PART 2 : SECTION 4

CHAPTER 13

CARRIER OPERATIONS

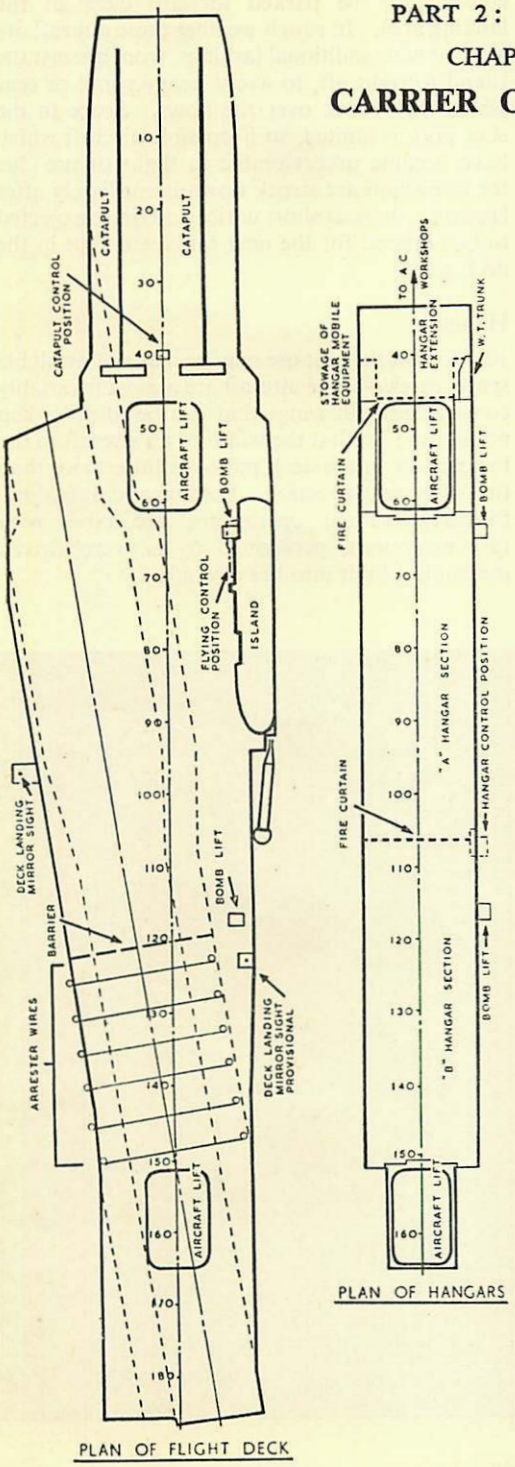

Fig. 1.
Plan View of the Flight Deck of H.M.S. *Victorious*

The Aircraft Carrier

1. An aircraft carrier is virtually a compact floating aerodrome ; her mobility enables fighter defence and strike aircraft to be brought to bear in areas outside the range of similar shore-based friendly aircraft.

2. The ship is stored and provisioned so that, if necessary, she can remain at sea for long periods, although she normally returns to harbour at frequent intervals for maintenance and replenishment, thereby providing recreation for the often overcrowded crew.

3. Basically a carrier consists of a hull on which is mounted an oblong box ; the top of this box forms the flight deck, and the interior the hangar, below and around which are the living quarters, workshops, storerooms, and engine rooms. Some carriers have two hangars, one below the other.

Flight Deck

4. The flight deck, designed to give the maximum area for aircraft to be flown-off and landed-on, extends the full length and breadth of the ship. The landing area, which comprises about three-quarters of the carrier's length, is angled between 5° and 10° to the centre line, and necessitates a diagonal landing from starboard to port. The angling of the carrier's deck provides a greater landing area for faster and heavier aircraft. A further advantage over "straight-deck" carriers is that aircraft which miss the arrester wires can overshoot instead of entering the crash barriers which were necessary in " straight-deck" ships to protect aircraft positioned on the deck park forward.

5. Along the sides of the flight deck, in the turrets indenting its sides, is mounted the main gun armament ; close-range weapons are located in convenient positions on both sides of the ship.

