

28M. Flap control system and rear baggage bay - monowheel

The flaps are driven, via the pins in each flap root, by a cross-tube which is hinged to brackets mounted through the fuselage floor, the flap hinge centre being below the fuselage. The general arrangement is shown in figure 1 at the end of this chapter.

The cross-tube is pushed or pulled to extend or retract the flaps by a push-rod which is operated by an adjustable horn attached to the starboard landing gear retraction arm LG08S, causing the flaps to retract when the landing gear retracts and vice-versa. The operating horn is adjustable because a build up of constructor tolerances inevitably results in differing flap angle movements for a given landing gear articulation angle, but more of this in detail later.

The flap / landing gear retraction lever LG12 is directly attached to the port side retraction arm LG08P and is the means by which the pilot may retract or extend the landing gear and, at the same time, the flaps.

The baggage bay floor extends over the flap cross tube, and is fitted with two underfloor compartments - one for the battery and the other for an electric fuel pump. The rear of the baggage bay is closed by a bulkhead which includes a removable panel to provide access to the rear fuselage.

Retraction lever installation

Step 1

A two-part handle is required to be bolted onto the radiused end of the lever. Make the handle from 25 mm diameter wooden dowel, one part being 45 mm long and the other 10 mm long. Shape and round off the handle as required. With a hole through the centre, attach the longer handle to the pilot's side of the lever and the short piece to the other side. This orientation ensures clearance within the instrument module when the landing gear and flaps are retracted.

Step 2

To allow installation of the landing gear/flap retraction lever, a slot will need to be cut in the top of the wheel well tunnel. Initially, establish the centerline of the tunnel and mark a line. Mark a parallel line 75 mm to the port side and another at 85 mm. The final length of the slot will be established by the required movement of the lever but to start with, cut it according to figure 2.

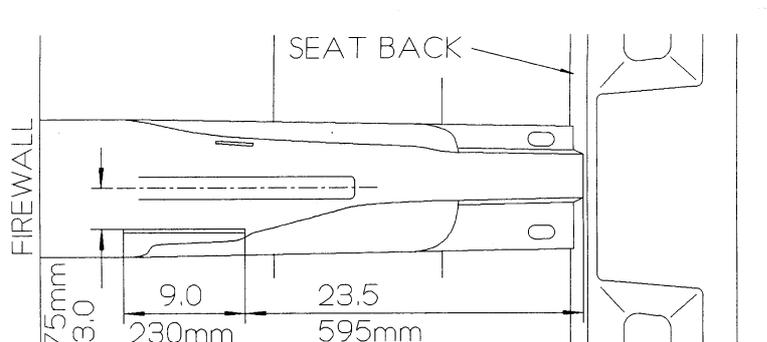


Fig 2. Position of retraction lever slot.



Step 3

The lever LG12 is to be sprung into gates filed into the guide slot and so is required to be bent slightly. Hold the first 50 mm (2") of the end of the lever which attaches to LG08 in a vice. Bend the lever enough so that, when a second bend to realign the lever is made, it is 10-13 mm (3/8" - 1/2") offset towards the aircraft centreline. The second bend should be made just before the elbow of the lever. Use soft jaws in the vice and make gentle bends in the metal.

Insert the lever LG12 through the slot and loosely bolt it with one AN4-6A bolt to the outboard side of the tongue of LG08P as indicated in figure 3. The bolt head should be inboard for clearance.

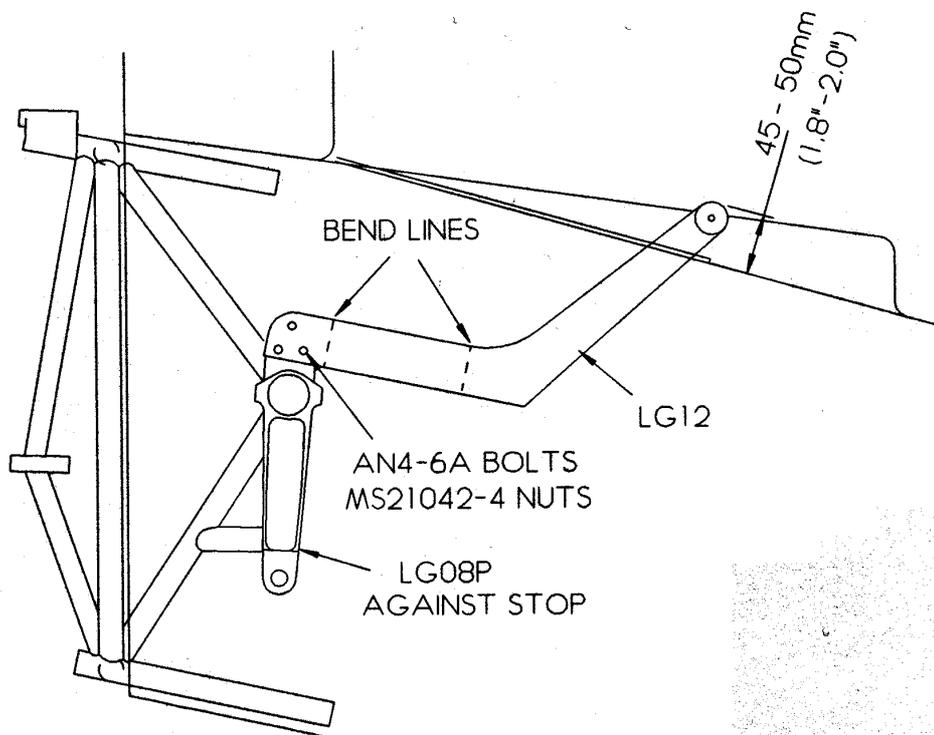


Fig 3. Fixing retraction lever LG12 position with LG08P.

Holding both LG08's against their stops on the landing gear frame, rotate the lever on its single bolt until there is a clearance under the handle of approximately 20 mm (3/4"); sufficient so that fingers will not get crushed between the handle and the top of the tunnel. Extend the slot as required.

