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Chapter 3

EJECTION SEAT, TYPE 2H

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LIST OF ILLUSTRATIONS

Introduction

1. The Type 2H ejection seat (Ref. No. 27L/50007) is installed in Hunter F Mk. 4 and 5 aircraft.

GENERAL DESCRIPTION

2. The seat structure (*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.

3. The canopy is jettisoned and the ejection gun is fired by the action of pulling the face screen firing handle right down over the face. This handle draws out from the headrest 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 prevents it from jerking forward during ejection. Attached to the face screen is a bifurcated cable attached to the canopy jettison and time-delayed ejection gun firing unit. When the face screen is pulled down over the face, the cable withdraws the sear from the canopy jettison unit firing body; at the same time the cable operates the time-delay mechanism trip lever and, after approximately 1 sec., the ejection gun is fired. The face screen and cable are proportioned in such a manner that the ejection gun will be fired whether the occupant is wearing a protective helmet or not.

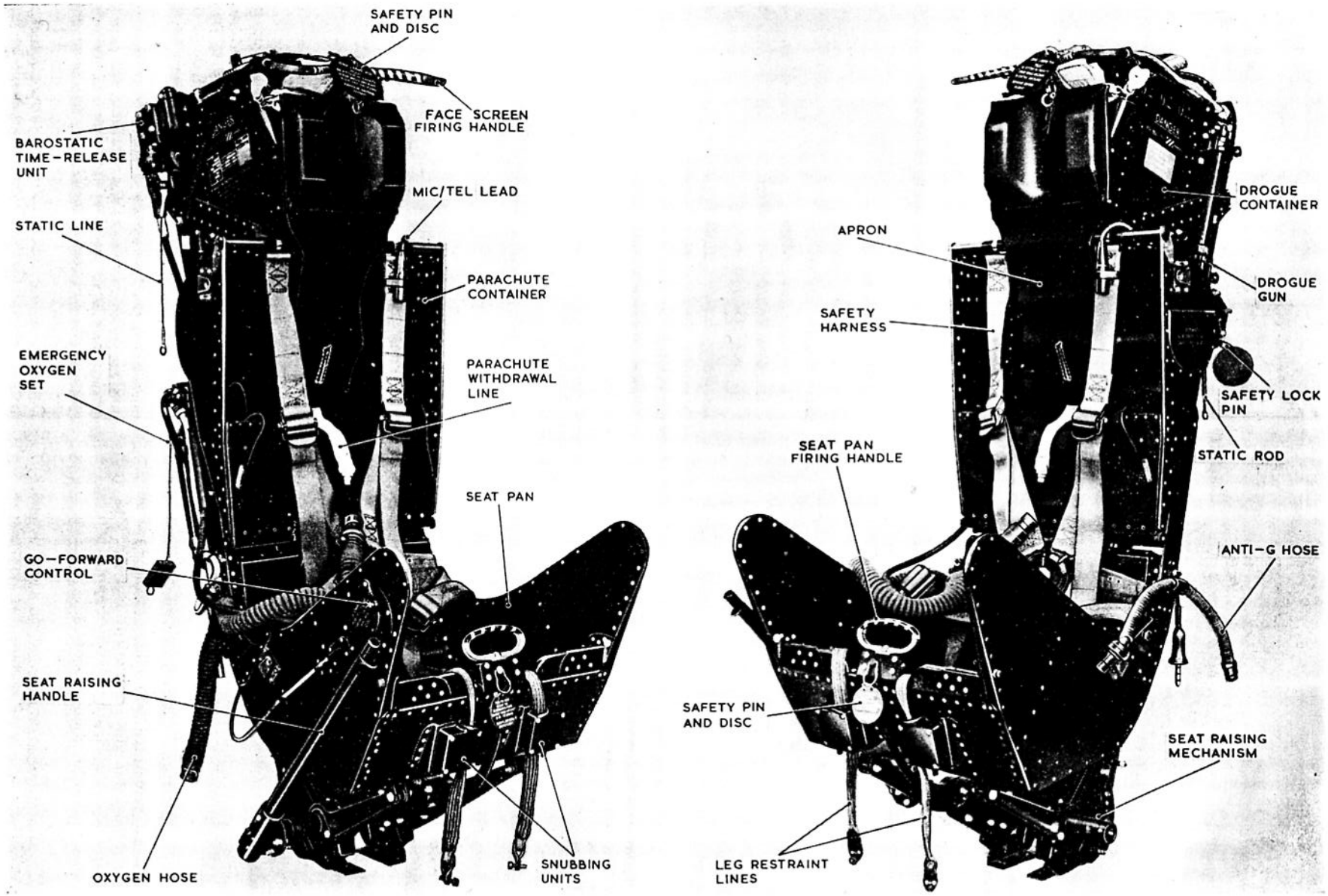

Fig. 1. Type 2H ejection seat

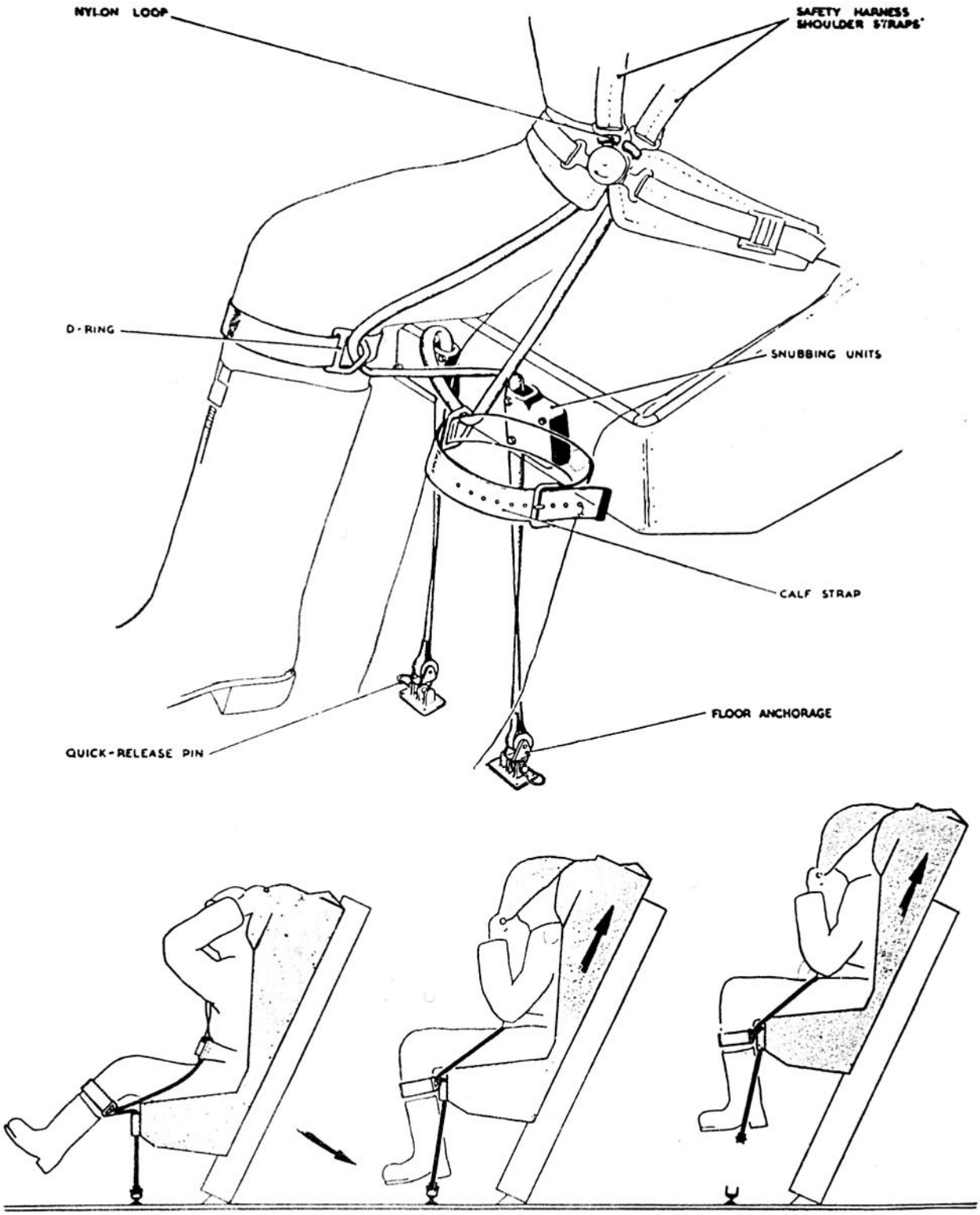

Fig. 2. Leg restraining device

