LOCKHEED ELECTRA . . .

even the most common, Electra engine. One Lockheed engineer said, bluntly, "we want the engine from Derby; and if we can't have the Rolls engine in time, the Eland has a good chance."

Anyway, for the time being the Electra is wrapped around four Allison 501s. Each is installed as a complete power package and, except for certain handed items and accessories, all four are interchangeable. These Allison engines have the reduction gearbox mounted remotely from the power section (see detail drawing on p. 715), thus allowing the air intake free entry to the compressor. In the C-130 the intake is under the spinner, but various factors have resulted in the Electra engine being "the other way up," i.e. the axis of the airscrew lies below the axis of the engine, and the main air intake duct passes down from the top of the cowling behind the spinner.

The cowling and nacelle structure contains a high proportion of stainless steel and titanium alloy, and firewalls divide the interior into three zones, each of which is provided with "the latest fire surveillance" and high-rate extinguishing systems. In the large cut-away drawing the starboard outer powerplant is shown with the various access doors open. All doors and panels are secured by quick-release latches, and may be completely removed at the hinges if necessary. Loads from the reduction gear and engine are taken out through a tubular structure which is finally anchored to the front spar. By removing the turbine-access door, disconnecting the firewall connections and then releasing the four engine-mounting bolts, the complete engine-change unit, with airscrew, can be inched forward slightly and then lifted clear of the airframe.

Airframe accessories are nearly all mounted on the airscrew reduction gearbox, projecting to the rear. The oil tank is carried above the compressor, and the oil cooler is mounted beneath the engine in an individual air tunnel, with a flush, thermostatically controlled exit vent. The jet pipe is carried back across the wing, from which it is sealed by a stainless-steel firewall over the unbroken wing upper skin.

Considerable attention has been paid to reducing the drag of this installation, both externally and internally. Lockheed claim that, by "Coke-bottling" the tailpipe fairings over the area of maximum wing thickness, the drag of this region has been reduced, particularly at high speeds. Interference drag can be considerable at the speeds for which modern transports are designed. For the Electra, design limit speeds are: diving, 420 kt i.a.s. to 7,000ft and $M = 0.725$ above; and level flight, 335 kt i.a.s. to 11,000ft and $M = 0.625$ above.

Airscrews are of 13ft 6in diameter—slightly on the small side, one would think—and have four wide-chord blades. Aeroproducts are expected to supply units for the first production Electras, although Curtiss (and possibly Hamilton Standard) are in the market with suitable units. Airscrew de-icing is electric, and feathering and reversing are to be provided, with auto-feathering for take-off being (at present) a specified requirement.

Engine starting is pneumatic. Each engine carries a Bendix-Eclipse air-turbine starter working off a 3,000 lb/sq in supply. When one engine has fired-up properly, it can serve as the source of air for the other three.

Undercarriage. Each main leg carries two wheels, with dimpled tyres and multi-disc brakes fitted with anti-skid units. Retraction is in a forward direction under the action of a single hydraulic jack, the up-locks being mechanical. The gear can be lowered without hydraulic power, and can lock down under gravity and air loads. Conversely, the units cannot be retracted on the ground unless hydraulic power is present, since the static position of the leg is "over-centre."

Each main leg is a simple machined forging, housing an oleo-pneumatic shock strut. The wing attachments are also large machined forgings, and Lockheed have stressed the fact that excessive loads from the main legs cannot normally rupture the wing tankage, the latter nowhere coming into the close proximity of the leg attachments. It may be observed that the retracted main units require quite a bulge in the underside of the inner nacelles, although the wing structure is not broken into.

The nose unit also carries two wheels, and is likewise a forging with an oleo-pneumatic shock absorber. The unit is mounted on a pair of forged attachments under the floor of the flight deck (which at this point also serves as the boundary of the pressure hull), and is hydraulically steerable. The unit retracts forwards, hydraulically, into an unpressurized bay. All undercarriage bays are closed by twin doors.

Power Services. Most of the accessory power of the Electra is electrical, and the entire load is generated as three-phase A.C. at 208/120 V, 400 c.p.s. by four alternators, one on each powerplant. It is the manufacturer's intention that output should be paralleled. Low-voltage D.C. supplies are provided by advanced rectifiers, most of this load being required by ancillary heating and lighting services.

In the unpressurized bay under the wing centre-section (under the passenger-cabin floor) is an electrical service centre, reached from outside *via* large downward-hingeing doors. In this area are fitted hundreds of circuit-breakers, fuses, junction boxes and every other electrical component which could reasonably be put there. The interior is electrically lit and is painted white to improve the level of illumination.