Tighten the bolt and also clamp the lever to LG08P to ensure it doesn't move, then remove the temporary 6 mm bolt and remove the LG08P/LG12 sub-assembly. Using the holes in LG08P as a guide, drill the remaining two 1/4" diameter holes in LG12 and bolt LG12 to LG08P using AN4-6A bolts and MS21042-4 nuts. Reassemble the LG12/LG08P sub-assembly onto the shaft LG01A and finally fix it into position with a 6 mm roll pin. Discard the temporary bolt.

Step 4

Retraction lever guide plate

Using the plate FL24 provided drill the 4.8 mm diameter holes as indicated in figure 4.

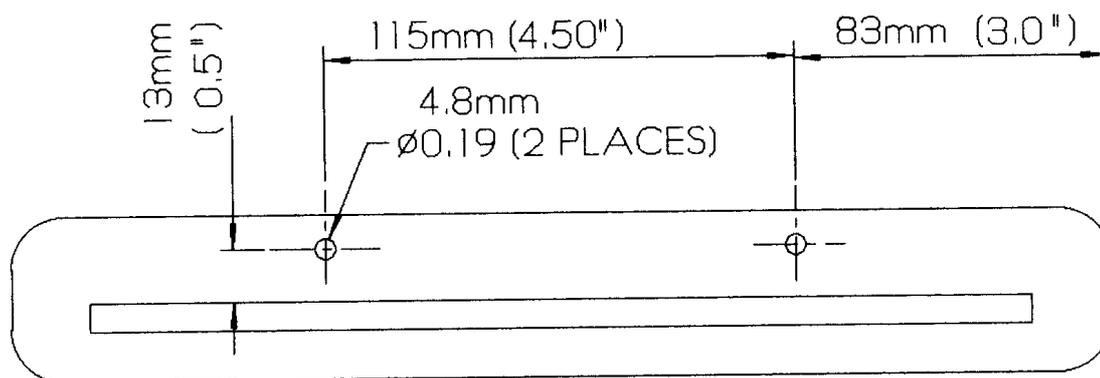


Fig 4. Slot dimensions for retraction lever guide plate.

The slot has already been cut, so you'll only need to square off the ends.

Remove the handle from the retraction lever to enable the plate to be placed onto it then, with the retraction lever fully back, move the plate forward so the rear end of the slot is just touching the lever.

Align the slot of the plate to be parallel to the aircraft centreline and drill through both tunnel and plate with a 4.8 mm drill and locate it with two AN525-10R16 bolts. Trim the port side of the plate to match the side of the cockpit module.



Down gate

Mark the plate where the front edge of the lever is, then noting that the forward edge of the lever is at an angle to the plate, file the gate to allow the lever in. Make the gate 7 mm (0.25") wide. See figure 5.

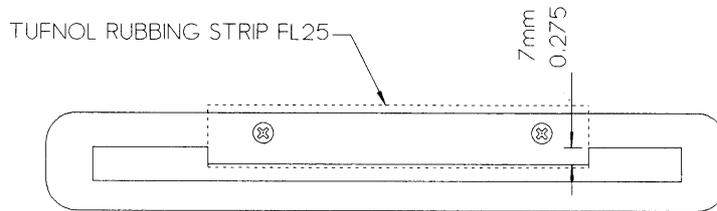


Fig 5. Retraction lever guide plate with gates.

Step 5

Up Gate

The maximum movement of the retraction lever from its down gate position is limited by clearance between it and the instrument module and the proximity of the shock absorber top reaction plate with the retraction arms LG08. Clearance for a hand to grip the handle should obviously also be taken into account. With the lever pushed forward as far as possible but with the necessary clearance with the instrument module, mark the plate in line with the lever's rear edge. Extend the length of the slot as necessary.

File the up gate to accommodate the lever and make sure the slot will allow the handle to move forwards an extra 5 or 6 mm. The technique used to moved the lever from the retracted to extended is to initially push it forwards slightly then sideways to disengage it from the gate.

Step 6

Rubbing Strip

To prevent the lever being damaged by metal to metal contact as it travels within the slot, a strip of 12 mm thick Tufnol is provided. Position the strip to the underside of the tunnel on to the inboard side of the slot such that it just pushes the lever away from the guide plate. Drill the two 4.8 mm holes through the Tufnol and bolt the guide plate and rubbing strip each side of the tunnel.

File the ends of the Tufnol strip to match the lever in each gate and so offer some extra support at these points.

When all is as it should be, remove the guide plate and rubbing strip and thoroughly abrade and clean all contacting surfaces then bond them back in place using Redux 420 adhesive. Fasten the bolts with AN970-3 washers and MS21042-3 nuts to hold everything in the correct position.

Safety latch

To avoid inadvertent retraction of the landing gear whilst on the ground, a safety latch is attached to the retraction lever which rotates into the guide slot and so prevents the lever from being moved out of the down gate. The latch should be free enough to rotate under its own weight and so drop into position without assistance. A positive action is required however, to enable retraction to take place. A simple action with one finger moves the latch out of the slot to allow the retraction lever out of the gate. Figures 6 and 7 show the end of the landing gear retraction handle with the latch in the “safe” and “unsafe” positions.

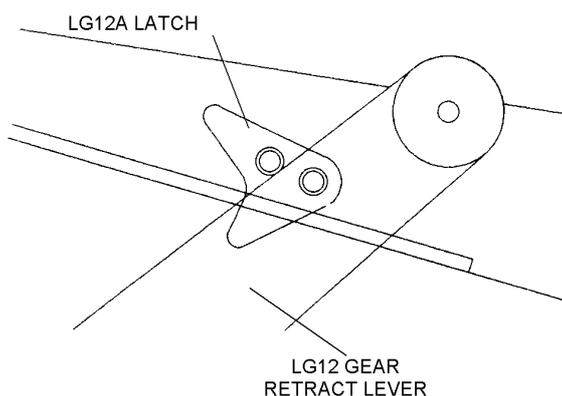


Fig 6. Gear down and locked.

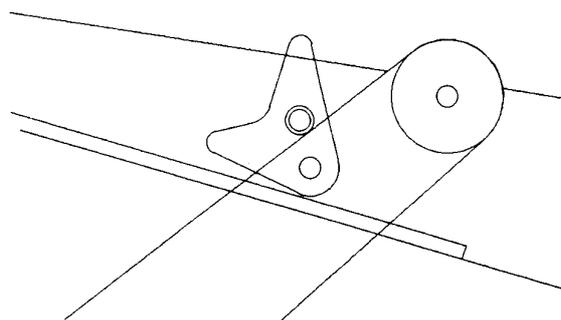


Fig 7. Gear unsafe.