4. The seat pan accommodates a personal survival pack, Type J.J. and it is provided with thigh guards. It can be adjusted for height by means of a handle on the starboard 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 pad whatever the position of the seat pan. Mounted at the front of the seat is the seat pan firing handle which is used only if it is impossible to reach the face screen firing handle in conditions of high g forces.

5. A leg restraining device (*fig.* 2) is incorporated to ensure that the occupant's legs are drawn back automatically and restrained close to the front of the seat pan; this provides leg clearance during ejection, and also prevents the legs from flailing in the airstream after ejection.

6. A Mk. 13 back-type parachute assembly is supported in a metal container hinged at its lower edge to the seat pan and attached at its upper edge to the seat frame by telescopic radius arms. Type ZF safety harness is provided which has the two shoulder straps attached to the parachute container at the radius arms. The arms may be freed in flight by operating a lever projecting from the starboard thigh guard, thus permitting the occupant to lean forward when required; the arms can also be locked in intermediate positions.

7. 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

Fig. 3. Seat reaction spring

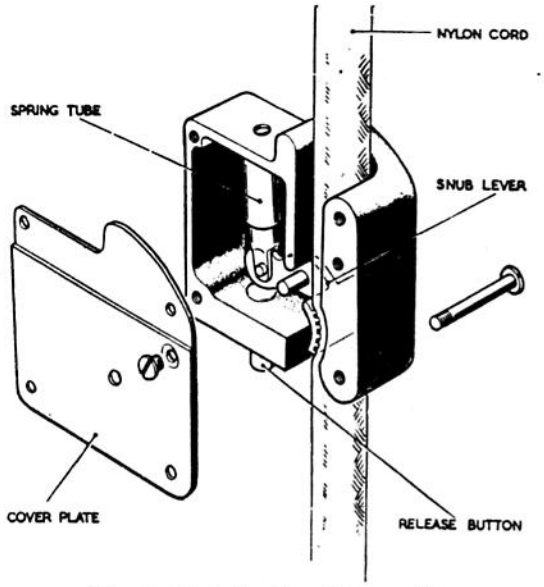

Fig. 4. Details of snubbing unit

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.

