

## Chapter 2

(Cancelled AL 17)

## EJECTION SEATS, TYPE 3CT/1 and 3CT/2

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**Introduction**

1. The Type 3CT/1 and 3CT/2 ejection seats (Ref. No. 27L/50083 and 50085 respectively) are installed in Canberra T Mk. 4 and T Mk. 13 aircraft.

2. The two seats are basically similar but handed, ◀ in addition the Type 3CT/2 seat is fitted with swinging attachments; ▶ therefore only the Type 3CT/1 seat will be dealt with in this chapter.

**GENERAL DESCRIPTION**

3. The complete seat (*fig. 1*) slides during ejection on four rollers in a guide rail attached to the aircraft structure. It is propelled by the cartridge-operated ejection gun which is located within the hollow guide rail.

4. The ejection gun is fired by the action of pulling the firing handle and attached face screen right down over the face. The face screen is flexible, it covers the occupant's face and so protects it from the effects of the airstream. It also holds his head back against the headrest and prevents it from jerking forward during ejection. A restraining device is incorporated to prevent the face screen from being sucked out of its compartment by the airstream. Attached to the screen is a cable which is connected to a sear in the firing body of the ejection gun. When the firing handle is pulled right down over the face the cable withdraws the sear and the gun is fired. The face screen and firing cable are proportioned in such a manner that the ejection gun will be

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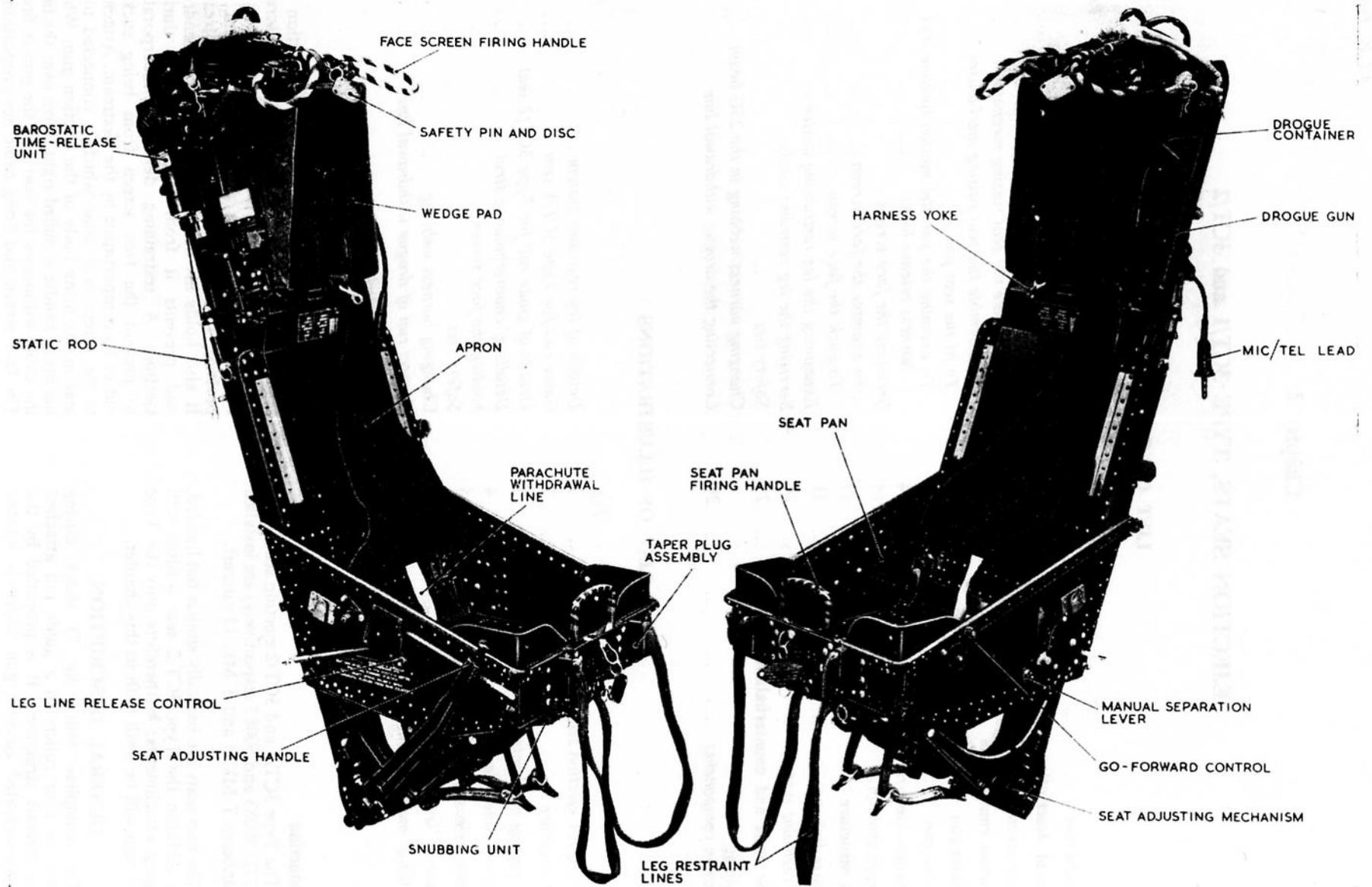


Fig. 1. Type 3CT/I ejection seat

fired whether the occupant is wearing a protective helmet or not. A seat pan firing handle is provided on the front of seat pan in case the occupant cannot reach the main one in conditions of high "G".

5. The seat pan accommodates a parachute assembly and a personal survival pack containing a dinghy and other items of survival equipment. It can be adjusted for height by means of a hinged handle on the side of the seat structure. The seat pan moves relative to the headrest and can thus accommodate different body lengths, at the same time ensuring that the occupant's head will always be correctly located on the headrest whatever the position of the seat pan.

6. A leg restraining device is incorporated to ensure that the occupant's legs are drawn back automatically and restrained close to the seat pan. This provides leg clearance during ejection and also prevents injury from the legs being blown apart by the airstream after ejection.

7. A combined harness is used with this seat; it has a three-point attachment, one at the 25G beam and at two points in the seat pan. An offset apron is provided to pitch the occupant forward after the scissor shackle has opened and one portion of the parachute withdrawal lines is integral with the apron; its purpose is to deploy the parachute canopy as the occupant falls away from the seat.

8. The instructor's seat (Mk. 3CT/2) is beside the entrance door and, to allow aircrew to reach their seats, the guide rail is arranged to swing 5 deg. forward and approximately 20 deg. backward. The guide rail is hinged at the top, three separate and independent controls are provided and a spring-loaded counterbalance strut is incorporated to assist the swinging movement.

#### Safety precautions

9. A red disc carrying a safety pin is provided and when the aircraft is parked, this pin is passed through the safety lock to secure the face screen firing handle against any possibility of withdrawal. Another pin and disc is provided to lock the seat pan firing handle. The static rods which operate the drogue gun and time-release mechanisms permit a limited amount of seat movement before the sears are withdrawn. Before entering the cockpit, or before any servicing is commenced on or near the seats, the authorised safety precautions are to be applied in accordance with current instructions.

#### COMMON COMPONENTS

10. These components are fully described in A.P.4288A, Vol. 1, but the general details are being included in this chapter for guidance.

#### Ejection gun

11. The Type 3, Mk. 1 ejection gun has a stroke of 72 in., with an ejection velocity of 80 ft. per sec. and consists of three telescopic tubes. The outer or cylinder tube is attached at its lower end to the bottom mounting block fitted in the guide rail and the inner or piston tube is attached to the

upper end of the top cross-beam of the seat frame; the intermediate piston tube is situated between the other two and its purpose is to lengthen the stroke and to offer restraint against bending loads imposed on the gun by the airstream. The explosive is contained in five cartridges; a primary cartridge and four secondary cartridges.

12. At the upper end of the inner piston tube is a breech containing the firing body and the primary cartridge. When the firing cable is pulled it withdraws the wedge-shaped sear; the movement of the sear first compresses the firing pin spring and then releases the firing pin to strike the percussion cap of the primary cartridge. The gas pressure frees a release piston and the two piston tubes are propelled upwards, so uncovering two pairs of ports in turn so that the secondary cartridges are ignited by the flame of the primary cartridge.

#### Drogue gun

13. The Type ◀5▶ drogue gun is bolted to the port side beam of the seat structure and consists of a time-delay mechanism, a barrel and a piston. As the seat ascends the guide rail during ejection, a static rod withdraws a sear and the time-delay mechanism is tripped. After 0.5 sec. delay, a small cartridge is detonated, the gas pressure shears a split pin which holds the piston in position in the barrel and the piston is ejected. Attached to the upper end of the piston is the drogue withdrawal line which deploys the drogues.

