ALIGHTING GEAR

Reference:- AP 4505 B Vol 1
AP 1803 E (Dowty u/c Equipment)
AP 2337 A (A/c wheels and tyres and brakes)

1. Introduction

The alighting gear consists of - Two main wheel units.
One nose wheel unit.

The main wheels retract - Forwards and upwards.

The nose wheel retracts - Rearwards and upwards.

All units retract into compartments which are enclosed by doors when retraction is completed.

Main wheel compartments - Outboard of C/Section transport rib, from front spar of inner mainplane to approximately half way aft towards the rear spar.

Nose wheel compartment - Aft of the rear pressure bulkhead, to a bulkhead at the forward end of No.2 tank.

The main wheels are fitted with plate type brakes. The nose wheel is fitted with steering mechanism and centring jack.

2. Main Undercarriage Unit

The main undercarriage unit consists of the following components:-

a. Mag. alloy main fitting. Incorporates:- Internal sliding tube, bogie trim jack. The fitting is pivoted on bearings attached to the airframe.

b. Trailing bogie frame. Incorporates:- Front and rear axles, four plate type brakes, four mag alloy wheels each with two tubeless tyres.

c. Drag link. Forward of the main pivots, to which is attached the upper ends of two converging bracing tubular struts.

d. Two bracing tubes. Connected at their lower end to an upper universal joint formed by the down lock strut and the drag strut, and by their upper ends to item c above.

e. Tubular lower drag strut. Extends downwards in front of main fitting, from the upper universal joint to a lower universal joint at the lower end of the main fitting.

f. Fluted down lock strut. Extends aft from upper universal joint to a down lock assembly on top of the main fitting.

g. Retraction jack. Attached at its cylinder end to the inboard stubpin bearing of the drag link (item c.), and at its piston rod end to an extension lever on the inboard pivot of the main fitting. A shuttle valve provides for emergency air operation.

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h. Liquid spring shock absorber. Is connected between the centre of the bogie frame and a lug on the rear face of the main fitting, with its associated separator unit and recuperator valve.

j. Down lock assembly. Incorporates:- two slide plates, toggle mechanism, slide bearings, down lock jack and shuttle valve for emergency air operation.

k. Door and fairing. To enclose wheel compartment when complete undercarriage assembly is retracted. The main door is secured by four hinge arms to the outer wall of the undercarriage bay and are closed by two hydraulic jacks AFTER the undercarriage has been correctly stowed, and, only partially seal the compartment. A rectangular fairing attached by its hinge to the bulkhead at the aft end of the undercarriage bay, and by spring loaded struts to the rear face of the main fitting, complete the enclosure. A hinged spring loaded flap on the rectangular fairing allows the downlock strut to pass through the fairing on undercarriage retraction.

l. Side load strut. Mounted above the main fitting diagonally, and is fitted to cater for side loads, particularly when the aircraft is being turned on the ground.

NOTE:
The Port and Starboard main fittings are NOT interchangeable due to the 'handing', of the extension levers.

The bogie frame is attached to the base of the sliding tube by the front axle which is in turn secured in the sliding tube by a pin. The sliding tube is held in the main fitting by a bearing ring abutting the lower bearing. The ram end of the bogie trim jack is attached to the down lock assembly side plates, the body is connected to the sliding tube by a bayonet type fitting.

The rear axle is attached to the bogie frame by two pins. Each brake is held in position on the axle by a steel collar and pin. The front brakes are prevented from rotating around the axle when a braking effort is applied by an attachment to the sliding tube. From these attachments, two connecting rods run aft to each of the rear brake units to prevent their rotation about the rear axle. Bogie frame rotation is prevented by torque link attachment to the main fitting, lower forward face.

3. Operation.

Three jacks are operated to retract or lower each unit:-

(i) Main retraction jack.

(ii) Bogie trim jack.

(iii) Down lock jack.

4. Retraction

On extension of the sliding tube and torque links, on take-off, the torque links micro-switch is made which energises the lever lock solenoid of the pilots UP selector. On selection of UP, the down lock jack lifts the joint between the associated toggle plates, allowing the roller to be lifted clear of the down lock strut. Simultaneously, the retracting jack is extended causing the leg to rotate forward about the main pivots. The retracting strut assembly folds at the upper universal joint

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during this movement, towards the rising leg and the lock strut is pushed aft through the down lock assembly, also, the bogie trim jack is shortened and the sliding tube is consequently raised, causing the bogie to pivot about the shock-absorber attachment until it is in line with the main fitting. This places the bogie assembly in the correct attitude for stowage into the compartment.

On complete retraction of the sliding tube, a micro-switch is made, which, in series with a micro-switch that is made when the undercarriage is correctly stowed in the compartment, energises the main door selector to close the door. The shock-absorber remains fully extended, the correct pressure being maintained by the separator and recuperator valve.

A permanent hydraulic selection maintains the undercarriage in the UP position.

5. Lowering.

On selection of DOWN, the door selector only is energised to open the door, which when fully open, makes a micro-switch which allows the retraction jack to contract and lower the leg. Simultaneously, oil is expelled from the bogie trim jack allowing its compressed air charge to extend the sliding tube assembly to the landing position. In addition, the down lock jack movement is reversed but cannot operate until the lock strut has been withdrawn which occurs when the leg is down. The centre and rear links align and a thrust is applied to straighten the retracting strut and lock the unit down.