8. Emergency oxygen is provided for use subsequent to ejection and it takes the form of a Mk. 4A emergency oxygen set which is mounted at the rear of the seat pan.

Quick-release connections

9. When the seat is ejected, the aircraft oxygen and Mic/Tel. services disengage automatically at quick-release connections. Further quick-release connections are provided for disengaging these services when the occupant leaves the seat subsequent to ejection. Quick-release connections are also provided for the emergency oxygen system; one to operate the emergency oxygen set on ejection and then disengage, and another to enable the oxygen mask to be disconnected from the system. The latter action is not automatic.

Safety precautions

10. Safety pins complete with red discs are provided for rendering the seat safe for parking or servicing. A fabric strap is attached to the top front edge of the drogue container; when this strap is passed through the bar of the face screen firing handle and locked by the safety pin provided, the handle is locked against the possibility of inadvertent withdrawal. When a separate safety pin is inserted in the seat pan firing handle, the seat is safe for parking.

11. Before any work is done in the aircraft cockpit on or near the ejection seat, safety pins are to be inserted in the firing mechanism sears in accordance with current authorized instructions.

Principle of operation

12. On ejection, the drogue gun is fired by its static rod and, after 0·5 sec. delay, the drogues develop. Simultaneously the barostatic time-release unit is actuated by its static line, the

emergency oxygen supply is turned on and the leg restraining cords are freed from the cockpit floor anchorages by the light-alloy rivets being sheared. Assuming an ejection has been necessary above an altitude of 10,000 ft., a steadied free fall occurs until this height is reached. Thereupon, after 1·25 sec. delay, the barostatic time-release unit operates, the scissor shackle opens, the drogues and safety harness are released, the apron straightens and the occupant is pitched forward. The withdrawal line attached to the apron withdraws the main parachute from its pack and the escapee is lowered in the normal manner.

13. If an ejection occurs below 10,000 ft., the same sequence occurs without the free fall. In both instances, however, the barostatic time-release unit time-delay is subject to the overriding influence of the G-controller switch if the speed is excessive for safe parachute deployment.

COMMON COMPONENTS

14. 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

15. 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.

16. 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

17. 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. 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.

Canopy jettison and time-delayed firing unit

18. This is the standard unit which provides the power for jettisoning the cockpit canopy and incorporates a time-delay mechanism which fires the ejection gun approximately 1 sec. after the canopy gun has fired.

Barostatic time-release unit

19. The barostatic time-release unit, Type ◄ 1, 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

20. 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.

SEAT STRUCTURE

21. The seat structure 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 tube, and at the bottom by a cross-shaft through which passes the countershaft carrying the seat raising handle. Each side beam carries at its lower end two of the rollers which engage with the guide rail. The upper rollers leave the top of the guide rail at the moment that the piston tube emerges from the cylinder tube at the end of the ejection stroke.

22. The seat structure is secured to the ejection gun piston by a spring-loaded plunger and the gun itself is secured to the bottom mounting block within the guide rail by a second spring-loaded plunger. When both latch plungers are correctly positioned, the seat and occupant are secured against the possibility of moving up the guide rail during inverted flight or similar manoeuvres.

23. The seat pan is supported on two seat raising levers and restrained at its upper corners by two blocks which slide in guides machined in the side beams. By this means the adjustment provided is confined to the seat pan which moves relative to the headrest attached to the main frame so that occupants of different body lengths can be accommodated. The sides of the seat pan are

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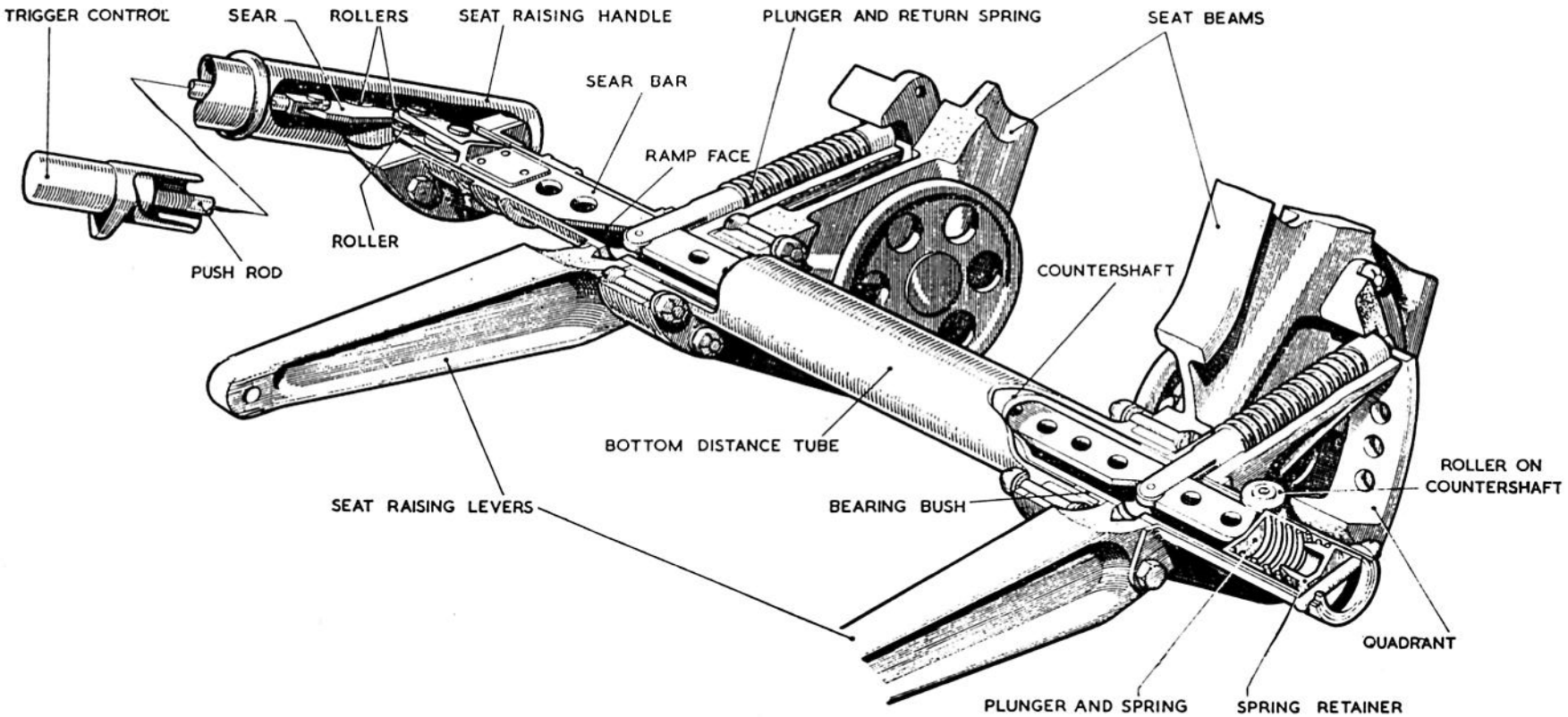