Referring to inset illustration in figure 14, install the stop in the latch then, with the retraction lever in the fully down position but not in its gate, set the latch beside it with its stop against the retraction lever's front edge. Clamp it in place and drill through the lever with a 4.8 mm drill.

Remove the latch from the retraction lever then open up the pivot hole *in the latch only* to 1/4" diameter.

Install the latch to the port side of the lever according to figure 14.

Flap actuating cross-tube installation

Step 7

Mounting the cross-tube

Clean the rim of both GE12E bearings and bond each, using Loctite 638, into a thoroughly cleaned bearing housing FL17.

Next, push the bearing housings into the ends of the flap cross-tube FL15, don't bond them in at this stage. Refer to figure 9 at the end of this chapter.



The bearing housing serves two purposes; i) to hold the bearing in the end of the tube and ii) to prevent the ball swivelling further than a few degrees which makes insertion of the flap drive pin easier during rigging of the wings. The self-aligning ball is necessary as, when the flap operates, the flap drive pin alters its relative angle to the tube.

Step 8

The next step is to support the cross-tube on the flap drive pins with the wings rigged to the fuselage. Before this can be done, however, curved slots through the fuselage sides for the cross-tube will need to be cut.

Note : *Any scribed lines found on the fuselage sides indicating the curved slots for the flap cross-tube should be ignored.*

Rig the wings to the fuselage and mark the arc of the flap drive pin centre on each side of the fuselage from fully retracted to approximately 27° down.

Mark each side of your line to allow sufficient space for the cross-tube to pass through with about 3-4 mm clearance each side. Cut the slot at the flap-retracted area first, extending it as required to allow full movement of the cross-tube.

With the slot cut, hang the cross-tube on the flap drive pins, with the twin lugs that are near the centre of the tube on the *starboard* side and set the flaps to the retracted position using your wing template. There should be a small clearance between the bearing in the cross-tube and the flap root rib. Without a clearance, the flaps will be pushed outboard as they retract. Cut the cross tube as necessary. When you're happy with the length of the cross-tube, bond in the bearing housings FL17.

Step 9

Hinge arm slots

To determine the slot positions for the hinge arms and brackets to pass through the fuselage bottom skin, slide the hinge arms FL16 between the pairs of outer lugs on the cross-tube and clamp them so that they touch the fuselage floor. Checking that there is equal clearance at the flap root each side of the cross-tube, mark a line on the floor on the outboard side of each hinge arm. This marks the outboard edge of the slots. Extend these lines from the baggage bay rear bulkhead 90 mm (3-1/2") aft ensuring they run parallel to the centreline. Mark a second line 15 mm (5/8") inboard of and parallel to these lines to define the slot width. Cut out the material between the lines to make the two slots for the hinge arms and brackets. See figure 8.

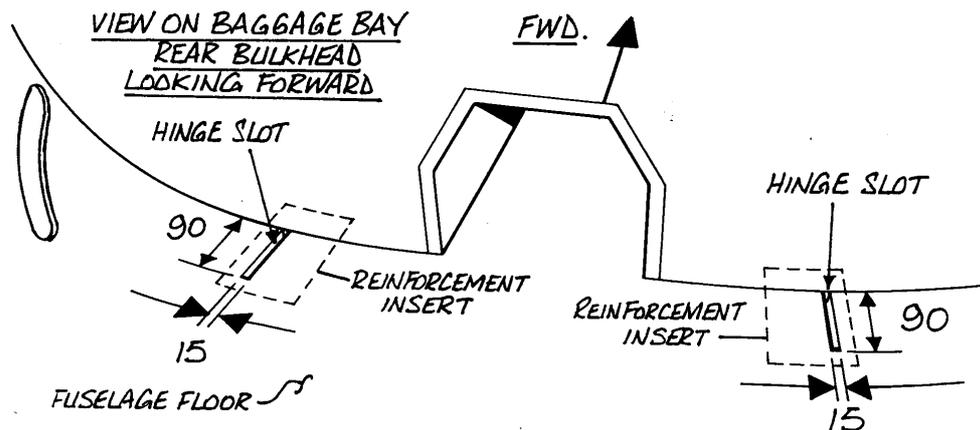


Fig 8. Slots through fuselage floor for cross-tube hinges.

Step 10

Trial set-up with hinge brackets

Pass the hinge brackets FL18P and FL18S through the slots in the floor so that each bracket's mounting flange is pointing inboard, and is therefore over the reinforcement inserts. The brackets' horn is oriented forwards.

Note : *The P and S of the part numbers indicate Port and Starboard.*

Install an AIC 040604 bearing in each cross-tube hinge arm FL16 with Loctite 638 then attach them to the brackets according to figure 9 which is to be found at the end of this chapter.

With the flaps up check that the brackets FL18 are where they should be by swinging the hinge arms up to engage between the lugs on the cross-tube.

Make any necessary adjustments to the slots in the fuselage floor then mark lines on the fuselage floor to help re-position the brackets later.

Step 11

Hinge bracket installation

Remove all the parts from the slots then scuff sand the underside of the brackets' flanges and the fuselage floor, where they will be in contact, in preparation for bonding. Don't rub off the reference lines though.

With the wings rigged to the fuselage and all retaining pins inserted, remove the inboard flap hinge pivot bolts and thread a string through the holes of both inboard flap hinges and both cross-tube hinge brackets.



Important: The hole centres of both hinge brackets must be lined up, as close as possible, with the hole centres of the inboard flap hinge holes.

If required, remove material from the slot in the fuselage to allow for correct alignment. Prepare any shims or wedges that may be required to set the brackets in their correct position.

The brackets must be set up as shown in figure 10, both being parallel to each other and with both mounting flanges level with each other.

