet a.g.l. Fly level finals showing flarepath and A.A.I. indications.	(*a*) Undershooting:— (i) Note close spacing of flares. (ii) Two reds on A.A.I. (*b*) Approach path:— (i) Red/green on A.A.I. — lower band of approach path. (ii) Green/green on A.A.I. — correct approach path. (iii) Optimum flare spacing. (iv) Amber/green on A.A.I.— upper band of approach path. (*c*) Overshooting :— (i) Flares appear widely spaced (ii) Two ambers on A.A.I.

AL 5
400 ft

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
4. **Going Round Again.**	(*a*) R/T call. (*b*) Normal procedure, but use instruments. (*c*) Reposition in relation to other aircraft in circuit.
5. **Taxying.**	(*a*) Distances from lights deceptive. (*b*) Judging speed. (*c*) Instrument checks. (*d*) Use taxi lamps or stop when in doubt. (*e*) Marshalling point :— (i) Check that parking brake is holding. (ii) Idling r.p.m. — generator charging. (iii) Vital actions. (iv) Lighting adjusted for intensity.
6. **Take-off.**	(*a*) R/T clearance. (*b*) Clearance from runway controller. (*c*) Note aircraft attitude in relation to flares to assist judgement of hold-off. (*d*) Take off with minimum delay. (*e*) Use of runway lighting to keep straight. (*f*) Danger of raising tail too high. (*g*) Immediate transfer of attention to instruments when airborne. (*h*) Importance of obtaining an immediate and adequate rate of climb. (*j*) Airborne R/T call .
7. **Climb to Downwind.**	(*a*) Climb on instruments but maintain lookout. (*b*) Climbing turn above 500 feet. (*c*) Use of instruments, not flarepath, to turn to crosswind leg. (*d*) Level off. (*e*) Note position in relation to flarepath for turn onto downwind leg.
8. **Downwind Leg.**	(*a*) "Downwind" R/T call made opposite upwind end of flarepath. (*b*) Pre-landing—checks. (*c*) Track parallel to flarepath—use of D.I. (*d*) Lookout and listening watch. (*e*) Position to turn onto base leg.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
9. **Approach and Landing.**	(*a*) Base leg and finals as for powered approach. (*b*) Use of approach lighting. (*c*) Position to turn finals. (*d*) R/T call. (*e*) Adjust approach by appearance of flarepath and A.A.I. indications. (*f*) Touchdown before double flare is reached. (*g*) Judging hold-off height by appearance of flares only. (*h*) Use of flarepath to keep straight. (*j*) Speed sufficiently low before turning off flarepath. (*k*) R/T call when clear of flarepath. (*l*) Checks before taxying.

POST-FLIGHT DISCUSSION

EXERCISE 21

PILOT NAVIGATION

AIM : TO TEACH HOW TO NAVIGATE THE AIRCRAFT USING PILOT-NAVIGATION METHODS.

INSTRUCTIONAL GUIDE

General

1. The student should have been introduced to the following aspects of navigation during his general flying :—

(*a*) Use of large features for orientation.

(*b*) Use of direction indicator.

(*c*) Map orientation.

(*d*) Simple map reading.

(*e*) Estimation of distances, bearings and headings to reach a chosen point.

Before Flight

2. The student should be helped with the preparation of the flight plans for his first navigation exercises. His working of the computor should be checked. He should be helped to prepare his map and advised on the choice of check points and positions for obtaining bearings. Any other aids available for the exercise should be discussed.

3. **Preparatory Instruction.** (See para. 6 of Introduction.)

(*a*) Meteorological forecasts.

(*b*) Map preparation and use of maps for low-and medium-level navigation and at night.

(*c*) Computation of headings, ground speed, safety heights, and E.T.A.

(*d*) Methods of correcting heading.

(*e*) Uses and limitations of available radio aids.

(*f*) Air traffic regulations in V.M.C. and I.M.C.

(*g*) Procedure when lost.

(*h*) Diversions.

(*j*) Range and endurance flying.

References—A.P. 129, Vol. 2, Part 2, Sect. 4, Chap. 14 ; Sect. 2, Chap. 1, and Part 3, Sect. 2, Chaps. 1 and 2; and A.M.F.Os. Nos. 141 to 149.