Fig. 5. Details of seat adjusting mechanism

shaped to form thigh guards. The lower pair of safety harness straps are attached to the seat pan and the weight of the occupant and his equipment is counterbalanced by two direct acting compression springs (*fig.* 3).

24. The snubbing units which are borne on the front of the seat pan are both similar in construction but are handed. Each unit (*fig.* 4) consists of a casing which incorporates a slot through which passes one of the leg restraining cords. The casing houses a snub lever, a spring tube and a release button. The object of the snubbing unit is to allow the cord to pass freely *down* through the unit, but to lock the cord against any *upward* movement. Thus during ejection the cords, which are anchored to the aircraft floor, become taut and pull the seat occupant's legs backwards and together. The lower ends of the cords are anchored by means of deadeyes and brackets; the deadeyes are held in the brackets by light alloy rivets which are stressed to shear at approximately 400 lb. Since the cords cannot pass upwards through the snubbing units, the occupant's legs are prevented from flailing in the airstream and are restrained in this position until the safety harness is released by the time-release unit. When this occurs, the upper loops of the cords are pulled through the leg garter D-rings, so freeing the legs. The release button is provided to allow the occupant to adjust the cords to give comfortable leg movement.

25. The seat raising mechanism (*fig.* 5) is operated by the handle of the starboard side of the seat. The trigger control by means of the sear and the roller displaces axially the sear bar which in turn withdraws the pair of spring-loaded plungers from engagement with the quadrants and allows the seat raising levers attached to the countershaft to be rotated by the seat raising handle. On releasing the trigger control the two plungers, under the action of their return springs, engage adjacent holes in the quadrants to lock the seat in the new position.

26. The drogue container is a riveted metal box mounted at the top of the seat frame, and at the front it embodies a leather covered pad for the occupant's head. Above the pad is the face screen firing handle which is normally retained in position by spring-loaded locking plungers. The firing handle is attached to the front edge of the face screen, the rear edge of which is riveted to the drogue container. The face screen, which is folded in the front compartment of the drogue container, is made of lined canvas and is specially shaped to protect the occupant'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 passed through a conduit and connected to the firing mechanism. The top of the drogue container is closed by four fabric flaps which retain the drogues.

27. The parachute container (*fig.* 6) is a riveted sheet metal box hinged at its lower edge to a pair of brackets bolted to the seat beams. The hinge is formed by spring-loaded plungers which are freed by pulling the withdrawal knobs. The container supports the weight of the parachute during flight and takes sideways loads. The parachute lifts easily out of the container when the occupant leaves the seat. 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 point forms the attachment for the shackle for 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 either of these notches the seat occupant can return the container to the next position to the rear by leaning back without operating the harness release 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 in the starboard thigh guard.

28. In the position shown in fig. 6, the mechanism is locked right back. The three other notches provide positions of restraint against forward movement, and the unchamfered one against backward movement also. 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 parachute pack.

GUIDE RAIL

29. The guide rail 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 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.

SERVICING

30. At the six-monthly and annual servicing of the ejection seat, service the ejection gun, drogue gun, canopy jettison and time-delayed firing unit, barostatic time-release unit and drogue assembly in accordance with A.P.4288B, Vol. 5 and A.P.4288A, Vol. 1. The following instructions apply to the Bay servicing of the seat structure.

Servicing the seat structure

To remove the seat pan

31. (1) Pull out the withdrawal knobs and hinge the parachute container upwards out of the way.

(2) Remove the manual harness release control cables from the bracket on the side member by unscrewing the two 2 B.A. bolts and detach the cross-shaft lever from the cross-shaft by undoing the nut and bolt. To facilitate removal, undo the special nut at the pivoting point of the radius arm and ease the radius arm out sufficiently to withdraw the cross-shaft lever.

(3) Remove the automatic harness release cable from the side of the seat pan by undoing the four 4 B.A. nuts.