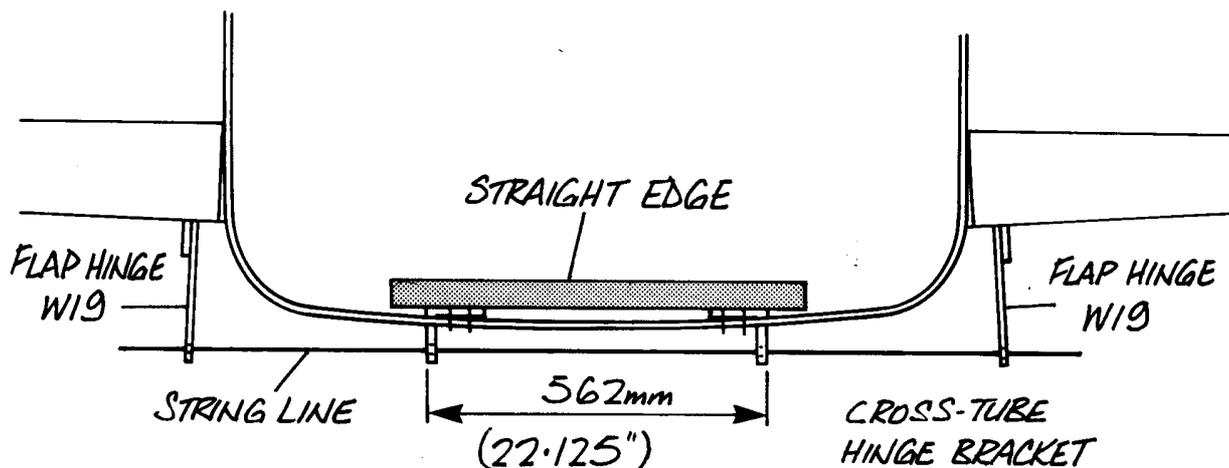


Fig 10. FL18 brackets viewed from behind.

Step 12

When you are satisfied with the set up for the brackets, mix up some Redux 420 with flox and bed them in place on the fuselage floor, ensuring the correct position is re-achieved before allowing them to cure fully.

The edges of the slots which are not covered by the brackets should be sealed with flox. First push the exposed foam between the skins back a few millimetres, then trowel the flox in. Don't disturb the set up of the brackets if you decide to do this at the same time as bedding in the brackets.

Step 13

After cure, drill through the four holes in each bracket right through the fuselage floor with a 4.8 mm drill. Install AN525-10R16 bolts in each hole from the underside, with an AN970-3 washer under the bolt head to spread the load. Use an AN960-10L washer under each MS21042-3 nut.

Remove the string from the hinge pivot holes and replace the bolts that were removed from the flaps. A section through the hinge pivot to remind you of the assembly sequence is shown in figure 11.

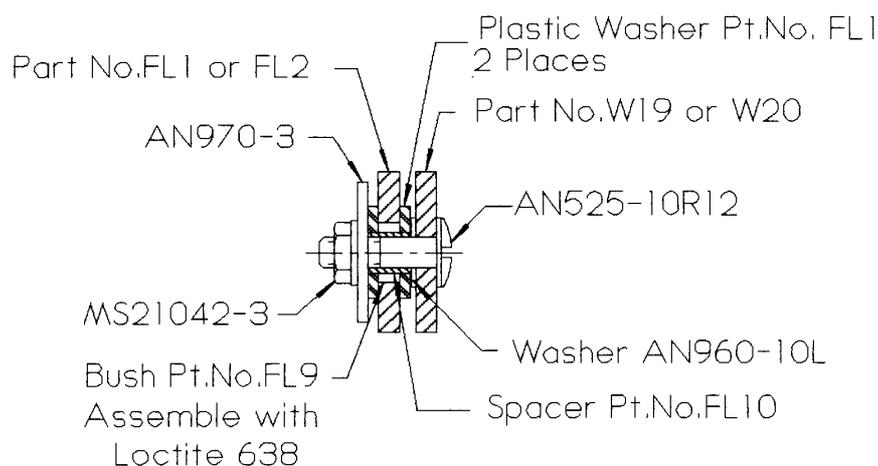


Fig 11. Section through flap hinge pivot.

Step 14

Attach the hinge arms FL16 to the brackets FL18 then swing them up to engage between the two pairs of lugs that are welded to the cross-tube, rotating the tube so that the lugs and the hinge arms are in line. Clamp the lugs and hinge arms together then, using the two small diameter holes in each lug as a centre, drill right through with a 4.8 mm drill. Insert an AN3-5A bolt in each hole and reposition the clamp if necessary before drilling the second hole then, placing on an AN960-10L washer, tighten each bolt up with an MS21042-3 nut and remove the clamps.

The flaps will now extend and retract together and only require linking to the landing gear retraction mechanism.

Step 15

Push-rod

Install an AN490-HT-11P end fitting to each end of the push-rod FL20 according to figure 12.

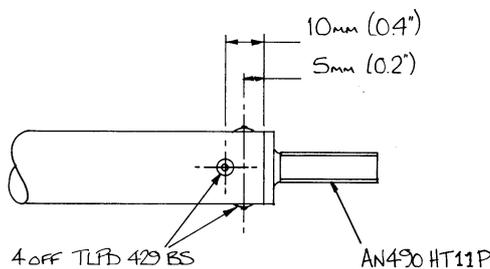


Fig 12. Push-rod end fitting attachment.

Placing on an AN316-5R check nut first, screw on an MW5 rod-end to the end of the push-rod with the long straight length of tube, and a 175-601-208 fork end to the other end.



The rod-end engages between the two lugs of the flap cross-tube, according to figure 13, with the push-rod going forwards and angled down from this point. The push-rod then angles upwards to go over the top of the pitch torque tube CS10, then runs along the starboard side of the wheel well. Once clear of where the main wheel tyre will be when retracted, it cranks in towards the centreline to avoid the brake master cylinder before attaching to the flap actuating horn. Install the bolt temporarily for now.

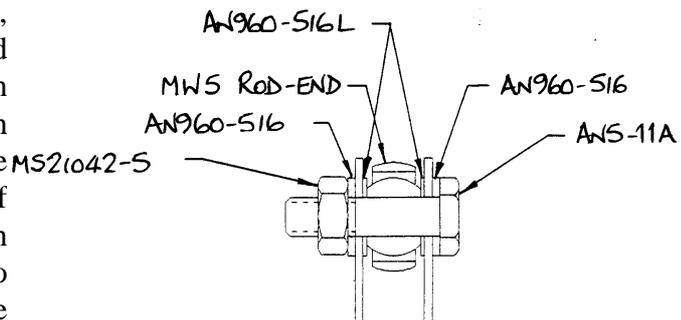


Fig 13. Section of bolt and washer arrangement for rod-end.