6. Indicator Lights

An undercarriage indicator on the pilots centre instrument panel shows GREEN lights for undercarriage LOCKED DOWN, RED lights for undercarriage UNLOCKED, and NO LIGHTS for undercarriage UP and main door CLOSED.

7. Shock absorber recuperation

When the shock-absorber is fully extended, i.e. the aircraft weight is off the wheels, any drop in pressure in the shock-absorber is made good by fluid forced in by hydraulic pressure applied to the floating piston of the separator, at 1500 psi. The fluid in the shock-absorber (O.X.16) when compressed by the landing load, is prevented from causing an excessive back pressure into the separator, by the recuperator valve which acts as a non-return valve between the shock-absorber and the separator, thus sealing off the connection between the two. Therefore, the whole of the weight of the aircraft is taken by the shock-absorber as the effect of the bogie trim jack, due to its relatively low pressure, is negligible. When the shock-absorber is fully extended once again, and the oil pressure drops to less than 1500 psi, i.e., due to a leak in the unit, the recuperator valve will open under the influence of the separator piston and allow topping up to take place, and prepare the shock-absorber for taking the aircraft weight. On aircraft with Mod 1280 embodied, the recuperator valve is opened by hydraulic pressure on an UP selection.

8. Bogie Action

On landing the rear wheels of the bogie contact the ground first. This causes the shock-absorber to compress until the front

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wheels are also in contact with the ground. All the braking effort is then transferred through the tyres, wheels and brakes, then to the brake connections on the main fitting, therefore, the axles and bogie frame are not subject to brake torque.

9. Door Operation

When each door closes, the two door hooks automatically engage with their respective catches. On a down selection, the door jacks begin to extend along the slots in their attachment brackets causing the hooks to be withdrawn from their catches. Further jack extension then opens the door.

10. Nose Undercarriage Unit

The nose undercarriage unit consists of the following components:-

a. Mag alloy main fitting. Accommodating a pivot bracket assembly, complete with hydraulic steering and centring components.

b. Pivot bracket. Accommodated inside the main fitting and to which the body end of the shock-absorber is attached.

c. Lever arm. Incorporates:- The live axle assembly carrying two wheels, and is secured between the two lugs at the base of the pivot bracket by a large diameter pivot pin at its forward end, and by its centre to the shock-absorber ram end.

d. Steering lever. Splined on to the top of the pivot bracket inside the main fitting, and attached to the steering motor by a pin.

e. Steering motor. Attached to the rear face of the main fitting by trunnion mountings at the motor body, the ram of which passes through the main fitting to the steering lever.

f. Crank body. Attached to the top of the pivot bracket inside the main fitting by five bolts. An extension tube mounted vertically on the crank body plate, connects to the follow-up tube. A further stub pin on the crank body accommodates the ram end of the centring jack.

g. Centring jack. Attached by its body end to the inside of the main fitting and by its ram end to the crank body.

h. Follow up mechanism. Attached to the rear face of the rear pressure bulkhead complete with retraction link and follow up tube, which in turn connects to the extension tube of the crank body, by a sleeve coupling and two shackle pins.

j. Retraction strut. The port and starboard upper retracting struts connect at their upper ends to a cross shaft. The single lower retracting strut is hinged on a pin which joins the lower end of the two upper struts, and at its lower end to a pin bolt to the tubular drag stay.

k. Drag stay. Attached at its lower end to lugs on the main fitting, aft face. The upper end of the stay is bolted to the lug of a Y-member, and to the extension of the Y-member/drag stay connection is attached to the lower retraction strut.

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l. Y-member. Attached by the forks of the Y to two lugs, one on either side of the top of the main fitting, and at the base of the Y to item k.

m. Latch tube. A spring loaded tube extending from a lever at the end of the torque tube mounted on the cross shaft, to the down lock latch mounted between the lower ends of the two upper retracting struts.

n. Retraction jack. Mounted vertically, its body end being attached to the jack lever on the torque tube, and at its ram end to a lug on rear face of the main fitting, port side.

o. Cross shaft. Mounted laterally above the main fitting and is pivoted between bearings attached to the rear pressure bulkhead bracing castings.

p. Doors. Two firing doors, each operated by a hydraulic jack, enclose the compartment when the undercarriage has been correctly stowed, and are attached by six hinge points along each side rail of the compartment.

11. Operation

Only one jack is used to retract or lower the unit.

12. Retraction

On selection of UP, the retraction jack begines to contract and imparts a limited turning movement to the torque tube concentric with the cross shaft. This motion causes the lever at the other end of the torque to pull the latch tube, which releases the down lock. Further movement of the torque tube brings the end of its slot into contact with a pin connected to the cross shaft. This causes the cross shaft to rotate and break the geometric joint between the upper and lower struts above the drag stay, and continued closing of the jack pulls the main fitting up to the retracted attitude. When the main fitting is correctly stowed, a micro-switch is made which energises the doors selector to close the doors.

A permanent hydraulic selection maintains the undercarriage in the UP position.

13. Lowering.

On selection of DOWN, the doors selector only is energised to open the doors, and when fully open, makes 2 micro-switches which will energise the nose wheel selector valve to extend the retraction jack. This lowers the nose wheel unit, the upper and lower struts above the drag stay are straightened, and final movement of retraction turns the torque tube which applies the geometric lock at the joint between the upper and lower struts.