6. Over the whole of the after part of the flight deck, stretching athwartships, arrester wires are provided. When an aircraft is approaching to land, these wires are raised several inches off the deck by supports so that at the moment of touch-down a *hook* trailing below the aircraft engages with one of the wires. The wire, each end of which is attached to a hydraulic ram, yields

less and less easily as the rams are extended, thereby bringing the aircraft smoothly and quickly to rest. Because of the low height of the wires and their initial give, there is no danger of the undercarriage becoming entangled.

7. Located right forward are the *catapult tracks* —slots cut in the deck—one on each side of the ship. From each slot projects a hook, which is attached to the aircraft being catapulted and is connected to a propelling mechanism beneath the deck.

8. Aircraft are transported between hangar and flight deck by lifts, which form part of the deck surface.

9. Generally speaking, more aircraft are carried than can be stowed in the hangars. The exact number of such surplus aircraft (which usually amounts to about one-third of the total complement) is governed by the number which can conveniently be parked forward clear of the landing area. In rough weather these aircraft are secured with additional lashings, from abreast the island to right aft, to avoid heavy spray or seas which may break over the bows. Space in the *deck park* is limited, so if possible aircraft which have become unserviceable in flight or are due for inspection are struck down immediately after landing ; those at short notice and those expected to be required for the next range are kept in the deck park.

Hangar

10. So that the best use may be made of available space, carrier-borne aircraft are almost invariably constructed with wings that can be folded when not in use ; so that the width of an aircraft in the hangar—or in the deck park—is little more than that of its centre section. Folding and unfolding, formerly manual operations, are now, with rare exceptions, performed by a power-driven mechanism built into the aircraft.

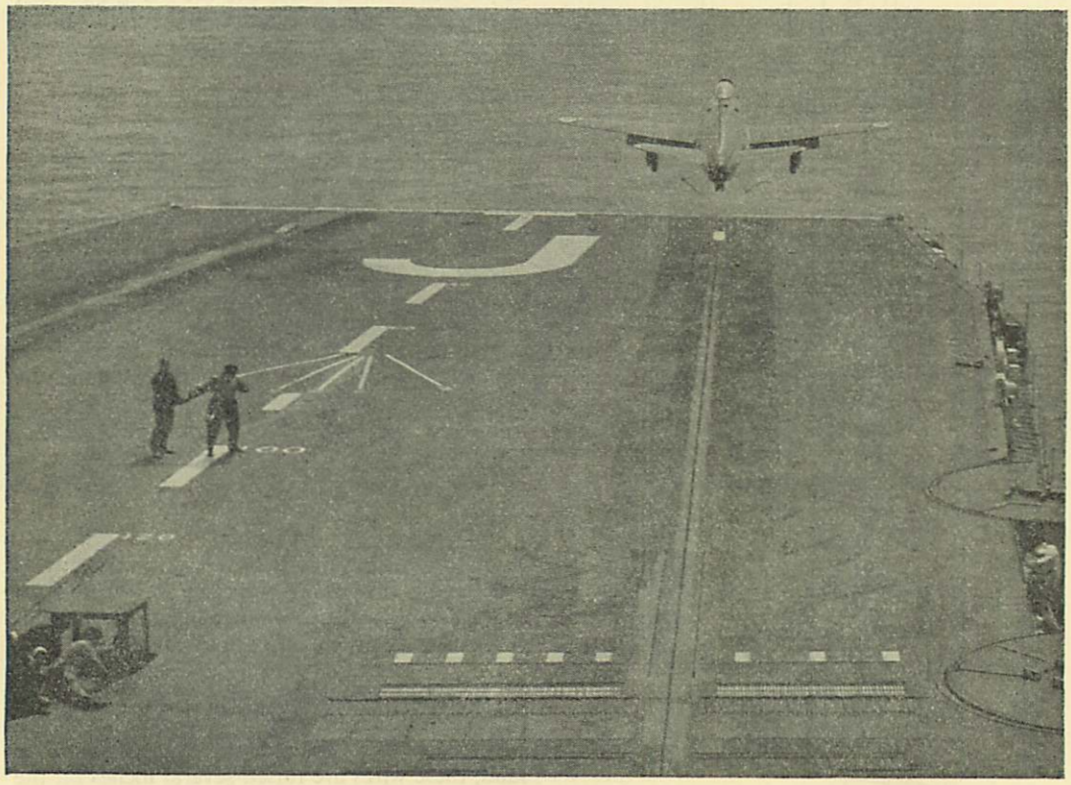

Fig. 2. Catapulting

The bridle is seen falling away below the aircraft. In the lower left corner can be seen the catapult engineers ; the directing officer is positioned at the left centre

