Chapter 5

EJECTION SEATS, TYPE 3L/1 and 3L/2, Mk. 1 and Mk. 2

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Introduction

1. The Type 3L/1 and 3L/2, Mk. 1 and 2 ejection seats are installed in the Victor B Mk. 1 and Mk. 1A aircraft.

2. The two seats are basically similar but handed in respect of the seat raising handle and the Mk. 7C emergency oxygen set being on the inboard side in each instance; therefore only the Type 3L/1, Mk. 1 will be fully described in this chapter.

EJECTION SEATS, TYPE 3L/1 and 3L/2, Mk. 1

General description

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

4. The canopy is jettisoned and the ejection gun is fired by the action of pulling down the firing handle situated at the top of the drogue container. This handle draws out from the drogue container a flexible screen which covers the occupant's face and protects it from the effects of the airstream. It also holds his head back against the headrest pad and so prevents it from jerking forward during ejection. Spring-loaded plungers prevent the face screen from being sucked out of its compartment by the airstream should the canopy be unlocked during flight. Attached to the face screen is a bifurcated cable; one leg of the cable is connected to the trip lever pawl and the other to the sear of the canopy jettison and time-delayed firing unit. An articulated link connects the canopy jettison and time-delayed unit to the sear of the ejection gun unit. When the face screen is drawn right down over the face the cable withdraws the canopy jettison sear which fires the cartridge. At the same time, the cable operates the time-delayed mechanism and, approximately one second after the restrictor pin is withdrawn by the jettisoned canopy, the articulated link withdraws the sear of the ejection gun firing unit and the gun is fired. The face screen and firing cable are proportioned in such a manner that the firing units will be operated whether the occupant is wearing a protective helmet or not.

5. The seat pan, accommodating a personal survival pack containing a liferaft and other items of

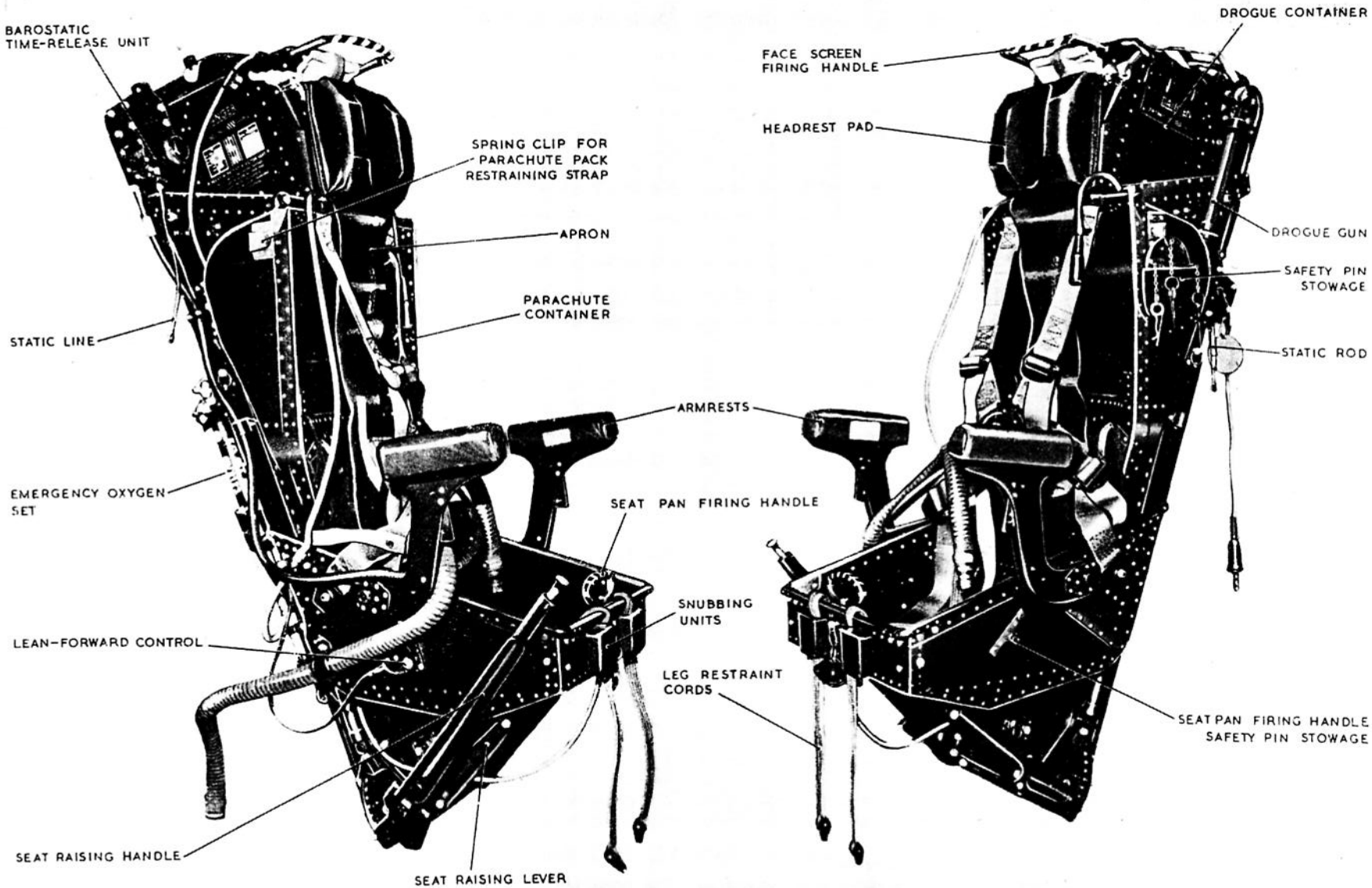

Fig. 1. Ejection seat, Type 3L/1, Mk. 1

survival equipment, can be adjusted for height by means of a hinged handle on the inboard 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. The seat pan incorporates retractable armrests. These can be rotated freely to the rear and, by operating the trigger, one of four forward positions can be selected. On the front of the seat pan is the seat pan firing handle which is used only if it is impossible to reach the face screen firing handle, e.g., in conditions of high 'G'. The seat pan firing cable is routed in a conduit to the top of the drogue container where it attaches, by means of the eye end, to the face screen firing cable.