Step 16

Flap actuating horn

The flap actuating horn is made up of two plates, one of which is bolted to the outside of the starboard landing gear retraction arm LG08S.

Install an AIC 040604 bearing into the horn FL21 with Loctite 638 and then bolt the horn to the outside of the plate FL19 as shown in figure 14 found at the end of this chapter.

Bolt this assembly to the outside of the LG08S (Starboard side). To ensure clearance when LG08 rotates, each bolt must be oriented with its head inboard.

Leave the bolt attaching FL21 to FL19 loose enough to allow it to pivot and, using a clamp, fix it into the approximate mid position. After the final position has been established another bolt will hold the two parts securely together.

Note: You will need to chamfer a small area of FL19 to allow clearance between it and the landing gear mounting frame when the LG08's are moved to the landing gear retracted position. The approximate position of this chamfer can be seen in figure 14.

Setting up

The object of the following exercise is to set the flaps so that when the landing gear is extended the flaps are down at 26°-27° and just beyond the point at which the outriggers latch down and when the flaps are retracted the landing gear retraction lever is located in its up-gate. Do not expect both latches to engage simultaneously.

Step 17

Extend and fix the flaps to a position past the point where the outriggers have latched down and where the bolt attached to the outboard flap hinge FL3 has moved approximately 4 to 6 mm (3/16" to 1/4") along the slot in OR5. Whatever you do, don't file the slot in OR5 to achieve this gap. If you do, the outriggers will not fully retract when the flaps are up.

The flaps should have moved through an angle of 26°-27° down from the retracted position. Do not exceed 27°.

With the LG08 arms in contact with the stops on the landing gear mounting frame, temporarily connect the flap actuating push rod to FL21 with its pin. Adjust the total length of the push rod by screwing the fork and rod-end in or out equal amounts.

Now move the retraction lever into the up gate position. If you're lucky, the flaps will have moved to their fully retracted position. Confirm this using your wing root template.

If the flaps are not fully retracted with the retraction lever in the up gate the flap actuating horn FL21 will have to be rotated to increase the distance between the fork attachment pin and the rotation centre of LG08. Figure 15 may help to clarify the principle.

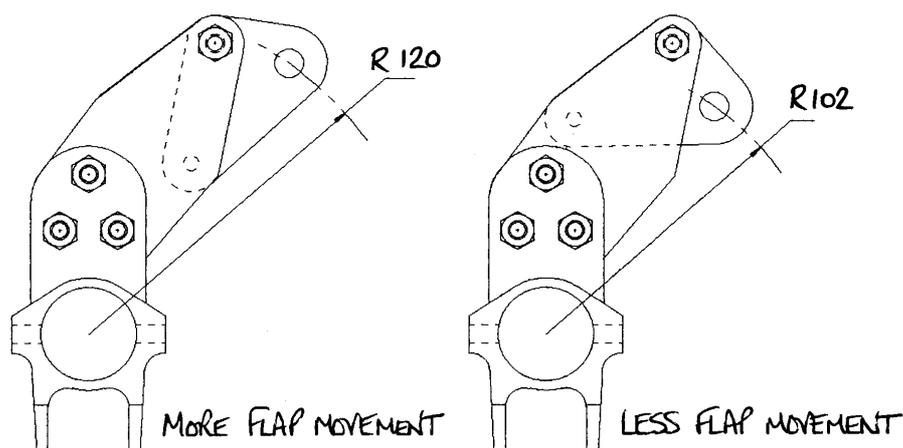


Fig 15. Positioning flap operating horn FL21.

This adjustment will increase the total angular movement of the flap but also cause the push-rod to extend the flap slightly so the original flaps down position will require re-setting by shortening the push-rod.

Conversely, if the flaps reach their fully retracted position and the retraction lever has not reached the up gate, FL21 will need to be rotated to decrease its effective radius of rotation. Again, the push-rod length will require altering and the original flaps down position will need to be reset.



Step 18

Once the correct relationship between retraction lever and flap has been found, remove the FL19/FL21 assembly from LG08S without removing the clamp or the bolt holding the two parts together. Tighten up the bolt, then, using the spare hole in FL21 as a guide, drill through FL19 with a 4.8 mm drill and install an AN3-6A bolt and MS21042-3 nut then remove the clamp.

Reinstall the flap operating horn assembly to LG08S and reconnect the push rod.

Now make a final check of the flap movement to ensure nothing has changed.

Clearance between the push-rod and the underside of the centre tunnel, the pitch torque tube CS10 running behind the seats and the starboard wing's spar is limited. Keeping the overall length of the flap actuating push-rod unaltered, adjust the rod-end and fork positions such that there is approximately equal clearance between each of the parts mentioned, checking also that nothing touches during actuation.

Remember to tighten the check-nuts afterwards.

Step 19

Flap root extension

When you made the flaps, one of the first things you did was put aside the root portion of the foam core. If you can still find them, now is when they become useful.

With the flaps retracted, fit the foam cores to the flap root, carving it away as required to clear the fuselage side. Add foam in the places that don't quite reach the fuselage side then attach the core, with the trailing edge support block still in place, to the end of the flange with rapid epoxy.

Remove the flaps from the wings and, with the foam covered in peel ply, layup 2 plies of 'bid' over the outside of the foam, lapping about 2 cm (1") onto the flap root flange. You will need to do the outside skin in two stages to achieve the 'glass to glass' trailing edge as on all the control surfaces.

After cure, trim the layup then dig out the foam, removing the peel ply, then layup 2 plies of 'bid' on the inside of the flanges, again lapping onto them about 2 cm (1"). Use floc where the two layups divide each side of the flap root flange to prevent air bubbles forming.

After cure, trim the edges to leave you with a 5-10 mm (1/4") gap between the flange extension and the fuselage.

Finally, cut an inspection hole of about 25 mm (1") diameter through the top of the flap root flange directly above the flap drive pin. This enables sighting the engagement of the pin into the flap drive cross-tube whilst rigging. A perspex window could be bonded into the hole if desired.