11. Except when being manhandled, aircraft are always secured to points in the hangar deck, since shifting, due to motion of the ship or to a sudden large alteration of course, would cause considerable damage as well as endanger life and the ship.

12. The various workshops connected with aircraft maintenance are situated as close to the hangar as possible and are equipped to deal with all except major repairs. To facilitate servicing, petrol, oil, and air leads are provided in the hangar as well as on the flight deck ; unless the circumstances are exceptional, however, aircraft are not armed in the hangar.

13. The increased fire hazard in this type of ship is guarded against by comprehensive fire-fighting installations and strictly enforced safety regulations. The hangar is divided into sections by fire curtains which can be lowered from control positions both inside and outside the hangar, thus enabling any section to be quickly isolated. In addition, the ventilation can be cut off to accelerate oxygen starvation and water sprays from the roof can be brought into operation.

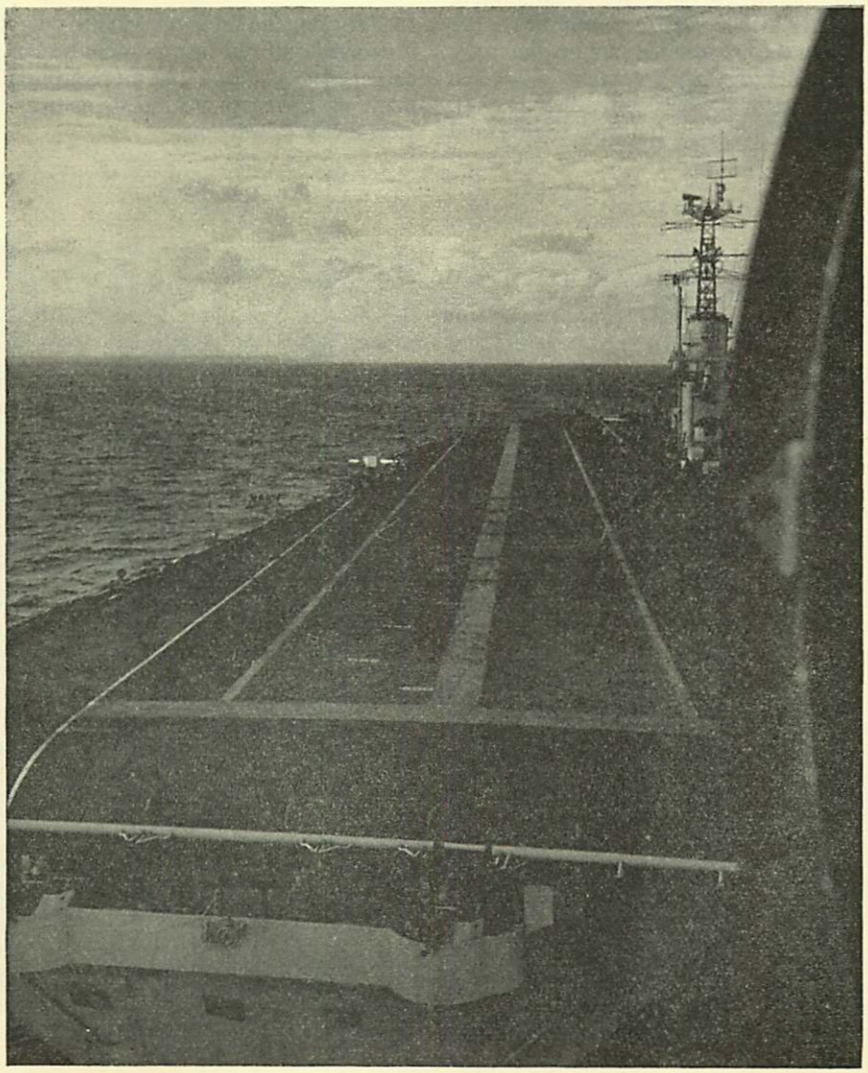

Fig. 3. Pilot's View of the Flight Deck just before Touch-Down

Preparing to Fly

14. The system of ranging aircraft on the flight deck depends on the method by which they are to be launched. This in turn is dictated by the take-off qualities of the aircraft under given load conditions, and the wind speed available. Piston-engined aircraft without overload fuel tanks or ordnance can usually be given a normal "free" take-off, in which case the aircraft are spotted aft, three abreast, with the flanking aircraft pointing inboard. With heavily loaded piston aircraft, jet-propelled, and propeller-turbine aircraft the catapult is almost invariably required, and the aircraft are consequently spotted aft and fed up in the centre line of the deck to the catapult(s). Engines are not started, however, until the chocks are manned and the crews settled in, for the range is so closely packed that propellers are often only a few inches from parts of other aircraft. When each pilot has run up his engine and signalled that he is ready to take off, the Flight Deck Officer (F.D.O.) is informed and, through him, the Officer-in-Charge Flying and the Captain.

15. Meanwhile, the course and speed of the ship have been adjusted to provide the wind required. Charts in the flying control position in the island show the wind speed needed for "free" or catapult launches for each type of aircraft under various load conditions. A slight sink over the bows is acceptable and is not infrequent when working near the limits in a "free" take-off.

16. Turning the ship into wind to operate aircraft is delayed until the last moment because to do so earlier merely means that more ground has to be made up to regain station thereafter. This is a vital factor in wartime.