4. **Pre-Flight Briefing.** (See para. 7 of Introduction.)

During Flight

5. **Airmanship.**

(*a*) The student should not neglect his lookout while engrossed in navigational matters ; any laxity should be checked.

(*b*) When it is necessary to descend below safety height to retain sight of the ground it must be remembered that the safety height must be quickly regained if it becomes necessary to enter cloud.

6. **Setting Heading.** Teach the student to make a common-sense check of the general direction by using his knowledge of local features. This avoids the chance of making gross errors such as flying on reciprocal headings or setting the airspeed as a heading, etc.

7. **Map Reading.**

(*a*) The value and reliability of a pinpoint depends mostly on whether it is unique in relation to its surroundings. The values of certain types of pinpoints may change with seasonal or weather conditions, *e.g.* large industrial towns may be obscured by haze, or rivers may have dried up through lack of rain.

(*b*) The student may often become confused by attempting to correlate an excessive amount of detail. He should be told to use only the major pinpoints in conjunction with the flight plan and D.R. calculations, and to avoid continuous map reading involving the location and identification of minor features.

8. **In Transit.** When a planned check point is reached the student should be taught to check the fuel contents and engine indications as a matter of routine.

9. **Use of Radio Aids.** All bearings should be checked carefully for their validity, especially when they indicate the need for a large change in the flight plan.

10. **Low-Level Navigation.** At low level, the vertical height and shape of a ground feature becomes more important than its appearance in plan. Small but unique features are often of greater use than large, more common ones. Features are more easily missed while at low level because they are in view for only a short time, especially those near the track ; the appearance of check feature must therefore be anticipated and, to this end, a careful pre-flight study of the map is most important. If one check feature is missed a search should not be made for it but the flight continued and the next check feature anticipated. However, if a series of check features are missed the student must gain height and find his position.

11. **Night Navigation.**

(*a*) Greater emphasis must be laid on a comprehensive flight plan since the chances of map reading are reduced. Under suitable conditions coastlines, rivers, woods, etc., can be seen and are useful checks but the best features are large towns and the available pundits and occults. A skeleton map showing these reference points is very useful.

(*b*) Radio aids assume greater importance at night because of the limitations of map reading.

12. **Range and Endurance.**

(*a*) It is important to maintain the optimum range speed of 80 to 85 knots.

(*b*) When the maximum weak mixture position for the throttle is marked on the quadrant, the throttle should not be forward of this point.

(*c*) Although the principles of flying for both range and endurance are taught in this exercise, every opportunity should be taken to practise the procedures during general flying such as when homing to the airfield on V.H.F. D/F.

(*d*) A realistic and practical demonstration of flying for range and endurance can be made by simulating a diversion on a cross-country practice and then simulating a standby after arrival at the diversion.

Common Faults

13. Most faults are of a random nature and do not form a consistent pattern. Their origin usually lies in over-concentration and over-hasty D.R. calculations.

EXERCISE 21

PILOT NAVIGATION

AIM : TO TEACH HOW TO NAVIGATE THE AIRCRAFT USING PILOT-NAVIGATION METHODS.

AIR EXERCISE

Airmanship

1. (*a*) In dispersal—check all radio channels to be used.
   (*b*) At marshalling point—set first heading on compass.
   (*c*) Before leaving airfield:—
      (i) R/T call for airfield clearances.
      (ii) Set regional pressure setting on 1013·2 mbs.
   (*d*) When crossing from one pressure setting region to another —set new regional pressure setting.