Baggage bay rear bulkhead

Step 20

Preparation

The moulding for the baggage bay rear bulkhead and floor (part no. F02A) incorporates joggles for two compartments under the floor, and for the rear fuselage access panel (part no. F08).

The 'D' shaped access panel which fits into the rear bulkhead is fitted with seven bolts: four along the base flange and three around the upper flange.

Mark out the hole centres on the panel so that they are approximately 13 mm ($\frac{1}{2}$ "') from the edges and spaced equidistantly. See figures 16.

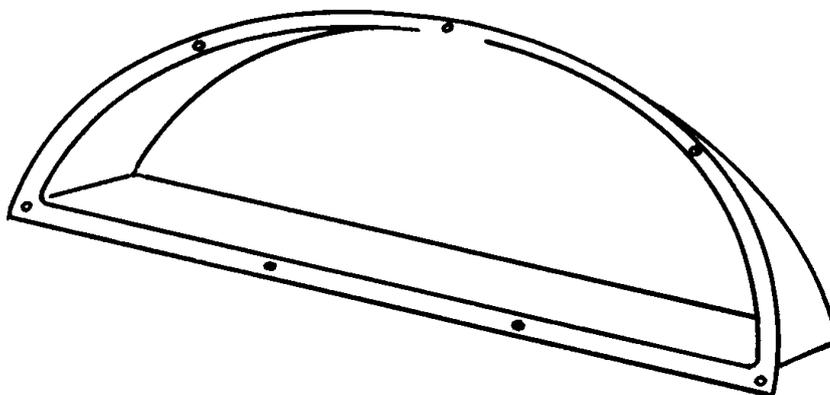


Fig 16. Fastener holes in rear access panel F08.

Position the panel in the aperture in the rear bulkhead and secure it with tape. Drill through both the panel and the rear bulkhead with a 4.8 mm drill at each of the seven hole centres. Remove the panel and install MS21047-3 anchor nuts on the rear side of the bulkhead using TAPK33BS rivets. Don't omit to countersink the glassfibre flanges for the rivets with a drill.

Countersink the forward face of the holes in the panel with a drill to accept NAS1169C10 Tinnerman washers. The panel is now ready for installation using MS24693-S272 screws.

The two access panels in the baggage bay floor are made from 3 mm plywood. Cut out the plywood to match the joggles in the moulding, and, using a similar technique to that for the panel above, fit the plywood using four screws, one in each corner.

Installation

The front flange of the bulkhead fits over the rear of the cockpit module. The first job is to cut away the centre of the bulkhead front floor so that it matches the rear of the cockpit module.

To support the weight of baggage and to stiffen the floor four 3mm thick plywood support ribs are fitted underneath the floor. The positions are shown in figure 17.

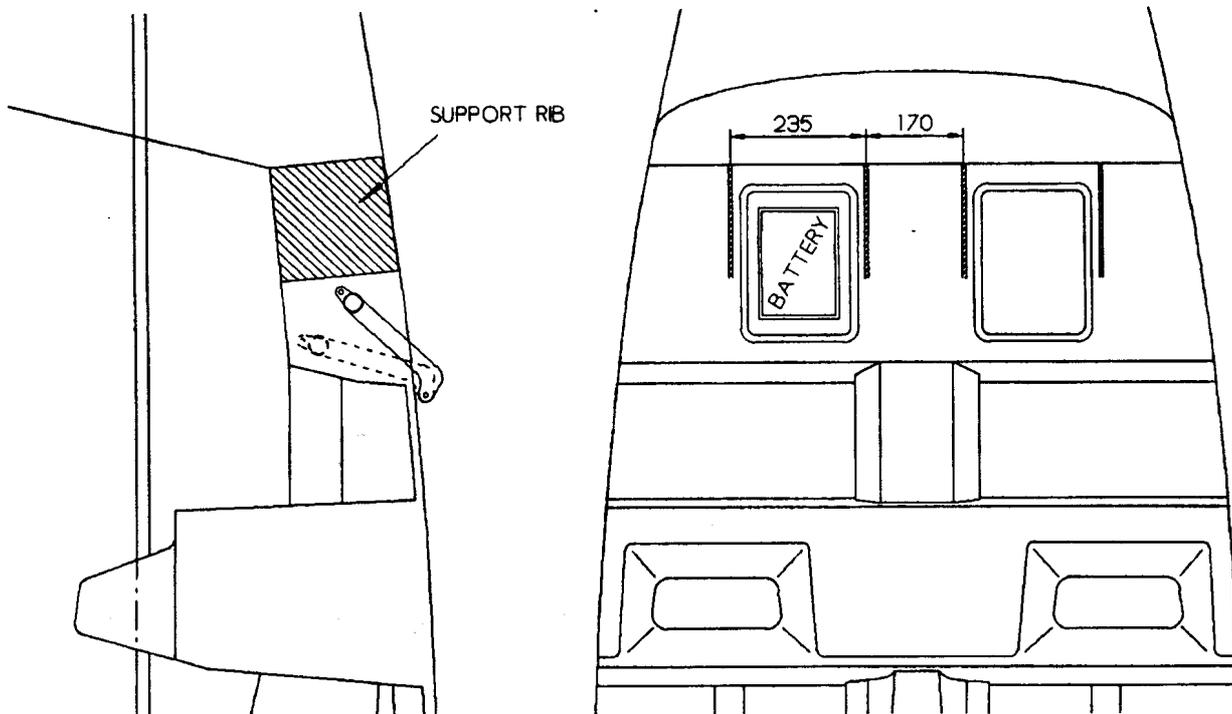


Fig 17. Baggage bay support ribs.

The ribs are to be fitted to the rear of the panel to ensure clearance for the operation of the flap drive cross tube.

Trial fit the bulkhead in place and measure the height of the ribs. Cut out the ribs approximately 3 mm (1/8") less in height than the measured figure and 20 cm (8") long, then layup one ply of 'bid' at $\pm 45^\circ$ onto each side. Scuff sand the areas of the underfloor / baggage bay floor where the ribs will fit. Attach the ribs to the bulkhead with a Araldite 420/flox mixture. After cure the joint should be reinforced with 2 plies of bid at $\pm 45^\circ$ lapping onto the ribs and bulkhead by 25 mm (1").