#### ◀ Note . . .

*The sear is connected direct to the static rod. The intermediate fork-end shackle is not used in this installation. ▶*

#### Barostatic time-release unit

14. The barostatic time-release unit, Type 5, Mk. 1 is mounted at the top of the starboard seat beam and its purpose is to free the drogues from the scissor shackle and to release the safety harness. As the seat ascends the guide rail during an ejection, a static line withdraws a sear and a time-delay mechanism commences to function provided ejection has occurred below approximately 10,000 ft. Above this height a barostatic remains in engagement with the train of gears and prevents the mechanism from operating until this height is reached. The mechanism provides a delay of 1.25 sec., but a G controller switch is incorporated which delays operation still further if the speed at the time of ejection is too high for safe parachute deployment.

#### Drogue assembly

15. This assembly when developed first checks the forward speed of the seat and then stabilizes the seat and occupant. It consists of a controller drogue with a diameter of 22 in. and a main drogue 5 ft. in diameter. The controller drogue is connected to the main by a nylon tape and the main drogue is connected to the lifting lines by nylon shroud lines.

16. Joined to the lower end of the shroud lines is an apron, the purpose of which is to pitch the occupant forward and then to open his parachute

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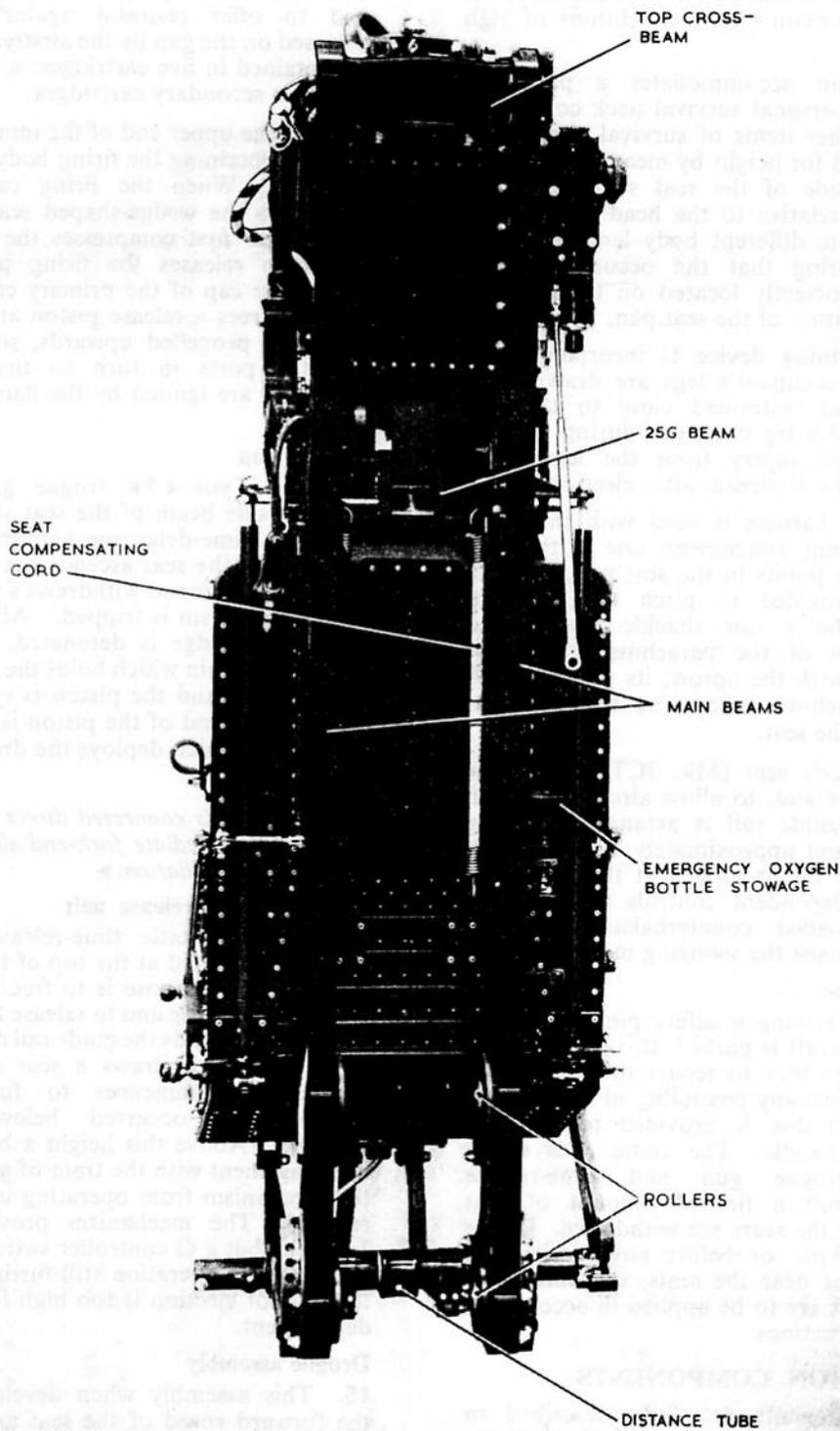


Fig. 2. Seat structure

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by means of a withdrawal line which is attached to the apron. It is fabricated from canvas and to its upper end is attached the headrest pad and to its lower end are attached two clips which retain the assembly to the parachute container. ▶

### SEAT STRUCTURE

17. The seat structure (*fig. 2*) is made almost entirely of light alloy. The main frame is built up from a pair of side beams connected at the top by a cross-beam which receives the thrust of the ejection gun piston, and at the bottom by a cross-shaft through which passes the countershaft carrying the seat raising levers and handle. Each side beam carries at its lower end two of the rollers which engage with the guide rail.

18. The seat raising mechanism (*fig. 3*) is operated by the seat raising handle; this is hinged and spring loaded sideways against the side of the seat to reduce the overall width. Depressing the trigger control displaces axially the sear bar through the bell-cranks sear lever and connecting link. This causes rollers on the pair of spring-loaded plungers to ride up the ramp faces and so withdraw the plungers from engagement with the quadrants. Rotation of the countershaft by the handle then raises or lowers the seat, the weight of the seat and occupant being counter-balanced by two elastic cords at the rear. Release of the trigger control allows the plungers to engage the nearest holes in the quadrant and so locks the mechanism in the desired position. Four positions are provided with a stop incorporated at the top of the quadrant to limit downward travel. The seat pan is supported on the seat raising levers and restrained at its upper corners by two blocks which slide in guides machined in the side beams.

19. The drogue container is a riveted sheet metal box mounted at the top of the seat structure. The face screen firing handle is fitted at the front edge of the container and is retained by two spring latch assemblies; additionally, a retaining strap is provided which, when secured by the safety pin, prevents accidental withdrawal during parking periods. The face screen is retained in its own compartment by two nylon cords which pass through conduits and are secured at the rear by two pins. These pins are withdrawn by a lifting line after the scissor shackle has opened, so freeing the face screen, firing handle, parachute restraining straps, headrest pad and upper part of the apron. The drogues and shroud lines are stowed in a separate compartment behind the diaphragm.

20. The top of the drogue container is closed by four fabric flaps which normally retain the drogues in their stowage. They are threaded on to a cone in a pre-determined order and locked by a pin which is fitted part-way along the drogue withdrawal line. A No. 8 cord safety tie prevents inadvertent withdrawal of the locking pin and a further No. 8 cord tie is secured between the drogue shackle and the cone on the underside of the pin.

This tie is introduced to prevent any movement of the scissor shackle in an upward direction.

### Important . . .

*The drogue withdrawal line MUST pass over the white shroud lines and the black P.V.C. lifting line so that the drogues can be withdrawn by the drogue gun piston without entanglement.*

### Release linkage

21. When the time-release unit is tripped by the static rod (*fig. 4*) the descending harness release plunger strikes the pad at the end of the release lever which, in swivelling downwards, operates the linkage; simultaneously the scissor shackle is freed, so releasing the lifting lines which withdraw the pins at the rear of the drogue container. The vertical link of the mechanism embodies a slot and, as the link descends, it withdraws the harness restraining plunger and also actuates a bell-crank lever which transmits the motion to a pair of torsion rods which free the two bottom harness plungers and the leg restraining cords.

22. The harness release mechanism with some other details is shown in *fig. 5*. The end of the harness with its lug is held by a locking plunger and the other end of the strap passes over a roller, over a snub lever and round a spring-loaded spool. Reference to the centre diagram shows how the harness strap is locked by the radiused top of the spring-loaded snub lever in the forward direction, but is free to pass to the rear under the action of the spring-loaded spool. A manually operated control on the port side of the seat pan is connected to the mechanism via a link (*fig. 6*) to enable the occupant to free the snub lever and lean forward in the aircraft cockpit; the harness returns automatically to the rearmost position and remains locked when the occupant leans back again.

23. A manual separation control is connected to the port torsion bar (*fig. 7*) by means of another link. Movement of this control upwards frees the occupant from the seat and, in conjunction with an over-ride D-ring on the harness, enables him to leave the seat after ejection should the automatic facilities fail and so make a normal parachute descent.