7. 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 the legs from being blown apart by the airstream after ejection.

8. A Mk. 9 back-type parachute assembly is carried in a metal container hinged at its lower end to brackets and attached at its upper end to telescopic radius arms. The brackets are attached to the main beams and protrude through slots in the seat pan. A back pad and seat cushion are attached to the parachute harness, which also embodies two quick-release couplings for attaching the personal survival pack to the outside of the parachute harness.

9. A Type ZF safety harness is provided and consists of two thigh straps attached to the seat pan and two shoulder straps attached to the parachute container at the radius arms. The radius arms may be freed by operating a lever on the starboard side of the seat pan, thus permitting the occupant to lean forward when required. The arms can also be locked in intermediate positions against forward movement.

10. The automatic system comprises a barostatic time-release unit which controls the opening of a scissor shackle at the top of the seat structure and the operation of the safety harness quick-release fitting. An apron, to which the parachute withdrawal line is attached, is provided to pitch the occupant forward and open his parachute.

11. A Mk. 7C emergency oxygen set is held in brackets on the starboard side of the seat structure at the rear of the seat pan. A static line is attached to the bottle operating cable by means of a quick-release clip and passes through a guide tube attached to the aircraft floor inboard of, and adjacent to, the seat. The other end of the static line terminates in the manual control knob. When the seat ejects the static line becomes taut and operates the emergency oxygen system or, in the case of a main oxygen failure, the emergency oxygen supply can be initiated by pulling the manual control knob.

Quick-release connections

12. When the seat is ejected, the aircraft oxygen and intercom. services disengage automatically at quick-release connections. Further quick-release connections are provided for disengaging these services and for disengaging the oxygen mask from the emergency oxygen system when the occupant separates from the seat subsequent to ejection.

Safety precautions

13. Two red warning labels carrying safety pins are provided. The first carries three pins for rendering the ejection gun firing unit and the canopy jettison and time-delayed unit safe. The second carries one safety pin for locking the seat pan firing handle. A further safety pin, attached by a length of cable to a red painted wooden block, is provided to prevent inadvertent operation of the emergency oxygen bottle. These safety pins must be in their correct positions at all times other than when the aircraft is manned.

14. A fabric restraint strap, attached to the front of the drogue container, has two metal fittings attached to its upper end. The strap is passed through the firing handle and the lower fitting is retained by a spring-loaded ball in a retaining block positioned on top of the drogue container. If for any reason it is necessary to ensure that the firing handle is not inadvertently withdrawn, the upper fitting of the restraint strap is retained in the retaining block by one of the pins attached to the red warning label.

15. It is the responsibility of the person entering the cabin of the aircraft to ensure that the appropriate safety precautions have been applied in accordance with current instructions.

COMMON COMPONENTS

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

Ejection gun

17. 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 locked at its lower end to the bottom mounting block fitted in the guide rail and the inner or piston tube is locked at its upper end to 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.