14. Indicator Light

An undercarriage indicator, incorporated with the main undercarriage lights, on the pilots centre instrument panel, show GREEN light for undercarriage fully locked down, RED for undercarriage unlocked and NO lights for undercarriage UP and both doors closed.

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15. Door Operation

Hook-type latches, located at the forward and rear ends of the doors are provided for locking the doors in the closed position. The latches engage with rollers on the forward and rear bulkhead of the compartment. The operation of the latch mechanism is similar to that of the main wheel doors.

16. Nose Wheel Steering

The controlling device in the steering system is a drum switch which is a follow-up device by which pre-determined positions of the nose wheel unit can be selected by operation of the rudder pedals.

Movement of the rudder pedals is transmitted by a torque lever, attached to the rudder control rod, and thence the drum switch. The turning movement of the nose wheels is transmitted to a follow-up tube, which projects through a beam at the top of the main fitting and thence to a torque lever and connecting rod which is attached to the lower half of the drum switch.

17. Operation

The nose wheel steering can only function when the nose wheel is on the ground, due to a micro-switch located at the base of the pivot bracket and operated by a striker on the lever arm. On extension of the shock absorber, the lever arm rotates about its pivot to strike the micro-switch and so de-energise the steering circuit to render it inoperative. The centring jack will then align the undercarriage before entering the compartment.

When the steering button on either of the pilots' control handgrip is depressed, the steering/stop valve is energised to open, which allows fluid from the hydraulic system to pass to the steering selector valve. Movement of the rudder pedals is transmitted to the upper rotating half of the drum switch, which in turn, applied an electrical feed to the steering selector valve. The valve is opened and hydraulic pressure is directed to the selected side of the steering motor, and the wheels are turned to the selected position. The follow-up tube transmits the turning movement through the push-pull rod linkage, causing the lower half of the drum switch to rotate, until the upper and lower halves of the drum switch are again in alignment. The electrical feed to the steering valve is now broken, and movement ceases until a further slection is made.

18. Limitations

The maximum towing angle of the nose wheel unit, is 43 degrees either way.

MAIN U/C UNIT MICRO-SWITCHES

Name	Location	Purpose
1. Torque links m"sw (1 off) Pre Mod 1280	Bottom front face of main fitting under upper torque link (Striker on upper torque link).	In conjunction with a similar m"sw on the other main u/c, to energise the pilots UP selector button when the u/c's are airbourne.
Bogie m/sw Post Mod 1280	Sliding tube end assembly.	
2. Indicator light m/sw (1 off)	Rear of down lock assembly, on top of main fitting (Striker on rear link).	To indicate the condition of the u/c down lock mechanism. i.e. Locked - GREEN LIGHT Unlocked - RED LIGHT
3. Bogie trim m/sw (1 off)	Bottom outboard face of main fitting. (Striker on sliding tube end fitting)	In conjunction with m/sw No.4, to select, main door close, when the bogie frame has correctly trimmed.
4. U/c stowed m/sw (1 off)	On side load strut above main fitting cross shaft. (Lever operated by a paxilin cam on the cross shaft)	In conjunction with m/sw No.3, to select, main door close, when the unit has correctly stowed.
5. Door latch m/sw (2 off)	U/c bay in board rib wall (operated by the door latches).	To extinguish the RED LIGHT to a NO LIGHT condition when the u/c is UP and door is closed.
6. Door hinge m/sw (1 off)	Outboard face of u/c bay outboard rib (operated by forward hinge on main door).	To select u/c DOWN when the door is FULLY OPEN

NOSE U/C UNIT MICRO-SWITCHES

Name	Location	Purpose
1. Steering isolation m/sw (1 off)	Inside face of left hand lug of jacking bracket (Operated by striker on the lever arm assembly).	To isolate n/w steering when u/c unit is airbourne (and vice-versa)
2. Indicator light m/sw (1 off)	On geometric joint latch mechanism on retraction struts. (Operated by a striker on the latch).	To indicate the condition of the latch. i.e. Locked - GREEN LIGHT Unlocked - RED LIGHT
3. U/c stowed m/sw (1 off)	U/c bay, rear pressure B/H above main fitting (Striker on main fitting, upper rear face).	To select doors close when u/c is correctly stowed.
4. Door latch m/sw (4 off)	At each end of U/C Bay, centre (Operated by door latches, two per door).	To extinguish the RED LIGHT to a NO LIGHT condition when U/C is UP and doors are closed.
5. Door hinge m/sw (2 off)	One on each door hinge line at rear of u/c bay. (operated by a cam).	To select u/c down when BOTH doors are FULLY OPEN.