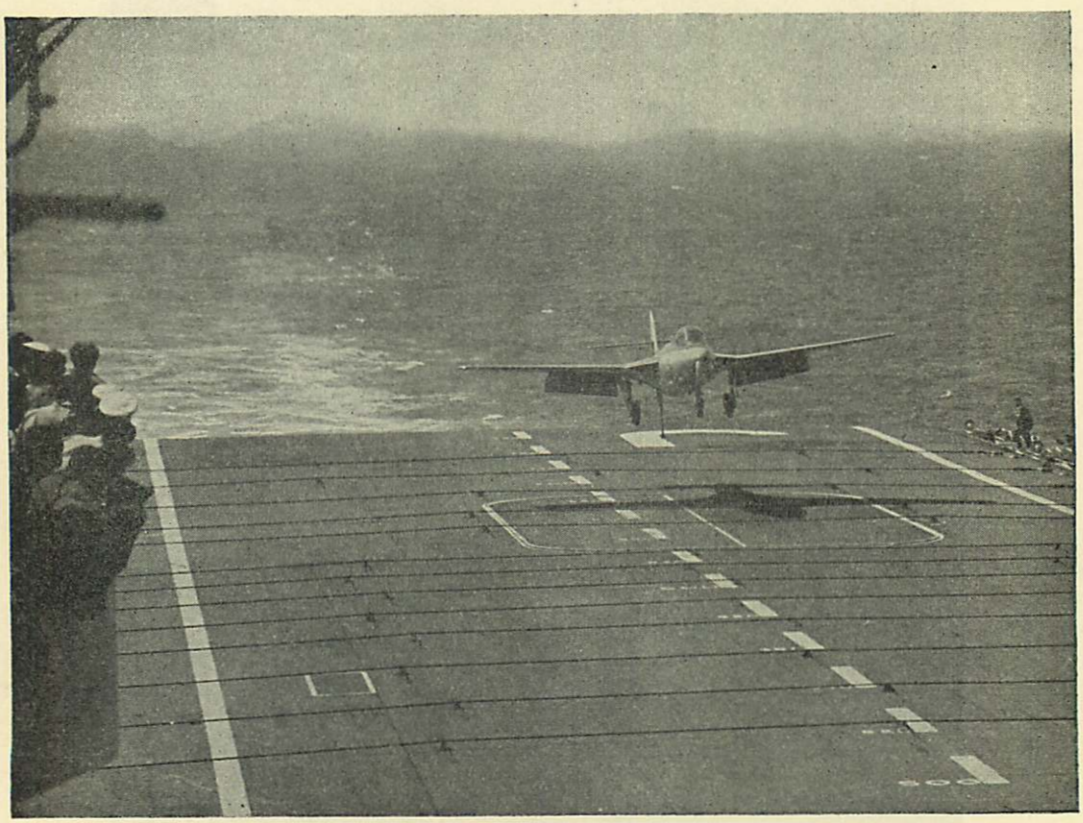

Fig. 4. A Sea Hawk About to Engage the Arrester Wires

Flying-Off

17. As the ship turns into wind, chocks are removed from the first aircraft ; the pilot taxies forward far enough for his wings to be extended without fouling flanking aircraft, and then remains stationary on his brakes until waved away by the F.D.O.'s green flag. Flying-off may begin as soon as the officer-in-charge flying switches on a steady green light, known as the "affirmative", at his position on the island.

18. During the take-off, it is essential that the aircraft are kept straight, since, particularly with some aircraft, there is little clearance between the wing tip and the island. However, because of the high wind speed over the deck—30 kts. or more —positive rudder control is gained as soon as the brakes are released and any tendency to swing can therefore be checked quickly.

19. The aim of the F.D.O. is to get the range into the air as quickly as possible. From the moment the first aircraft begins to move, ratings, known as *aircraft directors*, rapidly marshal those behind it to the take-off point. This operation requires concentration from both pilot and director, for in such congested conditions a mistake could seriously delay the fly-off, as well as cause damage to other aircraft. As soon as each aircraft is clear of the ship, it jinks to starboard to disperse its slipstream from the deck before climbing away on the original heading. The F.D.O. is thus able to keep the take-off interval down to about 10 to 15 seconds.

20. **Rocket-Assisted Take-Off.** When, for any reason, the available take-off run is insufficient, additional thrust can be obtained from rockets. These are normally fitted in pairs and mounted on either side of the fuselage, in the neighbourhood of the wing roots. Each rocket provides about 1,200-lb. thrust and has a burning time of about four seconds. They are fired by the pilot at a predetermined point in the take-off run where maximum acceleration will be obtained.