18. At the upper end of the inner piston tube is a breech containing the firing body and the primary

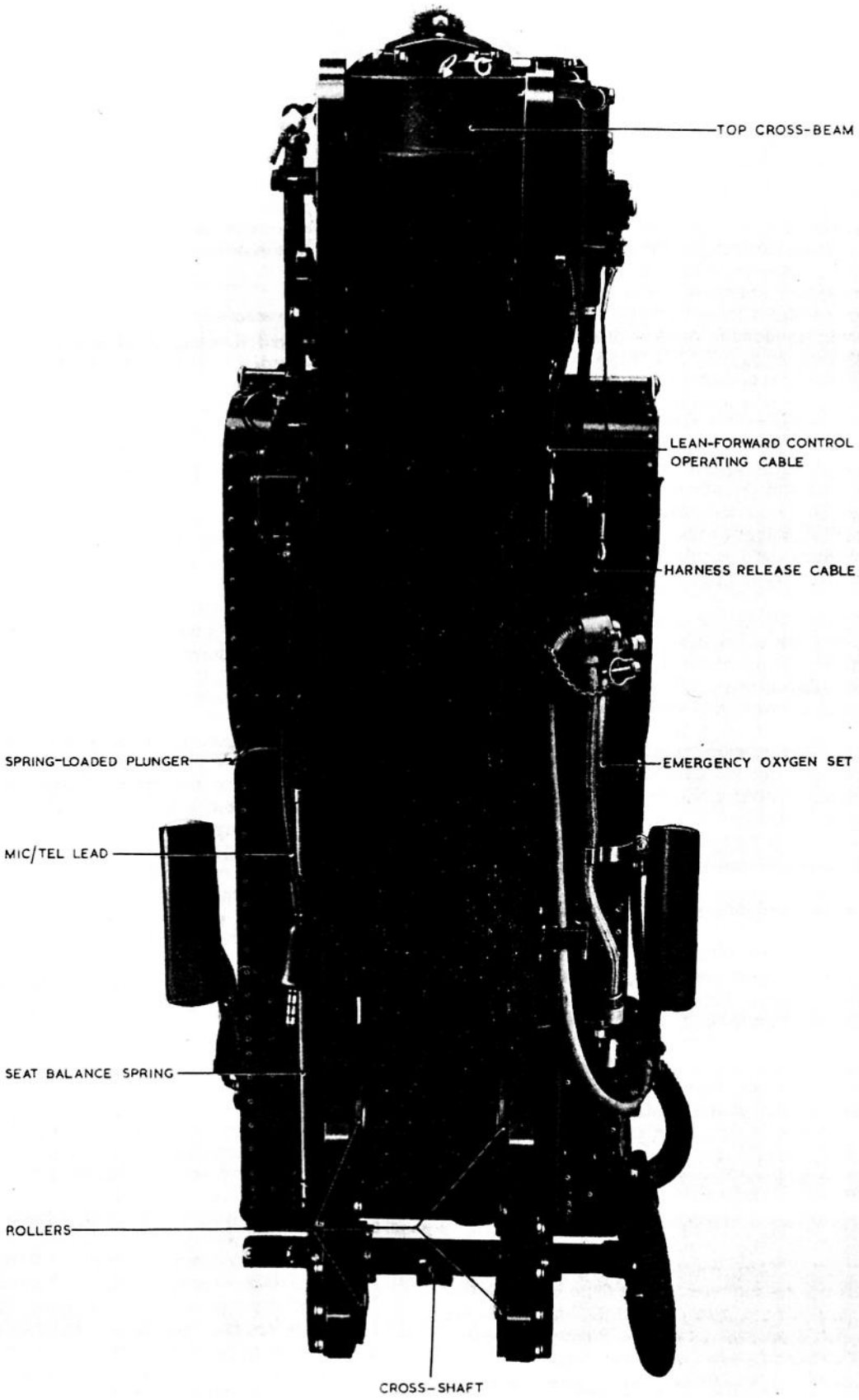

Fig. 2. Seat structure

cartridge. The secondary cartridges are housed towards the lower end of the cylinder tube in horizontally-opposed pairs. At the lower end of the cylinder tube is a release piston which retains the inner piston tube. When the sear of the ejection gun firing unit is withdrawn by the articulated link of the canopy jettison and time-delayed firing unit, 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 from the primary cartridge frees the 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

19. The Type 2 drogue gun is mounted on the port side beam of the seat structure and consists of a time-delay mechanism, a barrel and a piston; contained in the barrel is a cartridge and, attached to the upper end of the piston is the drogue withdrawal line. The piston is retained in the barrel by a split pin 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, the cartridge is detonated, the gas pressure propels the piston upwards, the split pin is sheared, the piston is ejected and the drogues are deployed.

Barostatic time-release unit

20. The barostatic time-release unit, Type 1, Mk. 1, consisting of a time-release mechanism, a barostat and a 'G' controller 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 ejection, a static line withdraws a sear and the time-delay mechanism commences to operate provided ejection has occurred below the barostat capsule operating height. Above this height the barostat 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 the 'G' controller will delay the operation still further if the speed at the time of ejection is too high for safe parachute deployment.

Drogue assembly

21. 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 drogue by nylon tape and the main is connected to the drogue shackle by nylon shroud lines.

Canopy jettison and time-delayed firing unit

22. This unit provides the power for jettisoning the canopy and incorporates a time-delay mechanism which withdraws the sear of the ejection gun approximately 1 sec. after the canopy has been jettisoned. The canopy jettison and time-delay mechanisms are contained in separate compartments within a casing which is mounted at the top of the guide rail.

23. A restrictor pin, positioned in the time-delay mechanism, is attached to the canopy by a length of steel cable, thus the functioning of the time-delay mechanism is prevented until the restrictor pin is withdrawn by the canopy as it leaves the aircraft. A separate control is provided so that the canopy can be jettisoned independently. This consists of a manual operating lever, attached to the canopy jettison unit sear and connected, by a bowden cable, to a canopy jettison manual control handle on the pilot's console in the flight deck.

SEAT STRUCTURE

24. 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.

WARNING . . .

The seat structure is secured to the ejection gun piston tube by a spring-loaded latch and the gun itself is secured to a mounting block within the guide rail by a second spring-loaded latch. It is most important that both latches are fully engaged when the seat is installed in the aircraft otherwise during certain manoeuvres, the seat and occupant would move up the guide rail with possibly disastrous results.

25. Each side beam carries at its lower end two of the rollers which engage in the guide rail. The upper rollers leave the top of the guide rail at the moment that the intermediate piston tube reaches the end of its stroke.

26. The seat pan is supported on the seat raising levers and restrained at its upper end by two spring-loaded plungers which slide in guides machined in the side beams.

27. The armrests (*fig.* 3) can be retracted freely but, by operating the trigger, one of four forward positions can be selected. Movement of the trigger is transmitted by the tension link to the bell-crank lever and thence by the compression link to the actuating lever. Integral with this lever is a spring-loaded plunger which can engage one of four segments in a quadrant.

28. The leg restraining cords pass through snubbing units on the front of the seat pan. The lower ends of the cords are anchored to brackets on the aircraft floor and the upper ends are attached to the lugs of the shoulder harness.