SEQUENCE	OBSERVATIONS
2. Setting Heading.	(*a*) After take-off, climb and turn so as to arrive over airfield at correct altitude, heading, and airspeed. (*b*) Log time of departure. (*c*) Calculate E.T.A. (*d*) Accurate heading—importance of synchronizing D.I. with compass. (*e*) Common-sense check of heading by use of local features.
3. In Transit.	(*a*) Check D.I. against compass frequently. (*b*) No alterations of heading made until certain of position. (*c*) Log keeping. (*d*) Fixes. (*e*) Changes of heading. (*f*) Changes of airspeed. (*g*) Revisions of E.T.A. (*h*) Maintain accurate headings, altitude, and airspeed.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
4. Location of Destination.	(*a*) Approaching E.T.A. (*b*) Map read more carefully when approaching destination. (*c*) Be prepared to make large changes of heading. (*d*) If destination is a turning point:— (i) Set next heading on compass. (ii) Manoeuvre so as to arrive at correct height and heading over turning point.
5. Map Reading.	(*a*) Orientation of map. (*b*) Read from map to ground. (*c*) Anticipation of pinpoints by D.R. calculation. (*d*) Distance estimation affected by altitude. (*e*) Use of distant features as a rough guide to position. (*f*) Reliance on D.R. in featureless country. (*g*) Relative value of ground features.
6. 10-Degree Line Method and Double Track Error.	(*a*) Direct indication of angular track error. (*b*) Suitable for short distances only. (*c*) Used for heading changes near destination. (*d*) To fly parallel to track, alter heading by amount of track error. (*e*) To regain track, alter heading by twice the track error.
7. The 1 in 60 Method.	(*a*) Track error, in degrees, is calculated from distance off track and distance covered. (*b*) Method is practicable over any distance. (*c*) Used alone or in conjunction with 10-degree line method:— (i) To fly parallel to track. (ii) To regain track. (iii) To fly direct to destination.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
8. Making Good an E.T.A.	(*a*) Dog-leg procedure:— (i) Used only to lose time. (ii) More convenient than changing airspeed. (iii) Time taken to dog-leg 60 degrees is twice the time for a straight leg. (iv) Time taken to dog-leg 30 degrees is ¼th more than time for a straight leg. (*b*) Airspeed changes:— (i) Used to gain or lose time. (ii) Early decision to avoid large airspeed changes. (*c*) Accuracy of timing essential.
9. Use of Radio Aids.	(*a*) Setting heading—I.M.C. use radio aids to find overhead position. (*b*) Flying away from base:— (i) Use true bearings to find track error. (ii) Use of D/F bearings to obtain fix—use stations that are well to port or starboard. (*c*) Simultaneous bearings to obtain a fix. (*d*) Homing bearings.
10. Low-Level Navigation.	(*a*) Changed aspect and relative importance of features. (*b*) Limited field of vision. (*c*) Features in view for a short time, therefore need for:— (i) Anticipation. (ii) Quick recognition. (iii) Careful pre-flight map study. (*d*) Overriding importance of look-out. (*e*) Limited use of line features.
11. Night Navigation.	(*a*) Limited use of map reading. (*b*) Use of pundits and occults. (*c*) Distances deceptive. (*d*) Identification of towns. (*e*) Use of radio aids. (*f*) Lookout for other aircraft.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
12. Range Flying.	(*a*) Optimum height between 3,000 and 5,000 feet. (*b*) Optimum speed 80 to 85 knots. (*c*) Weak mixture.
13. Flying for Endurance.	(*a*) Fly as low as is safe and practicable. (*b*) Adjust power to obtain endurance speed of 65 knots.
14. Procedure when Lost.	(*a*) Used when radio aids have failed and flight plan has been flown. (*b*) After E.T.A. has elapsed, maintain heading for 10 per cent. of flying time since time of last fix. (*c*) Circle of uncertainty centred on destination—radius 10 per cent of distance from last fix. (*d*) Fly for endurance. (*e*) Check fuel state—calculate endurance. (*f*) Check flight plan—compass and D.I. (*g*) Square search. (*h*) Map read from ground to map.

POST-FLIGHT DISCUSSION

EXERCISE 22

FORMATION FLYING

AIM : TO TEACH HOW TO JOIN A FORMATION AND HOLD STATION, HOW TO CHANGE STATION, AND HOW TO LEAD.

INSTRUCTIONAL GUIDE

General

1. The high degree of concentration needed when practising the exercise is tiring in the early stages. Therefore the first lessons should be of short duration only and, if necessary, the spacing between aircraft should be more than the customary half-wing span.

2. Before flying solo in formation, the student should be competent at joining formation, breaking formation in an emergency, station-keeping, formation changing, and performing a stream take-off and landing.