(4) Disconnect the starboard safety harness thigh strap from the pan.

(5) Disconnect the oxygen and anti-G suit supply pipes from the clips on the side of the seat pan.

(6) Adjust the seat to its top position whilst sitting in the seat to counteract the load of the seat reaction springs.

(7) Remove the locking wire from the two spring-loaded plungers and, while pressing the pan back against the seat to relieve the

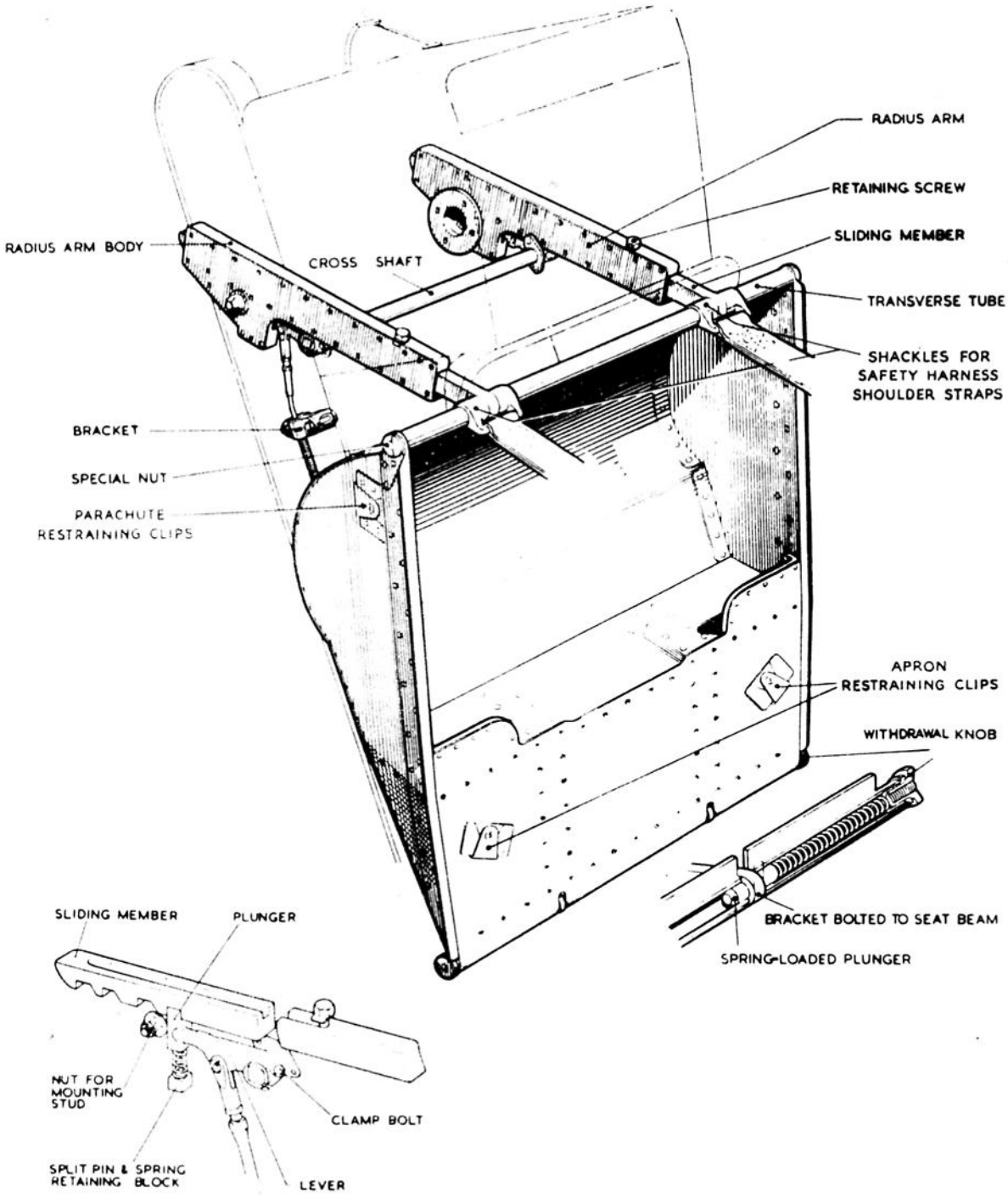

Fig. 6. Details of parachute container

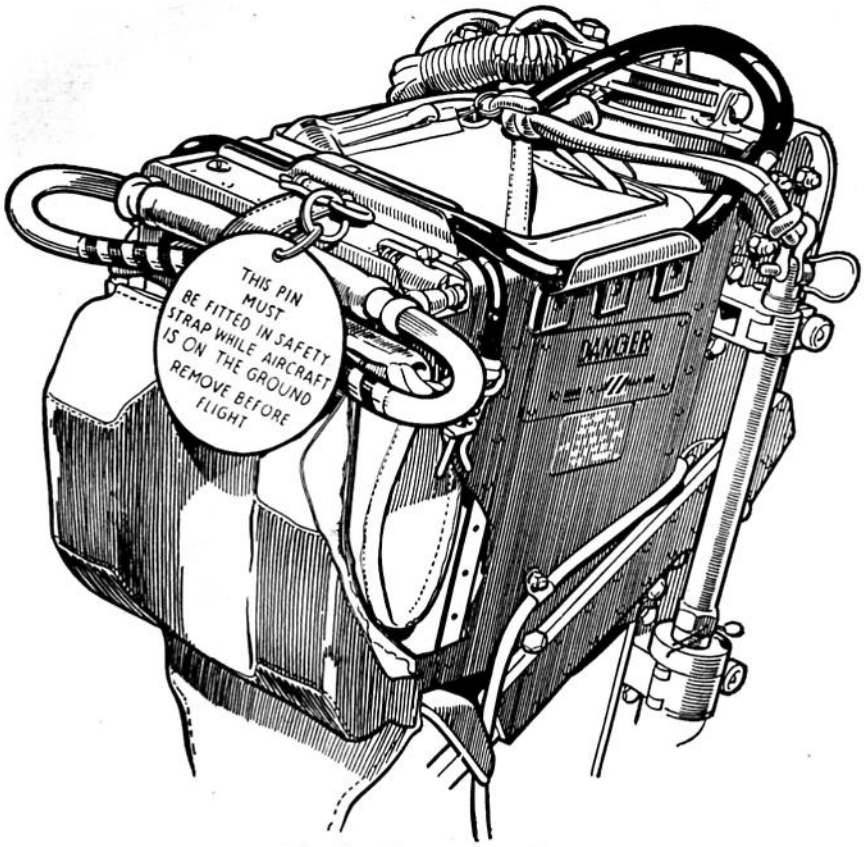

Fig. 7. Drogue container

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.

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

To remove and dismantle the parachute container radius arms

32. (1) Withdraw the split pin, remove the special nut at the starboard upper corner of the parachute container and withdraw the transverse tube to port from the container.

(2) Remove the clamping bolt and the nut and withdraw sideways the radius arm body and the lever simultaneously.

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

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

To examine and assemble the parachute container radius arms

33. (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 the radius arm into the radius arm body and tighten the retaining screw. Use a new tab washer (Ref. No. 27L/295).

(5) Insert the plunger and spring retaining block and split pin.

(6) Assemble the radius arm body and lever, insert the clamping bolt and tighten the nut.

