Chapter I

DUAL SYSTEM OF COCKPIT LIGHTING

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Introduction

1. When an aircraft is in flight at night, the pilot's attention is divided between observation of the instruments and observation of objects outside the aircraft. If the markings on the instruments are too bright, after observing them the pilot's ability to see objects outside the cockpit will be impaired for a time, and his attention will be distracted by the presence of these bright markings just below his normal line of sight.

2. On the other hand, if the markings are not sufficiently bright and distinct, the pilot will lose time in observing the instruments and will suffer additional eye-strain and general fatigue. As these times may be critical for the success of a night operation, or for the safety of the aircraft, particularly when landing, it follows that every care must be taken both in the layout of the cockpit and in the method of illumination to ensure that the instruments can be read at a glance without the pilot's vision being impaired or his attention distracted.

3. In the dual system of cockpit lighting, two kinds of illumination are used in the same cockpit, fluorescent lighting for the instrument panel, and red lighting for the

whole cockpit. An emergency system operated from an entirely independent battery is provided for use in the event of a failure in the aircraft supply system.

DESCRIPTION

Principles of the dual system

Elimination of reflections

4. For good lighting it is essential that the layout of the cockpit is such that it lends itself to the suitable installation of the lighting fittings, and is so arranged that it is possible to screen both the instruments and the lamps so that reflections can be avoided. A black coaming is fitted underneath the windscreen, as shown diagrammatically in fig. 1, so that the windscreen and those parts of the sidescreen immediately next to it reflect a black surface. As the coaming cannot extend round the sides of the cockpit, reflections in the sidescreens cannot be entirely prevented, but their brightness can be much reduced if the inside of the cockpit is painted matt black, and if all light-coloured objects are removed. The clothing, particularly the gloves, of the pilot and co-pilot should also be black. If the lamps are mounted as high as, or higher than, the top row of instruments the pilot will not see reflections of the lamps in the instrument cover glasses.

General lighting

5. For equal intensities, red light impairs adaptation of vision to darkness less than light of any other colour. The "tail of the eye" is less sensitive to red than to any other colour, the ratio of sensitivity being about 500 for blue, 200 for green, 10 for yellow-orange and 1 for red, so that when the pilot is looking out of the window the red instrument lighting disturbs him 200 times less than would green. It follows that red light of low intensity is the most difficult to pick up if the observer does not know in which direction to search. Experiments have shown that with the red lights turned down to the level for comfortable working, the red glow from the cockpit lighting is visible only in directions more or less immediately above the aircraft, at a distance of 50 yards or less. As this is less than the distance at which the silhouette of the aircraft can be seen against the ground, the red lighting does not increase the risk of detection by an enemy.

Fluorescent instrument lighting

6. To increase the visibility of the instruments without raising the general illumination to a high level, the instruments required for night flying are marked with a paint which fluoresces orange when activated by ultra-violet radiation. Orange is used rather than red because it is more efficient in its response to ultra-violet, so that a lower intensity of ultra-violet is required. To cut down the number of bright markings, only those which experienced pilots require at night are made fluorescent. Extra markings which might be required by a pilot learning to fly in the daytime are marked in green paint; these green markings do not show up under either red light or ultra-violet radiation.