### Leg restraint system

24. The leg restraining cords pass through snubbing units on the underside of the seat pan (*fig. 8*). The lower ends of the cords then pass over rollers, down to further rollers held in shackles and up to anchorages beneath the seat. The second set of rollers are held in the shackles by rivets which are stressed to shear at approximately 400 lb. The upper ends of the cords terminate in fittings which engage with two taper plug housings. A cross-tube carried in bearings on the front of the seat pan has two small levers to raise the plugs against spring tension to free the upper ends of the leg restraining cords. The

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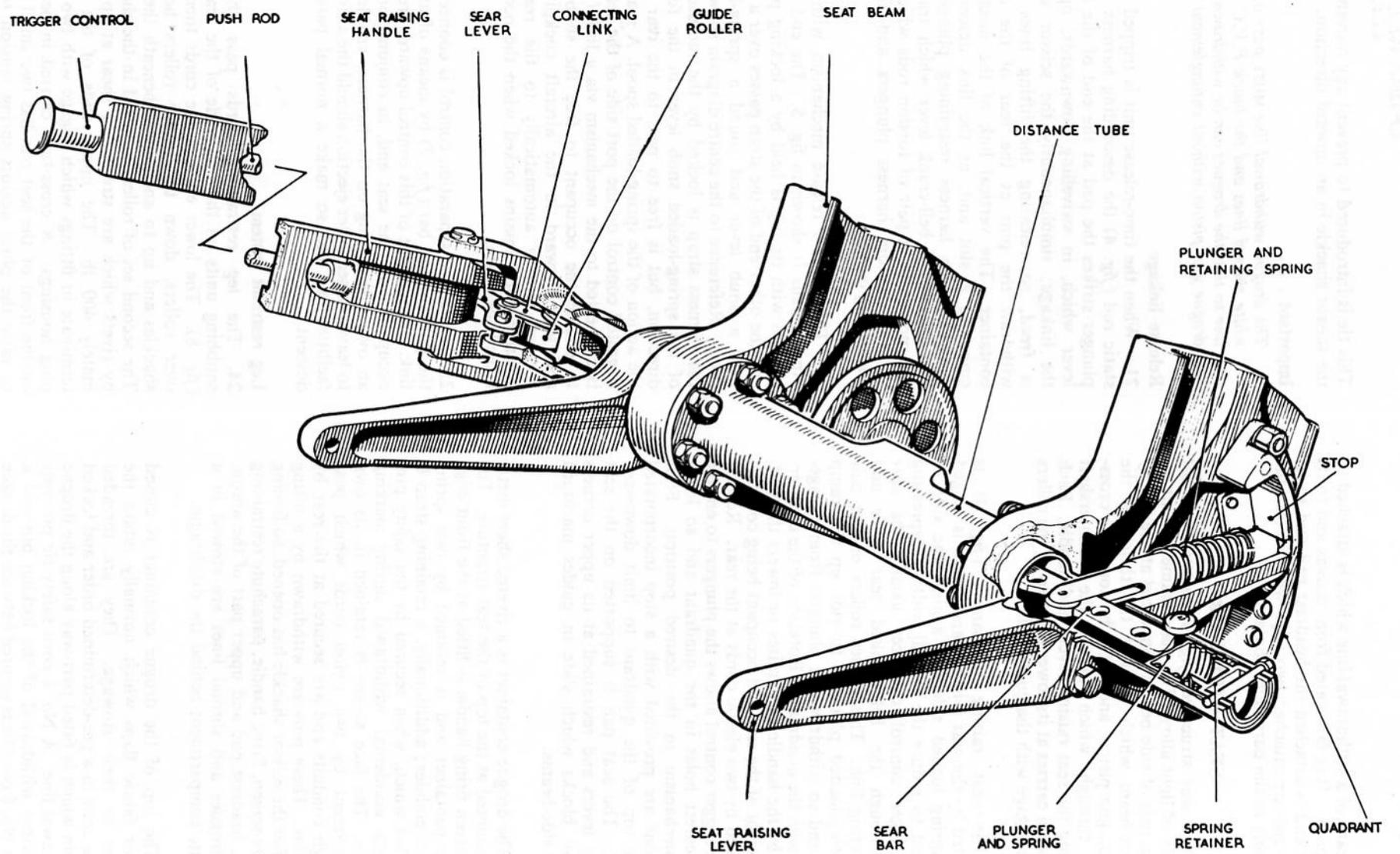


Fig.3. Seat raising mechanism

cross-tube is connected by a tie bar to a lever on the starboard side of the seat pan. This control enables the occupant to release the leg restraining cords on vacating the seat.

#### GUIDE RAILS AND COUNTERBALANCE STRUT

25. The guide rail for the Mk. 3CT/1 seat (Ref. No. 27L/50084) consists of a single extrusion bolted to the aircraft structure and normally it should not be necessary to remove it. Built into it towards its lower end is the mounting block and plunger (fig. 9) which retains the ejection gun cylinder tube. The slots in the upper end of the guide rail receive the seat cross-beam and restrain the forward impulse of the seat in the event of a crash landing.

26. Bolted to the rear of the guide rail are two brackets to which the static rods for the drogue gun and time-release unit are attached by quick-release pins. Provision is made on one of the brackets to house the Tel/Mic. lead, and mounting brackets complete the assembly.

27. The guide rail for the Mk. 3CT/2 seat (Ref. No. 27L/50086) is arranged to swing about the top 5 deg. forward and approximately 20 deg. aft

when necessary but is retained in its normal flight position by the bottom lock plunger (fig. 10), which engages in a socket on the aircraft floor. Three separate and independent controls are provided to lift the plunger from its socket when necessary to enter or leave the cockpit; the one on the side can be operated by either pilot, the rear lever can be operated by the rear seat occupant and the front lever can be operated from outside the entrance door. The front operating lever is mounted onto a torque shaft which has integral with it a small lever acting directly on to the plunger. The rear and side levers are interconnected with a lift rod which raises the plunger through two bell-crank levers.

28. A large proportion of the weight of the seat during the upward swing is taken by a counterbalance strut (fig. 11). This consists of a spring arranged in a pair of sliding housings; one end of the assembly is fitted to a bracket on the guide rail and the other to the aircraft structure. When the seat and guide rail are in the normal flight position, the counterbalance strut is in compression; hence, when the locking plunger is released, the initial part of the swing is accomplished automatically and very little extra effort is needed to move the seat to the desired position for entry or exit.

