
19. Pitch trim system

Overview

Your Europa uses an all flying tailplane with an anti-servo/trim tab on the trailing edge.

The tab, as its name suggests, has two functions:-

- * 1. To stabilize the tailplane and provide the correct stick force to the pilot.
- * 2. Longitudinal trim.

Trim control is by means of an electric trim motor mounted onto the rear bulkhead along with a small bellcrank assembly. The bellcrank assembly reduces further the motor gearing, has stops in case the motor should either run away or become detached, and a damper system that would stop the tabs from oscillating. A steel tube 'tee' bar, connected to the bellcrank, drives the tabs through slots in the fuselage sides. Figure 1 shows the general arrangement of the various components of the trim system.

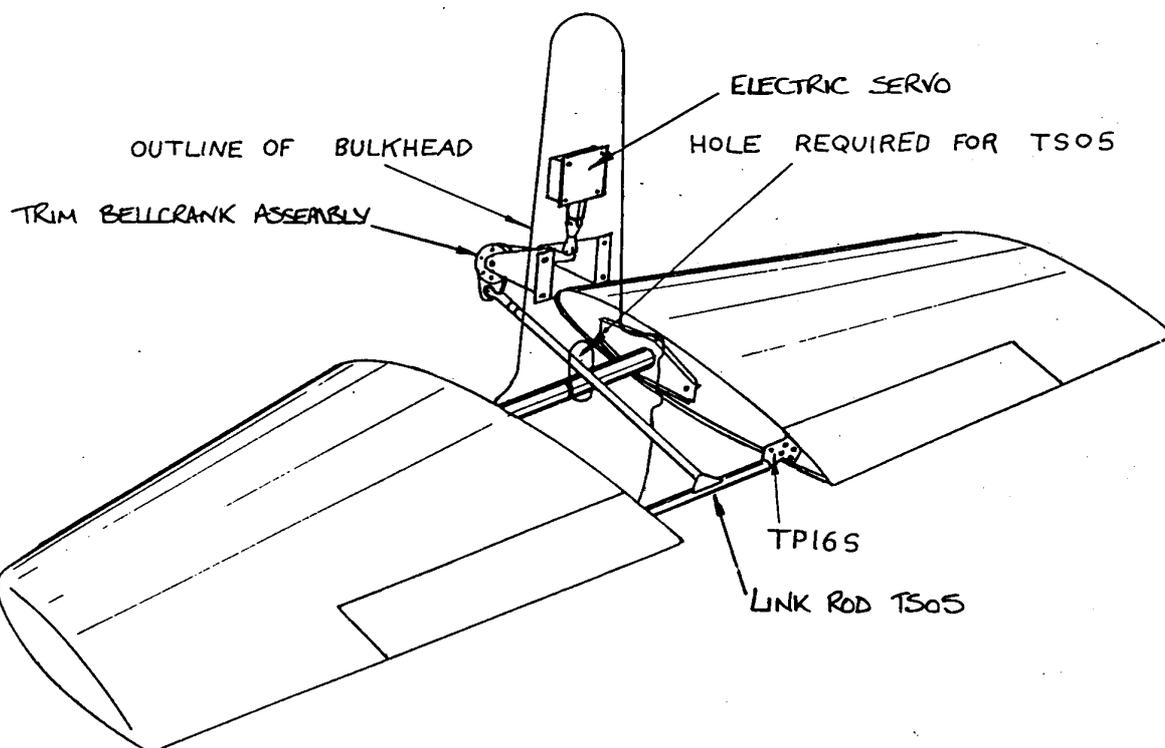


Fig 1. General arrangement of pitch trim system.