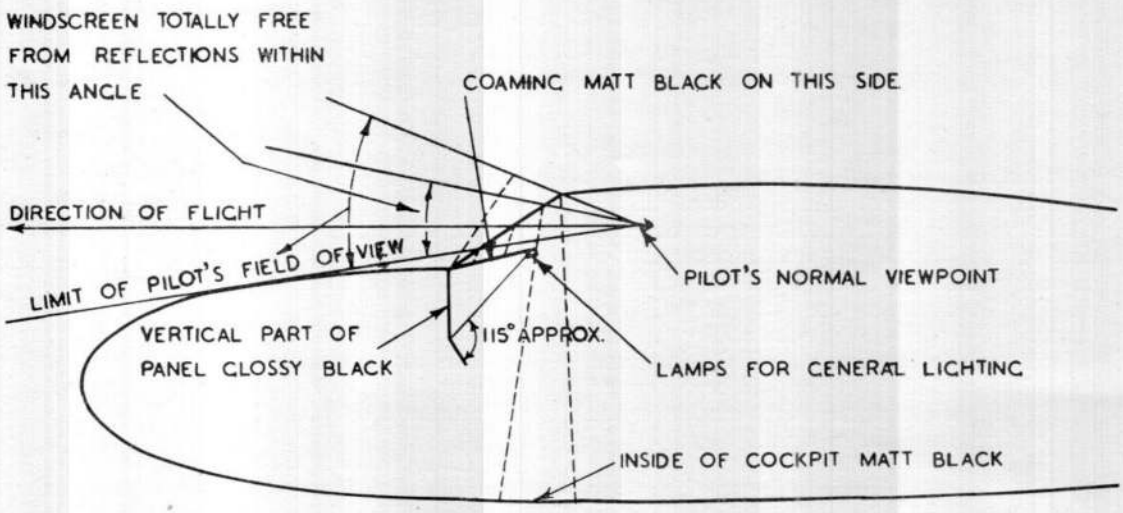

Fig. 1. Diagram showing anti-reflection coaming

Equipment used in the dual system

General lighting

7. The whole cockpit, i.e., the instrument panel and sides, is normally floodlit from two cockpit lamps, Type C, No. 2, mounted underneath the coaming and controlled by a single dimmer switch, Type R. The cockpit lamp, Type C, No. 2, is described in A.P.4343E, Vol. 1, Sect. 7; it is normally fitted with a clear red lamp, but may alternatively have a clear yellow lamp. That chapter also describes the range of screens which are available for use with this lamp.

Fluorescent instrument lighting

8. The panel is irradiated with ultra-violet obtained from two lamps in a small cockpit, or from four such lamps in a large one. The lamp used is the ultra-violet cockpit lamp, Type B, described in A.P.4343E, Vol. 1, Sect. 7. The lamps are controlled by dimmer switches independently of the cockpit general lighting.

Ancillary lighting

9. The instruments such as the magnetic compass, which cannot adequately be lighted otherwise, are illuminated by separate cockpit lamps, Type C, No. 2, each controlled by its own dimmer switch.

Emergency lighting

10. As the general, fluorescent and ancillary lighting is all supplied from the general aircraft supply, a failure of this would mean that the pilot was left in complete darkness. One additional cockpit lamp, Type C, No. 2, supplied from a separate alkaline battery, is therefore mounted over the flying instrument panel. As orange filters transmit more light than red, a clear amber lamp is used here to conserve the charge in the battery.

11. When one lamp only is fitted, an alkaline battery, 2·4-volt, 1·2-amp. hr. (Stores Ref. 5J/3082) is used; for two lamps, a 2·4-volt, 3-amp. hr. battery (Stores Ref. 5J/1961). The circuit is controlled by a switchbox, Type B, fitted with a luminous plate; either the 20-amp. switch (Stores Ref. 5CW/543), with luminous plate (Stores Ref. 5CW/3189), or the 7-amp. switch (Stores Ref. 5CW/2497), with luminous plate (Stores Ref. 5CW/3613), may be used.

Dimmer switches

12. A circuit diagram, showing the manner in which the cockpit lighting is controlled by the dimmer switches, is given in fig. 2. The switch used is the dimmer switch, Type R, as described in A.P.4343B, Vol. 1, Sect. 20. The table below indicates the range of these dimmer switches which is available, and their applications in the dual system of cockpit lighting for 24-volt circuits.

TABLE 1

Dimmer switches, Type R

Type of lighting	No. of lamps	Resistance (ohms)	Stores Ref.
Cockpit general lighting	2	135	5CW/2452
	3	115	5CW/2531
	4	75	5CW/2530
Ultra-violet radiation	2	22	5CW/2451
	4	13	5CW/2525
Ancillary lighting	1	275	5CW/2453
	2	135	5CW/2452
	3	115	5CW/2531
	4	75	5CW/2530

OPERATION

Cockpit lighting

13. In a well-laid-out cockpit the general red lighting, if used at the lowest level at which the markings can be read, causes no measurable interference with vision outside the cockpit, but the markings appear flat and are not instantly readable. Ultra-violet, on the other hand, causes some slight interference with vision outside the cockpit, but makes the fluorescent markings stand out very distinctly. The best way of using the dual system is therefore to turn up the general lighting until the controls and markings can just be dimly seen, and then to turn up the ultra-violet until the markings stand out sufficiently clearly for comfortable working. The ultra-violet should be used sparingly in conditions where seeing out of the cockpit is of the first importance, but may be turned full on when flying mainly by instruments, and vision of objects outside the cockpit is not required.