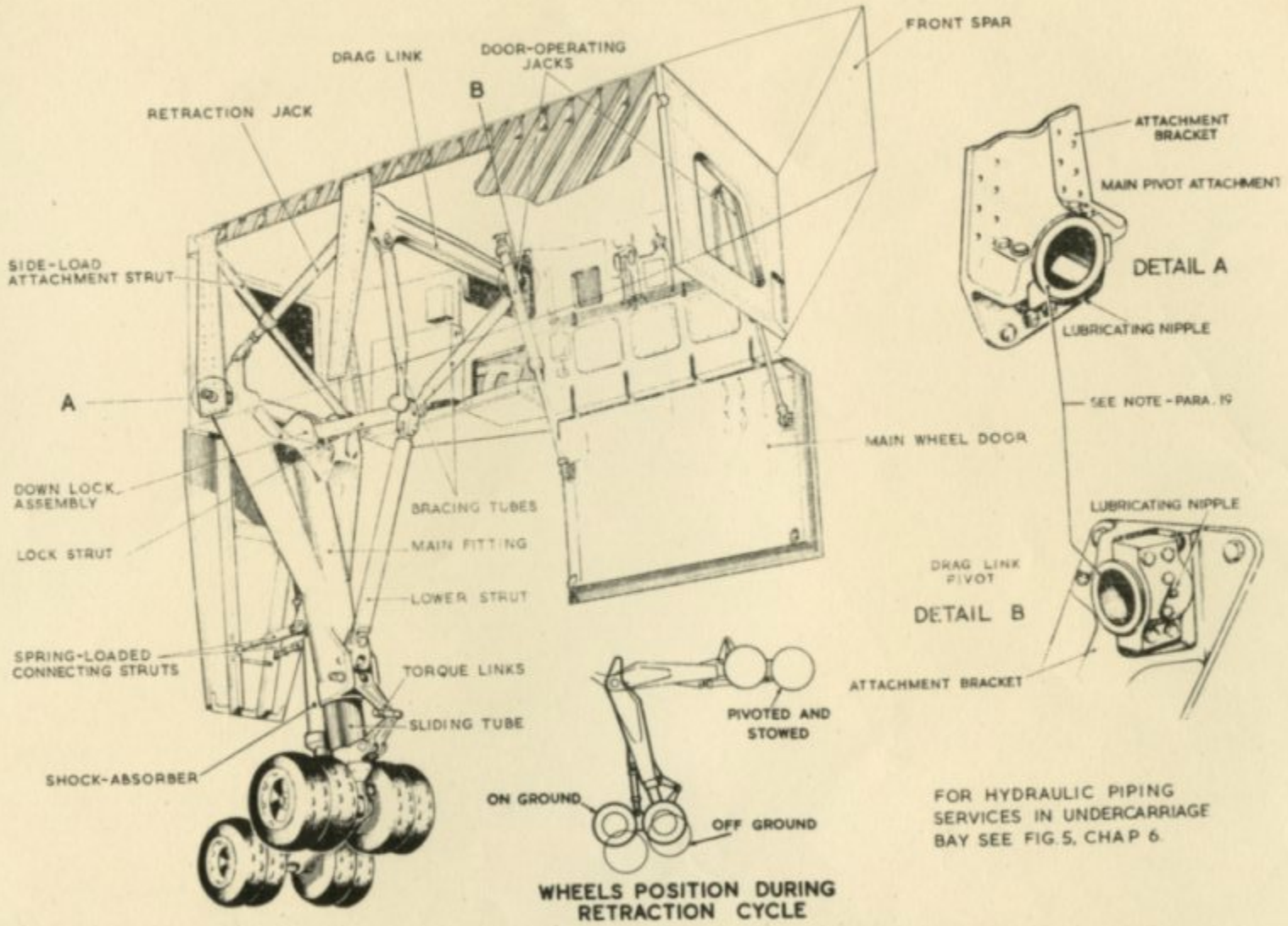
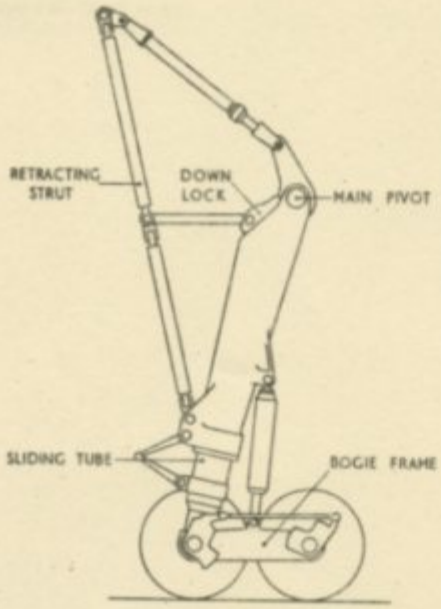
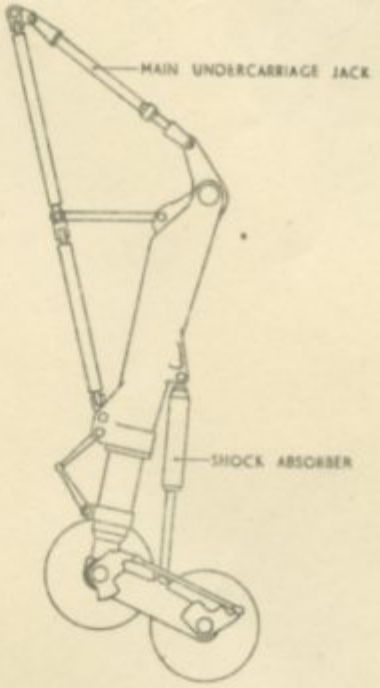


Fig. 1. Main-wheel unit (port)