Bellcrank assembly and mounting

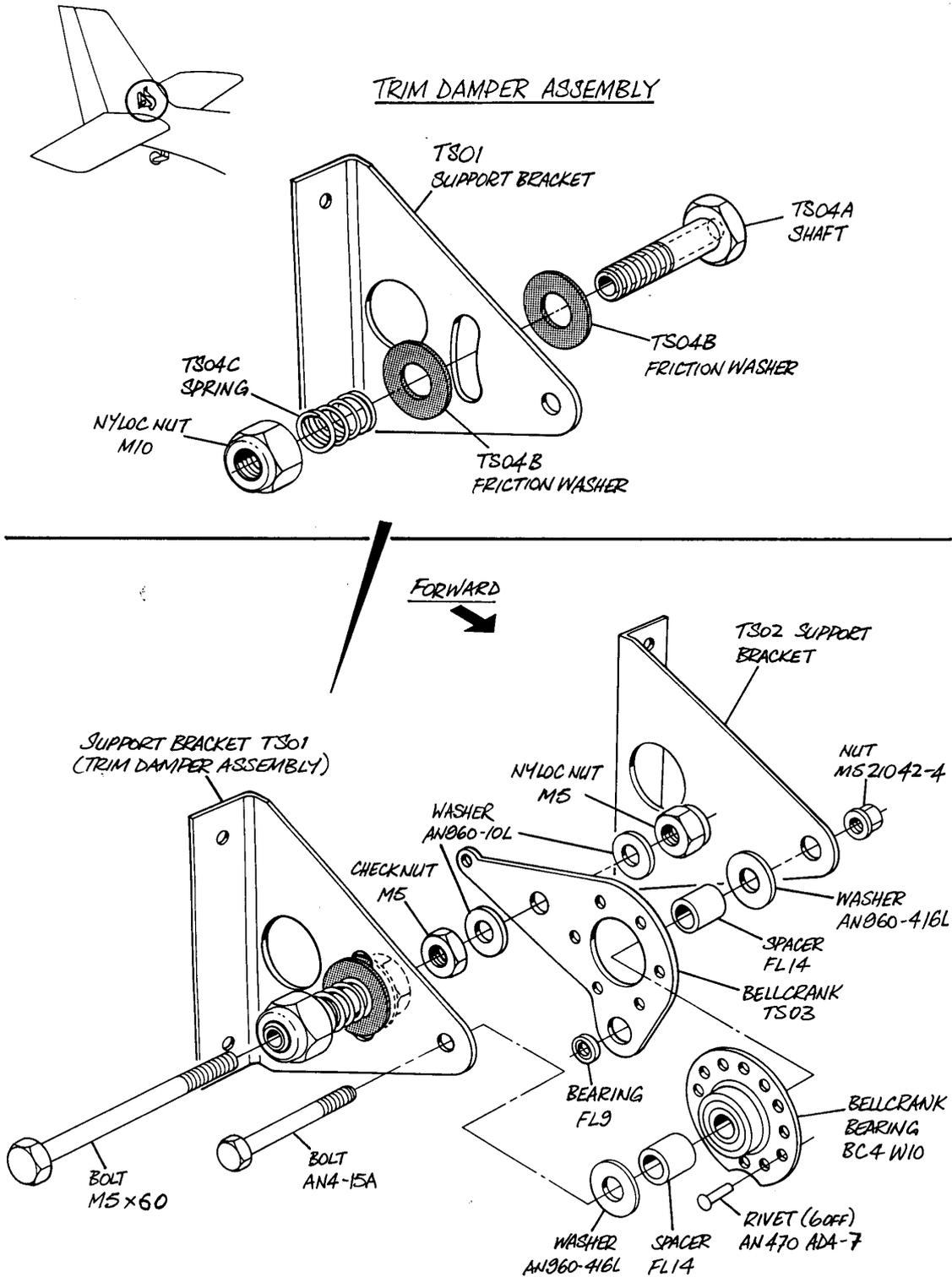


Fig. 2. Trim damper and bellcrank assembly

Step 1

Bond an FL9 plain bearing into the bellcrank TS03 using Loctite 638 Bearing Retainer then temporarily connect the fork-end AN486-2P to it with an AN4 type bolt. Radius the edge of the large hole in the bellcrank to ensure that the BC4W10 bellcrank bearing fits snugly up against the face of the bellcrank. Locally file the flange of the BC4W10 to allow it to fit in place when the fork is parallel to the bellcrank's long arm then, noting from figure 3 which side the bearing is fitted, rivet it in place using six AN470AD4-7 solid or TLPD435BS pop rivets. See figure 3.