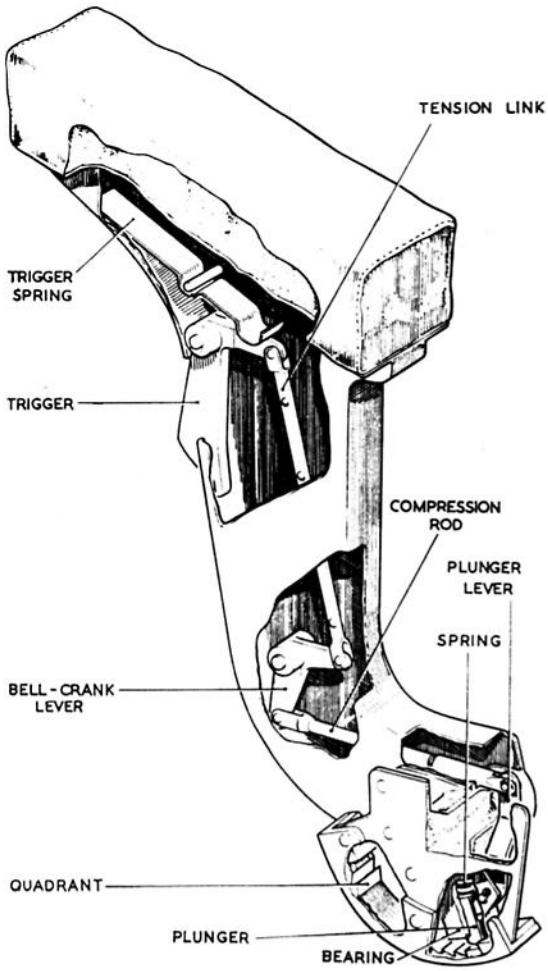

Fig. 3. Details of armrest

29. The seat raising mechanism (*fig.* 4) 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. Depression of the trigger control, through the sear lever and connecting link, displaces axially the sear bar. This causes rollers on the pair of spring-loaded plungers to ride up the ramp faces and 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 occupant being counterbalanced by two direct acting compression springs. Release of the trigger control allows the plungers to engage the nearest hole in the quadrant and lock the mechanism in the desired position. Seven positions are provided with a total adjustment of 6 in.

30. The parachute container, consisting of a sheet metal box, supports the weight of the parachute. The container, together with the backrest flap, is attached by spring-loaded plungers to a pair of brackets bolted to the seat beams. The spring-loaded plungers form a hinge and can be freed by pulling the withdrawal knobs. The upper edge of the container is secured to a pair of telescopic radius arms, the body of each of which is pivoted to the seat beam and the sliding member to the container upper edge. This latter forms the attachment for the shackle of the Type ZF safety harness shoulder strap. Each sliding member has four notches which may engage with the spring-loaded plunger. Three of these notches are chamfered on their forward faces, so that if the plunger is in one of these notches, the seat occupant can return the container to the next rearward position by leaning back without operating the lean forward control lever. The spring-loaded plungers are controlled by the levers mounted on the cross-shaft, the starboard lever being operated by the flexible cable from the control lever situated on the starboard side of the seat pan.

31. In the position shown in fig. 5 the mechanism is locked right back with the plunger engaged in the unchamfered notch; the three other notches provide positions of restraint against forward movement. With all the notches forward of the plunger the sliding member moves freely, but is limited in the forward direction by the retaining screw which butts against the edge of the groove in the sliding member. The parachute container embodies clips for restraining the apron and the parachute pack.

32. The drogue container is a riveted sheet metal box mounted at the top of the seat frame. A leather covered headrest pad is secured to the front of the container by two pins which are withdrawn by the lifting lines after the scissor shackle has opened. The firing handle is attached to the front edge of the face screen. The face screen, which is normally retained folded in the front compartment of the drogue container, is made of lined canvas and is specially shaped to protect the user's face from the airstream and to provide support for the head. The firing cable is attached to the centre of the face screen by a sewn nylon cord loop and then passes through a conduit to the canopy jettison and time-delayed firing unit. The conduit prevents the cable from being inadvertently pulled and so operating the firing units.

33. The top of the drogue container is closed by four fabric flaps which normally retain the drogue assembly.

GUIDE RAIL

34. The guide rail (*fig.* 6) consists of a single extrusion attached to the aircraft structure and normally it should not be necessary to remove it. Built into it towards the lower end is a block which receives the thrust of the ejection gun cylinder and incorporates the bottom latch which retains the cylinder tube. The slots in the upper end of the guide rail receive the cross-beam and restrain the forward impulse of the seat in the event of a crash landing.

35. Bolted to the rear of the guide rail are two brackets to which the static rod for the drogue gun and the static line for the time-release unit are attached by means of quick-release pins. The brackets incorporate special guards to prevent