STATIC LOAD



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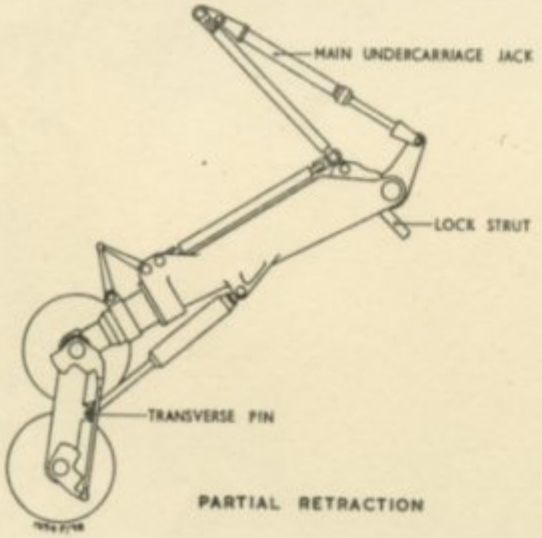

PARTIAL RETRACTION

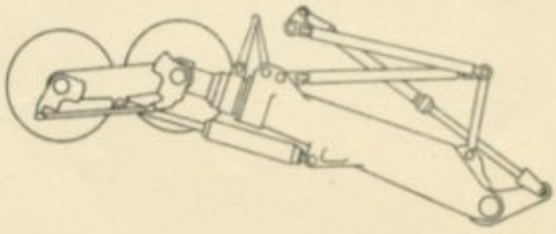

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FIG. 7 PRINCIPLE OF RETRACTION

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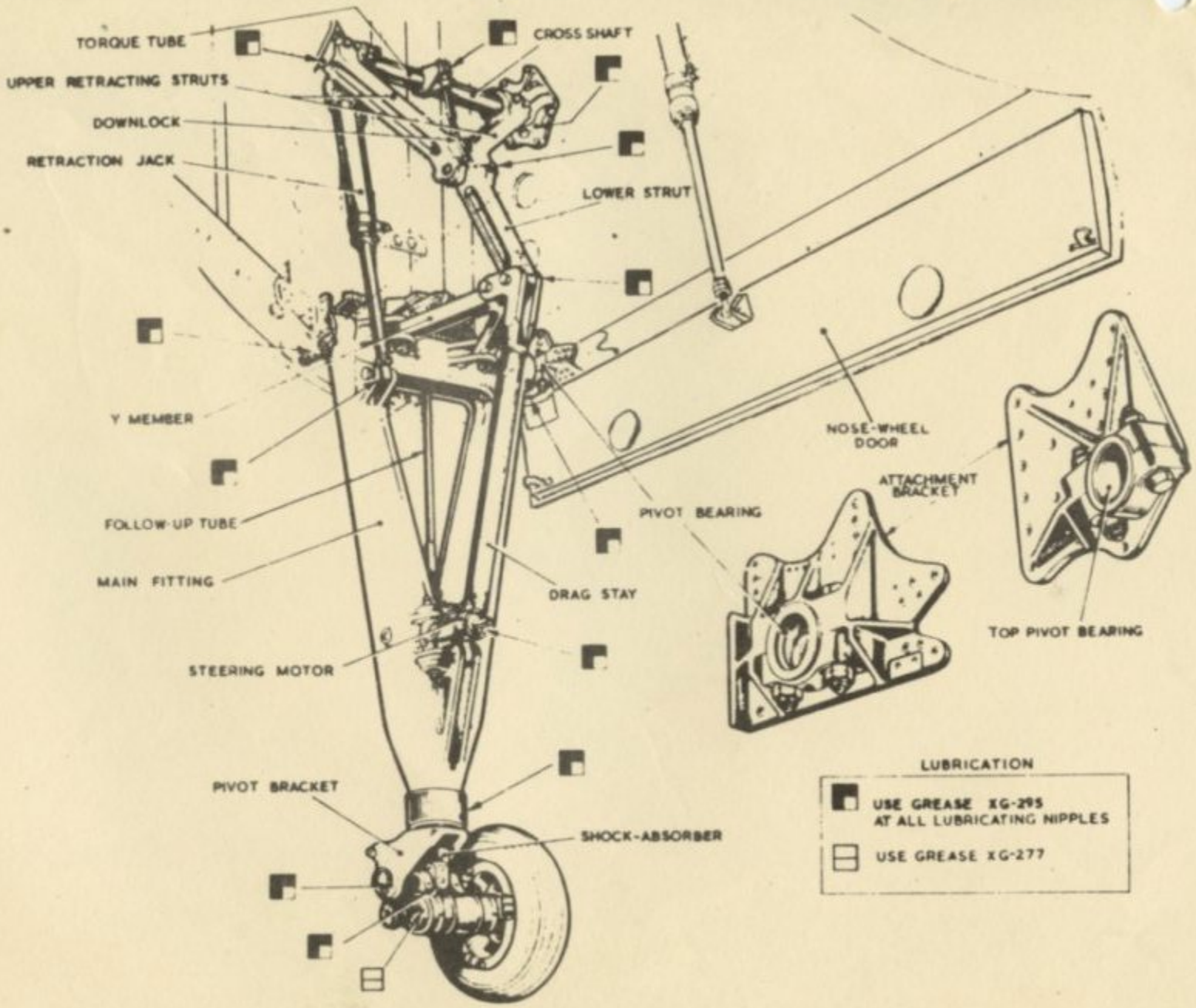