Before Flight

3. **Preparatory Instruction.** (See para. 6 of Introduction.)
   (*a*) Hand and R/T signals used in formation.
   (*b*) Basic formation positions.
   (*c*) Station-keeping.
   (*d*) Formation changing.
   (*e*) Taking-off and joining formation.
   (*f*) Leading.

References—A.P. 129, Vol. 2, Part 2, Sect. 4, Chap. 10, and A.M.F.O. No. 407.

4. **Pre-Flight Briefing.**

   (*a*) This briefing must be comprehensive. The leader's intentions for the whole flight must be outlined and must include the sequence of the changes to be made and also any changes of leader. Each pilot should be allotted a position in the formation and his responsibilities during formation changes detailed. Make sure that each pilot knows the identification letters of all the aircraft in the formation.
   (*b*) A student should be told that when the horizon is obscured he may become disorientated. To combat this disorientation he must trust his leader, maintain an accurate formation position, and make a conscious effort to relax both mentally and physically.

5. **Taxying Out.**

   (*a*) Before taxying, the leader should check R/T communication with the other aircraft of the formation; all channels likely to be used in flight should be checked.
   (*b*) The spacing should be such that other aircraft cannot intervene in the procession, but not so close as to be a possible cause of incidents or difficulty in manoeuvring.

6. **Station-Keeping.**

(*a*) Before starting any instruction it is advisable to allow the student time to settle down and accustom himself to the novelty of the experience.

(*b*) During the student's first attempts at station-keeping the leader should fly for relatively long periods on a constant heading so as to ease the student's task.

(*c*) Good formation flying involves the ability to be relaxed while concentrating on station-keeping, it also requires the ability to anticipate the need for control movements and the effect of the movements made. The importance of accurate trimming and the full use of the natural stability of the aircraft should be stressed.

7. **Breaking and Rejoining Formation.**

(*a*) The use of the ailerons to control the distance between aircraft causes a change of heading; the student should be warned of this effect and told to anticipate and make the correction to the heading in good time.

(*b*) When joining formation, large throttle and control movements may be required and these should be anticipated to avoid over-controlling.

8. **Changes from the Basic Formation.** When moving into line astern, it is important to anticipate the aileron movement required to position the aircraft correctly ; if the aileron movement is not anticipated the aircraft will overshoot the desired position. The principle of keeping the wings level and making small corrections with the rudder, applies in the same way as for the basic formation position.

9. **Stream Take-off.** When the student is competent to do so he should be shown how to join the formation by turning inside the leader—"cutting the corner".

10. **Formation Leading.**

(*a*) The student should be aware that the leader is responsible for the safety of the formation as a whole insofar as the overall lookout and similar points of airmanship are concerned. The student should realize that a good leader can considerably ease the task of the pilots in the formation.

(*b*) When leading large formations the leader should remember that the aircraft farthest from him must make large changes in airspeed and altitude in order to maintain formation; this applies particularly when flying in echelon formation. Therefor turns should be entered and completed very gently and the rate of turn kept low.

11. Warn the student of the dangers and penalties of unauthorized formation flying.

Common Faults

12. The wing dihedral angle often leads to the student adopting an incorrect level attitude and flying with crossed controls.

13. Harsh control movements and over-controlling in general are usually due to muscular and mental tension ; a conscious effort is needed to relax. In the early stages, the instructor should take over control for short periods if it is evident that the student is having trouble in this respect.

EXERCISE 22

FORMATION FLYING

AIM : TO TEACH HOW TO JOIN A FORMATION AND HOLD STATION, HOW TO CHANGE STATION, AND HOW TO LEAD.