(7) Insert the transverse tube, tighten the special nut and lock with a split pin.

To dismantle the seat raising mechanism

34. (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. 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 quadrant is withdrawn; the four bolts remain in place.

(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

Fig. 8. Testing the lifting lines

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

35. (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.

36. (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 and split pin.
(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, and insert the taper pin and lock-nut.
(4) Replace the quadrants and the seat raising handle.

◀**Note . . .**

When refitting the seat raising handle ensure that the special bolt (Ref. No. 27L/1251) is fitted in the top position.▶

To fit the seat pan

37. (1) Place the pan on the seat raising levers, which must be in the top position, and insert and secure the bolts.
(2) Insert the seat reaction springs and press the pan back against the seat, so compressing the springs. Operate the spring-loaded plungers to engage with the guides in the side beams and lock with non-corrodible steel locking wire. Ensure that the spring-loaded plungers have engaged correctly.
(3) Replace the harness release cables.
(4) Connect the parachute container to the lower brackets by operating the release knobs.

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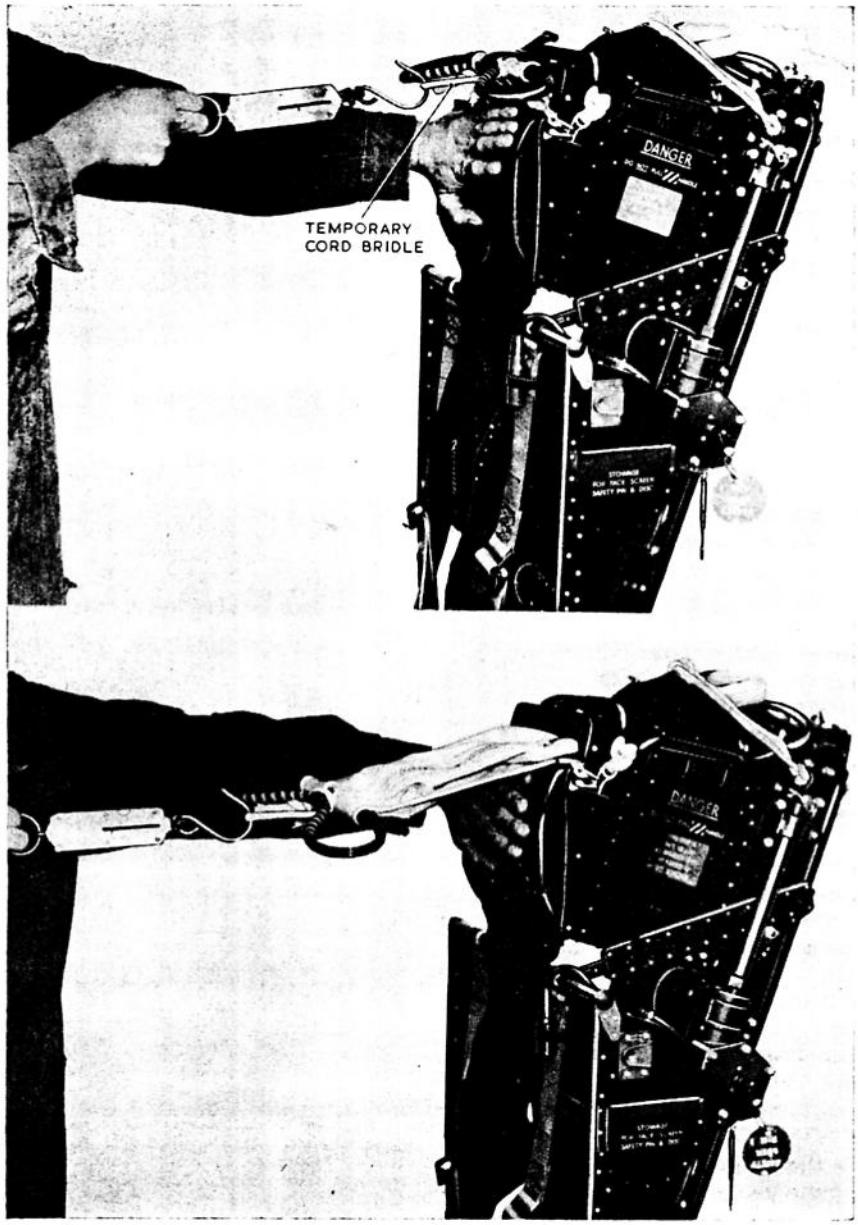