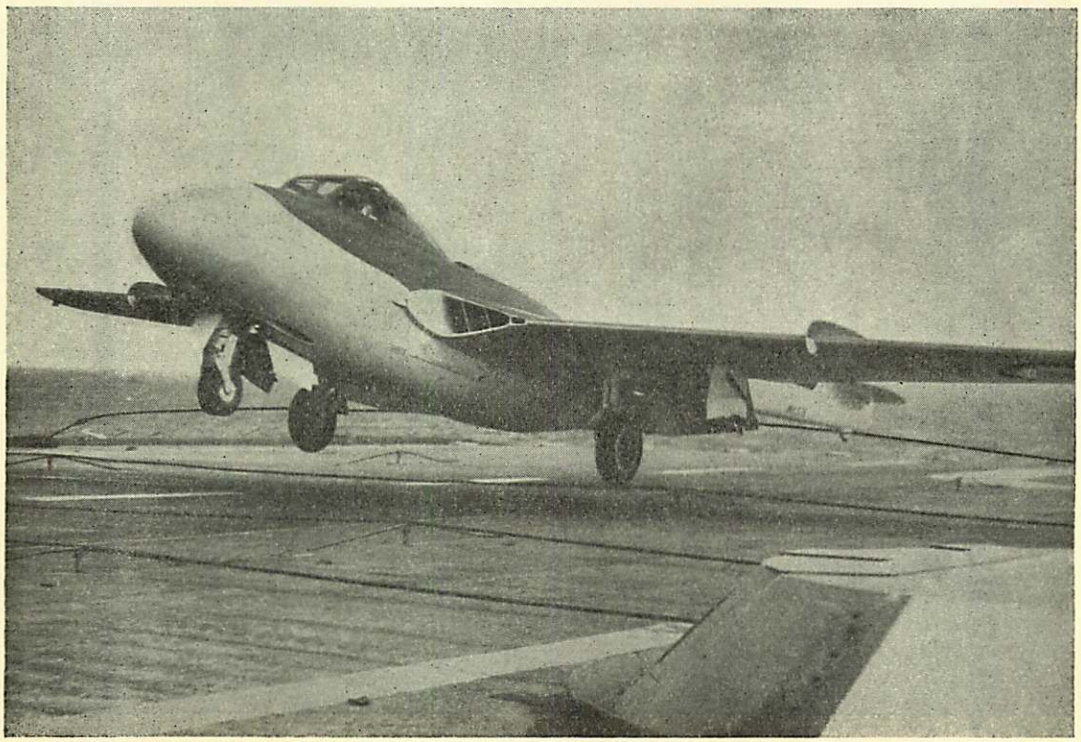

Fig. 5. A Sea Venom Engaging No. 1 Arrester Wire

21. **Catapulting.** As previously stated, the catapult is used for launching loaded piston-engined aircraft and practically all turbine-engined aircraft. Most jet aircraft require more than 40 kts. of wind over the deck for a free take-off, and in consequence the catapult has become the primary means of launching them. Catapults provide a launching speed of over 100 kts., but owing to the high stalling speed of jet aircraft the wind speed required over the deck is considerable, and to provide it the carrier has still to make use of her own speed or any natural wind.

22. The aircraft is taxied into position on the catapult, the pilot being assisted by guide boards, and, in some carriers, by mechanical means. When correctly aligned, the catapult bridle is attached to the launching hook(s) on the aircraft. At a signal from the directing officer, the pilot opens the throttle, and when ready for launching raises his left hand momentarily. On seeing this, the directing officer gives the signal to launch. The acceleration to which the pilot is subjected is $2\frac{1}{2}g$ and, provided he is correctly braced in the cockpit, is not unpleasant; there may be, however, a false sensation that the aircraft is climbing steeply. This impression follows from the effect of the acceleration on the pilot's vestibular organs and muscle sense, and needs to be guarded against as the aircraft becomes airborne. Launching intervals aimed at are 40 seconds per aircraft per catapult.

Landing-On

23. The procedure followed by aircraft returning to a carrier is designed to complete landing-on as quickly as possible, and to avoid interference with aircraft from other carriers which may be in the vicinity.