Nose-wheel unit

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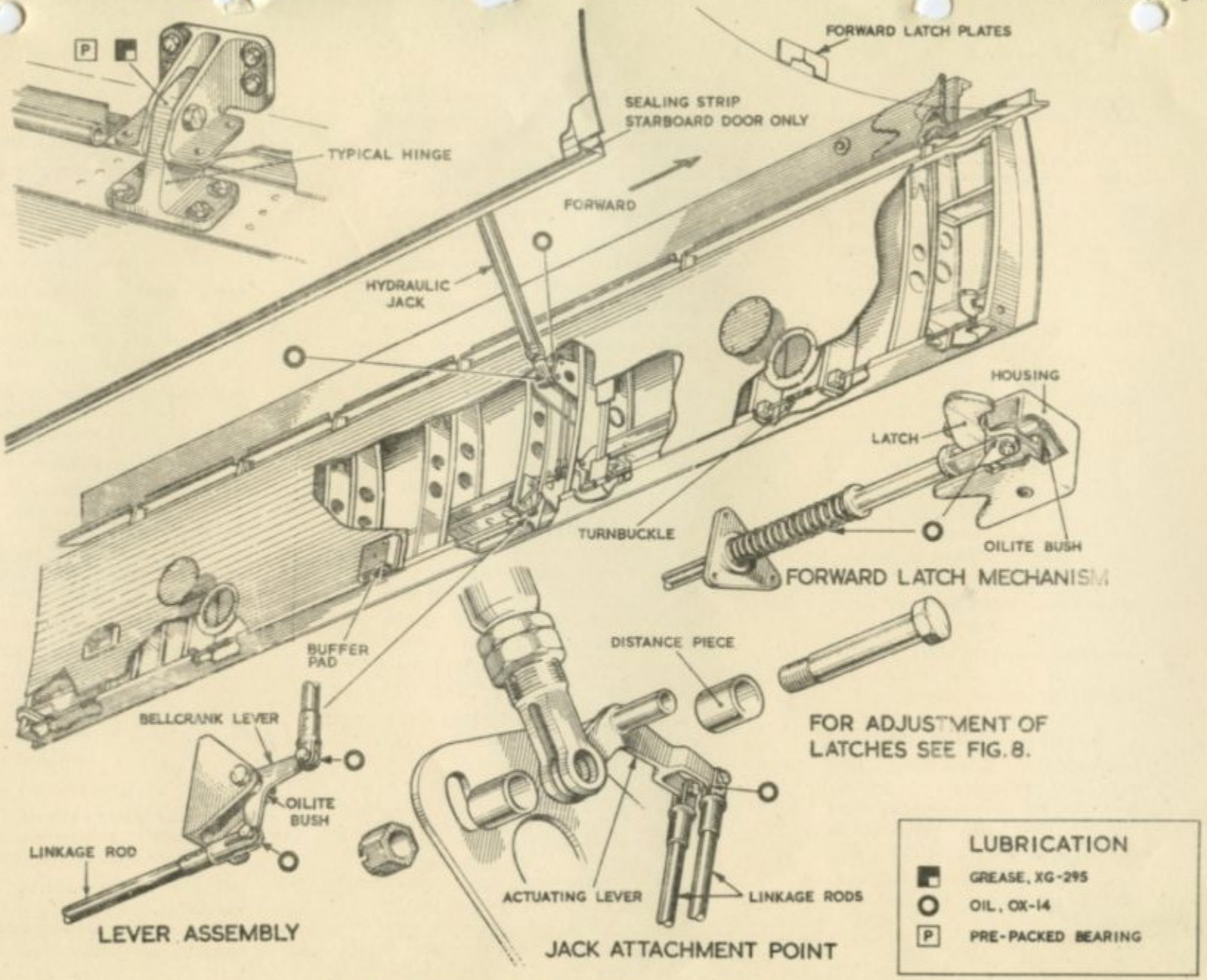