Fig. 9. Testing the face screen

(5) Connect the starboard safety harness thigh strap.

(6) Connect the oxygen and anti-G suit supply pipes.

Testing the lifting lines

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

(2) Connect the spring balance to the drogue shackle and pull upwards. The lifting lines should not pull out of the first clip until the scale registers 16 lb. as indicated in fig. 8, and 12 lb. for the remaining clips. A tolerance of ± 2 lb. is permissible, and adjustments may be made by opening or closing the clips as necessary.

Fitting the lifting lines

39. 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. 8.

Servicing the face screen

To test the face screen

40. Fit a temporary cord bridle to the B-handle, connect a spring balance to the bridle (*fig.* 9) and pull until the spring-loaded plungers disengage, watching the scale whilst doing so. The face screen should not pull out of its housing until the scale registers 25 to 45 lb. Remove the bridle.

To examine the face screen

41. (1) Withdraw the face screen to its fullest extent.

(2) Examine the fabric of the face screen and check the security of the attachment of the front edge to the firing handle, and the two fittings at the rear edge.

(3) Examine the attachment of the firing cable to the face screen.

To pack the face screen

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

(2) Push the fullness up into convex form (upper diagram, *fig.* 10).

(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.* 10). 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 a face screen is repacked (or the firing cable is connected to the 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 of the cable when the firing handle is pulled, possibly resulting in non-firing of the ejection gun.

(6) Insert the firing handle into its socket but before pressing home the locking plungers ensure that the restraining plate is located behind the firing handle cross-bar.

Servicing the leg restraining device

43. (1) Examine the cords for fraying or deterioration, particularly at the ends.

(2) Check the cords for freedom of movement through the snubbing units in a downward direction but complete restraint in the upward direction.

(3) Check the release buttons for correct operation.

◀ Servicing the leg restraint cords

44. Suspend each leg 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 end of the fabric loop at the other end. The length should be 50 in. ± 2 in., and any cord exceeding the upper limit is to be renewed. ▶

Safety ties

45. After the drogues have been packed and the retaining pin tie has been made, proceed as follows:—

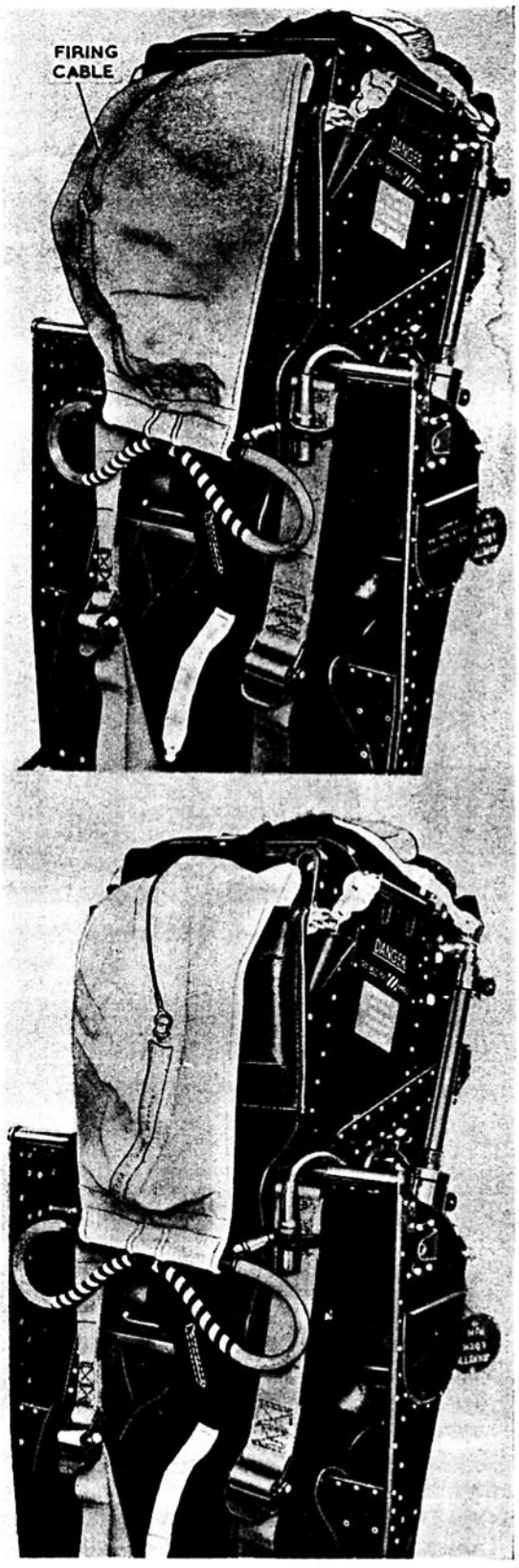

Fig. 10. Folding the face screen

Lower the scissor shackle and secure the drogue shackle and flap closure pin by a length of No. 8 cord passed through the drogue shackle and under the securing pin (*fig.* 11); tie off with a reef knot and one or two half-hitches.