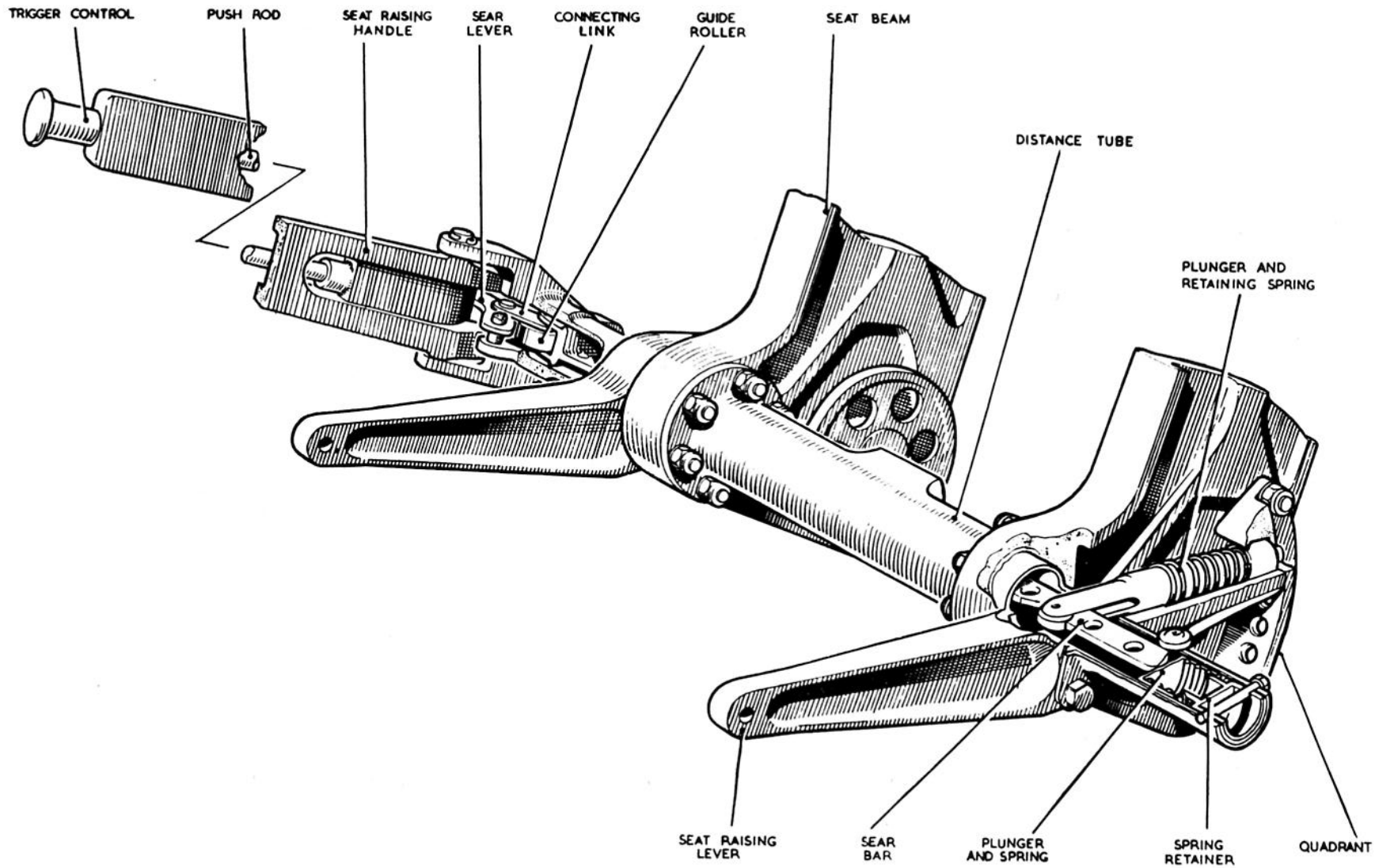

Fig. 4. Details of seat raising mechanism

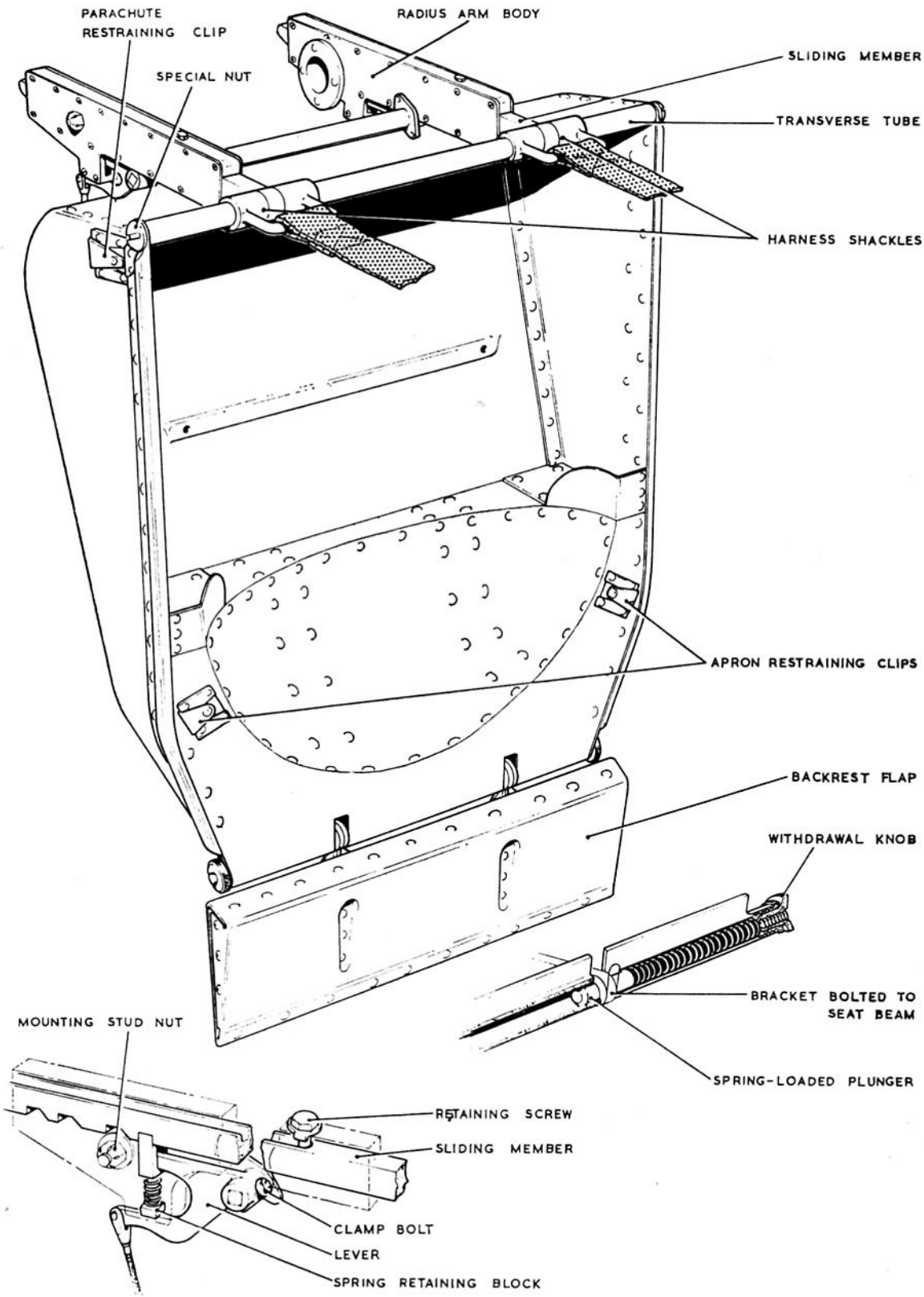

Fig. 5. Details of parachute container control

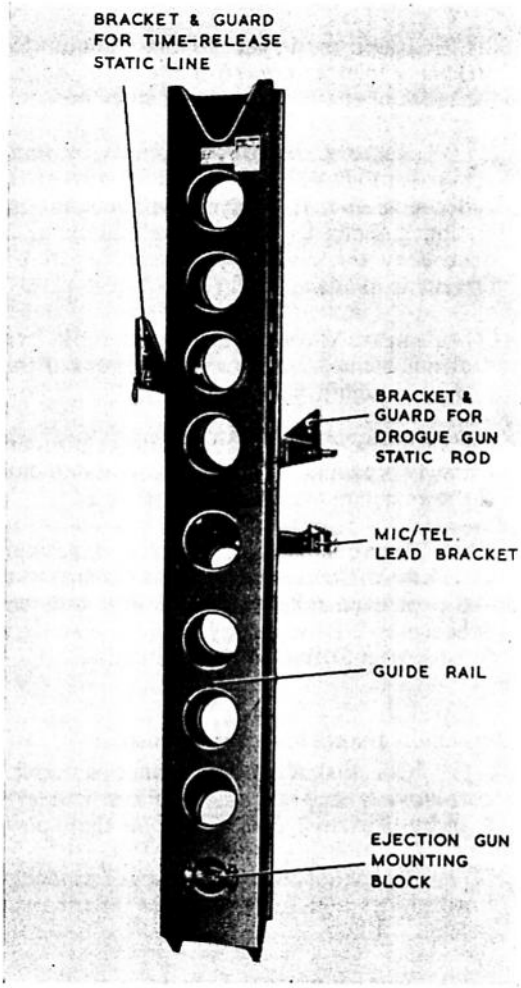

Fig. 6. Guide rail

accidental operation of the release units by personnel passing between the seats on the flight deck of the aircraft. An additional bracket carries the Mic/Tel lead.

Note . . .

The time-release bracket on the Type 3L/1 guide rail and the drogue gun bracket on the Type 3L/2 guide rail are packed out to provide clearance for the emergency oxygen cylinder.

EJECTION SEATS, TYPE 3L/1 and 3L/2, Mk. 2

General

36. The Type 3L, Mk. 2 ejection seats are identical with the Type 3L, Mk. 1 seats previously described except that:—

(a) an anti-squid Duplex drogue assembly complete with a re-designed drogue shackle is fitted.

(b) Canopy jettison and time-delayed firing unit Part No. D/MBCJ/1220 is fitted in lieu of D/MBCJ/1020 together with a modified face screen firing cable.

(c) An additional safety pin is fitted on the red warning label for rendering the control column retraction firing unit safe.

37. Canopy jettison and time-delayed firing unit, Part No. D/MBCJ/1220, embodies an extra firing unit to initiate the control column retraction so that on pulling the firing handle the control column is retracted, the canopy is jettisoned and, approximately 1 sec. later, the ejection gun firing unit sear is withdrawn by the articulated link.

38. The face screen firing cable consists of a bifucated cable and two links which connect to the control column retraction and canopy jettison firing unit sears and the trip lever of the time-delayed firing unit.

SERVICING

Common components

39. At the periodic servicing of the ejection seat, service the ejection gun, canopy jettison and time-delayed firing unit, drogue gun, barostatic time-release unit and drogue assembly in accordance with the instructions issued in A.P.4288A, Vol. 5.

Servicing the seat structure

40. *To remove the seat pan*

(1) Withdraw the seat pan firing handle, remove the nut and special washer and separate the handle from the cable.

(2) Remove the cable and clamp from the front inside edge of the seat pan.

(3) Pull out the withdrawal knobs, remove the fairing flap and hinge the parachute container upwards out of the way.