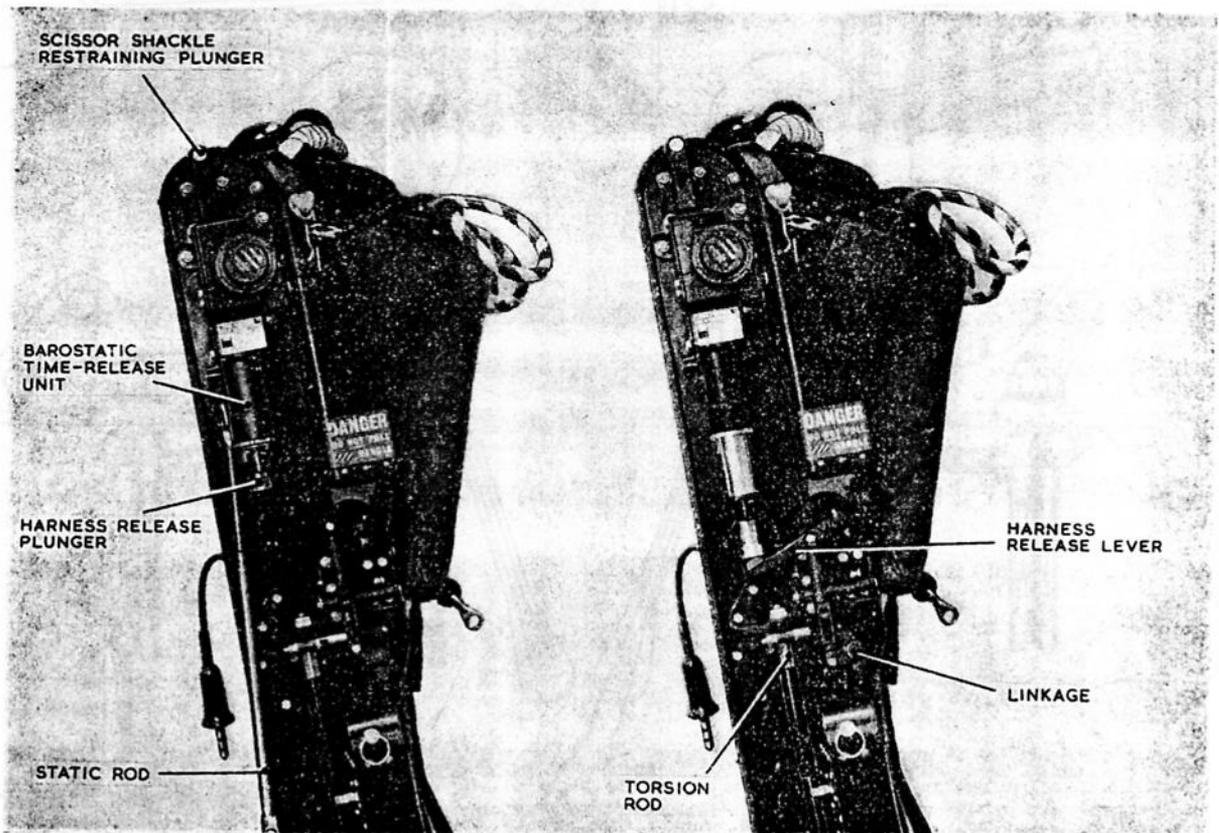


Fig. 4. Action of time release unit

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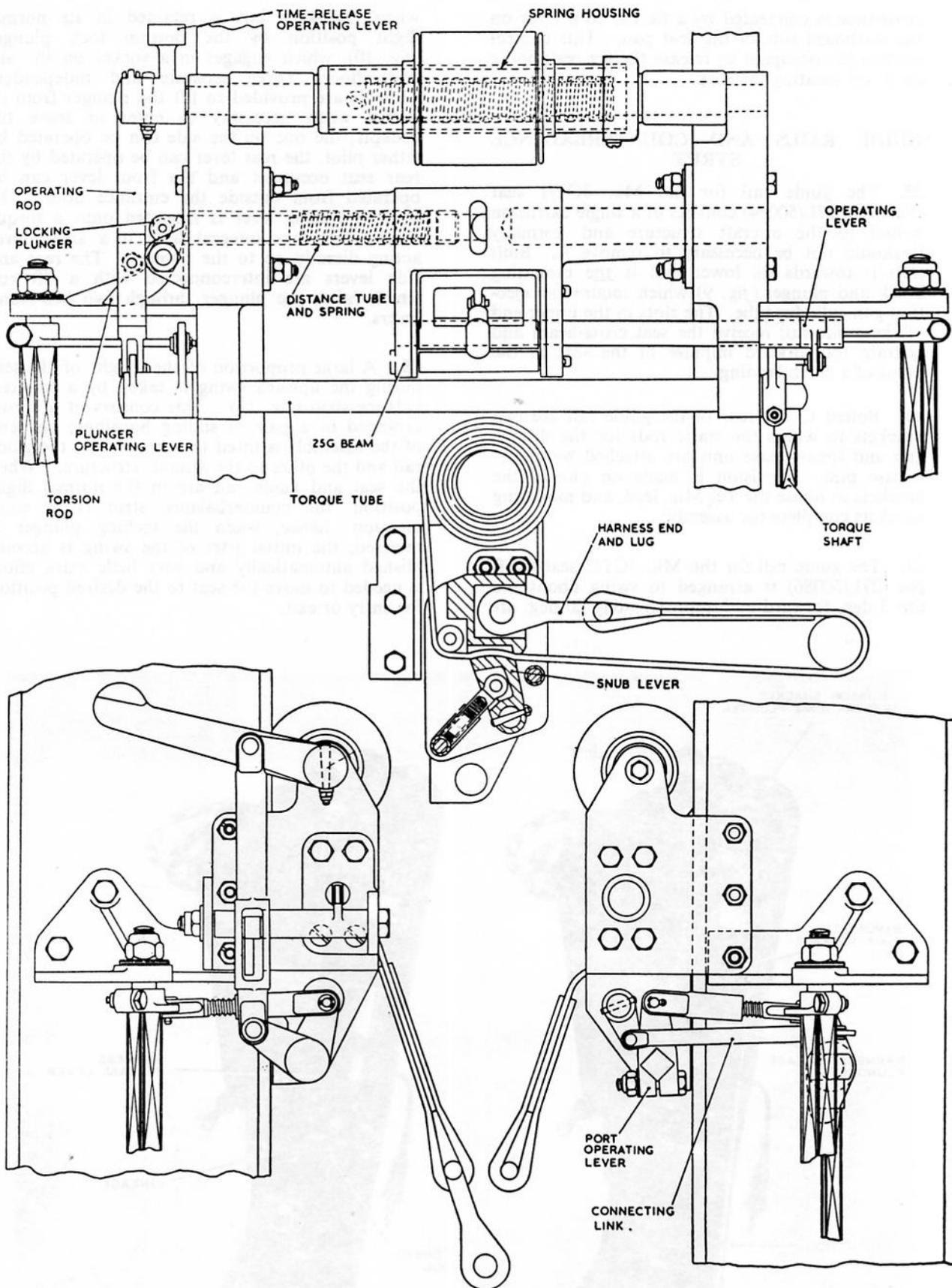


Fig. 5. Harness release mechanism

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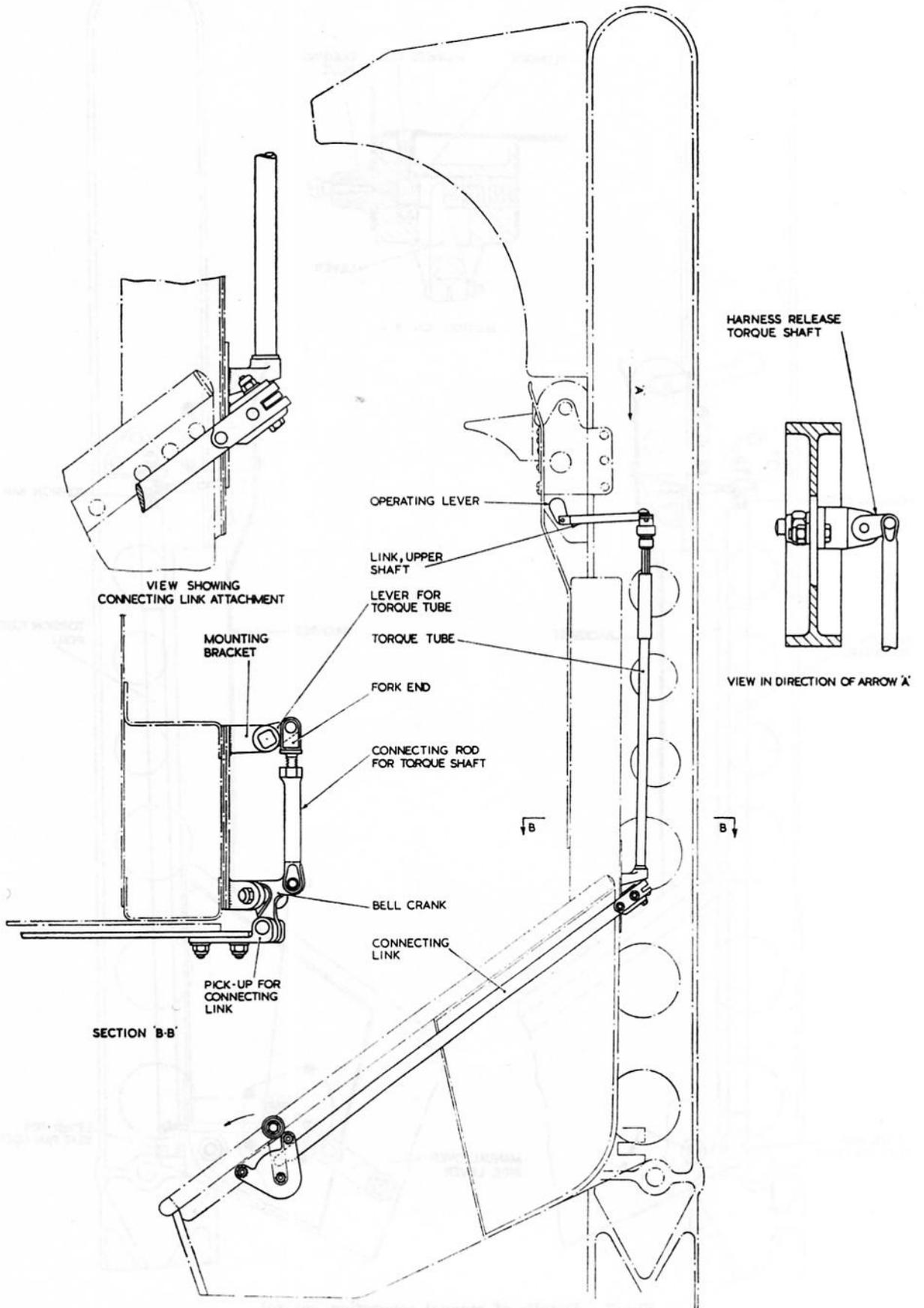