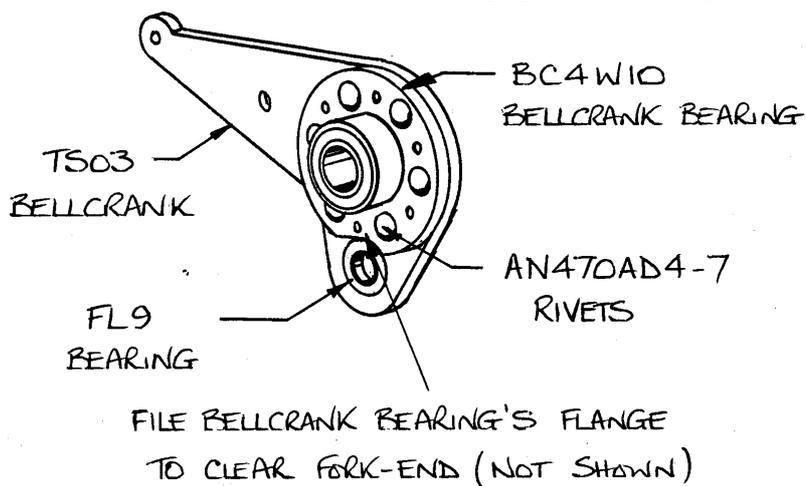


Fig 3. Bellcrank riveted to bearing.

Assemble the brackets TS01 and TS02 with the bellcrank TS03 using FL14 spacers and AN960-416L washers at either side of the bearing to space the brackets apart. See figure 4.

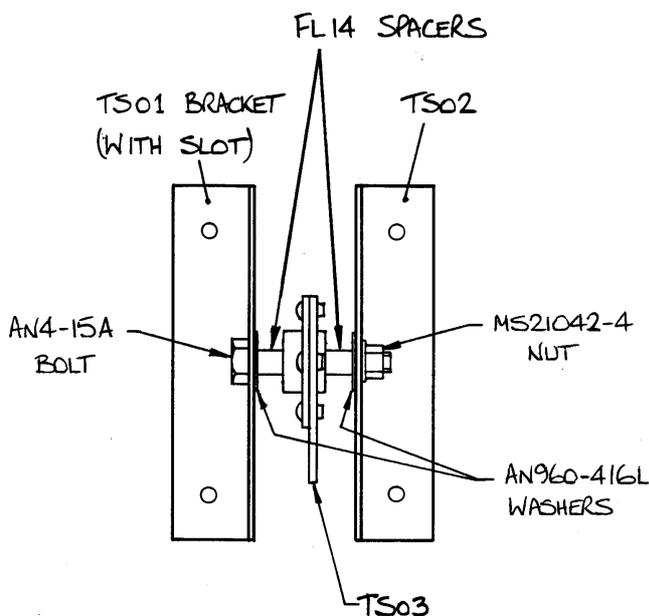


Fig 4. Bellcrank assembled with brackets.



Step 2

Study all the drawings in this chapter then make the template TST, found in Annex A, from plywood or alloy.

The template will be used to set the critical distance from the tailplane torque tube TP4 to the pivot of the bellcrank TS03. This distance gives the correct gearing ratio of tab to tailplane movement.

Push the hole in the template onto the end of the bolt that the bellcrank bearing pivots on.

Step 3

Referring to figure 5 set the bellcrank assembly in place on the rear bulkhead, using the template to set its height above the torque tube and, making sure that the **bellcrank** is on the aircraft centre line, drill through the bulkhead with a 4.8 mm drill using the holes in the brackets as guides.

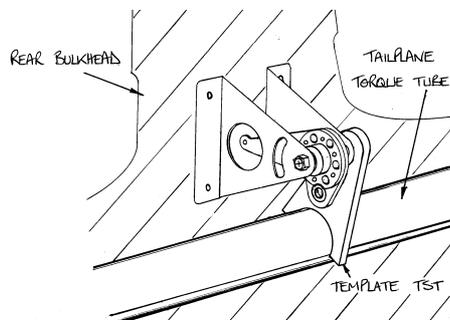


Fig 5. Template TST positioning trim bellcrank assembly.