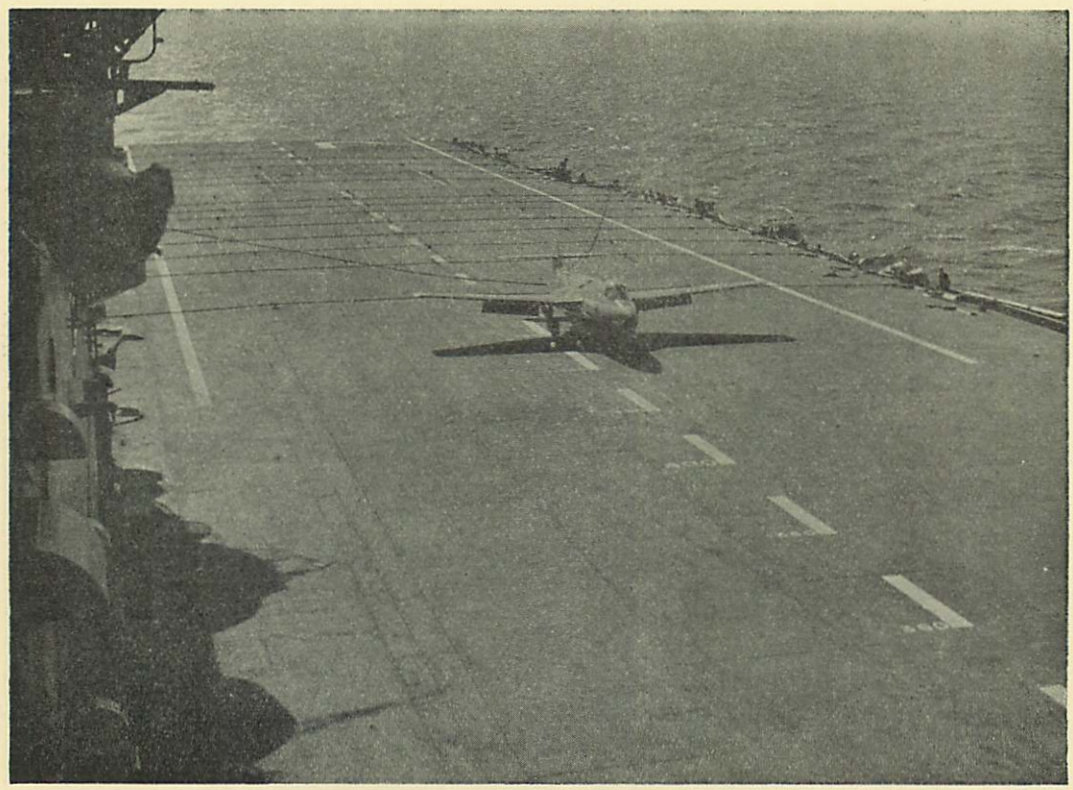

Fig. 6. The End of the Landing Run

24. The aircraft first return to a waiting area, from which they are called down by R/T to orbit at 1,000 ft. adjacent to their carrier. From this position each division (flight) is brought down by its leader into the landing circuit, which is very much the same as the standard airfield circuit, but at a height of 300 ft. The aircraft, of which there should be not more than six at a time in the landing circuit, are then spaced out at 30-second intervals, and it is upon each pilot's ability to fly the circuit accurately, maintaining his distance from the next ahead, that the speed and success of the landing operations largely depend.

25. Situated to port of the landing area is the *deck landing mirror sight*, designed to assist the pilot in judging his flight path to the deck. This consists, briefly, of a mirror, gyro-stabilized in pitch, with coloured horizontal datum lights on either side, and a white source light located abaft the mirror. This light, reflected in the mirror, is picked up by the pilot on his final approach, who then adjusts his height according to the position of the light in the mirror relative to the datum lights. A standby mirror is located on the starboard side of the deck. A steady throttle setting is maintained throughout the approach, except when large height and/or speed errors exist. If all the wires are missed the pilot merely continues up the deck and overshoots to port of the bows. When the hook engages an arrester wire the pilot cuts his throttle and the aircraft is brought to rest in about 120 ft. In jet aircraft little difficulty is experienced in lining up owing to the excellent view inherent in these aircraft. In piston and some propeller - turbine aircraft, however, additional concentration is required.