Fig. 6. Details of 'Go-forward' control

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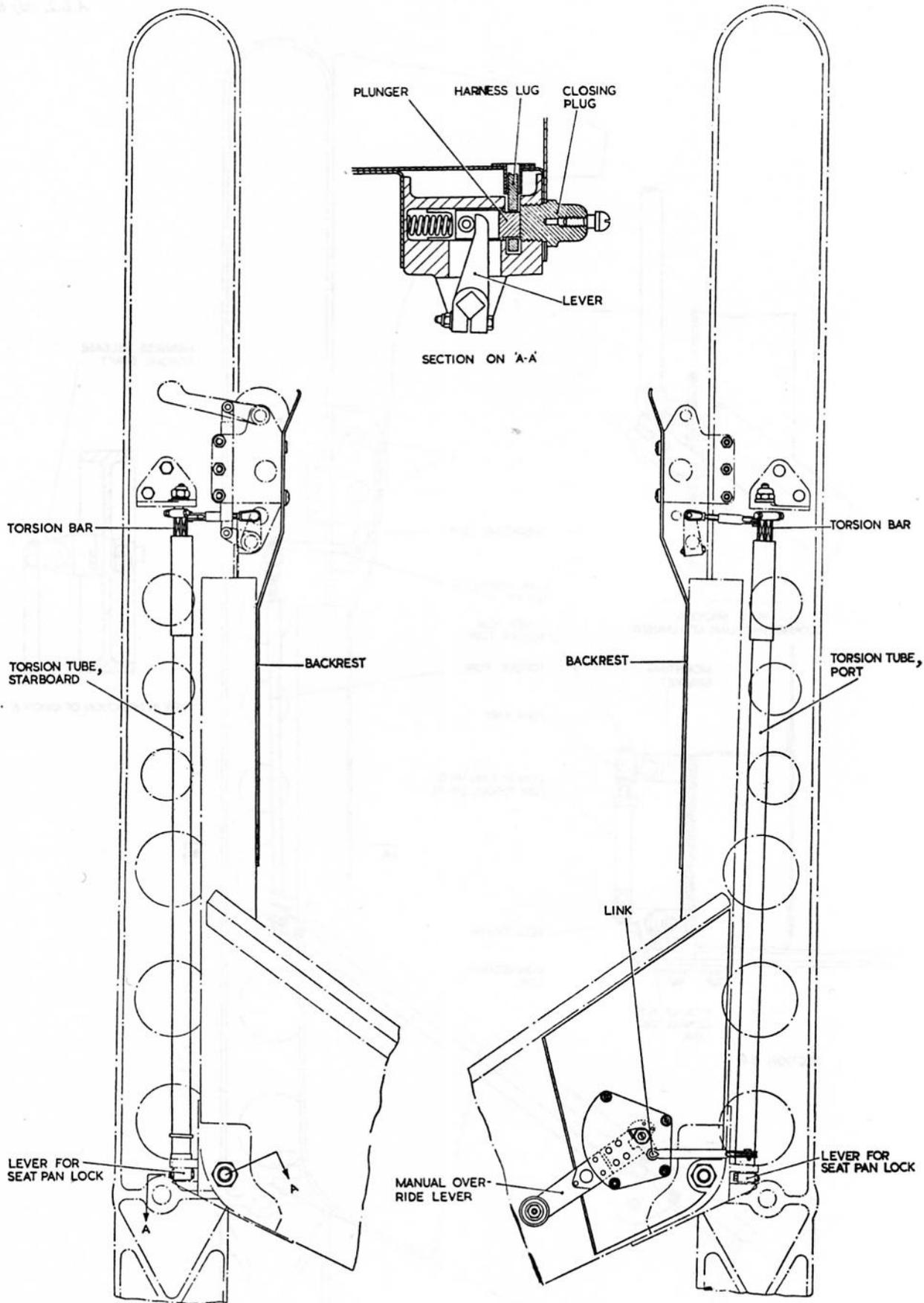


Fig. 7. Details of manual separation control

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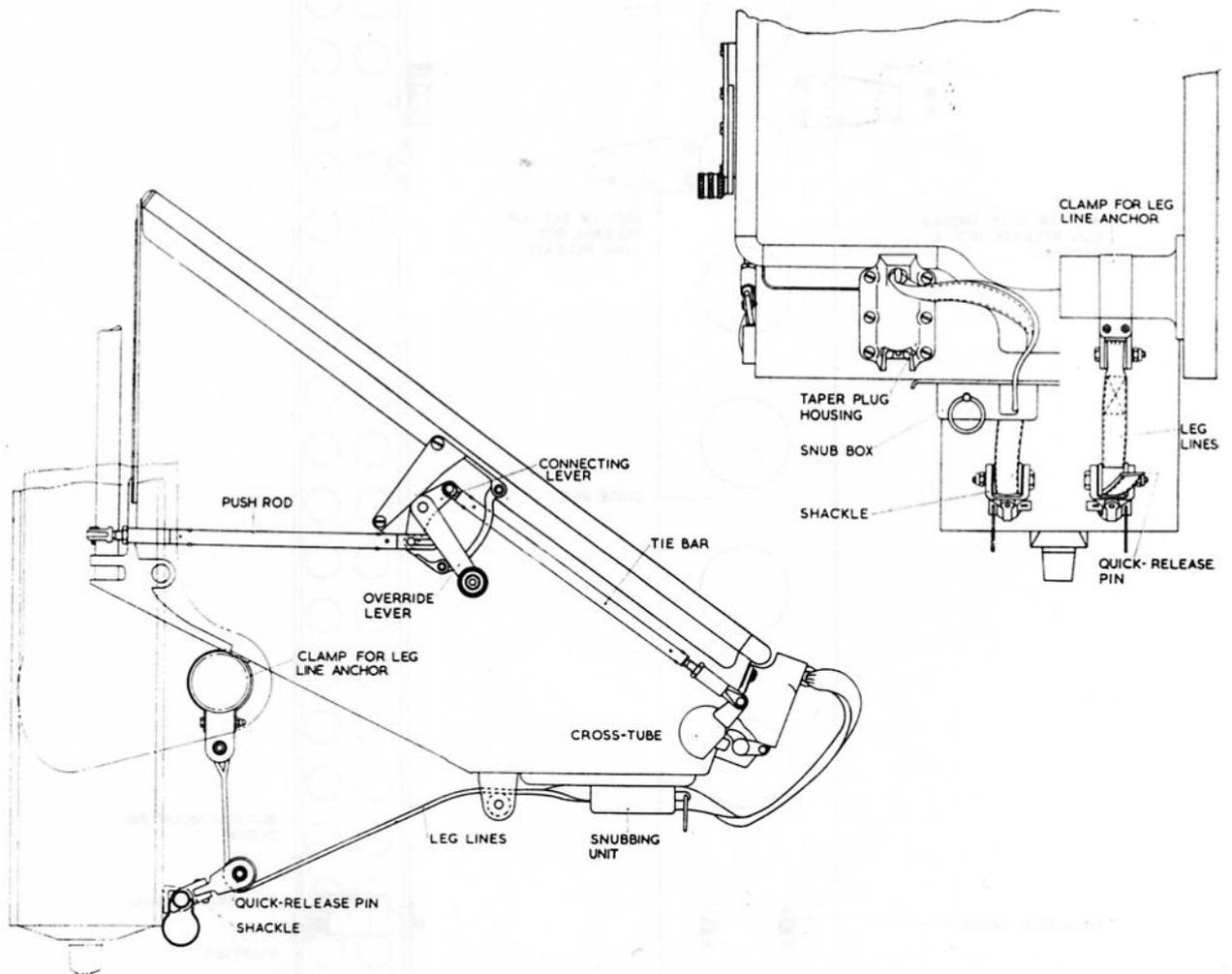