Hydraulic power is provided by engine-driven pumps supplying a 3,000 lb/sq in system. Full pressure is used for undercarriage retraction, air-stair actuation and other main power functions, and reduced pressure is employed for wheel braking. Compressed air at 3,000 lb/sq in is delivered by multi-stage compressors, and serves for engine starting.

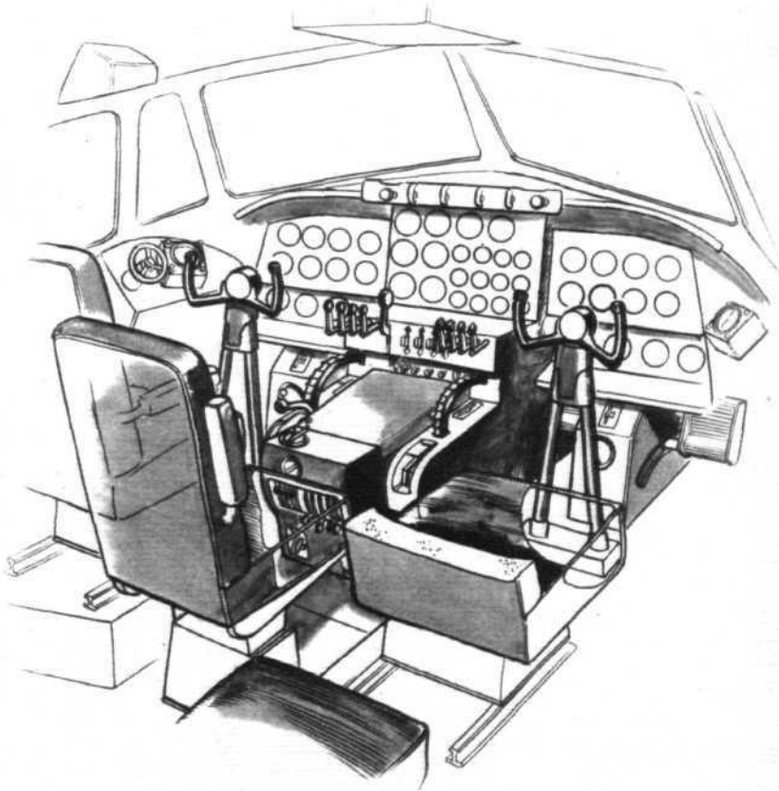
Fuel. All fuel is housed in integral tanks formed by the main wing box bounded by the front and main spars and the upper and lower, integrally stiffened skins. There are two such tanks in each wing, each tank being inboard of the engine which it serves in normal flight (although, of course, any engine could draw fuel from any tank).

Total capacity in the normal four-tank system is 3,480 Imp. gal, but this can be supplemented, in a long-range aircraft, by some 500 gal outboard of each outer engine. Provision is made for jettisoning in flight. The entire system is replenished *via* a single pressure-fuelling socket under the fuselage, close to the fillet beneath the starboard wing. This socket can be reached without trestles.

Cockpit. Very extensive study has gone into the design of the Electra flight deck, which is laid out for a normal operating crew of three, although two-man crew operation is possible. In each case an additional jump-seat is provided. Lockheed have also allowed plenty of room for crew kit stowage.

General form of the flight deck is fairly conventional, with a classic type of nose entry, and windscreen panels of normal shape and angle. The transparent areas are electrically heated and comply with bird-proofing requirements for high airspeeds. Additional windows are provided in the roof. Comfortable seats, of unusually large dimensions, are provided for the two pilots, each of whom has a pillar-type control column and a full set of flight instruments. The general arrangements of the controls, instruments and lighting is in close conformity with the requirements of S.A.E. Committee S-7.

The accompanying drawing shows the manner in which flight instruments face each pilot and are separated by engine instruments in neat rows with miniature faces. Extinguishing and other emergency controls and warning lights are arranged below



The Electra cockpit is designed to S.A.E. recommendations and provides for a flight crew of two or three, with a fourth seat (visible in the foreground) for a supernumerary. On the pedestal are radio controls and, to port, the flight-idle gate release, and flap controls to the rear of the big trim wheels. The fuel panel is on the rear face of this pedestal. Power levers are on each side, sandwiching the four condition levers and the large undercarriage lever. On each side of the facia is a P.P.I. display for storm-warning radar and the nosewheel-steering wheel is just behind the captain's radar display to port.