Scuff sand all the areas where the bulkhead will fit onto the fuselage and onto the rear of the cockpit module section of the baggage bay.

Drill and cleco the bulkhead front flange onto the rear face of the cockpit module. Remove the clecos and bond the bulkhead onto the cockpit module with Araldite 420/flox; fit the clecos or use rivets to hold the items securely whilst the adhesive cures.

Layup 2 plies of 'bid' onto the bottom of the floor support ribs, lapping them onto the fuselage floor and ribs by 25 mm (1"). Also layup 2 plies of 'bid' each side of the join between the fuselage and the rear baggage bay bulkhead, lapping them onto each by 25 mm (1").

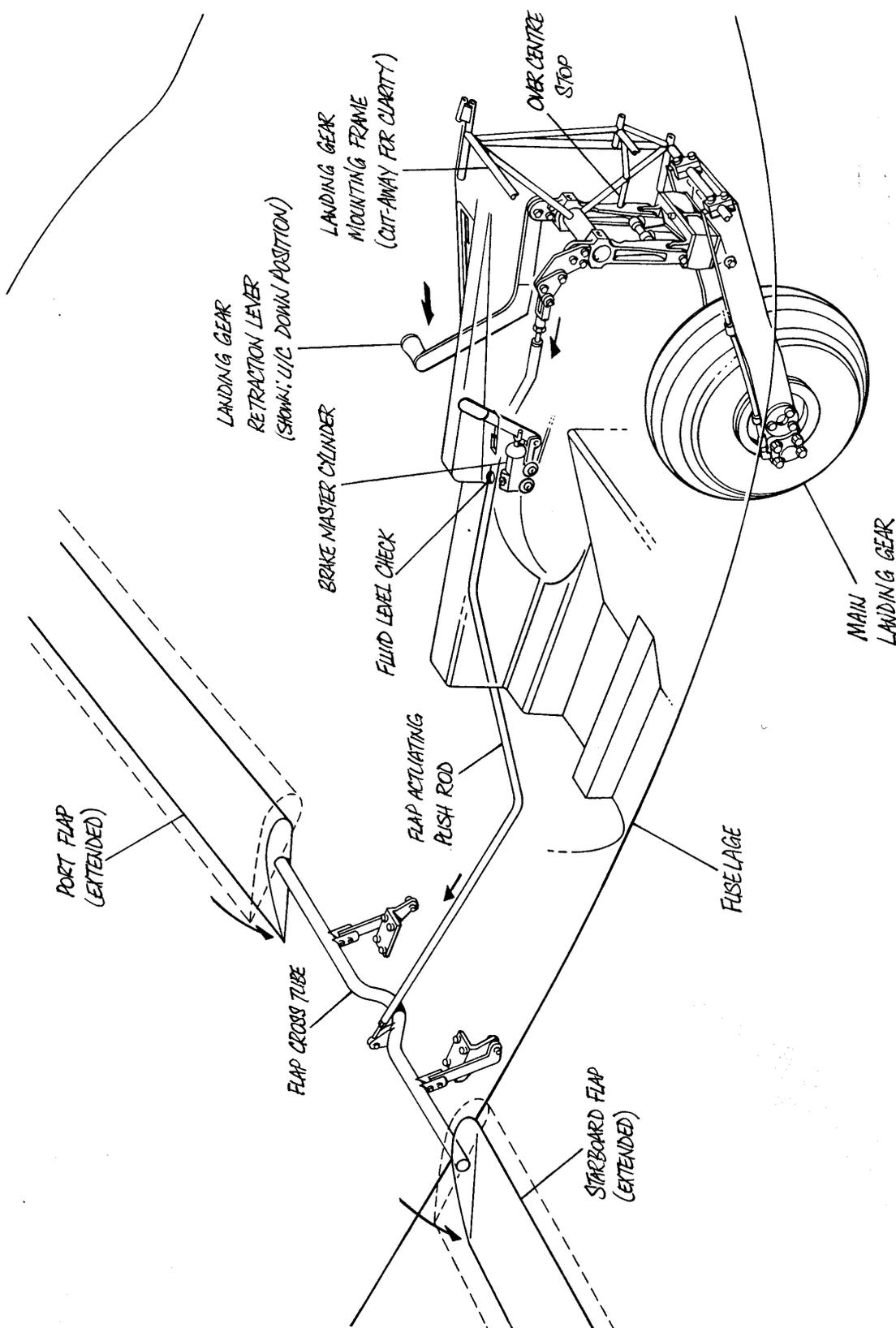


Fig 1. Flap / landing gear operating mechanism G.A.