26. Each pilot turns in from his down-wind leg at a position abreast the carrier. The final approach is made with engine and should be at as slow a speed as possible, compatible with full control and safety (usually about 10 knots above stalling speed). A short "straight-away" (final approach path) is desirable, and he aims to cross the stern of the ship at between 10 and 15 ft.

27. If the pilot cannot lower the arrester hook, or in some other emergency when overshooting may be undesirable or unacceptable, an emergency barrier can quickly be rigged across the landing area to prevent the aircraft going over the side.

28. If during landing operations it becomes necessary for the ship to alter course, or if a hold-up on deck occurs, the officer-in-charge flying can wave off approaching aircraft by firing a remote-controlled Very light or by switching on a distinctive light signal in the D.L. mirror position.

29. As an aircraft comes to rest, it is pounced on by ratings who clear the wire from, and retract, the hook ; at the same time the arrester wires are lowered. Taxying forward under the guidance of directors, the pilot gets clear of the landing area as quickly as possible, for the next aircraft is only 30 seconds behind him and a few seconds' delay in re-erecting the arrester wires may necessitate a wave-off. Wings are folded as the aircraft taxies up the deck and it is finally parked forward and the engine stopped.

Sea Rescue

30. A helicopter, fitted with a winch from which a strop may be lowered to the water, is available for rescue of aircrew at sea. During flying operations it is kept airborne, clear of the landing circuit. In addition, a destroyer, when available, is detailed for rescue duties ; during flying operations she may be stationed astern of the carrier.