(4) Remove the parachute container control cable from the bracket on the starboard side beam by removing the 2 B.A. screws and clamp.

(5) Disconnect the cable from the radius arm operating lever by removing the S.P. 4 pins.

(6) Disconnect the safety harness release cable and the starboard safety harness thigh strap from the seat pan.

(7) Disconnect the oxygen supply pipe from the clips on the side of the seat pan.

(8) Adjust the seat pan to the top position.

(9) Whilst pressing the seat pan back against the side beams to relieve the plungers of the balance spring load, slide outwards the spring-loaded plungers. Allow the pan to hinge forward under the force of the balance springs until the springs are relaxed; they may then be removed.

(10) Remove the bolts from the ends of the seat raising levers and remove the seat pan.

(11) If necessary the armrests may now be removed by removing the circlips and withdrawing the armrests from their stub-shafts.

To remove the parachute container and dismantle the radius arms

41. (1) Remove the Mic/Tel cable from the parachute container.

(2) Withdraw the split pin and remove the special nut at the starboard upper corner of the parachute container. Withdraw the transverse rod to port from the container and remove the shoulder straps as they become free and the container from the radius arms.

(3) Remove the clamping bolt and nut from the port operating lever and special nut and washer at the radius arm pivot; withdraw sideways the radius arm body and lever simultaneously.

(4) Remove the split pin and spring retaining block and withdraw the spring and plunger.

(5) Remove the retaining screw and tab washer and withdraw the sliding member from the radius arm body. Discard the tab washer.

(6) Repeat operations (3), (4) and (5) for the starboard radius arm assembly.

To examine and assemble the parachute container radius arms

42. (1) Check that all components are free from corrosion and that all moving parts operate freely without excessive slackness.

(2) Check that the radius arms are straight in both planes and that there are no signs of burring on the notch faces; remove any burrs with a slip stone.

(3) Lightly smear all moving parts with grease XG-275.