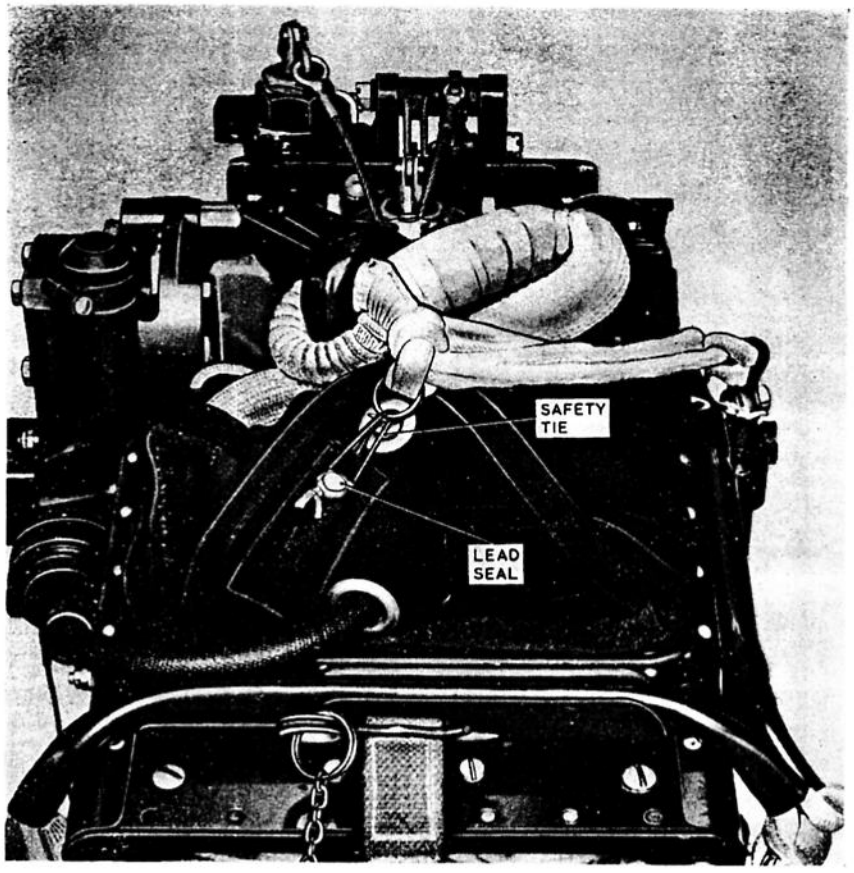

Fig. 11. Safety ties

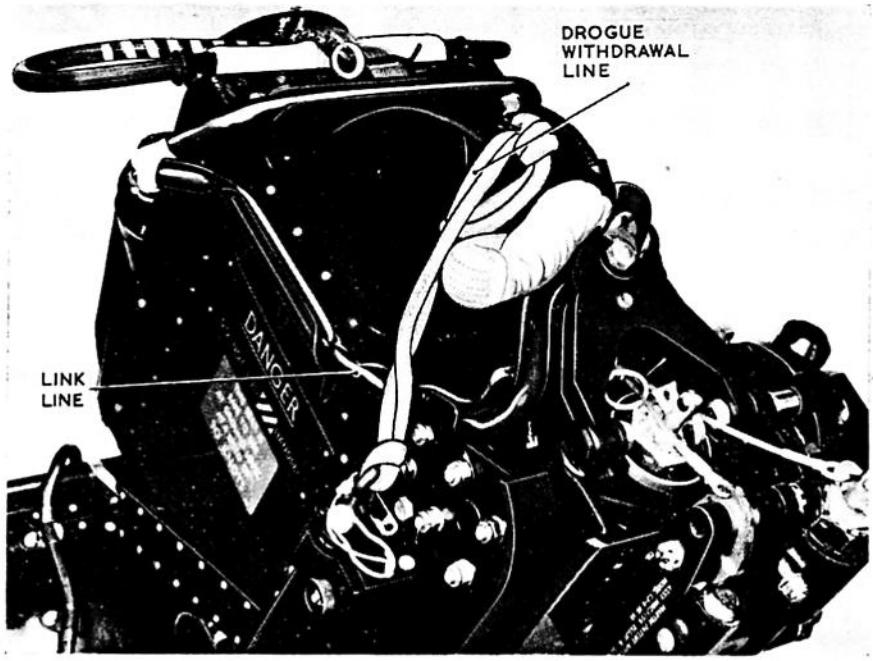

Fig. 12. Drogue withdrawal line

Fig. 13. Correct run of firing cables

Caution . . .

It is of the utmost importance that the cord passes under the securing pin, otherwise the drogues could not be withdrawn without obstruction.

Drogue withdrawal line

46. Ensure that the drogue withdrawal line is routed *above* the link lines (*fig.* 12) and is thus able to withdraw the drogues without entanglement.

Firing cables

47. Fig. 13 shows the correct method of connecting the firing cables. It is essential that the eye end of the seat pan firing cable is threaded over the cable with the red sleeve which connects with the trip lever of the time-delayed firing unit.

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