Fig. 4 Nose-wheel door and operating mechanism

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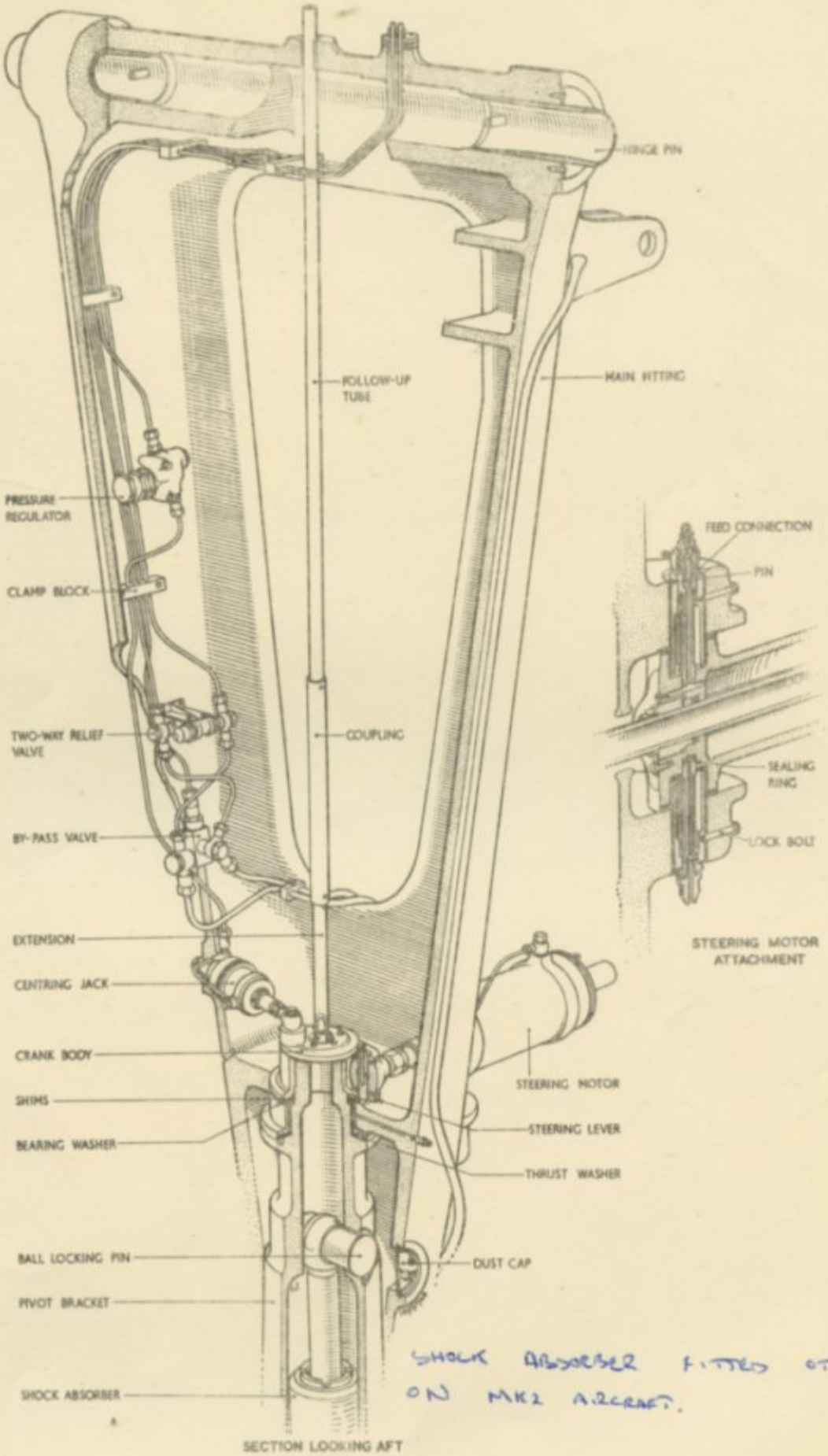

SHOCK ABSORBER FITTED OTHER WAY UP ON MK2 AIRCRAFT.