(4) Insert radius arms into radius arm bodies and refit retaining screws using new tab washers.

(5) Insert the plunger spring and spring retaining block into the radius arms and secure with a split pin.

(6) Refit the radius arms and operating levers.

(7) Refit the parachute container and shoulder straps to the radius arms, insert the transverse rod, tighten the special nut and secure with a split pin.

(8) Refit the Mic/Tel cable to the parachute container.

To dismantle the seat raising mechanism

43. (1) Remove the 2 B.A. lock-nut and washer, tap out the taper pin from the port end of the countershaft and remove the spring retainer, spring and plunger.

(2) Remove the roller from the countershaft fitting. Do not remove the $\frac{1}{4}$ in. bolts from the faces of the seat raising lever bosses.

(3) 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 securing bolts remain in place.

(4) Remove the seat raising handle by withdrawing the split pin and tapping out the seat raising handle hinge pin.

(5) Remove the sear lever hinge pin, push up the two plungers simultaneously and pull out the sear bar from the starboard side.

(6) Remove both plungers and springs and withdraw the countershaft to starboard out of the port seat raising lever and countershaft bearings. If necessary, remove the starboard raising lever from the countershaft.

To examine the seat raising mechanism

44. (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 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.

45. (1) Pass the shaft with the starboard seat raising lever attached through the bearings in the side beams and pass the port raising lever with the countershaft end fitting attached on to the shaft. Assemble the roller to the countershaft.

(2) Insert the locking plungers and springs into the 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.

(3) Replace the plunger, spring and spring retainer into the end of the countershaft, fit the taper pin, washer and lock-nut.

(4) Replace the quadrant, sear lever axis pin and seat raising handle.

To fit the seat pan

46. (1) Position the seat raising levers in the top position, place the seat pan on the levers, insert the bolts and secure them.

(2) Insert the seat balance springs and press the pan back against the main beams so compressing the springs. Operate the spring-loaded plungers to engage with the guides in the side beams.

(3) Connect the starboard safety harness thigh strap and safety harness release cable to the seat pan.

(4) Connect the parachute container and backrest flap to the lower brackets by operating the withdrawal knobs.

(5) Refit the parachute container control cable to the side beam and to the operating lever; ensure that the cable is correctly adjusted.

(6) Refit the seat pan firing cable and clamp to the seat pan using new bolts and peening them over; refit the firing handle to the cable.

(7) Connect the oxygen supply pipe to the seat pan.

Testing the lifting lines

47. (1) Disconnect the drogue withdrawal line from the drogue gun, and disconnect the drogue shackle from the scissor shackle.

(2) Connect a spring balance to the drogue shackle and pull upwards. The lifting lines should not pull out of the rear clip until the scale registers 16 lb. and 12 lb. for the remaining clips. A tolerance of ± 2 lb is permissible and any necessary adjustment may be made by carefully opening out or closing in the clips as appropriate.

Fitting the lifting lines

48. Commencing at the front of the drogue container, press the lifting lines down into their clips, using thumb pressure until the final result is similar to that shown in fig. 7.

Packing the face screen

49. (1) Stretch the face screen to its full extent.

(2) Push the fullness up into a convex form (upper diagram, *fig.* 8).

(3) Form a longitudinal crease just right of the centre line.

(4) Fold the centre bulk to lie on the right edge of the screen so that the edges are roughly parallel and the cable anchorage is proud (lower diagram, *fig.* 8). The face screen is now in three thicknesses on the right and one on the left.

(5) Carefully retaining this fold, roll the screen over the lower edge of the slot in the container and press it down into its compartment.

WARNING . . .

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

(6) Insert the firing handle plungers into their sockets and the tongue of the restraining strap into the retaining clip.

Note . . .

Ensure that the eye ends of the face screen tapes are positioned on top of those of the headrest tapes.

Examining the leg restraining device

50. (1) Check that the nylon cords can be drawn downwards freely through the snubbing units, but that the units restrain any upward movement.

(2) Grasp each cord in turn and pull upwards; whilst doing so, depress the release button beneath the snubbing units. Check that when the button is depressed, the cord can be pulled freely in either direction and, when the button is released, that the cord is restrained from upward movement once again.

(3) Examine the nylon cords for damage and deterioration; in particular, check the upper loops for fraying.

Servicing the leg restraint cords

51. 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 to the end of the fabric loop at the other end. The length should be 47 in. ± 2 in., and any cords exceeding these limits are to be renewed.

Connecting the drogue withdrawal line

52. When the aircraft servicing is completed and the seat is re-armed make absolutely certain that the drogue withdrawal line passes OVER the lifting line (*fig.* 9). This is vital to enable the drogue gun piston to withdraw the drogues without obstruction or entanglement