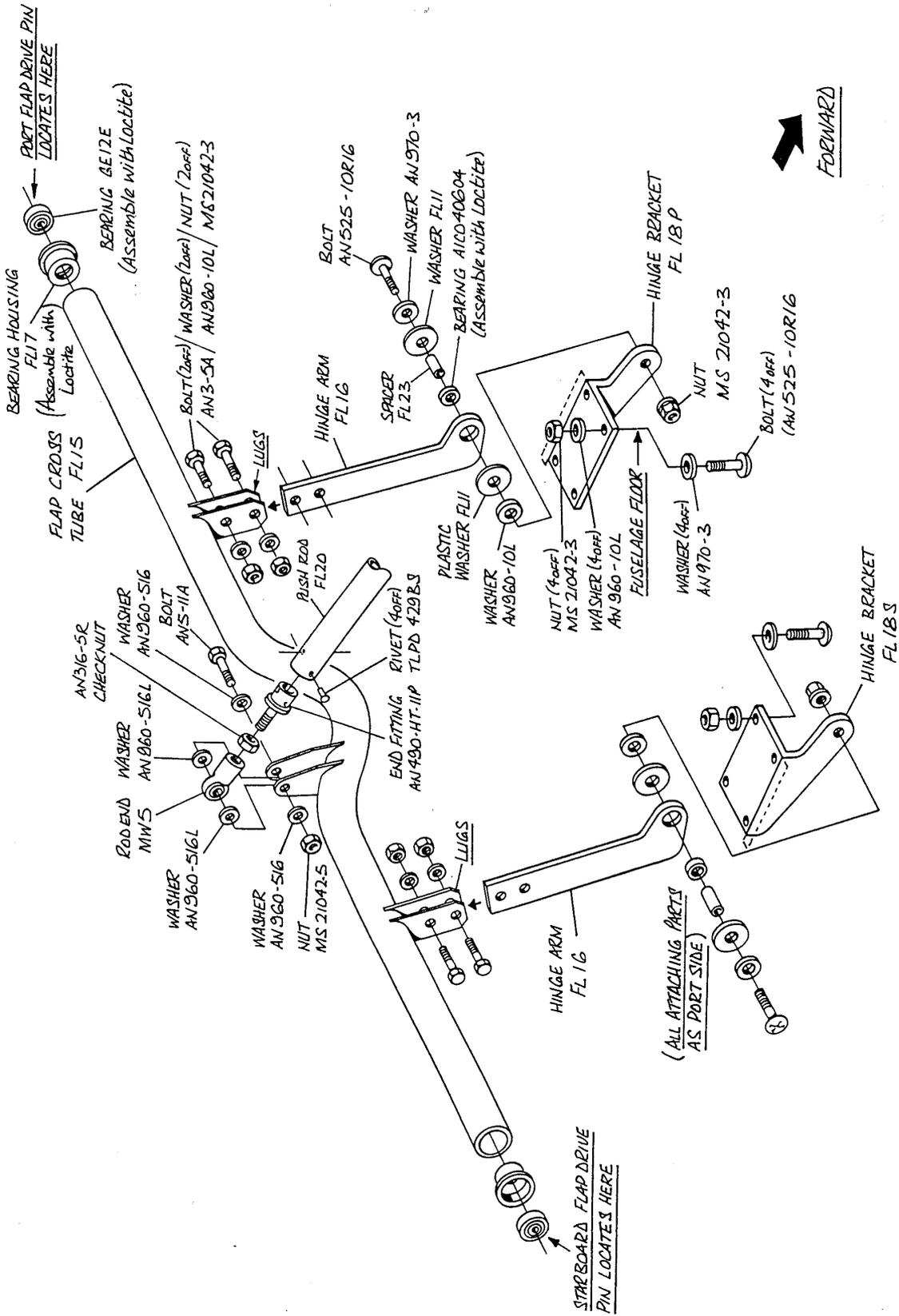


Fig 9. Flap operating cross tube and hinge assembly.

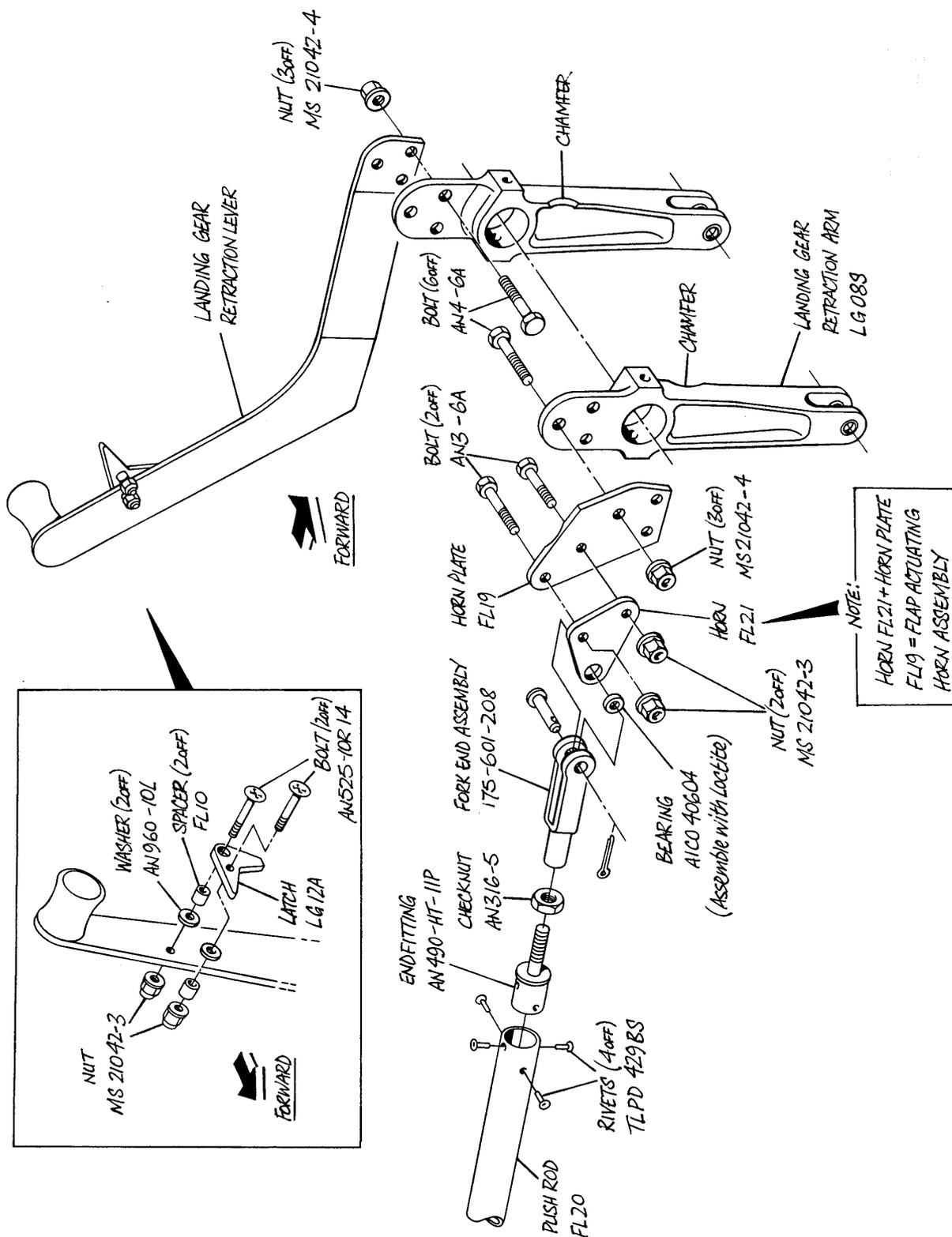


Fig 14. Retraction lever and flap actuating horn assembly.



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