Step 4

Referring to figure 6, cut the shaft TS04A to be 28 mm (1.1") long, measuring from under the head, then build up and assemble the damper unit onto TS03 and TS01. Now the brackets may be bolted onto the front of the bulkhead using AN3-5A bolts with wide area AN970-3 washers under the MS21042-3 nuts.

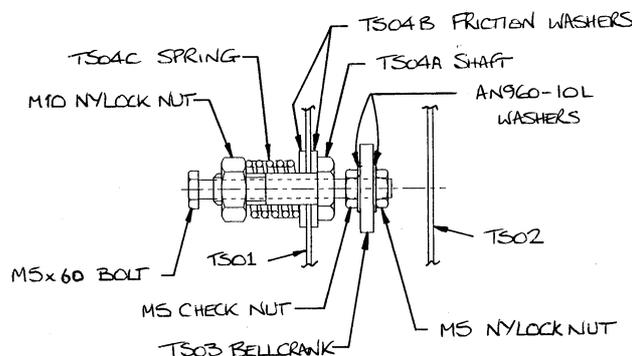


Fig 6. Sectional view of trim damper.

Trim servo

Step 5

Unpack the MAC electric trim servo and study all the instructions.

Cut off a 32 mm (1¼") piece of the threaded rod and screw on the two plastic fork-ends until they are butted together.

Solder the extension wires to the servo wires, insulating them from each other then, using a 9 volt battery, run the servo to its full in position and then connect it to the bellcrank's small hole with the ⅛" clevis pin, using the two plastic fork-ends as a link. With the servo against the bulkhead slide it up until the damper unit has been pulled up to the top of its slot, then push the servo down so the damper's bolt is just clear of the end of the slot. Mount the servo to the bulkhead in this position, drilling through both the servo's flange and the bulkhead with a 4.2 mm (11/64") drill and fastening it using four MS27039-0808 bolts, AN960-8 washers and MS21042-08 nuts. See figure 7.

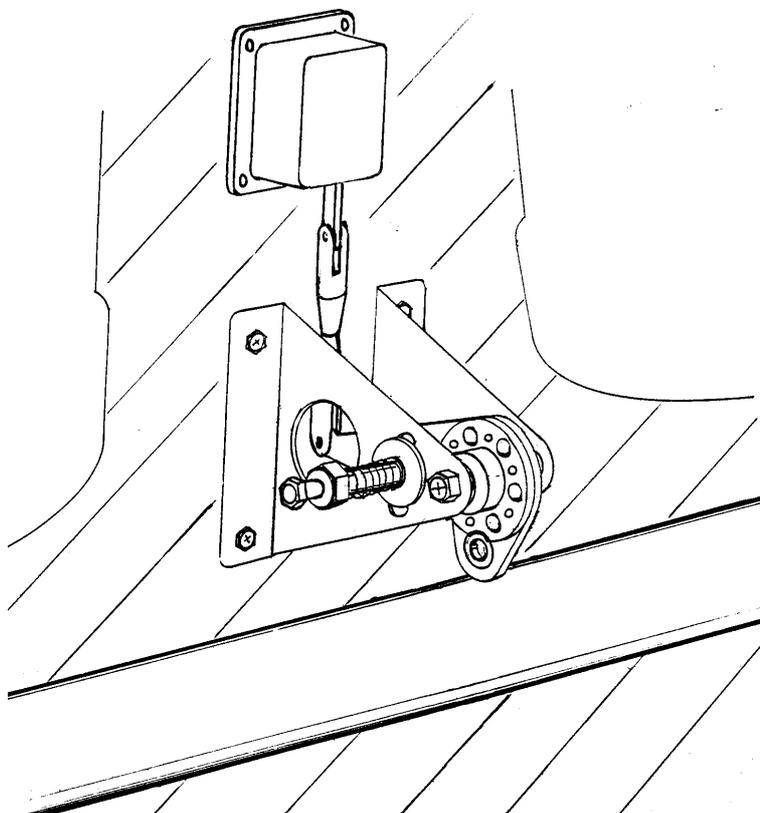


Fig 7. Servo's position on rear bulkhead.

Run the servo motor both ways making sure that it comes to its own internal limit stop switches before the damper reaches the end of the slot in the mounting bracket.