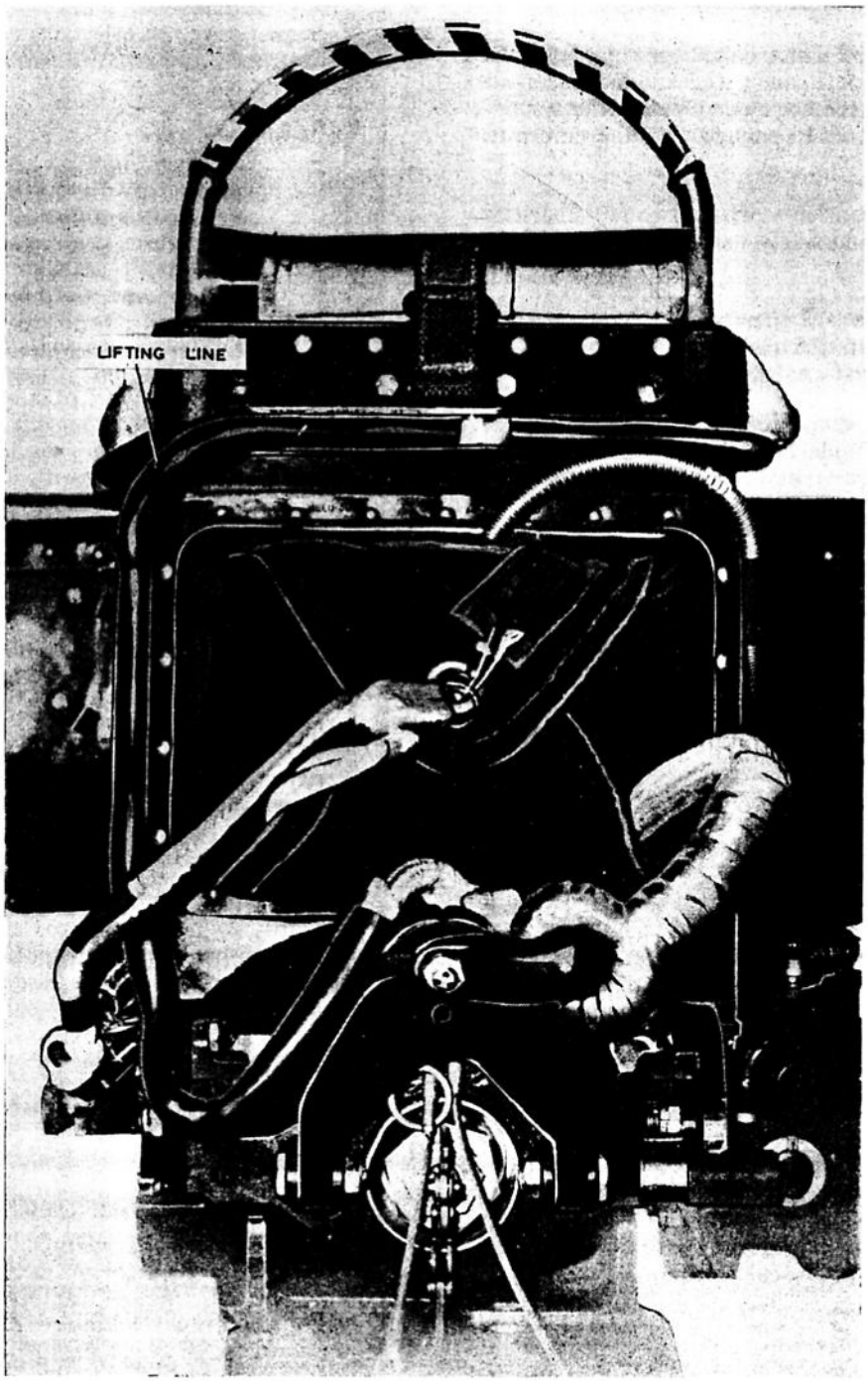

Fig. 7. Fitting the lifting lines

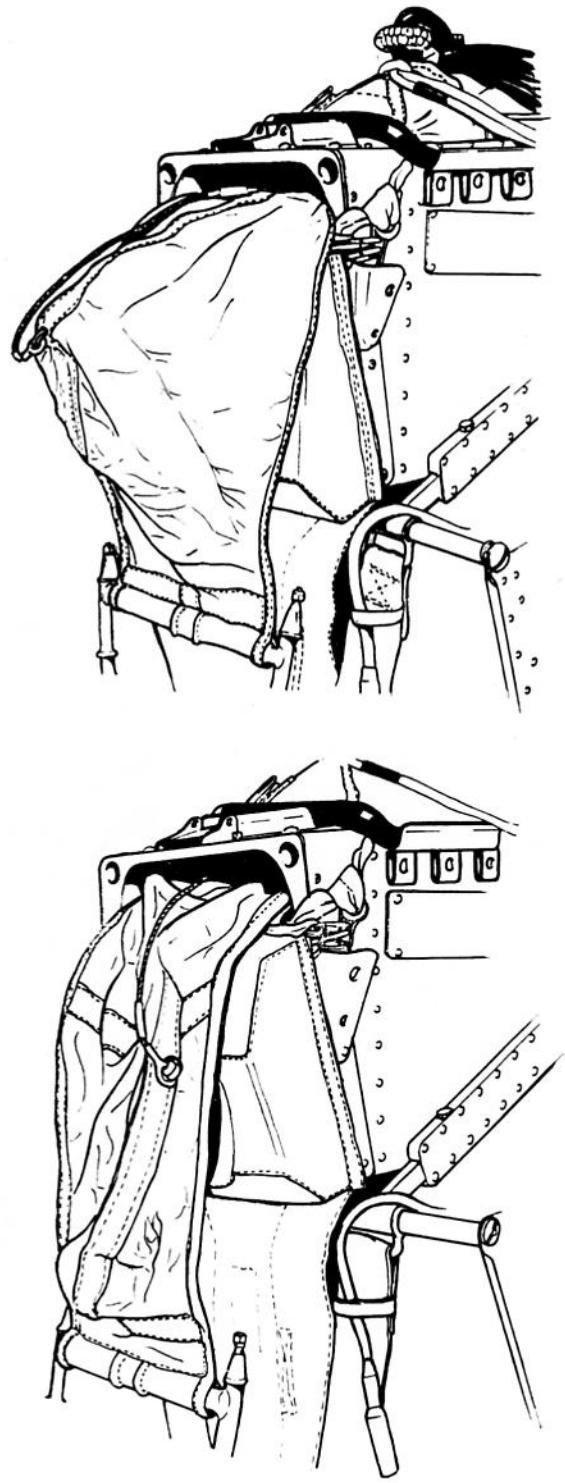

Fig. 8. Packing the face screen

Fig. 9. Correct routing of drogue withdrawal line

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