Fig. 8. Details of leg restraint system

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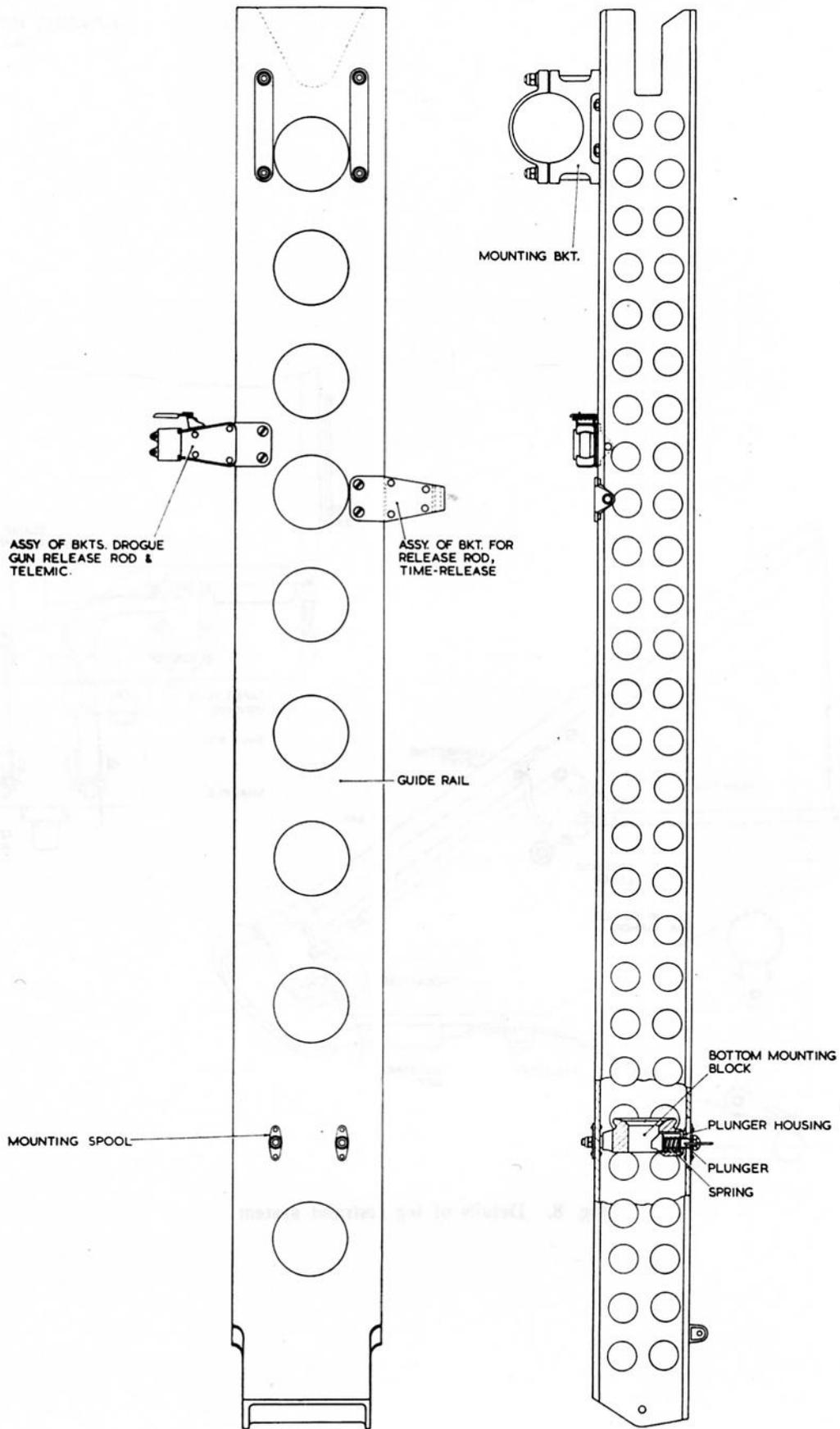


Fig. 9. Guide rail for Type 3CT/1 seat

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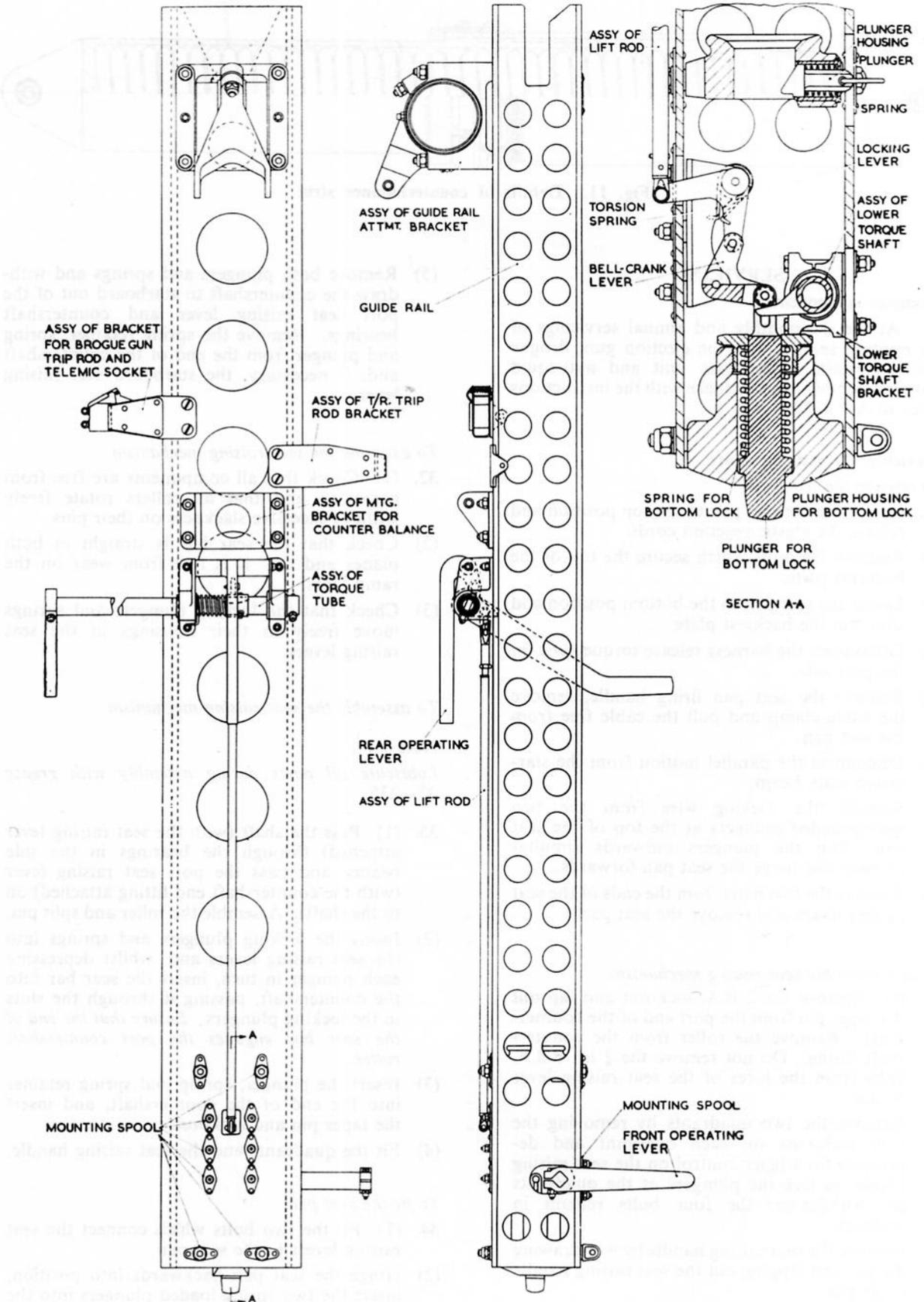


Fig. 10. Details of guide rail for Type 3CT/2 seat

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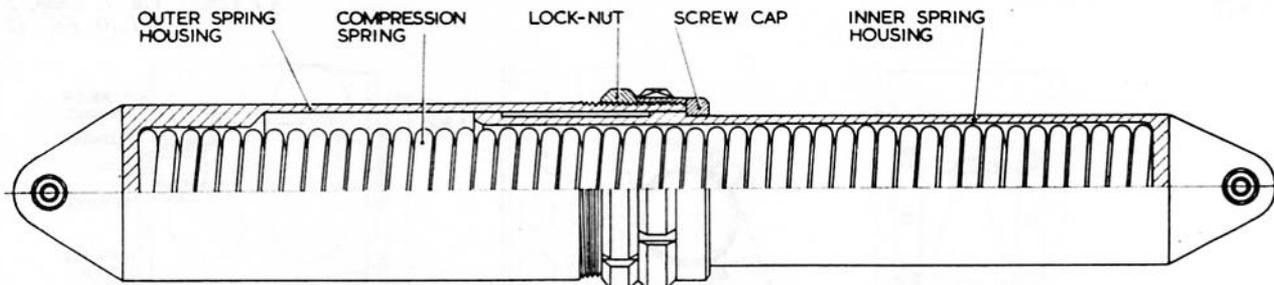


Fig. 11. Details of counterbalance strut

## SERVICING

### Common components

29. At the six-monthly and annual servicings of the ejection seat, service the ejection gun, drogue gun, barostatic time-release unit and anti-squid drogue assembly in accordance with the instructions given in A.P.4288A, Vol. 5.

### Servicing the seat structure

#### To remove the seat pan

30. (1) Raise the seat pan to the top position and release the elastic reaction cords.
- (2) Remove the bolts which secure the top of the backrest plate.
- (3) Lower the seat pan to the bottom position and slide out the backrest plate.
- (4) Disconnect the harness release torque tube on the port side.
- (5) Remove the seat pan firing handle, remove the cable clamp and pull the cable free from the seat pan.
- (6) Disconnect the parallel motion from the starboard main beam.
- (7) Remove the locking wire from the two spring-loaded plungers at the top of the seat pan. Pull the plungers outwards simultaneously and hinge the seat pan forwards.
- (8) Remove the two bolts from the ends of the seat raising levers and remove the seat pan.