Now set the servo in its central position and confirm that the indicator needle is in the middle of the scale. Adjust it if necessary.

Tab link-rod

Step 6

The 'tee' end of TS05 will protrude through the sides of the fuselage when installed to drive the trim tabs. Cut out the slots in the fuselage bottom moulding which have been pre-marked at the aft end of the tailplane fairings but start by making these cutouts $\frac{1}{4}$ " smaller than the scribe marks then enlarge them as necessary on the final system check.

If you haven't already done so, cut a small hole in the rear bulkhead, as shown on the rear bulkhead template so that TS05 can pass through it.

The link-rod TS05 should already be the correct length, but may need to be shortened slightly so don't rivet the end fitting in without first checking.

Before installing the bushes TS06 in the cross-tube of the link-rod, slide the tailplanes onto the torque-tube and measure the distance between the plates of the tab drive pins on the anti-servo tabs. The cross-tube should be 5 mm (0.2") shorter than your measured dimension to allow for the bush flanges. Bond the bushes into the cross-tube of the link-rod using rapid epoxy. Screw the fork AN486-2P onto the insert AN490HT8P leaving 9 mm ($\frac{3}{8}$ ") of thread showing. Refer to figure 8.

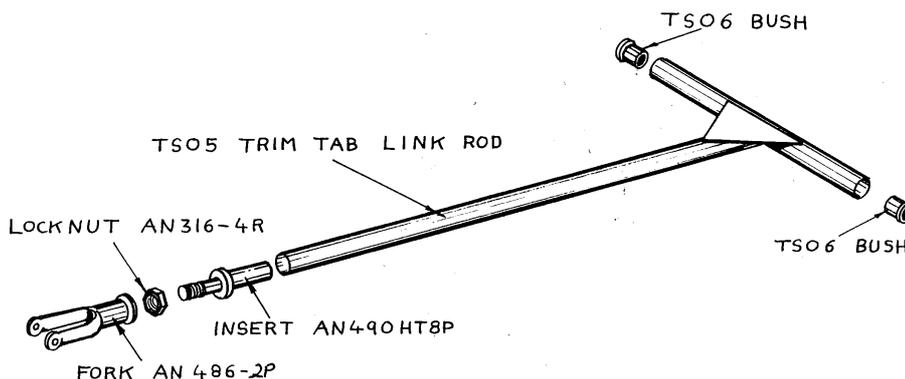


Fig. 8 Trim tab link-rod assembly.

With the link-rod through the hole in the rear bulkhead, engage the tab pins into the bushes and, checking that the servo is still in the neutral position, hold the tailplanes in the neutral position (aligned with the fairings) and the tabs also neutral. Bring the fork-end of the link-rod up to the bellcrank TS03 and measure the misalignment between the centres of the holes through the fork and the bellcrank. If the link-rod is more than 5 mm too long shorten the tube by the measured amount then rivet the insert AN490HT8P into the end using two AN470AD4-10 rivets as shown in figure 9.

Connect the fork to the bellcrank TS03 with an AN4-6A bolt and MS21042-4 nut with an AN960-416L washer under the nut.

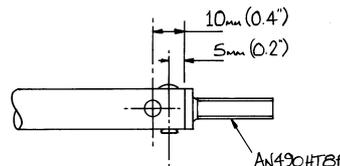


Fig. 9. Rivet pattern for insert.

Finally enlarge the slots in the fuselage sides. Remember that the slots must be made wide enough for the link-rod with the trim set at both extremes of travel and should long enough so that the link-rod will not make contact even if it overshoots due to the inertia of the tailplane.

System check

To check the trim system for correct function you will need an inclinometer (clino), a simple device for measuring angles. You can either borrow one or make one from a protractor. See figure 10. Of course a digital level could also be used if you don't mind the expense.