AIR EXERCISE

SEQUENCE	OBSERVATIONS
1. Taxying Out.	(*a*) Leader:— (i) R/T check with formation. (ii) R/T call for taxi clearance. (iii) Taxi with consideration for formation. (iv) Marshalling point, vital actions. (v) Check that formation is ready, then request take-off clearance. (*b*) Formation :— (i) Answer R/T check in numerical order. (ii) Stay at correct distance from leader. (iii) Marshalling point—line up close to leader and complete vital actions. (iv) Signal when checks completed.
2. Station Keeping.	
(*a*) Fly in vic formation spaced half a wingspan from the leader.	(*a*) Appearance and behaviour of other aircraft in formation. (*b*) Correct position:— (i) Fore and aft. (ii) Vertically. (iii) Laterally. (*c*) Attention fixed on leader. (*d*) Importance of relaxing.
(*b*) Show use of each control in turn for station keeping.	(*a*) Elevators:— (i) Control vertical position. (ii) Small movements essential (iii) Importance of trim. (iv) Illusion of leader moving. (*b*) Rudder :— (i) Lateral spacing when in close formation. (ii) Wings level—ailerons. (iii) When in position check that there is no slip or skid.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
	(*c*) Aileron:— (i) Lateral spacing when in open formation. (ii) Wings parallel to leader's—illusion caused by dihedral. (iii) Anticipate removal of bank when closing on leader. (*d*) Power :— (i) Controls fore-and-aft movement. (ii) Need to anticipate power changes because of aircraft inertia. (iii) Try to obtain constant throttle setting—avoid over-controlling. (iv) Anticipation of trim changes with changes of power.
(*c*) Turns in formation.	(*a*) Same bank angle as leader. (*b*) Need for change of power on entry and completion of turn. (*c*) Station-keeping as for level flight. (*d*) Maintain same relative position to leader.

3. Breaking and Joining Formation.

Climb so that leader is hidden under wing then break away from formation and rejoin.	(*a*) Positive upward and outward break. (*b*) Danger of rejoining from above. (*c*) Locate leader. (*d*) Rejoining :— (i) Manoeuvre to a position two or three wingspans to one side and slightly behind leader. (ii) Initial large throttle movements. (iii) Use of aileron when well spaced. (iv) Use of rudder when close in. (*e*) Systematic adjustment of position:— (i) Vertical. (ii) Fore and aft. (iii) Horizontal.

4. Changing Formation.

(*a*) Change in correct order.
(*b*) Drop back clear of leader's tail before crossing.
(*c*) Reduce height to miss slipstream.
(*d*) Half a wingspan or whole aircraft length between individual aircraft.
(*e*) No violent movements.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
5. Other Formations.	
(*a*) Line astern.	(*a*) Vertical positioning:— (i) Angle of sight through windscreen. (ii) Avoid slipstream of aircraft ahead. (*b*) Horizontal positioning—wings parallel with leader's. (*c*) Fore-and-aft positioning—one aircraft length behind.
(*b*) Echelons of more than two aircraft.	(*a*) Formate on neighbouring aircraft, not leader. (*b*) Importance of steadiness. (*c*) Large height and throttle changes during turns.
6. Stream Take-off.	(*a*) Leader :— (i) Line up and hold. (ii) Ensure that formation is ready. (iii) Slow throttle opening. (iv) Accurate climb. (*b*) Formation :— (i) Line up on alternate side of runway. (ii) Signal when ready. (iii) Use of low power against brakes to anticipate leader's movement. (iv) Take-off intervals.
7. Leading a Formation.	(*a*) Responsibility for safety of formation :— (i) Lookout. (ii) Fuel checks. (iii) Navigation. (iv) R/T. (*b*) Smooth and accurate flying—smooth and gradual power changes. (*c*) Signals completed before manoeuvre is started. (*d*) Constant bank in turns. (*e*) Dazzling effect of sun on formating pilots.

SEQUENCE (*contd.*)	OBSERVATIONS (*contd.*)
8. **Rejoining Circuit and Stream Landing.**	(*a*) Echelon away from circuit direction. (*b*) Rejoining:— (i) Dead side of circuit, parallel with runway. (ii) Circuit height and speed. (*c*) Leader:— (i) Level break made through 90 degrees. (ii) Downwind turn made at normal distance from runway. (iii) Use oval approach. (iv) Land on port side of runway centre line. (*d*) Formation :— (i) Level break made at intervals. (ii) Downwind leg in loose line astern. (iii) Importance of correct approach speeds. (iv) Land on alternate side of runway centre line.

POST-FLIGHT DISCUSSION

Printed for H.M. Stationery Office by CWSLtd., Stockport.
(2858) Wt.28925-BL3048 375 8/63 G.941