Lighting at crew stations

14. The lighting requirements at crew stations differ from those of the cockpit in that the crew member does not have to keep close watch both inside and outside the aircraft at the same time. In general, it may be said that at most stations red light offers the most practicable and satisfactory solution,

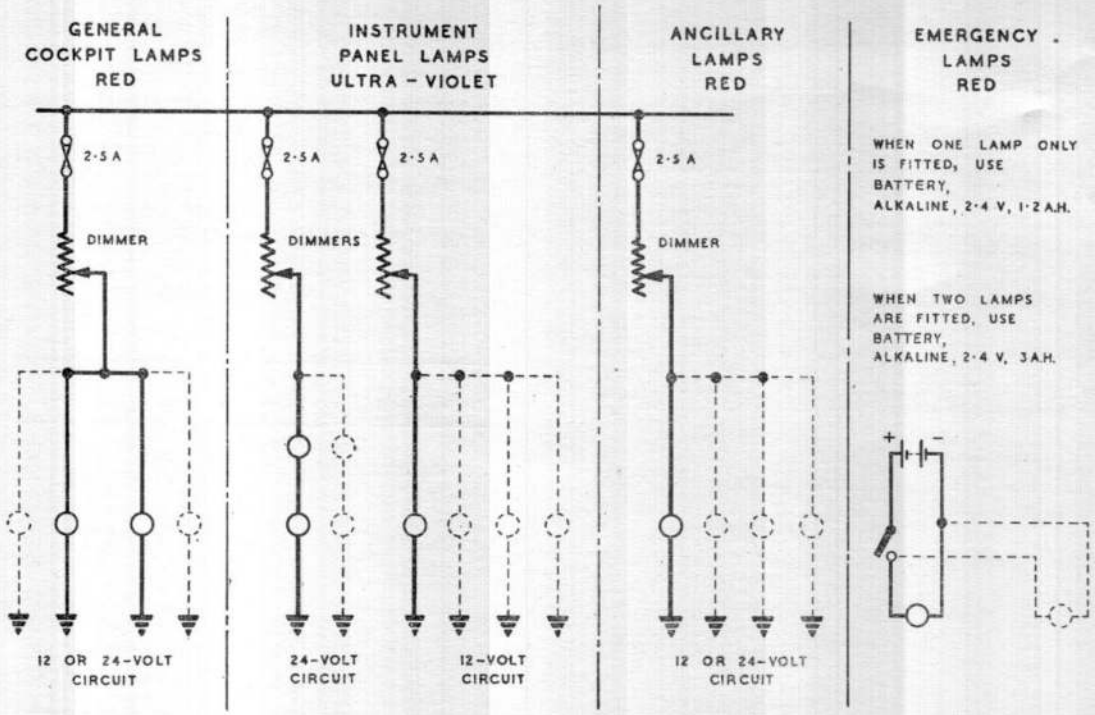

Fig. 2. Wiring diagram for the dual system

mainly because it is the least distracting colour, and has little effect on dark adaptation if used at a reasonably low level. If colour discrimination is required, orange light may have to be used instead of red. Ultra-violet is seldom suitable because it does not show up anything which is not coated with fluorescent paint.

SERVICING

15. No special servicing is necessary beyond renewing filament lamps which have failed. It is essential that damaged or worn-out lamps, switches and fittings should be replaced by new ones of the type specified for that particular position; this is particularly important with regard to dimmer switches.

16. The black coaming in each aircraft has been especially designed for the particular type, and damaged coaming should therefore be renewed with the utmost care exactly as it was originally.

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