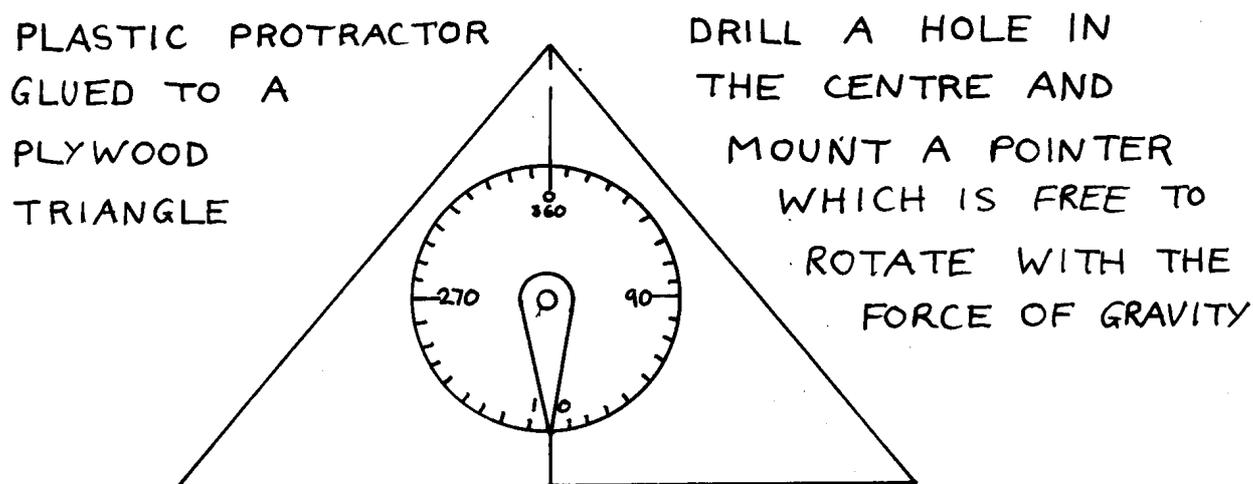


Fig 10. Homemade inclinometer.

The pitch control stops will be installed later when you have completed the fuselage but for now you can check for correct movement and enlarge the slots in the rear fuselage to allow the required clearance around the tab link-rod TS05.

Step 7

With the tailplanes in the zero position the tabs should be aligned with them. If they're not, adjust the length of TS05 by screwing the fork either in or out. Don't forget to tighten the lock nut afterwards. Keeping the tailplanes and tabs set at zero, place your clino on the flat trailing edge portion of the aerofoil outboard of the trim tab and orientated fore and aft and make a note of the clino reading.

The tailplane trailing edge needs to rotate upwards 12° and downwards 4° to cover the full range. You will notice (I hope) that as the trailing edge of the tailplane is raised the trailing edge of the tab raises even further, the ratio being approximately 1.3 to 1. Therefore, when you have raised the trailing edge of the tailplane by 12° , the tab should have raised 15.6° relative to the tailplane or 27.6° from the zero start position.

A maximum total movement of 18° and a minimum of 14.4° relative to the tailplane is acceptable.



Similarly, moving the tailplane trailing edge down 4° from the zero reference point the tab should move down 5.2° relative to the tailplane, or 9.2° relative to the zero reference position. A maximum total movement of 6° and a minimum of 4.8° of tab movement relative to the tailplane is acceptable.

Step 8

Once you have checked that the tabs move as they should, put the tailplanes back to the zero setting and run the trim motor in both directions noting that the tab moves up or down relative to the tailplane.

Check that you have a trim range of 6° each way.

Caution: *Make sure that the slots in the fuselage sides can accommodate the forward and aft movement of the TS05 link-rod before running the motor to its full extremes.*

Once you have the necessary clearance repeat the trim movement with the tailplane set 12° trailing edge up and 4° trailing edge down. Check that no binding occurs between the fuselage slots and the link-rod as the tailplane sweeps through its full range with the tabs at both extremes of travel. Allow approximately 3 mm ($\frac{1}{8}$ "") of clearance.

To seal the exposed foam in the cutout slots dig out 2 or 3 mm and pot in some wet flox, covering it with peel ply or sanding it flush when fully cured.

Step 9

To aid rigging and derigging the tailplanes a means of preventing the TS05 link rod from moving too far sideways should be fitted. There are various ways of achieving this; possibly the simplest method is to bond a length of 3 mm plywood vertically each side of the link rod just ahead of the slots, leaving a 20 mm ($\frac{3}{4}$ "") gap for it to run up and down in.