#### To dismantle the seat raising mechanism

31. (1) Remove the 2 B.A. lock-nut and tap out the taper pin from the port end of the countershaft. Remove the roller from the countershaft fitting. Do not remove the  $\frac{1}{4}$  in. B.S.F. bolts from the faces of the seat raising lever bosses.
- (2) Remove the two quadrants by removing the four lock-nuts on each quadrant and depressing the trigger control on the seat raising handle to free the plungers as the quadrants are withdrawn; the four bolts remain in position.
- (3) Remove the seat raising handle by withdrawing the pin and tapping out the seat raising handle hinge pin.
- (4) Push up the two plungers simultaneously and pull out the sear bar from the starboard side.

- (5) Remove both plungers and springs and withdraw the countershaft to starboard out of the port seat raising lever and countershaft bearings. Remove the spring retainer, spring and plunger from the end of the countershaft and, if necessary, the starboard seat raising lever.

#### To examine the seat raising mechanism

32. (1) Check that all components are free from corrosion and that all rollers rotate freely without excessive slackness on their pins.
- (2) Check that the sear bar is straight in both planes and that it is free from wear on the ramp faces.
- (3) Check that the locking plungers and springs move freely in their housings in the seat raising levers.

#### To assemble the seat raising mechanism

#### Note . . .

Lubricate all parts during assembly with grease XG-275.

33. (1) Pass the shaft (with the seat raising lever attached) through the bearings in the side beams, and pass the port seat raising lever (with the countershaft end fitting attached) on to the shaft). Assemble the roller and split pin.
- (2) Insert the locking plungers and springs into the seat raising levers and, whilst depressing each plunger in turn, insert the sear bar into the countershaft, passing it through the slots in the locking plungers. *Ensure that the end of the sear bar engages the port countershaft roller.*
- (3) Insert the plunger, spring and spring retainer into the end of the countershaft, and insert the taper pin and lock-nut.
- (4) Fit the quadrants and the seat raising handle.

#### To fit the seat pan

34. (1) Fit the two bolts which connect the seat raising levers to the seat pan.
- (2) Hinge the seat pan backwards into position, insert the two spring-loaded plungers into the guides in the side beams and lock with 20 S.W.G. non-corrodible steel locking wire.

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- (3) Connect the parallel motion on the starboard main beam.
- (4) Fit the cable clamp and the seat pan firing handle.
- (5) Connect the harness release torque tube on the port side.
- (6) With the seat pan in the bottom position, slide the backrest plate into position and fit the securing bolts.
- (7) Raise the seat pan to the top position and fit the two seat reaction cords.
- (8) Check (by operation) that the seat pan locks in all positions.

**IMPORTANT . . .**

*The seat raising mechanism must NOT be operated with the manual separation lever in the UP (operated) position.*



*To examine the parallel motion linkage and harness release locks*

35. (1) Examine the parallel motion linkage, levers and torque tubes for damage, bowing and security of attachment.
- (2) Examine for freedom of movement by depressing the 'go forward' lever and manual separation lever in turn.

- (3) Lightly lubricate moving parts with oil OM-13.

**Servicing the face screen**

*To examine the face screen*

36. (1) Pull out the main firing handle to its full extent (left-hand diagram, fig. 12) and examine the fabric of the face screen for damage and deterioration.
- (2) Check for security of attachment of the front edge to the firing handle and of the nylon tapes at the rear. Check the security of attachment of the eye ends at the rear of the tapes.
- (3) Examine the attachment of the firing cable to the face screen.

*To pack the face screen*

37. (1) Fold the face screen into two double folds (one each side) to reduce the width so that the fabric will pass through the slot in front of the drogue container (right-hand diagram, fig. 12).
- ◀ (2) Insert the face screen into the container and, if the firing cable has been removed from the container, thread it through the aperture in the front flap, pass it (together with the seat pan firing cable) over the rear flap and over the lines and then connect it to the ejection gun seat. ▶

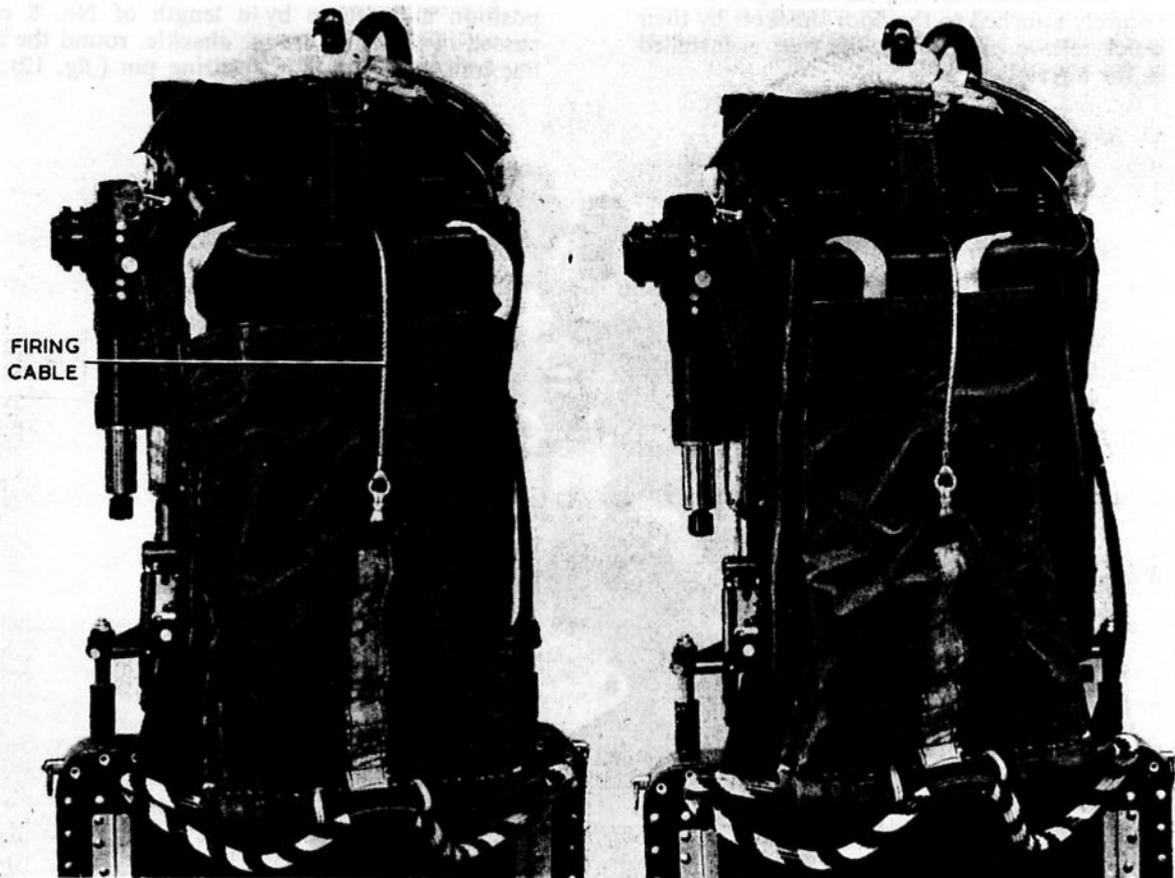


Fig. 12. Folding the face screen

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- (3) Pack the face screen into its compartment in a series of double folds approximately the width of the slot. Press well to the rear all the time.

**Warning . . .**

*Whenever a face screen is re-packed (or the firing cable is connected to the ejection gun sear) ensure that the exposed firing cable is kept as short as possible between the sear and the drogue container, i.e. only leave sufficient cable to reach the sear. If not, there is a serious danger of snagging when the firing cable is pulled, possibly resulting in non-firing of the ejection gun.*

- (4) Press the folds well into the housing with the thumbs and ensure that the forward outer edges of the screen are pressed well home; *this is most important.*
- (5) Insert the firing handle in the spring-loaded latches and press home until it locks in position.
- (6) Check that the rear ends of the nylon tapes are correctly secured by the retaining pins.

**Note . . .**

*The eye ends of the tapes are placed on top of those for the parachute harness straps.*

**Examining the leg restraining device**

38. (1) Ensure that the leg restraining cords are securely attached to the floor brackets by their quick-release pins (when the seat is installed in the aircraft).

- (2) Ensure that the cones on the ends of the leg restraining cords lock correctly into their housings at the front of the seat pan.
- (3) Ensure that the cones disengage when the control lever is operated.
- (4) Examine the cords for fraying or deterioration, particularly at the ends.
- (5) Check the cords for freedom of movement through the snubbing units in a downward direction but complete restraint in the upward direction.
- (6) Check the release buttons for correct operation.