FIG 2 NOSE UNDERCARRIAGE

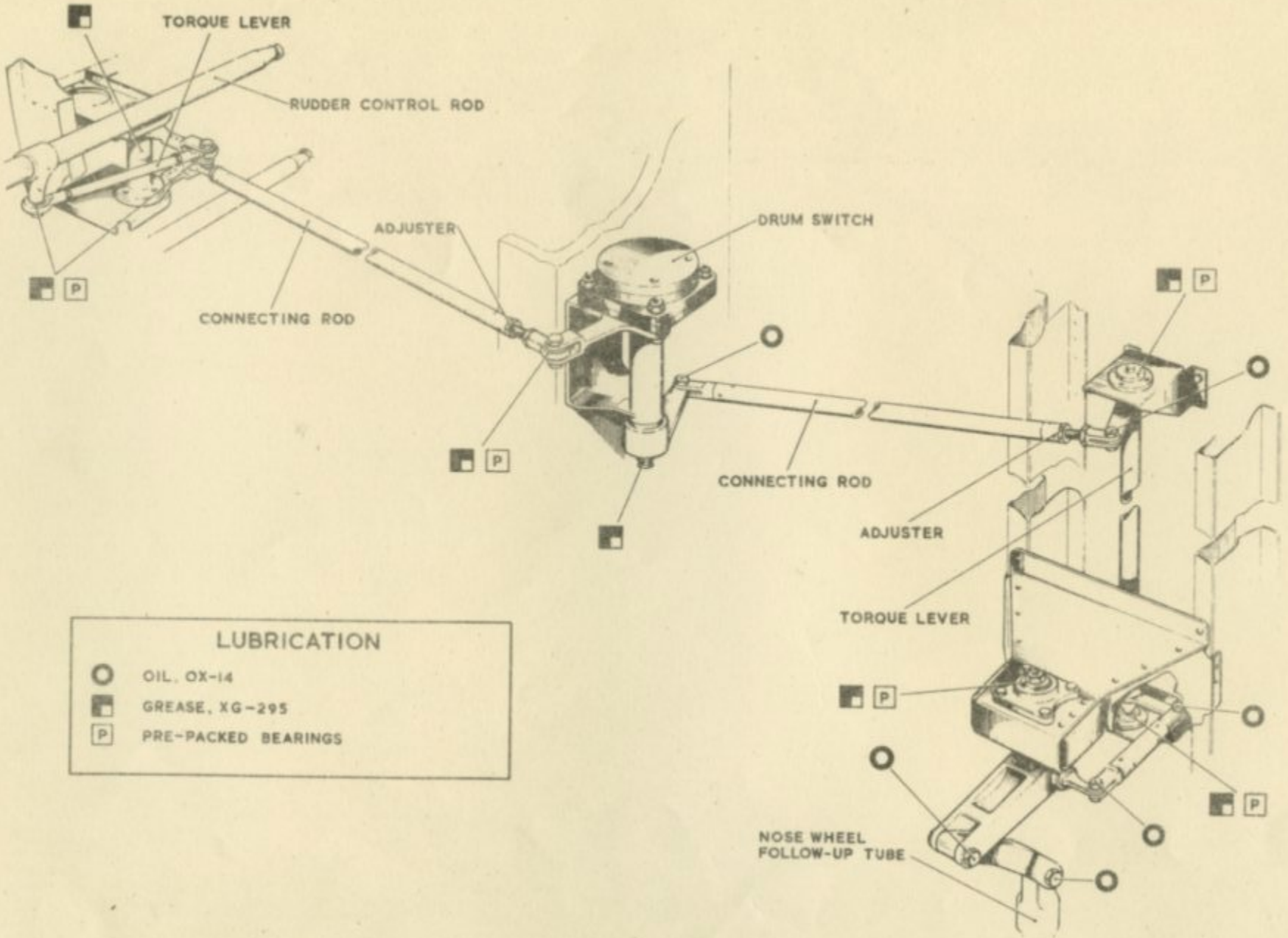

Fig. 5 Nose-wheel steering system

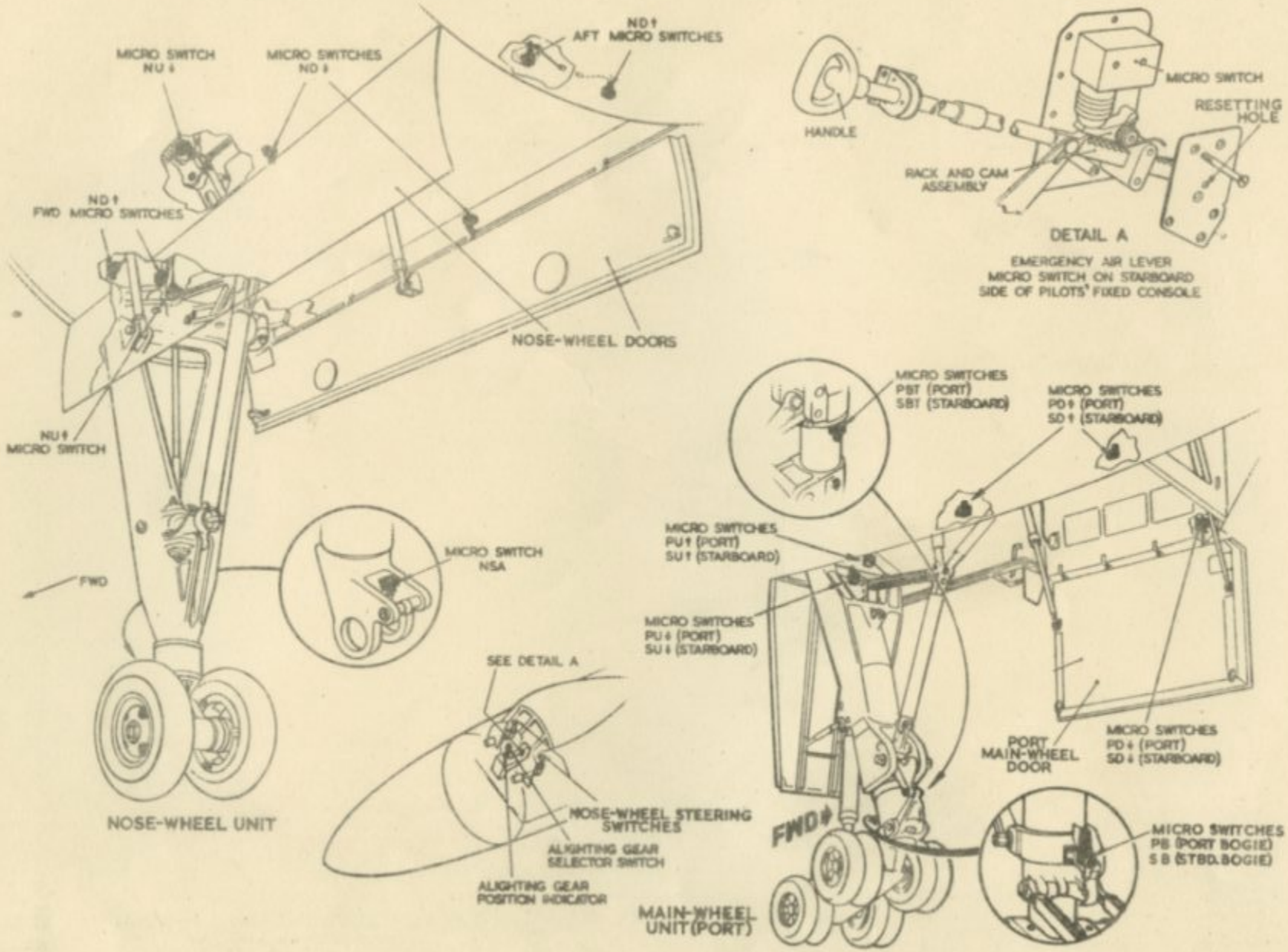

Fig. 11. Location of micro switches