◀ **Servicing the leg restraint cords**

39. Suspend each leg restraint cord by one end and attach a dead weight of 5 lb. to the other end, taking care that the load is applied without producing a snatch on the cord. Measure the length of the cord from the centre of the shear rivet at one end of the cord to the centre of the fabric loop by which the taper plug fitting is attached to the other end. The length should be 50 in.  $\pm$  2 in., and any cords exceeding the upper limit are to be renewed. ▶

**Safety ties**

40. After the drogues have been packed (Sect. 5, Chap. 3), lower the scissor shackle to the stowed position and secure by a length of No. 8 cord passed *through* the drogue shackle, round the link line and *under* the flap securing pin (fig. 12); tie

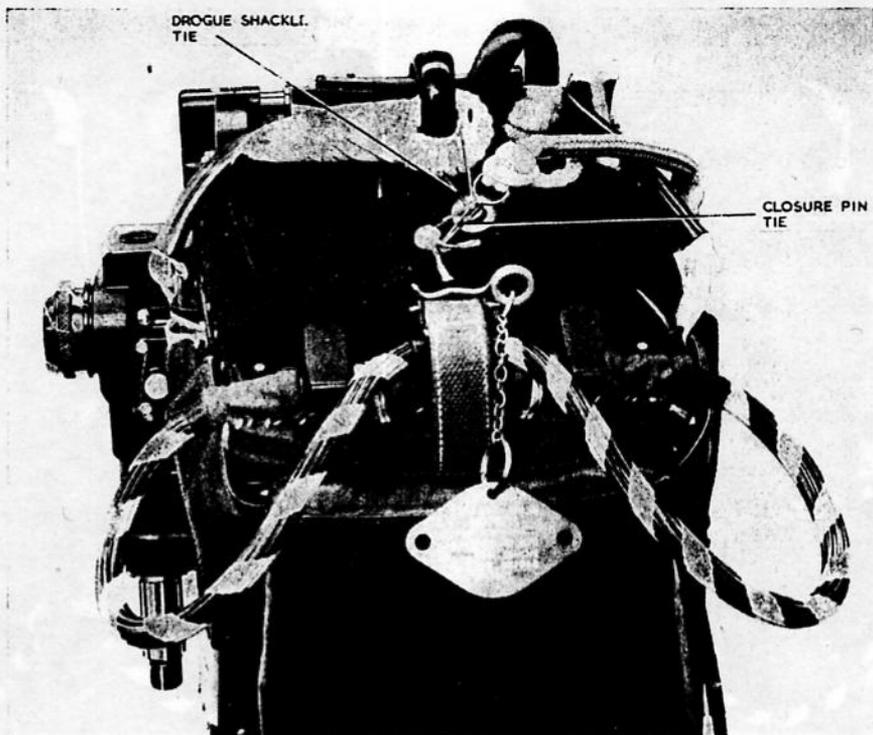


Fig. 13. Safety ties

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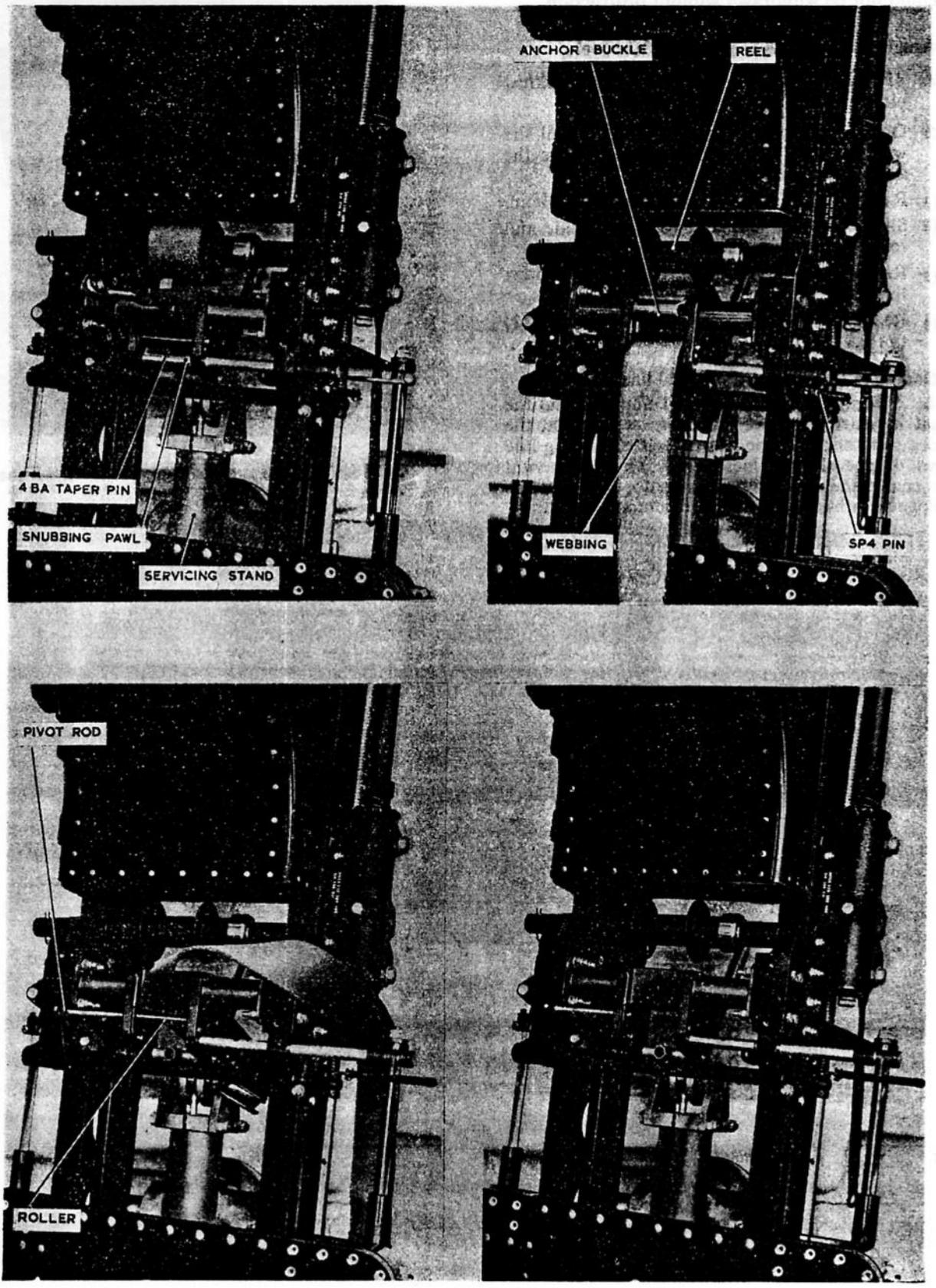


Fig. 14. Changing harness webbing

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off with a reef knot and two or three half-hitches. It is of the utmost importance that the cord passes under the securing pin, otherwise the drogues could not be withdrawn without obstruction.

#### Changing harness webbing in the 25G beam

41. (1) Lower the seat and remove the backrest plate.
- (2) Operate the 'go forward' lever and pull the webbing out to its full extent. Release the anchor buckle (*fig. 13*).
- (3) Remove the 4 B.A. taper pins and the SP.4 pin.
- (4) Slide the pivot tube and rod to the side and remove the snubber and roller.
- (5) Remove the unserviceable webbing and insert the new one.
- (6) Reverse the operations given in sub-para. (1) to (4).

#### Connecting the drogue withdrawal line

42. When aircraft servicing is completed and the seat is re-armed, *make absolutely certain* that the drogue withdrawal line passes *OVER* the lifting line and drogue shroud lines (*fig. 15*). This is vital to enable the drogue gun piston to withdraw the drogues without obstruction or entanglement.

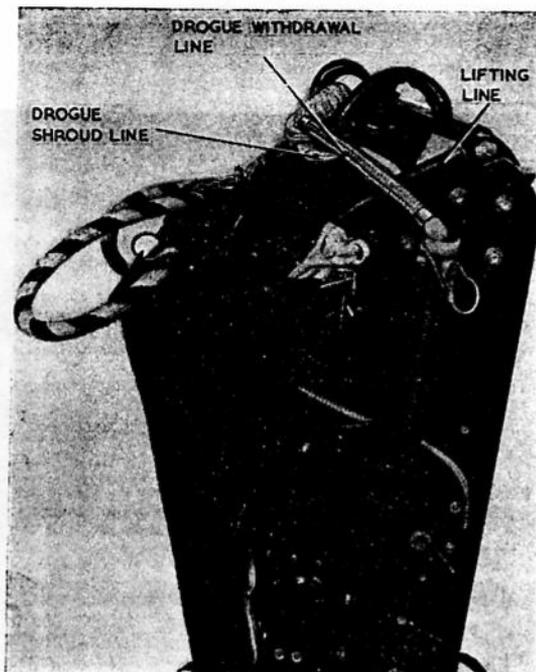


Fig. 15. Correct run of drogue withdrawal line

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